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The U.S. Government's Global Hunger & Food Security Initiative

Cereal Systems Initiative for South Asia (CSISA) Phase II

EVALUATION REPORT

USAID

FROM THE AMERICAN PEOPLE

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During the review, we were very ably assisted by Amgain Lal Prasad in Nepal, Yashbir Shivay in India and Mashihur Rahman in Bangladesh. They not only served as logistical coordinators but also translated when asked to do so and contributed background information to the report.

We take responsibility for this report, including any errors in facts. Time did not permit extensive cross-checking. We hope the report is useful to the broader CSISA alliance and to the donors who support it.

AUTHORS

Eric Kueneman, PhD, *Evaluation Team Lead*

Dr. Eric Kueneman's experience encompasses over 60 countries worldwide and he has published widely on plant breeding and applied agronomy. As Director of Kueneman Consultancy (KC), Dr. Kueneman contributes to the interface of global agriculture, food systems, and the environment. KC infuses broad experience in international development, plant breeding, crop production, and protection to provide specific advice to development institutions on formulating, implementing, and evaluating models for good agricultural practices.Recent consultancies include:

- The Bill and Melinda Gates Foundation
- The Clinton Foundation – Global Development Initiative (CDI)
- International Institute for Tropical Agriculture (IITA)
- United States Agency for International Development (USAID)
- Centro Internacional de Agricultura Tropical (CIAT)
  International Fund for Agricultural Development (IFAD)
- United Nations Food and Agriculture Organization (FAO)
- Cornell University

Prior to his work at KC, Dr. Kueneman served a 23-year career in the United Nations Food and Agriculture Organization (UN FAO), where he served as an emissary in negotiations with ministerial policy makers and donors in relation to sustainable agricultural development. He retired from his appointment as Deputy Director of the FAO Crop Protection and Protection Division in April, 2010. He earned his PhD. from Cornell University in Plant Breeding and International Agriculture and he received his Bachelor of Science from the University of Idaho.

Donald G. Brown, *Agribusiness and Policy Technical Expert*

Don Brown is a specialist in food security, agricultural policy, and market analysis. He has worked more than 40 years in Africa and South Asia in agricultural policy; economic growth; as well as agricultural marketing, project design, implementation, and evaluation. He spent 20 of these years as an agricultural economist/senior agricultural officer with USDA and USAID, where he was responsible for management of overall agricultural programs and development of agricultural and economic country plans in long term assignments in Rwanda, Senegal, Zaire (DRC), and Bangladesh.

As an independent consultant, Brown has undertaken a wide range of evaluations, project designs, and program strategies in more than 15 countries in Africa and South Asia. He spent two years in Uganda as an agricultural policy adviser to help establish a regional east and central Africa policy network, ECAPAPA (PAAP), as part of ASARECA, the regional association of national agricultural research organizations. In 2003, he joined Chemonics International full-time and worked as a Director in both the Middle East and Africa Regions, supporting programs in Egypt, Malawi and Nigeria. He also served as a Chief of Party to implement a complex market and poverty reduction program in Nigeria for the British Government's DFID. While working with this program, Brown collaborated with a core group of international experts to develop an innovative development process known as Market Development or M4P (Making Markets Work for the Poor).

Brown has recently returned to independent consulting and, among other assignments, has served as agribusiness advisor and co-author of a draft economic growth strategy for USAID/Timor Leste and as team leader of a 10-week mid-tour evaluation of the Agricultural Education and Research (ERA) project in Senegal for USAID/Senegal

He holds an M.P.A. from Harvard's John F. Kennedy School of Government, an M.S., in Agricultural Economics, from the University of Minnesota, St. Paul, and a B.S. in Horticulture from Washington State University, Pullman.

Thomas S. Walker, PhD, *Economic Systems Technical Expert*

Since 1968, when he attended and carried out research at the Escuela Agricola Panamerica in Zamorano, Honduras, Tom Walker has worked in International Agricultural Development. Two themes weave their way throughout Tom's career.

First, as an agricultural economist, he has been committed to supporting the work of biological and physical scientists in research. Whether working at national agricultural research programs such as CENTA in El Salvador with the University of Florida (1977–1979) and IIAM in Mozambique (2002–2006) with Michigan State University or at International Agricultural Research Centers such as ICRISAT (1980–1991) and CIP (1992–2001), the focus of that work has not changed. It consists of priority-setting exercises, the economic analysis of experiments, adoption studies, and impact assessment of technological change. From 2009 to 2012, Tom was the coordinator of the DIIVA (Diffusion and Impact of Improved Varieties in Africa) Project that documented with expert opinion and nationally representative surveys the uptake of improved varieties and hybrids in 20 food crops in 30 countries in Sub-Saharan Africa. Part of that project addressed the adoption of improved rice varieties in five countries in South Asia and five dryland crops in peninsular India. Tom's most recent outputs in impact assessment include practitioner guidelines for impact assessment of technological change and the coordination of the impact evaluation of policy research based on seven case studies from the CG Centers in 2008 and 2009.

Secondly, Tom has always believed that credible data were a critical input for informed decision making in reducing poverty and improving food security. Well-collected data have a public-goods character that makes them more valuable to society when they are widely shared over and above the products of one's own research. In South Asia, this belief was epitomized by Tom's involvement in the collection, analysis, and distribution of ICRISAT longitudinal Village-Level Studies (VLS) that were the raw material for more than 200 journal articles, research reports, Ph.D. theses, and a book synthesizing the findings of this very large collective effort featuring researcher participation from 25 institutes, universities, and agencies. Twenty-three years later after the VLS formally closed in 1984–1985, Tom was fortunate to have the opportunity to draft the proposal for the renewed VLS that was funded by the Bill and Melinda Gates Foundation. Data collection now not only takes place in the original six villages with the same household members and their offspring, but was also expanded to nine more villages in India's SAT, 15 villages in East India with ICAR, and 15 villages in Bangladesh with IRRI. Moreover, the same project has invested in assembling and updating an agricultural database across hundreds of districts in India, Bangladesh, and Nepal from 1970–2012.

Calvin O. Qualset, PhD, *Plant Genetics Technical Expert*

Cal Qualset is Professor Emeritus in the Department of Plant Sciences at the University of California, Davis, where he taught graduate and undergraduate courses in agronomy, genetics, statistics, genetic resources conservation, and plant breeding. Additionally, he led a team that established a non-profit foundation in California and a research center in Lithuania that introduced asparagus production. At UC Davis his team developed and released 28 varieties of wheat, oat, and triticale for California farmers and he has published more than 350 research papers, reviews, and reports.

Qualset has served the Crop Science Society of America (CSSA) in numerous capacities during his 50 years as a member. He was Editor-in-Chief and President, a founding influence for the International Crop Science Congress, and initiated the formation of the Plant Genetic Resources Division. He also served as President of the American Society of Agronomy and Chair of the Board of Trustees of the Agronomic Science Foundation. He has participated in numerous reviews of Centers and Programs of the CGIAR and national centers and programs.

Qualset earned both his Master of Science in Agronomy and his PhD in Genetics from the University of California. He holds a Bachelor of Science in Agriculture from the University of Nebraska. He has received numerous awards related to his career in plant breeding research, genetic resources conservation, and public service, including CSSA's Presidential Award for career contributions, the Black award from CAST for public service and communications, as well as the Brown and Meyer Medals for plant genetic resources. He was elected Fellow of ASA, CSSA, and AAAS as well as receiving Fulbright awards to Australia and Yugoslavia (Serbia).

CONTENTS

ACRONYMS AND ABBREVIATIONS

AFP	Axial flow pump
AFT	Axial flow thresher
AWD	Alternate wetting and drying
AWP	Annual work plan
BAMETI	Bihar Agricultural Management & Extension Training Institute
BAU	Bihar Agricultural University
BHU	Banaras Hindu University
BMGF	Bill & Melinda Gates Foundation
CA	Conservation agriculture
CGIAR, CG	Consultative Group for International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
COP	Chief of Party
CSISA	Cereal Systems Initiative for South Asia
CSISA-BD	Cereal Systems Initiative for South Asia – Bangladesh
CSISA-MI	Cereal Systems Initiative for South Asia – Mechanization and Irrigation
CSISA-NP	Cereal Systems Initiative for South Asia – Nepal
CSISA-'Big Tent'	Holistic innovation domains and processes that cut across the Initiative
CT	Conventional tillage
DAS	Days after sowing
DCED	Donor Committee for Enterprise Development
DOA	Department of Agriculture
DQA	Data Quality Assessment
DSR	Direct-seeded rice
EC	Executive committee
EIGP	Eastern Indo-Gangetic Plains
ERWCS	Early Rice-Wheat Cropping System (based on early sowing of wheat to avoid heat-kill during maturation)
ET	Evaluation team
FAO	Food and Agriculture Organization
FBD	Flat bed dryer
GHG	Greenhouse gas
Ha	Hectares
HICD	Human and Institutional Capacity Development
HP	Horsepower
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICT	Information communication technology

iDE	International Development Enterprises
IFAD	International Fund for Agriculture Development
IFPRI	International Food Policy Research Institute
IGP	Indo-Gangetic Plains
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
IWM	Integrated weed management
IWMI	International Water Management Institute
KDAD	Knowledge-Driven Agricultural Development Project
Kg	Kilograms
KII	Key informant interview
KVK	Krishi Vigyan Kendra
LLL	Laser land levelling
LSP	Local service provider
M&E	Monitoring and evaluation
Mha	Mega hectare
MT	Management team
MTNPR	Machine-transplanted non-puddled rice
MTPR	Machine-transplanted puddled rice
NARC	Nepal Agricultural Research Council
NARS	National agriculture research systems
PMP	Project management plan
PRSSP	Policy Research and Strategy Support Program
R&D	Research and development
SOW	Scope of work
SRI	System of rice intensification
SRSPDS	Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh
STRASA	Stress Tolerant Rice Africa and South Asia
USAID	United States Agency for International Development
Winrock–KISAN	Knowledge-based Integrated Sustainable Agriculture and Nutrition Project
ZT	Zero tillage

EXECUTIVE SUMMARY

The evaluation team (ET) appraised background documents, and for 21 days, visited field sites in Nepal, India and Bangladesh during February 2015. Field time in Bangladesh was restricted to only one of six hubs due to risks associated with socio-political disturbances (severe hartals). The Cereal Systems Initiative for South Asia (CSISA) staff presentations to the ET helped compensate for reduced field visits, but we are the first to recognize that site visits are critical to gaining data and understanding the program.

The CSISA Initiative is complex. It is composed of different management across countries and a diversity of innovation and adoption processes, involving many diverse international and national stakeholders. This complexity made it challenging for the ET to capture all aspects evenly, in all places. On the other hand, this complexity also makes CSISA a powerful, holistic research and development model that can, and does, bring about changes in sustainable intensification and strategic farm-level diversification. Complexity should be understood as a positive dimension, regardless of the difficulties in appraising CSISA's "Big Tent" (projects across the Initiative) performance and impact.

Multi-component impact pathways are bringing together pioneering solutions to constraints and opportunities that cannot be harnessed by reductionist research approaches. CSISA is mostly about well-focused 'production-systems' research and concomitant development. Addressing mechanization constraints within a production system, for example, facilitates rapid turnaround time between harvesting and replanting crops within a calendar year and permits meaningful strides toward sustainable intensification of smallholder production systems. Likewise, irrigation and water management innovations enable new varieties and agronomic practices to be harnessed for sustainable intensification. There is strong inclusion of the private sector, including a new, powerful farmer-cum-service provider who uses new mechanization innovations on his/her farm and also on his neighbors' farms via a contractual service. Public institutions, especially at the state level, are pivitol and have empowered members of the Initiative. CSISA also strategically encompasses rice and wheat breeding as well as policy research focused on CSISA's goals. Rice and wheat breeding efforts are targeted at the needs of evolving production systems and the mitigation of climate change impacts. Policy-level research provides insights on opportunities and constraints, informing decision-makers on implications of externalities on the innovation pathways and informs policy-makers about available choices and their consequences.

Building on 20 years of research and development (R&D) work in the Rice-Wheat Consortium, CSISA is likely to be one of the most productive investments in the agricultural R&D portfolios of the United States Agency for International Development (USAID) and the Bill & Melinda Gates Foundation (BMGF). This conclusion is not surprising because the Rice-Wheat Consortium was widely acknowledged to be the most attractive of the earlier CGIAR Systemwide Ecoregional Initiatives. The major success story in CSISA's "Big Tent" is the rapid uptake of early planted wheat, facilitated by shorter-duration rice varieties and hybrids, the use of zero-tillage seed drills and full-duration, high-yielding wheat varieties in east India.

In 2013–14, more than 500,000 farmers adopted components of the 'early' rice-wheat cropping system in Bihar and eastern Uttar Pradesh, where CSISA has worked since 2009. The area planted, by a CSISA-supported network of 1,700 service providers, in wheat and under-zero tillage increased by 42 percent between 2012–13 and 2013–14, reaching more than 50,000 farmers. The value of area planted by CSISA's service providers in the 'early' rice-wheat cropping system was equivalent to $4.4 million in 2013–14. The increase in net benefit with the adoption of zero tillage in the rice-wheat cropping system in central and east India is almost identical to the level found in the highly productive areas of northwest India in 2005 ($100 per hectare). About half of this estimate is generated by increased productivity in wheat (about 450 kilograms per hectare); the other half comes from cost savings.

The validity of the estimates in the previous paragraph is triangulated from several sources. USAID/India has contributed to a highly effective M&E system; the area covered by service providers is carefully chronicled in their diaries. Moreover, supportive research by economists from International Maize and Wheat Improvement Center (CIMMYT) and the International Rice Research Institute (IRRI) is thorough and confirms the Feed the Future (FTF) results, which were substantiated by perceptions of CSISA staff and their partners elicited in the ET's online survey.

Policy change has reinforced the technological change to the 'early' rice-wheat cropping system. CSISA's statistically significant and mutually reinforcing on-station and on-farm results have induced the government of Bihar to change its recommendation for wheat planting from after November 15 to before this date. The changed planting date recommendation may be the precursor of more well-documented policy changes in Bihar and in other states. CSISA research results have ample potential to play a role in reversing some entrenched, but no-longer true, beliefs about 'best' practices.

The FTF indicators in CSISA-Bangladesh also indicate widespread adoption of improved technological options in rice-based cropping systems, especially on land that is not constrained by waterlogging. The highest-ranking technologies identified in an online survey were those that intensified rice-cropping systems by adding another crop following shorter-duration rice varieties in the aman season. Examples included rice-mustard-rice, rice-lentil-rice and rice-maize-mung bean systems. Household-based pond aquaculture with vegetables planted on the dykes was the second-ranked technology among the 16 listed for selection by CSISA staff and partners in Bangladesh. What the FTF-related results imply for the sustainable uptake of technologies will be firmly established through research on adoption that should be completed prior to the scheduled project closing in September 2015. CSISA-Bangladesh has a good plan based on longitudinal sampling for the conduct of such work.

Improved varieties of rice and wheat are developed by IRRI, CIMMYT and their national partners for environments characterized by heat, drought and saline stresses in South Asia. From 2011-14, 19 of a total of 33 wheat releases in India, Bangladesh and Nepal were CIMMYT elite advanced lines.

In spite of this progress in varietal development and delivery, recent International Food Policy Research Institute (IFPRI) evidence on wheat in Haryana, conducted through CSISA, reconfirms a major finding from earlier studies on rice in South Asia: many released varieties never reach a 1 percent adoption rate. Additionally, varietal turnover is slow, ranging from a weighted average age of 12 years for improved wheat varieties in Haryana to more than 20 years for improved rice cultivars in Odisha. Although improved, short-statured rice and wheat cultivars from the green revolution have been fully adopted in South Asia, the estimated current velocity of varietal turnover leaves much to be desired and is not significantly different from comparable estimates for improved rice and wheat varieties in sub-Saharan Africa. The recent introduction of CSISA-developed varieties of wheat may be countering this trend. For example, adoption of these new varieties was estimated, based on seed system delivery in 2014, to be 18, 24, and 34 percent of the planted crops in India, Nepal and Bangladesh, respectively. Embedding rice and wheat improvement in CSISA is a force for accelerating varietal change in response to the transformations in crop management that are now occurring on the Indo-Gangetic Plain. Rapidly evolving crop management, featuring reduced tillage, leads to modifications in pest and disease populations and changes in the incidence of abiotic stresses and edaphic environments that condition differential varietal response. The latter makes a compelling argument for including rice and wheat breeding as components of the Initiative's "Big Tent."

The ET believes that the following five elements contribute to CSISA's distinctiveness in R&D in India, Bangladesh and Nepal:

- the concept of the hub for an alliance of key stakeholders to focus R&D
- the emphasis on service providers for appropriate mechanization adoption
- the mix of private- and public-sector partnerships
- a cropping systems perspective
- the validation of prospective technologies in participatory on-farm trials
- the effective integration of supportive, socioeconomic and policy research

Of these, the emphasis on encouraging service provision and training service providers is likely to be the one that is institutionally the most sustainable and transformative. In rice-wheat, rice-maize and rice-rice cropping systems on the Indo-Gangetic Plains, small-scale mechanization opportunities to be conducted by service providers are available nearly year around. In central and east India, these opportunities have not yet been fully exploited by the private sector, including by service providers. Training trainers of service providers and making linkages among stakeholders is a work in progress.

CSISA's commitment to service providers is unprecedented in terms of international agricultural R&D projects. The Initiative's training style is also innovative, and based on extensive interviews, we conclude to be highly effective. CSISA in India has emphasized 'hands-on' training administered by lower-level, but highly competent, field technicians. This style of training complements conventional instruction in the Krishi Vigyan Kendra (KVKs) as well as state-level agriculture departments' extension activities, which are most often demonstrations and/or classroom learning by less specialized, but more highly educated scientists. Engaging in a large-scale project that seeks to transfer CSISA's widely adaptable and highly validated rice-wheat and rice-maize technologies when Phase III ends could make significant progress in institutionalizing CSISA's emphasis on and approach to training service providers in both the KVKs and the state departments of agriculture in India.

The CSISA program has been able to create a shared vision of its approach and goals across its staff and stakeholders. Its cropping systems-based innovations have linked public, private and civil society individuals and organizations within and across Bangladesh, India and Nepal. This vision is embraced by USAID/India and to a more limited extent by USAID/Bangladesh and USAID/Nepal.

In general, program management of the various elements under CSISA is effective and efficient. The quality of senior program staff is remarkable. Program management is supported by Impact Pathways-based planning in the CSISA-India and CSISA-Bangladesh projects. These Pathways were found to be a highly effective mechanism for coordination of activities among a wide range of project actors, providing clarity on who does what, where, how and when. CSISA-Nepal uses more traditional work-planning mechanisms to good effect. The Impact Pathway planning process could also be a useful tool to facilitate better coordination between the CSISA and Knowledge-based Integrated Sustainable Agriculture and Nutrition (KISAN) projects in Nepal. All of the CSISA component elements are endowed with active communication efforts.

There is a strong sense of collaboration among most of the CSISA partners. CIMMYT and IRRI, in particular, seem to work well together. In Bangladesh, WorldFish also coordinates well with its other Consultative Group for International Agricultural Research (CGIAR, or CG) partners. Reflecting the spirit of research with a farming systems perspective, 17 of 18 respondents to our online survey concurred with the statement that "In the future, separate projects by IRRI, CIMMYT and WorldFish in Bangladesh will not be as effective as CSISA-Bangladesh because the scope for productive interactions will be limited."

The International Livestock Research Institute's (ILRI) research role is less compelling than it should be for an effective contribution to CSISA. Broadening ILRI's current extension orientation to include strengthening the mandate of adaptive research on crop-livestock integration in general, and on smallholder dairy production in particular, is one of principal recommendations of this evaluation. In contrast, IFPRI's CSISA-related research output in India is high for a relatively small investment. That work is effectively coordinated with the other CG partners in annual and semi-annual planning meetings. ILRI and IFPRI CSISA-related outputs are substantially more visible in India than in Bangladesh and Nepal, where activities take place outside CSISA's reach. IFPRI's research is contained in a separate project objective, which is generally well coordinated with the other CG's activities (see section on Policy, p. 24).

The CSISA team members have collaborated to a significant extent with local stakeholders, including public agencies. In most cases, collaboration is stronger at the local and state levels than at the national level. Misperceptions by some interviewees of CSISA as a stand-alone project in Phase I has been corrected at the state and local levels, but attention to awareness and joint ownership at the national levels still merits some attention in all three countries.

Collaboration with the private sector is a key element in the CSISA effort. This collaboration exists at the formal business level (Bayer, Rangpur Foundry, ACI Limited, etc.) and more informally among local suppliers and firms. A core mechanism to assure sustainability of the CSISA activities is through fostering a growing network of local service providers—essential private sector entrepreneurs and many of whom are, themselves, farmers.

A major effort has been made by USAID and CSISA to improve the Initiative's monitoring and evaluation (M&E) systems. This effort has resulted in well-developed and strong M&E structures within CSISA. An area of concern in the M&E efforts is the limited ability of the Initiative to gather longer-term technology adoption and impact information. For example, the movement of resources in Nepal from the Central Terai to further west before technologies could be fully deployed result in insufficient time the program to consolidate gains and financially restricts the ability to evaluate long-term impact on and ownership of technology by beneficiaries.

Selected recommendations

The following is is a selected list of key recommendations. A fuller discussion of all the ET's recommendations can be found in the Recommendation section (see p. 40).

1. We recommend continued emphasis on the following R&D activities that are central to CSISA:
    - Optimization of rice-wheat production systems in Bihar and Eastern Uttar Pradesh in India
    - Optimization of rice-based production systems in "low-yielding" Kharif rice systems typified by Odisha (also relevant in Jharkhand and other states of East India)
    - Optimization of rice-based production systems in central and northern Bangladesh, including Rangpur and Mymensingh hubs, each with about 15 million people
    - Optimization of rice-wheat production systems in the Terai of central and western Nepal; hill-lands R&D to continue only if appropriately funded
2. We recommend that in Phase III, CSISA-India draft as project outputs one to three carefully crafted 'investment-grade' joint proposals in collabortation with the state governments of Bihar and Uttar Pradesh to massively disseminate the 'early' rice-wheat cropping system. These large joint endeavors may also benefit from assistance of the Investment Center of the Food and Agriculture Organization (FAO), perhaps with funding for formulation from the Asian Development Bank or from the International Fund for Agriculture Development (IFAD), if necessary.
3. We recommend that one or more donors enable CSISA, perhaps with support of other partners, to delineate soils and water resources, in parallel with studies on socio-economic constraints for "rabi fallow" zones in Odisha, to enable the targeting of sustainable intensification research.
4. We recommend that CSISA-MI be strengthened, perhaps with support of other advanced water management partners, to assist the Government of Bangladesh to formulate and map out strategies to mitigate saline toxicity in its mandate area of southern Bangladesh.
5. We recommend that USAID and/or BMGF support mechanization in hubs in northern and northwestern Bangladesh where private-sector partners need science support on mechanization.
6. We recommend that in order to stimulate greater integration between agronomists, who are undertaking specific and process research, and plant breeders, who are working on rice and wheat varietal development, we recommend that CSISA consult and explore, with national agricultural research systems' (NARS) leadership, workable protocols enabling NARS scientists to appraise and advance breeding lines in controlled on-farm environments in India, Bangladesh and Nepal.
7. We recommend that plant breeding continue to be an integral part of CSISA in Phase III for South Asia. Crop management is rapidly changing on the Indo-Gangetic Plain. Varieties need to be selected to optimize dynamic new production systems, especially emphasizing early maturity, heat tolerance and resistance to plant diseases that are emerging with the new production interventions. Close interactions between breeders and agronomists will reinforce the process of change and accelerate the turnover of improved new cultivars.

INTRODUCTION AND CONTEXT

The Cereal Systems Initiative for South Asia (CSISA) builds on the work carried out in the Rice-Wheat Consortium. Partnering with National agriculture research systems (NARS) of Bangladesh, India, Nepal and Pakistan in 1990, the International Rice Research Institute (IRRI) and the International Maize and Wheat Improvement Center (CIMMYT) established a joint research project that addressed concerns about stagnating productivity and flagging sustainability in rice-wheat, the most extensively cultivated cropping system in South Asia. After completing the first phase in 1994, the project members established the "Rice-Wheat Consortium for the Indo-Gangetic Plains" under the leadership of NARS members.

The Rice-Wheat Consortium and the success of zero tillage

The Rice-Wheat Consortium was a major system-wide eco-regional initiative of the Consultative Group for International Agricultural Research (CGIAR, or CG). It represented a significant departure from the traditional way of doing business in international agricultural research. Instead of the crop, the cropping system became the locus for investigation, with contributions made by multiple international and national agricultural research centers.

The Rice-Wheat Consortium focused on the generation and dissemination of Resource-Conserving Technologies (RCTs) to improve the productivity and ensure the sustainability of the rice-wheat cropping system as a whole. The early sowing of wheat, facilitated by zero tillage, was the most successful of these. Zero tillage started to spread in the late-1990s, accelerated in the early aughts and was estimated to have been used on approximately 1.76 million hectares by 620,000 farm households by 2010. Net benefits approached roughly $100 per hectare, equally divided between monetary gains from increased productivity in wheat and cost savings in operations and water use. The Rice-Wheat Consortium played a pivotal and innovative role as facilitator, information provider, technology clearinghouse and capacity builder" (Erenstein 2010, p. 69).

The complex initiative that is CSISA

The widespread adoption of zero tillage in the northwest of the Indo-Gangetic Plain figured prominently in expanding the scope of work of the Rice-Wheat Consortium and transforming it into CSISA in 2009, with funding from the Bill & Melinda Gates Foundation (BMGF) and the United States Agency for International Development (USAID). CSISA has been referred to as a "Big Tent" Initiative that covers four areas: 'Base'-CSISA in India, CSISA-Bangladesh (CSISA-BD), CSISA-Nepal (CSISA-NP) and CSISA-Mechanization and Irrigation (CSISA-MI) (Figure 1). Effectively, 'Base'-CSISA has been augmented with additional USAID Mission and Washington-funded projects, not replaced as Figure 1 suggests.

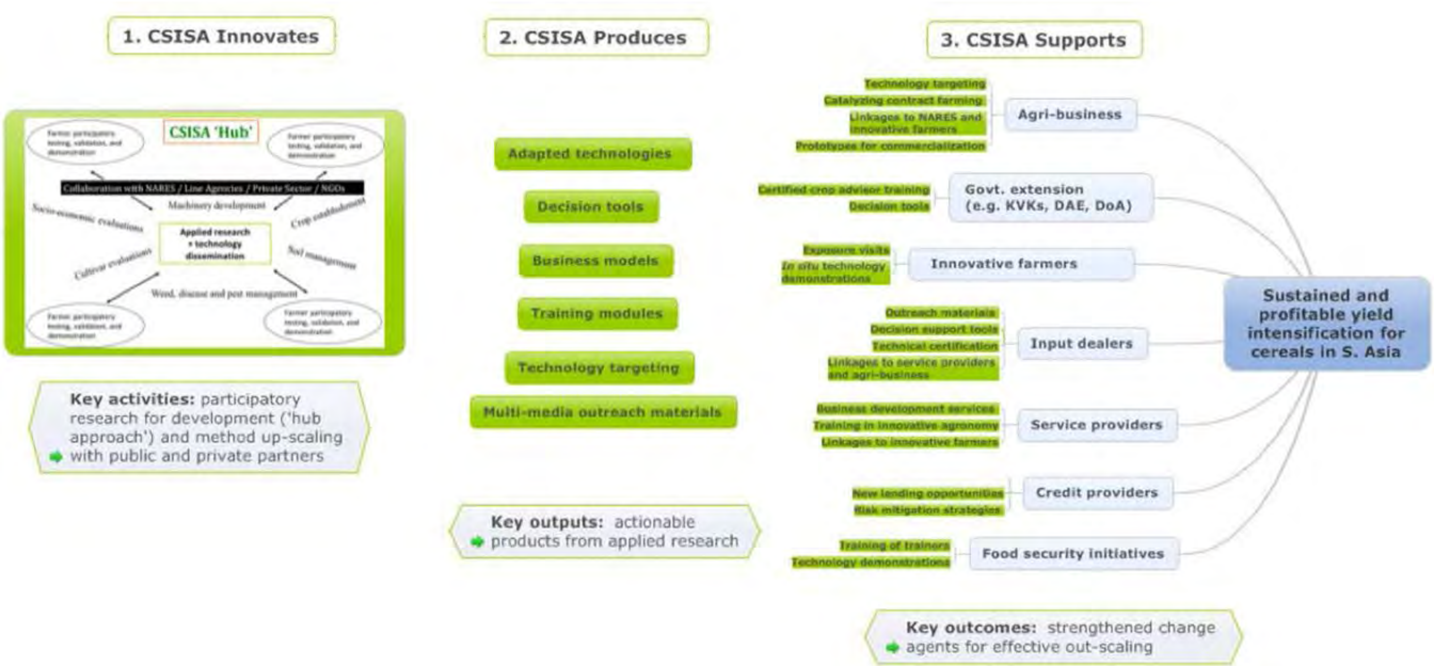
Integral to CSISA is the concept of a "hub" that is a locus for staff and partner interactions, information provision, a technology clearinghouse, and a forum for capacity building. CSISA scientists in each hub work in three to 10 neighboring districts on rice-wheat or rice-based cropping systems, or in the case of some hubs in Bangladesh, rice-fish farming systems. The multi-dimensional role of the hub is described in Figure 1.

The 'Base'-CSISA is founded on six objectives that aim to (1) catalyze the widespread dissemination of production and post-harvest technologies, (2) engage in process-based research mainly in cropping-systems agronomy, (3) develop high-yielding heat- and water-stress tolerant rice varieties, (4) develop high-yielding, heat- and water-stress tolerant and disease-resistant wheat varieties, (5) contribute to the development of improved policies and institutions for inclusive agricultural growth and (6) ensure high-quality project management, data management, measurement and evaluation and communications. Four CG Centers, CIMMYT, IRRI, the International Food Policy Research Institute (IFPRI), and International Livestock Research Institute (ILRI) and their national and international partners participate in the Base-CSISA. IRRI and CIMMYT carry out cropping systems and crop improvement research and technology transfer on rice and wheat in the first four objectives. IFPRI is responsible for the policy and institutional work encapsulated in the fifth objective. ILRI joins in India to enhance the productivity of crop-livestock interactions. WorldFish joins CSISA-BD to optimize farm-family benefits in rice cum fish (and crustaceans) systems. Partners are synonymous with public-sector research institutes and extension services, universities, private-sector companies and nongovernmental organizations (NGOs).

The CSISA program in Bangladesh is implemented through a partnership among three CGIAR centers: IRRI, CIMMYT and WorldFish. CSISA-Bangladesh is funded by USAID's Feed the Future initiative and aims to test and disseminate new cereal, system-based technologies that will raise family incomes for 60,000 farming families. The Cereal Systems Initiative for South Asia Mechanization and Irrigation Project is a CIMMYT-implemented initiative that operates under the wider CSISA program in Bangladesh. CSISA-MI is operational in southwestern Bangladesh and is funded by the USAID Mission in Bangladesh under the Feed the Future initiative. In CSISA-MI, CIMMYT partners with International Development Enterprises (IDE) and works to transform agriculture in Bangladesh's Feed the Future zone by unlocking the productivity of the region's farmers during the dry season through surface water irrigation, efficient agricultural machinery and local service provision.

The CSISA program in Nepal receives funding from the USAID Mission in Nepal with a co-investment from USAID/Washington. USAID/India also provides some resources to CSISA-NP work as part of its regional development portfolio. In Nepal, CSISA's focus is primarily on participatory technology development and verification, inclusive of insights into business and market development for machinery and seeds. Disseminating technologies vetted by CSISA is the responsibility of the Winrock- Knowledge-based Integrated Sustainable Agriculture and Nutrition Project (Winrock-KISAN) project, funded through USAID under the Feed the Future initiative.

FIGURE 1. The Multidimensional Role of CSISA's Hub (courtesy of Cynthia Mathys, CSISA, 2015)



The earlier Rice-Wheat Consortium was exhaustively reviewed in 2003, and 'Base'-CSISA and CSISA-BD have each been reviewed once. Principal recommendations from those reviews are found in Annex Q.

Initial review and report

The evaluation team (ET), supported by the Feed the Future Knowledge-Driven Agricultural Development (KDAD) project, was charged with assessing the main accomplishments and constraints of the CSISA "Big Tent" to provide evidence on areas for future focus both at the country level (Bangladesh, India and Nepal) and in the Initiative-wide context. Specifically, we were asked to understand if and how targeted results were occurring, evaluate what program component approaches are working well and which are not performing as expected and to provide constructive feedback to the CSISA implementation team to improve program effectiveness. The evaluation plan derived from the scope of work, presented in Annex I.

Tasked with assessing performance along the six Phase II objectives, the ET spent 21 days conducting a field-based review across three countries. The team conducted a total of 37 interviews and 20 group sessions involving over 400 CSISA staff members, partner organizations, service providers and farmers (see Annex N for list of people contacted). The team also disseminated an online survey to CSISA staff and partners and received a total of 168 responses. The ET reviewed all annual reports, planning documents, previous project reviews and many of the technical publications and communication publications (see references in Annex O). Our team corresponded (personal communicaitons) with many people with knowledge of CSISA and/or relevant agriculture research and development knowledge.

In structuring the evaluation report, the ET took into account the different objective structures of the various component parts of CSISA. For example, Bangladesh uses a single project objective (increase rural household incomes) with seven intermediate results (IRs); whereas India has six strategic objectives: 1) Hubs, 2) Research, 3) Wheat Breeding, 4) Rice Breeding, 5) Policy and 6) Project Management. To permit a uniform structure across this report, the ET has constructed a hybrid of Bangladesh, Nepal and India's structures reflected in topic domains (see Table 1) to explain how findings led to descriptions, conclusions and recommendations across countries. In addition, the ET replaced the term "Hub" as a Strategic Objective with "Catalyzing Change" to reduce confusion with its alternative meaning as a geophysical dimension.

In other words, under Findings, this report will follow the slightly modified organizational structure:

- Strategic Objective 1 (Hubs) is discussed primarily under the Catalyzing Change section.
- Research conducted at the hubs (geophysical and organizational) is discussed under the Biological and Physical Research section. This includes agronomy, breeding, water, mechanization, livestock and fish. The Research section composes Strategic Objectives 2, 3 and 4.
- Strategic Objective 5 (Policy) remains the same under the Policy and Socio-economics Research section.
- Similarly, Strategic Objective 6 (Project Management) remains the same under the Management section.

TABLE 1. Domains for report organization

Findings
Catalyzing Change – work done primarily at innovation hubs including innovation applications to policy and enabling processes. It includes the work done to foster development such as partnership building and training, as well as stakeholder enabling through impact pathway-based holistic approaches.
Biological and Physical Research – All research except macro-level policy research. Subsections include: economics at the farm level, crop-specific research, process/systems research, rice breeding, wheat breeding, research related to livestock production enhancement by ILRI, and fish in Bangladesh by WorldFish
Policy and Socio-economics Research – overarching economics research by IFPRI
Management – CIMMYT leads for India and Nepal and IRRI has the principle management role in Bangladesh
Cross-Cutting Themes – Mechanization/labor constraints, gender, water management, nutrition and climate change
Program Future
Recommendations

FINDINGS

Catalyzing Change (Objective 1)

Discussion of this section cannot exclude research validity because to a major degree, validity is documented by tangible changes that result from the research. Such changes related to project work is documented under "Research Validity" in this report, so we suggest that these twin domains be read in conjunction for a fuller understanding of research and its development impact.

The simple identification in Bihar and eastern Uttar Pradesh of the need for change in the planting date for wheat (so that it would not mature prematurely in the high temperatures of late March) was the 'driver' for the cascade of associated innovation applications. Sustainable intensification like this can and will result in major increases in the scale of food security in these regions if adopted dynamically by the states. Going forward, we will refer to this innovation cluster as the 'Early Rice-Wheat Cropping System (ERWCS).' In India, early sowing of wheat, zero tillage and machine transplanting of rice easily topped a list of 16 CSISA-related interventions with potential for impact in Bihar and eastern Uttar Pradesh. Laser land leveling (LLL), direct-seeded rice (DSR) and full-season, recently released wheat varieties composed a second group with high expectations for impact. Presently, the returns to farmers from the adoption of early sowing of wheat before November 15, zero tillage seed drills and long-duration wheat varieties in eastern Uttar Pradesh and Bihar are sufficient to cover all the costs of CSISA through Phase III, which ends in September 2018.

In Odisha State India, perceptions on technologies that were judged to be the most promising for impact were not nearly as sharp and clear as they were in Bihar and eastern Uttar Pradesh. This fuzziness in perception was expected because Odisha is not nearly as advanced in technological development as the hub where the dominant rice-wheat cropping system is common and where research had been conducted for 20 years prior to the implementation of CSISA. Rice nursery management, mechanical transplanting, DSR, improved rice varieties, site-specific nutrient management, LLL, improved machine threshing and mechanical seed drills to facilitate higher cropping intensities all garnered some support as the most likely candidates for impact.

CSISA can influence agricultural development in South Asia in multiple ways. Technological change is the first dynamic that comes to mind. The empirical evidence cited earlier and the numbers in the Feed the Future indicators point to an impressive track record of early adoption for an R&D initiative that began five to six years ago in Bangladesh and India. Technological success was not preordained in accelerating productivity in the rice-wheat cropping system, but it was expected. CSISA effectively drew on 20 years of applied research in the Rice-Wheat Consortium. Techology adoption in more remote eastern India (such as in Odisha) and in the Terai of Nepal will also follow, if appropriate R&D support is provided. The implications for food security and livelihood enhancement for millions is evident. However, as the socio-economic basis, compared to Bihar and eastern Uttar Pradesh, is less developed, additional time for adoption should be expected as local institutions are strengthened. We strongly support the concept of continued and unbroken support for the R&D work of the CSISA Initiative.

CSISA has also influenced policy change in its short life span. CSISA's findings on the benefits to early wheat planting have led to revised thinking in the form of changed cropping recommendations in the State Department of Agriculture in Bihar in India. The prospects are bright that CSISA's work will also result in further changes in Bihar and in Uttar Pradesh. Changing a planting date recommendation may sound trivial, but those who have spent their lives working in agricultural R&D in India realize that it is a big deal. Similarly, CSISA-BD through its sub-project, Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh (SRSPDS), facilitated an important bilateral agreement between India and Bangladesh to permit the exchange of varieties and accept varietal registration in both countries. It is also worth recognizing that CSISA's policy research contributes evidence to many of the heated policy debates over sustainable intensification in South Asia. This evidence may ultimately influence policy-making at some future point.

Other potential paths for change can be identified by responding to the following query: What makes CSISA unique? The ET believes that the following six elements contribute to CSISA's distinctiveness in R&D in India, Bangladesh and Nepal:

- The concept of the hub
- The emphasis on service providers

- The mix of private and public-sector partnerships
- A cropping systems perspective
- The validation of prospective technologies in on-farm trials in a participatory setting
- Interdisciplinary research and extension, featuring strong collaboration between agronomist. and economists

Each of these elements can be a vehicle for transformative change by themselves, but the synergies between them are worth highlighting. Although the hubs in India, Bangladesh and Nepal maintain a small physical office, they are best thought of as virtual venues for leveraging increased productivity in complex systems that do not rely on silver bullets for their transformation. The hub is a place where multiple partners come together to seek solutions to well-defined problems, identified in farmers' fields or in consumers' markets. Problems are not defined on research stations where scientists are posted. Hub scientists have the resources and the freedom to address problems wherever they feel constraints can be most effectively tackled and opportunities most appropriately exploited.

It is too early to tell whether or not the concept of a "hub" will endure in CSISA countries. In Phase III, a brief, focused study on the fate of the Phase I hubs in Haryana, Punjab and Tamil Nadu could consolidate evidence on the hub experience and point to paths for incorporation into more formal R&D systems in India. The online survey results show that CSISA staff and partners in India are deeply committed to the hub concept and are optimistic that it and/or its activities will survive CSISA in both India and Bangladesh.

Of the characteristics that describe CSISA's uniqueness, the emphasis on encouraging service provision and training service providers is likely to be the one that is institutionally most sustainable. In rice-wheat, rice-maize and rice-rice cropping systems on the Indo-Gangetic Plains, small-scale mechanization opportunities are available 12 months of the calendar year. In central and east India, few if any of these opportunities have been fully exploited by the private sector.

CSISA's commitment to service providers is unprecedented in terms of CGIAR-based agricultural R&D projects. Their style of training is also innovative and seems to be highly effective. CSISA-India has emphasized hands-on training administered by lower-level, but highly competent, field technicians. This style of training complements conventional instruction in the KVKs that feature more classroom learning by less specialized, but more highly educated scientists. Even technology demonstrations by state extension personnel place less emphasis than CSISA on increasing the practical skills of farmers or service provider intermediaries. Engaging in a large-scale project that seeks to transfer CSISA's widely adaptable and highly validated rice-wheat and rice-maize technologies when Phase III ends could make significant progress in institutionalizing CSISA's emphasis on training service providers in both the KVKs and the state departments of agriculture in India.

CSISA also represents an important step in increasing the private sector's participation in agricultural research and extension in India, Bangladesh and Nepal. The online survey results confirm the importance of private-sector participation in the minds of CSISA staff and partners. Eighty of 88 respondents agreed or strongly agreed that "the private sector can effectively participate in the transfer in most of the technologies recommended by the CSISA project." Only one respondent disagreed with this statement.

Although CSISA has played an important role in forging multiple private-sector partnerships in India, it will be difficult to attribute CSISA's activities to greater private sector involvement in agricultural R&D in India in a generalized setting without concrete examples on how CSISA's work changed the behavior of government institutions, the regulatory framework and general ways of doing business. Respondents in the survey could list examples of specific technologies (of interest to CSISA) that elicited responses from the private sector, but could not cite examples of behavioral change of public-sector institutions that resulted in more penetration by the private sector into agricultural R&D in India. In Nepal, catalyzing change was mainly limited to the introduction of new private-sector mechanical technologies in public-sector research stations in midwest Nepal. In spite of the difficulties in quantifying the Initiative's attribution, the ET believes that CSISA has been a catalyst for change in opening up agricultural development to greater and more effective private-sector participation.

Adaptive, on-farm research with a cropping systems perspective that features farmer participation is not new to India; however, it is not widely practiced in India's formal R&D systems. Technology validation and extension requires transforming India's top-down approach to adaptive research, which is a daunting task that is outside the main objectives in CSISA's mandate on increasing production to reduce rural poverty and food insecurity. Nevertheless, because CSISA is such a close partner with NARS, the Initiative should be expected to have some influence on how those public-sector research institutions conduct their business. Even if CSISA is encouraging change at the margins, there should be some value in recognizing transformative change as a secondary objective. This influence will increase further should CSISA adopt the recommendation for the next phase to work with state governments, such as Bihar and eastern Uttar Pradesh, to elaborate an "investment-grade" proposal toward scaling the adoption of key innovations, such as the ERWCS.

CSISA's approach to technology validation and to extension is effective. It features on-farm trials and tests on large plots and fields that can also serve as extension demonstrations. Survey results strongly suggest that the large majority (more than 90 percent) of CSISA staff and partners in India, Bangladesh and Nepal believe that CSISA's approach to technology validation, participatory research and extension is innovative and that a lot of effort is expended on testing technology in farmers' fields. Examples of the validity of this is the number of farmers in Bihar and eastern Uttar Pradesh who are adopting the 'suite of technologies' for ERWCS and also the number of new service providers choosing to take up the work (pay is based on what a neighbor farmer is willing to pay).

CSISA's way of validating technology does represent a paradigm shift to business as usual in India, but it is unlikely to result in a transformative change in how Indian government institutions go about technology validation and extension. Influence is more likely to be felt in the local and international NGO communities that partner with CSISA. In the future, they may emulate the good practices that CSISA is inculcating in their day-to-day partnership activities. CSISA is also in a position to capitalize on the best practices demonstrated by their NGO colleagues.

Research with a farming-systems perspective takes on new meaning in Bangladesh where rice cultivation is carried out following the harvest of fish in aquaculture ponds. Rice productivity benefits heavily from fish residues in these rice-gher farming systems. Many of the scientists in the six hubs in Bangladesh are on leave from their respective national programs. They experienced first-hand research with a farming-systems perspective and shared administrative responsibilities in the management of the program at their hub. They could be a strong force for catalyzing change when they return to their national crop and fisheries research institutes. Reflecting the spirit of research with a farming-systems perspective, 20 of 22 respondents to the online survey concurred with the statement that "In the future, separate projects by IRRI, CIMMYT and WorldFish in Bangladesh will not be as effective as CSISA-BD because the scope for productive interactions will be limited."

BIOLOGICAL AND PHYSICAL RESEARCH (OBJECTIVES 2, 3, & 4)

Results and validity

Introduction

The topic of validity of research, in part, is predicated on there being tangible outcomes/changes, also parameters in the previous section. We have documented most aspects on "development results derived from research" in this section, but suggest readers also read the section on Catalyzing Change section for the full picture.

Like many agricultural R&D ventures, one success story is sufficient to more than account for all the costs of the project generating high internal returns on investment that can approach or exceed 20 percent. CSISA-related improved rice and wheat varieties have generated an attractive and steady return on investment in South Asia, but the major success in CSISA's "Big Tent" centers on the rapid uptake of early planted (before 15 November) wheat. This success is facilitated by shorter-duration rice varieties and hybrids, the concomitant use of zero tillage seed drills for rapid turn-around time between harvesting rice and sowing wheat, and full-duration, high-yielding wheat varieties in the eastern Uttar Pradesh and Bihar hubs in India. Enabled by the full suite of appropriate technologies, this symphony of process research and development, including farmer "service providers" for use of no-till seed drills, is providing awe-inspiring outcomes that can be scaled up in several states in India and in the Terai of Nepal, where rice/wheat systems dominate. See the India country report in Annex E for additional details.

India

In 2013–14, over 500,000 farmers have adopted ERWCS in central and east India where CSISA has worked since 2009. CSISA supports a network of 1,700 service providers. According to CSISA's 2014 Annual Report, the area planted in wheat with zero- or strip tillage with service providers increased by 42 percent, or up to approximately 50,000 hectares (ha) between 2012–13 and 2013–14. Although only about 1 percent of rice-wheat farmers in Bihar and eastern Uttar Pradesh have been reached, these results are truly exceptional positive outcomes of the CSISA Initiative, and they set the stage for elaboration of an "investment-grade" proposal by the state governments to scale adoption of ERWCS. Millions of farm families could be empowered by variety choices (early and medium maturing rice) and by appropriate no-till planting mechanization (see also the Recommendations section of this report, p. 90). CSISA should work with state govenments of Bihar and Uttar Pradesh to create a shared vision of the way forward, and then focus on the elaboration of investment projects to scale-up the innovations.

The validity of these estimates is beyond question. As discussed in the previous section, the area covered by service providers is carefully chronicled in their diaries. The productivity of CIMMYT and IRRI economists in the support of Objective 1 is equally impressive. Past and ongoing diagnostic research, economic analysis of technology options based on partial budgets and adoption research on early technology acceptance has continued to provide reliable information on validity. In 2013 and 2014, 10 studies have been carried out in the CSISA hubs, mainly in Bihar and Odisha. In particular, the zero-tillage adoption and service provider inquiries in Bihar have been very informative. The increase in net benefit with the adoption of zero tillage in the rice-wheat cropping system in central and east India is almost identical to the level found in northwest India in 2005—$100 per hectare. About half of this estimate is generated by increased productivity in wheat; the other half comes from cost savings.

In the eastern Uttar Pradesh and Bihar hubs, a consensus was easily obtained in the online survey that the most promising and impactful technological options are imbedded in the "early" rice-wheat cropping system. Early sowing of wheat, zero tillage and machine transplanting of rice topped a list of 16 CSISA-related interventions with potential for impact in Bihar and eastern Uttar Pradesh. LLL, DSR and full-season, recently released wheat varieties comprised a second group with high expectations for impact.

Policy change has reinforced the technological change to the "early" rice-wheat cropping system. CSISA's overwhelming, mutually reinforcing on-station and on-farm findings have induced the State Government of Bihar to change its recommendation for wheat planting from after November 15 to before November 15. A planting-date recommendation paves the way for a more concentrated assault on the traditional practice of late planting with shorter-duration season varieties that are characterized by lower-yield potential. The November 15 planting date recommendation may also play a role in reversing entrenched beliefs in other states about improved practice. CSISA's emerging results that refute the supposed economic superiority of the system of rice intensification (SRI) in Bihar exemplify where the CSISA is paying dividends. Consideration of access to external inputs (including labor) need to be appraised by the farmers, so having a "basket of choices" through CSISA's research is helpful. Recommendations on tactics need to be nuanced, but the need to plant early is fundamental to avoid low wheat productivity and enable, in some cases, an additional third crop. The change in planting date by state governments in India is a prime candidate for impact assessment by economists in CSISA in Phase III.

Bangladesh

The Feed the Future indicators in CSISA-BD also indicate widespread adoption of improved technological options in rice-based cropping systems, especially on higher land that is not constrained by waterlogging. Submergence-tolerant rice varieties have been released and adopted in some deep flooding lowlands. Saline-tolerant rice and hybrid rice (which are relatively salt-tolerant too) have found acceptance in some moderately brackish water ecologies. CSISA-BD is also introducing sunflower as an alternative crop for saline soil conditions. In the online survey, the highest-ranking technologies within CSISA-BD were those that intensified rice-cropping systems by adding another crop after shorter-duration rice varieties in the aman season. Examples included: rice-rice-mung bean, rice-mustard-rice, rice-lentil-rice and rice-maize-mung bean. Household-based pond aquaculture with vegetables on the dykes was the second ranked technology among the 16 listed for research and development attention by CSISA staff and partners in Bangladesh. Indeed, returns to aquaculture, if practiced with good management, can be very high in Bangladesh.

The validity of these results for CSISA-BD can only be established by research on adoption that should be carried out prior to the scheduled closing of the project in September 2015. CSISA-BD has a good plan based on longitudinal sampling for the conduct of such work. Research on adoption is a priority because CSISA-BD has not invested as much (compared to CSISA-India) in supportive socioeconomic research. In particular, the economic assessment of pooled data across years is a priority in order to detect the variation in gross margins and net benefits of technology-related treatments over time.

Changing villages prematurely, perhaps before development gains are consolidated, helps CSISA-BD to meet beneficiary targets, but it also incurs an increased cost in assessing the sustainability of adoption. CSISA is striving to develop better understanding and metrics to determine at what stage of the intervention it is most beneficial to move to new villages and reduce investment and attention at existing hub village sites. CSISA-BD is a regional leader in developing the concept of "service provider entrepreneurs," who are empowered and trained to provide reduced-tillage planting and other key mechanization services (Amir Kassam personal communication, 2015).

Due to restrictions in the form of "severe hartals' during our mission, the ET was unable to interact extensively with service providers in Bangladesh in order to quantify (and corroborate) data on technology diffusion. In India, each of the many service providers interviewed had their work registry available for our appraisal.

Nepal

Due to USAID-mandated relocation of CSISA's work in Nepal from the Central Terai to the mid- and far-west districts, service providers are in a very early stage of generation. Consequently, technology diffusion on most CSISA sustainable intensification innovations is premature. However, adequate support to CSISA-NP for a reasonable period of time should result in impacts on innovative sustainable intensification and crop diversification in the Terai biome similar to those observed and documented in eastern India.

In Nepal's western districts, applied process research is underway and appears promising, based on farm-level observations in both Nepal and the same agro-ecology where CSISA-India has been focused. Sustainable intensification of both rice-wheat systems can be optimized, and there is exciting scope for innovative crop diversification (e.g., pigeon pea, maize, soybean and cassava in poor soil areas). The USAID restriction of CSISA to only focus on rice, maize and lentil is not helpful in optimizing production systems; especially obstructive is the mandated exclusion of wheat. On-farm trials indicated about a $60/ha advantage of mechanical transplanting over conventional, manual transplanting. DSR resulted in small declines in yields, but important savings in production costs and ease of crops establishment, which is especially relevant to the feminization of agriculture as men who plow frequently move outside the village for employment. Weed control problems are solved by use of the smallholder-friendly herbicide, pendimethalin. The ET believes that establishing DSR with appropriate seed drills will eventually become prevalent. CSISA-NP had just facilitated the first national distributor of seed drills. A paradigm shift will be required in farmer adoption of an early irrigation of Kharif rice to enable germination before the first rains. Farmers, who adopt no-till seed drilling for wheat following Kharif rice will likely begin experimenting with DSR, as has been the case in India (Malik, personal communication, 2015). This work is being rigorously conducted with farmer participation. However, financial support, restrictions on inclusion of wheat and drastic relocation to the western region after Phase I limit outputs.

In Nepal, the farmer practice of relay sowing lentil into wheat at around grain milky stage appeared to be better than other options being tested by CSISA. Poor plant-stands of lentils was commonly observed. Changing of lentil varieties did not look helpful. Research conducted is well done, but major increases in lentil productivity remain elusive. Possible insertion of improved pigeon pea management into the system merits consideration and testing. The crop is already very important but grown in blocks as a semi-perennial. Short-duration dwarf and semi-dwarf varieties could be relayed with boro crops like wheat or maize, which are harvested by hand.

On-farm research in Nepal demonstrated that maize yields could often be doubled from about 1.5 to 3 tonnes/ha by optimizing plant stands and ensuring weed control. Much higher Kharif maize yields on farmers' fields were obtained by increasing fertilizer doses and even more when fertilizer and hybrid seed are used in combination. CSISA is working on economics from diverse input combinations in major agro-ecologies. This will help KISAN shape its extension messages.

Process research

Sustainably-intensified production systems

The process research at innovation hubs (benchmark study areas), including on farmers' fields, is conducted to tune the best-best production system by integrating components such as: crop varieties with selected maturities, land preparation options, fertilizer optimization for the crop and the system, selective use of herbicides when needed, planting dates, planting methods (e.g. mechanized versus labor-intensive), pest control, harvest options, post-harvest choices, cropping sequences and patterns, market linkages, input channels to farm gate and others. Process research is systems management where constraints and strategies are identified that can lead to tangible stakeholder-managed solutions. CSISA may be the best substantial example of process research in the CGIAR and should be commended and encouraged. Process research is not as far along in Nepal, where the program was instructed by USAID to move work from the Central Terai to the mid- and far-west districts. In Bangladesh, and especially in India, strong partnerships of diverse stakeholders converge around the broad action plans. In India, financial resources for hub and process research are allocated on negotiated action plans determined in stakeholder planning meetings.

Although CSISA is an adaptive research-cum-extension initiative that focuses on the short- to medium-term, it continues to invest in strategic research in longer-term field trials. These uniform trials have four cropping-systems treatments plus a control and are carried out across four locations in India's Indo-Gangetic Plain. They are conducted with three replications in very large plots in agricultural research stations at Haryana Agricultural University, PUSA-IARI in Bihar, BISA in Bihar and in Punjab and in the State Agricultural University in Odisha. The trial results over the past five years are interesting, important and relevant for CSISA. For a small amount of money, CSISA has been able to monitor technological performance in response to temperature, rainfall and salinity. The results of these long-term experiments generate valuable information on the sustainability of cropping systems encompassing more than 10 million hectares in India.

The process research has led to focus areas for scaling up. One of the best examples is the optimization of rice-wheat production systems in eastern India (Bihar and eastern Uttar Pradesh). By planting wheat before November 15, full-season, high-yielding varieties can express their potential. For this to happen, the previous rice crop must be harvested and out of the field so that wheat can be sown zero tillage into the rice stubble. Irrigation for the wheat crop is also a prerequisite. Process reseach cuts across mechanization and irrigation innovations as well. Tube wells are already common, but the promotion of axial flow pumps to facilitate movement of surface water is a CSISA innovation that increases efficiencies and opportunities for crop diversification. It is introduced in the context of enhancing the production systems. In the case of Bangladesh, these pumps are helpful for crops and fish-farming, alike.

The process research also addresses the option, before sowing rice (once every five years), of LLL. LLL is common in developed countries and has gained popularity in the Punjab and Haryana states (partly from CSISA Phase I), as it improved efficiency of irrigation and reduced the land area used for water-controlling bunds within irrigated fields. Therefore, potentially more land is available for production. Over time, it may be widely adopted in Bihar and Uttar Pradesh but service providers have to be well trained and have access to both a leveler and a larger tractor, of approximately 45 horsepower (HP) or more. CSISA management is mindful that LLL will not likely be as widely popular in Bangladesh and the Terai of Nepal, where farmers' plots are very small and larger tractors are uneconomical. CSISA has worked hard to provide options for mechanized crop establishment both from 2-wheel and 4-wheel tractors, which fits importantly into the process research for the system. DSR has potential, though early issues of weed control had to be resolved. The same planting equipment for DSR is used for direct-seeded wheat, maize and mustard (and more recently, combined with strip tillage). Farmers in South Asia are reluctant to abandon transplanting of rice, though farmers in the Punjab are increasingly sowing rice in unpuddled conditions. Mechanical transplanting is an option that has been integrated into the process research, as well as mechanized reapers to rapidly harvest rice to permit quick succession planting of rabi wheat (see also the section on Mechanization under Cross-Cutting Themes, p. 54). Given labor contraints (availability and costs), the need to re-plant quickly between crops, coupled with rapid progress of service providers' skills and availabilities, we believe these innovations will be adopted widely over time—first in India, then in Bangladesh and Nepal. While one might have the impression that the above observations are a sum of individual, disconnected research findings, they actually represent the entirety of process research as CSISA finds ways to tune the entire cropping system and/or modify it to improve livelihoods.

In Bangladesh, where salinity toxicity has become a critical constraint in certain zones, varietal selection for tolerance becomes important in the process research and water management to reduce toxicity becomes a priority. In such saline toxicity zones, aquaculture attains importance as fish, prawns and shrimp adapted to saline conditions can be raised in integrated systems with rice, such as the gher. In Bangladesh, CSISA took note of price differentials for rice quality and worked on harvest practices to capture this opportunity. Worldfish, under the CSISA-BD, fostered adoption of better practices of rice-fish systems in Banglesh. Again, the CSISA Initiative has demonstrated creativity in looking at the entire production system and worked with stakeholders to identify opportunities toward sustainable intensification.

Process research will be required to address the constraints that currently result in millions of hectares in South Asia being fallowed after the kharif rice crop. In India, a government initiative called "Bringing Green Revolution to Eastern India" is based on this opportunity. CSISA scientists have begun to also look at this, but more attention to harnessing fallows is recommended for the future.

Diversification

To date, most of the process research has focused on existing cropping systems. There is ample scope to include other crops, such as potato and pigeon pea, more effectively in these cereal-based cropping systems. New crops, such as cassava or tropical sugar beets, could have potential as well, if the processing value chains could be established. The process research and development work associated with diversification in India emphasizes maize as a key crop to be considered both in the kharif and rabi seasons, depending on elevations and other factors. As the feed sector is expanding exponentially in South Asia, the market for maize will be strong. Therefore the focus on this crop has merit. In some cases, soybean as a rotation crop in maize lands could be promoted, but high-seed vigor is a must for the success of tropical soybean. The poor longevity of soybean seed in the humid and sub-humid tropics must be addressed. This has been done in Madhya Pradesh in the last four decades. Furthermore, India is the fifth largest producer of soybean globally. Soybean, like maize, will need market research on linkages to the farm gate. In humid and dry zones that have more marginal soils, cassava might be a new crop that merits research for animal feed, and perhaps even for food, industrial starch and ethanol. Market linkages would have to be put in place for this crop to attain regional importance; exploratory research could point to its prospects for potential production in marginal lands in Odisha. CSISA addresses the broader vision of development and its process research work can lead to non-incremental scaling up through inputs to strategic planning for investment-scale projects.

Crop-specific agronomy research

Fertilizer-use efficiency, plant spacing, time of planting, weed control and other practices are being studied by stakeholder partners in the hub benchmark sites for the rice, wheat and maize varieties under consideration for the major cropping systems of the agro-ecology. Much work in CSISA-India is coordinated during joint-planning meetings, which helps insure coherence. Student research both from national and international students contribute to this body of research, especially in India. The work is substantial and well conducted both on-station (observed in four locations in India, two in Nepal and none in Bangladesh due to political disruptions/hartals) with adequate treatment replications and on farmers' fields (observed at about a dozen sites), where each farmer is one experimental block in a randomized-block design trial. Results are thoroughly analyzed and shared with stakeholder partners. Most technical publications of this work reflect the multiple contributions provided by many partners who are researchers. These joint, multi-authored publications also create a very positive working environment. Students were inspired to be part of a larger development initiative.

Livestock and fisheries research

ILRI's work on CSISA was observed in five sites in India and Bangladesh and is heavily oriented towards extension. Their guiding philosophy is summarized as "Keep it Super Simple" (KISS). ILRI primarily demonstrates that use of choppers to cut up crop residues, mostly stems of rice, wheat, maize and haulms of legumes, enhances the biological food value of these feeds. This has been known for many years. ILRI has stimulated additional local manufacturing of the choppers and raised awareness of this important management practice. ILRI has also formulated and disseminated the know-how to produce balanced rations of concentrate for dairy production that are superior to feeds commonly found in the market and promoted by dairy cooperative societies. Summing up, ILRI has focused almost exclusively on extension, in partnership with NGOs, and is supported by the extensive dairy associations that populate rural India. ILRI has also produced attractive extension materials on the merits of crop choppers and improved-balanced concentrates for dairy feed.

ILRI does not have a full-time international research scientist engaged in CSISA Phase II. For extension, the KISS principle seems appropriate, but ILRI's research output in the Initiative is negligible. The lack of research commitment is disappointing because, in the past, ILRI did participate actively in the Rice-Wheat Consortium. ILRI has a research presence backed by a full understanding of the context and intricacies of livestock production in the Indo-Gangetic Plain, but that scientist is currently posted in another ILRI regional program. From the perspective of a cropping system, research on dairy production is important largely because the feeding of cross-bred cows depends on the quantity and quality of crop residues. Dairy production is also the activity that most directly impacts gender-specific outcomes on CSISA. There are several researchable areas that could be addressed. For starters, the village cooperative dairy societies have accumulated a wealth of data that could be analyzed to explain the variation in daily milk production and lactation duration in the CSISA hubs. ILRI does have a researcher in Hyderabad, India who contributes to the CSISA program. But the ET believes that the collaboration is not sufficient to address the research needs of improving livestock production and crop-livestock integration in CSISA. The ET fully recognizes the importance of smallholder dairy for families, and especially for women who mostly manage the animals and milk. Dairy is central to food security and provides opportunities to improve livelihoods for millions. Milk output is currently very low in hub zones and can be easily doubled by enhancing feed quality. The ET noted scope for more research-support for family-farm dairy intensification. ILRI's ongoing analysis of feed assessment surveys, along with the adoption and impact surveys, should enable ILRI to focus its research and spin-off promotion of old innovations, such as fodder choppers, to selected NGO partners. ILRI's lead in promoting safer fodder choppers warrents appreciation. ILRI's eventual "ground-truthing" of intended benefits of breeding for feed quality of wheat, rice and maize stovers will be another opportunity for science-based impact. Its planned research on adoption will also help shape future research and related hub-based extension activities as well as policy and strategy for broad scaling of adoption.

In contrast, aquaculture research and extension is one of the most dynamic areas of CSISA-BD. It was not apparent to the ET how much of that work is innovation research, but an array of species and management techniques are being tested/confirmed, especially in the rice-gher system. Many fisheries' scientists from WorldFish and the national program are deeply involved in, integrated into and committed to CSISA-BD. Their heavy participation is one of the strengths of the program in Bangladesh and is covered in more detail in the previous section on Catalyzing Change.

Breeding research (Objectives 3 & 4)

CSISA is forward-looking and aims to advance productivity, resource conservation and profitability through an integrative systems approach. CSISA appropriately includes crop variety development as two of its objectives. In the CSISA target region, a dominant cropping system is for rice and wheat. This implies that these two grains are key components in agriculture individually on farms or together in sequential production. Yet, wheat and rice yields are stagnating in the target region. They have not increased substantially in the past three decades.

CSISA aims to develop and distribute interventions to the traditional agricultural systems of the target region. These interventions are meant to increase food and fodder production in an "intensively sustainable" manner. Improved varieties are among the factors or forces that must be emphasized to bring both wheat and rice yields out of stagnation.

During the evaluation, farm labor and water shortages, land availability and income generation were repeatedly mentioned. Coping with vagaries of weather as climate changes are realized has become a factor, especially with increased temperatures during the crop growing season and water shortages. All of these factors indicate that genetic improvements in rice and wheat plants are necessary interventions to move productivity and profitability upward.

Hence, the ET has concluded that genetic improvement (Objectives 3 and 4) is vital in meeting the development goals for durable, intensively sustainable advancement in productivity. CSISA is designed to find and deploy the means to reach those goals. The ET offers this strong recommendation: Phase III of CSISA must sustain its commitment to the breeding objectives for rice and wheat.

The following discussion is presented to validate this recommendation. CSISA Phase II objectives were carried forward from Phase I for rice and wheat breeding. Substantial progress was achieved in Phase I, and the linkages established with NARS were expanded and solidified. During the evaluation, one team member visited CIMMYT and IRRI headquarters in Mexico and the Philippines, respectively. He followed these visits with an intensive schedule of field and institute visitations with project staff and NARS scientists in both wheat and rice research in India. He met with CSISA project leaders and scientists. Details from those discussions are articulated in Annex G. Even though variety development and deployment requires many years (typically six to eight), it is remarkable that already 33 wheat and five rice varieties have been released that have origins in the CSISA project. In 2014, based on variety identification and production figures, new varieties were deployed to 18, 24, and 34 percent of the wheat areas in India, Nepal and Bangladesh, respectively.

IRRI and CIMMYT have global mandates for rice and wheat research, respectively, and they place lesser emphasis on in-country development. These two centers conduct front-running research on crop biology and genetics—an aspect that is very important to CSISA's project Objectives 3 and 4 for breeding improved germplasm for national programs. They develop breeding technologies and materials relevant to most of the global agro-environments where rice and wheat are grown. These two centers have excellent, long-term genetic improvement programs and offer strong, practical training programs for national country scientists, including degree students.

With the inception of CSISA in 2009, both centers were poised to expand their scope to emphasize the South Asia production region. IRRI had already begun its involvement in Stress Tolerant Rice Africa and South Asia (STRASA) funded by BMGF, which addresses some similar problems, but its emphasis is on rain-fed production areas; whereas CSISA emphasizes the humid zones. CIMMYT was actively engaged in drought and heat tolerances in wheat for Africa, Asia and other regions.

This meant that the centers would emphasize abiotic stress tolerance, i.e., tolerance to high temperature and reduced water availability, and also address biotic stresses due to diseases and pests that are emerging (for example, wheat spot blotch in the eastern

Gangetic plains) or will emerge as a result of modifying certain components of the rice-wheat cropping system. Both centers could offer support in measuring physiological responses of wheat and rice to establish criteria for evaluation of plants' response to stresses. They were able to direct attention to emerging diseases, as for example, the potentially dangerous Ug99 race of wheat stem rust and spot blotch. Evaluations of breeding materials from India were included in the rust evaluation program in Kenya that is coordinated by CIMMYT.

A pertinent question was whether IRRI and CIMMYT could or would carry out this research without direct financial support from CSISA. The answer was clear: They would not be able to expand their research to meet specific CSISA objectives in terms of supplying validated germplasm to NARS breeding programs and could not provide in-country support for training and guidance of the breeders. But it is also clear that South Asia is on notice for rice and wheat production constraints, and national breeders could expect to receive generic nurseries of advanced breeding lines for local evaluation. The CSISA project permitted assignment of scientific staff to the CSISA region or could provide timely visits to the various participating centers. Finally, the CIMMYT and IRRI breeding programs depend upon multiple funding sources to sustain global activities. CSISA provided funds that helped to sustain breadth and continuity in their programs.

The major interventions in the rice-wheat cropping system that are being implemented include direct seeding of rice, mechanical transplanting, early harvest of rice/early planting of wheat and fodder quality of wheat and rice straw, all of which require genetic adjustment of the basic wheat and rice varieties. During Phase II, significant progress was made in identifying plant traits, discovering genetic resources, validating genetic control, and, in some cases, developing molecular markers to aid in plant selection. Many trials were organized by IRRI and CIMMYT, including lines developed by NARS, IRRI and CIMMYT, and distributed to national programs. New varieties were released after national program trials (33 wheat, five rice released by 2014) and are being multiplied for introduction to farmers. For example, small lots of 30 kilograms (kg) of new varieties of rice seed are sold to farmers at field days. In Tamil Nadu, India, for example, a field day in 2013 attracted 4,500 farmers. Most elected to try the new varieties.

Constraints to the breeding programs were minimal, but capacity building definitely needs additional financial support for training activites. A second constraint is the movement of seed from India to other countries. Both IRRI and CIMMYT find this to be a problem. High-level discussions are under way to resolve this constraint.

On-site review of programs revealed outstanding enthusiasm by NARS scientists for their breeding programs and for the opportunity to participate in CSISA. Many graduate student projects were facilitated by CSISA support at local universities.

Phase III is poised to enter new, advanced lines of rice and wheat into the national trials scheme to evaluate for release to farmers. Many new hybrid populations were developed in Phase II that will be advanced to evaluations for heat tolerance of wheat and rice, suitability of direct planting of rice and early maturity of wheat and rice.

POLICY AND SOCIO-ECONOMICS RESEARCH (OBJECTIVE 5)

One of the strengths of Phase II of the CSISA program is the breadth and depth of its policy and socioeconomics research that supports the cropping systems research, especially at the level of the three hubs in eastern Uttar Pradesh, Bihar and Odisha in India. For example, economics research on prospects for, constraints to and outcomes in CSISA-related interventions in mechanization has not only confirmed conventional wisdom on the importance of awareness, but has also generated several surprises, such as the potential for small and medium-sized farm households to emerge as specialized service providers.

Because it is extremely difficult to document impact from policy research, the Feed the Future indicators present a formidable challenge to economists who engage in policy research. If policy change occurs, it most likely will only be detected several years after CSISA has been completed, when attribution of influence will be fuzzy. However, CSISA economists are in the enviable position that results from the program having already had a transparent influence on policy.

In addition, CSISA's reputation and results have helped lead to policy change. As mentioned above, CSISA's overwhelming, mutually reinforcing on-station and on-farm findings have induced the State Government of Bihar to change its recommendation for wheat planting from after November 15 to before November 15.

Research capacity in economics is supplied by IFPRI, CIMMYT, IRRI and their national and international partners. In general, economists and other social scientists in CSISA-India feel that they are an integral part of the Initiative. They participate actively in interdisciplinary research in the biannual planning meetings that effectively use impact pathways to plan and prioritize research, extension and training activities.

The output of IFPRI economists and their partners is impressive. In three principal research areas—(1) seeds, traits and biotechnology; (2) appropriate-scale mechanization and (3) rural finance and weather-index insurance—they have authored 20 open-access discussion papers and nine journal articles from 2009–2015, with an annual investment of only about one-and-a-half Full-Time Equivalent (FTE) scientists. Some of the policy studies address constraints and opportunities in Bangladesh and Nepal, but that work is not as visible in the CSISA "Big Tent" as the research undertaken in India.

Important empirical findings include:

- The uptake of hybrid rice is presently higher and more promising in eastern India than in Punjab, Haryana and western Uttar Pradesh. Farmers are willing to pay premium prices for earlier-maturing hybrids with tolerance to abiotic stresses such as drought, heat and salinity.
- Participation in nationally mandated rural public works' programs in India has increased the demand for labor-saving mechanization by 15 percent.
- The adoption of LLL is constrained by its cost at the farm level. Per-hour cost has to decline to about Rs. 400/hour before coverage exceeds 20 percent of area.
- Varietal turnover in wheat in Haryana, a state with high-production potential, is lower than expected. The area-weighted average age of varieties in farmers' fields is 12 years, indicating a moderately slow velocity of turnover that has dampened returns to plant breeding in recent years.

Additionally, empirical findings on the scope for improving seed systems in India and Bangladesh has been highly complementary to CSISA research, especially crop improvement activities with rice. In Bangladesh, for example, this work has been led by IFPRI in partnership with CSISA-BD, USAID, local partners and the Policy Research and Strategy Support Program (PRSSP), the IFPRI country program in Bangladesh that is separately funded by the the USAID country Mission using Feed the Future funds. The work documents, analyzes and prescribes additional modifications to key reforms necessary to improve private-sector participation in Bangladesh's seed system and increase farmer access to recently released varieties and hybrids (Naher and Spielman, 2014).

The convening function of IFPRI in strengthening private and public-sector partnerships does not appear to have been as integrated into CSISA as their research activities. Two events were held in 2014, but they do not seem to have generated specific examples of additional collaboration over and above what CSISA was already doing. Perhaps it is too early to assess the value of these events, but the decision to place less emphasis on IFPRI-branded events seems like a step in the right direction for Phase III.

Reviews of the Rice-Wheat Consortium and CSISA have emphasized the need for investing in baseline data collection and priority setting. CSISA invested in baseline data during Phase I in 2011–12 (Pede et al., 2012). The baseline had some positives. Social scientists from IRRI and IFPRI contributed to its design and execution. The dataset from the baseline questionnaire is well documented and is available on the Internet.

The baseline also had some negatives. Some responses about specific technologies were not that informative. Household income was not quantified. Responses from the Punjab were not reported. The authors of the baseline survey concluded that data could not be used as a reference point for rigorous impact assessment.

The baseline also demonstrates why rigorous baseline data collection and formal priority-setting are risky activities in the conditions under which CSISA is operating. Data were collected on 2,628 households in a total of eight hubs in Bangladesh, India and Nepal. By Phase III of the Initiative, CSISA will only be active in three of these hubs. It is very unlikely that the data from the baseline contributed to decision-making on which hubs to de-emphasize or from which to divest. Indeed, the baseline's only recommendation on the geographic allocation of resources across the hubs never came to fruition—because of a higher estimated incidence of poor households in the baseline survey, the Central Terai Hub in Nepal was singled out for more emphasis within CSISA. Within one year of making this recommendation, the emphasis in Nepal was moved to the midwest and far-west divisions to comply with USAID's district prioritization in Feed the Future. The Central Terai Hub was abandoned. Under these conditions of donor programmatic instability, recommendations for rigorous baselines and formal priority-setting exercises should not be heeded.

MANAGEMENT (OBJECTIVE 6)

Overall vision and operational culture

In much of the CSISA activities, a shared vision of goals across staff and stakeholders provides a sense of pride that CSISA is important and is greater than the sum of its parts.

CSISA's Vision

"Operating in rural hubs in Bangladesh, India and Nepal, CSISA involves public, civil society and private sector partners in the development and dissemination of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems and policies and markets. In essence, CSISA is an innovation systems platform that links a wide range of public, private and civil society sector programs within and across South Asia.

"The needed increase in cereal yield cannot be achieved in a piecemeal fashion through a few traits, component technologies or blanket recommendations, but must be achieved through an integrated systems approach to research for development, scalable models for training and extension and innovative partnerships. This logic underlies CSISA."

Source: http://csisa.org/about-csisa/overview/

India

In eastern Uttar Pradesh and Bihar, for example, innovations such as early sowing of wheat, zero-tillage planting, LLL, hybrid maize and hybrid rice are all being rapidly adopted by farmers exposed to these innovations. Close collaboration with national R&D partners, service providers, agriculture input companies and NGOs enhances farmers' awareness of the advantages of CSISA-related technologies en route to sustained adoption. CSISA's management has correctly recognized the priority of diagnostic research to unlock the potential for increased cropping intensity in the millions of hectares fallowed in the rabi season following the rainy season rice crop in Odisha. Finding the levers that need to be pulled and the focal points that require pushing is a necessary first step in making double-cropping a reality in coastal Odisha and probably other states with similarly extensive rabi fallows, such as west Bengal and Jharkhand.

A shared vision and a consensus on the most promising technologies is transparent in the survey responses in the two hubs where rice-wheat is the prevailing cropping system. Slow growth in rice and wheat and the lack of crops that can either replace or complement rice and wheat accounted for 87 percent of the responses to a question on the most important agricultural problem confronting farm households in the hubs (n=103).

Nepal

Of the three country programs the ET visited, Nepal faced the most constraints for carrying out the vision of the CSISA model and implementing its operational culture. CSISA's mandate is different from donor requirements. Because the CSISA-NP program receives no funding from the BMGF, the program is structured solely around USAID/Nepal's Feed the Future strategy. This has a number of important consequences for the CSISA-NP program. These include:

- Wheat is not a priority commodity in the USAID/NP Feed the Future strategy. Yet, rice-wheat is the most common cropping system in western Nepal where CSISA is supposed to work. CSISA is fundamentally a cropping system R&D program; but in Nepal, the program's systems perspective is limited to rice, maize and lentil. This restriction means that Nepalese farmers in the midwest and far-west will not be able to benefit from the "early" rice-wheat cropping system that drove adoption of improved practices and varieties in the northwest Indo-Gangetic Plain in the Rice-Wheat Consortium.

- Additionally, KISAN and CSISA-NP staff stated that selected horticulture crops are critical to the farming systems in the midwest and far-west of Nepal. Among these crops is potatoes. This crop is not among the few selected by USAID/Nepal in its Feed the Future strategy.
- CSISA-NP's latitude to carry out research is very restricted. USAID/Nepal requires that CSISA-NP only do adaptive research on already proven, off-the-shelf technologies and adjust them to the specific conditions found in the KISAN project area. This orientation subverts CSISA's basic hub model of research and demonstration.
- In USAID/Nepal's view, the primary purpose of CSISA-NP is to provide proven technology related to selected commodities to KISAN and to train KISAN staff and its partners in the use of these technologies. This limits the scope of the CSISA-NP effort.

On a positive note, both USAID/Washington and USAID/India are developing proposals to provide funding for CSISA-NP. Such assistance will add stability to CSISA's work in Nepal and will effectively exploit the Initiative's comparative advantage in cropping systems R&D. Two areas are targeted for support: (1) mechanization and seeds with greater linkages to Indian manufacturers and suppliers from USAID/Washington and (2) assistance to vulnerable regions with climate adaptation funding from USAID/India. This additional funding will help to loosen the current restrictions on the CSISA-NP program and provide better linkages, particularly in the Terai, between the India and Nepal programs.

Support from the BMGF for CSISA R&D in the Terai would be a welcome addition. As discussed in the India country report in Annex E, the CSISA baseline survey found that households in the erstwhile Central Terai Hub in Nepal were poorer than respondents in the other seven hubs surveyed in India and Bangladesh. In the context of potential for poverty reduction from CSISA's agricultural R&D, the shift to the midwest and far-west does not make economic sense and is unlikely to be justified with more rigorous scrutiny.

CSISA-NP scientists and partners share the same vision as CSISA staff and partners in India. Eleven of the 14 online survey responses concurred with the statement "The rice-wheat cropping system is the basis for the project activities in research and extension." Thirteen of 14 responses supported the vision of CSISA-NP as "increasing production to reduce poverty and to enhance food security." In contrast to India, the institutional difficulties described above have also seemed to diminish staff and partner optimism about the sustainability of CSISA-NP's work once the Initiative is completed. Six of 10 respondents said that it was unclear if CSISA-NP's work could be assimilated by existing institutions using their own resources when the project closes. The ET concurs with this concern, noting that the NARS institutions in Nepal are under-resourced compared to counterparts in India.

USAID/Nepal raised some concerns about management issues in CSISA-NP. One of these issues was their feeling that CSISA-NP lacked a true Chief of Party that the program could relate to and seek information from about the activities of the program, its funding situation (burn rate, pipeline, etc.) and other topics. This management concern appears to be driven more by a misunderstanding on the part of USAID regarding the structure and nature of the CSISA-NP program (See Nepal Annex F for more details). What is needed is an open discussion between CSISA-NP senior staff and USAID/Nepal on how CSISA-NP can realistically be responsive to USAID's needs given the resource constraints of a cooperative agreement with limited funding.

Bangladesh

Program management in Bangladesh is solid overall, but still has room to tighten relationships at national levels and with CSISA in India to share lessons learned and enhance staff work across countries, when justified. Two features on vision and operational culture stood out to the ET in terms of vision and operational culture.

First, the emphasis on R&D in CSISA-BD is very much on development. The direct and indirect goals described above, and as encapsulated in the Feed the Future indicators discussed later in this section, were foremost in the minds of CSISA-BD staff. The vast majority of staff shared the vision that development was a core priority for CSISA-BD.

Second, IRRI, CIMMYT and WorldFish staff shared managerial responibilities equitably, which in turn, promoted integration in R&D with a farming systems perspective. At the level of the hub, the hub manager was rotated among the three CG partners every year. Because of this practice, and the fact that most R&D activities took place in the same village, everyone knew what everyone else was doing without having to incur substantial transactions costs. It was easy for the practitioners of CSISA-BD to see that the whole was greater than the sum of the parts. This gave rise to the shared perception that working together, they were accomplishing more than if they each worked separately. Reflecting the spirit of research with a farming systems perspective, 18 of 22 respondents to the online survey concurred with the statement that "In the future, separate projects by IRRI, CIMMYT and WorldFish in Bangladesh will not be as effective as CSISA-Bangladesh because the scope for productive interactions will be limited."

In addition to an emphatic commitment to development and to R&D with a farming systems perspective, management projected a self-contained view of CSISA-BD. The CSISA Phase II Objective 3 on rice genetic improvement was viewed by CSISA-BD's management as being outside the project with limited scope for interactions in terms of transmitting demands for crop improvement priorities. Likewise, IFPRI's work on policy in Bangladesh was perceived by management as being unrelated. ILRI engages in extension activities in three of the hubs, but it too was viewed by management as outside of CSISA-BD.

The ET recommends that in order to enhance communication within CSISA in South Asia, it would be beneficial to hold an annual workshop where results from research, extension and training activities are discussed. Such an event would help to make project-related boundaries more porous and permeable.

In terms of effectiveness of program management, particularly among the multiple organizations involved in implementing the various components of the program, the ET was impressed with the activities it observed in India, Bangladesh and Nepal. In most cases, the various organizations worked together smoothly and effectively. From the online survey, 80 of 90 respondents strongly agreed or agreed with the statement "research and extension activities are well coordinated." In addition, 77 of 87 respondents strongly agreed or agreed to the statement "the project management in the hub is efficient and effective." This management effectiveness appears to be the result of two important factors: (1) the quality of program leadership, including the project leader, project manager, objective and hub managers and project chiefs of party; and (2) the use of effective management tools, such as Impact Pathways in India, that created a practical means for joint planning and execution of project activities with clear roles and responsibilities.

Impact Pathways

CSISA-India manages its activities with a management tool they call Impact Pathways. These Impact Pathways are created during the joint planning of activities among the various CG partners and other stakeholders. The format of the Impact Pathway is a hybrid of more traditional logical frameworks (LogFrames) and the more elaborate Results Chains used by the Donor Committee for Enterprise Development (DCED) for management and evaluation. Basically, the Impact Pathway consists of an Excel workbook with one spreadsheet for each global activity to be undertaken (i.e., early-sowing wheat, zero-tillage wheat, women focus, etc.). The spreadsheet columns are broken down by crop concerned, the primary outcome of the global activity, the intermediate outcomes of the global activity, the description of the specific activity, where the specific activity is to take place, when the specific activities are to take place and the name(s) of the staff person responsible for the specific activity (see Annex C for an example).

The CSISA Initiative has a management core that cuts across activities in three countries (India, Bangladesh and Nepal), including multiple hubs as well as sub-projects in each country. In Phase II, CSISA management, led by Andrew McDonald and Cynthia Mathys, has been highly skilled and motivated. They have created an affirmative, progressive culture, not only for project staff but also for the program's diverse partners. This culture encourages people to enable others and share responsibilities, credit, tasks and ownership. Effective leadership is especially evident in India at the state and community levels. In their interactions with project staff, partners and stakeholders, these levels of leadership truly care about realizing the Initiative's goals, their colleagues and those they serve.

CSISA-India's Impact Pathways approach entails activities which lead to outcomes delineated by where, when, how and by whom. The commitment to Impact Pathways as a planning tool diminishes transaction costs in arriving at budgetary allocations that everyone can buy into. Impact Pathways provide a clear programmatic foundation that is negotiated and agreed upon in broad planning meetings for project work at the hub-level and on process-based agronomic research. Equally important in CSISA's organizational structures are its extensive links to national research and extension partners, including national and international universities. These linkages enable many graduate students to participate and contribute to understanding biological, economic and geo-physical parameters relevant to strategic objectives 1 (hub activities) and 2 (agronomic process R&D).

CSISA-NP does not use Impact Pathways, but there appears to be good overall management of program resources. The use of Impact Pathways, however, could be extremely useful in reinforcing the collaboration between CSISA-NP and KISAN staffs and would improve program coordination. This would require not only the CSISA-NP staff but also KISAN staff to work together on development and monitoring of Impact Pathways.

CSISA-MI also does not employ Impact Pathways and instead uses more traditional, jointly planned annual work plans (AWP) (see Annex D). These AWPs are linked to the programs M&E system. They embrace Impact Pathway logic of systems goals, and consequently, parallel the Impact Pathways approach of the CSISA-India. CSISA-BD maize and wheat teams used the Impact Pathway planning tool for the first time last year to develop their work plan.

Communication

Communication activities vary according to the specific CSISA country and program. Phase II of CSISA-India, for example, scores high marks for its extensive internal and external programmatic communication and information sharing. During this period, communication was conducted in a variety of forms including annual reports (2), research notes (6), research publications (22) and technical publications (6). In general, the CG Centers involved in CSISA have a strong track record in getting their research findings out to a broard audience of many interested parties. For example, IFPRI has invested heavily in making its outputs (discussion papers, research notes, project papers, conference materials and presentations) widely and openly available through cross-listings on the main CSISA website (http://csisa.org/) and the IFPRI-hosted CSISA web page (http://www.ifpri.org/book-736/node/8754) (see also IFPRI Insight at http://insights.ifpri.info/2012/06/farming-smarter/).

While formal documents are important, the most significant communication activities of the CSISA-India program has centered on the dissemination of information on new technologies and practices to its stakeholders. The ET heard positive comments about CSISA's communication activities from a range of stakeholders including service providers, NGO officials and staff, KVK officials and staff, state departments of agriculture officials and farmer and women's organizations. CSISA was seen by many as the principal source of information on new technology in mechanization and on increasing the production of rice, wheat and other crops. These stakeholders view CSISA not only as the source of information on new technologies but also on the application and use of that technology. In several cases, CSISA personnel were cited as providing links to sources of spare parts and equipment maintenance, and even gave advice on how to gain access to government officials.

Communication and management questions related to CSISA-BD need to be reviewed in the context of its multiple components. These components include: CSISA-BD, the original core CSISA project in Bangladesh; the IRRI-managed sub-project known as Sustainable Rice Seed Production and Delivery System for Southern Bangladesh; and a sister project of the latter, CSISA-Mechanization and Irrigation (CSISA-MI). Each component has had its own communication structure, the most important being CSISA-BD and CSISA-MI. CSISA-BD, for example, produces annual reports, has hosted over 10 large workshops, including an annual hub-level stakeholder event, and produces a number of printed materials, including the book Made in Bangladesh: Scale Appropriate Machinery for Agricultural Resource Conservation. Six research publications are noted on their web page. In addition, CSISA-BD has a Facebook page (www.facebook.com/csisabd) that is updated weekly. CSISA-MI undertakes similar communication activities including brochures, video CDs and technical publications. Some of these publications are in both English and Bangla.

Given the small size and configuration of the CSISA-NP program, the communication activities are relatively modest. CSISA-NP produces semi-annual reports to USAID as well as an annual report. It also disseminate a series of success stories that are posted on the CSISA-NP web page as part of the larger CSISA website. Four research publications are listed for the program, but they are all outcomes of CSISA Phase I, which focused on cereal work, mostly from central Nepal.

Organizational structure

The organizational and funding structure of the 'Base'-CSISA program and its components has changed over time. The coordination unit of the base (for the India and Nepal hubs) is currently located in Nepal. Through frequent engagement with a very strong national counterpart manager in India, the coordination unit is able to facilitate planning through Impact Pathways and implementation of the work in India, which involves many national partners along with CGIAR core teams. The coordination unit also provides oversight, coordination and reporting for the smaller, yet substantial program of work in Nepal. The full regional project ('Base'-CSISA) was initially supported by USAID/Washington and the BMGF. Phase I of CSISA was under IRRI leadership, but this was changed to CIMMYT in Phase II. With funding from USAID/Bangladesh, CSISA-BD began in 2010 with IRRI as the lead organization working with CIMMYT and World Fish. ILRI does not receive funding from CSISA-BD, but does maintain hub-based activities in Bangladesh with support from 'Base'-CSISA investment. ILRI's work in Bangladesh hubs (Jessore, Khulna and Rangpur) appears to focus narrowly on fodder choppers, but their promotional materials stress the need for broader enhancements in feed quality. IFPRI also has programming in Bangladesh that is supported from 'Base'-CSISA. CSISA-MI is a separately funded program by USAID/Bangladesh and has complementary objectives to CSISA-BD, which focus on the Feed the Future geographic areas in the southern part of the country. This activity is managed by CIMMYT and iDE and is also limited to Feed the Future areas. CSISA-MI is currently programmed and funded through 2018. With all of these similarities, the coordination of activities between CSISA-BD and CSISA-MI could be a major issue, but the ET did not find this to be the case. CSISA-MI has a new manager who we believe will further optimize synergies with all other elements of the CSISA Initiative. However, CSISA-MI is a Feed the Future project, with activities restricted to only southwestern Bangladesh. Companion support by BMGF could be helpful in enabling CSISA-MI or CSISA-BD to work on irrigation and mechanization linked to sustainable intensification of rice-wheat cropping systems with fish, more broadly.

CSISA-NP is structured differently from the core program in India, and to a degree, from the CSISA program in Bangladesh. CSISA-NP does not have a larger formal hub structure; to keep in local context, it works in smaller units called Agricultural Research and Training Centers in the midwest and far-west districts of Nepal. Contributions in Nepal by ILRI, IFPRI and the breeding objectives are part of the 'Base'-CSISA investment and, for the most part, implemented independently from the mandate given to CSISA-NP by the USAID Mission.

Given the complexity and the convoluted history of the management of the CSISA Initiative, it is remarkable, if not astounding, how well teams work together and are aware of each others' programs. We found through interviews a very strong sense of belonging and staff pride in the larger program and their role in it. This reflects especially high-quality management, which is also evident from the quantity and quality of creative research, including complex process research for catalyzing change requiring tight interaction and collaboration. We observed repeatedly great competence and dedication of management and staff.

Collaboration

The level of collaboration among the various organizations and institutions working together in CSISA is critical to the success of the CSISA hub model. With some exceptions, this collaboration has been very good. CIMMYT and IRRI, for example, have worked closely together in a number of areas at the various hubs. This collaboration can be seen in the Impact Pathways (the basic work planning document of the CSISA-India project). Neither ILRI's nor IFPRI's activities however are included in the Impact Pathways. It is unclear how well the ILRI activities link into the various CSISA programs. ILRI attends planning meetings, but activities appear to 'stand-alone.' The ET viewed several ILRI activities, but these were all located, by necessity, in areas with already-established dairy cooperatives. These activities were in a different location than the local, cereal-based work of CIMMYT and IRRI. 'Base'-CSISA process research should work more actively with farmers in the dairy cooperatives where ILRI is active in order to build synergies to ILRI's work. IFPRI's activities also follow a more independent path than the CIMMYT-IRRI activities; however, IFPRI staff participates actively in the biannual planning meetings and carry out some work jointly with other CSISA economists and scientists.

In terms of collaboration with local stakeholders, the CSISA programs have done very well in making these linkages. In India, for example, key collaborators listed for Objective 1 include 23 for Bihar and seven each in Odisha. The project lists 17 additional collaborators in Bihar, 12 in eastern Uttar Pradesh and 27 in Odisha. In the ET's site visits throughout India, the sense of ownership and collaboration among the project stakeholders was strong.

In some cases, collaboration was stronger at the local level than at the state or national levels. For example, the collaboration of CSISA-BD at the local level seems to be strong, but collaboration and inclusion of more senior Government of Bangladesh departments and officials appears weaker (see Annex D). Nevertheless, the CSISA-BD project has a number of close contacts at senior levels. For example, the current director general of the Department of Agricultural Extension was the district director of agriculture in Barisal where he worked very closely with CSISA-BD. There is room to develop modalities, whereby stakeholders are more fully involved in the planning and implementation of the project, such as broadening participation in the Impact Pathway planning meetings.

Coordination between CSISA-NP and KISAN could be improved. The two programs do work together and engage in joint planning in a regularly structured manner, but improvements could be made (see Annex F). Part of the disconnect stems from structural issues and differences in expectations and size of the respective projects. Some problems appear to be partially a result of KISAN's own difficulties in turnover of senior management.

In contrast, CSISA-NP enjoys harmonious relations with scientists and administrators in Nepal's National Agricultural Research Council (NARC). CSISA-NP is also working with other national institutions, including Tribuhuvan University and the Department of Agriculture, on technologies that are new and show promising potential, particularly in mechanization. For example, the Department of Agriculture capitalizes on CSISA-NP to provide its program on training of trainers in mechanization and also to provide enhanced regional capacity to agrovets.

In all of the CSISA activities observed by the ET, there was active participation by both public and private partners. This participation appears to be a fundamental part of the CSISA approach. Of the 89 respondents in the online survey, 74 strongly agreed or agreed with the statement "government research and extension agencies are well represented and participate actively" in CSISA's work. In addition, 80 of 87 respondents believe that in their hub "all partners both contribute and benefit from the CSISA project."

Partnering with the private sector is fundamental to CSISA's approach. CSISA has been able to utilize the private sector's entrepreneurial drive to disseminate technology. As noted previously, in the online survey, 80 of 87 respondents felt that "the private sector can effectively participate in transfer of technology recommended by the CSISA project." This collaboration can be seen in various forms in all components of CSISA's "Big Tent."

CSISA-BD and CSISA-MI, for example, have developed important relationships with major private sector operators in mechanization. The connection with Rangpur Foundry is one of the best examples of how a private-sector linkage can bring significant, additional resources in support of mechanization especially, in the west and north of the country. The project has had considerable success in these two northern hubs (Mymensingh and Rangpur), particularly in terms of direct seeding and more conventional agricultural machinery. Rangpur Foundry is based in the area and has made a substantial investment (approximately $500,000) to support the project's effort in mechanization. Unfortunately, these two zones in the center and north of the country are now in an area outside of the designated, southern Feed the Future geographic zone supported by USAID/Bangladesh. Consequently, USAID/Bangladesh continues to support manufacturing, but it will no longer support hub work in important non-Feed the Future zones. If this disconnect is not resolved, another donor should be sought to ensure continuity of development work at hubs, as well as continuity of concept, where the manufacturing agro-industry is a development driver only when linked to users.

In addition to Rangpur Foundry, CSISA-BD and CSISA-MI also work with ACI Limited, a large equipment and agri-industrial firm based in Dhaka. The ET visited the executive director of ACI Limited. At that time, he expressed his strong interest and support for CSISA's work and looked forward to working with the project on rice transplanters and other farm equipment. He felt that the demonstration work done by CSISA has helped increase his sales of specific machines ten-fold. While noting the impressive results he has had with CSISA-MI, he also commented on the fact that many, and likely more, machines could be sold and used successfully in other areas of the country. The north and west of the country are best suited for many of the pieces of equipment used in Bangladesh farming.

Besides efforts with large firms such as Rangpur Foundry and ACI, the project is correctly basing much of its scalability and sustainability on training and engagement of smaller service providers. CSISA-NP, for example, is working with private-sector actors at a number of levels. In its mechanization programs, CSISA-NP is working with both local dealer/suppliers and service providers. The local dealers are the main source of small-scale equipment (power tillers, mini-tillers, reapers, threshers, etc.). CSISA collaborates with them to introduce more equipment to the project area for evaluation. The local service providers are often farmers with some additional resources that can purchase/rent this equipment and then provide services (planting, harvesting, threshing, etc.) to their neighbors and fellow farmers. CSISA helps them upgrade their skills in running the equipment and in managing their service provision business.

Monitoring, evaluation and reporting

Monitoring, evaluation and reporting are critical elements of the CSISA program. At the start of the Initiative, the M&E system was a weak element. Both USAID and the staff of CSISA in Phase II have put in a significant effort to upgrade and improve the program's M&E and performance management systems. Additional staff have been hired; an M&E handbook has been developed and integrated into the M&E system of the program; and several data quality assessments (DQAs) have been carried out. USAID staff in India have been very supportive and have engaged in DQA spot checks, as has CSISA staff. The results of the DQAs have been positive. In addition, the CSISA project has invested in adoption of, and related impact studies on, interventions such as zero tillage and direct-seeded rice that are described later in this report. These studies are a source of triangulation on the quality of the project's M&E reporting.

The improvements in M&E were evident to the ET. For example, in group discussions with service providers in four locations in Bihar and eastern Uttar Pradesh, the ET observed each service provider proudly displaying his or her service journal, which had been provided by the project. These journals were filled out each time the service provider worked with farmers. The journal included information such as equipment used, date of work, time of effort, hectares worked on and costs to the farmer. This detailed information is not only used for the service providers to understand the profitability of their business, but it is also communicated to the project's M&E staff for reporting on the appropriate Feed the Future indicators.

The ET was able to review the M&E structure in some detail in Bangladesh. CSISA-BD has put together an elaborate and well-structured M&E system and, as a consequence, has been able to "put forth the numbers," as a USAID official put it. An M&E handbook has been developed and is in use at each hub. In addition, a standard operating procedure manual has also been created and made mandatory at the hubs. The program does not use Impact Pathways as in CSISA-India. According to their M&E staff, Impact Pathways are not used because they are not part of the standard USAID management and reporting system. Instead, they have joint annual work planning sessions where they sit with stakeholders at the field level to do joint drafts of local work plans. Such drafts are compiled by each hub and forwarded to Dhaka, where the Chief of Party (COP), with representatives of the three cooperative partners (IRRI, CIMMYT and World Fish), use them to establish the AWP for each hub. These AWPs are then used by the M&E coordinator at each hub with the COP to develop an annual project management plan (PMP) for the hub.

CSISA-BD then uses off-the-shelf software to collate and cross-check data related to the PMP, which are then gathered at each hub from NGOs and other stakeholder partners. The hub M&E coordinator verifies the incoming data and does spot DQAs to ensure accuracy of the data on monthly basis. This data is then sent to headquarters in Dhaka to be compiled for the project's reporting to USAID. DQAs are done internally by CSISA staff and externally by USAID. Hard copies of all the reporting documents are classified and stored at each hub. While not quite as elaborate, similar systems have been put into place in India and Nepal.

The one serious issue in M&E observed by the ET was the limited ability of the program to gather longer-term technology adoption and impact information. An example is the shift made by USAID to drop the research and demonstration work done by CSISA-NP in the Central Terai in Phase I and move CSISA-NP's efforts to the midwest and far-west Terai and Hills. The three-year effort in the central region was beginning to produce results. The move to the midwest and far-west prevented CSISA-NP from having an opportunity to promote Phase I technological advances toward widespread adoption in the central region where they were developed. Because this effort was not followed up, it is difficult to assess what could have happened if CSISA-NP had been allowed to bring its effort in the Central Terai to full fruition.

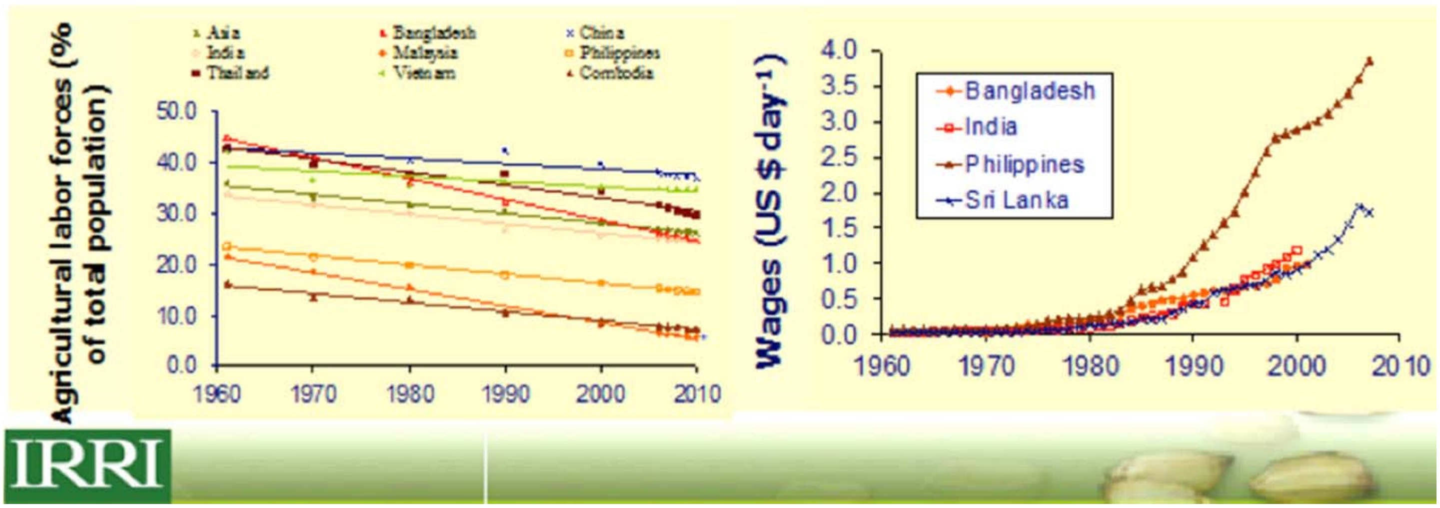
Other examples include the decision to shift focus to new areas and beneficiaries by KISAN and CSISA-DB every couple of years to generate additional numbers of beneficiaries for the project. This narrow focus on short-term benefits of people trained on new technologies or management practices, or on those that have applied improved technologies, hinders realization and measurement of more important long-term benefits such as number of farmers who accept, utilize and modify new technologies (i.e., have ownership of the technology).

CROSS-CUTTING THEMES

Mechanization

Mechanization is an essential piece of the puzzle to realize sustainable intensification. Traditional practices of agriculture in South Asia are very labor intensive. Labor at critical periods is now in short supply in most areas in the Indo-Gangetic Plains where CSISA is focused. Wage rates are rising (Figure 2). The potential for innovations to contribute to sustainable intensification of the rice-wheat production systems depends critically on timely field operations. Currently, male farm laborers from remote areas work as migrant laborers for rice planting and harvest (multiple times in some systems in Bangladesh). Local stakeholders, including women's groups, highlight labor shortages as a key constraint and a driver for adoption of appropriate mechanization. In the Indo-Gangetic Plains, total rice area far exceeds the area for wheat, maize and lentil combined. Given the labor demand for rice systems as they are now, this is enormous. Consequently, emphasis on rice mechanization needs to be prioritized even further.

FIGURE 2. The increasing labor scarcity in Asia by country

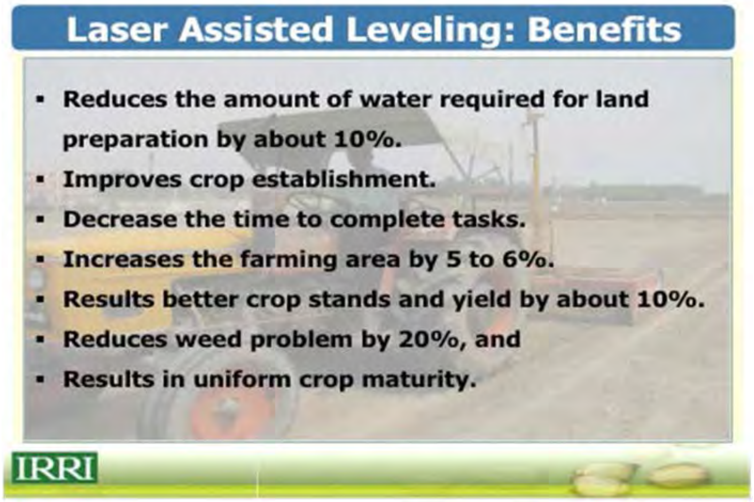


Courtesy of J.K Lahde, IRRI, 2015

The option to use a LLL is the first mechanized, chronological entry point for decision-making in the cropping cycle. LLL has to be custom-made by a service provider who not only has a LLL, but also has a tractor large enough (45 HP or more) to pull it. And the service provider must know how to use it properly. Training of trainers has been conducted by CSISA on its use.

Laser-land leveling needs to be carried only once in about five years, normally prior to establishing the Kharif rice crop. The effects of LLL use are multiple, but the greatest impact is improving efficiency in irrigation. It also allows reduction of in-plot soil-bundling that farmers use on un-level land to control irrigation water. Mechanization in India is subsidized especially on the first purchase of equipment. Because of its longer term benefits, especially in enhancing spatial groundwater availability, LLL is a better candidate for subsidization than most other mechanical innovations that are presently underwritten by the state departments of agriculture in India.

FIGURE 3: Benefits of Laser Assisted Leveling



Use of a two-wheel (power tiller) or four-wheel, tractor-mounted seeder for most crops (rice, wheat, maize, mustard, etc.) is increasingly common and with a knowledgeable service provider, these seeders can permit zero till, though most farmers are still puddling soils for their rice crops. These seeders are critical for quick and precise crop establishment, especially of the rabi crop.

Increasingly, service providers are acquiring 4-wheel tractors and hiring out services after they do the work on their own farms. But in many areas power tiller-based mechanization is still attractive, especially to reach small plots of land (and there are millions of them).

At the time of harvest, especially for the kharif rice crop, it is imperative to harvest the rice crop quickly so that the wheat crop can be established (zero till) before November 15. For this, mechanized reapers are very helpful. At the time of our mission, farmers preferred to contract service providers who have dedicated reaper machines, but the smallholder machinery industries are working to perfect reapers that can be easily mounted on the front of normal power tillers, which are common in Bangladesh and which have potential in Nepal. In India, small combines, provided on contract basis by service providers, are increasingly available and are useful where access to land is not an impediment. CSISA correctly monitors these developments and encourages careful stakeholder (service providers and equipment dealers) appraisal on what level of mechanization is most advantageous through basic cost/benefit and break-even point analysis.

Farmers in the Indo-Gangetic Plains have been transplanting rice for centuries. The concept of mechanical transplanting of rice is greatly appreciated by many farmers. The imported planters work well in the hands of well-trained operators, and the production of the seedling mats looks to be an additional business for service providers. The transplanted rice system is attractive also where weed control is problematic. CSISA has made good progress in identifying herbicides for use in DSR but training needs scaling-up. We recommend that CSISA continue to work with private-sector providers of the key herbicides to train trainers on safe, judicious use of environmentally benign herbicides.

One must take water management into consideration in the context of mechanization. Certainly tube wells, mostly with diesel pumps, are driving the increased cropping intensities. Bangladesh has gone from a food-deficit country in the late 1990s to a food-surplus country, primarily based on importing improved pumps for tube wells. Currently, CSISA is introducing flow pumps for very efficient (up to 50 percent) surface water lifting in and around fields. These pumps are now being produced in Bangladesh commercially by Rangpur Foundary, in addition to investing $328,000 of their own resources to support and complement CSISA's awareness-raising. This is a reflection of CSISA's work and legacy projects.

In all three countries, CSISA's applied research and capacity building, especially with private-sector service providers, who are also themselves farmers, is having very positive effects, especially on mechanization. We recommend additional human resources be identified to work on remaining mechanization issues and to run training of trainers programs, including for the staff of local dealers of machinery, to scale up the number and skills of service providers.

Gender

The ET saw considerable evidence that the gender component of CSISA Phase II was strong and dynamic. For example, at extended visits with two women's groups, one in Bihar and the other in Odisha, the team was able to have energetic discussions with over 300 women farmers. In the village of Rajanpur Dihuli, Bihar, the team met with a large group of women who are part of a government-supported program known as *Mahilya Samakhya*. CSISA has had direct intervention in this program through its focus on women farmers under the name of *Kisan Sakhi*. The focus of the program is on four areas: (1) support the identity of the women as farmers, (2) provide women access to knowledge and technology about farming, the principal support of which is being done by CSISA, (3) support leadership of women in their communities and (4) support economic empowerment of the women, also a role that CSISA is supporting. In a series of interviews with these women, the ET found the women greatly benefited and appreciated the support they received from the CSISA project. Specific examples of these benefits are in the Annex E.

The results of the group interviews were broadly supported by the responses to the online survey. Among the 103 respondents to the questions "women will benefit as much as men from the technologies transferred by CSISA," 80 of the respondents concurred.

In addition to CSISA's work with women crop and dairy farmers, the ET was quick to notice the number of women represented in the program's leadership and management positions and in research activities. In Nepal, the team was able to interact with a number of senior-level women scientists working and/or partnering with the program, including Dr. Devkota, the lead agronomist in CSISA-NP. In India, the team viewed a number of presentations at field trials by women scientists and graduate students. At a visit to CSISA-supported student research trials at Odisha University for Agriculture and Technology (OUAT) seven of the nine graduate student presentations were made by women.

Agricultural water management

Tube wells with efficient pumps have been a major transforming factor in South Asia, enabling a reliable rabi crop and, more recently, a third irrigated crop in some zones with ample groundwater resources. Food security in the region rests on this innovation. More recently, CSISA's promotion of axial flow pumps is congruent with increased water-use efficiency in crop and aquaculture systems.

Nearly all the innovations under promotion are enabled or constrained by water availability and quality at the right price. Good-quality research on water use is being realized, but if this project (or a new project) is undertaken to substantially reduce the incidence of rabi fallows, a greater emphasis on water management and hydrology needs to be brought to bear to effectively address this challenge. Increasing salinity with climatic change also calls for prioritizing water management and hydrology. The social and economic dimensions of water management should not be overlooked because a purely hydrological approach in CSISA will not untangle the complexities of land ownership, water markets and returns to investment in irrigation, all of which are socioeconomic phenomena. CSISA's internal capacity for agricultural water management is very high and is currently collaborating with several national, such as International Water Management Institute (IWMI), and international partners (Georgia Tech, Columbia University, Commonwealth Scientific and Industrial Research Organisation) to round out its competencies. Additional resources need to be brought on board in Phase III to empower this important and critical work.

Nutrition

In discussion with CSISA staff in India, Bangladesh and Nepal, the question of the project's direct impact on human nutrition, other than increasing the availability of fish and some vegetables, was considered more in the domain of HarvestPlus, another global project in South Asia. However, the HarvestPlus high-density zinc and iron materials in both rice and wheat are fully integrated with the lines that are being selected, tested and disseminated in Objectives 3 and 4. Therefore, these nutrient-dense improved varieties should be available for adoption in the CSISA hubs once they are released nationally. Their adoptability depends on minimizing negative trade-offs in traits that farmers desire.

Although CSISA is designed to increase production to reduce rural poverty and food insecurity, the linkages between human nutrition and CSISA outcomes in production and cost-savings are not direct or transparent. The ET believes that rigorous quantification of the production and cost-savings outcomes is necessary before the impacts on poverty and food insecurity can be evaluated. Hence, quantification of outcomes and not impacts should still be the priority in Phase III in CSISA in India and Nepal.

Increased fish and vegetable production in CSISA-BD are an exception, as a large share of the improvement in the targeted household income of $350 will have to come from an abrupt shift upwards in the production of aquaculture species. Such a large increase in such a nutrient-rich food source could generate nutritional consequences that are amenable to quantification and documentation. In the coming months before CSISA-BD ends in September 2015, project staff may want to elicit proposals for an impact assessment of the nutritional impact of increased fish production, especially in rice-gher systems. WorldFish, IFPRI and a well-established nutritional research institute in Bangladesh could come together to conduct this potentially relevant and methodologically challenging assessment.

Climate change adaptation and mitigation

Arguably, CSISA scientists have the most leverage over climate change adaptation through the work of CSISA-MI in the hubs of southern Bangladesh. Initial research points to opportunities to design water management approaches and practices to take advantage of the massive inflow of three freshwater rivers into this extensive delta. CSISA-MI, with inputs from other hydrological partners, can and should provide strategic research to underpin water-use investment strategies for current conditions and those expected to evolve with climate change scenarios. We recommend that an output of the next phase would be for CSISA and governments to formulate jointly one or more "investment-grade" proposals for scaling up practical solutions to salinity encroachment that is being driven by climate change with rising sea levels.

Other contribtions of CSISA R&D on climate change are worth mentioning. CSISA-related agronomic practices emphasizing reductions in tillage contribute to adaptations during both drought and erosive rainfall events. The additional organic matter in the soil, derived from zero tillage, improves carbon sequestration, thereby reducing carbon dioxide in the atmosphere. Crop feed with higher digestibility reduces methane associated with livestock flatulence. CSISA has characterized reductions in greenhouse gas (GHG) per unit of grain produced with site-specific nutrient management. At its research platforms, CSISA is also quantifying net GHGs associated with different development trajectories and best-practices when deployed in combination. This "upstream" research is applauded by the ET.

Improved rice and wheat varieties, the outputs of CSISA's breeding research (also Objectives 3 and 4), are selected for resistance and tolerance to abiotic stresses, such as drought, heat and salinity. Climate change increases the incidence of these abiotic stresses. Tolerant/resistant varieties are more robust and stable-yielding; in principle, they reduce farmers' vulnerability to adverse and increasingly frequent events from global warming.

PROGRAM FUTURE

Prioritization and Reprioritization

> "CSISA's 10-year vision of success aims to significantly increase the incomes and staple crop productivity of six million farm families by 2018.These increases are to occur through widespread adoption of efficient and productive agronomic practices, substantial increases in the cultivation of high-yielding and stress-tolerant cereal cultivars, better access to information and progressive policies and strengthened markets that stimulate the same with results-oriented public and private investments"
>
> A . MacDonald, personal communication

While these examples show clearly what can be realized for a few innovations in specific agro-ecosystems, it must be emphasized that to accomplish the potential scale of impact, beyond incremental adoption, a more coherent, inclusive and well-funded strategy needs to be put in place for scaling up. For these special opportunities to materialize, it is recommended that the CSISA project during its next phase include an output of up to three carefully crafted "investment-grade" project proposals on early sowing of wheat to be elaborated for one or two states in India and for advancing adoption of salt-tolerant rice in southern Bangladesh. These extension-oriented proposals would be crafted and owned by the state governments, with formulation support from CSISA staff. They also may benefit from assistance from the Investment Center of FAO, perhaps with funding from Asian Development Bank or from IFAD, if necessary.

A major research project is also justified to characterize land and water resources to target strategic innovations to bring extensive fallows (after rainy-season rice) into production. CSISA staff are beginning to diagnose this seemingly limitless opportunity, especially in Odisha. It is estimated that 12.5 mega hectares (Mha) of fallow lands, with potential in east India, are available for more intensified cropping. While in southern Bangladesh, as many as 800,000 ha, are candidates for sustainable intensification by farming fallow lands (Krupnik et al., 2015). Some of this is due to saline infusion, but other areas such as Barisal, are prime candidates for sustainable intensification.

Obviously, water management is the requisite. The ET recommends that one or more donors enable CSISA-MIA, perhaps with support of IWMI and/or other partners, to formulate and map out strategies to achieve the mitigation of saline toxicity and to harness the potential of sustainable intensification in southern Bangladesh.

Sustainability and Scalability

There are sustainability issues that merit discussion linked to future actions and scalability. There are also issues of project design and project policy interventions that affect the outputs and outcomes, and generate frustration for both donor and implementing agency. In this context, we found that much of the Initiative was logically designed and donors (especially the USAID country missions) have truly engaged and done all that is possible to optimize CSISA's program of work. India and Bangladesh missions were exemplar in their understanding and support to CSISA.

The exception, in the case of Bangladesh, was the over-emphasis on satisfying (and exceeding) Feed the Future success indicators. Hub activities introduced at the village-level were untimely moved to another village the following year with no consideration for the need to help farmers implement what they had seen CSISA do the previous year. Sustainability and true impact is jeopardized by such project policies to generate favorable indicator numbers on areas and farmers reached, with less attention on establishing antecedents to true long-term, sustainable adoption. The case of mid-stream re-orientation of both geographic and thematic 'goal-posts' was much worse in Nepal (see Annex F Nepal country report for details.) There are often external factors that cannot be overcome that cause shifts in project focus mid-way through, but project managers would be well-advised to calculate carefully the implications of changing focus 'mid-stream' in the life of an agricultural R&D project. A dialogue with project management is strongly suggested before policy changes are finally determined and mandated.

CSISA-BD had five years to set up and impact innovation and adoption by millions of small family farmers who have minimal financial and social capital. An additional three-year period is recommended for serious consideration by USAID and the BMGF. If hub prioritization is absolutely required for a new phase, then we recommend a renewed emphasis on the northern hubs of Rangpur and Mymensingh that are in close proximity to a mechanization manufacturing company that has a strong interest in seeing farmers trained to use machinery by CSISA. This appears like a probable win/win opportunity to engender change.

RECOMMENDATIONS

1. We recommend that CSISA-India in Phase III draft one to three carefully crafted "investment-grade" joint proposals with the state governments of Bihar and Uttar Pradesh to massively disseminate the 'early' rice-wheat cropping system. These large, joint endeavors may also benefit from assistance of the Investment Center of FAO, perhaps with funding for formulation from the Asian Development Bank or from IFAD, if necessary.
2. In order stimulate greater integration between agronomists and plant breeders, we recommend that CSISA consult and explore with NARS' leadership workable protocols enabling NARS scientists to appraise and advance breeding lines in controlled, on-farm environments in India, Bangladesh and Nepal.
3. We recommend that the plant breeding continue to be an integral part of CSISA in Phase III for South Asia. Crop management is rapidly changing on the Indo-Gangetic Plain. Varieties need to be selected to optimize dynamic, new production systems. Close interactions between breeders and agronomists will reinforce the process of change and accelerate the turnover of improved new cultivars.
4. We recommend that ILRI continue to support IRRI's encouraging research on the genetics of improving rice-straw quality in Phase III. We also recommend that the assessment of the effects of crop management be factored into the analysis of fodder quality and that ILRI, in general, allocate more resources to research that is germane to CSISA's core activities. In that regard, we suggest that ILRI transfer more of its extension work on promoting fodder choppers and better-balanced rations to selected NGOs capable of this extension function, while keeping emphasis on research on adoption and on other innovations.
5. We recommend that CSISA work with private-sector providers of the key herbicides to train trainers on service providers on safe, judicious use of environmentally benign herbicides.
6. We recommend additional human resources be identified to work on remaining mechanization issues and to run training of trainers programs to scale-up the number of service providers.
7. We recommend continued emphasis on the following R&D activities that are central to CSISA:
    - Optimization of rice-wheat production systems in Bihar and eastern Uttar Pradesh in India
    - Optimization of rice-based production systems in "low-yielding" Kharif rice systems typified by Odisha (also relevant in West Bengal and Jharkhand states)
    - Optimization of rice-based production systems in central and northern Bangladesh, including Rangpur and Mymensingh hubs, each with about 15 million people
    - Optimization of rice-wheat production systems in the Terai of central and western Nepal; hill-lands research and development to continue only if appropriately funded
8. We recommend that CSISA-MI be strengthened, perhaps with support of IWMI and/or other advanced water management partners, to assist the Government of Bangladesh to formulate and map out strategies to mitigate saline toxicity in its mandate of southern Bangladesh.
9. It is recommended that one or more donors enable CSISA, perhaps with support of IWMI and/or other partners, to delineate soils and water resources, parallel with studies on socio-economic constraints for key currently "rabi fallow" zones in Odisha, enabling targeted sustainable intensification research.
10. In view of the fact that the present high quality of the management of the CSISA activities is attributed to the quality of its staff, USAID and the BMGF should work with the CG Centers to ensure that excellent staff quality is maintained.
11. In the Indo-Gangetic Plains, total rice area far exceeds the area for wheat, maize and lentil combined, and the labor demand for rice systems as they are now, is enormous. Consequently, emphasis on rice mechanization needs to be prioritized even further.
12. USAID and the BMGF need to recognize the opportunity costs of the restrictive nature of the Feed the Future strategies on the operation of CSISA and seek ways to deal with these restrictions. Besides the restriction on CSISA-NP, the projected dropping or reducing support to northern and western Bangladesh is an important opportunity cost that should be avoided

if possible. The envisaged unrestricted funding by USAID/India and USAID/Washington will allow CSISA-NP to exploit its comparative advantage. We recommend the donors examine the opportunity costs of restrictions on zones of work and explore complementary support as needed to ensure continuity of investment.

13. Given the infeasibility of drawing empirically based inferences on sustainble adoption from the Feed the Future indicators alone, IFPRI and other social scientists in CSISA are encouraged to continue and expand their in-depth research on technology diffusion, especially in the context of CSISA-BD and KISAN, CSISA's partner for technology delivery in Nepal.
14. CSISA-NP leadership and USAID/Nepal should hold discussions to clarify roles and responsibilities in its obligations to report financial and other budget-related information, and engage in supportive activities of KISAN.
15. USAID/Nepal should encourage CSISA-NP and KISAN management and staff to use more clear and specific mechanisms, such as Impact Pathways, to coordinate their joint activities. This will require both organizations to invest energy in a more effective, joint planning process. The arrival of a new COP for KISAN should be viewed as an opportunity to better facilitate coordination between the two organizations.
16. In order to enhance communication within CSISA in South Asia, it would be beneficial to hold an annual workshop where results from research, extension and training activities are discussed. Such an event would help to make project-related boundaries more porous and permeable.

FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

ANNEXES

USAID
FROM THE AMER CAN PEOPLE

ANNEX A: EVALUATION QUESTIONS

- How effectively has the program management succeeded with multiple organizations involved in implementing various components of the program?
- How well are the complex set of activities and outcomes integrated with one another across hubs and countries?
- In what ways does the organizational structure add value to the work of individual scientists and partners (e.g., by providing sufficient resources, by disseminating information)? In what ways is it overly burdensome or restrictive?
- How effectively are outputs, outcomes and impacts being properly tracked and reported (e.g., timely and high quality reports)?
- What proportion of research activities will likely achieve tangible development outcomes relevant to smallholder farmers (e.g., does the design include participatory research approaches is it appropriate for a research-for-development program?)?
- How has CSISA influenced/impacted the government policies and practices in Nepal, Bangladesh and particularly India?
- How clear, detailed and realistic is the plan (i.e., the impact pathway) for the program to disseminate and scale research outputs, whether carried out by the program itself or by other development partners?
- How consistently and effectively is the CSISA Hub model catalyzing the sustained adoption of improved varieties/hybrids, technologies, management practices and targeted information to smallholder farmers? Which hubs are producing the desired results and which are underperforming. (Note: our term wants to put our caution around terms such as "underperforming" as hubs have highly contextual situations in their development.)
- How has CSISA engaged with the private sector to utilize their entrepreneurial drive to disseminate technology?
- Which partnerships are most effective in achieving dissemination goals (e.g., host country governments, private sector, academic institutions, local NGOs, other USAID projects)? Which potential partners should be involved?
- What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
- Which components/objectives should receive greater support and/or be expanded and which should be cut back?
- To what extent are the activities of the hubs expanding in number and becoming self-supporting over time? How are the hubs ensuring the self-sustainability of the activities?
- If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?

ANNEX B: METHODS AND TOOLS

It was difficult to have a single methodology for the CSISA evaluation. The CSISA program is composed of a number of nested projects in three different countries with different funding sources and timing paranneters.

The evaluation team used mixed-method evaluations producing both quantitative and qualitative data allowing for the triangulation of data. The evaluation methods were (1) document review, (2) in-depth interviews with key informants and selected groups, and (3) an online web-based survey targeted to specific project hubs and components. Using this combination of methods to answer key questions improved the reliability of the findings and the ability of the team to evaluate the results and to make data-driven recommendations.

Each of the three methods was used according to its appropriateness for the particular question asked and audience addressed. Details of the online survey questions and proposed methods used to evaluate the questions asked are presented in Annex K.

Document review

During the first two weeks of the evaluation, each member of the evaluation team reviewed the principal documents related to the CSISA project. These documents include:

- The request for proposals (RFP) for the CSISA activities,
- Annual and semi-annual reports of CSISA and supplemental programs including CSISA-BD and MI,
- The CISIS M&E handbook and its revisions
- The Feed the Future Global Food Security Research Strategy
- The USAID Evaluation Policy

In addition, both before and during the evaluation, individual team members reviewed a host of additional supplementary documents detailed in the Annex O. During the initial in-country evaluation team meetings and a subsequent discussion, the team members discussed initial reactions, questions and clarifications about the reviewed documents to gain a mutual understanding of the documents.

Key Informant Interviews

In collaboration with CSISA project staff, the evaluation team selected individuals and groups of individuals as key informants for interviews. Selection of the individuals and groups was based upon their knowledge and/or influence related to the specific questions of the evaluation. In addition, selection was done to ensure a diverse and representative range of project beneficiaries and participants. The evaluation team took detail notes of the interviews and audio recordings were made of interviews as appropriate for verification of those notes. The evaluation team undertook 37 key informant interviews.

Groups interviews

The evaluation team strategically used interviews with groups to assess progress in delivering stated services and performance toward expected results of the project. Each group explored a specific evaluation questions related to itsparticipation in the project. These groups included service providers, women self-help groups, and general hub staff. Some of these groups were composed of 100 or more people. With these large groups, the evaluation team broke the group into small subgroups of 8 to 12 participants and interviewed them by individual evaluation team members. Due to time and resource limitation, the selection of the groups was done by the local CSISA related staff. Notes were taken of the discussion by each evaluation team member.

RESULTS. The evaluation team held 22 group sessions with approximately 10 to 12 people at each session. Three of these group discussions, one in Nepal and two in India, were with women farmers. The team had at least 3 group sessions with private sector representatives, and 10 group session were held with service providers (generally local farmers with additional resources to purchase equipment that they used to provide services to their neighbors.

Online survey

Finally, the evaluation team developed a comprehensive online survey to cover broad-based perspectives about CSISA from both a staff and partner perspective. The survey, which was over 40 questions long, asked targeted questions based on where geographically the hubs were located and the primary crop of focus

The survey had 162 respondents over the course of a three-week period. Results are available upon request.

Limitation in Methodology

Key informant interviews are open to potential bias depending on the informant. The tone and style of the interviewers' style can make comparative data analysis difficult. The methodology is not suitable for strictly quantitative data collection, although tendencies can be identified. The key informants whom the evaluation team interviewed were a mix of individuals (mostly heads of institutions or principal focus points of the project) and of technical working groups thathad more than one member. This potentially colors the results of the key informant activities. Analysis of the data from the interviews was done by reviewing collected written notes.

The group interviews were used to gather representative information of an entire community. Individuals within a group could have swayed the views of the group. The participants in the group may also have biased their views in response to the interviewer of the group. The evaluation team did not have the ability to screen group participants, and most of those who attended were selectedby CSISA staff. Data from the group were collected by parsing written notes for common issues and comments. Since the discussions were often in Nepalese, Hindi or Bangla and had to be translated for the interviewer, there was potential for bias and error.

The online survey included questions based on a Likert scale and thus suffered the limitation of all Likert-based surveys: Respondents to the survey had only limited choices on their view of the statements even though people's views are often more nuanced than the five choices provided as survey responses. Also, it is possible that answers tended to be influenced by pervious questions. Moreover, Likert scale surveys can suffer from respondents taking one side or the other for most of their responses, i.e., all good or all bad. Respondents to Likert-based surveys may also avoid the "extremes" in their options and select responses that are more neutral than their true positions.

Due to time limitations, the survey the evaluation team used did not have extensive pre-testing. In addition, language could have been an issue in some of the surveys as the survey document was in English, and some of the respondents might not have fully understood survey statements. Given the limited scale and lack of randomization, the results of the survey can only be used to provide information on tendency in one direction or another of the respondents and not precise data on target group opinions.

ANNEX C: IMPACT PATHWAYS

CSISA-India manages its activities with a management tool called Impact Pathways. Impact Pathways are created during the joint planning of activities to be undertaken by the various Consultative Group for International Agricultural Research (CGIAR or CG) partners and other stakeholders. The format of the Impact Pathway is a hybrid of more traditional logical frameworks (LogFrames) and the more elaborate Results Chains used in the Donor Committee for Enterprise Development (DCED) standard for management and evaluation. Basically, the Impact Pathway consists of an Excel workbook with one spreadsheet for each global activity to be undertaken, e.g., early sowing wheat, zero tillagewheat, women focus. The spreadsheet columns are broken down by crop concerned, the primary outcome of the global activity, the intermediate outcomes of the global activity, the description of the specific activity, where the specific activity is to take place, when the specific activity is to take place, and the name(s) of the staff person(s) responsible for the identified activity (see Figure 3 below).

FIGURE 1: Example of an Impact Pathway

Zero Tillage

Crop	Primary Outcome	Intermediate outcomes	Activities	Where	When	Staff person responsible
Wheat	Farmers widely adopt **Zero Tillage** practices for wheat	Better bet agronomic practices for zero-tillage promoted	Identify sites and establish trials for nutrient manager and monitor that farmers use recommended fertilizers.	All Districts	November-December	Pratibha, Vipin & Concerned Ag Specialist
			Distribute one page pamphlet related to better bet agronomy for farmers & service providers partnering with Krishi Salahker.	All Districts	November	Concerned Ag Specialist
			Collaborate with distributors and manufacturers of sulfosulfuron based ready mixtures for post-emergence treatment of weeds.	Patna	November	R K Malik, Virender & Anurag Ajay
			Identify new long-duration varieties and source of availability of seeds.	Patna & Gorakhpur	November	R K Malik, Virender & Ajay
			Organizing meetings with farmers/extension agents to increase area under HD-2967 (see LD & HY pathway).	All Districts	November	Concerned Ag Specialist
			Ensure the seeding of wheat at least 10 days earlier than what was done in the year 2012-13 (see early sowing wheat pathway).	All Districts	November	Concerned Ag Specialist
			Discourage farmers from using PBW-154, HD-1553/Sonalika & UP-262 through demonstration of new varieties.	All Districts & HD-1553 for Ara & Buxar	November	Concerned Ag Specialist
		Technology performance evaluated & verified	Characterize comparative yield & economic performance of ZT using valid checks - three plot techniques (3-4 per district)	All Districts	November-April	Concerned Ag Specialist
			Documentation of factors contributing to yield & economic productivity by random cropcut (20-25 per district)	Patna	November-December	Virender
			Cost and return analysis through survey by interns.	Patna & Gorakhpur	TBD	Anurags, Ajay & Prabhat
			Record GPS points of SPs.	All Districts	November-December	Concerned Ag Specialist

An apparent advantage of the Impact Pathway as a management tool is the simplicity and clarity of its presentation. The more fundamental advantage, however, is the concerned partners' required discussion and thinking about what they will do (identify the activity), why they are going to do it (identify the primary and, more critically, intermediate outcomes of the activity), and who is responsible for the activity and where and when it will take place. By requiring all parties related to the activity to be explicit on these points so that the spreadsheet can be developed, CSISA-India is able to assure a greater mutual understanding and coordination of the work being done by its various partners.

ANNEX D: CSISA COUNTRY SYNTHESIS FOR BANGLADESH

Introduction

The Cereal Systems Initiative for South Asia in Bangladesh (CSISA-BD) shares a common history with and is similar in many substantive ways to the Base-CSISA (see Figure 1 on page 12). But the two programs have different Consultative Group on International Agricultural Research (CGIAR or CG) institutional partners, management systems and objectives. CSISA-BD is implemented through a partnership among three Consultative Group on International Agricultural Research (CGIAR or CG) centers, International Rice Research Institute (IRRI), International Maize and Wheat Improvement Center (CIMMYT), and WorldFish. CSISA-BD is funded by the U.S. Agency for International Development's (USAID's) Feed the Future initiative in Bangladesh. Its twin goals are (1) to test and disseminate new cereal system-based technologies that will raise household income by at least $350 for 60,000 farming families and (2) to expose an additional 300,000 to new technology through participation in field days and farmer-to-farmer information and technology transfer.

CSISA-BD was approved in October 2010, began activities in June 2011, and ends in September 2015 (CSISA-BD Annual Report, 2014). It is a relatively short-term project with only four cropping years from 2011–12 to 2014–15 to reach its twin goals directly and indirectly benefitting 360,000 households.

CSISA-BD operates in 29 districts of Bangladesh through six hubs in northwestern, northern, and southwestern Bangladesh. The four southwestern hubs correspond to priority areas for Feed the Future for USAID-Bangladesh.

CSISA-BD has generated two other CSISA-related initiatives in Bangladesh. A subproject known as Sustainable Rice Seed Production and Delivery System for Southern Bangladesh (SRSPD) ran from March 2011 to December 2013. It was the vehicle for the distribution of just less than one million 2.5 kg packets of seed of recently released improved rice varieties with emphasis on abiotic-stress tolerance for the southwestern Bangladesh Feed the Future zones.

CSISA-Mechanization and Irrigation (CSISA-MI) builds on the lessons learned and opportunities identified by CSISA-BD and aims to scale out agricultural mechanization and irrigation services to benefit smallholder farmers in the Feed the Future zones of southern Bangladesh. While CSISA-BD maintains a focus on adaptive technology testing, deployment of new crop varieties, direct training work with farmers and facilitating output markets, CSISA-MI goes beyond this emphasis to focus on upstream market interventions involving machinery manufacturers, dealers and local service providers. CSISA-MI commenced in July 2013 and continues to 2018.

Limitations on the ability of evaluation team to implement a comprehensive review of CSISA-BD. Three members of the CSISA evaluation team were in Bangladesh from February 21 to February 25, 2014. The evaluation team's plant-breeding specialist did not go to Bangladesh, but he did visit IRRI in the Philippines. The team spent two days in Dhaka and two days in Jessore, one of the hubs of CSISA-BD. In December 2014 and January 2015, more extensive field visits were carefully planned, but the hartals in Bangladesh forced the evaluation team to curtail their stay in the country.

The opportunity to interact with senior project staff, particularly those from CIMMYT and WorldFish, who worked in the hubs, was limited. In contrast, in March 2014, the CSISA-BD Mid-Term Review consultants visited five of the six CSISA-BD hubs and met most of the main CSISA-BD partners through a series of regional and national stakeholder workshops.

In spite of the attenuated schedule, CSISA-BD provided the fora whereby the evaluation team interviewed a wide range of stakeholders, partners and beneficiaries from the public and private sectors and USAID. Additionally, CSISA-BD staff and partners responded to an online survey that was tailored to the rice-based production realities of Bangladesh and to the relevant technologies that CSISA-BD was validating and transferring. The evaluation team's earlier visits to Nepal and India provided a comparative perspective on the performance of CSISA-BD. One member of the evaluation team had lived in Bangladesh in the early 1990s and worked there for USAID in the early 1990s. Nevertheless, the inability to visit five of the six hubs and to spend more time with senior project staff meant that the review panel could not fully appreciate the research, extension and training activities of CSISA-BD in response to opportunities and challenges. In particular, the evaluation team could only begin to understand the regional heterogeneity of Bangladeshi agriculture across the six hubs and the main elements contributing to ecological variation within the hubs.

Management

VISION AND OPERATIONAL CULTURE. Two features stood out to the evaluation team in terms of vision and operational culture. Firstly, the emphasis on research and development (R&D) in CSISA-BD is very much on development. The direct and indirect goals described above and as encapsulated in the Feed the Future indicators discussed later in this section were foremost in the minds of CSISA-BD staff. The evaluation team could find no examples that even hinted at "research for the sake of research." The vast majority of staff shared the vision that development was core reason for CSISA-BD.

Secondly, IRRI, CIMMYT, and WorldFish staff shared managerial responsibilities equitably, which in turn promoted integration in R&D with a farming systems perspective. At the level of the hub, the hub manager was rotated among the three CG partners every year. Because of this practice and the fact that most R&D activities took place in the same village, everyone knew what everyone else was doing without having to incur substantial transactions costs. It was easy for the practitioners of CSISA-BD to see that the whole was greater than the sum of the parts. This gave rise to the shared perception that, working together, they were accomplishing more than if they each worked separately. Reflecting the spirit of research with a farming systems perspective, 17 of 18 respondents to the evaluation team's online survey concurred with the following statement: "In the future, separate projects by IRRI, CIMMYT and WorldFish in Bangladesh will not be as effective as CSISA-Bangladesh because the scope for productive interactions will be limited."

In addition to an emphatic commitment to development and to R&D with a farming systems perspective, management projected a self-contained or nuclear family view of CSISA-BD. The Base-CSISA's Objective 3 on rice genetic improvement was viewed by CSISA-BD's management as being outside the project with limited scope for interactions in terms of transmitting demands for crop improvement priorities. Likewise, International Food Policy Research Institute's (IFPRI's) work on policy in Bangladesh was perceived by management as being unrelated to CSISA-BD. International Livestock Research Institute (ILRI) engages in extension activities in three of the hubs, but it, too, was viewed as outside of CSISA-BD.

RECOMMENDATION. In order to enhance communication within CSISA in South Asia, it would be beneficial to hold an annual workshop where results from research, extension and training activities are discussed annually. Such an event would help to make project-related boundaries more porous and permeable than they now are.

ORGANIZATIONAL STRUCTURE. IRRI is the lead partner working with CIMMYT and WorldFish in managing CSISA-BD. CSISA-MI is managed by CIMMYT and IDE. The coordination of activities between CSISA-BD and CSISA-MI could be a major issue. The evaluation team did not find this to be the case. Because CSISA-MI falls within the CSISA-BD family, the COP of CSISA-BD has a nominal role as overall COP of the CSISAs. This allows for some coordination between the projects. We observed that senior staff within the projects is also committed to working together and sharing experiences. The ET was informed that placing CSISA-MI staff in the CSISA-BD office has helped to coordinate work at the hub level.

As far as IRRI understands, CSISA does not have a core management that cuts across India, Nepal and Bangladesh. The CSISA-BD management is not under the CSISA-Phase II management. CSISA-BD and CSISA-Phase II collaborate but are managed separately. The COP for CSISA-BD is a member of the CSISA-South Asia Executive Committee. CSISA-BD posts reports on the CSISA-Phase II website and provides CSISA-Phase II with a summary of CSISA-BD work for the semi-annual and annual reports. Several staff members at the northwestern Rangpur hub office are paid from CSISA-Phase II funds from the Bill & Melinda Gates Foundation.

COMMUNICATION. Communication and management questions related to CSISA-Bangladesh need to be reviewed in the context of its multiple components. Each component has had its own communication structure. SRSPD was the venue for a targeted communication effort on the superiority of recently released, improved rice varieties and the proper use of the small packets of seed that this subproject distributed in the southwestern Bangladesh. CSISA-BD and CSISA-MI, on the other hand, each has a fully functional communication mechanism. CSISA-BD publishes an annual report, has organized more than 10 large workshops including an annual hub-level stakeholder event, and produces a number of printed materials ranging from technology-specific leaflets for farmers to a book (Made in Bangladesh: Scale Appropriate Machinery for Agricultural Resource Conservatio. published by SCISA-MI) for potential service providers. Six research publications are cited on the CSISA webpage. In addition, CSISA-BD has a Facebook page (www.facebook.com/csisabd) that is updated weekly.

CSISA-MI does similar communication activities including production of brochures, video CDs and technical publications. Some of these publications are in both English and Bangla.

Communication featured prominently in a three-hour long discussion in Jessore with local government officials, NGOs and private sector operators. After some initial skepticism from official of the Department of Extension on how well the project communicated and worked with his office, he noted that, at the local block level, his officers helped select farmers to work with the program and had worked jointly with CSISA on development of demonstrations plots. In general, the tenor of that meeting was that CSISA did a good job of working with government and stakeholders at the local level, but it may not have had as much contact with officials at higher levels. CSISA is a localized activity whereas the governmental departments work in the whole country. At the same time, it was noted that one of the strengths of CSISA was its ability to link national organizations, such as Bangladesh Agricultural Research Center and the DAE, with local private-sector service providers and farmers.

COLLABORATION. The three principal partners in CSISA-BD (IRRI, CIMMYT and WorldFish) plan activities and implement them in a collaborative way. The gher planting system, for example, links both fish culture and rice production, and both IRRI and WorldFish take part in it. Likewise, CIMMYT's work with CSISA-MI closely overlaps with mechanization effort of CSISA-BD.

As noted in the section on communication, the collaboration of CSISA-BD at the local level seems to be strong, but collaboration and inclusion of more senior Government of Bangladesh departments and officials appears weaker. Nevertheless, the project has a number of close contacts at senior levels. For example, the director general of the Department of Agricultural Extension was closely associated with CSISA-BD at the beginning of the project.

CSISA has developed important relationships with major private-sector companies in mechanization. The connection with Rangpur Foundry has proven to be an important one and has provided significant additional resources in support of mechanization. Rangpur Foundry has particular focus on the west and north of the country. However, CSISA-MI is not working in the north and west of Bangladesh. Rangpur Foundary, ACI and Metal Engineering are working with CSISA-MI in the Feed the Future zone in southwest Bangladesh. Rangpur Foundry and the other private sector partners would like CSISA-MI to work with them in north and west Bangladesh where they have their bases and where they consider there is most potential for selling the machines promoted by CSISA-MI. Rangpur Foundry works with CSISA-MI on axial flow pumps and two-wheel tractor mounted planters. ACI works with CSISA-MI primarily on selling reapers; Metal Engineering is working on planters and reapers. (personal communication, Timothy Russell, 2015)

Unfortunately, the evaluation team was unable to meet with the CEO of this firm to get a fuller understanding of its relationship with the project. The evaluation team did meet with the executive director of ACI Limited, a large equipment and agri-industrial firm based in Dhaka. He expressed his strong interest and support for the work of CSISA and look forward to working with the project on rice transplanters and other farm equipment. He felt that the demonstration work done by CSISA has helped increase his sales of certain specific machines tenfold, especially reapers. He noted the good results of the work he has had with CSISA-MI, but he also commented on the fact that many, and likely more, machines could be sold and used successfully in other areas of the country than the south. The north and west of the country are best suited for many of the pieces of equipment used in Bangladesh for farming.

MONITORING AND EVALUATION SYSTEMS/PERFORMANCE MANAGEMENT. CSISA-BD has put together an elaborate and well-structured M&E system and, as a consequence, has been able to "put forth the numbers" as stated by a USAID/India official. A monitoring and evaluation (M&E) handbook has been developed and is in use at each hub. In addition, a standard operating procedure (SOP) manual for administrative management has also been created and made mandatory at the hubs.

Unlike CSISA India, CSISA-BD has not relied heavily on Impact Pathways as a planning tool for its research, extension and training activities. (The CSISA-BD Maize and Wheat team used Impact Pathways as a planning tool for the last two years).

CSISA-BD staff has annual work planning sessions where staff members sit with stakeholders at the field level to carry out joint drafts of local work plans. These drafts are compiled by each hub and forwarded to Dhaka where the COP with representatives of the three cooperative partners (IRRI, CIMMYT and WorldFish) establish the annual work plan for each hub. The annual work plans are the raw material for the development of an annual hub-specific project management plan (PMP).

CSISA-BD employs a purchase software (Central MS Access) to collate and cross check data related to the PMP that is gathered at each hub from nongovernmental organizations (NGOs) and other stakeholder partners. The hub M&E coordinator verifies the incoming data and does spot data quality assessments to assure accuracy of the data on a monthly basis. These data are then sent to headquarters in Dhaka to be compiled for the project's reporting to USAID. Data quality assessments are done at two levels—internally by CSISA staff and externally by USAID. Hard copies of all the reporting documents are classified and stored at each hub.

Research

RESULTS AND VALIDITY. We had fewer opportunities to view multi-locational experimental trials in Bangladesh than in Nepal and India because of the political unrest and the consequent travel restrictions in Bangladesh during our mission. Our observations, however, indicated that solid attention is being given to treatment selection and to efforts to minimize unwanted random variation while the meaningfulness and relevance of trials were ensured. The trials we observed were primarily on farmers' fields in the Jessore Hub. National research programs conduct agronomic studies at the experiment station level, and, in general, a strong case cannot be made for having the CSISA team duplicate on-station trials.

Impressive forward thinking and planning was evident in the research to tackle increasing salinization and to take advantage of untapped fresh-water availability in southern part of the country. Strategies are being articulated by CSISA to recover or use the zones having permanent salinity by rearing selected salt-tolerant fish and prawn while designing different approaches for zones that can be flushed with fresh/sweet water.

Negative research results in technology validation are also valuable in defining recommendation domains for clusters of components. Prospective technologies that have not worked or are not economically viable or that have very narrow recommendation domains include super bags, alternate wet and dry irrigation, and the deep placement of urea briquettes. Research is still being carried out on some of the old themes, such as site-specific nutrient management, of the Rice-Wheat Consortium from the 1990s. The work now is mainly focused on how to make these web-based advisory services available to farmers with limited access to the Internet. CSISA-BD has wisely not invested in other themes, such as integrated pest management for rice that is central to other projects and initiatives. CSISA-BD liases with IPM clubs and beneficiaries have adopted some practices, like the use of bird perches, which are highly visible in farmers' rice fields.

PROCESS RESEARCH. Introduction to the rice-based cropping systems. In Bangladesh, field agriculture is dominated by rice which accounts for 85 percent of gross cropped area. Although rice's relative importance has not changed over time, maize and potato have steadily expanded in area since 1990.

There are three recognized rice production seasons: the aus, the aman and the boro. The aus, which is a short pre-monsoon rainfed season, generally results in the lowest rice yields and poor grain quality. The aman is the main monsoon rice crop. Aman yields are superior to aus-rice, but low solar radiation results in lower productivity than a well-grown boro-rice crop, which follows the aman and is high in its consumptive use of water.

With about 5.6 million hectares in 2010, the national area of aman rice has not changed since 1980. In contrast, the area in aus has declined from about 3.0 to 1.0 million hectares, and the area in boro has increased from 1.2 to 4.8 million hectares in the same time span. Since 1990 the productivity of aman rice has increased from about 2.4 to 3.4 metric tons/ha; aus' productivity has risen from about 1.6 to 2.8 tonnes/ha; and boro's productivity has increased from 3.7 to about 5.8 metric tons/ha in paddy by 2010.

Across the six hubs in 2009, the area in boro rice ranged from 145,000 hectares in Barisal to 465,000 hectares in Rangpur. At 5.7 t/ha in paddy, average productivity in the six hubs was not statistically different from the mean national average yield for boro rice. The area in aman rice in 2009 varied from about 180,000 hectares in Faridpur to about 585,000 hectares in Rangpur across the six hubs. Expressed in 3.3 t/ha of paddy, average productivity in the six hubs was also not statistically different from the mean national average yield for aman rice. Unlike India, average regional differences in rice productivity are not marked in Bangladesh.

PROCESS RESEARCH: WATER MANAGEMENT. The monumental increase in Bangladeshi rice and its concomitant food security comes almost entirely from increases in production and productivity of boro rice. Policies in 2001 to permit importation of tube-well pumps largely led to this revolution (FAO, and personal communication, Dr. Ed Pulver). CSISA's work on use of axial flow pumps in both crop and fish-farming is an important component of the holistic process research. Strategies to optimize Bangladesh's surface water resources for agriculture, aquaculture and other uses warrant greater emphasis, and we recommend that Bangladesh-MI be further strengthened to contribute to such strategic studies.

PROCESS RESEARCH: CROPPING INTENSITY. Where ecologically appropriate, CSISA-BD and CSISA-MI both correctly emphasize diversification options to aman and boro rice. Farm-level presentation of CSISA with development partners of both hybrid rice and selected salt- and submergence-tolerant inbred rice varieties is helping thousands of farmers obtain at least one crop on enormous areas of delta rice under salinity stress. The ability to manage water on-farm is essential for nearly all production innovations. The early maturing rice coupled with water management through axial flow pumps is giving farmers additional options for second and third crops to increase cropping intensities, overall productivity and income generation.

Diversification of rice-rice production systems is not widely opted for in areas where there is adequate quality water for both aman and boro rice. In the aman (monsoon) season, rainfall and associated flooding reduce the land-use choices to rice and/or aquaculture in all lowlands. Then, the following boro rice crop with supplemental irrigation is a favorite because higher solar radiation results in high yields and grain quality. Interviewed farmers in Jessore responded that boro rice was their most remunerative crop. The project has had considerable impact on the introduction of mustard between aman rice and boro rice achieved through the introduction of short-season aman varieties. This is now common in northern hubs such as Mymensingh and in Faridpur hub in the south. Jute is the most common crop grown in Faridpur and many parts of Jessore and Khulna hubs (personal communication, Timothy Russell, 2015).

On saline soils, sunflower production is gaining popularity. Wheat and maize are widely grown instead of boro rice in many hubs, especially in Rangpur, Jessore and Faridpur. In Mymensingh and Barisal, the project has been able to introduce wheat and maize production on sandy soil riverine islands. In medium and higher elevation ecologies, mustard, wheat, maize and pulses are more frequently found where water is too scarce to plant boro rice. Soybean might also be a potential intercrop or rotation crop with maize, and both crops will help meet urgent feed needs for livestock, including aquaculture. In more marginal soils, cassava could be tried. Continued work on adapting mechanization options for these crops is recommended.

PROCESS RESEARCH: CROP-SPECIFIC AGRONOMY. The program is working effectively on validating crop-specific agronomy (e.g., planting date; populations, weed and pest control, fertilizer optimization) through a large number of farmer participatory trials and demonstrations on rice, wheat, maize, mustard and jute. This is a good approach and should continue. This work is adequately documented in annual reports.

Herbicide studies to complement weed management needs associated with direct seeding of diverse crops are constrained by the USAID protocol (pest evaluation report and safe use action plan – PERSUANT). Consequently, it is recommended that CSISA staff encourage the herbicide industry to run appropriate trials and seek government clearances as required.

Fertilizer use is fundamental for most efforts in sustainable intensification. CSISA-BD conducted 200 trials and demonstrations on urea deep placement in rice. The demonstrations featured the use of all the urea granule placement equipment and the use of urea deep placement on boro, aman and aus rice crops. In addition, over the last two aman seasons, CSISA has sponsored a Ph.D. student, as part of a collaborative program with BRRI, to study the use of urea super granules in tall local aromatic rice varieties in tidally flooded regions of Barisal District (T. Russell, personal communication). Similary, rice agronomic demonstrations compare farmers practice with rice crop-management recommendations. IRRI and CIMMYT have spent a lot of time on nutrient omission trials to provide data for the Crop Manager program.

BREEDING RESEARCH. CSISA-BD and CSISA-MI do not engage in crop genetic improvement research. CSISA-BD extends improved crop varieties based on the results of large-scale participatory varietal selection trials and demonstrations, including genotype by management interaction studies involving newly released rice varieties. Variety trials compare recently released varieties with old varieties used in farmer participatory trials.

Rice variety selection has concentrated on comparing varieties suitable for saline soil, submergence, premium quality markets, early maturity (aman rice) with farmers' varieties, standard mega varieties such as BRRI dhan28 and the hybrids sold by the private sector.

AQUACULTURE AND LIVESTOCK RESEARCH. Aquaculture in both fresh and brackish water ponds is often associated with all three rice-cropping seasons. Bangladesh has in excess of 500,000 ha of fresh water ponds and another 200,000 ha or so of brackish water ponds or ghers. Ponds and especially ghers are increasing and are projected to expand throughout the south. Their increasing importance opens up opportunities for the increasing production of shrimp, freshwater prawns and tilapia (which can be produced in brackish water).

Bangladesh's increasing penetration into the international markets for fish, shrimp and prawn enhances the contribution that WorldFish can make to CSISA in rice-based aquaculture by ensuring strong demand for the output of aquaculture. Improved plant-based fish feeds have been appreciated by farmers and are a key component in the six aquaculture systems that CSISA-BD has extensively tested and is aggressively promoting. Net benefits per unit area are higher in aquaculture than in crop-based agriculture; hence, adoption of aquaculture systems can go a long way to meet the goal of increasing net income by $350 per hectare for the direct beneficiaries of CSISA-BD.

WorldFish contributes to the CSISA goals of increasing aquaculture productivity in the context of rice-based production systems in Bangladesh. The ET's observations in Jessore supported impressive, improved aquaculture developments described in the 2014 Annual Report, which was drawn on to provide the following highlights. Developments in integrated systems were achieved through training and demonstrations that show farmers the best methods for raising crops and fish, developing systems that allow farmers to obtain good seed of the best varieties, and testing and introducing new crop and fish varieties. For example, in 2014 in Mymensingh and Rangpur, 49 upazilla fisheries officers and farm managers from the Department of Fisheries (DoF) were given training on fish seed quality. CSISA-BD has been working with various hatcheries in collaboration with DoF to ensure that quality seed production and distribution adheres to basic genetic principles and hatchery rules and regulations. To build the capacity of partner extension staff, CSISA-BD organized a six-day training of trainers course at the Khulna Hub for 26 extension staff. Gher farming has proven to be highly successful in the south. CSISA-BD is promoting the adoption of this system with high potential in northwest Bangladesh in a three-pronged approach of visit, observe and learn.

Farmer participatory trials are central to WorldFish's approach. As reported in the 2014 Annual report, 217 Year 4 trials have been established. The results from Year 3 trials show that farmers who apply the technology taught in demonstrations almost double production. Interestingly, the trials also show that, despite the high value of fish, home consumption of fish increased 29 percent for shrimp-based systems and 76 percent for homestead pond-based systems. This is a clear indication that increased production of high-value products such as fish can be translated into increased consumption by producers. From discussions and interviews, the ET has no evidence that WorldFish's input into CSISA-BD is anything less than successful, though, as is the case for all appraisal work in Bangldesh, our own observations were limited by hartals.

As mentioned in the introduction, ILRI works in three of the hubs where CSISA-BD is active. In Jessore, ILRI was demonstrating the use of mobile chaffer cutters to enhance the digestibility of cereal straw especially rice straw. Women were involved in owning and in renting the machine. Like much of the rest of South Asia, women in Bangladesh tend to livestock, especially dairy cattle. ILRI's role in CSISA in Bangladesh was similar to its activities in CSISA-India: it focuses on the delivery of simple extension messages.

Socioeconomics and Policy Research. CSISA-BD and CSISA-MI have not made substantive investments in policy research. CSISA-BD has invested in supportive socioeconomics research that carries out adoption studies and impact assessments, the partial budgeting of on-farm trials in a format that USAID refers to as 'Gross-Margin' analysis, and value-chain analyses. Project management is aware that adoption research looms large as a priority. What the impressive Feed the Future-related results imply for the sustainable uptake of technologies can only be established through adoption research that should be completed prior to the scheduled project closing in September 2015.

CSISA-Bangladesh has a good plan based on longitudinal sampling for the conduct of such work from a Year 2 baseline of about 1,200 households equally divided for the study of rice, maize and wheat, and aquaculture technologies. The summary results for rice showed that short duration aman rice varieties were rapidly being adopted. BINA Dhan 7 cultivation went from zero to 30 percent of exposed households in the Feed the Future zone and from zero to 48 percent of the trained households in the non-Feed the Future zones in northern and northwestern Bangladesh. In maize, 44 percent of the farmers trained in Year 2 adopted maize for the first time in Year 3 in the southernmost hub in Barisal. As expected, partial adoption of improved management practices appears to be the norm in both maize and wheat as farmers had very diffuse perceptions on what they ranked as the agronomic component they valued most. Turning to aguaculture, survey households practiced improved fish-culture technology on 0.15 hectares in 2012–13. A comparable average for households that cultured improved prawn/shrimp technology was 0.34 hectares. Nine of ten aguacultural households said that they wanted to continue fish or prawn/shrimp culture in 2013–2014; most wanted to expand their activities.

The inclusion of Year 3 and Year 4 farmers in the survey—some carefully selected—and the absence of farmers to control for the effect of the production year should provide the basis for an informative study on the durability of adoption over time and on the related sustainability of impacts. Project management should try to elicit IFPRI's interest in participating in this benchmark adoption study that addresses the longer-term viability of the Feed the Future estimates.

An interdisciplinary research publication of the on-farm trial and demonstration results over the past four cropping years is another priority. Many of the thematic areas are characterized by dozens of observations that can be pooled over time and across locations in a more rigorous statistical and economic analysis that could address both production and market risk especially in the non-rice crops. Deriving lessons learned from the value chain analyses are also a priority output prior to the closing of CSISA-BD in September 2015.

Cross-Cutting Themes

MECHANIZATION. The evaluation team's discussions with farmers in Jessore were dominated by the widespread perception that the scarcity of labor, especially for rice transplanting and harvesting, loomed larger every day as a constraint. Male labor from northern Bangladesh migrates seasonally to Jessore for transplanting and harvesting of both aman and boro rice. For sustainable intensification, crops following aman rice need to be established quickly. Consequently, the desirability of mechanization is rated very high on farmers' priority lists. However, unlike in India, there appears to be little recognition of the importance of laser land leveling on saving water management and on increasing productivity.

Although there are two private-sector companies ready to import and distribute machinery though sales to Service Providers (SPs), mechanization is only slowly reaching farmers for sowing direct-seeded rice, wheat and maize as well as for mechanically transplanted rice. Mechanized reapers are also required for facilitating rapid harvest and removal of crops from the field. The evaluation team had an opportunity to observe a training of trainers for service providers undertaken by the other CSISA-MI partner, IDE. The focus of the training was on the viability of service providers as future businesses. A greater emphasis on financial analysis and on hands-on use of the equipment in field conditions would be highly complementary to the focus on conventional business practices. It is recommended that CSISA-MI further scale-up training of SPs on hands-on equipment-use in cooperation with the machinery industry and NARS.

There is an urgent need for resolving the still limited adoption of mechanically transplanted rice. We also recommending additional agronomic research on "direct-seeded rice," especially on weed control and yield enhancement. Work in these two areas should be carried out as on-farm research with experienced agronomists working with SPs, especially those SPs associated with private-sector machinery dealers, and farmers. Addressing transplanting bottlenecks should also be highly complementary to Bangladesh-MI's current emphasis on sustainable intensification in the form of axial flow pumps for fallows, seed drills, reapers and bed planters.

In the two northern hubs (Rangpur and Maymensingh) work has only now begun to train adequately the service providers who will enable the farm community to be in an adequate developmental state to benefit from Bangladesh-MI's platform of research supporting mechanization. Hence, we recommend that CSISA-MI include work in these two northern hubs that have brighter and more imminent prospects for mechanization than the southern region. Moreover, the two northern hubs are in proximity to one of the most important farm machinery companies (RFL) that has already invested in the project. CSISA-MI and/or the Bill & Melinda Gates Foundation should finance this work in north and west Bangladesh.

Bangladesh has a high density of two-wheel power tillers (tractors) in use for transport in rural areas, but other than for soil rotavations, these could be better exploited for use in conservation agriculture. Strip tillage followed by direct drilling can work for many crops and CSISA-MI intends to scale up research and adoption facilitation, Enhancement of exposure to SPs and farmers merits attention.

The online survey results shed light on the perceptions of CSISA staff and partners on prospects for mechanization. Thirteen of eighteen respondents either agreed or strongly agreed with the perception that "by 2030, mechanization in the districts covered by CSISA-BD will rely more heavily on four-wheel tractors than on power tillers." Thirteen of sixteen respondents believed that rice reapers would be the rice-related machinery that would be the most commonly found in the 29 CSISA-BD districts by 2030.

GENDER. Gender aspects in Bangladesh are considerably different from what the evaluation team saw in Nepal and India. We did not visit with large groups of women farmers nor did we see senior female technicians making presentations. We also did not see women-headed farm households. In our brief visit, there was only one woman present in the partner meetings we had (a female extension agent in Jessore). The ER is cognizant of the cultural differences between India and Bangladesh. Women play different roles in Muslim societies than in Hindu societies.

Women in Bangladesh do not work on crop production and do not leave the homestead. Because fish ponds are based on the homestead and are a women's enterprise, about 40 percent of participants in aquaculture training are women. By contrast, women participation in rice, wheat and maize training is about 20 percent. (personal communication, T. Russell, 2015)

Nevertheless, the project continues to make efforts through mainstreaming of women farmers, establishing "info women" and other gender-specific activities. CSISA-BD provides women with support through training in crop production and postharvest technology and through participation in field-day events. Aquaculture and the related vegetable production programs attract the greatest participation from women. The evaluation team was not able to see much of these efforts, but we got a sense that the CSISA-BD and CSISA-MI staffs are serious in their desire to support women in the Bangladesh program. Indeed, in the earlier newsletters of the project, women's training workshops and events were heavily featured, so much so that they may have imparted a distorted view of what the project was really about.

While CIMMYT, WorldFish and IRRI all had women scientists who had responsibilities for gender within the project, we did not see continuity in the approach to gender in CSISA-BD. The topics that were invested in and the events that were undertaken were too fragmented and episodic to generate significant and sustained impact in advancing women's welfare. The failure to find and hire a scientist who could oversee all the aspects of CSISA-BD's gender program with the autonomy to mold them into a cohesive whole was an acknowledged deficiency. (T. Russell, personal communication)

CLIMATIC CHANGE. In Bangladesh, CSISA scientists have the most leverage over adaptation to climatic change through the water management research of CSISA-MI in the four hubs of southern Bangladesh. Initial research points to opportunities to design water management approaches and practices to take advantage of the massive inflow of three freshwater rivers into this extensive delta. CSISA-MI with inputs from hydrological partners in specialized regional and national research institutes provide strategic research to underpin water-use investment strategies for current conditions and those expected to evolve with climate-change scenarios.

Improved rice varieties and hybrids tolerant to the abiotic stresses of deep water, salinitity, and heat are also forces that facilitate adaptation to climatic change. Tolerant/resistant varieties are more robust and stable-yielding; in principle, they reduce farmers' vulnerability to increasingly frequent adverse events from climatic change.

Catalyzing Change

TECHNOLOGICAL CHANGE. During it short lifespan, CSISA-BD scores high marks on the transfer of technologies that have ample potential to increase the income of small farm households. The project has met or exceeded almost all of its Feed the Future targets.

In the spirit of the Rice-Wheat Consortium that operated in Bangladesh throughout the 1990s and early 2000s, earlier planting of the crop following rainy-season rice is a necessary condition for increasing the productivity of the cropping system as a whole. The first step in any Bangladesh sustainable intensification program has been the focus on the short-duration aman rice HYVS. CSISA-BD can take some credit for the rapid spread of those varieties in southern Bangladesh. In cooperation with DAE, BRRI, private sector seed dealers and, at times, rice millers, CSISA has carried out large-scale participatory varietal trials and demonstrations of more intensified cropping systems that feature the insertion of a post-rainy season crop, such as mustard, after aman rice is harvested and boro rice is planted in February. When boro rice is not planted, earlier harvesting of aman rice and the earlier sowing of the following crop permits an intensified rice-maize-mung bean or rice-maize/garden pea relay and intercropping systems. CSISA-BD has focused its intensification of rice-based cropping systems in southwestern Bangladesh and patterned its work after the expansion in the 1990s and early 3000s of maize and potato in the northern and northwestern regions, where rice-mustard-rice systems and rice-maize or rice-wheat systems are finding adoption. In the south, sunflower has been developed to follow aman rice, including in saline ecologies. Follow-up studies on adoption are planned.

Indeed, the highest-ranking technologies identified in the online survey were those that intensified rice-cropping systems by adding another crop following shorter duration rice varieties in the aman season. Examples included rice-mustard-rice, rice-lentil-rice, and rice-maize-mung bean systems.

Household-based pond aquaculture with vegetables planted on the dykes was the second ranked technology among the 16 listed for selection by CSISA staff and partners in Bangladesh. Fifteen of twenty-one respondents to the online survey stated that Tilapia was the most promising species in the expansion and intensification of aguaculture, especially water ponds contiguous with rice fields called ghers that CSISA-BD was validating and subsequently promoting. Tilapia culture in ponds has attained yields as high as 20mt/ha and is averaging more than 10 mt/ha. CSISA efforts have increased the number of commercial ghers in the greater Jessore, Khulna and Faridpur hubs.

Although not ranking as high as intensified rice-based cropping systems and aquaculture, there is no doubt that component technologies such as saline- and submergence-tolerant rice varieties and so-called "premium" higher-quality rice cultivars. CSISA-BD has facilitated increases in adoption, of premium quality basmati type rice in the Jessore hub; such adoption has gone from 0 ha in 2011 to about 40,000 ha in 2015. The introduction of maize into the far southern Barisal hub have also made smaller but important contributions to augmenting household income in CSISA-BD's areas of operation.

Any discussion of technological change also begs the following question: Has CSISA-BD's research led to the generation of new components that were not already on the shelf or in the pipeline? The evaluation team did not find persuasive positive support for an affirmative response to this query. For example, site specific nutrient management—a priority since the early days of the rice-wheat consortium—is still being tested and tailored to crop and nutrient management conditions in Bangladesh. An emphasis on development partially explains the evaluation team's perception that CSISA-BD will be known more for its short-term contributions to technology transfer than for its substantive achievements in applied and adaptive research. Moreover, achieving breakthroughs in component research that lead to improved farming systems is a daunting task in only four cropping years, especially when development in the short-run is the priority. The ongoing research holds considerable promise, but it is too early to tell if it will result in tipping points for future technological change.

INSTITUTIONAL CHANGE. The survey results partially confirm the hypothesis that CSISA-BD has influenced the work of both NGO and private-sector partners. Sixteen of twenty respondents to our online survey agreed with the statement: "We can cite several examples where partners have incorporated into their own activities new methods learned from their work in the CSISA Project. However, only three respondents offered specific examples. They included the promotion of maize in southern Bangladesh; NGO programs extending and focusing on agricultural machinery and on their own, private-sector partners investing in new agricultural machinery on their own; NGOs making use of CSISA extension material on their own; and farmers and service providers adapting practices to suit their own needs, using CSISA-conducted training as the basis of their learning.

CSISA-BD should be credited for pioneering the concept of local service providers (LSPS) where village entrepreneurs sell mechanization services. The use of LSPS by CSISA-BD first dates to 2012. It is now well established in Bangladesh and seen by many actors outside of CSISA-BD as a model for provision of services to farmers.

Support was less evident for CSISA's influence on the way that public-sector research and extension institutions go about their business in Bangladesh. The evaluation team did not uncover any concrete examples of transformative public-sector change that could be attributed to CSISA. However, the practice by CSISA-BD of hiring scientific staff on leave from their host government research and/or extension institutes establishes a basis for future institutional change. A deep-seeded commitment to agricultural development in general and to research with a farming systems perspective in particular was transparent in the field visits, group discussions, and survey results. That shared thinking is highly conducive for catalyzing change in how public-sector R&D is carried out in the future.

POLICY CHANGE. Although policy research does not figure prominently in the objectives of CSISA-BD, policy change could have been forthcoming through the research and extension activities of the project. That does not appear to be the case. The evaluation team did not encounter any documentation that the project directly influenced decision-making on policy.

However, CSISA-BD has indirectly contributed to policy change through its subproject, SRSPDS. In a SRSPDS-sponsored workshop in 2013, a protocol was signed by India, Bangladesh and IRRI for strengthening collaboration in the rice seed sector between the two countries with IRRI as a facilitator. Areas identified for immediate cooperation included joint varietal evaluation and release, reciprocal recognition of data for varietal release, reduced time for evaluation for MAS-generated varieties, acceptance of participatory varietal selection data for varietal release, prerelease seed multiplication and dissemination, encouraging private companies to get involved in the seed sector, and the harmonization of seed systems.

These changes will take some time to analytically digest and document. Given the porosity of the border between India and Bangladesh and the size of the informal sector in the trade of rice, the magnitude of benefits from this cooperative agreement are uncertain, even with strict adherence to its provisions. Nonetheless, the protocol is a sizable step in the right direction, and it warrants a future investment in post impact assessment if anecdotal evidence suggests positive benefits and significant changes from the status quo, which in this case would be an appropriate counterfactual.

Program Future

CSISA-BD ends in September, 2015, and another phase is not envisaged by USAID-Bangladesh, which has decided to invest in more institutionally specific and less holistic agricultural R&D projects. Overall, the evaluation team was impressed by what CSISA-BD achieved in only four cropping years. We have every reason to expect that the project has reached or will soon reach its goal of increasing household income for a total of 360,000 households. In summary, USAID-Bangladesh received good value on its investment.

Initial expectations along these lines were partially confirmed in 2013 when Year 2 direct beneficiaries were surveyed. This assessment needs to be updated with the Year 3 beneficiaries. CSISA-BD is in a good position to carry out a final project adoption study that will provide insight on the uptake of the clusters of component technologies that have been transferred through the project since 2011. Once that study is finalized, the magnitude of the success of the project can be quantified.

For the evaluation team, the commitment of hub scientists from three diverse and complementary research institutions to seamless cooperation in the performance of agricultural R&D with a farming systems perspective was arguably the most outstanding behavioral aspect of the project. If a second phase of CSISA-BD had been feasible, the evaluation team would have endorsed its desirability. However, a greater emphasis would need to be placed on applied agricultural research and less priority given to extension if the CG Centers were to lead the effort and maintain the same level of involvement. Agricultural productivity in Bangladesh is now at a high level in farmers' fields in several important thematic areas such as the productivity of boro rice, maize yields, and cropping intensity. Increasing potential productivity via strategic and applied research is becoming more important over time than reducing the yield gaps between representative farmers and those that use best practice.

REPRIORITIZATION. Geographically, CSISA-MI should be re-prioritized to include mechanization activities in the Mymensigh and Rangpur hubs where the prospects for mechanization are as bright as or brighter than in the southwestern hubs. For the evaluation team, the exclusive focus on the Feed the Future priority districts results in a high opportunity in foregone benefits. Focusing on irrigation and water management in the southwest makes sense but restricting support for mechanization to the southwest flys in the face of experience and past investments made in CSISA-BD.

SUSTAINABILITY AND SCALABILITY. The adoption research described above can provide good insight on the prospects for sustainability by broad technology type. The evaluation team did not have sufficient time in Bangladesh to identify the most likely candidates for scalability. The online survey results illuminate several of the best prospects, such as improved tilapia culture and rice reapers, but we do not have sufficient regionally specific insight and contextual knowledge to arrive at consensus choice for a large-scale investment in an extension program. In East India, it was easy to see that the "early" rice-wheat cropping system was the obvious and logical candidate for such a program. In Bangladesh, there are more clusters of options, and the adapatability of those technologies is more uncertain.

Although some project staff maintain that it is not an issue, the evaluation team is persuaded that switching village locations every other year to maximize extension delivery and satisfy Feed the Future targets can take a toll on several aspects of project performance. For example, the training and follow-up to introduce sustainable mechanization for rice-based systems requires periodic monitoring over several years. Adaptive research should be carried out in representative benchmark sites that are endowed with opportunities for learning by doing. Switching village locations is necessary for extension delivery, but it is also conducive to opportunistic behavior in not coming to grips with a representative village reality.

Recommendations

1. In order to enhance communication within CSISA in South Asia, it would be beneficial to hold an annual workshop where results from research, extension, and training activities are discussed annually. Such an event would help to make project-related boundaries more porous and permeable than they now are.
2. CSISA management should increase interactions with high-level stakeholders in the government's agriculture, fisheries, extension, research and strategic planning departments. CSISA's work at the state and village levels (as seen in hubs) seems robust but frequently not well understood or properly valued in the higher administrative realms.
3. It is recommended that CSISA-MI scale up training of LSPs on hands-on equipment-use in cooperation with the equipment industry and NARS.
4. CSISA-BD should not move from one village to another in a one-year time frame in order to meet and exceed Feed the Future indicators for innovations involving mechanization.
5. In medium and higher elevation ecologies, mustard, wheat, maize and pulses are more frequently found. Jute, too, is found, especially in the Faridpur hub. Continued work on adapting mechanization options for these crops is recommended.
6. CSISA-MI's geographic remit on support to mechanization should be extended to the two northern hubs (Rangpur or Rajshahi and Mymensingh), which have high potential and are in proximity to one of the most important farm machinery companies (RFL).
7. Strategies to optimize surface water resources for agriculture, aquaculture and other needs merits greater emphasis, and we recommend that CSISA-MI be further strengthened to contribute to such strategic studies.
8. There is an urgent need for resolving the still limited adoption of mechanically transplanted rice. We strongly recommend attention be given to this because labor for transplanting rice is increasingly problematic.
9. We also recommend additional agronomic research on "direct-seeded rice," especially on weed control and yield enhancement. Strip tillage followed by direct drilling can work for many crops, but uptake in Bangladesh is still sub-optimal and quality exposure of SPs and farmers merits attention.
10. We recommend that CSISA staff encourage the herbicide industry to run appropriate trials and seek government clearances, as required, in order to meet weed control needs associated with innovations in direct seeding technologies.
11. We endorse CSISA-BD's plans to carry out comprehensive adoption research in 2015 to determine the sustainability of the early acceptance of technologies tested and demonstrated over the past four cropping years.

ANNEX E: CSISA COUNTRY SYNTHESIS FOR INDIA

Research

RESULTS AND VALIDITY. CSISA's work correctly and wisely builds on the research from the earlier Rice and Wheat Consortia Program and on relevant research and developments from national partners, even those loosely linked to CSISA (e.g., those outside the CSISA districts). The quality of the research focus, design, implementation, analysis and communication is high.

PROCESS RESEARCH. Research is focused on cropping systems to identify innovations that will solve problems such as weed invasion whose resolution will enhance productivity and augment household income. Capturing benefits from increasing cropping intensification is emphasized via changes in crop timing, relay cropping and intercropping that are often enabled by planting with zero tillage. The introduction of zero tillage reduces the time required for land preparation and, if coupled to short-duration hybrid rice varieties, permits three crops per year. Hence, minimizing the time between harvest of the first crop and planting of the second through reduced tillage opens up many opportunities for intensive cropping of products that include hybrid rice, wheat/mustard, lentil; or hybrid maize/potato, wheat/mustard, and mung bean.

Laser land leveling optimizes plant stand establishment by ensuring more uniform depth of planting, but even more importantly, it results in substantial savings of water for crops under irrigation. Savings in pumping costs can extend up to 5 years, especially when laser land leveling is followed by minimal tillage practices. To date, most of the process research has focused on main cropping systems in existence. There is ample scope to include other crops such as potato and pigeon pea more effectively in these cereal-based cropping systems. New crops, such as cassava or tropical sugar beets, would also have potential if the processing value-chains could be established.

The process research and development work associated with diversification emphasizes maize as a key crop to be considered both in the kharif and rabi seasons, depending on elevations and other factors because the feed sector is expanding exponentially in South Asia, the market for maize will be strong. Sothe focus on this crop has merit. In some cases, soybean as a rotation crop in maize lands could be promoted, but high seed vigor is a must for the success of tropical soybean. The poor longevity of soybean seed in the humid and sub-humid tropics must be addressed. This has been done in Madhya Pradesh in the last four decades, and India is the fifth largest producer of soybean globally. Soybean, like maize, will need marketing research on linkages to the farm gate. In humid and dry zones that have more marginal soils, cassava might be a new crop that merits research as feed and perhaps even as food, industrial starch and ethanol. Market linkages would have to be put in place for this crop to attain regional importance; exploratory research could point to its prospects for potential production in marginal lands in Odisha.

CROP SPECIFIC AGRONOMY RESEARCH. Fertilizer use efficiency, plant spacing, time of planting, weed control and other practices are being studied by stakeholder partners in the hub benchmark sites for rice, wheat and maize varieties that are under consideration for the major cropping systems of the agro-ecology. The work is substantial and well conducted both on station (observed in four locations) with adequate treatment replications and on farmers' fields (observed at about a dozen sites), where each farmer is one experimental block in a randomized block design trial. Results are thoroughly analyzed and shared with stakeholder partners. Most technical publications of this work reflect the multiple contributions provided by many partners who are researchers. These joint multi-authored publications also create a very positive working environment.

Breeding Research

LIVESTOCK RESEARCH. ILRI's work in CSISA was observed in four sites in India. ILRI's participation in CSISA is heavily oriented toward extension. Their guiding philosophy is summarized by the acronym KISS: keep t super simple. ILRI primarily demonstrates that use of choppers to cut up crop residues, mostly stems of rice, wheat and maize and haulms of legumes, enhances the biological food value of these feeds. This has been known for many years. ILRI has catalyzed additional local manufacturing of the choppers and raised awareness of this important management practice. ILRI has also formulated and disseminated the know-how to produce balanced rations of concentrate for dairy production that are superior to feeds commonly found in the market and promoted by dairy cooperative societies. ILRI has catalyzed extension work by a number of NGOs and dairy associations and has produced attractive extension materials on the merits of crop choppers and improved balanced concentrates for dairy feed.

In the current phase, ILRI does not have a full-time international scientist engaged in CSISA Phase II. For extension, the KISS principle seems appropriate, but ILRI's research output in the Initiative is negligible. The lack of research commitment is disappointing because, in the past, ILRI did participate actively in the Rice-Wheat Consortium. ILRI also has a research presence who fully understands the context and intricacies of livestock production in the Indo-Gangetic Plain, but that scientist is currently posted in another ILRI regional program. From the perspective of a cropping system, research on dairy production is important largely because the feeding of crossbred cows depends on the quantity and quality of crop residues. Dairy production is also the activity that most directly impacts gender-specific related outcomes in CSISA. There are several researchable areas that could be addressed. For starters, the village cooperative dairy societies have accumulated a wealth of data that could be analyzed to explain the variation in daily milk production and lactation duration in the CSISA hub. If a meaningful research commitment by ILRI is not made for Phase III, we recommend that further support for this work be reduced or transferred to NGO partners.

Policy and Socio-economics Research

In the 1990s and early 2000s, social scientists participated in Rice-Wheat Consortium, but socioeconomics research was not one of the strong suits of this system-wide initiative. Indeed, the 2003 review highlighted the need for strengthening this area. Between 2003 and 2010, the contribution of socioeconomics to the performance of the Rice-Wheat Consortium increased markedly as CIMMYT and ILRI economists carried out very sound, in-depth microeconomics research on the spread of zero tillage and on the role of livestock in household welfare.

This trend toward improvement has continued. One of the strengths of CSISA Phase II is the breadth and depth of its policy and socioeconomics research, which contributes directly to Objective 5 and supports the work in Objectives 1 through 4, especially Objective 1 at the level of the three hubs in eastern Uttar Pradesh, Bihar, and Odisha. For example, economics research on prospects for, constraints to, and outcomes in CSISA-related interventions in mechanization has confirmed conventional wisdom on the importance of awareness, but it has also generated several surprises, such as the potential for small- and medium-sized farm households to emerge as specialized service providers.

Research capacity in economics is supplied by IFPRI, CIMMYT, IRRI, and their national and international partners. In general, economists and other social scientists in CSISA in India feel that they are an integral part of the initiative, and they participate actively in interdisciplinary research in the biannual planning meetings that effectively use impact pathways to plan and prioritize research, extension and training activities.

Policy research figures explicitly in CSISA Phase II as Objective 5: Improved policies and institutions for inclusive agricultural growth. Policy work primarily is embodied in research and communication activities that strengthen the policy environment around the development and delivery of new technologies and practices relevant to CSISA and, secondarily, comprises convening activities that reinforce private investment in inputs and services that foster more robust partnerships among actors in the public and private sectors.

The output of IFPRI economists and their partners is impressive. In three principal research areas on inclusive agricultural growth; (2) appropriate-scale mechanization; and (3) rural finance and weather-index insurance . IFPRI economists have authored 20 open-access discussion papers and 9 journal articles from 2009 to 2015 with an annual investment of only about 1.5 full-time equivalent (FTE) scientists. CSISA has afforded IFPRI the opportunity to contract out some of this research, but almost all of the research has been conducted in-house with IFPRI-affiliated post-docs, senior staff, partners and students. Some of the policy studies address constraints and opportunities in Bangladesh and Nepal, but that work is not as visible within CSISA Phase II as the research undertaken in India.

Important empirical findings include:

- The uptake of hybrid rice is presently higher and more promising in east India than in Punjab, Haryana and Western Uttar Pradesh. Farmers are willing to pay premium prices for earlier-maturing hybrids with tolerance to abiotic stresses such as drought, heat and salinity.

- Participation in nationally mandated rural public works programs in India has increased the demand for labor-saving mechanization by 15 percent.
- The adoption of laser land leveling is constrained by its cost at the farm level. Per-hour cost has to decline to about Rs. 400/hour before coverage exceeds 20 percent of area;
- Varietal turnover in wheat in Haryana, a state of high production potential, is lower than expected. The area-weighted average age of varieties in farmers' fields is 12 years indicating a moderately slow velocity of turnover that has dampened returns to plant breeding in recent years.

The convening function of IFPRI in strengthening public-private partnerships does not appear to have been as integrated into CSISA as IFPRI research activities. Two events were held in 2014, but they do not seem to have generated specific examples of additional collaboration over and above what CSISA was already doing. Perhaps it is too early to assess the value of these events, but the decision to place less emphasis on IFPRI "brand" events seems like a step in the right direction for CSISA Phase III.

One way to enhance private-sector partnerships so as to contribute to household welfare in the rice-based cropping systems of the Indo-Gangetic Plain would be to invest in more comprehensive monitoring of private=sector research undertaken by the agricultural sector in India with national partners. In other words, the convening function of strengthening partnerships and identifying areas for improvement in the policy environment could be transformed into a research function. Funds would have to be secured from other sources to design and carry out a systematic and time-bound monitoring of private-sector research investments in agricultural research. Presumably, CSISA would not be the only beneficiary, as several IFPRI-related projects in South Asia would stand to benefit from a more rigorous monitoring of private-sector participation in agricultural research. With its emphasis on private-sector participation in service provision, CSISA would appear to be an appropriate locus for beginning such a database initiative.

IFPRI's agenda for CSISA Phase III is ambitious in terms of contextual behavioral research on technology adoption and on more aggregate technology-scenario analyses. An increase of 0.5 FTE Scientist is warranted. The planned inquiry on the time allocation of women replaced by the adoption of mechanical transplanters is an exciting research area where CSISA economists should enjoy a comparative advantage in shedding light on what could be one of the most important gender-related aspects of the CSISA Project.

In CSISA Phase III, IFPRI economists should be wary that the technologies in the planned scenario analyses are not too broadly defined and hypothetical to be of interest, importance and relevance to biological and physical scientists in CSISA.

Moreover, if such work were to have been carried out without CSISA, it would have been better to invest time and energy in more contextual targeting assessments that interest CSISA project managers and scientists in lieu of generalized ex-ante technology evaluations.

Because it is extremely difficult to document impact from policy research, the USAID Feed the Future indicators present a formidable challenge to economists who engage in policy research. Claims of influence should be taken with a large grain of salt. If policy change occurs, it most likely will only be detected several years after CSISA has been completed, when attribution of influence will be fuzzy. However, CSISA economists are in the enviable position that results from CSISA having already had a transparent influence on policy.

CSISA's overwhelming and mutually reinforcing on-station and on-farm findings have induced the State Government of Bihar to change its recommendation for wheat planting from after November 15 to before November 15. A planting-date recommendation may not sound like an important policy, but its change paves the way for a more concentrated assault on the traditional practice of late planting with shorter-duration season varieties that are characterized by lower yield potential. The November 15 planting-date recommendation may also be the precursor of other dynamics in recommendations in other states where CSISA research results could play a role in reversing entrenched beliefs about improved practice. CSISA's emerging results that refute the supposed economic superiority of Seeded Rice SRI in Bihar is another example where the CSISA findings could pay dividends in terms of policy change. The change in planting date by state governments in India is a prime candidate for impact assessment by economists in CSISA.

The productivity of CIMMYT and IRRI economists in the support of Objective 1 is equally impressive. Past and on-going diagnostic research, economic analysis of technology options based on partial budgets, and adoption research on early technology acceptance has been and still seems to be solid. In 2013 and 2014, 10 studies have been carried out in the CSISA hubs, mainly in Bihar and Odisha. In particular, the zero tillage adoption and service provider inquiries in Bihar have been very informative. The increase in net benefit with the adoption of zero tillage in the rice-wheat cropping system in central and east India is almost identical to the level found in northwest India in 2005: $US 100 per hectare.

The data collected in these surveys could have been more exhaustively analyzed, which might have clarifi some uncertain data. For example, the evaluation team received mixed messages on the importance of sharecropping in Bihar and in eastern Uttar Pradesh. A higher incidence of sharecropping will be a deterrent to the adoption of more capital-intensive technologies such as laser land leveling unless landowners are willing to fund at least 50 percent of the cost. A "quick-and-clean" analysis of the land rental market is equally important: Are those who lease in land small and marginal farmers or larger farmers who are interested in expanding their cultivated area?

Fragmentation is another dimension of the land market that was frequently cited as an obstacle to adoption of improved components in the rice-based cropping systems of central and east India. At inheritance, fields are often equally subdivided among sons, which results in smaller, equally scattered plots with each successive generation. Land fragmentation is often regarded as an immovable constraint, especially in East India, but how malleable is land fragmentation and what is its cost for technology intervention in CSISA are questions that innovative research could address.

CSISA social scientists should also be alert to the possibility of using available datasets to enrich their characterization research in support of Objective 1. For instance, the project on Village Dynamics in South Asia (VDSA), which is also funded by the Bill & Melinda Gates Foundation, has invested in longitudinal village studies in Bihar, Odisha and Bangladesh since 2009. That project has also compiled meso-level data at the district level in India and Bangladesh. Although only a few of the VDSA villages may be found in the districts where CSISA is active, those locations (with a resident investigator) could provide an important touchstone for responding to highly focused diagnostic questions in the remaining months of CSISA Phase II and in CSISA Phase III.

Reviews of the Rice-Wheat Consortium and CSISA have emphasized the need for investing in baseline data collection and priority setting. CSISA invested in baseline data during Phase I in 2011–12 (Pede et al., 2012). The baseline had some positives. Social scientists from IRRI and IFPRI contributed to its design and execution. The dataset from the baseline questionnaire is well documented and is available on the Internet.

The baseline also had some negatives. Some responses about specific technologies were not that informative. Household income was not quantified. Responses for the Punjab were not reported. The authors concluded that the baseline data could not be used as a reference point for rigorous impact assessment.

The baseline also demonstrates why rigorous baseline data collection and formal priority setting are risky activities in the conditions under which CSISA is operating. Data were collected on 2,628 households in a total of eight hubs in Bangladesh, India, and Nepal. By Phase III of the Initiative, CSISA will only be active in three of these hubs. It is very unlikely that the data from the baseline contributed to decision-making on which hubs to de-emphasize or divest of. Indeed, the baseline's only recommendation on the geographic allocation of resources across the hub never came to fruition: because of a higher estimated incidence of poor households in the baseline survey, the Central Terai Hub in Nepal should be considered for more emphasis within CSISA. Within 1 year of making this recommendation, the emphasis in Nepal was moved to the West and Far West Divisions to comply with USAID's district prioritization in Feed the Future as the Central Terai Hub was abandoned. Under these conditions of donor instability, recommendations for rigorous baselines and formal priority-setting exercises should not be heeded.

Cross-Cutting Themes

MECHANIZATION. CSISA has made very good progress on the adaptation, dissemination and uptake of several innovations that reduce the amount of labor and increase the productivity of rice-based cropping systems. In Bihar and eastern Uttar Pradesh, CSISA-trained service providers, who are now relatively skilled, are small private-sector suppliers of mechanization services that include laser land leveling; direct-seeded rice, wheat, maize, legumes, mustard, sesame and other field crops using new reduced tillage seeders with appropriate weed control; and mechanical transplanting of rice including the preparation of seed mats for this process, mechanical reaping, and the use of axial flow pumps for water management.

The evaluation team interviewed about 20 groups, ranging from 5 to 15 individuals. The interview results suggested:

Service providers were animated and encouraged by their business prospects.

Most of the providers contracted out for custom-hiring zero tillage seed drills. Laser land levelers and mechanical rice transplanters were also popular as were reapers, but most service providers had invested in only one machine. Many expressed an interest in purchasing machines of a different type to expand their business. Demand for paddy threshers that CSISA works on and potato planters that CSISA does not work on was strong in the hubs of central India;

Providing services was a "learning by doing" exercise. Typically, area coverage in the first year was small at 30–50 acres; by the third and fourth year, some providers were "servicing" 300–500 acres.

Zero tillage seed drills with fertilizer application were very well adapted; they did not seem to present any notable or systematic difficulties in establishing stands with good plant populations. Laser land levelers required 50 hp tractors or above. Mechanical transplanters occasionally required gap filling by hand. Spare parts were mentioned as a problem when the issue was brought up, but the discussion suggested that it was an insurmountable problem for only a small minority of service providers.

The perceived life of most of the machines was 5tion were very well adapted; they did not seem to present any difficulties in establishing stands with good plant populations. Almost all farmers said that they would be willing to replace their machine without a subsidy when its useful life ended. They also said that they would be happy to accept the subsidy if it were available again.

Although many went outside their respective villages to procure work, none of the farmers perceived that the density of machines had reached a saturation point in their areas of operation.

The entrepreneurs who sell equipment—some produced in India, mainly in the Punjab, and others imported from China and Vietnam—also provide critical training and support to their distributors who transfer their knowledge to the service providers. CSISA has done an exceptional job in India in facilitating this part of the "strategic alliance" of stakeholders. In India, private-sector service providers are well established and appreciated in Punjab state, which provides a model for what can be done. Continued work on mechanization research and especially capacity building of service providers needs to be emphasized for Phase III, especially in Odisha.

GENDER. The evaluation team saw considerable evidence that the gender component of CSISA Phase II was as strong and dynamic as the gender team engaged in CSISA's gender program. At extended visits with two women's groups, one in Bihar and the other in Odisha, the evaluation team was able to have energetic discussions with 300+ women farmers. In Rajapur Dihuli, Bihar, for example, the team met with a large group of women who are part of a government-supported program known as Mahilya Samakhya. CSISA has had direct intervention in this program through its focus on women farmers under the name of Kisan Sakhi. The focus of the program is on four areas: (1) support the identity of the women as farmers, (2) provide women access to knowledge and technology about farming, for which principal support comes through CSISA, (3) support leadership of women in their communities, and (4) support economic empowerment of the women, also a role that CSISA is supporting. The evaluation team had rotating interviews with these women farmers in small groups of 7–10. The women interviewed:

- Belonged to small and marginal farming households. Many of them leased in small amounts of land in addition to their own land that they farmed with their husbands. Many were milking 1–2 crossbred cows;
- Noted that CSISA had not only given them lectures about the new technology, but allowed them to actually use it. Some had started a small business making mats of transplantable rice seedling for mechanical rice transplanters. Although all women transplanted rice, we encountered only one case where a woman felt threatened that she could be displaced by mechanical transplanting;
- Cited several benefits from CSISA including access to new varieties and having a better understanding on how much fertilizer to use. Before CSISA, they claimed they were at the mercy of local shop dealers and had to take what was given to them. Now, they know about the rice varieties and the fertilizer they should be using and can demand what they need;
- were interested in new crops such as maize that could provide fodder and straw for their animals and income for their families;

- Welcomed innovations such as zero-tillage seed drills that were perceived as reducing their labor demand on the farm so that they could allocate more time to more household activities and informal enterprises. The vast majority of women felt that they did not have to work as hard as their mothers and said that was a good thing.

The results of the group interviews were broadly supported by the responses to the online survey questionnaire in India. Two-thirds of the 35 respondents who expressed an opinion agreed or strongly agreed "that women will benefit as much as men from the technologies transferred by CSISA." Eight of the respondents disagreed with this statement. There are technologies that would seem to be prejudicial to women's welfare, but these are not being researched or extended by CSISA. For example, cereals harvested by large self-propelled combine harvesters are characterized by inferior straw quality compared to residues that result from hand harvesting. Inferior residue quality translates into less nutrient digestibility and availability for dairy cattle and buffaloes.

AGRICULTURAL WATER MANAGEMENT. Nearly all the innovations under promotion are enabled or constrained by water availability and quality at the right price. Good quality research on water use is being realized, but if this project (or a new project) is undertaken to substantially reduce the incidence of rabi fallows, a greater emphasis on water management and hydrology needs to be brought to bear to effectively address this challenge. Increasing salinity with global climatic change also argues for a greater priority attached to water management and hydrology. Possibly, International Water Management Institute or an advanced research institute might be brought on-board in Phase III to empower this important and critical work.

NUTRITION. In discussion with CSISA staff, the question of the project's direct impact on human nutrition other than increasing the availability of basic grains and some vegetables was considered more in the domain of HarvestPlus, another global project in South Asia. However, the HarvestPlus high-density zinc and iron materials in both rice and wheat are fully integrated with the lines that are being selected, tested and disseminated in Objectives 3 and 4. Therefore, these nutrient-dense improved varieties should be available for adoption in the CSISA hubs once they are released nationally. Their adoptability is yet unknown and may depend on minimizing negative trade-offs in traits that farmers desire.

Although CSISA is designed to increase production to reduce poverty and food insecurity, the linkages between human nutrition and CSISA outcomes in production and cost-savings are not direct or transparent. The Evaluation team believes that rigorous quantification of the production and cost-savings outcomes is necessary before the impacts on poverty and food insecurity can be evaluated. Hence, quantification of outcomes and not impacts should still be the priority in Phase III.

CLIMATE CHANGE ADAPTATION AND MITIGATION. Agronomic practices that are used in the CSISA project, emphasizing reductions in tillage, contribute to adaptation to both drought and to erosive rainfall excesses. The additional organic matter in the soil, derived from zero tillage, improves carbon sequestration thereby reducing CO2 in the atmosphere. Crop feed with higher digestibility reduces methane associated with livestock flatulence.

Improved rice and wheat varieties, the outputs of CSISA's Objectives 3 and 4, are selected for resistance and tolerance to abiotic stresses, such as drought, heat and salinity. Climatic change increases the incidence of these abiotic stresses. Tolerant/resistant varieties are more robust and stable-yielding; they reduce farmers' vulnerability to the adverse and increasingly frequent events from climate change.

Although CSISA is an adaptive research cum extension initiative that focuses on the short- to medium-term, it continues to invest in strategic research in longer-term field trials. These uniform trials have four cropping-systems treatments plus a control and are carried out across four locations in India's Indo-Gangetic Plain. They are conducted with three replications in very large plots in agricultural research stations at Haryana Agricultural University, PUSA-IARI in Bihar, BISA in Bihar and in Punjab, and in the State Agricultural University in Odisha. The trial results over the past 5 years are interesting, important and relevant for CSISA. For a small amount of money, CSISA has been able to monitor technological performance in response to temperature, rainfall and salinity. The results of these long-term experiments generate valuable information on the sustainability of cropping systems encompassing more than 10 million hectares in India. Sustainability hinges on how those systems react to increasing trends in the incidence of abiotic stress caused by global warming. Given the potential value of this information, the excellent statistical quality of the existing estimates, and the smallish sums of money involved, the research team recommends that this strategic research continue in Phase III.

Catalyzing Change

CSISA can influence agricultural development in India in multiple ways. Technological change is the first dynamic that comes to mind when one thinks of a cropping systems initiative like CSISA. The empirical evidence cited earlier in this country annex and the numbers in the Feed the Future Indicators point to an impressive track record of early adoption for an R&D initiative that began only 6 years ago. Technological success was not preordained in accelerating productivity in the rice-wheat cropping system, but it was expected. CSISA effectively drew on 20 years of applied research in the Rice-Wheat Consortium.

CSISA has also influenced policy change in its short life span. CSISA's findings on the benefits to early wheat planting have led to revised thinking in the form of changed cropping recommendations in the State Department of Agriculture in Bihar. The prospects are bright that CSISA's work will also result in further changes in related recommendations in Bihar and in Uttar Pradesh. Changing a planting-date recommendation may sound trivial, but those who have spent their lives working in agricultural R&D in India realize that it is a big deal.

Other potential paths for change can be identified by responding to the following query: What makes CSISA unique? The evaluation team believes that the following five elements contribute to CSISA's distinctiveness in R&D in India:

- The concept of the hub
- The emphasis on service providers
- The mix of public-private partnerships
- A cropping systems perspective
- The validation of prospective technologies in on-farm trials in a participatory setting

Each of these elements can be a vehicle for transformative change. Although the hubs in India maintain a small physical office, they are best thought of as virtual venues for leveraging increased productivity in complex systems that do not rely on silver bullets for their transformation. The hub is a place where multiple partners come together to seek solutions to well-defined problems identified in farmers' fields or in consumers' markets. Problems are not defined on research stations where scientists are posted. Hub scientists have the resources and the freedom to address problems wherever they feel constraints can be most effectively tackled and opportunities most appropriately exploited.

It is too early to tell whether or not the concept of a hub will endure in agricultural R&D in India. In Phase III, a brief, focused study on the fate of the Phase I hubs in Haryana, Punjab, and Tamil Nadu could consolidate evidence on the hub experience and point to paths for incorporation into more formal R&D systems in India.

The online survey results show that CSISA staff and partners in India are deeply committed to the Hub Concept and are optimistic that it and/or its activities will survive CSISA. When asked about the biggest advantage of the CSISA Project, 44 percent of 34 respondents cited "its multiplicity of partners who can discover technology nationally and internationally for regional adaptation and local transfer"; 38 percent selected "its solid research-extension linkages and innovative methods to test technology," and the remaining 18 percent stated that "its abundant resources to carry out field days, demonstrations, and farmer training" was CSISA's biggest advantage. Twenty-eight of the thirty-four respondents were sanguine about the continuation of CSISA's work when the initiative ends. They believed that the prospects were bright for sustaining CSISA's work from other resources by other institutions.

Of the characteristics that describe CSISA's uniqueness, the emphasis on encouraging service provision and training service providers is likely to be the one that is institutionally most sustainable. In rice-wheat and rice-maize cropping systems on the Indo-Gangetic Plains, small-scale mechanization opportunities are available in all 12 months of the calendar year (Table 2). In central and east India, few if any of these opportunities have been fully exploited by the private sector.

TABLE 1. Opportunities for service providers in eastern India associated with the rice/wheat production system.

Months	Business Activities for earning more profit margins
January	Paddy Thresher & Herbicide Spray (Wheat) & Rice Hauler
February	Paddy Thresher & Multi crop planter (Maize) & Rice Hauler
March	Zero-tillage (Green Gram) & Multi crop planter (Maize) & Rice Hauler
April	Wheat Thresher & Laser Land Leveller
May	Laser Land Leveller, Zero-tillage Machine (DSR), Mat-type Nursery & Sale of Rice Seed
June	Zero-tillage Machine (DSR), Mat-type Nursery, Laser Land Leveller, Rice Trans-planter, Bed Planting Maize, Sale of Rice Seed & Sale of Herbicide
July	Rice Trans-planter, Bed Planting Maize, Herbicide Spray (Paddy & Maize) & Sale of Herbicide
August	Rice Trans-planter, Herbicide Sale & Spray (Paddy & Maize)
September	Pesticide Sale & Spray (Paddy & Maize)
October	Zero-tillage (Mustard), Laser Land Leveller & Sale of Wheat Seed
November	Zero-tillage (Wheat & Mustard), Multi crop planter, Bed Planting (Maize). Herbicide Sale & Spray (Wheat), Paddy Thresher & Sale of Wheat Seed
December	Zero-tillage (Wheat), Paddy Thresher, & Herbicide Sale & Spray (Wheat & Maize)

Courtesy of R. K Malik, 2015

CSISA's commitment to service providers is unprecedented in terms of agricultural R&D projects. Its style of training is also innovative and seems to be highly effective. CSISA has emphasized hands-on training administered by lower level but highly competent field technicians. This style of training complements conventional instruction in the KVKs that feature more classroom learning by less specialized but more highly educated scientists. Engaging in a large-scale project that seeks to transfer CSISA's widely adaptable and highly validated rice-wheat and rice-maize technologies when Phase III ends could make significant progress in institutionalizing CSISA's emphasis on and approach to training service providers in both the KVKs and the State Departments of Agriculture.

CSISA also represents an important step in increasing the private-sector's participation in agricultural research and extension in India. The survey results confirm the importance of private sector participation in the minds of CSISA staff and partners. Twenty-seven of 34 respondents agreed that "the private sector can effectively participate in the transfer in most of the technologies recommended by the CSISA Project." No one disagreed with this statement.

Although CSISA has played an important role in forging more than 100 private-sector partnerships in India, it will be difficult to attribute CSISA's activities to greater private sector involvement in agricultural R&D in India in a generalized setting without concrete examples on how CSISA's work changed the behavior of government institutions, regulatory frameworks and ways of doing business. Respondents in the survey could list examples of specific technologies (of interest to CSISA) that elicited responses from the private sector, but they could not cite examples of behavioral change of public-sector institutions that resulted in more penetration by the private sector into agricultural R&D in India. In spite of the difficulties in quantifying the Initiative's attribution, the Evaluation team believes that CSISA has been a catalyst for change in opening up agricultural development to greater and more effective private-sector participation.

Adaptive on-farm research with a cropping systems perspective that features farmer participation is not new to India; however, it is not widely practiced in India's formal R&D systems. Transforming India's top-down approach to adaptive research, technology validation and extension is a daunting task that is outside the main objectives in CSISA's mandate on increasing production to reduce rural poverty and food insecurity.

CSISA's approach to technology validation and to extension is effective. It features on-farm trials and tests on large plots and fields that can also serve as extension demonstrations. Survey results strongly suggest that the large majority (more than 90 percent) of CSISA staff and partners believe that CSISA's approach to technology validation, participatory research and extension is innovative and that a lot of effort is expended on testing technology in farmers' fields.

Participatory varietal selection (PVS) in India is constrained by the requirement that only registered and released varieties can be sown on farmer's fields. With more than 1,000 rice and wheat varieties released in each crop, this regulation may not pose a binding constraint to PVS. However, it does entail an opportunity cost in not being able to incorporate farmers' input into the selection and more expedient release of advanced lines.

CSISA's way of validating technology does represent a paradigm shift to business as usual in India, but it is unlikely to result in a transformative change in how Indian governmental institutions go about technology validation and extension. Influence is more likely to be felt in the local and international NGO communities that partner with CSISA. In the future, they are likely to emulate the good practices that CSISA is inculcating in its day-to-day partnership activities. CSISA is also in a position to capitalize on the best practices demonstrated by its NGO colleagues.

Management

Overall Vision

The shared vision of goals across staff and stakeholders is clear and provides a sense of pride that Cereal Systems Initiative for South Asia (CSISA) is important and is greater than the sum of its parts through clear synergies of technologies and through tight collaboration in and across the partnerships. In eastern Uttar Pradesh and Bihar, innovations, such as early sowing of wheat, zero tillage planting, laser land leveling, hybrid maize and hybrid rice are all being rapidly adopted by farmers exposed to these innovations. Close collaboration with national research and development (R&D) partners, service providers, agriculture input companies and nongovernmental organizations (NGOs) enhances farmers' awareness of the advantages of CSISA-related technologies en route to sustained adoption. CSISA's management has correctly recognized the priority of diagnostic research to unlock the potential for increased cropping intensity in the millions of hectares fallowed in the rabi season following the rainy season rice crop in Odisha. Finding the levers that need to be pulled and the focal points that require pushing is a necessary first step in making double cropping a reality in this extensive area of high production potential in Coastal Odisha.

A shared vision and a consensus on the most promising technologies are transparent in the survey responses in the two hubs where rice-wheat is the prevailing cropping system. Slow growth in rice and wheat and the lack of crops that can either replace or complement rice and wheat accounted for 75 percent of the responses to a question on the most important agricultural problem confronting farm households in the hub (n=34). Only 25 percent of CSISA staff and partners responded that soil and environmental degradation and the excessive use of water for irrigation represented the most important agricultural problem.

Early sowing of wheat, zero tillage (ZT) and machine transplanting of rice easily topped a list of 16 CSISA-related interventions with potential for impact in Bihar and eastern Uttar Pradesh. Laser land leveling, direct-seeded rice (DSR) and full season, recently released wheat varieties composed a second group with high expectations for impact. Presently, the returns to farmers from the adoption of early sowing of wheat before November 15, ZT seed drills and long-duration wheat varieties in eastern Uttar Pradesh and Bihar is sufficient to cover all the costs of CSISA through Phase III, which ends in September 2018.

In Odisha, perceptions on technologies that were judged to be the most promising for impact were not nearly as sharp and clear as they were in Bihar and eastern Uttar Pradesh. This fuzziness in perception was expected because Odisha is not nearly as advanced in technological development as the hub where the dominant rice-wheat cropping system is common and where research had been conducted for 20 years prior to the implementation of CSISA. Rice nursery management, mechanical transplanting, DSR, improved rice varieties, site-specific nutrient management, laser land leveling, improved machine threshing, and mechanical seed drills to facilitate higher cropping intensities all garnered some support as the most likely candidates for impact.

COMMUNICATION. CSISA Phase II scores high marks for its extensive internal and external programmatic communication and information sharing. In CISA Phase II (2013–2015), communication has taken place in a number of forms that include annual reports (2), research notes (6), research publications (22) and technical publications (6). The most important communication activities of the CSISA-India program have centered on the dissemination of information on new technologies and practices to its stakeholders. The evaluation team heard positive comments about CSISA's communication activities from a range of stakeholders including service providers, NGO officials and staff, KVK officials and staff, State Department of Agriculture officials, and farmer and women's organizations. CSISA was seen by many as the principal source of information on new technology in mechanization and on increasing the production of rice, wheat and other crops. These stakeholders view CSISA as the source of information not only on new technologies but also on the application and use of that technology. In several cases, CSISA personnel were cited as providing links to sources of spare parts, equipment maintenance and even guidance on how to gain access to government officials. In addition to having an active outreach and communication effort in support of its technical support to its stakeholders (including an innovative video-based effort with Digital Green, OUAT and the Government of Odisha), CSISA uses impact pathways (see below) as a management and communication tool to pull together the various partners on specific interventions to understand the roles and responsibilities of each partner and the timing of various activities related to the intervention. Finally, communication efforts of the CSISA project benefit from the reputation and respect of the initiative's senior staff member (Dr. Malik) among CSISA's stakeholder partners.

ORGANIZATIONAL STRUCTURE. The initiative has a core management that cuts across activities in two countries (India, Nepal) and multiple hub as well as sub-projects in each country. In Phase II, CSISA management, led by Andrew McDonald and Cynthia Mathys, has been highly skilled and motivated. Management has created an affirmative, progressive culture among not only project staff but also the diverse partners with whom people empower others and share responsibilities, credit, tasks and ownership. Effective leadership is especially evident in India at the state and community levels. In this leadership's interactions with staff, partners and stakeholders, it reflects true care about realizing CSISA's goals and about the people it works with and those it serves.

Planning based on impact pathways is the project's logical framework. It includes activities leading to outcomes delineated by where, when, how, and whom. The commitment to impact pathways as a planning tool diminishes transaction costs in arriving at budgetary allocations that everyone can buy into. Impact pathways provide a clear programmatic foundation that is negotiated and agreed on in broad planning meetings for project work at the hub level and on process-based agronomic research. Equally important in CSISA's organizational structure are its extensive links to national research and extension partners, including national and international universities, which enable many graduate students to participate in and contribute to understanding biological, economic and geo-physical parameters relevant to strategic objectives 1 (hub activities) and 2 (agronomic process R&D).

COLLABORATIONS. The International Maize and Wheat Improvement Center (CIMMYT) and the International Rice Research Institute (IRRI) work closely together in a number of areas at the various hubs. In the impact pathways (the basic work planning document of the CSISA-India project), neither the International Livestock Research Institute's (ILRI's) nor the International Food Policy Resource Institute's (IFPRI's) activities are included. The evaluation team viewed several ILRI activities, but these were all located by necessity in areas with already established dairy cooperatives and were in a different location than local cereal-based work of CIMMYT/IRRI. IFPRI's activities follow a more independent path than the CIMMYT-IRRI activities; however, IFPRI staff participate actively in the biannual planning meetings and carry out some work jointly with other CSISA scientists.

In terms of collaboration with local stakeholders, CSISA-India has done very well in making these linkages. Listed key collaborators for Objective 1, for example, shows 23 for Bihar and 7 each in eastern Uttar Pradesh and Odisha. The project lists 17 additional collaborators in Bihar, 12 in eastern Uttar Pradesh and 27 in Odisha. In the evaluation team's site visits throughout India, the sense of ownership and collaboration among the project stakeholders was strong.

The survey results confirm the impressions of the Evaluation team on the high degree of partnership articulation in CSISA. Thirty-one of 34 survey respondents felt that all partners in their hub both contribute to and benefit from CSISA. Project lists 17 respondents agreed with the statement, "Government research and extension agencies are well-represented and participate actively."

MONITORING AND EVALUATION SYSTEMS/PERFORMANCE MANAGEMENT. At the start of the initiative, one of the weakest elements was its monitoring & evaluation (M&E) system. Both USAID/India and the staff of CSISA Phase II have put in a significant effort to upgrade and improve the program's M&E and performance management systems. Additional staff have been hired, an M&E handbook has been developed and integrated into the M&E system of the program and several data quality assessments (DQAs) have been carried out. USAID/India staff have engaged in DQA spot checks as have CSISA staff. The results of the DQAs have been positive. In addition, CSISA has invested in adoption of interventions, such as ZT and DSR, and related impact studies that are described later in this section. These studies are a source of triangulation on the quality of the project's M&E reporting. In group discussions with service providers in four locations in Bihar and eastern Uttar Pradesh, the evaluation team observed all of the service providers proudly displaying their respective service journals, which they had received from CSISA. Each had filled out his or her own journal detailing work they had provided to farmers in terms of equipment used, date of work, time of effort, hectares worked on and costs to the farmer. Not only is this detailed information used by the service providers to understand the profitability of their business, but it is also communicated to the project's M&E staff for reporting on the appropriate Feed the Future indicator.

Program Future

A Notable Technology and a Formidable Constraint

CSISA is in the enviable position that it has validated improved cropping systems technology that is widely adaptable in central and east India. Most of CSISA's technological options are not new in themselves but, like technical interventions deployed in conservation agriculture in the Americas and Australia, they are refined and adapted to a specific farm context. In the Indo-Gangetic Plain, the on-farm context is extensive and covers more than 13 million hectares in the rice-wheat cropping system.

The key component that underpins CSISA's core technology is amazingly simple: the recognition that wheat needs to be sown by November 15 in hub zones of central and eastern India so that the crop escapes the drastic "terminal" heat during the early grain-filling period in March. To consistently realize this earlier sowing, it is essential that the rainy-season rice crop is harvested and removed from the field early. A mechanical reaper, being promoted by CSISA to be used by local service providers, helps speed up the rice harvest, but short-duration, high-yielding rice varieties are vital to the early sowing of wheat. Once the rice (and part of its straw residue) is removed from the field, direct drilling of wheat is possible on residual soil moisture, often followed by one to three irrigations during the growing season. Again, the 'direct drilling' innovation is part of the CSISA agronomic package. Wheat varieties that are less sensitive to "terminal heat stress" are being identified as part of Strategic Objective 4 of CSISA 2, and they also play a role in realizing a successful rabi crop.

1. The rapid harvest of kharif rice also permits diversification from the rabi wheat. Already many farmers broadcast mustard seed (used as an important source of vegetable oil) into rainy season rice, sometime mixed with lentils or other short-season food legumes. Depending on market linkages and access to supplemental irrigation, maize can also follow the rainy-season rice. More upland conditions favor the planting of maize in the post-rainy season.
2. Scaling up the improved rice-wheat cropping system in central and east India in a larger technology transfer project
3. Eventually, shorter duration rice varieties, the use of Zero Tillage seed drills, and full-season wheat varieties will make their way into the rice-wheat systems throughout Eastern Uttar Pradesh and Bihar, but their incorporation is knowledge intensive and is going to take time. In order to speed up the diffusion of the new rice-wheat system, CSISA management should consider the design of a multilateral technology transfer project in Phase III. This project would be a spin-off of CSISA's Phase I and Phase II work and would be targeted at extending the "early" rice-wheat system to the districts in Bihar and eastern Uttar Pradesh (and perhaps even Jharkhand) where CSISA has not worked. Such a project would require a much more extensive area approach than CSISA's work in Phases I–III. Unlike CSISA, it should have a fixed term of 3–4 years where achieving an area target in one district would mean that extension resources would be transferred to other districts in the program that were still lagging behind in adoption.

4. The extensive approach needed for the proposed technology transfer project is not suitable for the adaptive research and technology validation that CSISA is charged with. Therefore, ideally, a CSISA Phase 4 project could co-exist with the proposed time-bound extension initiative. Increasing cropping intensity in the "early" rice-wheat system should loom large as a research priority in any further adaptive research/technology validation initiative. Research on incorporating maize and other crops in rice-based cropping systems would also figure as an on-going priority in Eastern Uttar Pradesh and Bihar.

Research priorities for the future

In Odisha, diagnostic research on rabi fallows, approaching 5 million hectares, should remain a priority through CSISA Phase III. Findings in Odisha could also be relevant to Jharkhand and Chattisgarh, which have a total of about 5.5 million hectares of fallowed land after kharif rice season.

The major opportunity for CSISA is in coastal Odisha (e.g., Badrak, Balasore) where water resources are relatively rich. In this area, intensified full-season cropping (e.g., maize) is possible with groundwater-based irrigation. CSISA is in the process of acquiring groundwater-monitoring data from the state authorities in Odisha, which will help further refine technical entry points in the coastal area. Where irrigation development is not possible (or not perceived as advantageous), e.g., the plateau region of Odisha, cropping system design (e.g., a transition to shorter duration kharif crops) coupled with efficient harvesting and zero tillage holds good scope for making the best of residual soil moisture with oilseed and pulse crops. CSISA's mung bean trials in this agro-ecology look promising.

The set of determinants of rabi fallowing is very large, and the breadth of possibilities underscores the importance of solid diagnostic research. Based on the online survey, the CSISA staff in the Odisha hub perceive that the lack of location-specific irrigation resources and ineffective irrigation policy are the primary determinants of rabi fallowing. As recommended earlier in this annex, CSISA needs to ensure that they have the critical mass to quantify irrigation considerations that potentially condition rabi fallowing.

In spite of the apparent primacy of water-related constraints, there are many technical and non-technical areas that need to be assessed in order to facilitate cropping in the rabi-fallowed areas. Open-access for livestock following the harvest of the rainy season crop, output markets and seasonal labor availability opportunity costs need to be considered in tandem with water resources development, mechanization varietal choice plus cropping systems design, and zero tillage. Leading with 'packages' can demonstrate the production potential in these areas, but just as importantly will be efforts to identify 'precursor' enabling factors that must first be in place to give farmers confidence to invest. CSISA plans on using game-based approaches and choice experiments to more clearly quantify first entry points/enabling factors that may catalyze rabi cropping. This work merits expanded emphasis.

In Phase III, CSISA scientists may want to expand the crops they are researching to diversify the rice-wheat cropping system. Blocks of pigeonpea (Cajanus cajan L.) are grown extensively in the rainy season in northern India. Pigeonpea is a popular dhal in S. Asian diets and has a strong market. These patches of pigeonpea were also ubiquitous in the Terai ecology of West and far West Nepal. Because pigeonpea is deep-rooted and an excellent nutrient cycling crop there may be merit in exploring wider use of pigeonpea in relay cropping, for example in maize systems, where the crop would mature after the principal crop (maize) has been harvested.

Potato is also a common short-duration crop, is one of the lowest priced vegetables on the Indo-Gangetic Plain, and is characterized by a strong demand. During our visit, we saw CSISA trials where maize/potato intercrops were attractive both from agronomic and market perspectives. Potato does not score high marks on water use efficiency, but it is highly responsive to management and will substitute for wheat in compact, well-defined pockets of the Indo-Gangetic Plain.

While there are currently no crop transformation capabilities for cassava or soybean in eastern India, these crops are important in other parts of the country. In Bihar and eastern UP where maize is making inroads primarily as a feed crop for the expanding poultry and dairy sectors, soybean would be a logical rotation crop following maize. In Odisha on rabi fallows, cassava could be chipped and dried for livestock feed or for industrial starch or ethanol production. Cassava is one of the most versatile root crops in terms of end uses. Because the crop is tolerant to both water-logging and to drought, it could be well-adapted to rabi fallows. Cassava requires minimal external inputs for around 10 t/ha carbohydrate production; if well managed, however, cassava yields often exceed 20 t/ha.

Recommendations

- *It is recommended* that a major effort (perhaps another well-funded project as part of the CSISA platform) is placed on strategic research to address the opportunities to reduce land area under rabi fallow, especially in Odisha state.
- If no meaningful *research* activities are proposed by ILRI for CSISA Phase III, *we recommend* that further support for this work be stopped and left to the NGO partners through small support grants. This recommendation holds for ILRI's inputs in all three countries of CSISA II.
- If this project (or a new project) is created to increase emphasis on the issue of excessive rabi fallows, *an analysis is recommended* of the professional hydrology staff needed. More hydrology staff may also be required to address more widely the problems of salinity. Possibly IFPRI or other technical institutions might be brought on-board in CSISA Phase III to empower this important and critical work.
- For the states of Bihar and eastern Uttar Pradesh where there is strong adoption in the few focal hub of the innovation package (see Sustainability and Scalability section above), investment projects should be elaborated in CSISA Phase III by the states with support from the project and other partners toward a major scaling-up of farmer/stakeholder adoption across all relevant districts in the state(s). For these situations it seems appropriate, and *therefore recommended*, to move from incremental adoption to a more concerted and broader process of farmer and stakeholder engagements for adoption of better practices, with continued and expanded buy-in by the state governments, enabling a greater institutionalization of the adoption process.
- In this context, it is *also recommended* that Dr. Malik, the highly respected and well know agronomist currently working in CSISA, play an ambassadorial role with Bihar and UP state planners and policy makers to raise awareness on needs and opportunities for scaling up better practices of the rice/wheat production systems in these states.
- Continued work on mechanization research and especially capacity building of service providers needs to be emphasized for Odisha in CSISA Phase III
- Preliminary trials on alternative rotation and relay crops such as pigeon pea (in all three states), soybean (with maize in Bihar and UP), and cassava (in Odisha) should be conducted and then for where the biology of production is favorable, CSISA could organize a workshop for entrepreneurs and policy makers to create awareness.

ANNEX F: CSISA COUNTRY SYNTHESIS FOR NEPAL

Introduction

The Cereals Systems Initiative for South Asia in Nepal (CSISA-NP) receives funding from the U.S. Agency for International Development (USAID)/Nepal with a co-investment from USAID Washington. In Nepal, CSISA's focus is primarily on participatory technology development and verification and on business and market development for machinery and seeds. Disseminating technologies validated by CSISA in on-farm trials is the responsibility of the Winrock-KISAN Initiative, the USAID Feed the Future project in Nepal.

When the evaluation team visited Nepal in the first week of February 2015, CSISA was in its second cropping year in working in the Mid-West and Far-West Divisions of Nepal. In CSISA-Phase I, the initiative was concentrated in the Central Terai. Its geographic focus shifted in response to district priorities emerging from USAID's Feed the Future program to Mid-West and Far West districts.

Of the three CSISA country programs the evaluation team visited, Nepal had the most issues in terms of carrying out the vision of the CSISA model and in performing in the operational culture in which it was working. In many ways, CSISA-NP (CSISA-NP) is a smaller cousin in the CSISA family; its development in terms of where it can work, what it can work on and how it can work has been stunted by USAID's approach to Feed the Future in Nepal. The evaluation team believes that these restrictions have not helped and may have compromised CSISA's ability to contribute to agricultural development in Nepal.

Research

RESULTS AND VALIDITY. CSISA's work in Nepal has been too "uprooted" and too spread out to give rise to concrete examples of outcomes and impact in the time-frame of the project. To make matters even more incongruous, USAID-Nepal has insisted that CSISA drop applied research activities and focus on packaging simple innovations into sound bites for technical content of the USAID funded extension support project, KISAN. We believe, under these circumstances, that R&D outputs and outcomes that feed into KISAN may not be forthcoming in CSISA-NP's time frame.

PROCESS RESEARCH (SUSTAINABLE INTENSIFIED PRODUCTION SYSTEMS). In spite of the aforementioned institutional difficulties and sources of instability, the early work on mechanization and training of selected service providers looks promising in the western Terai biome. The recent tuning of mechanization innovations such as: mechanical transplanting and direct drilling of wheat, rice, maize, mustard, lentil and other crops for the Mid-West and Far-West districts should enable the training of agrovets and service providers, including those linked to KISAN and the regional programs of the DOA.

In the online survey, CSISA-NP staff ranked the most promising project-related technologies for impact as (1) mechanical reapers for cereals, (2) maize hybrids, (3) two-wheeled tractors for tillage and other operations, (4) direct seeded rice (DSR), (5) hybrid rice, and (6) zero tillage with improved seeders. Other technologies such as mechanical rice transplanters and super bags and other post-harvest practices were ranked at the lowest end of scale for impact. Specific questions addressing the prospects for raised beds and laser land levelers indicated that widespread variation in perceptions among CSISA staff and partners.

CROP-SPECIFIC AGRONOMY RESEARCH. Replicated "minus one" plant nutrition studies are underway in appropriate on-farm Terai sites. While simpler best-bet treatments are compared to farmers' practices on-farm demonstrations in the remote hill-land locations, wheat is excluded from the system, so, much is lost in understanding optimization of the production system Simple demonstrations of agronomic practices for maize varieties (both OPVs and hybrids) had looked promising. Poor stand establishment in lentil production was ubiquitous. The best lentil plant stands seem to be from existing farmers' practices of broadcasting lentil seed into rice fields just before or just after harvest of the rice.

BREEDING RESEARCH. All the rice varieties released recently in Nepal are derived from International Rice Research Institute's breeding activities in South Asia through Objective 3. Many of the improved wheat cultivars also come from CIMMYT's contribution to the CSISA regional breeding project in Objective 3. Contrary to the opinion expressed by some of our informants, many maize hybrids from the Indian private sector have been registered in Nepal. These hybrids provide a firm foundation for testing in the Mid-West and Far-West Terai and Hill Sub-regions for winter and spring planting on the Terai and for summer planting in the Hills. Hence, registration should not be an obstacle for participatory varietal selection.

SOCIO-ECONOMICS AND POLICY RESEARCH. CSISA-NP does not begin to have the socio-economic research capacity that CSISA-India has; however, at this stage in Phase II and on into Phase III, CSISA-NP has invested in enough social science capacity to adequately support the agricultural R&D carried out by the initiative in the ARTCs. Economic analysis of the innovations at the farm level still seems to be in its infancy, but this area has been strengthened by two recent hires that should focus on partial budgeting of prospective technologies and on early acceptance studies of technologies that are the subjects of demonstrations and training in the KISAN Project. IFPRI's projected study on the economics of mechanization across the three CSISA countries should also be informative for both research and extension.

The need to follow-up KISAN's demonstrations with early acceptance studies warrants more discussion. In order to meet their Feed the Future indicator targets, KISAN changes their village locations each year. Although KISAN has a plan to carry out studies that document technological uptake and quantify adoption and dis-adoption, the overwhelming imperative to satisfy the Feed the Future indicators seems to overshadow any rigorous assessment of sustainable adoption.

Therefore, the structure and emphasis of KISAN in meeting its USAID Indicator number of farmers each year opens up an opportunity for CSISA to conduct follow-up randomized statistical investigations on the uptake of technologies that CSISA staff have validated and KISAN staff have demonstrated in the previous or earlier years. Such early acceptance studies should sharpen the focus of technology dissemination in future years of the KISAN project. Investing in these early acceptance studies also provides feedback to CSISA researchers on the diffusion of validated technologies and will assist in restructuring and prioritizing the adaptive research that CSISA is carrying out. These assessments are one of the few mechanisms that can be deployed to ensure that CSISA and KISAN R&D activities meet the demands of farmers for technological change. Evaluating farmers' perceptions—that is, their demand for technologies with specific characteristics is one of the important by-products of this feedback research on the incidence and determinants of adoption of well-defined technologies.

Cross-Cutting Themes

MECHANIZATION. Work in this area is also mentioned above under "process research." With the increasing scarcity of labor for transplanted rice and for rapid harvest and re-sowing of new crops as soon as rice is harvested, mechanization in Nepal, and in most of South Asia, is a central over-arching priority. There is a very good start on awareness-raising of two-wheel tractor-based mechanization in Nepal stemming from the efforts of CSISA and Service Providers. Equipment sales shops are very appreciative of the progress in this aspect of CSISA-NP. Because the tractors are very widely used in both urban and rural zones for transport (load carts are attached), it is rather easy to get tractor owners to invest in attachable implements such as planters and perhaps reapers. The evaluation team was informed the '"dedicated" reaper does a superior job of cutting and windrowing. We concur that mechanically transplanted rice and direct seeding of rice, wheat and maize will be increasingly important innovations as labor becomes increasingly expensive.

GENDER. The evaluation team saw a number of gender-related activities being undertaken by CSISA-NP. USAID/NP sees CSISA-NP as an important tool to provide technical information and support to women farmers, particularly those farmer households that have been impacted by the major outmigration in the rural area of men seeking work in the Middle East and other areas. The evaluation team was able to visit a self-help group of women in the hill country above Surkhet where the project has been working to introduce appropriate scaled mechanization (mini-tillers). The team also visited a woman-headed pilot farm in the Terai, which was incorporating a large number of advanced agricultural practices and new technologies. In addition, the team was able to interact with a number of senior-level women scientists working with and/or partnering the program including Dr. Devkota, the lead agronomist in CSISA-NP.

AGRICULTURAL WATER MANAGEMENT. Comments on this cross-cutting issue are the same as for India. See the India country annex.

HUMAN NUTRITION. Comments on this cross-cutting issue are the same as for India. See the India country annex.

CLIMATE CHANGE ADAPTATION AND MITIGATION. Comments on this cross-cutting issue are the same as for India. See the India country annex.

Catalyzing Change

Because CSISA-NP is only in its second cropping year in the Mid-West and Far West and because no follow-up study has been undertaken to assess the uptake of earlier work in Phase I in the Central Terai, it is premature to speculate on the quantum of technological, policy, and institutional change that CSISA-NP can take credit for.

At this time, the potential for catalyzing change is most visible in the introduction of mechanical technologies for research purposes. CSISA has introduced and demonstrated for the first time several mechanical technologies into western Nepal. These include laser land leveling, the bed planting of lentils, and the power-tiller rice reaper. All of these have been included in the research program of NARC's regional station in Nepalgunj. Without CSISA-NP, it is likely that these introductions would have occurred later.

As in India, CSISA-NP is working with private sector actors at a number of levels. In its mechanization programs, CSISA partners with both local dealer/suppliers and service providers. The local dealers are the main source of small-scale equipment (power tillers, mini-tillers, reapers, threshers, etc.). CSISA is working with them to get more equipment into the project area. The local service providers are often local farmers with some additional resources that they can use to purchase/rent this equipment and then provide services (planting, harvesting, threshing, etc.) to their neighbors and fellow farmers. CSISA is working with them to upgrade their skills in running the equipment and how better to manage their service-provision business.

CSISA is also working with the seed importers on supply of hybrid seeds for maize and rice. Most of these seeds come from seed companies in India and are primarily use by farmers in the western Terai.

Management

OVERALL VISION & OPERATIONAL CULTURE. Because the program receives no funding from other donors such as the Bill & Melinda Gates Foundation, CSISA-NP program is structured solely around USAID-Nepal's Feed the Future strategy. This dependency has a number of important consequences for the CSISA-NP program. These include:

Wheat is not a priority commodity in the USAID-NP Feed the Future strategy. Rice-wheat is the most important cropping system in the Mid-West and Far-West Divisions in Nepal. CSISA is fundamentally a cropping system R & D program, but in Nepal, the program's systems perspective is limited to rice, maize, lentil and horticultural crops. This restriction means that Nepalese farmers in the Mid-West and Far West will not be able to "earl" rice-wheat cropping system that drove adoption of improved practices and varieties in the Northwest Indo-Gangetic Plain in the Rice-Wheat Consortium and is now conditioning the diffusion of essentially the same practices with newer varieties in CSISA-Phase II in India.

Additionally, KISAN and CSISA-NP staff stated that selected horticultural crops are critical to the farming systems in the Mid-West and Far West of Nepal. Potato is a low price vegetable with strong demand, but potato is also not among the horticultural crops selected by USAID-NP in its Feed the Future strategy.

CSISA-NP's latitude in how it can carry out agricultural research and development (R&D) is also constrained by the donor's programmatic structure. USAID-NP requires that CSISA-NP only conduct adaptive research on already proven on-the-shelf technologies. CSISA role is limited to validation of these technologies to specific conditions and circumstances found in the KISAN project area. This orientation subverts CSISA's basic Hub model of research and demonstration.

In USAID/NP view, the primary purpose of CSISA-NP is to provide proven technology to KISAN and to train KISAN staff and partners in the use of this technology.

USAID-NP flagged several management issues in CSISA-NP. They felt that CSISA-NP lacked a true Chief of Party whom USAID-NP could relate to and seek information about the activities of the program, about its funding situation (burn rate, pipeline, etc.), and about related information that presumably arose from demands from USAID/Washington. Although the CSISA Project Leader lives in Kathmandu, he is often (75 to 80 percent of the time) on the road overseeing the whole of the CSISA activity and is not readily available to USAID-NP. The CSISA management is available through Internet full time. Other International Maize and Wheat Improvement (CIMMYT) staff scientists reside in Nepal and are available, but they do not appear be of the stature USAID is seeking (USAID-NP raised as an issue of their inability to make significant decisions about the project.) The evaluation team strongly believes that these scientists are able and capable to handle this role in what is, after all is said and done, a small cooperative agreement.

These management concerns appear to be driven more by a misunderstanding on the part of USAID of the structure and nature of the CSISA-NP program. CSISA-NP has a budget of only $500,000 a year over 3 years. This size of program could not afford the luxury of a full-time COP. Further, CSISA-NP is a cooperative agreement where it is common to have accounting and money management of the program handled by the cooperative partner in the agreement, in this case CIMMYT. It appears that CIMMYT's central accounting structure is not as responsive to USAID financial requests as other for-profit or nongovernmental organization (NGO) contractors. What is needed is an open discussion between CSISA-NP senior staff and USAID-NP on how CSISA-NP can realistically be responsive to USAID's needs given the resource constraint of a small cooperative agreement.

On a positive note, both USAID/Washington and USAID/India are developing proposals to provide funding for the CSISA-NP. Such assistance will add stability to CSISA's work in Nepal and will effectively exploit the initiative's comparative advantage in cropping systems R&D. Two areas are targeted for support: mechanization and seeds with greater linkages to Indian manufacturers and suppliers from USAID-Washington and assistance to vulnerable regions with climate adaptation funding from USAID/India. This additional funding will help to loosen the constrictions now on the CSISA-NP program and provide better linkages, particularly in the Terai, between the India and Nepal programs.

Support from the Bill & Melinda Gates Foundation for CSISA R&D in the Terai would also be a welcome addition that would ballast the Initiative. As discussed in the India country annex, the CSISA baseline survey found that households in the erstwhile Central Terai Hub in Nepal were poorer than respondents in the other seven hubs surveyed in India and Bangladesh. In the context of potential for poverty reduction from CSISA's agricultural R&D, the shift to the Mid-West and Far West does not make economic sense and is unlikely to be justified with more rigorous scrutiny.

CSISA-NP scientists and partners share the same vision as CSISA staff and partners in India. Eleven of the fourteen online survey responses concurred with the statement, "The rice-wheat cropping system is the basis for the project activities in research and extension." Thirteen of 14 responses supported the vision of CSISA-NP as "increasing production to reduce poverty and to enhance food security." In contrast to India, the institutional difficulties described above have also seemed to have diminished staff and partner optimism about the sustainability of CSISA-NP's work once the Initiative is completed. Six of 10 respondents said that it was unclear if CSISA-NP's work could be assimilated by existing institutions using their own resources when the project closes.

COMMUNICATION. Given the small size and configuration of the CSISA-NP program, the communication activities of the program are relatively modest. CSISA-NP produces 6-month reports for USAID and also puts out an annual report. They disseminate a series of success stories that are posted on the CSISA-NP webpage as part of the larger CSISA website. Four research publications are listed for the program, but they are all outcomes of CSISA Phase I with a focus on cereals mostly from central Nepal. Phase II of CSISA is attached to the KISAN project and, thus, linked to the communication work of that project. Given the length of time CSISA has been in country in both Phases I and II, the program is generally well known within the government and the NGO communities. CSISA scientists should report the results of their validation research in fora that include KISAN and extension staff, National Agricultural Research Council staff, and other CSISA project scientists from India and Bangladesh.

MONITORING AND EVALUATION SYSTEMS/PERFORMANCE MANAGEMENT. A serious issue for the success of CSISA-NP's efforts was the shift made by USAID to drop the research and demonstration work done by CSISA-NP in the central Terai in Phase I and move CSISA-NP's efforts to the Mid-West and Far-West Terai and Hills. The 3-year effort in the central region was beginning to produce results. The move to the Mid-West and Far West prevented CSISA-NP from having an opportunity to promote Phase

I technological advances toward widespread adoption in the central region where they were developed. Because this effort was not followed up, it is difficult to assess what could have happened if CSISA-NP had been allowed to bring its effort in the Central Terai to full fruition. Moreover, the ecology of the Mid-West and Far West and especially the Hills will require a considerable effort to adapt technologies developed initially for the Central Terai. This additional work will result in delays in CSISA-NP obtaining results on farmer's fields sought by both CSISA-NP and USAID.

We did not see any specific examples of CSISA-NP's M&E structure. It appeared to be mostly handled by the CSISA project manager (Cynthia Mathys). From the reports we examined, the monitoring and evaluation (M&E) system seemed to be working. USAID-NP raised no issues about it.

Although, CSISA-NP does not use impact pathways, there appears to be generally good overall management of program resources. The use of the impact pathways, however, could reinforce the collaboration with KISAN staff and would improve program coordination, which is needed (see below). This, however, would require not only the CSISA-NP staff but also the staff of KISAN to work together on the development and monitoring of impact pathways.

STAFFING. CSISA-NP is structured somewhat differently than the core program in India. CSISA-NP has smaller hubs that are called Agricultural Research and Training Centers (ARTC's two hubs are active in Phase II, Nepalgunj in the Mid-West and Dhangadi in the Far West. Three districts are covered in each ARTC. The International Livestock Research Institute does not work directly in CSISA-NP program. The International Food Policy Research Institute (IFPRI) has limited direct involvement with CSISA-NP.

Although the work of the existing staff reflects creativity, energy and dedication, it is hard to make up for the fact that CSISA personnel are spread very thin across their mandated geographic areas and subject-matter specialties. The spatial and seasonal responsibilities in the Mid-West and Far-West Divisions, covering the Terai and Hill agro-ecosystems with multiple growing seasons, present a daunting challenge for CSISA-NP.

COLLABORATION AND PARTNERSHIP. CSISA-NP and KISAN work together and engage in joint planning in a regularly structured manner. Nevertheless, coordination between CSISA-NP and KISAN could be improved. This is readily apparent when one contrasts the formal presentation by the KISAN to the evaluation team—a highlighted photocopy of the responsibilities of CSISA-NP to KISAN was the basis for discussion of perceived deficiencies in collaboration—to the informal and very supportive interview the evaluation team had with the NARC's Regional Research Station in Nepalgunj and the director of Agricultural Development (DOAD) in Surkhet. He viewed them as separate activities.

CSISA staff were not aware that plot size in their adaptive field trials was an issue. Another dissonance in communication concerns seed production by CSISA for KISAN. In the photocopy of the KISAN contract that the KISAN staff presented to the evaluation team, there was the stipulation that CSISA-NP was to "focus on creating a community-based production and supply system of improved rice and lentil seed.. CSISA-NP did not know about this stipulation. Likewise, the home office (Winrock) director of the KISAN project was also unaware of this responsibility of CSISA-NP to KISAN.

Part of the disconnect stems from structural issues and differences in expectations and size of the respective projects. Some problems appear to be partially a result of KISAN's own difficulties in over of senior management.

In contrast, CSISA-NP enjoys a harmonious relation that is founded on mutual respect with scientists and administrators in Nepal's National Agricultural Research Council (NARC). The regional research capacity in the Mid-West and Far-West Regions is perceived to be among the weakest in the five divisions of Nepal. Regional research is short on staff and deficient in infrastructure. Public-sector national program and regional research staff believe that infrastructure is the main deficiency. Nonetheless, considerable on-station research is carried out at NARC's regional research station for the Mid-West and the Far West in Nepalgunj. The regional research station's 2013/14 annual report of results is impressive.

The last external support project to national research was completed 11 years ago, and national research capacity needs more attention, especially to address food insecurity and climatic change-mediated stresses.

With an emphasis on on-farm validation of technology, CSISA complements regional research. The perceptions of CSISA by NARC scientists in both national and regional research programs seem very positive. The leaders of the two ARTCs are respected scientists who recently retired from NARC's headquarters location in Kathmandu.

CSISA-NP is also working with other national institutions including Tribuhuvan University and the DOA on new and potential promising technologies particularly in mechanization. For example, the Department of Agriculture capitalizes on CSISA-NP to provide its program on training of trainers in mechanization and agrovets with enhanced regional capacity.

Program Future

REPRIORITIZATION. While USAID-Nepal tasks CSISA for providing "finished" innovations for the KISAN extension "pipeline," and despite the fact that relevant applied research in the Terai zone was realized in Phase I, the conditions in the Mid-West and Far-West zones where CSISA is currently focusing in Phase II in both Terai and Hills are different. For some of the technologies, additional time is required for adaptive research prior to promotion under KISAN. Hill production systems might warrant a separate project with its own realistic metrics of success.

Other important crops that fit into the rice and maize production systems include: pigeonpea, chickpea, soybean and potato in addition to the "KISAN-focus" vegetable crops such as tomato, cauliflower, and cucurbits. CSISA in this phase has only been looking at lentils. Opportunities and needs are being missed, and this has been noted by KISAN. While there was, and still is, pressure for CSISA to concentrate on just a few crops (even to the exclusion of wheat), opportunities to harvest "low-hanging fruit" that could greatly enhance the productivity and sustainability of the cropping systems are being lost.

SUSTAINABILITY AND SCALABILITY. If the national programs are going to meaningfully interact with private-sector partners in western Nepal, then more serious funding for staff, infrastructure and operational funding will be required. Neither CSISA nor KISAN can fully replace the need for empowering national institutions.

The investment in the training of service providers will contribute to the partial scaling-up of mechanization. Training of women's groups to produce quality seedling mats for mechanical transplanting of rice merits investment as a sideline agro-business to support service providers.

Recommendations

- Nepal can and should benefit significantly from a well-focused but flexible research for development initiative, capturing the experience from the previous rice-wheat consortium research efforts. The evaluation team recommends that USAID help identify resources to enable CSISA to function in a manner consistent with its comparative advantage as a cropping systems R&D Initiative. CSISA can and should do more than package simple extension messages for KISAN. Many of the more meaningful shifts to enable sustainable intensification for the future needs of Nepal will require more knowledge-intensive changes in farming practices that permit fast transitions from one crop to the next and early-maturing varieties suited to such systems.
- Companion donor support that is able to embrace longer-term initiatives would be very valuable if linked to CSISA NP. We understand the governmental pressures on USAID for fast impact, but this needs to be coupled to longer-term R&D. We recommend that the BMGF or another donor with vision and flexibility to embrace longer-term research for development be identified to complement the USAID-Nepal program.
- Wheat is a major omission in USAID Nepal's emphasis in the second phase of the CSISA Project. In Nepal, CSISA cannot really be called a cropping systems initiative because it ignores the dominant cropping system, rice-wheat, in Nepal. We strongly recommend that the Mission in Nepal make an exception to the general rule on number of crops in a project to include wheat in future projects where the farming system is the subject of R&D.
- We recommend that there be continued applied research on tuning mechanization for Terai production systems including: mechanical transplanting, direct drilling, and reaping.

- We recommend that a separate project (maybe involving CSISA Consultative Group on International Agricultural Research institutions) with greater extension focus (probably with a solid NGO in the lead) be put in place for the Hill tracts in the Mid-West and Far West Divisions. These remote areas cannot be compared with Terai systems for impact indicators of Feed the Future. Pretending to do so, will result in frustration and disappointments. The arguments for work in the remote hill-land systems may compelling from a political perspective, but numbers of people reached per unit of resource spent will be relatively small and thus will not be optimal for meeting Feed the Future goals.
- If lentil yields cannot consistently exceed 1 t/ha under high-level management, we suggest that for CSISA this crop be maintained only as a catch with present farmer practice, by relaying it into rice or wheat fields to benefit from the residual soil moisture. Research effort on lentil agronomic management by CSISA in Nepal, should probably cease even though lentils are by far the most important pulse in the country. The production of any pulse crop under residual moisture has been highly resistant to technological change in South Asia.
- We recommend that CSISA in partnership with other institutions, place more emphasis on several crops that fit well into the rice, wheat and maize production systems of Nepal such as: pigeon pea, chickpea, soybean, potato and vegetable crops such as tomato, cauliflower, cucurbits, etc. These could greatly enhance the productivity and sustainability of cropping systems as well as their nutritional value. Research should increase cropping flexibility by weaving them into production and value chains as opportunities arise. Farmers could be given a broader range of options though simple demonstrations.

ANNEX G: CONSOLIDATED APPRAISAL OF CEREAL BREEDING

Objectives 3 and 4 of Cereal Systems Initiative for South Asia (CSISA) have carried forward from Phase I to Phase II and are proposed for Phase III. These objectives have been managed through International Maize and Wheat Improvement Center (CIMMYT) and International Rice Research Center (IRRI), which share the grant funds at approximately $5 million each for three years. In Phase I, IRRI was the lead contractor and in Phase II CIMMYT had the lead.

IRRI and CIMMYT are centers of the Consultative Group for International Agricultural Research with mandates for conducting research broadly on major crop commodities: rice at IRRI and maize and wheat at CIMMYT. Each center takes global responsibility for improvement of their respective crops. CSISA is geographically oriented to three countries where wheat and rice are major food commodities. Thus IRRI and CIMMYT, with global mandates, have direct interest and responsibility for supporting and improving sustainable food security in the CSISA countries (India, Bangladesh and Nepal). At the same time, it must be recognized that many of the crop production attributes needing attention by CSISA are common to those crops in other countries. Both IRRI and CIMMYT have comprehensive breeding (i.e., genetic improvement) programs relevant to their crops wherever they are grown, albeit mainly directed to countries having limited research and development capacity.

Therefore, the participation of IRRI and CIMMYT in meeting the goals of CSISA is highly appropriate because they have the basic knowledge of the genetic resources needed and available to direct toward CSISA objectives. Many of the products of their breeding programs are relevant to CSISA as well as to other countries. Both IRRI and CIMMYT expanded their breeding efforts to support the goals of CSISA, which entails greater attention to specific traits and, most importantly, to provide genetic adjustment of wheat and rice to meet the major focus of CSISA, that is, to develop and deploy interventions in agricultural production systems that enhance intensive sustainable food production. **The development goals of CSISA cannot be achieved without evaluating the genetic characteristics of the targeting crop plants.** Hence this project has, from its origin, had the proper blend of science, technology and socio-economic context to effect positive change in food supply and human condition in its targeted countries.

During this evaluation, the evaluation team has had opportunity to visit firsthand some sites of CSISA intensive activity. With respect to the crop breeding objectives, the structural aspects will be highlighted along with the progress and attained outcomes and impacts. Also, the status of progress in breeding to contribute to new interventions in sustainable crop production systems will be discussed.

Evaluation Strategy

IRRI has its management and research headquarters in Los Banos, The Philippines, about a 1.5-hour drive from Manila. The facilities included research labs, greenhouses, about 200 ha of research land, the largest genebank for genetic stocks of wild and cultivated rice, and scientists and technical support staff in all relevant areas for study of rice agrobiology and production. A team of socio-economic scientists are included, who conduct assessments and analyses relevant to current and proposed interventions in agricultural production. IRRI's research on pests, diseases, nutritional quality and agronomic aspects of production provides information for the global rice community. With respect to varietal development, it conducts field trials under conditions relevant to many rice-producing countries. The products of these trials, data and plant materials, are shared openly and widely. The selected plant materials, called breeding lines, are assembled into sets and the seeds sent to participating collaborators in many countries. With respect to CSISA, the project specifically targets heat tolerance during grain formation, growth duration, disease and pest resistance and grain attributes dictated by consumers. These traits are critical to the CSISA goals to provide interventions to traditional rice-wheat cropping systems in South Asia, especially for wheat-rice rotations and wet or dry direct seeding of rice. Thus special CSISA trials [or nurseries] are assembled and distributed to the CSISA partners. This activity is shared by staff at Los Banos and Hyderabad, India. IRRI's breeding activities are closely aligned and collaborative with national rice research programs. Its research group based at ICRISAT in Hyderabad conduct relevant breeding and evaluations for CSISA.

CIMMYT headquarters are in Mexico where it operates several research sites. These sites simulate many of the wheat-growing areas, especially in Asia. Hence selection for critical traits for CSISA, such as earliness of maturity, heat stress tolerance, and spot blotch resistance, may be done in Mexico before breeding lines are sent to the CSISA countries. CIMMYT has staff based in Nepal for coordination and conduct of research there and in India and Bangladesh. CIMMYT coordinates the movement of germplasm from India to Kenya for stem and stripe rust evaluations. It assembles and distributes many nurseries for specific traits to more than 120 global sites. Special CSISA nurseries for heat tolerance and early maturity are assembled in and distributed from Mexico.

A series of questions and requests were assembled for both IRRI and CIMMYT as a guide to the evaluation process. One member of the evaluation team (Qualset) visited both CIMMYT and IRRI headquarters in Mexico and The Philippines, respectively, before visiting CSISA sites in India. No visits were made to Bangladesh and Nepal for the plant breeding objectives. For rice, one representative from Nepal joined the review in New Delhi, and also for rice, Bangladesh collaborators provided PowerPoint presentations for review.

Findings

The pattern adopted for this assessment shows the status and accomplishments as learned during the review. At the end of each topic are comments in italics containing assessment and recommendation language.

RICE BREEDING (OBJECTIVE 3)

1. **Specific goals for CSISA rice breeding.**

   IRRI and the CSISA partners have common goals: (a) to develop elite lines with higher yield potential, improved grain quality and superior feeding value; (b) to develop varieties that perform well with mechanized direct-seeding and water-saving irrigation practices; and (c) to develop heat-tolerant rice varieties for intensive rice-wheat cropping system.

   These goals are mutually compatible with goals established for wheat breeding and therefore are consistent with CSISA goals for providing information and genetic materials for improved rice-wheat cultural systems.

2. **Finance provided by USAID and the Bill & Melinda Gates Foundation.**

   Funding for Objective 3 is shared by the Bill & Melinda Gates Foundation (BMGF) and the U.S. Agency for International Development (USAID). Each of 12 collaborators in India, Bangladesh and Nepal is subcontracted at about $13,500 per year. In addition, IRRI provides funds for National Agricultural Research Systems (NARS) scientists to travel to training events and other meetings. Funds are allocated to IRS staff at IRRI/Los Banos and Hyderabad based on their research on CSISA objectives. Detailed review of budgets and expenditures was not conducted.

   During interviews with national program collaborators, great appreciation was expressed for the support provided because it permitted them to expand their programs to meet CSISA goals and to interact with their peers.

3. **Nutritive value of rice straw for livestock feeding.**

   Proximate nutritive analysis was conducted on 400 rice accessions, including IRRI-bred lines, consisting of aromatic lines, hybrids, indicas, japonicas, new plant types, released varieties; private-bred hybrids; and NARES breeding lines that were grown under puddled transplanted and direct-seeded conditions. Evaluations were done for grain and straw yields and straw quality traits, including nitrogen content (N %), neutral detergent fiber (NDF %), acid detergent fiber (ADF %), acid detergent lignin (ADL %), silica content (%), *in vitro* organic matter digestibility (IVOMD %) and metabolizable energy. Based on IVOMD, entries were classified into different category percents: IVOMD: >45% = very good, 43%−45% = good, 40%–42% = medium, 37%–39% = poor and <36% = very poor.

   As per the survey conducted by ILRI, small differences in fodder quality can command surprisingly high price premiums. A wide range of variation for the above-mentioned traits was observed among the accessions. Many entries were found to have high grain yield as well as high IVOMD of more than 45percent. Hybrids have a higher frequency of very good IVOMD types. Among the machine-sown direct sowing rice machine (DSR) entries belonging to different maturity groups, IVOMD ranged from 41 to 49.8 percent in the early-maturity group, followed by 36–48.2 percent in the medium-early-maturity group and 41–47.7 percent in the medium-maturity group.

Based on these studies, it can be concluded that among most cultivar types, IVOMD varied by about 10percent, which is at least three times the difference observed between the best and medium/low category rice straws traded in Kolkata fodder markets. Highest average straw IVOMD was observed in rice hybrids, which also had the highest average grain yields. Trade-offs between straw fodder quality traits and grain yield were generally absent; therefore, genetic improvement of rice straw would provide a clear win-win opportunity for increasing the value of rice production, making higher quality feed available and thereby increasing profitability for farmers. Based on these results, many promising breeding lines with better straw digestibility traits were used in the crossing program to develop a large number of new breeding lines with high grain and fodder yield and better grain quality and straw digestibility traits. Some 340 diverse breeding lines from IRRI and NARES centers were evaluated for three seasons at Hyderabad. The phenotyping of these materials for all the straw digestibility traits mentioned above is in progress. Association mapping work is in progress. Four mapping populations have been developed for the identification of quantitative trait loci (QTLs) for straw digestibility traits.

Contrary to results on straw nutritive value of wheat, the results for rice are much more positive. This is noted as a rice breeding objective for Phase III and appropriate hybrids and populations have been developed to assure success. Costs of nutritive analyses per sample are high, and that factor should be considered in the next Phase of CSISA. Increased collaboration with ILRI would assure that relevant assays and feeding trials would be conducted.

4. **Developing varieties for conservation agriculture (CA)**

In the rice-based cropping system, conservation agriculture is an important component for ensuring sustainable crop production. Many breeding lines with high yield potential and better adaptability to machine-sown dry DSR conditions were developed. DSR followed by zero-till wheat or mustard or linseed or mungbean or spring maize are some of the CA-based cropping systems that are becoming popular in South Asian countries. Growing of DSR varieties with reduced duration and high grain yield potential followed by early sowing of wheat is known to increase overall system productivity.

The breeding program focuses on enhancing CA through work on trait development, such as early uniform emergence, early vigor, better nutrient uptake, and grain yield under dry direct-seeded conditions. QTLs for grain yield under dry direct-seeded conditions ($qGY_{1.1}$, $qGY_{6.1}$, $qGY_{10.1}$) and a QTL for early vigor ($qEV_{9.1}$) were identified and found to be effective in two populations under a wide range of conditions. QTLs for several seedling-stage traits co-located with QTLs for grain yield, including early vegetative vigor and root hair length. On chromosome 5, several QTLs for nutrient uptake, such as $qNU_{5.2}$, co-located with QTLs for root hair density and nematode gall rating under natural nematode occurrence. The co-location of QTLs for yield, early vegetative vigor, and root traits indicates that the identified QTLs could be immediately exploited in marker-assisted breeding to develop novel high-yielding rice varieties for direct-seeded conditions. Seven QTLs (qEV-1, qEV-2, qEV-3, qEV-6, qEV-7, qEV-9 and qEV-11.1) were identified for early and uniform emergence on chromosomes 1, 2, 3, 6, 7, 9, and 11, respectively. Among the identified QTLs, a few of them have novel alleles/genes for early emergence and early vigor, and those major/minor QTLs are being used to significantly improve seedling vigor by marker-assisted breeding.

A large number of breeding lines with early uniform germination and emergence, early-stage seedling vigor, better adaptability to dry DSR conditions, varied maturity groups and grain types, and high yield potential were developed and tested under machine-sown dry direct-seeded conditions through multi-location trials. A few lines with earliness, complete panicle exertion, strong culm and large and heavy panicles with medium slender or long slender grain type yielded up to 8 t/ha under machine-sown DSR.

The rice breeding for CA has concentrated on identification of traits relevant to stress tolerance, mainly through root and canopy studies. The variety development challenge is to produce varieties that complement other crops, such as wheat, in an intensive cropping system that conserves soil resources, sustains soil structure and provides high yields for farmers. These are admirable challenges, and developing basic information and genetic materials is a critical step in the process.

5. Technical aspects of rice breeding

Many donors for direct-seeded rice traits were identified across experiments. Some of the traits and donors are (1) early vigor: UPLRi7, NERICA4, and KaliAus; (2) root length density, proportion of lateral roots, and proportion of roots at depth (below 15 cm): Sambha Mahsuri, WAB880-1-27-9-2-PI-HB, Dular, and NERICA4; (3) root hair length: Swarna; (4) root hair density: Mikhudeb; (5) low canopy temperature under drought: Dular; (6) response to fertilizer application: Vandana and Dular; and (7) nutrient use efficiency (yield/uptake): Dular. The identified donors were used to develop complex crosses to combine traits that enhance rice yield under dry, direct-seeded conditions and, once a population is developed, to identify QTLs/genes for these traits.

More than 20 heat tolerant accessions were found among more than 500 accessions from the IRRI Genebank. A large number of crosses involving heat-tolerant donors and popular varieties were made, and segregating generations were screened under field and controlled conditions. At the IRRI-South Asia hub in Hyderabad, more than 100 crosses and 25 BC1F1s are made each year, and selections from segregating generations were advanced for evaluation.

For Bangladesh and Nepal, country-specific crosses for the irrigated ecosystem were made at IRRI headquarters, and fixed lines were sent to the respective countries. At the same time, suitability of lines for their likely performance is checked at the IRRI-South Asia hub in Hyderabad. For India, part of the materials were sent from IRRI headquarters, and many country-specific crosses involving Indian mega-varieties and IRRI elite breeding lines with desirable traits were made at the IRRI-South Asia hub in Hyderabad, and selections were made in different segregating generations of simple crosses and backcrosses. A large number of breeding lines specifically developed for Indian market segments are in national and state-level multilocation trials. Heat-tolerant breeding lines were developed at IRRI headquarters and sent to Indian and Bangladeshi NARES partners. A recurrent selection program was taken up at IRRI headquarters, and fixed lines were sent to South Asian countries. In addition to the development of breeding lines by IRRI, NARES partners in India, Bangladesh, and Nepal developed many crosses involving IRRI-bred materials and local varieties/elite breeding lines and an array of new breeding lines was developed. Many entries are in national and state-level multilocation trials.

A large number of genotypes were characterized in field and rainout shelter experiments for the traits hypothesized to be beneficial for direct-seeded conditions across four seasons at IRRI in four treatments per season: a well-watered fertilizer-applied treatment and a reproductive-stage drought stress, no-fertilizer-applied treatment, with each using both transplanted lowland and dry direct-seeded upland establishment methods. Such a range of treatments was used to identify the most adaptable genotypes. Early vigor was measured in terms of shoot biomass at the time of transplanting and two weeks after transplanting in lowland conditions, by normalized difference vegetation index (NDVI) at four and five weeks after sowing in upland conditions, and in terms of the relative growth rate between those two dates. Root length density and mass with depth (to 60 cm) and the proportion of lateral roots, as well as root hair length and density (in a seedling-stage greenhouse study), were characterized because these traits have been reported to confer improved nutrient and water uptake in aerobic soils. Leaf nutrient content was determined at three dates across each season in each treatment: at the vegetative stage (after which fertilizer topdressing was applied), 10 days after the application of fertilizer, and when the first genotype flowered in the well-watered treatment). Response to fertilizer application in the well-watered treatments was calculated as the change in leaf N, P and K uptake (concentration × biomass) between the first two sampling dates. Nutrient use efficiency was calculated as grain yield/N, P and K uptake. Canopy temperature and NDVI were characterized.

The heat tolerance of selected elite breeding lines was evaluated by using temperature-controlled indoor growth chambers. In segregating and advanced generations, local checks and parents are used to select for appropriate phenology, plant height, early vigor, maturity, grain type and yield component traits. Artificial screening for seedling-stage leaf blast is being done at Hyderabad. Advanced lines are evaluated in replicated trials laid out under machine-sown dry DSR and/or puddled transplanted conditions to validate yield superiority over the best checks. Large-scale field screening for anaerobic germination ability and submergence tolerance is being done at IRRI headquarters.

The marker-assisted selection (MAS) approach is an integral part of the breeding strategy. Genes/QTLs for anaerobic germination (AG1), phosphorus uptake (Pup1), and submergence tolerance (SUB1) were used for MAS in the genetic background of IR64, Samba Mahsuri, and Ciherang. Cloned genes such as SCM2, Gn1a, and SPL-14 are being transferred into four IRRI varieties (NSIC Rc82, NSIC Rc158, NSIC Rc222, and NSIC Rc238) and three Indian mega-varieties (Swarna, Samba Mahsuri, and MTU1010) by MAS. Two QTLs (qHTSF1.1 and qHTSF4.1) were identified and fine-mapped, and PCR-based markers were developed for MAS. Near-isogenic lines (NILs) and a QTL pyramiding line (HT+EMF) were developed by MAS. In addition, a systematic marker-assisted breeding program has begun at IRRI using QTLs identified in the CSISA project as well as QTLs/genes identified by other research programs at IRRI to develop better rice varieties for DSR. Thirty-two QTLs have been discovered for 14 quantitative traits that are being used in the breeding program.

The above discussion exemplifies the rigor and depth of the basic information that has been developed by rice scientists at IRRI, primarily, but with many national programs collaborators. The tools for improving rice to meet environmental complexities are available and may be deployed to national program breeders. IRRI will continue to provide advanced training opportunities so these tools may be used by breeders in all CSISA countries. The prognosis for using the QTLs and MAS in breeding new varieties is good.

6. **Physiological traits for yield improvement and stress tolerance**

It is clear from the above comments that rice breeders are adopting morph-physiologic traits in their breeding programs. This enhances probability of developing rice varieties closely tuned to their environments and also of developing resiliency to meet the vagaries of climate change.

7. **Collaborations with national program partners**

Advanced breeding lines are grown at CSISA hub sites. Advanced elite breeding lines nominated by NARS partners are also grown together with IRRI-bred lines. Released varieties and private-bred hybrids suitable for different crop establishment methods are also being tested in research platforms and at CSISA hub sites in farmers' fields in various South Asian countries.

Early-generation breeding lines developed at IRRI headquarters were evaluated for heat tolerance in Bangladesh (BRRI) and India (PAU and TNAU), and NILs and QTL pyramiding lines were sent to India for field evaluation. Advanced breeding lines and populations developed at IRRI were distributed to NARES partners in India, Nepal and Bangladesh. Precise plant development and growth stages described under DSR are being studied in three contrasting locations in South Asia as variety × transplanting or direct seeding or flooded or aerobic experimental treatments. The elite breeding lines are being tested in national and/or state-level multilocation trials at all the sites mentioned in the CSISA partners' list as mentioned below:

India:

- Punjab Agricultural University (PAU), Ludhiana
- Govind Bhallav Pant University of Agriculture and Technology (GBPUA&T), Pantnagar
- Bihar Agricultural University (BAU), Sabour
- Odisha University of Agricultural Technology (OUAT), Bhubaneswar
- Andhra Pradesh Rice Research Institute (APRRI), Maruteru
- Agricultural Research Station, Gangavathi, and UAS, Raichur
- Tamil Nadu Rice Research Institute (TNRRI), Aduthurai, and Tamil Nadu Agricultural University (TNAU), Coimbatore

Nepal:

- National Rice Research Project (NRRP), Hardinath,
- RARS, Tarahara

Bangladesh:

- Bangladesh Rice Research Institute (BRRI), Gazipur

The CSISA concept for international collaborations is clearly evident by these joint projects. During the evaluation interviews in Delhi and Hyderabad, presentations were made by leaders of 10 national rice breeding programs (India and Nepal). Each of them was enthusiastic about the progress they had made and proud of working collaboratively to common goals, albeit working in very different agroecologic settings.

8. **Screening for disease and pest resistance**

Screening of breeding populations and genetic resources accessions is done at Los Banos and at the IRRI-South Asia hub at Hyderabad. Disease and insect damage assessments are also made at the various NARS stations.

Disease and insect resistance is a high priority for rice production wherever it is grown. The CSISA project is aware of the importance and is taking actions to assure that resistant varieties are developed and released to farmers.

9. **Germplasm-sharing: Issues in international movement of seeds.**

There is no problem to transfer germplasm (seeds) from IRRI/Los Banos to India, Bangladesh and Nepal, but locally bred germplasm in India cannot be sent to other countries. IRRI is having dialogue with National Bureau of Plant Genetic Resources to resolve this problem.

Germplasm exchange with India has long been a one-way transfer. While reviewing the CSISA Wheat breeding objective, the director of Wheat and Barley Research at Karnal said that if germplasm exchange was specified in the research agreement, there would be no problem. This arrangement needs to be explored as CSISA goes forward.

10. **Human Resource development-Capacity-Building (CB)**

Human resource development is an important component of the CSISA project in addition to field days and conferences, IRRI reported that 6 Ph.D. and 8 M.Sc. students worked on the CSISA project. Short-term training was provided to nine scientists and IRRI/Los Banos. An often unreported indicator of training effectiveness is the publication of research results in peer-reviewed journals. These are usually coauthored by more than one trainee and investigators from IRRI and collaborating institutions. During this period, 12 papers appeared. Twelve presentations were made at scientific meetings.

The training component was significant, but probably declined in Phase II as was noted for the wheat breeding objective. Phase III must pick up the pace to accommodate more national program scientists and students in advanced degree programs.

11. **STRASA: A Complementary international program to CSISA**

The Gates Foundation-sponsored project Stress Tolerant Rice for Africa and South Asia (STRASA) is an ongoing program, started before CSISA, that places emphases on stress tolerance related to rain-fed rice crops. During this review, few details were discussed about the complementarities of the two projects. CSISA clearly focuses on multicrop systems, mainly rice and wheat, and has addressed environmental stresses on those crops in different ways. However, the gene systems to be used are similar for the targets of both crops.

While STRASA concentrates in rain-fed submergence, drought, salinity-affected single rice cropped areas with cropping intensity of around 120 percent and very limited opportunity to produce a second crop after rice due to unavailability of water in the dry season, CSISA concentrates its activity in double crop rice, i.e., wheat areas with cropping intensity of more than 200 percent. Also, the problem of labor shortage has been more predominant in CSISA operational areas because of higher industrialization than better access of population to jobs in industries than in STRASA operational areas. CSISA project has been operated as a breeding cum management project with target to mechanize agriculture as against STRASA that concentrated enhancing tolerance to abiotic stresses together with biotic stresses.

While some components of STRASA, such as drought tolerance can be useful in CSISA breeding objectives, breeding to develop better rice varieties for labor-short mechanized agriculture has to concentrate on inclusion of new traits in breeding such as early and uniform emergence, early vigor, higher number of lateral and root hairs to increase water and nutrient uptake, lodging resistance, nematode tolerance and grain yield under dry direct-seeded situations together with biotic stresses.

Phase III could benefit from more coordination of CSISA and STRASA, especially for germplasm development and capacity-building.

12. **Transition strategy upon completion of CSISA**

The main purpose of the CSISA project is to widen the network of NARES breeding centers and strengthen them by supplying elite and novel germplasm, improved or prebreeding lines, mapping populations, and QTL/gene/marker data sets, and by facilitating capacity building in the area of conventional and molecular breeding approaches. Later on, the public-funded centers would be able to advance their own breeding programs through in-house projects or in-country network projects. However, rice breeding is a continuous and long-term activity for tackling emerging challenges in present and future rice-based cropping systems. In this context, IRRI is viewed as a strong partner to conduct upstream and innovative research leading to the development of novel technologies and to develop and distribute novel genetic resources to national programs to support advancement of crop production in the CSISA framework and beyond.

IRRI can assure development of strong national rice breeding programs through germplasm distribution, regular visits by its scientist, and development of new information and technologies for gene deployment into new varieties, and it can provide guidance on crop production systems.

13. **Personnel associated with CSISA**

Names and expertise of all project scientists were provided but will not be listed here. There are 15 IRRI scientists working the CSISA project. Most of them have multiple assignments to other projects. Three of them are located in India. Twelve country coordinators were identified, and some of them had associated scientists.

FUTURE PLANS FOR CSISA PHASE III: THE CASE FOR INVESTMENT IN RICE BREEDING FOR SOUTH ASIA (PREPARED BY IRRI, NOT NECESSARILY FINAL VERSION)

The production of conventional puddled transplanted rice is facing severe constraints because of labor and water scarcity and the increasing challenges posed by a variable monsoon climate. Increased demand for labor in the non-agricultural sectors has led to significant decrease in the availability of labor for the agricultural sector. Although, 59 percent of the total population across the world was engaged in agriculture in 1961, the proportion had declined to 38 percent by 2011 (Kumar and Ladha, 2011), and the trend continues. It is also seen that the population employed as agricultural labor declined from 28 percent in 1961 to 19 percent in 2011 across the world (Kumar and Ladha, 2011). This trend has been seen in the past 50 years in Asia, the traditional rice cultivation area, where the percentage of the population engaged in agriculture declined from 78 percent in 1961 to 46 percent in 2011 and agricultural labor decreased from 38 percent in 1961 to 24 percent in 2011 (Kumar and Ladha, 2011). As transplanting is a labor intensive operation, the shortage of labor work force at critical times sometimes results in fields being left unplanted. Water, too, is a fast dwindling resource, and it is als. emerging as another critical constraint and a future threat to the transplanted, flooded method of rice cultivation in the world in general, and in South-Asia region in particular. By 2025, it is anticipated that 2 million ha of Asia's irrigated dry-season rice and 13 million ha of its irrigated wet-season rice will experience "physical water scarcity," and most of the approximately 22 million ha of irrigated dry-season rice in South and Southeast Asia will suffer "economic water scarcity." The situation will be more precarious as dry season rice cultivation is becoming necessary to meet burgeoning global demand of rice. In addition to an overall shortage of water, an equally important condition is unavailability of large amounts of water early in the season for puddled-land preparation in absence of early rains. Late arrival of monsoon or a long spell between two rains in the beginning of the rice planting season does not allow timely transplanting of the rice crop, causing significant yield losses resulting from transplanting of over-aged seedlings. Over last three years, the rice crop seasons looked to be shortening because of the late arrival of monsoon and occurrence of rainfall in November. Furthermore, for the boro season rice (dry season, December–May), a low temperature spell at seedling and vegetative stage in most of the double rice crop area makes it difficult for medium- and long-duration varieties to mature well before the closure of the season to escape the high temperature at reproductive stage. New varieties are required to combine tolerance to both cold temperatures at seedling stage and high temperatures at reproductive stage in addition to tolerance to drought at reproductive stage. Low-light intensity due to prolonged cloudy conditions in wet season as well as the cold fog conditions during the initial two months (December–January) of the dry season is another emerging constraint that limits full expression of yield potential in South Asia, and this needs immediate attention. Unfortunately, there is no focused research targeting this important problem.

Breeders failed to address grain quality adequately during the green revolution era. For breeders, grain quality domain has largely been restricted to amylase content, head rice recovery, chalkiness and gelatinization temperature, and gel consistency. The approach has not allowed breeders to capture many of the traits related to cooking and nutritional quality of the rice. The effect is largely seen in terms of difference in quality traits of green revolution varieties as compared with traditional rice varieties. By adding quality traits, breeders will be able to deliver varieties to farmers with higher market value and thereby enhance farmers' returns.

Fluctuating climatic conditions-late arrival of monsoon/early arrival of monsoon, water shortage at the initial stage/too much water during germination, seedling stage cold, high temperature during the reproductive stage, shortened duration of wet and dry seasons, and increased water and labor shortages indicate that varietal development domain has to be realigned. A shift is required from developing varieties for specific transplanted/dry direct-seeded situations to varieties with greater plasticity to allow adaptation to a range of environmental and management situations across regions.

ACHIEVEMENTS OF CSISA OBJECTIVE 3 (RICE BREEDING)

New varieties for dry direct-seeded situations developed and delivered

- Five varieties suited for cultivation in dry direct-seeded situation—CR dhan 201, CR dhan 202, CR dhan 203, CR dhan 204 and CR dhan 205—from breeding lines developed at IRRI have been released as varieties by Central Rice Research Institute (CRRI), Cuttack.
- An array of new breeding lines with varied plant types and maturity groups with different grain types, including medium and short slender, long slender, and long and medium bold suitable for diverse market segments of northern, southern and eastern parts of India were developed. Many entries recorded more than 7–8 tons grain yield per hectare. Twelve breeding lines are currently being evaluated in All India Coordinated Rice Improvement Program in India and eight breeding lines are in evaluation in State multilocation trials of Punjab, Uttarakhand, Bihar and Odisha provinces (Table 3). Some of the newly developed breeding lines showed yield advantage of 12-29 percent over the best check variety under-irrigated and rain-fed situations (Figure 4, 5).
- Recurrent selection approach using 26 parental lines was used, and a base population of more than 50,000 plants was developed. About 4.3 percent of the plant families had more than 20 percent higher grain yield than the check. Eight percent of the tested families (from ~0.5% of base population individuals) were selected for intermating to develop population for the next cycle. Two hundred lines developed using bi-/tri-parental recurrent selections were tested in observational yield trials (OYT) at IRRI, during dry season 2014. Seventeen were ranked within the top 3 percent of promising entries out of 1,500 entries with yield ranging from 5.3 to 6.2 tons/ha.

TABLE 1: Rice varieties released, promoted for release in All India and state levels

SN	Name	Designation	State, release year
Breeding lines released as varieties			
1	CR Dhan 201	IR 83380-B-B-124-1	2014, Chhattisgarh, Bihar
2	CR Dhan 202	IR 84899-B-154	2014 Jharkhand, Madhya Pradesh, Bihar, Odisha
3	CR Dhan 203	IR 84899-B-185	2014, Odisha, Maharashtra Madhya Pradesh
4	CR Dhan 204	IR 83927-B-B-279	2014 Chhattisgarh, Madhya Pradesh
5	CR dhan 205	IR 86931-B-578	2014, TN, Gujarat, Odisha, Punjab
Breeding lines nominated to All India Coordinated rice improvement program			
1	IR 83141-B-17-B	AICRIP	PAU, Ludhiana
2	IR 08N159	AICRIP	PAU, Ludhiana
3	IR 65482-7-216-1-2-B	AICRIP	GBPUAT, Pant Nagar
4	IR 65482-7-216-1-2-B	AICRIP	GBPUAT, Pant Nagar
5	IR 81494-10-1-3-3-1	AICRIP	GBPUAT, Pant Nagar
6	UPRI 2012-15	AICRIP	GBPUAT, Pant Nagar
7	UPRI 2012-16	AICRIP	GBPUAT, Pant Nagar
8	IRRI 132	AICRIP	GBPUAT, Pant Nagar
9	PR 35887-1-21-2-1	AICRIP	UAS, Raichur
10	PR 35766-B-24-3-18,	AICRIP	UAS, Raichur
11	IR 78806-B-B-16-1-2-2	AICRIP	UAS, Raichur
12	BP10620F-BB4-12-BB8-30	AICRIP	UAS, Raichur
Breeding lines nominated in respective state trials			
1	HHZ 17-DT6-SAL-3-DT1	State Trials	PAU, Ludhiana
2	HUANGHUZHAN	State Trials	PAU, Ludhiana
3	IR 09N496	State Trials	OUAT, Odisha
4	HHZ 17-DT6-SAL-3-DT1	State Trials	OUAT, Odisha
5	IR 71700-247-1-1-2	State Trials	BAU, Bihar
6	HHZ 11-Y6-Y1-Y1	State Trials	BAU, Bihar
7	IRRI 119	State Trials	BAU, Bihar
8	UPRO 2012-5	State Trials	GBPUAT, Pant Nagar

FIGURE 1: Percent yield improvement of new breeding lines over MTU1010 with machine-sown DSR irrigated at IRRI SA Hub, Hyderabad

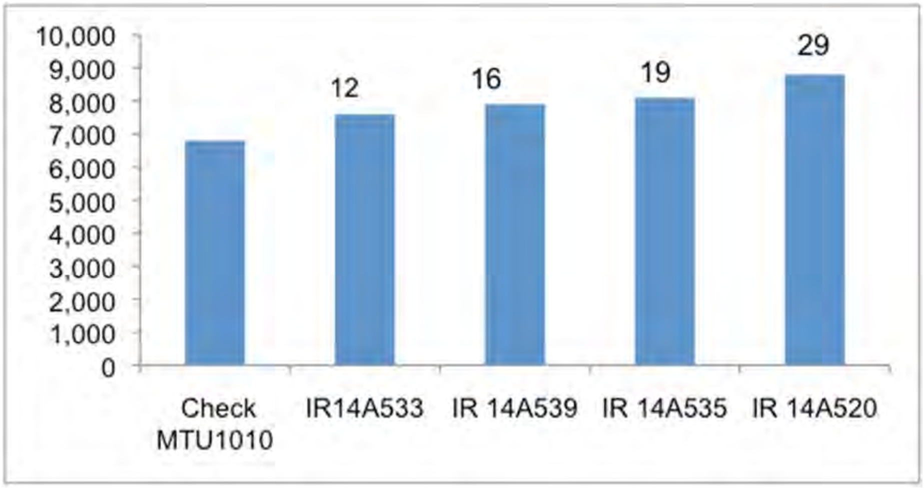
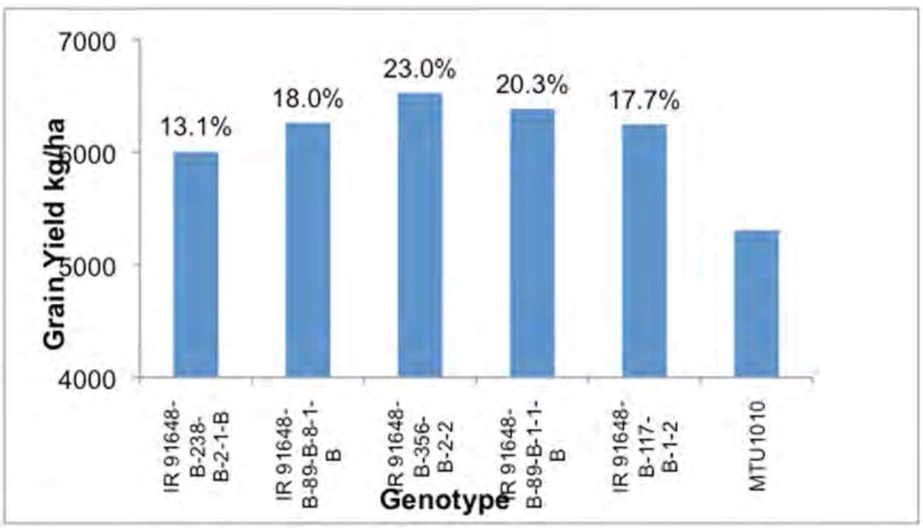


FIGURE 2: Percent yield improvement of new breeding lines over popular variety MTU1010 under poor soil conditions of rain-fed situation under DSR at IRRI SA Hub, Hyderabad



Marker-assisted breeding for enhancing yield potential, combining new traits for DSR

- Marker-assisted breeding to improve yield potential using four varieties of IRRI (NSIC Rc82, NSIC Rc158, NSIC Rc222, and NSIC Rc238) and three mega varieties of India (Swarna, Samba Mahsuri and MTU1010) as recipients resulted in backcross-derived populations with introgressed cloned genes viz , high grain number (*Gn1a*), bigger panicle size (*Spl14*), and strong culm (*SCM2*).
- Through marker-assisted backcrossing, progenies of IR64-*Pup1-AG1* and Samba Mahsuri-*Sub1-AG1-Pup1* were developed. Breeding lines for tolerant to *AG* alone or *AG+Sub1* evaluated in the field screening for *AG* and *SUB* tolerant at IRRI-headquarters. Seven promising lines with *Sub1+ AG* were identified.
- IR64 introgression lines with fine-mapped QTL regions for tolerance to high temperature on chromosome 4 tested in two independent experiments (i) short duration stress (6 hours) coinciding with anthesis and (ii) for 14 days covering the entire flowering period. Across both these exposures spikelet fertility was increased by 10 to 15 percent.
- IR64 NIL with QTLs for tolerance to high temperature and early morning flowering pyramided. A recombinant inbred line (RIL) population consisting of 246 F_7 lines was developed and is being used for high night temperature (HNT) QTL mapping and other heat tolerance studies. An array of new breeding lines with reproductive stage heat tolerance was developed.

Straw quality characterized and high yield potential and good straw quality lines identified

- Straw quality traits, including nitrogen content (N %), neutral detergent fiber (NDF %), acid detergent fiber (ADF %), acid detergent Lignin (ADL %), silica content (%), *in vitro* organic matter digestibility (IVOMD) (%), metabolizable energy were studied among 300 entries comprised of hybrids, varieties, and breeding lines. Many promising breeding lines with better straw digestibility traits were identified. Further, some of these lines were used in the crossing program to develop a large number of new breeding lines with high grain and fodder yields, better grain quality and straw digestibility.

New gene donors and QTLs for traits related to dry direct-seeded situations developed

- New donors were identified for traits relevant to dry direct-seeded situations. These include donors for anaerobic germination (Khao Hlan, Ma-Zhan Red, Nanh), early vigor (UPLRi7, NERICA4), Kali (Aus); root length density, proportion of lateral roots, and proportion of roots below 15 cm (Sambha Mahsuri, WAB880-1-27-9-2-PI-HB, Dular, NERICA4), root hair length (Swarna), root hair density(Mikhudeb); low canopy temperature under drought (Dular), response to fertilizer applicatio. (Vandana, Dular), nutrient use efficiency (yield/uptake) (Dular), seedling stage cold tolerance (Jinubu), high temperature (N22); first Indica donor tolerance to nematode (IR78877-208-B-1-2); and lodging resistance-(Moroberekan).
- A set of 12 complex populations utilizing identified donors have been developed. As an alternative approach to develop better breeding lines for DSR, more than 10,000 plants for each complex F_2 generation were planted and plants combining different traits identified in segregating generations.
- QTLs were identified for grain yield under dry direct seeded situation ($qGY_{1.1}$, $qGY_{6.1}$, $qGY_{10.1}$); anaerobic germination ($qAG_{9.2}$, $qAG_{7.1}$, $qAG_{7.2}$), early uniform emergence ($qEUE_{1.1}$), early vegetative vigor- ($qEVV_{9.1}$); nutrient uptake ($qNU_{5.2}$) colocated with QTL for root hair density; nematode tolerance ($qGYLD_{10.1}$), seedling stage cold tolerance (qCTS4a, qCTS11a), lodging resistance ($qLDG_{3.1}$, $qLDG_{4.1}$), high temperature tolerance($qHTSF_{1.1}$, $qHTSF_{4.1}$), and drought tolerance ($qDTY_{1.1}$, $qDTY_{3.1}$, $qDTY_{12.1}$).

The following goals are identified for integrating physiological tools to enhance breeding efficiency

- Develop better understanding of the physiological bases for plant growth and plant development as relevant a more integrated crop model for DSR
- Evaluate and develop best practices through trials and simulations and use platform trials to identify and evaluate donors with desired phenological traits
- Establish field phenotyping facilities and protocols for heat tolerance/avoidance in CSISA hubs across hot-dry (Hyderabad and Ludhiana in India) and hot-humid (Tamil Nadu in India and Joydebpur in Bangladesh) regions.
- Develop relationship between maintenance respiratory losses, grain filling and crop duration for HNT established and quantified under field conditions. Identify promising lines tolerant of HNT at reproductive stage.

Strengthening partnership with public and private sector

CSISA Objective 3 effectively linked with the national breeding programs where breeding for DSR is a goal. An effective multilocation evaluation trial system in collaboration with national partners in India, Bangladesh and Nepal to evaluate and identify superior lines for DSR situations has been put in place. Many of the breeding lines from IRRI are under evaluation. CSISA provided a platform for evaluation of private-bred hybrids under machine-sown dry direct-seeded conditions in Punjab, Uttrakhand Odisha, Bihar, Telangana, Karnatakka and Tamil Nadu. Promising hybrids reached farmers' fields. A number of scientists from different institutes trained on breeding for DSR, including marker-assisted breeding, statistical data analysis and phenotyping. More than 15 students carried research to contribute to enhancing yield under DSR, including trait development, physiology and high temperature tolerance.

Moving forward to breeding in CSISA Phase III

Breeding for crop improvement is a continuous process that goes hand in hand with gene donors and trait development to address emerging constraints. Breeding for dry direct-seeded rice is one such area. Most of the crop management options as well as mechanization recommendations for DSR have come from experiments involving rice varieties better adapted for transplanted situations than dry direct-seeded situations. However, dry direct-seeded rice is one area where mechanization and improved nutrient, water and weed control management practices are guiding the evolvement of appropriate breeding strategies for developing suitable rice varieties for DSR.

Over last three years significant progress has been made in varietal development and identification of QTLs and genes for traits related to dry direct-seeded situations. The donors, traits and genes identified for DSR have provided breeders with new opportunities to combine them following marker-assisted breeding to develop short duration varieties (1) better adapted to a changing climate scenario and (2) for expanding mechanized agriculture in labor- and water-short areas of South Asia (Figure 6). Input responsive lines with excellent performance under mechanized transplanted situation with required adaptability to the climatic conditions shall be used as one of the parents in the MAS.

As the rice cultivation shifts from total anaerobic to extended period of aerobic conditions, solutions to abiotic and biotic constraints predominant in aerobic soil conditions, such as Fe and Zn and resistance to nematode needs immediate attention. Recent research at IRRI on tolerance to M. graminicola has identified some donors and QTLs for resistance to nematode; more such donors and QTLs are needed. Similarly, donors and QTLs with better tolerance to Fe and Zn are required. Sustaining higher rice yields under low light intensity is another area needing immediate attention. Suitable genetic resources and QTLs need to be identified for use in the breeding programs. In the genomics era, the characteristics of high end-use quality of traditional varieties can be revealed by integrating genomics and cereal chemistry using traditional and new varieties to provide breeders with new traits to develop better quality rice varieties.

A detailed exercise on priorities for IRRI to undertake breeding and management research in South Asia undertaken by IRRI staff based in India indicates that the important areas of research, such as breeding for DSR, nematode tolerance, tolerance to low radiation, and variety fit to variable situations (Table 2) have an important place for sustainable rice production in South Asia. However, concentrated efforts to have lead research in these areas are lacking. The third phase of the project proposal will undertake systematic research to find solutions to these emerging problems.

In CSISA Phase III the following outputs are proposed to be targeted:

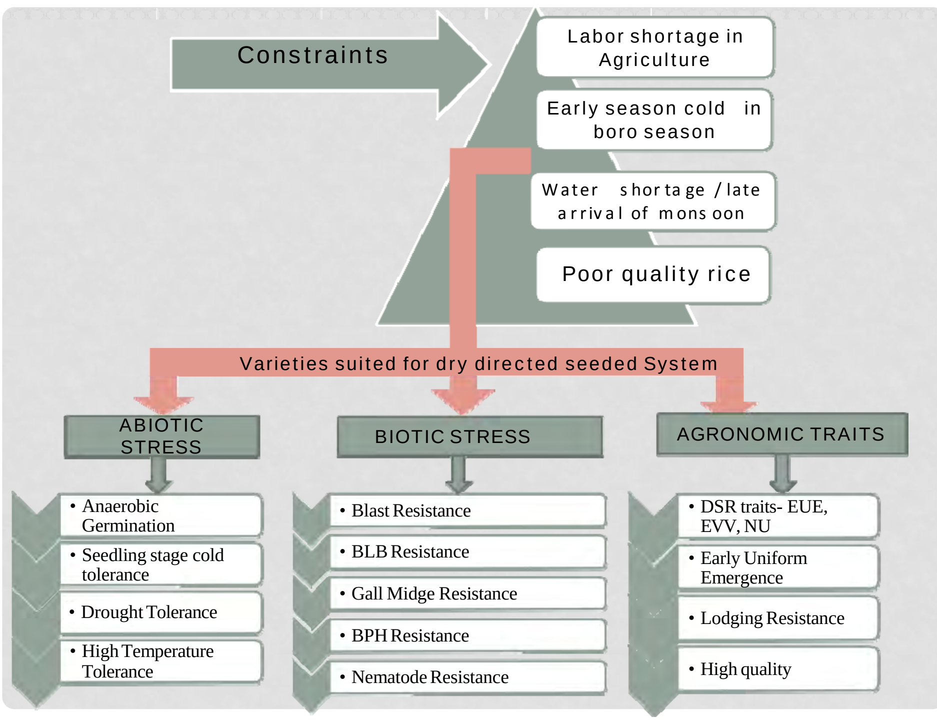
- Disseminate new DSR rice varieties together with mechanized DSR cultivation practices linked with CSISA Objective 1
- Multilocation evaluation and release newly developed breeding lines developed in CSISA phase II through national systems in India, Nepal, and Bangladesh
- Develop next-generation DSR rice varieties with adaptability to a broad range of fluctuating soil and environmental conditions through combination of tolerance to anaerobic germination, seedling stage cold, early uniform emergence, early vegetative vigor, higher nutrient uptake, lodging resistance, reproductive stage high temperature tolerance, grain yield under DSR, and resistance to blast, bacterial leaf blight, gall midge, and brown plant hopper using MAS with QTLs and traits identified in CSISA Phase II
- Identify new donors and QTLs for tolerance/resistance against M. graminicola nematode
- Identify new donors and QTLs for tolerance to Fe and Zn soil deficiencies
- Identify donors and QTLs for increased yield under low light intensity
- Identify traits related to good cooking quality in rice and integrate these traits with breeding

Expected outputs

- Seed production process for DSR varieties will be in place and linked with national/provincial seed production systems; DSR varieties will be disseminated with mechanized cultivation and management practices.

- New high yielding varieties and breeding lines for DSR will be developed in India, Nepal and Bangladesh with breeding for DSR implemented by national partners in South Asia.
- New DSR lines combining traits needed for high yield and tolerance to abiotic and biotic stresses will be developed through MAS by NARS and IRRI scientists.
- Donors and stable QTLs for tolerance/resistance against nematode will be identified and delivered to breeding programs.
- Donors and QTLs for tolerance to Fe, Zn soil deficiency will be discovered and delivered to breeding programs.
- Donors and QTLs to enhance rice productivity under low light intensity will be identified an. delivered to breeding programs.
- Improved cooking quality will be studied and key traits identified for use in breeding programs.

FIGURE 3: Traits combinations needed to develop new generation rice varieties with broader adaptation to fluctuating climatic and soil condition



Participating partners: BAU-Bihar Agricultural University, Sabour, Bihar, India; OUAT-Odisha University of Agriculture and Technology, Bhubaneshwar, Odisha, India; GBPUAT-GB Pant University of Agriculture and Technology, Pant nagar, Uttrakhand, India;, PAU-Punjab Agricultural University, Ludhiana, Punjab; NG Ranga APAU-NG Ranga Andhra Pradesh Agricultural University, Center Maruteru, Andhra Pradesh, India; DRR-Directorate of Rice Research, Hyderabad, Telangana, India; BRRI-Bangladesh Rice Research Institute, Gazipur, Bangladesh; NRRP-National Rice Research Project, RARS, Tarharra, Nepal

WHEAT BREEDING (OBJECTIVE 4)

1. **Specific breeding goals for CSISA project.**

   CSISA wheat breeding will develop wheat varieties with higher yields (>5% than current varieties by year 5 and 15 percent higher by year 10) that are well buffered against the vagaries of climate change, have greater tolerance to heat, resistance to biotic stresses (such as leaf, yellow, and stem rusts, and spot blotch), are adapted to CA practices and have consumer preferred end-use qualities. Objective 4 provides products for Objectives 1 and 2, including new lines that will be well-adapted to CA practices.

These objectives are relevant and critical for the eventual interventions in the wheat-rice cropping systems that will be adopted from CSISA research.

2. **Finance provided by USAID and Gates Foundation.**

Funding for Objective 4 is shared between BMGF (69%) and USAID (31%). Each NARS collaborating institution is subcontracted at about $15,000 per year. In addition, about $100,000 per year is spent on NARS for attending annual meetings and regional or international travels to visit Mexico, Kenya or other venues.

The collaborators in Bangladesh and India are in great need of the funds provided to be able to expand their programs to meet the important goals of CSISA. These relatively small provisions provide the glue to strong collaborations.

3. **Animal nutritional quality of wheat straw.**

The project had an objective for breeding for enhanced nutritive value of the straw for livestock. In Phase II, this component was merged with Objective 1 and no longer included in the wheat breeding objective. Results obtained in the first three years were substantial and may be used to justify future interventions in animal feeding in the wheat-rice cropping system. Some results from this research follow. (a) Near-infrared spectrometry (NIRS) equations for prediction of wheat straw quality traits were validated and refined. A new NIRS instrument (FOSS Forage Analyzer 6500) was calibrated with the updated NIRS equations (for wheat straw); (b) Use of wheat straw in crop-livestock systems was investigated from farm to fodder trader to feed processors. (c) A wide range of CIMMYT wheat germplasm (CSISA Heat Tolerant Early and Normal Maturity, Semi-Arid Wheat Yield Trial, Elite Spring Wheat Yield Trial, and 1st and 2nd CSISA Drought Tolerant Yield Trials) was investigated in several environments in India, Nepal and Bangladesh. Straw fodder quality and grain yield were inversely associated, but some cultivars/lines had incorporate favorable grain and straw fodder quality traits; (d) Genomic association mapping was used establish the relationship between genetic structure and wheat straw fodder quality differences. Favorable acid detergent fiber (ADF) and acid detergent lignin (ADL) content showed good association with an SNP located on chromosome 5B.

The pull-back on this objective for the wheat breeding aspects is supported by this review. The likely gains in nutritional value of straw are likely to be small relative to costs and the traits are highly influenced by the wheat management fertilization regimes and seasonal climatic conditions. However, wheat as a green fodder crop is under investigation where harvests are made during tillering/preheading stages. This permits the crop to continue to grow and produce grain. Critical research is needed to identify genotype-harvest stages for optimum production of fodder and grain.

4. **Wheat traits important to enhance conservation agriculture.**

The CSISA project goal of establishment of wheat after harvesting rice (or some other crops) sown in the monsoon season requires earlier planting of wheat. With zero-till planting machines widely available at affordable price, planting can be done up to two weeks earlier, depending on the moisture in the soil; however, the crops are exposed to warmer temperatures. This requires wheat plants that take advantage of the soil moisture for germination, but they must remain in vegetative phase to permit tillering and development of high biomass to support high grain yields. This allows wheat crop extra time to grow and produce higher biomass and grain yield. Identification of wheat germplasm to meet these requirements has been underway for three seasons with early sowing in Mexico and with six partners in India with assistance of a BMZ project (terminating 30 June 2015). Resistance to spot blotch and tan-spot are also being improved as these diseases are expected to increase under-zero tillage and have become important in the Eastern Gangetic plains. Elite germplasm is under evaluation in field and greenhouses in Mexico. Advanced lines are also being evaluated under conservation agriculture (CA) practices (including zero till and raised beds) both at CIMMYT and by NARS. Participatory and multi-location testing of new wheat varieties is done in different management systems, including CA systems.

This aspect of CSISA is critical and the progress up to now is substantial, based on discussions and review of data. The project requires several more years of linkage of the breeding programs to Objective 1 activities to realize the full impact of new cereal production systems in South Asia.

5. Technical aspects of breeding.

Parents for CSISA crosses include new CIMMYT lines identified especially for high yield, heat tolerance, drought tolerance, earliness and disease resistance. The parents are identified by testing under a wide range of environments imposed in the northern Mexico research site and in CSISA collaborating institutes. Released varieties in South Asia, promising lines, and other sources of heat and drought tolerance or spot blotch resistance identified by the physiology/pathology group are also used.

Within CSISA, about 500 simple and 400 BC1/3-way crosses each year are made in Mexico. The size of BC1/3-way crosses is about 400 plants. Crosses are also made by each of the NARS partners using the materials selected by them from their own breeding programs and from introductions coming from Mexico and other breeding programs in India. At CIMMYT crosses are made at the Cd. Obregon and El Batan stations. A Mexico-Kenya shuttle breeding scheme is used for selection for disease resistance (Kenya cost absorbed by the DRRW/Cornell project). F3/F4 and then F4/F5 segregating generations are grown in Kenya for two consecutive seasons each year and then F5/F6 are grown in Obregon for final plant selections. Advanced lines return back to Kenya for phenotyping of stem rust resistance. The same populations are grown under drought as F3/F4 in Obregon. Physiological tools CTD, NDVI, visual selection grain yield in unreplicated trials are all used in evaluating the populations for drought tolerance. For CSISA NARS, crosses are made at the main research station and generation advancements are done utilizing off-season facility at Keylong (Himachal Pradesh) and Wellington (Tamil Nadu).

In segregating and advanced generations, local checks are used to select for appropriate phenology, plant height, maturity, and yield traits. Artificial epiphytotic is created to select resistant plants/lines having other desired traits. Advanced lines are evaluated in replicated trials to validate yield superiority over best checks.

Presently in Mexico, high-throughput measurement of NDVI and CTD is under investigation in yield trials. Genomic selection models are under development (supported by the USAID genomic selection project through KSU).

Molecular markers are used to characterize parents for traits, such as disease resistance and end-use quality in Mexico. One of the objectives of the project is to identify markers for heat tolerance and spot blotch resistance for utilization in breeding. Genomic selection strategies are being implemented to predict heat tolerant lines. Marker-assisted selection is becoming part of breeding at NARS, mainly for rust resistance and grain protein content.

The CSISA project collaborators receive substantial support from CIMMYT through its sharing of genetic materials arising from the extensive breeding activity in Mexico. The genetic materials are relevant and the testing environments in Mexico are representative of the main environmental issues of South Asia. At the same time, the local environments provide the most important selection sites for advancing CSISA's goals. Several CSISA collaborators have facilities for evaluation of heat and drought tolerance and provide key support to the identification of parental lines for their hybridization programs and for CIMMYT/Mexico.

6. Physiological trait-based approaches to breeding.

The uses of physiological and morphological measurements in plant breeding have been greatly advanced in recent years by new instrumentation allowing for rapid and accurate measurements on large populations of plants. CIMMYT, with leadership by Matthew Reynolds, has successfully evaluated several traits that are highly correlated to yield performance. The methods have been outlined, with rationale for use, in a principles volume and in user's manual. These methods were seen to be used in breeding programs in India during this evaluation. Alistair Pask, consultant and former CIMMYT scientist has visited CSISA partners each year. The best lines from pre-breeding evaluations in Mexico are being distributed as a stress adaptive trait yield nursery (4th SATYN is currently growing in CSISA network) and as Wheat Yield Consortium Yield Trial (WYCT) (the second WYCYT was grown in CSISA in 2013, and the third WYCYT will go out in 2015).

This aspect of wheat breeding to meet CSISA goals is highly relevant and likely to aid in meeting the complex breeding goals for CSISA's cropping systems approach to intensive sustainability of wheat-maize production in South Asia.

7. Details of collaborations in-country.

All recently released varieties and those identified for release are tested at all CSISA hub locations in each of the three countries. In addition, potential superior advanced lines are also grown, and these varieties/advanced lines are also grown in research platforms (Objective 1).

Advanced lines from CIMMYT (in different trials/nurseries) and those developed by NARS are grown in replicated trials in the main NARS breeding stations. For example, in current cycle (2014-15), more than 100 trials/nurseries were shipped from Mexico and were planted in different locations. The four mapping populations developed for characterization of spot blotch resistance are being phenotyped at Agua Frias, Mexico (CIMMYT) and four NARS experimental sites (BHU-Varanasi, PUSA-Samastipur, UBKV-Coochbehar (India) and BARI-Dinajpur (Bangladesh)).

Many non-CSISA centers also plant these trials. The number of NARS partners increased from 11 in Phase I to 42 in the Phase II. Linkage with private sector was also strengthened. From one private sector collaborator in Phase I, there are 10 private companies linked in Phase II in India. Likewise, in Nepal and Bangladesh, around a dozen private seed companies, nongovernmental organizations (NGOs) and farmers' groups are given seed of advance lines for pre-release multiplication and that of released varieties for large scale adoption by farmers.

CIMMYT and the collaborating countries have developed exceptionally mutually beneficial programs. This can be attributed to outstanding leadership by the CIMMYT team, based on several decades of collaboration. The sharing of germplasm is a major achievement, both from CIMMYT to NARS and from NARS to NARS programs. CSISA has provided the framework for realizing its goals of identifying and validating critical interventions for cereals production in South Asia, which depend on sustained collaboration and integration of Phase III. The small amount of funds provided to each NARS breeding program is a tangible benefit to the national breeding programs that permitted expansion of their programs to meet CSISA goals.

8. The Kenya connection for disease evaluations.

The CSISA project has benefitted from the CIMMYT coordination of disease screening for rust resistance in Kenya. This was motivated by a new race of stem rust (Ug99), discovered some years ago, that has potential to infect wheat throughout the globe. Breeding lines from India have been sent directly to Kenya for screening and returned to India via Mexico.

Since this race is not present (yet) in the CSISA countries, this anticipatory breeding may not be needed, but is highly worthy of the effort because once the disease becomes important 10 years or more are needed to succumb it via distribution of resistant wheat varieties.

9. Movement of seed into the target countries.

CIMMYT has been able to send seed to all collaborating countries. It only sends seed assured not to be infected with Karnal bunt (smut). Receiving seed from other countries is generally possible, but India does not allow seed to be sent out unless it is for an approved project. So far, for the CSISA wheat breeding this has been satisfactory.

The restriction on germplasm exchange exercised by India is problematic for many collaborators, including rice breeders, and this is under active discussion at policy levels and should be a high priority activity in Phase III.

10. Human resource development (Capacity-building, CB)

CB that has been a very important segment of CIMMYT's program since the days of Dr. Norman Borlaug, it was included in Phase I but dropped in the Phase II for lack of funds. In Phase I, Mexico-based training was conducted for about 30 breeders, pathologists and physiologists from the three countries. Two training programs (in 2010 and 2011) were conducted by CIMMYT/Nepal for 43 young scientists. In addition, each year around a dozen participants attended rust course at Kenya.

In Phase II, from limited resources, a series of training programs, interaction meetings, field days and workshops were organized for scientists, technical staff, farmers, state agriculture department officials, NGOs, and other stakeholders within the three CSISA countries. A total of 996 NARS were engaged in capacity-building activities that included a range of subjects in wheat breeding, pathology, physiology, plant protection, seed production, HarvestPlus, statistics and crop management.

CIMMYT's goal for CB in Phase III will be to train at least 12 young scientists each year, and about 10 CIMMYT scientists travel to the region to provide necessary training and scientific support. On an annual basis, two wheat courses by CIMMYT (at Mexico and Kenya) and one in the region will lead to strong CB and interest in the breeding program.

Human resource development is a critical function for CSISA, and it was unfortunate that this activity was limited in Phase II. Clearly, Phase III must include capacity-building as it moves to transition of the breeding efforts to greater involvement and innovations by the CSISA country research organizations.

11. Complementary collaborative projects.

The Genomic Selection (GS) project under Kansas State and Cornell Universities, funded by the U.S. Agency for International Development (USAID) and BMGF, is a new initiative to test and implement GS models to select heat tolerant lines. A diverse population of 600 wheat varieties and advanced lines is being grown in Mexico, three BISA sites in India and one in Pakistan. The trials will provide phenotypic data to complement genomic data collected on each line. The goal is to establish relationships of desired traits to specific DNA sequences and ultimately use those sequences as selection criteria for breeding improved varieties with the intent of providing greater gains over a shorter period of time.

At this time, this project does not directly assist CSISA, but it is developing a new breeding technique for future use. If the method is successful it will be a relevant component of Phase III.

12. Transition strategy at eventual closure of CSISA.

As NARS gets strengthened, its own programs will be able to meet CSISA objectives, especially in India where government support is substantial. However, CIMMYT is viewed as a strong partner with high expectations to deliver new breakthroughs.

Phase III should have strong capacity-building components with training in breeding program management as well as breeding technologies.

13. Personnel assigned to CSISA wheat breeding at CIMMYT and in the three participating countries

Names and assignments were provided by CIMMYT of 26 scientists affiliated with the CSISA project. This included 11 CIMMYT scientists who had complete, but more likely partial, assignment to CSISA. Twelve national program leaders were identified and some of those have associated scientists in their programs.

FUTURE PLANS FOR CSISA PHASE III: THE CASE FOR INVESTMENT IN WHEAT BREEDING FOR SOUTH ASIA. (PREPARED BY CIMMYT, NOT NECESSARILY FINAL VERSION)

Wheat is vital for food security in South Asian countries Nepal, India, Pakistan and Afghanistan and has become important in Bangladesh providing 13 percent, 20 percent, 37 percent, 66 percent, and 6 percent of calories and protein, respectively. Given the challenges imposed by climate change, increasing population, dwindling resources and a range of socio-economic issues in the region, wheat breeding is of significant importance for sustainable food security and poverty reduction in the region. Over the short term, existing yield gaps can be reduced through a combination of higher yielding stress-tolerant and disease-resistant varieties, improved agronomic management practices, innovative extension initiatives and reduced post-harvest losses. Over the longer term, increasing yield potential is being re-vitalized and breeding programs adjusted to utilize modern molecular breeding methods for producing climate resilient improved varieties that will be more productive in future cereal systems.

CIMMYT's contribution to the Green Revolution is well known. Elite wheat lines developed and distributed by CIMMYT are today grown annually on more than 150 sites worldwide. CIMMYT distributes around 1,000 advanced breeding lines each year, adapted to major agro-ecologies affecting small holder farmers throughout the developing world, and are evaluated by co-operating breeders for biotic and abiotic stress tolerance. Wheat in South Asia covers more than 40 million ha and is a primary target region for CIMMYT's Global Wheat Breeding Program, which supports and cooperates with breeding program of the national agriculture research system (NARS) and more recently private seed companies for an uninterrupted development of germplasm, varietal release and seed dissemination among a vast number of stakeholders and farmers. CIMMYTs wheat program also provides major support to other wheat breeding investments (USAID Genomic Selection project for climate resilient wheat; HarvestPlus for biofortified wheat; Durable Rust Resistance Wheat–DRRW) with relevance to South Asia. Overall, CIMMYTs wheat breeding program has played a foundational role in cooperating with both NARS in South Asia and project partners based in Advanced Research Institutes (ARIs) like KSU and Cornell.

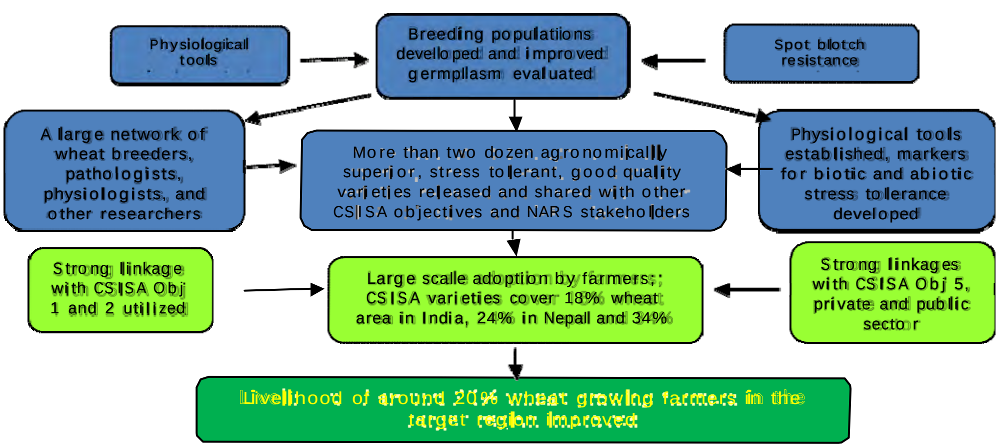
Since 2009, wheat breeding work (Objective 4) within CSISA has been a major breeding program in South Asia with both CIMMYT and NARS playing an excellent collaborative role. CSISA wheat breeding endeavored to develop bread wheat varieties with higher yields (>5% than current varieties by year 5 and 15% higher by year 10), are well buffered against the vagaries of climate change, have greater resistance to biotic stresses (such as leaf, yellow, and stem rusts, and spot blotch), are adapted to CA practices, and have consumer preferred end-use qualities. It provided products for Objectives 1 and 2, including new lines well adapted to CA and other management practices. In addition, it was also strongly supported by social science work on seed systems and markets in Objectives 1 and 5. These objectives made a steady progress in both phases of CSISA and established strong linkages with Objectives 1 and 2 in taking new varieties to farmers and protecting them from vagaries of climate, new races of pathogen, which enabled a better livelihood of farmers. Further, the success was based in part on strategic contributions from various NARES institutions.

Therefore, an increased investment for wheat breeding in South Asia with CIMMYT and NARS is required for a long-term sustainability of food security and reduction of poverty in the region. The extended CSISA (Phase III) is supposed to take support from other wheat breeding initiatives such as Genomic Selection and further intensify linkages to the CSISA hubs through the development of a new cross-objective planning process that will align activities along common impact pathways.

ACHIEVEMENTS OF CSISA OBJECTIVE 4 (WHEAT BREEDING)

The general approach and achievements of Objective 4 to attain CSISA goal is summarized in Fig 1, which has already shown its ability to deliver impacts briefly summarized below.

FIGURE. 4. The general approach utilized in Objective 4 to attain the CSISA goals



Delivered outstanding varieties to farmers

In last three years, CSISA Objective 4 partners in national programs released 32 outstanding wheat varieties in India, Nepal and Bangladesh (Table 4), which proved attractive to farmers and stakeholders due to 5–10 percent agronomic superiority over the best check varieties along with disease resistance, good chapatti/bread making quality and capacity to adjust to heat and drought stresses. Hence seed multiplication and dissemination of new varieties was ensured. In 2014 alone, 21 outstanding wheat varieties were released for different environments and management conditions. This was achieved by evaluating around 50,000 breeding populations, 16,000 advanced lines in replicated trials, promoting 3,000 lines in national network trials, conducting 1,689 PVS/ adaptive trials in farmers' fields and by making more than 4,000 crosses.

TABLE 2. CSISA wheat varieties released in India, Nepal and Bangladesh during 2011–14 and the proportion of NARS and CIMMYT germplasm involved

Country	Number of varieties released	CIMMYT direct releases by NARS	CIMMYT pedigree involved in NARS hybrids	CIMMYT direct releases by NARS (%)	CIMMYT pedigree involved in NARS hybrids (%)
Nepal	5	2	3	50	60
Bangladesh	4	2	2	50	50
India	24	15	9	62.5	37.5
Total	33	19	14	57.6	42.4

Significant area covered by CSISA wheat varieties

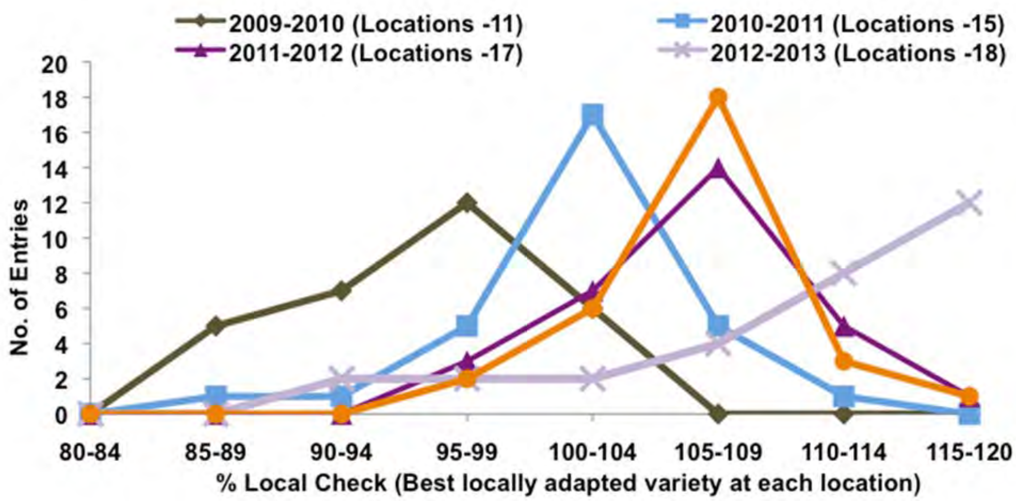
Seed growers and farmer groups continued seed dissemination of superior lines produced under CSISA. Breeder seed indent and production figures indicated that in 2014 cycle, CSISA-bred lines had 18 percent share in in India, 24 percent in Nepal and 34 percent in Bangladesh. This seed production is expected to increase significantly in coming years through certified seed produced and varieties will cover proportional areas for the fact that new varieties will gain further ground. In addition to this, there are PVS promoted varieties such as Baj that are not yet released but are being grown in around 50,000 ha area in eastern Gangetic plains (UP, Bihar, Jharkhand and West Bengal).

FIGURE. 5: Percent wheat area covered by CSISA wheat varieties in south Asia in 2014 (estimates are based on breeder seed production figures and data provided by NARS)

Up-scaled breeding for terminal heat stress tolerance

Special efforts were initiated to breed for terminal heat tolerance by evaluating 3,000 advanced lines under very late (February) sowing at Cd. Obregon. Significant progress was achieved as shown in Fig. 3. The results suggest that the early maturing, high yielding heat tolerant lines developed at Mexico are adapting well to the diverse heat stressed areas of south Asia. One such variety—HD 3118 (ATTILA*2/PBW65//WBLL1*2/TUKURU) selected from the 1stCSISA Heat tolerant Early Maturing trial was released in 2014 for North Eastern Gangetic Plains (NEPZ) of India (encompassing Eastern UP, Bihar, Jharkhand, West Bengal, Assam and plains of NE States) as it demonstrated 6 ton/ha yield under late sown conditions. Another CIMMYT cross (INQALAB91/Turkuru) demonstrated 6.8 t/ha and was released as DBW19 for NEPZ of India in the current year.

FIGURE. 6. Performance of entries in 1st to 5th CSISA early maturity heat tolerant trials under Objective 4 in South Asia (Target area: 10 million ha) in India, Nepal and Bangladesh



Farmers are protected from adverse effects of aggressive strains of diseases

All the 33 wheat varieties delivered through CSISA Objective 4 are resistant to all three rusts in South Asia and several have adequate levels of Ug99 and spot blotch resistance. Hence, without addition of any cost, farmers are protected by durable resistance embedded in the seed along with agronomic superiority. This was achieved by screening all 50,000 breeding populations and 16,000 advanced lines under artificial epiphytotic conditions for spot blotch and rusts including Ug99 resistance in Kenya.

Spot blotch research was systematically augmented. From around 10,000 genotypes evaluated by CIMMYT and NARS over last three years for spot blotch resistance, around 250 superior lines identified by national program for use in breeding and crossing program. By mapping four populations in South Asia and Mexico, first mapping results for spot blotch were obtained.

Physiological tools deployed

Lines identified from genetic resource collections that show favorable expression of heat adaptive traits were phenotyped across South Asia and suitable physiological traits providing adaptation to heat stress were determined. Results of physiological trials supported the proof of concept that yield potential can be increased up to 10 percent through strategic physiological trait crossing. Two manuals on the use of physiological breeding were published and widely distributed. A network of physiological breeding established with continued program of onsite training and capacity building imparted to all collaborators.

Partnership increased, including private sector

The number of NARS partners increased from 11 in Phase I to 42 in the Phase II. Linkage with private sector was also strengthened. In Phase I, there was one private sector collaborator; in Phase II, 10 private companies are linked in in India. Likewise, in Nepal and Bangladesh around a dozen private seed companies, NGOs and farmers groups are given seed of advance lines for pre-release multiplication and that of released varieties for large scale adoption by farmers. Variety Super 272, selected from 3rd CSISA-HT-EM trial, was released in 2014 by a private seed company with expected seed production of 1,200 tons in 2014/15 season.

Capacity building of NARS strengthened

Capacity building being key mandate for CIMMYT, a series of training programs, interaction meetings, field days and workshops were organized for scientists, technical staff, farmers, state agriculture department officials, NGOs and other stakeholders in past three years. A total of 996 NARS were engaged in capacity building activities that included a range of subjects in wheat-breeding, pathology, physiology, plant protection, seed production, HarvestPlus, statistics and crop management.

Spill-over and leverage benefits observed

The most tangible spillover occurred on August 13, when the Government of Bhutan released two new improved wheat varieties (Bajosokhaka and Gumasokhaka) from CIMMYT. This was the first release of any wheat variety in this country in the last 20 years. Both varieties have water stress tolerance and good resistance to yellow rust and yielded on average, 50 percent higher than the most popular variety, Sonalika, in three years of multi-location testing in Bhutan. Two wheat varieties from Punjab (PBW621, PBW644) that were released for North Western Plains Zone got large seed indent from Bihar due to excellent performance. HD2967, a dominant variety of NWPZ of India was released for eastern Gangetic Plains. Likewise, CSISA bred wheat varieties in Bangladesh spread to new areas - southern Bangladesh (Jessore, Khulna, and Barisal) benefitting around 10,000 farm families.

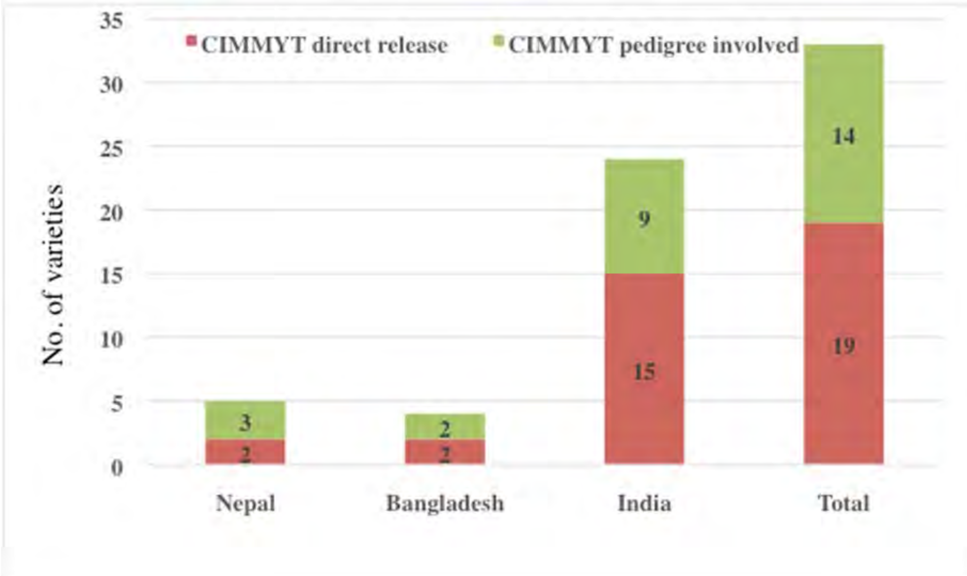
Leverage was also seen in Objective 4 in south Asia influences by success of new wheat varieties. For instance, due to release of new varieties, West Bengal (India) government decided to replace older but popular cultivar PBW 343. Increased profit due to new wheat varieties led to discouragement of boro rice by Bangladesh government in traditional wheat areas. Bangladesh government has also taken steps to promote early maturing rice varieties to encourage timely sowing of wheat in Bangladesh.

Focus of Objective 4 in Phase III

Wheat productivity needs to increase worldwide by 1.6 percent annually until 2050 to meet the demand. On the other hand, climate change is projected to reduce wheat productivity at the same rate and to compensate these negative effects the actual required efforts are equivalent to annual gains of around 3 percent. To achieve the required productivity gains, strong breeding emphasis in enhancing yield potential together with climate resilience and disease resistance must continue. This makes a strong case for continuation in well targeted wheat breeding investments for South Asia where wheat is grown on 40 million ha and almost entirely consumed locally. Since productivity gains will need an integrated investment in breeding together with a more precise agronomic management under conservation agriculture and capacity building to reach to small farmers, it will be extremely advantageous to continue breeding program within CSISA. The combination of genetic potential and agronomic management will provide a synergistic outcome to address urgently required food security requirements in the region.

The major breeding focus in Phase III will be the Eastern Gangetic Plains and central India, terai of Nepal and all of Bangladesh, where terminal heat and water stress and spot blotch are serious constraints to enhancing wheat production, however spillover effects will also be seen in other wheat growing regions of South Asia. The national wheat program has its own breeding program, which gets reinforced from a sustained supply of outstanding germplasm from CIMMYT. The shuttle breeding derived breeding material selected in Mexico and Kenya (also selected by participating visiting scientists from South Asia) brings in a new genetically superior and more resilient germplasm pool to the region. This can be understood from the fact that of a total of 24 CSISA partners released varieties in India since 2011, 15 (62.5%) were direct CIMMYT releases while remaining 9 (37.5%) had CIMMYT germplasm in the pedigree (Figure 7). Likewise, in Nepal and Bangladesh, of five and four varieties released respectively, half (50%) were direct release in Bangladesh, 40 percent in Nepal. The remaining had CIMMYT germplasm in the pedigree (Figure 7).

FIGURE 7. CSISA wheat varieties released in India, Nepal and Bangladesh during 2011–14 and the showing the numbers of direct releases by NARS of CIMMYT lines and the number of varieties released after hybridization of CIMMYT and NARS parental lines.



In coming years, breeding activities will be enhanced with greater involvement of South Asian collaborators in the development and evaluation of breeding populations and advanced lines. USAID supported Feed the Future Innovation Lab on Applied Genomics, KSU, leverages upon the breeding activities conducted under the CSISA and other projects such as DRRW funded by BMGF and is implementing the genomic selection strategies to improve the selection efficiency for heat tolerance.

The role of the private sector will be increased in the evaluation and dissemination of new varieties. CIMMYT's global cooperative evaluation network will continue to be used for breeding and characterizing a large number of lines for various agronomic, disease resistance, and physiological traits. The best selected materials will be shared with NARES and extended testing will be done in South Asia. Wheat populations will be shuttled between Mexico, Kenya and South Asia to incorporate durable resistance to biotic stresses, and broad adaptation to diverse abiotic stresses.

Summary of vision of the investment for Phase III

- The target area will be northwestern and eastern Gangetic Plains and central India, terai of Nepal and all of Bangladesh and Pakistan where high yields, terminal heat and water stress, rust resistance and spot blotch are serious constraints. These regions also require good processing quality.
- The various breeding efforts at CIMMYT with relevance for South Asia, i.e., current CSISA Objective 4 components with breeding, physiology and leaf blight resistance will be closer integrated with other major breeding programs, i.e., HarvestPlus (Zn and Fe enrichment in grain), Durable Rust Resistance for Wheat, and Genomic Selection Program with KSU and Cornell. These programs already build upon one another. Breeding emphasis will be to enhance yield potential together with climate resilience and disease resistance.
- CIMMYT's global cooperative evaluation network will be used for breeding and characterization of a large number of lines for various agronomic management systems and disease resistance.
- Parental lines and segregating populations are selected for physiological stress-relevant traits.
- The best selected materials will be shared with NARES and extended testing will be done in South Asia.
- Wheat populations will be shuttled between Mexico, Kenya (rust resistance) and South Asia (local adaptation) to incorporate durable resistance to biotic stresses and broad adaptation to diverse abiotic stresses, in particular heat tolerance and water use efficiency.

- Elite lines will be developed in CSISA are used in H+ program as parents for Zn and Fe enrichment.
- Increased use of non-conventional and molecular tools to the following achieve annually:
  - o >100 lines with required rust and spot botch resistance
  - >50 lines with enhanced heat and drought tolerance (~5% less decline under same management, as today).
- Greater number of NARS will be involved in the development and evaluation of breeding populations and advanced lines. We wish to include almost every wheat center (depending upon resource available)
- A cross-connection with USAID-supported Feed the Future Innovation Lab on Applied Genomics, KSU and other projects such as DRRW, funded by BMGF, will be strengthened to improve the selection efficiency for climate resilience.
- Role of private sector will be increased (by >50%) in the evaluation and dissemination of new varieties.
- Capacity building through simultaneous visits of NARS and CIMMYT scientists to the respective locations will be strengthened following Borlaug's legacy. At least a dozen young scientists trained each year and CIMMYT scientists travel to the region

Anticipated outputs for the Phase III are:

1. Improved early, medium and normal maturing bread wheat varieties for heat and water-stressed environments with at least 1 percent annual yield gains
2. Improved wheat germplasm for rust and spot botch resistance using molecular markers

   Goal: >100 lines with required rust and spot botch resistances
3. Apply physiological tools and molecular genetics to improve heat and drought tolerance

   Goal: >50 lines with enhanced heat and drought tolerance (~5% less decline under same management)

Funding requirements for wheat breeding

In view of the greater breeding challenge and almost a doubling of efforts required to meet current targets, proportionally enhanced funding from previous years will be required. An increase (~30%) of collaborating centers from NARS and private sector will also demand significant increase in the budget. Capacity building that has been a very important segment of CIMMYTs program since the days of Dr. Normal Borlaug was included in Phase I but dropped in the Phase II. It would be of immense benefit for this activity to be reinitiated in Phase III. The target will be to train at least a dozen young scientists each year and to have around the same number of CIMMYT scientists travel to the region to provide necessary training and scientific support. On an annual basis, two wheat courses by CIMMYT (Mexico, Kenya) and one in Sotuh Asia will lead to strong capacity building and interest in the breeding program.

ANNEX H: CONSOLIDATED APPRAISAL OF POLICY RESEARCH

Introduction and Antecedents: The Rice-Wheat Consortium and the Base- CSISA

CSISA has invested substantially in supportive socioeconomic and policy research to further its agenda and quantify its impact. Aspects of country-specific policy and socioeconomics research are reported in the annexes on Bangladesh, India and Nepal. Here we discuss issues common to CSISA that have implications for the three countries, especially India.

In the 1990s and early 2000s, social scientists participated in the Rice-Wheat Consortium, but socioeconomics research was not one of the strong suits of this System-Wide Ecological Initiative. Indeed, the 2003 review highlighted the need for strengthening this area. Between 2003 and 2010, the contribution of socioeconomics to the performance of the Rice-Wheat Consortium increased markedly as CIMMYT and ILRI economists carried out very sound, in-depth microeconomics research on the spread of zero tillage and the role of livestock in household welfare.

This trend toward improvement has continued. One of the strengths of CSISA Phase II is the breadth and depth of its policy and socioeconomics research, which contributes directly to Objective 5 and supports the work in Objectives 1 through 4, especially Objective 1 at the level of the three hubs in eastern Uttar Pradesh, Bihar and Odisha in India. For example, economics research on prospects for, constraints to and outcomes in CSISA-related interventions in mechanization has confirmed conventional wisdom on the importance of awareness, but it has also generated several surprises, such as the potential for small- and medium-sized farm households to emerge as specialized service providers.

Institutional suppliers in CSISA-Phase II, CSISA-BD and CSISA-Nepal

Research capacity in socio-economics is supplied by IFPRI, CIMMYT, IRRI and their national and international partners. In general, economists and other social scientists in CSISA in India feel that they are an integral part of the initiative, and they participate actively in interdisciplinary research in the biannual planning meetings that effectively use impact pathways to plan and prioritize research, extension and training activities.

Policy research figures explicitly in CSISA Phase II as Objective 5: Improved policies and institutions for inclusive agricultural growth. Policy work primarily is embodied in research and communication activities that strengthen the policy environment around the development and delivery of new technologies and practices relevant to CSISA, and secondarily, comprises convening activities that reinforce private investment in inputs and services that foster more robust partnerships among actors in the public and private sectors.

In Bangladesh, IRRI, CIMMYT and WorldFish contribute social science input to analyze the profitability and uptake of tested technologies in the six priority hubs of CSISA-BD. CIMMYT supports similar social science input in Nepal in the two ARTCs in the Mid-West and Far-West regions.

IFPRI also uses "base" funding to support its work in Nepal and Bangladesh on topics such as mechanization, seed systems and risk management. IFRRI has partnered with CSISA-BD through IFPRI's sub-project: Policy Research Strategy Support Program based in Dhaka.

Output and performance

The output of IFPRI economists and their partners in Objective 5 is impressive. In three principal research areas—(1) seeds, traits and biotechnology; (2) appropriate-scale mechanization; and (3) rural finance and weather-index insurance—IFPRI economists have authored 20 open-access discussion papers and nine journal articles from 2009 to 2015 with an annual investment of about 1.5 full-time equivalent (FTE) scientists. CSISA has afforded IFPRI the opportunity to contract some of this research, but almost all of the research has been conducted in-house with IFPRI-affiliated post-docs, senior staff, partners and students. As mentioned above, policy studies also address constraints and opportunities in Bangladesh and Nepal, but that work is not as visible within CSISA Phase II as the research undertaken in India.

Important empirical findings include:

- The uptake of hybrid rice is presently higher and more promising in East India than in Punjab, Haryana and western Uttar Pradesh. Farmers are willing to pay premium prices for earlier-maturing hybrids with tolerance to abiotic stresses such as drought, heat and salinity.
- Participation in nationally mandated rural public works programs in India has increased the demand for labor-saving mechanization by 15 percent.
- The adoption of laser land leveling is constrained by its cost at the farm level. Per-hour cost has to decline to about Rs. 400/hour before coverage exceeds 20 percent of area.
- Varietal turnover in wheat in Haryana, a state of high production potential, is lower than expected. The area-weighted average age of varieties in farmers' fields is 12 years, indicating a moderately slow velocity of turnover that has dampened returns to plant breeding in recent years.

Additionally, empirical findings on the scope for improving seed systems in India and Bangladesh has been highly complementary to CSISA research, especially crop improvement activities undertaken on rice. In Bangladesh, for example, this work has been led by IFPRI in partnership with CSISA-BD, USAID, local partners and PRSSP (the IFPRI country program in Bangladesh that is separately funded by the Country Mission from Feed the Future monies). The work documents, analyzes and prescribes additional modifications to key reforms necessary to improve private-sector participation in Bangladesh's seed system and increase farmer access to recently released varieties and hybrids. See Naher and Spielman (2014).

Given mixed messages received by the Evaluation Team from the Initiative's management and IFPRI, the smaller convening function of IFPRI in strengthening public-private partnerships has not been as well integrated into CSISA as IFPRI's larger research activities. Two events were held in 2014, but their value in creating additional collaboration over and above what CSISA was already doing and in shedding light on the constraints and opportunities for such collaboration in the Eastern Indo-Gangetic Plain was not obvious to project management. Perhaps it is too early to assess the value of these events, but the decision to place less emphasis on larger IFPRI "brand" conferences and workshops seems like a step in the right direction for similar functions in CSISA Phase III. Ultimately, IFPRI needs to persuade project management of the value of pursuing the convening sub-objective in Phase III.

One way to enhance private-sector partnerships so as to contribute to household welfare in the rice-based cropping systems of the Indo-Gangetic Plain would be to invest in more comprehensive monitoring of private-sector research undertaken by the agricultural sector in India with national partners. In other words, the convening function of strengthening partnerships and identifying areas for improvement in the policy environment could be transformed into a research function. Funds would have to be secured from other sources to design and carry out a systematic and time-bound monitoring of private-sector research investments in agricultural research. Presumably, CSISA would not be the only beneficiary, as several IFPRI-related projects in South Asia would stand to benefit from a more rigorous monitoring of private-sector participation in agricultural research. With its emphasis on private-sector participation in service provision, CSISA would appear to be an appropriate locus for beginning such a database initiative.

The evaluation team realizes that some episodic efforts have been undertaken in the past to characterize private-sector investment in agricultural research and development in India. Given the steadily increasing involvement of the private sector in agriculture R&D in India, a more formal and routine monitoring initiative is called for.

The Phase III agenda for Objective 5

IFPRI's agenda for CSISA Phase III is ambitious in terms of contextual behavioral research on technology adoption and more aggregate technology-scenario analyses. An increase of 0.5 FTE scientist is warranted. The planned inquiry on the time allocation of women replaced by the adoption of mechanical transplanters is an exciting research area where CSISA economists should enjoy a comparative advantage in shedding light on what is one of the most important gender-related aspects of the CSISA Initiative.

In CSISA Phase III, IFPRI economists should be wary that the technologies in their planned scenario analyses are not too broadly defined and hypothetical to be of interest, importance and relevance to biological and physical scientists in CSISA. Moreover, if such work were to have been carried out without CSISA, it would have been better to invest time and energy in more contextual targeting assessments that interest CSISA project managers and scientists in lieu of generalized ex-ante technology evaluations.

CSISA's influence on policy change

Because it is extremely difficult to document impact from policy research, the USAID Feed the Future indicators present a formidable challenge to economists who engage in policy research. If policy change occurs, it most likely will only be detected several years after CSISA has been completed, when attribution of influence will be fuzzy. However, CSISA economists are in the enviable position that results from CSISA having already had a transparent influence on policy.

CSISA's overwhelming and mutually reinforcing on-station and on-farm findings have induced the State Government of Bihar to change its recommendation for wheat planting from after November 15 to before November 15. A planting-date recommendation may not sound like an important policy, but its change paves the way for a more concentrated assault on the traditional practice of late planting with shorter-duration season varieties that are characterized by lower yield potential. The November 15 planting-date recommendation may also be the precursor of other dynamics in recommendations in Bihar and in other states where CSISA research results could play a role in reversing entrenched beliefs about improved practice. CSISA's emerging results that refute the supposed economic superiority of production by the System of Rice Intensification (SRI) in Bihar is another example where the CSISA findings could pay dividends in terms of policy change. The change in planting date by state governments in India is a prime candidate for impact assessment by economists in CSISA.

CSISA-BD has indirectly contributed to policy change through its improved varietal distribution subproject, SRSPDS. In a SRSPDS-sponsored workshop in 2013, a protocol was signed by India, Bangladesh and IRRI for strengthening collaboration in the rice seed sector between the two countries with IRRI as a facilitator. Areas identified for immediate cooperation included joint varietal evaluation and release, reciprocal recognition of data for varietal release, reduced time for evaluation for MAS-generated varieties, acceptance of PVS data for varietal release, prerelease seed multiplication and dissemination, encouraging private companies to get involved in the seed sector, and the harmonization of seed systems.

These changes will take some time to analytically digest and document. Given the porosity of the border between India and Bangladesh and the size of the informal sector in the trade of rice, the magnitude of benefits from this cooperative agreement are uncertain even with strict adherence to its provisions. Nonetheless, the protocol is a sizable step in the right direction, and it warrants a future investment in ex-post impact assessment if anecdotal evidence suggests positive benefits and significant changes from the status quo, which in this case would be an appropriate counterfactual.

Socio-economic research supporting Objective 1

The productivity of CIMMYT and IRRI economists in the support of Objective 1 is equally impressive. Past and ongoing diagnostic research, economic analysis of technology options based on partial budgets and adoption research on early technology acceptance has been and still seems to be solid. In 2013 and 2014, 10 studies have been carried out in the CSISA hubs, mainly in Bihar and Odisha. In particular, the zero tillage adoption and service provider inquiries in Bihar have been very informative. The increase in net benefit with the adoption of zero tillage in the rice-wheat cropping system in central and east India is almost identical to the level found in northwest India in 2005: $100 per hectare.

The data collected in these surveys could be more exhaustively analyzed. For example, the Evaluation Team received mixed messages on the importance of sharecropping in Bihar and in eastern Uttar Pradesh. A higher incidence of sharecropping will be a deterrent to the adoption of more capital-intensive technologies such as laser land leveling unless landowners are willing to fund at least 50 percent of the cost. A "quick-and-clean" analysis of the land rental market is equally important: Are those who lease in land small and marginal farmers or larger farmers who are interested in expanding their cultivated area?

Fragmentation is another dimension of the land market that was frequently cited as an obstacle to adoption of improved components in the rice-based cropping systems of central and east India. At inheritance, fields are often equally subdivided among sons, which results in smaller, equally scattered plots with each successive generation. Land fragmentation is often regarded as an immovable constraint, especially in East India, but how malleable is land fragmentation and what is its cost for technology intervention in CSISA are questions that innovative research could address.

In India, Bangladesh and Nepal, CSISA socioeconomists have to respond to the priority to document sustainable adoption of tested and demonstrated technologies. Contextual information on how such diffusion studies can be carried out is given in the country annexes.

CSISA social scientists should also be alert to the possibility of using available datasets to enrich their characterization research in support of Objective 1. For instance, the project on Village Dynamics in South Asia (VDSA), which is also funded by the Bill & Melinda Gates Foundation, has invested in longitudinal village studies in Bihar, Odisha and Bangladesh since 2009. That project has also compiled meso-level data at the district level in India and Bangladesh. Although only a few of the VDSA villages may be found in the districts where CSISA is active, those locations (with a resident investigator) could provide an important touchstone for responding to highly focused diagnostic questions in the remaining months of CSISA Phase II and in CSISA Phase III.

For example, recent VSDA data on the rural labor market in the four study villages in Jharkhand in East India shows stagnating wages from 2010–2014. The trend in this State departs markedly from most labor market experience in the rest of India and South Asia (Figure 8). It suggests that the landless and other poor workers could be adversely affected from subsidized mechanization and the widespread, untargeted support of local service providers. The applicability of the CSISA model in geographies such as Jharkhand should be thoroughly invested before it is applied throughout East India.

Baseline data collection and priority setting

Reviews of the Rice-Wheat Consortium and CSISA have emphasized the need for investing in baseline data collection and priority setting. CSISA invested in baseline data during Phase I in 2011–2012 cropping year (Pede et al., 2012). The baseline had some positives. Social scientists from IRRI and IFPRI contributed to its design and execution. The dataset from the baseline questionnaire is well documented and is available on the Internet.

The baseline also had some negatives. Some responses about specific technologies were not that informative. Household income was not quantified. Responses for Punjab were not reported. The authors concluded that the baseline data could not be used as a reference point for rigorous impact assessment.

The baseline also demonstrates why rigorous baseline data collection and formal priority setting are risky activities in the conditions under which CSISA is operating. Data were collected on 2,628 households in a total of eight hubs in Bangladesh, India and Nepal. By Phase III of the Initiative, CSISA will only be active in three of these hubs. It is very unlikely that the data from the baseline contributed to decision making on which hubs to de-emphasize or divest of. Indeed, the baseline's only recommendation on the geographic allocation of resources across the hub never came to fruition: Because of a higher estimated incidence of poor households in the baseline survey, the Central Terai Hub in Nepal should be considered for more emphasis within CSISA. Within one year of making this recommendation, the emphasis in Nepal was moved to the West and Far West Divisions to comply with USAID's district prioritization in Feed the Future as the Central Terai Hub was abandoned. Under these conditions of donor instability, recommendations for rigorous baselines and formal priority-setting exercises should not be heeded.

ANNEX I: SCOPE OF WORK

External Performance Evaluation of the Cereal Systems Initiative for South Asia (CSISA)

Funded by: United States Agency for International Development (USAID) and Bill & Melinda Gates Foundation (BMGF)

USAID Grant ID: BFS-G-11-00002 & BMGF Grant ID: OPP1052535

Purpose

The Purpose of this mid-term evaluation of the Cereal Systems Initiative for South Asia (CSISA) is to assess program performance, to identify program successes and areas of concern, to help program implementers improve program effectiveness and to provide recommendations to the U.S. Agency for International Development and the Bill & Melinda Gates Foundation on future programming and support for sustainable intensification of cereal systems across the Indo-Gangetic plains.

Background

The Cereal Systems Initiative for South Asia (CSISA) was established in 2009 to promote durable change at scale in South Asia's cereal-based cropping systems. CSISA supports regional and national efforts to improve cereal production growth in South Asia's Indo-Gangetic Plains, home to the region's most important grain baskets. Operating in rural "innovation hubs" in Bangladesh, India and Nepal, CSISA involves more than 300 public, civil society and private sector partners in the development and dissemination of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems and policies and markets. In essence, CSISA is an innovation systems platform that links a wide range of public, private and civil society sector programs within and across South Asia.

CSISA is run by a collaboration of five international agricultural research centers, all members of the Consultative Group on International Agricultural Research (CGIAR), and each with a distinct but complementary expertise in agricultural production systems. Partners include: the International Maize and Wheat Improvement Center (CIMMYT), the International Rice Research Institute (IRRI), the International Livestock Research Institute (ILRI), the WorldFish Center and the International Food Policy Research Institute (IFPRI). Funded by USAID and the Bill & Melinda Gates Foundation, CSISA utilizes strategic partnerships, participatory technology development, future-oriented cropping systems research, and capacity building to catalyze locally-appropriate, sustainable change in rural communities across the region.

CSISA, which was originally conceived as a 10-year initiative and as stated above, the 'base' investment for Phase I and Phase II of the projected has been jointly funded by USAID-Washington and the Bill & Melinda Gates Foundation (BMGF). USAID-India also has co-invested in the base investment to support programming at CSISA's innovation hubs in India since 2010. Further, USAID-Bangladesh made a companion investment in 2010 to form the aligned sub-project 'CSISA-BD' in 2010, USAID-Nepal did the same to form 'CSISA-Nepal' in 2012, and the Bangladesh mission made additional and targeted investments in mechanization and irrigation in 2013 ('CSISA-MI'). These 'sub projects' are fully aligned with CSISA (see Figure 1), but have their own funding streams, work plans, and management processes. As the program has now passed the second midpoint of Phase II (2011–2015) of the USAID Washington, D.C., funding, and Phase I for the USAID Nepal, India and Bangladesh mission funded projects, USAID and BMGF seek an evaluation to:

- understand if and how targeted results are occurring,
- assess what program component approaches are working well and which are not performing as expected,
- provide constructive feedback to the CSISA implementation team to improve program effectiveness

FIGURE 1.

CSISA is a broad scope program with activities ranging from upstream research on cereal-based cropping systems to downstream efforts to ensure that farmers benefit at scale from science-based innovation. CSISA Phase II has six objectives:

OBJECTIVE 1: Through its innovation hubs, CSISA aims to catalyze the widespread dissemination of production and post-harvest technologies to increase cereal-based systems productivity (including livestock and, in Bangladesh, aquaculture), resource use efficiency and income

OBJECTIVE 2: Through its research platforms, CSISA aims to conduct process-based research into crop and resource management practices for future cereal-based systems.

OBJECTIVE 3: Through plant breeding, CSISA aims to develop high-yielding, heat- and water-stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems

Objective 4: Through plant breeding, CSISA aims to develop high-yielding, heat- and water-stress-tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems

OBJECTIVE 5: Through policy research, CSISA aims to contribute to the development of improved policies and institutions for inclusive agricultural growth

OBJECTIVE 6: Ensuring high-quality project management, data management, monitoring and evaluation and communications.

Objectives 2 through 5 are crosscutting for all CSISA countries, whereas Objectives 1 and 2 are strongly influenced by the co-investments made by the USAID missions. Across the 'base' CSISA and companion investments, common activities and approaches include:

1. On-farm verification of key technologies conducted in collaboration with partners and farmers in each hub.
2. Assessments of system productivity, production economics, farmer acceptance and business and policy support requirements to accelerate adoption, and fine-tuning through applied research and iterative feedback from farmers, service providers and other end-users.
3. Clear communication of how different technologies work and why they are likely to be useful under certain conditions through simple messaging in extension materials. These materials include print, radio and video, as well as a central repository called the CSISA Knowledge Bank.
4. The design, evaluation and characterization of business models that can commercialize CSISA- priority technologies.
5. Pursuit of ways to foster improved input and output markets for value chain bottlenecks that are considered tractable.
6. Creative use of strategic partnerships where there is a strong value proposition for all parties to collaborate.
7. Analysis of the enabling environment for innovation created by different regulatory, subsidy, and investment policies.
8. Capacity development of key actors, such as extension agents or future cereal system scientists, who are well-placed to contribute toward sustainable intensification of cereal systems by influencing and supporting large numbers of farmers.

Below, are the specific objectives for the CSISA from the Nepal, India, and Bangladesh USAID Missions:

A. **Nepal USAID Mission CSISA SOW objectives:**

Objective 1. Strengthening and building sustainable seed systems.

- 1.1 Seed value chain for food crops strengthened.
- 1.2 Improved crop production and productivity through the use of quality seeds of new varieties.

Objective 2: Applied research and technology validation for rice, lentil and maize.

- 2.1 Scale-appropriate mechanization.
- 2.2 Site-specific and efficient nutrient management.
- 2.3 Conservation agriculture and better-bet agronomy for sustainable intensification.

Objective 3 (cross-cutting). Supporting 'change agents' for accelerating uptake of new technologies at scale.

- 3.1 Linkages, partnerships, and innovation platforms sustained after the life of the project.
- 3.2 Improved capacity of change agents and actors involved in agriculture networks.

Objective 4. Ensuring effective project implementation and governance, and good data management practices and communication.

- 4.1 Mechanisms for project implementation and governance established.
- 4.2 Best practices employed to manage data, and project communication channels established.

B. **India USAID Mission CSISA SOW objectives:**

Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income.

- 1.1 Implementation of a goal-oriented road map for transitioning existing hubs in Punjab, Haryana, Tamil Nadu, and Pakistan, and modalities for operationalizing new hubs in E. UP, Bihar, and Odisha.
- 1.2 Participatory technology testing and adaptation for sustainable intensification.
- 1.3 Translating research into actionable products and insights.
- 1.4 Mobilizing partnerships for catalyzing impact at scale.
- 1.5 Strategic capacity development to support key agents of change.

Objective 2. Crop and resource management practices for future cereal-based systems.

- 2.1.1 Optimized cereal-based cropping systems based on performance assessments of new and current technologies that are optimized for productivity, resource efficiency, and GWP.
- 2.2.1 Models for assessing cropping system performance under different agro-ecological conditions and climate-change scenarios.
- 2.3.1 Platform trials are adjusted to incorporate key knowledge gaps identified from on-farm adaptive research and technology verification trials. New insights developed at the platforms informs the design of on-farm trials for multi-locational testing.

Objective 3. High-yielding, heat- and water-stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems.

- 3.1.1 Next generation of elite rice lines with increased yield potential, improved grain quality, and superior feeding value, heat tolerance released.
- 3.2.1 Rice for mechanized direct seeding and water-saving irrigation practices developed and released.
- 3.3.1 At least two heat-tolerant rice varieties nominated for national varietal testing.

Objective 4. High-yielding, heat- and water-stress tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems.

- 4.1.1 Improved early, medium, and normal-maturing bread wheat varieties for heat- and water-stressed environments.
- 4.2.1 Spot blotch-resistant wheat germplasm and molecular markers for resistance to the disease.
- 4.3.1 Improved heat and drought tolerance in wheat.

Objective 5. Improved policies and institutions for inclusive agricultural growth.

- 5.1.1 Improved policies and incentives that encourage private investment and public-private partnerships in pro-poor technology development and delivery.
- 5.2.1 Improved policies and incentives that address changing labor, gender, assets, and migration dynamics related to pro-poor technology development and delivery.

Objective 6. Project management, data management, communication, evaluation, and decision support.

- 6.1 Project management.
- 6.2 Data management and communication.
- 6.3 Project evaluation of outcomes and impacts.

C. **Bangladesh USAID Mission CSISA objectives:**

Objective 1. Increasing on-farm productivity.

- 1. 1 Improved varieties and production technologies for cereal and fish systems.
- 1.2 Adaptive Research for developing agronomic and aquaculture practices.
- 1.3 Mechanization.
- 1.4 Postharvest.
- 1.5 Rice seed multiplication and delivery through SRSPDS.

Objective 2. Improving household nutrition status.

Objective 3. Increasing livelihood opportunities in the agricultural value chain.

Objective 4. Enhancing capacity of partners and staff.

The program is managed by a CSISA project leader with each component also having its own lead manager. The program is advised by a CSISA executive committee including donor representatives, CSISA management, and CGIAR representatives.

The CSISA project is encapsulated within USAID'S Food Security Innovation Center (FSIC). The FSIC enables USAID to manage its research, policy and capacity-strengthening portfolio by thematic area rather than by institutional home. Research focused projects such as CSISA along with the Feed the Future Innovation Labs (formerly CRSP) are now included in one of the following seven FSIC programs. Due to its systems approach and focus on sustainable intensification, the CSISA project is encapsulated within the Program of Sustainable Intensification.

1. **PROGRAM FOR RESEARCH ON CLIMATE RESILIENT CEREALS** – helps smallholder farmers adapt to climate change and build resilience by developing new cereal varieties with enhanced yield and tolerance to drought, heat, salinity and low soil fertility and delivering these varieties in diversified, sustainable farming systems.
2. **PROGRAM FOR RESEARCH ON LEGUME PRODUCTIVITY** – increases the production and consumption of critical, protein-rich legumes, by developing disease and stress tolerant, high-yielding varieties, improving market linkages and post-harvest processing and integrating legumes into major farming systems to improve household nutrition and incomes, especially for women.
3. **PROGRAM FOR ADVANCED APPROACHES TO COMBAT PESTS AND DISEASES** – harnesses US scientific expertise and emerging molecular tools to develop new animal vaccines and crops and animals resistant to pests and diseases that cause significant production losses in tropical systems.
4. **PROGRAM FOR RESEARCH ON NUTRITIOUS AND SAFE FOODS** – links research on the production and processing of safe, nutritious agricultural products to a learning agenda on household nutrition, including the utilization of and access to fruits, vegetables, meat, fish, dairy and legumes with the goals of preventing undernutrition, especially in women and children, improving child survival, and securing family investments in agriculture.
5. **PROGRAM FOR MARKETS AND POLICY RESEARCH AND SUPPORT** – works to achieve inclusive agricultural growth and improved nutrition through research on enabling policies, socioeconomics and technology targeting and by building the capacity

of partner governments to effect sustainable change in areas such as land tenure, financial instruments, input policies and regulatory regimes.

6. **PROGRAM FOR SUSTAINABLE INTENSIFICATION** – works with smallholder farmers to incorporate sustainable, productivity enhancing technologies and farming practices into major production systems where the poor and undernourished are concentrated, and through intensification and diversification of these systems, to enhance resilience, nutrition and agricultural growth.
7. **PROGRAM FOR HUMAN AND INSTITUTIONAL CAPACITY DEVELOPMENT** – strengthens individuals, scientists, entrepreneurs, educators and institutions, ensuring that food and agriculture systems in developing countries are capable of meeting the food security challenge and that women especially are poised to take advantage of new opportunities and provide critical leadership in agricultural research, private sector growth, policy development, higher education and extension services.

Description of the Cereal Systems Intensification in South Asia (CSISA)

Purpose

The aim of the CSISA project is to support regional and national efforts to improve cereal production growth in South Asia's most important grain baskets. Operating in rural hubs in Bangladesh, India and Nepal, CSISA involves public, civil society and private sector partners in the development and dissemination of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems and policies and markets. In essence, CSISA is an innovation systems platform that links a wide range of public, private and civil society sector programs within and across South Asia.

The CSISA activities include:

1. On-farm verification of key technologies conducted in collaboration with partners and farmers in each hub.
2. Assessments of system productivity, production economics, farmer acceptance and business and policy support requirements to accelerate adoption, and fine-tuning through applied research and iterative feedback from farmers, service providers and other end-users.
3. Clear communication of how different technologies work and why they are likely to be useful under certain conditions through simple messaging in extension materials. These materials include print, radio and video, as well as a central repository called the CSISA Knowledge Bank.
4. The design, evaluation and characterization of business models that can commercialize CSISA- priority technologies.
5. Pursuit of ways to foster improved input and output markets for value chain bottlenecks that are considered tractable.
6. Creative use of strategic partnerships where there is a strong value proposition for all parties to collaborate.
7. Capacity development of key actors, such as extension agents or future cereal system scientists, who are well-placed to contribute toward sustainable intensification of cereal systems by influencing and supporting large numbers of farmers.

The prioritized mix of technologies at each innovation hub is unique, and also varies within a hub and its surrounding influence zones. The technological starting points are dynamic and draw on the latest advances emerging from CSISA's agronomic, breeding, policy and socioeconomic research, as well as innovations from beyond CSISA. Activities are largely driven by hub-level prioritization and transition strategies, with backstopping from evaluation activities

Some of the activities to date:

Nepal

- On-farm lentil trials to assess the effects of improved practices and spring maize trials with new hybrids and farm varieties to assess their performance under different management practices.
- Facilitating access for women farmers to women-friendly, scale-appropriate machinery, including two-wheel tractors and rice and wheat harvesting equipment.
- Spring maize trials with new hybrids and farmer varieties.
- Seed drill demonstrations/trainings with farmers in Terai and river valley sites in close collaboration with three seed companies (Unique Seed Co., Panchashakti Seed Co., and Global AgriTech Enterprises–GATE) with local offices.
- A village survey instrument was developed, pre-tested, refined and administered in experimental sites; these data are currently being analyzed.
- A participatory market chain analysis focused on three Terai districts (Kailali, Banke and Dang) to understand opportunities and constraints for strengthening seed systems and making markets work for smallholders.

Bangladesh

- Training of farmers on best practices for improving the production of rice, maize, wheat, pulses, vegetables, and other crops including fish cultivation and aquaculture with new or enhanced species and varieties; summer tomato and orange flesh sweet potato cultivation for nutritional purposes; and use and application of land/soil management practices and technologies.
- Adaptive trials on best practice guidelines for some new crop technologies and land management/preparation techniques (particularly for maize and wheat)
- Introducing new *Boro* (dry) season rice varieties tolerant to saline soils, short-duration *Aman* (monsoon) season rice varieties and a mustard crop that can be cultivated between the *Aman* and *Boro* rice crops.
- Promotion of crops that require less irrigation than Boro rice, such a wheat, maize and sunflowers; facilitation of mechanized planting using two-wheel tractor-drawn strip till planters and bed planters; and promotion of irrigation interventions using axial flow pumps, which use only two-thirds of the fuel to pump water as conventional pumps.
- The experimental development of a five-ton capacity 'flat bed' grain drier, which uses rice husks as fuel to heat the air.
- The collection of fish market prices and transmission of these to fish pond owners through extension staff, assisting fish farmers to obtain a fair price for their products.
- Collaborating with women, known as 'Info Ladies,' who sell farmers web-based information, giving these women training in the use of web-based agriculture and aquaculture information sources to add to their existing information sources, which are largely health-, education- and government information-based.

India

- The Central Bihar Hub's prioritized activities include the promotion of early wheat sowing with accompanying best management practices; the involvement of service providers as key 'agents of change'; the involvement of women farmers; the area expansion of direct-seeded rice (DSR) under conventional tillage; machine transplanted unpuddled rice with accompanying rice nurseries; the testing of maize hybrids; bed planting; and training and capacity building on conservation agriculture-based technologies and better bet agronomy to extension personnel, service providers, farm advisors and farmers.
- The Eastern Uttar Pradesh hub works with farmers and other stakeholders for the context-specific adoption of technologies and practices such as long-duration wheat varieties, hybrid rice, direct-seeded rice, zero tillage, laser land levelling and increased cropping intensity. This hub also engages in capacity building for dealers and distributors, field officers and extension personnel and farmers. The Eastern Uttar Pradesh hub collaborates with the Department of Agriculture, Krishi Vigyan Kendras, agro-dealers, a state agriculture university, NGOs and local service providers.

- The Odisha hub included a demand analysis and a gender analysis study in the project's prioritized districts. The Odisha hub has also conducted a training program on farm mechanization for local governmental and non-governmental institutions, and demonstrations of zero-till establishment for maize and mustard and laser land leveling. The hub has also trialed mechanical transplanting under unpuddled conditions, and zero-till mungbean establishment.
- The Haryana hub collaborates with policy makers, farmers and private sector partners to promote broad-scale awareness of conservation agriculture, and prioritizes the following: developing scalable training modules on different components of conservation agriculture; supporting KVKs in conducting extension activities of the technologies in the national system; advocating for the inclusion of conservation agriculture-based crop management practices in state action plans and policies; conducting large-scale demonstrations of these technologies along with increased or new subsidies on conservation agriculture machines; encouraging crop diversification with the inclusion of maize and moong in conducting research experiments.
- The Punjab hub focuses on strategic research relevant to rice-wheat and cotton-wheat cropping systems, the two most predominant cropping systems in the northwestern Indo-Gangetic Plains (IGP). Both of these cropping systems can be heavily taxing on water resources and soil nutrients. In response to the constraints on and effects of these dominant cropping systems, CSISA's Punjab hub targets (1) strategic research in rice-wheat, cotton-wheat and maize systems (upcoming and potential crop rotations); (2) smart mechanization options; (3) capacity development of new generation of researchers; and (4) strategic partnerships for up-scaling technologies generated under CSISA.
- The Tamil Nadu hub domain consists mainly of Thanjavur, Thiruvarur and Nagappattinam districts of the Cauvery delta zone. Paddy is the main crop of the Cauvery delta districts and Thanjavur is known as the rice bowl of the state. TN CSISA hub has been conducting demonstrations and trainings on conservation agriculture technologies such as laser land leveling, zero-till and reduced-till direct-seeded rice, non-puddled mechanical transplanted rice, raised bed planting of black gram, improved weed management, reduced tillage maize, ground nut, zero-till black gram and mat-type nursery preparation. The hub has been prioritizing CSISA technologies based on farmers' needs. Various stakeholders such as service providers, women farmers, farmers' groups and private and public institutions are major partners in broadly disseminating CSISA technologies. For example, the state department of agriculture has been supporting DSR farmers by supplying critical inputs, incentives and subsidies for DSR adoption.

Additional information on the CSISA can be found at: http://csisa.org/

Geographic Focus

The geographic focus for CSISA is described here. http://csisa.org/where-we-work/. While the approaches are similar, the prioritized mix of technologies and partners at each innovation hub is unique, and also varies within a hub and its surrounding zones of influence. Technological starting points are dynamic and draw on the latest advances emerging from CSISA's agronomic, breeding, policy and socioeconomic research, as well as innovations from beyond CSISA. Activities are largely driven by hub-level prioritization and transition strategies, with backstopping from evaluation activities.

Along with progress and highlights to date, country-specific results frameworks for all the dimensions of the CSISAs are found in the most recent annual reports are available on the CSISA website and will be provided to the evaluation team. Below, are the specific district (hubs) information for the locations:

- Nepal (Dadeldhura, Achham, Surkhet, and Banke). For more details, please see the following link: http://csisa.org/csisa-nepal/
- Bangladesh (Faridpur, Jessore, Khulna, Barisal, Mymensingh and Rangpur). For more information on the locations, please see the following link: http://csisa.org/wp-content/uploads/sites/2/2013/07/CSISA-BD-map.jpg
- India (Bahraldh, Siddhath Nagar, Gorakhpur, Patna, Bhubaneshwar, East and West Champaran and more). For complete list of the CSISA India hubs, please the link. http://csisa.org/where-we-work/csisa-india/

Funding Mechanism

CSISA is jointly funded by USAID and BMGF through the Public International Organizations (PIO) mechanism. The CSISA project is in the 3rd year of its second phase award, which ends on September, 2015. Total funding ceiling is $33,100,000. The funding amount from BMGF is $18,600,314 while USAID's is $15,000,000. The contribution of USAID India has been $1 million *per year* for 2011–12, 2012–13, 2013–14, and 2014–15. The contribution of USAID Bangladesh to CSISA-BD has been $5 million per year for 2010–11, 2011–12, 2012–13, 2013–14, and 2014–15. For the SRSPD project $5 million was provided by USAID Bangladesh for an 18-month project that ran from October 2011 to March 2013. For CSISA-MI, the contribution of USAID Bangladesh has been $13 million over 5 years (2013–2018). For Nepal, the USAID Mission's contribution has been $1.5 million total over 2012–2015. This evaluation scope of work will focus on all the six objectives located in all the three countries (India, Nepal and Bangladesh).

Scope of Work

This performance evaluation will provide USAID, BMGF and the implementers of CSISA with constructive feedback on the program management, research program, training program and institutional capacity collaboration of the CSISA project and assess progress on all six objectives. Furthermore, since the CSISA project will be completing its second three-year phase in September 2015, the External Evaluation Team (EET) should consider whether a program extension for a third phase is warranted, and if so, make recommendations to USAID and BMGF on any necessary management adjustments and potential research focus changes during a third phase. In addition to assessing the program's progress on the six objectives, the EET will evaluate the following four components, using, when relevant, an evidence-based and data-driven approach.

1. Program management (Objectives 1 to 6, see page 110):
   - Program leadership
     - How effectively have program leaders & managers communicated the program's strategic vision and how the various project components, activities, and outcomes are integrated to scientists and partners working on the ground or at a specific component level?
     - To what extent are project beneficiaries engaged in the project and their expectations being met?
     - How effectively has the program management succeeded with multiple organizations involved in implementing various components of the program?
   - Organizational structure
     - How well are the complex set of activities and outcomes integrated with one another across hubs and countries?
     - In what ways does the organizational structure add value to the work of individual scientists and partners (e.g., by providing sufficient resources, by disseminating information)? In what ways is it overly burdensome or restrictive?
   - Monitoring, evaluation, and reporting (Objective 6).
     - How effectively are outputs, outcomes, and impacts being properly tracked and reported (e.g., timely and high quality reports)?
     - Given the massive reach of the program how effective are the CSISA methodologies in monitoring and reporting progress?
     - How accessible is the information generated by the program to those within the program? To those outside of the program (e.g., other development organizations)?
     - To what extent has the data management plan been operationalized (e.g., are program scientists following guidelines, are data properly curated and archived) and how well does it conform to USAID and BMGF requirements?
     - How effective has been the CSISA M&E system in accurately tracking and reporting on the key FTF indicators such as "4.5.2(5) Number of farmers and others who have applied new technologies or management practices as a result of USG assistance" and "4.5.2(2) Number of hectares under improved technologies or management practices as a result of USG assistance?
     - How have the social and economic impacts of key CSISA interventions been assessed?

2. Research programs (Objectives 2, 3, 4 & 5):
   - Research design.
     - o How well are the research activities designed to achieve scientifically valid and robust conclusions (e.g., will they pass peer review)?
     - o What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
     - o Are research results (data) being made available to the public, both through reports and publication, and upload of data to public databases?
     - o How has CSISA influenced/ impacted the government policies and practices, in Nepal, Bangladesh and particularly India?
     - Cross-cutting themes.
     - o How well are gender, climate change, and nutritional considerations integrated into the research program overall and within specific research activities?
     - o To what extent are women represented in the program's leadership and management positions and research activities?
     - o How much impact will the agricultural research likely have on nutritional outcomes?
3. Catalyzing change with farmers and the key intermediaries that support them (Objective 1 mostly):
   - Impact Pathways.
     - o How clear, detailed, and realistic is the plan (i.e., the impact pathway) for the program to disseminate, and scale research outputs, whether carried out by the program itself or by other development partners?
     - o How consistently and effectively is the CSISA Hub model catalyzing the sustained adoption of improved varieties/ hybrids, technologies, management practices and targeted information to smallholder farmers? Which hubs are producing the desired results and which are underperforming?
     - o How has CSISA engaged with the private sector to utilize their entrepreneurial drive to disseminate technology?
     - o To what extent has CSISA been able to engage in value chain constraints and improve marketing for the poor
   - Collaborations.
     - o Which partnerships are most effective in achieving dissemination goals (e.g., host country governments, private sector, academic institutions, local NGOs, other USAID projects)? Which potential partners should be involved?
     - o How are dissemination partners involved in the design and implementation of research activities? Should they be more involved?
4. Program Future
   - Reprioritization
     - o What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
     - o Which components/objectives should receive greater support and/or be expanded and which should be cut back?
     - o What is the appropriate balance between dissemination and research, and how does it different by country, hub, and technology?
     - o Should human and institutional capacity development (HICD) be emphasized more in the future? If so, what would be the priorities of HICD activities?
   - Program sustainability.
     - o To what extent are the activities of the hubs expanding in numbers and becoming self-supporting over time. How are the hubs ensuring the self-sustainability of the activities?
     - o If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?
     - o How successful has been the Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh (SRSPD) component of CSISA-BD in promoting new saline tolerant short duration rice varieties? How successful has the component been in terms sustainability and new variety adoption by the farmers?

Evaluation Methodology

The evaluation will be based on the following tasks, conducted in the following order, and completed by the dates given.

1) **CONFERENCE CALL WITH USAID** – *between December 3–10, 2014*
   A conference call will be scheduled between the EET and the USAID Evaluation Manager, the CSISA'S Agreement Officer's Representative (AOR), and other officials in the Research and Monitoring & Evaluation Divisions of the Bureau for Food Security to review the scope of work and answer questions concerning the implementation and delivery of the evaluation.

2) **DESK REVIEW** – *between December 1–12, 2014*
   The EET will conduct a desk review of CSISA'S publications and materials. The purpose of the desk review is to obtain needed background and context about the project and USAID in order to complete the Knowledge Gap Table and the Evaluation Plan (see below). Documents to be reviewed will include, but are not limited to, the RFPs (request for proposals), approved program proposals, the agreements, annual reports, work plans, program operation documentation, and funded research proposals. Team members will also review the CSISA M&E plan, the latest Semi-annual and Annual reports and familiarize themselves with the Feed the Future Global Food Security Research Strategy and the USAID Evaluation Policy.

3) **KNOWLEDGE GAP TABLE** – *due December 14, 2014*
   Based on the desk review, the EET will provide the USAID Evaluation Management the completed Knowledge Gap Table (see Appendix A).

4) **EVALUATION PLAN** – *due December 19, 2014*
   Using the Knowledge Gap Table as a guide, the EET will submit to the USAID Evaluation Manager the Evaluation Plan (see Appendix B). The purpose of the Evaluation Plan is, in part, for the EET to present their evaluation design which includes, in part, research questions, methodology for quantitative and qualitative data collection and data analysis, work plan, timeline and proposed domestic and international travel. The Evaluation Plan must be approved by the USAID before the EET can travel and begin their field work. USAID will provide approval or request changes by December 24, 2014. If required, the EET will submit a revised Evaluation Plan by December 28, 2014.

5) **INTERNATIONAL TRAVEL** – *to be completed by January 30, 2015*
   The EET will need to travel internationally to gather the needed data to answer the evaluation questions, implement the evaluation plan, and complete this scope of work. International travel is limited to one trip to visit international collaborators and stakeholders in India, Nepal, and Bangladesh with the CSISA staff. The evaluation team needs to set up a meeting with respective USAID Bangladesh, India and Nepal team members. The USAID Evaluation Manager must pre-approve all travel. All travel will be arranged for the EET by Knowledge Driven Agricultural Development (KDAD) and must be in accordance with U.S. Government travel regulations. The USAID Evaluation Manager will provide the EET with a travel protocol that outlines the procedures to be followed for all travel.

6) **INTERNATIONAL TRAVEL DEBRIEFS** – *prior to country departure from CSISA countries*
   A short summary of data collected and preliminary findings will be sent to the USAID Evaluation Manager for each country visited before departure from that country. This is not to be a trip report, nor should time be billed to write a trip report. Instead, it is meant to provide the USAID Evaluation Manager with progress made against the Evaluation Plan.

7) **PRELIMINARY FINDINGS** – *within one week of completion of travel*
   The EET will provide in writing to the USAID Evaluation Manager the preliminary findings that will be used to develop the draft evaluation report.

8) **DRAFT EVALUATION REPORT** – *due February 13, 2015*
   A draft of the evaluation report will be submitted electronically in MS Word format to the USAID Evaluation Manager (who will share the report with BMGF and USAID Mission staff). The evaluation report should demonstrate a clear line of analysis between findings, conclusions and recommendations that include adequate statistical evidence-based findings and recommendations to reinforce the conclusions. USAID will review the draft for content. The EM will review the draft for accuracy. The draft evaluation report should be shared with the USAID missions for comments. All comments, corrections and suggestions for consideration will be sent to the EET by February 20, 2014.

9) **FINAL EVALUATION REPORT** – *due February 27, 2015*
The final evaluation report should sufficiently address all comments and corrections provided to the draft report.

Evaluation Report Format

The evaluation report will present findings, evidence-based recommendations and conclusions of the topics outlined in this Scope of Work. The EET may include other topics that are deemed relevant and are evidence-based. The report should follow the format and page limits as outlined in Appendix C. The USAID Evaluation Manager will be made available to the EET as a resource person but will not contribute directly to the preparation of the report.

Level of Effort

The level of effort for the entirety of this Scope of Work will consist of no more than 45 billable days for the Team Leader and 40 billable days for each of the team members. All billable work is to be performed between December 1, 2014 and February 27, 2015. The following is the authorized number of billable days for each team member and leader for each task/ deliverable of this scope of work. Changes of more than two days for a task/deliverable must be authorized by the USAID Evaluation Manager in advance, before the days are worked. Significant changes will require the submission and approval of a new Evaluation Plan work plan (see Appendix B) before additional days are approved.

LEVEL OF EFFORT (by billable days)

Task/Deliverable	Each Team Member	Team Leader
Conference Call/Desk Review	4	4
Knowledge Gap Table	1	1
Travel & Travel Debriefs	21	21
Preliminary Findings	4	4
Draft Report	5	8
Final Report	2	4
Total	40	45

Payment of Services

The Knowledge Driven Agricultural Development (KDAD) will pay the EET for their services. Daily rate of compensation will be in accordance with U.S. Government regulations and based on verifiable past work experience. Payment will be made on a monthly basis in accordance with the billable day limits per task/deliverable outlined in the Level of Effort table above.

Team Composition and Qualifications

The technical qualifications of EET members must be matched with the technical areas of focus of the CSISA project. Team members must have the expertise necessary to evaluate the CSISA project and to address the Scope of Work topics. Each member is requested to submit a CV that includes relevant experience, along with a brief proposal. USAID will designate one team member as the Team Leader.

ADMINISTRATIVE/MANAGEMENT MEMBER (1). A senior-level evaluator with a minimum of ten years of experience managing and/or evaluating multifaceted international development research and/or university-based programs. The preferred candidate will be familiar with CGIAR, USAID, Bill & Melinda Gates Foundation (or other donor) funded programs. A background in agricultural development, with technical expertise in a field relevant to sustainable intensification of agricultural systems in South Asia is recommended. The candidate will also have: a) a demonstrated capacity to conduct independent program evaluation; b) an understanding of USAID's foreign assistance goals, and its particular objectives related to collaborative research, agricultural development and food security; and c) the ability to analyze issues and formulate concrete recommendations orally and in writing.

TECHNICAL TEAM MEMBERS (3). Must be experienced experts in international development related to agricultural research and technology dissemination. Technical team members will also have demonstrated the following: a) the capacity to conduct independent program evaluation; b) a thorough understanding of research methodology; c) experience in effectively conducting outreach and dissemination to policy makers, development practitioners and/or the private sector; and d) the ability to analyze issues and formulate concrete recommendations orally and in writing.

DISCIPLINES OF ALL MEMBERS (4). The team members need familiarity with South Asia's agricultural systems with the following required composition of skill sets among them: breeding/genetics, agronomist/agricultural systems, social/economics background, private sector and crop/livestock agricultural systems.

APPENDIX A: Knowledge Gap Table

	Key Knowledge	Knowledge Gaps
Program Management		
Research Program		
Training Program		
Institutional Capacity Collaboration		
Program Future		

APPENDIX B: Evaluation Plan

FTF Activity/Mechanism Name	
FTF Activity Country/Countries	
Evaluation Lead Investigator	
USAID Evaluation Manager	
Approximate start date	

Preface

This document describes the components needed to complete an Evaluation Plan for Feed the Future (FTF) Activities. For information regarding the Feed the Future, please see link: http://feedthefuture.gov/. Projects such as CSISA, report on a number of FtF indicators (see link: http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbook_indicators_october2014.pdf).

Below, please find the FtF indicators that CSISA has been submitting:

4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance (RIA) (WOG)

4.5.2(5): Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance (RIA) (WOG)

4.5.2(7): Number of individuals who have received USG supported short-term agricultural sector productivity or food security training (RIA) (WOG)

4.5.2(11): Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs receiving USG assistance (RIA) (WOG)

4.5.2(12): Number of public-private partnerships formed as a result of FTF assistance (S)

4.5.2(39): Number of technologies or management practices in one of the following phases of development: (Phase I/II/III) (S)

4.5.1(24): Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5) (S)

4.8.2(26): Number of stakeholders with increased capacity to adapt to the impacts of climate variability and change as a result of USG assistance

A. FTF Project Evaluation Design

1. FTF Activity/Mechanism Description
   Describe the FTF activity/mechanism being evaluated. Provide enough detail to make clear the justification for the proposed methodology. Include the following items: activity/mechanism goals and objectives, main program components/interventions an. delivery mechanisms, key activity/mechanism outcomes and indicators, target areas and target population groups, criteria for selecting target areas, criteria for selecting program participants, program implementation plan (start date, duration, deployment plan and timeline).(Note: much of this material can come from project documents.)

2. Program Logic
Please include either a diagram and/or a narrative that describes the program logic and articulates the causal pathways from activity implementation to the desired impacts. The description should include intermediate outcomes that would change along the way to final impacts or objectives of the project. (Note: this should also be available in project documents.)

3. Evaluation Research Question
Succinctly state the primary questions that the evaluation will seek to answer.(Note: this should be available in the evaluation SOW.)

4. Methodology for Quantitative and Qualitative Data Collection
Please indicate briefly the methods and plans for data collection. This section should include all methods for primary collection (interviews, surveys, direct observation, etc.) and secondary data collection (project documents, performance reports, etc.). Provide the timing of any qualitative and quantitative data collection and explain how the two will be integrated. Include the number of planned survey rounds as well as the expected local data collection partner if applicable.

5. Methodology for Quantitative and Qualitative Dat. Analysis
Describe the methods you will use to analyze the quantitative and qualitative information collected. Analysis methods should be described in detail for both quantitative (descriptive statistics, regression analyses, etc.) and qualitative (domain analysis, network analysis, etc.). Also, specific software that will be used should be mentioned (SPSS, STATA, ATLAS, etc.).

6. Outcome Measures
Briefly discuss the outcome measures that will be used for this study (quantitative and qualitative) and relate them to the evaluation research questions. Explain which evaluation questions the quantitative and qualitative data will help address and how. Define the variables or indicators that will be used to measure these outcomes. (A quantitative example would be an outcome measure of "Greater access to new technologies among partner developing countries" and corresponding indicator "Number of new technologies under research, field testing or made available for transfer". A qualitative example would be an outcome measure of "Effective management" and corresponding indicator of "Communication processes are well-established".)

7. Additional Pertinent Information
Use this section to describe any further information that is pertinent to this particular evaluation and should be considered as part of the evaluation design. For example, this section could be used to discuss collaboration agreements for analysis with other institutions or overlaps with other evaluations and coordination with those evaluations.

EVALUATION WORK PLAN (adapt timeline as required)

Activities	Dates of Activity	1st Month				2nd Month			
		1	2	3	4	5	6	7	8
TASK 1. Develop evaluation design and implementation plan									
Activity 1:									
Activity 2: etc.									
TASK 2: Data Collection									
Activity 1:									
Activity 2: etc.									
TASK 3: Data Analysis									
Activity 1:									
Activity 2: etc.									
TASK 4: Report Writing									
Activity 1:									
Activity 2: etc.									

B. Evaluation Budget (if applicable)

Submit a detailed budget with the evaluation design covering all costs related to conducting the evaluation, including data collection, labor, travel, and communications.

1. Budget Summary *(adapt timeline as required) (USAID will complete the Labor, Travel and Indirect costs line items)*

Category	Month 1	Month 2	Total
Labor			
Travel and subsistence			
Data collection			
Equipment			
Other costs			
Sub-total			
Indirect costs			
Total			

C. Data Collection and Management Plan

1. Interviewer/Enumerator Training *(if any)*
   Describe the plans for training for all data collection (if any), including length of training, location, expected number of participants, topics covered, and the approach to piloting or field testing during training.

2. Data Management and Security
   Describe how all data collected will be gathered, entered, managed, and stored. Please specify how data will be kept secure.

3. Data Collection Approvals
   Describe the process and results of all data collection approvals.

D. Data Collection Instruments

Submit a draft of any data collection instruments that will be used for the evaluation.

APPENDIX C: Report Format

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- Lessons Learned
- Recommendations

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- Conclusions
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- Recommendations

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C. Survey questionnaire
D. Travel itinerary, locations and dates of field visits
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ANNEX J: EVALUATION PLAN

Executive Summary

The Cereal Systems Initiative for South Asia (CSISA) is a complex integrated research and dissemination mechanism that spans across the Indo-Gangetic Plain, "to promote durable change at scale for South Asia's cropping systems." As a 10-year initiative, CSISA is concluding Phase II and this review will guide decision-making and funding priorities for the next phase of CSISA. Our team will travel to each priority innovation hub and through key informant interactions, surveys, and direct observation, derive tangible programmatic and management recommendations.

CSISA Phase II has six overarching objectives, yet the components of the CSISA approach vary by country program, hub and impact pathways, unique to the mechanism. Each of these have their own objective and milestones, and although these will be considered, our primary focus will be on CSISA Phase II objectives.

The final Scope of Work (SOW) of the evaluation contained over 31 research questions, many with additional questions. We have prioritized our assessment of the most critical of these within this document, by focusing on the four thematic domains: program management, research, catalyzing change and program future. Although our instruments will contain elements to address all questions, we will be forming recommendations primarily around our findings around these themes and sub-themes.

Methodologically, our team will map the interventions and impact pathways for each hub, review project data for each, create a common rubric of analysis for sub-domains such as private sector engagement or mechanization, and then triangulate with a broad based survey and qualitative data through interactions. This later tool will be loosely structure around interview domains, but held deliberately as a conversation to allow for probing deeper into points of interest that arise for the team. We will appraise the agronomic, plant breeding, livestock integration research and outreach for technical competence and application relevant for this project, and reflect on resource and strategy needs for scaling-up both applied research and innovation adoption. With a clear assessment of both the quality of innovations being researched and disseminated, along with seeing the performance against project benchmarks, our team will provide recommendations that take into consideration key issues in both sustainability and scalability.

Because CSISA has such a unique model, management questions will also be explored through KII with CSISA Staff, USAID Staff, and a multitude of CSISA affiliates and partners. Some for the key management questions are around coordination of this project across multiple Implementing Partners, working at the nexus of process-based research and dissemination, and communicating results to other stakeholders. Our assessment approach will examine how different hubs manage these issues to determine good practices to share for future management consideration.

This evaluation is set to take place between December 6 and March 11 with the submission of the final report. Our team will be in the field from January 19th until February 26th. Within this evaluation plan we have also included our Gantt chart of activities, our online survey, as well as our interview prompt matrix, customized based on the three stakeholder types. This plan will guide operations and serve as a bank of expectations and key considerations when appraising this complex yet fascinating project

CSISA Phase II Evaluation Design

Mechanism Description/Program Logic

The Cereal Systems Initiative for South Asia (CSISA) is an ambitious mechanism that seeks to drive large-scale change to small holder farmers across South Asia. Operating at the nexus of research and dissemination, CSISA's offers this explanation of their overarching approach:

"The Cereal Systems Initiative for South Asia (CSISA) was established in 2009 to promote durable change at scale in South Asia's cereal-based cropping systems. CSISA supports regional and national efforts to improve cereal production growth in South Asia's Indo-Gangetic Plains, home to the region's most important grain baskets. Operating in rural "innovation hubs" in Bangladesh, India and Nepal, CSISA involves more than 300 public, civil society and private sector partners in the development and dissemination of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems and policies and markets. In essence, CSISA is an innovation systems platform that links a wide range of public, private and civil society sector programs within and across South Asia."

CSISA has also undergone a distinct evolution over a number of years as highlighted by the Scope of Work (SOW):

"CSISA was originally conceived as a 10-year initiative. As stated above, the 'base' investment for Phase I and Phase II of the projected has been jointly funded by USAID-Washington and the Bill & Melinda Gates Foundation (BMGF), and there are also four additional sources of co-investment:

- USAID-India has co-invested in the base investment to support programming at CSISA's innovation hubs in India since 2010.
- USAID-Bangladesh made a companion investment in 2010 to form the aligned sub-project 'CSISA-BD' in 2010,
- USAID-Nepal did the same to form 'CSISA-Nepal' in 2012, and
- USAID Bangladesh made additional and targeted investments in mechanization and irrigation in 2013 ('CSISA-MI').

These 'sub projects' are intended to fully align with CSISA's base investments, but the. each have their own funding streams, work plans, and management processes. As the program has now passed the second midpoint of Phase II (2011–2015) of the USAID Washington DC funding, and Phase I for the USAID Nepal, India, and Bangladesh mission funded projects, USAID and BMGF seek an evaluation to understand if and how targeted results are occurring, and specifically to assess what program component approaches are working well and which are not performing as expected. This will provide constructive feedback to the CSISA implementation team to improve program effectiveness.

Overall, CSISA Phase II has six overall objectives, which are:

OBJECTIVE 1: Through its innovation hubs, CSISA aims to catalyze the widespread dissemination of production and post-harvest technologies to increase cereal-based systems productivity (including livestock and, in Bangladesh, aquaculture), resource use efficiency and income

OBJECTIVE 2: Through its research platforms, CSISA aims to conduct process-based research into crop and resource management practices for future cereal-based systems.

OBJECTIVE 3: Through plant breeding, CSISA aims to develop high-yielding, heat- and water-stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems

OBJECTIVE 4: Through plant breeding, CSISA aims to develop high-yielding, heat- and water-stress-tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems

OBJECTIVE 5: Through policy research, CSISA aims to contribute to the development of improved policies and institutions for inclusive agricultural growth

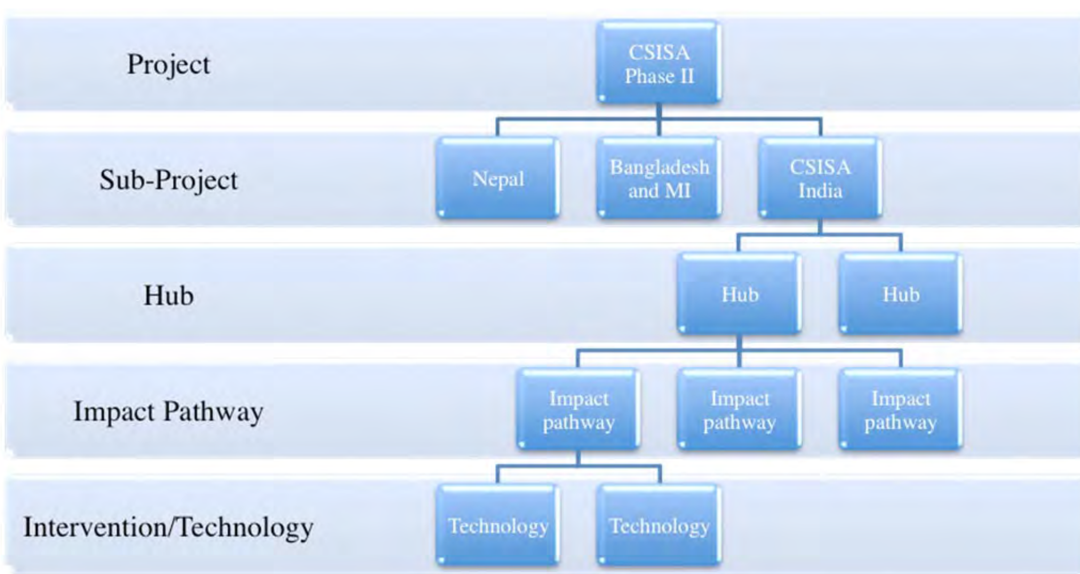
OBJECTIVE 6: Ensuring high-quality project management, data management, monitoring and evaluation and communications."

Overlaying these overarching objectives, CSISA Nepal, Bangladesh and CSISA MI all have their own independent work streams and corresponding objectives. Although sub-projects are supposed to be fully aligned, one research question will consider the benefits and challenges with a umbrella project that allows for division at a sub-project level. Each mechanism's indicators and key interventions for CSISA are available upon request. For the Feed The Future Initiative, CSISA reports the following indicators:

- 4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance (RIA) (WOG)
- 4.5.2(5): Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance (RIA) (WOG)
- 4.5.2(7): Number of individuals who have received USG supported short-term agricultural sector productivity or food security training (RIA) (WOG)
- 4.5.2(11): Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs receiving USG assistance (RIA) (WOG)
- 4.5.2(12): Number of public-private partnerships formed as a result of FTF assistance (S)
- 4.5.2(13): Number of rural households benefiting directly from USG assistance (S) (Nepal)
- 4.5.2(39): Number of technologies or management practices in one of the following phases of development: (Phase I/II/III) (S)
- 4.5.1(24): Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5) (S)
- 4.8.2(26): Number of stakeholders with increased capacity to adapt to the impacts of climate variability and change as a result of USG assistance

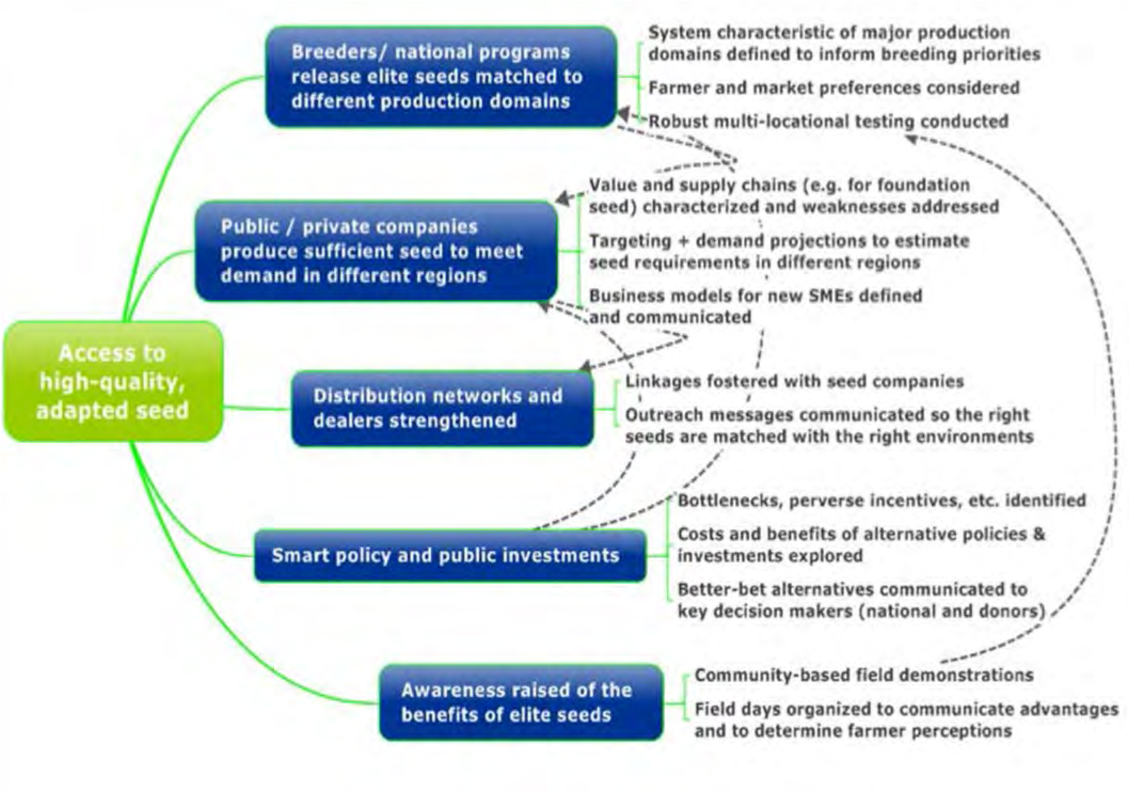
In India, CSISA works primarily in the priority hubs of Bihar, Odisha and Eastern Uttar Pradesh. Additional activities occur in Patna, Karnal, Haryana, and Hyderabad. In Bangladesh, activities occur in Gazipur, Jessore, Barisal, Rangpur, Mymensingh and Dinajpur. And in Nepal activities are in Nepalgunj and Dhangadhi.

Program Logic:
The CSISA model allows a significant degree of complexity, allowing sub-projects aligned to CSISA to develop their own pathways that take into account priorities at the hub level. Based on our review, this is how we see the overall project structure and logic. Please note this is not a complete map, but illustrative of the sub-units under which CSISA is organized:



CSISA's Results Framework is by design broad to incorporate the different strategies for each innovation hub, but is a combination of research and dissemination to smallholder farmers through high quality partnerships with research organizations but also distribution partners as well.

As stated by the M&E Plan for CSISA Phase II, "Each cropping season (i.e., Kharif and Rabi), CSISA scientists and hub and research platform leadership and staff develop impact pathways, which define the primary outcomes, intermediate outcomes, and activities to be undertaken at each hub during the upcoming season. Here is an example of one such impact pathway:



To detail every impact pathway and component in this document would be unnecessarily exhaustive, but the most promising technologies, progress towards impact pathways at the hub level, and objective progress at the sub-projects will be the units of analysis for assessing project performance.

Evaluation Research Question:
We will appraise each strategic objective in the context of each national program and where appropriate at the hub level. As expected, this project with several funding streams and priorities has generated a large set of evaluation questions from the various stakeholders. We will prioritize the questions that align most directly to the six objectives of CSISA Phase II.

TABLE 1. Research Question Prioritization

CSISA Objective	Question
OBJECTIVE 1: Through its innovation hubs, CSISA aims to catalyze the widespread dissemination of production and post-harvest technologies to increase cereal-based systems productivity (including livestock and, in Bangladesh, aquaculture), resource use efficiency and income	How consistently and effectively is the CSISA Hub model catalyzing the sustained adoption of improved varieties/hybrids, technologies, management practices and targeted information to smallholder farmers? Which hubs are producing the desired results and which are underperforming?
	How has CSISA engaged with the private sector to utilize their entrepreneurial drive to disseminate technology?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	To what extent are the activities of the hubs expanding in numbers and becoming self-supporting over time. How are the hubs ensuring the self-sustainability of the activities?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?
	How clear, detailed, and realistic is the plan (i.e. the impact pathway) for the program to disseminate, and scale research outputs, whether carried out by the program itself or by other development partners?
OBJECTIVE 2: Through its research platforms, CSISA aims to conduct process-based research into crop and resource management practices for future cereal-based systems.	What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	To what extent are the activities of the hubs expanding in numbers and becoming self-supporting over time. How are the hubs ensuring the self-sustainability of the activities?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?
OBJECTIVE 3: Through plant breeding, CSISA aims to develop high-yielding, heat-and water-stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems	What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?

TABLE 1. Research Question Prioritization

CSISA Objective	Question
OBJECTIVE 4: Through plant breeding, CSISA aims to develop high-yielding, heat- and water-stress-tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems	What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?
OBJECTIVE 5: Through policy research, CSISA aims to contribute to the development of improved policies and institutions for inclusive agricultural growth	What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?
	How has CSISA influenced/ impacted the government policies and practices, in Nepal, Bangladesh, and particularly India?
OBJECTIVE 6: Ensuring high-quality project management, data management, monitoring and evaluation and communications.	How effectively are outputs, outcomes, and impacts being properly tracked and reported (e.g., timely and high quality reports) and are reports reflecting reality at the field level?
	How has CSISA engaged with the private sector to utilize their entrepreneurial drive to disseminate technology?
	How effectively has the program management succeeded with multiple organizations involved in implementing various components of the program?
	How well are the complex set of activities and outcomes integrated with one another across hubs and countries?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	In what ways does the organization structure add value to the work of individual scientists and partners (e.g. by providing sufficient resources, by disseminating information)? In what ways is it overly burdensome?
Evaluation Questions	How effectively has the program management succeeded with multiple organizations involved in implementing various components of the program?
	How well are the complex set of activities and outcomes integrated with one another across hubs and countries?

TABLE 1. Research Question Prioritization

CSISA Objective	Question
Evaluation Questions (continued)	In what ways does the organizational structure add value to the work of individual scientists and partners (e.g., by providing sufficient resources, by disseminating information)? In what ways is it overly burdensome or restrictive?
	How effectively are outputs, outcomes, and impacts being properly tracked and reported (e.g., timely and high quality reports)?
	What proportion of research activities will likely achieve tangible development outcomes relevant to small-holder farmers (e.g., does the design include participatory research approaches, is it appropriate for a research-for-development program)?
	How has CSISA influenced/ impacted the government policies and practices, in Nepal, Bangladesh and particularly India?
	How clear, detailed, and realistic is the plan (i.e., the impact pathway) for the program to disseminate, and scale research outputs, whether carried out by the program itself or by other development partners?
	How consistently and effectively is the CSISA Hub model catalyzing the sustained adoption of improved varieties/hybrids, technologies, management practices and targeted information to smallholder farmers? Which hubs are producing the desired results and which are underperforming. (Note: our term wants to put our caution around terms such as "underperforming", as hubs have highly contextual situations in their development.)
	How has CSISA engaged with the private sector to utilize their entrepreneurial drive to disseminate technology.
	Which partnerships are most effective in achieving dissemination goals (e.g., host country governments, private sector, academic institutions, local NGOs, other USAID projects)? Which potential partners should be involved?
	What are the strongest (highest performing) aspects and what are the weakest (lowest performing) aspects of the program? Why (e.g., lack necessary resources)?
	Which components/objectives should receive greater support and/or be expanded and which should be cut back?
	To what extent are the activities of the hubs expanding in numbers and becoming self-supporting over time. How are the hubs ensuring the self-sustainability of the activities?
	If another funding phase is not approved or support is reduced, which of the interventions would likely be able to continue without USAID/BMGF support? Where would their support come from (e.g., other donors; profitable business model)?

Our team recognizes that the questions become duplicative across the different objectives. To refine these questions and avoid duplications we have identified Domains and Sub-Domains, to be explored in this review, with Domains being the original parts of the research questions, and Sub-Domains as its vital components to explore. We have created the structure as follows:

1) Program Management
   a) Overall Vision & Operational Culture:
   b) Communication
   c) Organizational Structure
   d) Monitoring and Evaluation Systems/Performance Management

2) Research Program

   a) Results, Validity, Resource Allocation
   b) Process Research (cropping systems& land and water mgt.)
   c) Crop Specific Agronomy Research
   d) Breeding Research
   e) Livestock Research
   f) Policy Research
   g) Cross Cutting Themes: Mechanization
   h) Cross Cutting Themes: Nutrition
   i) Cross Cutting Themes: Climate Change
   j) Cross Cutting Themes: Gender

3) Catalyzing Change

   a) Impact Pathways
   b) Notable Technologies
   c) Collaborations
   d) Private Sector Engagement
   e) Innovation behind research and extension process

4) Program Future

   a) Reprioritization
   b) Sustainability
   c) Scalability

Conceptually, we consider the first three domains, (program management, research program, and catalyzing change with farmers) to be largely summative questions, which answer critical questions about CSISA's performance to date. However given the overall objectives of this evaluation, we consider these to be the pieces required to answer the most critical fourth subset of research questions, program future, which is largely formative

Methodology for Quantitative and Qualitative Data

The data collection tools for this evaluation will include a review of program documentation and relevant research, key informant interactions with staff, partners and service providers (who are also farmers), a online survey, and site observations. The information collected will be organized into a matrix of the above domains and sub-domains.

Our approach is twofold: One, to assess the Strategic Objective Progress through analysis of FTF Indicators, Results Framework Progress, and Impact Pathways Analysis. This will give us a useful understanding of what CSISA has accomplished and where there are gaps. Secondly, our instruments, a broad based quantitative survey and interviews will help a) verify the results the data is reporting and b) address the domains/sub-domains as stated in the SOW to give insight into why performance may or may not be realized. Examples of this might be Collaboration issues under "Catalyzing for Change"

Document Review: An initial document review was conducted as a basis for constructing this evaluation plan. It was also used to develop a matrix identifying existing gaps in knowledge that will require additional data collection via other methods. The evaluation team will continually reference program documentation and research as they conduct interviews and consultations. Existing documents and research, as well as any outside peer-reviewed research, should provide supplemental quantitative data that the team can follow up on in discussions in country. In addition, the team will consolidate any existing monitoring and evaluation data gleaned from quarterly and annual reporting to support any findings on program outcomes and impacts. We will also compare this with historical district level production data that has been updated from 1979-2009 by the International Crops Research Institute for Semi-Arid Tropics (ICRISAT).

Hub Level Surveys: CSISA is expansive both in its network of partners but also in the amount of hubs where activities take place. Realizing that our team cannot visit every hub in such a limited time frame, our team developed a user friendly survey that can be disseminated online through SurveyGizmo. Utilizing KDAD HQ support, our team has developed both quantitative and qualitative questions to capture more broad based data around domain and sub-domains. This will be disseminated to all of the hubs and also through networks of the local agriculture through our logistics specialists. Most of the questions are Likert Style and can be disaggregated by hub and by stakeholder type. Detailed triangulation of corresponding questions to domains/ sub-domains can be found in Table 2. The preliminary data we receive should be able to give us informed insight on each hub on the aggregate and can help us ask more precise questions in interviews. The survey is available in Annex B.

Key Informant/Stakeholder Interviews: Key informants are well-regarded experts and leaders in the field who can assist in answering some of the evaluation questions, or persons such as project staff uniquely positioned to provide intimate program knowledge. One of the challenges of methodology for interactions with CSISA stakeholders is that our team might receive a formal presentation, have an informal interaction at a field location, or interact with a group of partners from one organizations. Increasing in complexity, even under the banner of partners, you can sub-divide into private sector, local government, local NGOs, National research partners and Academia. Because of this complexity one distinct interview guide does not easily fit. Instead we have prepared a list of sub-domains that will be addressed as a check list, which includes prompts for staff, partners or service providers. You can see the list of prompts in Annex A. Please note that these questions will not be uniformly applied, as for each stakeholder the nuance to these topics might necessitate different phrasing, or questions might not be relevant. However, this serves as a guide to ask probing question to captured relevant qualitative data around the sub-domains to ensure consistent analysis across CSISA.

For USAID and CSISA Staff we will have audio recordings of responses, but in the instance of private sector partners, and other collaborators we will take concurrent notes when possible. The idea behind the different techniques is due to us building a sense of honesty and openness to subjects where recordings may make them feel uncomfortable. Key informant interviews provide flexibility to explore new ideas and issues not anticipated during planning. They are also relatively simple to conduct. They may require special access or introductions from donors or project staff. It is important to retain anonymity and ensure confidentiality if requested in order to capture sensitive, frank and honest information. We will keep responses and quotes anonymous and be sure to receive permission any time our team wants to use names on the report itself

The team anticipates interviewing a variety of implementing field staff, including those involved in overseeing the M&E and data management plans, researchers, technicians, program managers, and directors. Other stakeholders to be interviewed would include USAID Mission staff, other relevant donors, partner organizations leadership from the NGO and private sector, and host country government officials within the Ministries of Agriculture, for example. The team will also be interested in speaking with gender experts or those working on related climate change or environmental issues, as well as nutrition experts.

Direct Observation: The evaluation team will endeavor to observe and inspect research facilities, training sites and/or model farm sites. This will allow processes to be observed in their natural setting, thereby providing a richer understanding of the subject. Direct observation can also help identify whether tasks are properly implemented and if required inputs are present or needed. Evaluators will develop and report through direct observation forms. Due to the limited time in the field, it may only be possible to conduct on or two site visits per country.

Methodology for Quantitative and Qualitative Data Analysis

Through desk review, survey work, focus groups and Key Informant Interviews, we will have several data collection sources to triangulate our recommendations. Our approach will fi map and identify project performance through results reported, which included FTFMS data, and performance indicated on the Results Frameworks and impact pathway. This will be done at each priority hub, and through our survey work, interviews, and observations, key factors for this data will be assessed. Our future programming recommendations will be explicitly divided into program and management, sections. What follows is our step by step analytical approach.

Analyzing project data from top down. As indicated from the program logic section, CSISA is a sprawling entity which encompasses a diverse array of activities. There is a wealth of data being collected not only for the overarching framework of CSISA phase II but also within each sub-project's own framework and impact pathways. As such, a thorough top down analysis of reported data will give an initial look into reported results. To complete this in a comprehensive way, the first level of analysis our team must undertake during desk review is to map each major technology to impact pathway, impact pathway to hub, and hub to sub-project.

With CSISA comprehensively mapped with it's corresponding data, our team will analyze the overarching results framework and collect the following statistics.

- Number of FTF indicators on target versus not on target
- Number results framework components met
- Number of impact pathway components met
- Change in performance across reporting periods
- The top 5% of indicators being met

When the team disaggregates this data there will be a clear sense of progress in impact pathways, hubs, and sub-projects as stated by their agreed upon performance management infrastructure. The team is mindful that success (rates of adoption) is not determined by the effectiveness of the research and development processes alone, appreciating that in many cases the rate of adoption is determined by levels of complexity of the biological and social factors. Some developments take more time than others and are still important and in the end necessary. Furthermore, the rates of adoption are also a result of locality transaction costs. For example, distances, coupled to poor roads, between target communities in the hill-lands in Nepal make comparisons of adoption numbers and rates between hubs in less constrained ecologies, meaningless. Impact Pathway Analysis, Surveys and Interviews will allow the team to triangulate the reasons behind milestones being achieved or not.

Scoring Survey Data. Our online survey is designed to be disaggregated by hub and also consists of several Likert style questions that assess prevailing attitudes about CSISA, predominantly around the domains outlined above. We have flagged certain questions to be indicators for attitudes around certain sub-domains such as coordination. By scoring the degree to which respondents agree with a statement on a five point scale, this gives us quantitative "scores" around domains that can give a broad sense of prevailing attitudes. For example, in one hub we may see that an impact pathway stalls progress on dissemination. Seeing the attitudes on that hub around say coordination and digging deeper with interview can unearth some causes as to why targets were not achieved. One key consideration of this survey, especially for staff members, is positivity bias. However, by comparing scores across different subthemes, one can still prioritize which statements respondents have the least amount of agreement. We expect most will "agree" or "strongly agree" with statements, but nevertheless the degree of concurrence can still be telling.

Analyzing across Domains in Key Informant Interviews. Our interviews/interactions with CSISA staff partners and service providers will also focus on the key themes under Program Management, Research, Catalyzing for Change and Program Future. These are linked to the survey data and will give deeper qualitative data behind why for example, in one hub respondents felt that research was more widely disseminated. Our analysis of interviews will add deeper context to the quality of both research and dissemination in CSISA's programming and then also the management of CSISA.

Domain Analysis: Research Program and Catalyzing Change. There are multiple considerations to take into account when looking at different interventions, especially for research and dissemination and deeming them "successful". The most straightforward is if the intervention is demonstrating widespread uptake, or if it is exceeding expected results not as indicated by project data, research results, or through stakeholder identifying technologies through survey. By reviewing the data and conducting interviews, our team will make this determination.

This systematic analysis will allow us to approach each component of CSISA with a comprehensive review that will guide funding decisions for the next phase.

Domain Analysis: Management. Management is more difficult to assess than the programmatic domain analysis as it is not always clearly linked to results in say an impact pathway. CSISA is unique in its complexity: its model of catalyzing innovation is through a unique combination of combining research and dissemination under one mechanism. Our team will pay compare at the hub level and sub-project level the qualitative attitudes and prevalent themes that occur across the sub-domains of program management. We will also cross list this with sub-domains that we score on the survey to see which sub-project has the most positive perceptions of management. This will help us distill best practice

We also will use this method to appraise the organizational structure of CSISA and determine whether respondents find the benefits outweigh the drawbacks. These are concepts such as research and dissemination in one project, and multiple implementing partners working on different components of CSISA

Outcome Measures

Our outcome measures will be aligned to the sub-domains that we aim to examine. For example, an outcome will be degree of private sector engagements, with variables that will include the corresponding survey questions and then also the qualitative data around this topic. This done across all sub-domains will offer a comparative analysis of the most high performing hubs and sub-projects across the various sub-domains.

The larger outcome measures will be determining future program considerations. From this we will take all of our findings across the research program and catalyzing change and then overlay this with factors such as sustainability, respondents' perceived need for prioritization, and whether the interventions are scalable. This will be a critical final piece of analysis that will help us sort through all of the various technologies and approaches listed and outline scenarios in which CSISA should continue to be the most transformational, the best value transactional cost, and the most high quality as a few examples.

Evaluation Work Plan

What follows is a more detailed evaluation plan for the four phases of the evaluation, Design, Collection, Analysis and Writing. For a more detailed trip itinerary, please see Annex 3.

TABLE 5. Evaluation Work Plan

Activities	January				February				March	
	1	2	3	4	1	2	3	4	1	2
Task 1: Develop Evaluation Design and Implementation Plan										
Draft Interview Guides and Survey	X	X	X	X						
Test interview guides and integrate feedback	X	X	X	X						
Scoping calls with USAID Missions	X	X	X							
Schedule Interviews/ Finalize Stakeholder Lists	X	X	X	X						
Data Collection										
Initial Interviews with Key CSISA Management		X	X							

Activities	January				February				March	
	1	2	3	4	1	2	3	4	1	2
M&E Document Review	X	X	X	X	X					
Interviews with DC based CSISA members (IFPRI)		X								
Interview with non-region based staff and CSISA leadership		X	X							
Interviews with CSISA Bangladesh/ MI and Stakeholders			X	X						
Interviews with CSISA Nepal and Stakeholders					X					
Interviews with India Staff						X	X			
Data Analysis										
Domain Review across hubs and themes						X	X	X	X	
Note transfer and coding					x	x	x	x	x	
Survey and Themes Triangulation							X	X		
Generate sub-domains scores							X	X		
Overlay sub-domain to future scoring								X	X	
Transmit Interview notes to HQ for additional analysis			X	X	X					
Report Writing										
Sketch out report outline		X								
Fill in Outline for India ("off day in Bangladesh")			X							
Exit report for USAID Bangladesh				X						
Fill in Outline for Nepal					X					
Exit report for USAID Nepal					X					
Fill in Outline for India ("off day")						X				
Exit report for USAID India							X			
Complete report as team				X	X	X	X	X		
Receive and integrate feedback									X	X

Interview Prompt Matrix

What follows is a working master list of questions to pull for the respective guides. We recognize that these will not all be applicable to stakeholders, so will use this as a pool to develop customize guides for each stakeholder, under consistent topics:

Interview Checklist

What follows is a summation of the main domains and subdomains to be discussed across each interview. Please note that prompts are divided by Staff, Partner and Service Provider:

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
Demographic					1–3
	Country, hub				1–3
	Org affiliation				1–3
Program Management					
	Overall Vision & Operational Culture	How would you describe CSISA's overall goal? What do you think are the most important values of the CSISA project?	How would you describe CSISA's overall goal? How do you fit within that model?	How would you describe CSISA's overall goal? How do you fit within that model?	4, 5, 6, 7, 34, 40
	Communication	How does CSISA communicate with partners? Can you provide examples of what other CSISA aspects are doing? Were the results of the research activity widely available to the public and in public databases?	What kinds of communication do you receive from CSISA, how do you communicate with them? Were the results of the research activity widely available to the public and in public databases?	What kinds of communication do you receive from CSISA, how do you communicate with them? How aware are you of other CSISA activities? Can you provide examples?	32
	Org Structure (country)	1. How would you describe the strengths and weaknesses of such a collaborative approach, with multiple funding streams and partners? How well does the program capitalize on the strengths and learn from weaknesses? Please provide concrete examples.	X	X	35
	Org Structure (research/ dissemination)	What is the benefit of having research and dissemination all under CSISA. What are the disadvantages?		What would the effect be if CSISA only focused on extension and not research?	32

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
	Org Structure (IPs)	How would you define the relationship with CIMMYT IRRI IFPRI ILRI? Where are roles most clear.? Where are they not? What are some advantages and disadvantages of this model? What suggestions would you make to improve and/ or streamline the integration of program activities, locally and/or regionally? How could this improve both dissemination of research as well as?	Which organizations implementing CSISA do you work with the most? Any others. Is it confusing to understand who works on what? What suggestions would you make to improve and/ or streamline the integration of program activities, locally and/or regionally? How could this improve both dissemination of research as well as?	X	XX
	M&E Systems	How are you involved with M&E systems? How do you use data to inform your management approach? Overall, how would you assess data quality? What are some of the weaknesses? Do you think the data collected is sufficient in telling CSISA's story? What key CSISA information is NOT being captured by the data?	Do you report data to CSISA? What's the process. How do you use the data you collect? How reliable do you think the data is? Does CSISA ever share larger results back?	Do you submit data to CSISA? How?	33
Research Quality					
	Results and validity	Please describe your research priorities. What has shown the most promising results in testing?	Please describe your research priorities. What has shown the most promising results in testing?	X	31, 37
		Which results are most scientifically valid? Where are there concerns?	Which results are most scientifically valid? What some risks to validity?	X	
		What research through CSISA has been published in peer review? Where?	What research through CSISA has been published in peer review? Where?	X	XX

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
	Process Research	How many farmers have adopted DSR in the Hub, and what are the principal constraints for broader adoption? How many Service Providers are there in the Hub region and of these how many have mastered the practical aspects of DSR and Mechanical Transplanted Rice? (We have about 30 questions for this sub-domain but they depend on the local context; so the above are indicative)	How many farmers have adopted Mechanical Transplanted Rice and what are the principal constraints for broader adoption? How many farmers have adopted DSR in the Hub, and what are the principal constraints for broader adoption? How many Service Providers are there in the Hub region and of these how many have mastered the practical aspects of DSR and Mechanical Transplanted Rice? (We have about 30 questions for this sub-domain but they depend on the local context; so the above are indicative)		15, 16, 21, 24, 28
	Crop Specific Agronomy Research	How many farmers are able to realize good plant stands of Direct-seeded Rice innovations and what is the range of desired plant populations for the currently sown variety? What is the economically optimal fertilizer recommendation for rabbi wheat in your hub domain? And, how did you find out? What is the impact of planting wheat before November 15th and where & when did you learn about this? (these are indicative; we have many crop specific questions depending on context)	How many farmers are able to realize good plant stands of Direct-seeded Rice innovations and what is the range of desired plant populations for the currently sown variety? What is the economically optimal fertilizer recommendation for rabbi wheat in your hub domain? And, how did you find out? What is the impact of planting wheat before November 15th and where & when did you learn about this? (these are indicative. we have many crop specific questions depending on context)		17, 18, 19, 20, 21, 22, 25, 26, 27, 29

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
	Breeding Research	Give examples of how CSISA's wheat (or rice) breeding activities have contributed to the release of improved varieties and or breeding methods? How does CSISA handle its segregating progeny (pedigree selection? or SSD bulk advance?); how does the national program do this? To what degree to advanced breeding lines get tested or selected in conditions of the farmers prior to extensive advanced varietal trials on stations? On farms?	Give examples of how CSISA's wheat (or rice) breeding activities have contributed to the release of improved varieties and or breeding methods? How does CSISA handle its segregating progeny (pedigree selection? or SSD bulk advance?); how does the national program do this? To what degree to advanced breeding lines get tested or selected in conditions of the farmers prior to extensive advanced varietal trials on stations? On farms?	When was the last time you changed your wheat variety. From what to what? When was the last time you changed your rice variety?	23
	Policy Research	What policies constrain the adoption of early planting of wheat and the adoption of zero till seed drills? Have the research results from the project changed and influenced national and state agronomic recommendations? If so, can the awareness of results and influence be documented so that policy change can be attributed to the project? Can socioeconomic constraints such as field size and land fragmentation be address by policy change or by economic growth? Do irrigation policy and infrastructure limit the prospects for reducing seasonal fallows and cropping intensity? Does policy research respond to the needs of biological and agronomic scientists in the CSISA Initiative?			
	Cross cutting themes: gender	Is there gender disparity in the beneficiaries. Where are these areas where women are underrepresented? How can nutrition be better integrated in future research?	Is there gender disparity in the beneficiaries? Where are these areas where women are underrepresented? How can nutrition be better integrated in future research?	How many of these technologies go to women farmers?	8

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
	Cross Cutting Themes Mechanization	What are the problems with the currently available zero-till planters? What are the problems with the currently available machines for mechanically transplanted rice?	What are the problems with the currently available zero-till planters? What are the problems with the currently available machines for mechanically transplanted rice?	Where do you get your planters repaired and how did you find out? Do you think having access to tractor-mounted herbicide sprayers will add to your business (to Service Providers)? What are the different uses you make of the Power Tillar and where did you learn about them?	
Catalyzing Change					
	Impact pathways	How would you describe the impact pathways? Is it realistic? Why or why not? What additional components do you think are missing from the impact pathway?	Are you aware of CSISA's impact pathway, how would you describe it? Is there anything missing from the pathway for it to achieve results?	Are you aware of the CSISA impact pathway? How does your work fit into it?	31
	Success technologies	What have been the most successful technologies transferred to the hubs? What has been the challenge? What are the key factors for this?	What technology at the hub have you seen disseminated the most effectively? Why?	What has been the most popular technology spread? In your opinion, what dissemination technique is most effective?	10–30
	Collaborations	How do you cultivate partnerships? What has been some of the most important lessons learned? Who are the most effective partners in theory.? (List NGO, private sector, government, other USAID projects, other). Is one type of partnership strongest or weakest? Why of why not?	Do you find new collaborations with CSISA? How did you partnership with CSISA begin? What do you think has been the best benefit for your organization?		11, 33–41

SOW Domain	SOW Sub-Domain	Staff	Partner	Service Provider	Relevant Survey Question?
	Private Sector engagement	How successful do you engage with the private sector? What technologies could be disseminated by the private sector solely? What are key PPP that you have developed?	(if private sector) how did you first start collaborating with CSISA? Is there a growing market for these technologies that you foresee?	X	37, 36
	Innovation behind research and process extension				10–13
Program Future					
	Reprioritization	If CSISA funding was drastically scaled back, what would be the most critical element to keep?	If CSISA funding was drastically scaled back, what would be the most critical element to keep?		31–32
		What part of CSISA is the most promising and in need of additional funding?	What part of CSISA is the most promising and in need of additional funding?		17, 15
	Sustainability	Who would fill the gaps if CSISA were to end altogether? What would be able to sustain itself?	Who would fill the gaps if CSISA were to end altogether? What would be able to sustain itself?		39
		How would you assess the local capacity to undertake CSISA's work? What additional HICD would be needed for local institutions to take on a greater role? Are there key skill gaps?	How would you assess the local capacity to undertake CSISA's work? What additional HICD would be needed for local institutions to take on a greater role?		
	Scalability	What portions of the CSISA do you think are most transferable to other potential hubs? Where? What makes is scalable?	What portions of the CSISA do you think are most transferable to other potential hubs? Where? What makes is scalable?		

ANNEX K: SURVEY QUESTIONNAIRE

CSISA Evaluation Survey

Demographic Information

1) At What CSISA Location do you Currently Work?

[ ] New Delhi
[ ] Bihar
[ ] Odisha
[ ] Eastern Uttar Pradesh
[ ] Haryana
[ ] Tamil Nadu
[ ] Kathmandu
[ ] Nepalgunj
[ ] Dhangadhi
[ ] Dhaka
[ ] Mymensingh
[ ] Jessore
[ ] Barisal
[ ] Khulna
[ ] Faridpur
[ ] Rangpur

2) Which best describes your relationship with CSISA?

[ ] I am a CSISA Staff Member
[ ] I collaborate with CSISA

3) Please provide the following details about your role on CSISA.

Position: ______________________________

Institution/Organization: ______________________________

Objective One

4) The emphasis in the CSISA Project is on increasing production to reduce rural poverty and enhance food security.

[ ] Strongly Agree
[ ] Agree
[ ] Neutral
[ ] Disagree
[ ] Strongly Disagree
[ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

5) The rice-wheat cropping system is the basis for the project activities in research and extension.

[ ] Strongly Agree
[ ] Agree
[ ] Neutral
[ ] Disagree
[ ] Strongly Disagree
[ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

6. In CSISA-BD, diversifying and intensifying the rice-based cropping system is the basis for project activities in research, training, and extension

[ ] Strongly Agree
[ ] Agree
[ ] Neutral
[ ] Disagree
[ ] Strongly Disagree
[ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

7) In the Odisha Hub, diversifying and intensifying the rice-based cropping system is the basis for project activities in research, training, and extension.
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Neutral
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

8) The very low incidence of rabi cropping in the coastal lowlands of Odisha is attributable to several factors but the most important is:
   - [ ] a. the absence of profitable cropping options
   - [ ] b. the lack of location-specific resources for irrigation
   - [ ] c. ineffective irrigation management and ineffectual policies that do not encourage water use-efficiency
   - [ ] d. small, scattered fields and fragmented landholdings

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

9) Through the use of shorter duration rice varieties, cropping in the rabi season in the coastal lowlands can be substantially increased without expanding the area under irrigation in the post-rainy season.
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Neutral
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

10) The rice-gher farming system that CSISA-BD is promoting can be expanded in most of the six Hubs in Bangladesh.
   - [ ] Strongly Agree
   - [ ] Agree
   - [ ] Neutral
   - [ ] Disagree
   - [ ] Strongly Disagree
   - [ ] Don't Know

Logic: Hidden unless: Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

11) In the rice-gher farming system that combines paddy fields with aquaculture, the most promising pond species are:
   - [ ] Prawn
   - [ ] Shrimp
   - [ ] Tilapia
   - [ ] Other fish species

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

12) In our Hub/Agriculture Research and Training Center (ARTC), the most important agricultural problem is:
- [ ] Slow growth in rice and wheat productivity
- [ ] The lack of diversification in crops that can either replace or complement rice and wheat
- [ ] The excessive use of water for irrigation
- [ ] Soil and environmental degredation
- [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

13) In CSISA-BD, the most important agricultural problem is:
- [ ] The lack of diversification in crops that can either replace or complement rice
- [ ] The excessive use of water for irrigation
- [ ] Soil and environmental degredation
- [ ] Don't Know

Logic: Hidden unless: Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

14) In the Odisha Hub, the most important agricultural problem is:
- [ ] The lack of diversification in crops that can either replace or complement rice
- [ ] The excessive use of water for irrigation
- [ ] Soil and environmental degredation
- [ ] Don't Know

15) The CSISA technologies that are researched and transferred respond well to farmer demand.

[ ] Strongly Agree	[ ] Agree	[ ] Neutral
[ ] Disagree	[ ] Strongly Disagree	[ ] Don't Know

16) Compared to the past, how much time do women now spend in agriculture:
- [ ] More time
- [ ] About the same amount of time
- [ ] Less time

17) Women will benefit as much as men from the technologies that are transferred in the CSISA Project.

[ ] Strongly Agree	[ ] Agree	[ ] Neutral
[ ] Disagree	[ ] Strongly Disagree	[ ] Don't Know

18) A lot of effort is put into field testing technologies prior to extension.

[ ] Strongly Agree	[ ] Agree	[ ] Neutral
[ ] Disagree	[ ] Strongly Disagree	[ ] Don't Know

19) The methods used in technology validation are new and highly participatory in the CSISA Project.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

20) The methods used in extension in the CSISA Project are innovative.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

21) We can cite several examples where partners have incorporated into their own activities new methods learned from their work in the CSISA Project.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "We can cite several examples where partners have incorporated into their own activities new methods learned from their work in the CSISA Project." #21 is one of the following answers ("Strongly Agree")

22) Please provide those examples.

____

____

____

23) Most of the technologies being extended in the CSISA Project are new and are not being transferred by the State Departments of Agriculture or other extension agencies.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Kathmandu","Nepalgunj","Dhangadhi")

24) From the list of technologies, please rank from greatest to least those that you believe will yield the largest impact?

[ ] Direct-seeded rice
[ ] Hybrid maize
[ ] Hybrid rice
[ ] Improved lentil production practices
[ ] Improved lentil varieties
[ ] Improved weed management with herbicides
[ ] Laser land levelers
[ ] Mechanical reapers for rice and wheat
[ ] Mechanical transplanters
[ ] Strip tillage
[ ] Superbags and improved post-harvest storage
[ ] Two-wheel tractors for tillage and other operations
[ ] Zero tillage with improved seeders

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Bihar","Eastern Uttar Pradesh")

25) What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative. Please rank the top five starting with the most important by clicking and dragging.

[ ] Balance concentrate feeding
[ ] Drought-tolerant rice varieties
[ ] DSR
[ ] Early wheat sowing
[ ] Efficient use of maize stover
[ ] Laser land levelling
[ ] Long-duration wheat varieties (Super 172, Baaz, HD-2967)
[ ] Machine transplanting
[ ] Mineral Mixture feeding practices
[ ] New Maize Hybrids
[ ] Post harvest maize
[ ] Post harvest Rice thresher
[ ] Residue Management
[ ] short-duration hybrid maize for grain/fodder
[ ] short-duration hybrid rice
[ ] Spring Maize and crop diversification and intensification in the winter and spring seasons
[ ] SSNM for maize, rice, and wheat
[ ] Zero Tillage (ZT)

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

26) What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative. Please rank the top five starting with the most important by clicking and dragging.

[ ] Direct Seeded Rice (DSR)
[ ] Feeding area chopped maize stover
[ ] Feeding area specific Mineral Mixture
[ ] Feeding chopped rice straw
[ ] Improved green gram varieties
[ ] Improved machine threshing
[ ] Improved rice varieties
[ ] Improved storage containers (Super bags, cocoon, painted pots)
[ ] Laser Land Levelling (LLL)
[ ] Maize Line sowing with seed drill
[ ] Mechanical Transplanting
[ ] Mechanization with seed drill, garden seeder, spreader, transplanter, etc.
[ ] Preparing balance concentrate feed based on local availabe resource and feeding
[ ] Rice Nursery management
[ ] Short duration hybrid maize
[ ] Site Specific Nutrition Management (SSNM)
[ ] Strip tillage in maize
[ ] Zero-Tillage

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

27) What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative. Please rank the top five starting with the most important by clicking and dragging.

[ ] Bulk storage of maize
[ ] Direct-Seeded Rice (DSR)
[ ] Good agronomic practices in rice (GAP)
[ ] Household-based pond aquaculture and vegetables on the dykes
[ ] Improved carp polyculture in ponds
[ ] Improved farming of rice-tilapia in gher
[ ] Improved rice-fresh water prawn and carp in gher
[ ] Legume intercropping with maize
[ ] Mechanized chaff cutting of maize, rice, and wheat stover
[ ] New machinery use in rice
[ ] Premium quality rice varieties
[ ] Saline-tolerant and Submergence-tolerant rice varieties
[ ] Short duration rice-mustard-rice, rice-maize-mung, rice-lentil-rice, etc. for intensified cropping
[ ] Sweet corn production and marketing
[ ] Wheat production for seed and grain
[ ] Zero Till, strip tillage, and line sowing in reduced tillage

Agronomy Considerations

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

28) CSISA is investing in opportunities for agricultural diversification of the rice/wheat production systems for income generation, including new crops, aquaculture, feed, and livestock. This work is important for the rural community.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

29) The crops that are most promising for diversification in the rice-wheat cropping system are:

Most important: ______________________________

Second most important: ______________________________

Third most important: ______________________________

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

30) In the lowlands the most promising crops to intensify rice-based systems are:

Most important: ____________________

Second most important: ____________________

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

31) In the coastal lowlands the most promising crops to intensify rice-based systems are:

Most important: ____________________

Second most important: ____________________

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

32) In the uplands, the most promising candidates include:

Most important: ____________________

Second most important: ____________________

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

33) In the plateau region, the most promising candidates include:

Most important: ____________________

Second most important: ____________________

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

34) In the rice-wheat cropping system in our Hub, which crop requires the most attention from research and extension to increase its productivity and generate more income for farmers?

[ ] Wheat
[ ] Rice

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Dhaka”,”Mymensingh”,”Jessore”,”Barisal”,”Khulna”,”Faridpur”,”Rangpur”)

35) The largest economic benefits from CSISA-BD will come from:
[ ] An expansion of improved aquaculture
[ ] Improved shorter-duration and premium priced rice varieties and hybrids
[ ] Improved crop management
[ ] The insertion of more cropping options in the rice-based cropping system

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Odisha”,”Dhaka”,”Mymensingh”,”Jessore”,”Barisal”,”Khulna”,”Faridpur”,”Rangpur”)

36) Adoption of ZT (zero tillage) makes it much easier for farmers to realize early planting (before 15 November) in appreciable areas in most of the Hub districts?
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Dhaka”,”Mymensingh”,”Jessore”,”Barisal”,”Khulna”,”Faridpur”,”Rangpur”)

37) Inserting crops and increasing intensity in the uplands is more promising than increasing cropping options in the lowlands in most of the Hubs of CSISA-BD?
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Odisha”)

38) Inserting crops and increasing intensity in the coastal lowlands is more promising than increasing cropping options in the plateau uplands in the Odisha Hub.
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Odisha”)

39) The extent of conservation agriculture that uses large amounts of crop residues as mulch is constrained in Odisha by the high demand for fodder.
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

40) By 2030, mechanization in the districts covered by CSISA-BD will rely more heavily on four-wheel tractors than on power tillers.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

41) The early planting of wheat, using full-season wheat varieties, is likely to be widely adopted.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

42) Cultivation on raised beds is an improved practice that will be widely adopted by farmers

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "The early planting of wheat, using full-season wheat varieties, is likely to be widely adopted." #41 is one of the following answers ("Disagree","Strongly Disagree")

43) Why Not?

____

____

____

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

44) Adoption of ZT wheat makes it much easier for farmers to realize early planting (before 15 November)?

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

45) Planting maize instead of wheat in the dry season is likely to be adopted where there is a stable demand for maize for feed.

[ ] True
[ ] False

46) Getting the rice harvested from the fields early in order to sow wheat early may require early harvest and threshing of rice without sun dry-down. Farmers and Service Providers are likely to adopt this combined innovation of short-duration rice and new mechanical threshers.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

47) Hybrid rice has bright prospects and will be adopted on 50% of rice-growing area by 2030.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is not one of the following answers ("Odisha","Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

48) Adoption of short duration 'catch crops' such as mung bean, mustard, cowpea, fresh maize etc. is likely to expand in the rice/ wheat systems as reduced tillage and early maturing rice become popular.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

49) In rice systems where water for flooding is limiting, weed control can be realized if herbicides are used. Are the right herbicides available?

[ ] Yes
[ ] No
[ ] Don't Know

50) Are they already frequently used?

[ ] Yes
[ ] No
[ ] Don't Know

51) Fertilizer, including manuring, is an expensive input, especially necessary for good rice, wheat and maize production. CSISA's work to help farmers use plant nutrient inputs efficiently and minimize risks is important and well done.

[ ] True
[ ] False
[ ] Don't Know

Logic: Hidden unless: Question "Fertilizer, including manuring, is an expensive input, especially necessary for good rice, wheat and maize production. CSISA's work to help farmers use plant nutrient inputs efficiently and minimize risks is important and well done." #51 is one of the following answers ("False")

52) How could this work be improved?

____

____

53) Laser Land Leveling can improve water use efficiency. It is likely to be widely adopted by farmers through Service Providers.

[ ] Strongly Agree | [ ] Agree | [ ] Neutral
[ ] Disagree | [ ] Strongly Disagree | [ ] Don't Know

54) Grain drying remains a serious problem at the farm level, resulting in crop losses and income loses. Are the grain drying and storage options from the project likely to be adopted and to solve the problems at the farm and farm-community levels?

[ ] Yes
[ ] No
[ ] Don't Know

Logic: Hidden unless: Question "Grain drying remains a serious problem at the farm level, resulting in crop losses and income loses. Are the grain drying and storage options from the project likely to be adopted and to solve the problems at the farm and farm-community levels?" #54 is one of the following answers ("No")

55) Why not?

____

____

____

56) Impact will be substantial from the CSISA Project and will be reflected in district-wise production statistics by 2020.

[ ] Strongly Agree | [ ] Agree | [ ] Neutral
[ ] Disagree | [ ] Strongly Disagree | [ ] Don't Know

57) The minimum time for a project like CSISA to achieve widespread impact is

[ ] Three years
[ ] Six years
[ ] Nine years
[ ] More than nine years

58) The research and extension activities are well coordinated.

[ ] Strongly Agree | [ ] Agree | [ ] Neutral
[ ] Disagree | [ ] Strongly Disagree | [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

59) In CSISA-BD, the institutional interactions among IRRI, CIMMYT, and WorldFish have been productive and synergistic in all the Hubs.

[ ] Strongly Agree | [ ] Agree | [ ] Neutral
[ ] Disagree | [ ] Strongly Disagree | [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha"

60) In the Odisha Hub, the institutional interactions among IRRI, CIMMYT, and ILRI have been productive and synergistic and all three CG partners have contributed meaningfully to the six objectives of the CSISA Initiative.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

61) The prospects for the adoption and diffusion of Direct-Seeded Rice (DSR) are more promising in Odisha than in other States in East India.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

62) In the future, separate projects by IRRI, CIMMYT, and WorldFish in Bangladesh will not be as effective as CSISA-BD because the scope for productive interactions will be limited.

[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don't Know

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Dhaka","Mymensingh","Jessore","Barisal","Khulna","Faridpur","Rangpur")

63) By 2030, which machines will be most visible in the districts presently covered by CSISA-BD?:

[ ] Rice Reapers
[ ] Mechanical rice transplanters
[ ] Laser land levelers

Logic: Hidden unless: Question "At What CSISA Location do you Currently Work?" #1 is one of the following answers ("Odisha")

64) By the end of the next phase, the largest economic impact in the CSISA Project will come from:

[ ] Increased rabi cropping in the coastal lowlands
[ ] Improved maize production in the plateau uplands
[ ] Improved dairy production in the four districts where Hub activities are carried out
[ ] Improved rice production in kharif

Logic: Hidden unless: Question “At What CSISA Location do you Currently Work?” #1 is one of the following answers (“Odisha”)

65) Based on the research and extension of CSISA scientists and partners in the Odisha Hub, the mechanical intervention that will have the most impact is the:
[ ] a. Laser land leveler
[ ] b. Mechanical transplanter in unpuddled conditions
[ ] c. Paddy thresher
[ ] d. Paddy reaper
[ ] e. Straw chopper

66) The project management and administration in our Hub are effective and efficient.
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

67) In our Hub, all partners both contribute to and benefit from the CSISA Project.
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

68) Government research and extension agencies are well-represented and participate actively
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

69) The private sector can effectively participate in the transfer in most of the technologies recommended by the CSISA Project.
[ ] Strongly Agree [ ] Agree [ ] Neutral
[ ] Disagree [ ] Strongly Disagree [ ] Don’t Know

70) In the next phase of three years more emphasis should be placed on:
[ ] Research
[ ] Extension
[ ] Training
[ ] Don’t Know

71) In the next three years, what are the research areas that warrant most attention in our Hub? (please write in on following lines)

Most important research area: ____

Second most important research area: ____

72) When the CSISA ends, the prospect for sustaining the work from other resources by other institutions are:
[ ] Bright
[ ] Unclear
[ ] Bleak

73) The biggest advantage of the CSISA Project is:

[ ] It's abundant resources to carry out field days, demonstrations, and farmer training.

[ ] Its solid research-extension linkages and innovative methods to test technology.

[ ] Its multiplicity of partners who can discover technology internationally for regional adaptation and local transfer.

[ ] Other:____

Thank You!

ANNEX L: SURVEY RESULTS

CSISA Evaluation Survey

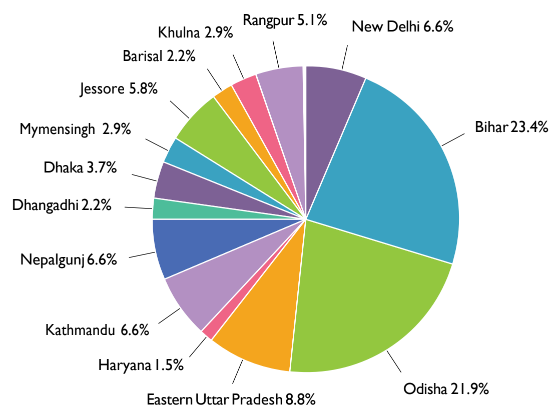
The evaluation team used a commercial survey software (www.surveygizmo.com) to elicit information from CSISA staff (65%) and collaborators (35%) about their views on the effectiveness of the CSISA program and its technologies. The survey consisted of 40–45 questions for each of CSISA's broad geographic mandate areas: (1) the rice-wheat cropping sequence in India and Nepal, (2) the rice-based cropping systems in Odisha in East India, and (3) the rice-based cropping systems in Bangladesh. Many questions were common to the three regional surveys; others, mainly those related to adaptability and the potential for adoption of technology, were specific to each of the three CSISA-mandated regions. Because the survey was in English and on-line, only participants who had access to the Internet and were comfortable in English were able to respond. A total of 141 respondents from 13 locations answered the on-line survey, but many participants did not respond to every question. In particular, partners had a difficult time responding to all questions in the survey because they were not as familiar with all aspects of the CSISA Initiative as staff were.

In general, response to the survey was positive; however, many respondents found it to be a taxing exercise because the questionnaire did not rely on open-ended responses. Some respondents were quick to point out that some alternative choices did not capture the location-specifi reality in their Hubs or did not mimic what was happening in the Initiative in their country. With hindsight, the evaluation team should have designed separate inquiries earlier in the review process in response to regional technological heterogeneity.

We thank the 141 respondents who took the time to share their perceptions on CSISA and its researched and transferred technologies. Although the survey was anonymous, our team estimates a 75% response rate from the projected pool of recipients. Across the three regions, responses to 74 questions were given by CSISA staff and partners. Responses to the 74 questions are presented in this Annex.

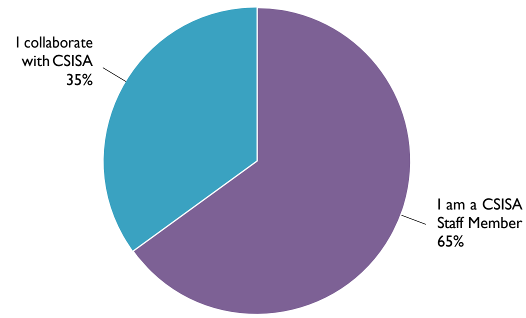
1. At what CSISA location do you currently work?

Value	Percent	Count
New Delhi	6.6%	9
Bihar	23.4%	32
Odisha	21.9%	30
Eastern Uttar Pradesh	8.8%	12
Haryana	1.5%	2
Tamil Nadu	0.0%	0
Kathmandu	6.6%	9
Nepalgunj	6.6%	9
Dhangadhi	2.2%	3
Dhaka	3.7%	5
Mymensingh	2.9%	4
Jessore	5.8%	8
Barisal	2.2%	3
Khulna	2.9%	4
Rangpur	5.1%	7
Total		137



2. Which best describes your relationship with CSISA?

Value	Percent	Count
I am a CSISA Staff Member	65.0%	78
I collaborate with CSISA	35.0%	42
Total		120



3. Please provide the following details about your role on CSISA.: Position.

Count	Response
1	Agriculture Specialist
1	ARTC Hub Manager
2	ARTC Manager
1	Advisory Committee Member
1	Ag Mech Specialist
1	Agricluture Extension Officer
2	Agriculture Engineer Intern
6	Agriculture Specialist
5	Agriculture Specialist
1	Agronomist
1	Assistant Scientist
1	Assistant Scientist – Extension Agronomy
1	Assistant Scientist – Applied Soci-Economics
1	Assistant Scientist – Applied Socio-Economics
1	Assistant Scientist – Extension Agronomy
1	Associate Scientist
1	COP, CSISA-BD
1	CSISA Field Coordinator
3	Consultant
1	Consultant Advisor
1	Coordinator
1	Cropping Systems Agronomist
1	Cropping Systems Agronomist & Objective 2 leader
1	Director
1	Division Chief
1	Executive

Count	Response
1	Extension Agronomist/Hub Manager
1	Field Coordinator
2	Finance & Admin. Assistant
1	Finance & Admin. Assistant
2	Fish Scientist/Hub Manager
2	Focal Person
2	Gender Specialist
3	Hub Manager
1	Lead Specialist, Partnership and Liaison
2	M&E Specialist
1	M&E Specialist assitance
1	M.Sc. Scholar
1	M.Sc. (Plant Physiology)
1	M.Sc. Scholar (Soil Science)
1	Objective 1 leader
1	Objective 5 leader
1	PDF: Soil Scientist/Nutrient Management Specialist
1	PI
1	PI, RP, Patna
2	Partner
1	PhD Scholar availing CSISA CIMMYT Fellowship
1	Post-Harvest Specialist
1	Principal Advisor for Livestock Activities of CSISA through ILRI
1	Principal Investigator (ICAR side)
1	Programme Coordinator

Count	Response
2	Project Coordinator
1	Project Leader, MI
1	Project Leader – Phase II 'Base' CSISA
2	Project Manager
1	Regional Manager CSR
2	Research Associate
1	Research Collaborator
1	Research Platform Coordinator
1	Research Team Leader, Former Project Leader, CSISA-MI
7	Scientist
1	Senior Associate Scientist – Agronomy
1	Senior Regional Manager
1	Senior Specialist
1	Senior Specialist – Agricultural Research & Development
2	Senior Specialist – Agricultural Research & Development/Hub Manager
1	Senior Scientist
1	Socio-Economist

Count	Response
1	Special Project Scientist
1	Specialist
2	Specialist – Training and Outreach
1	Sr. Specialist
1	Sr. Aquaculture Expert/Hub Manager
1	Technical Support
1	Training Officer
1	Umme Nehar – Executive Director D
1	Area Coordinator
1	M.Sc. Agronomy Student in OUAT, doing my thesis work under CSISA
1	Part of CSISA family for M.Sc. thesis work
1	Principal Investigator
1	Project Coordinator
1	Scientist
1	Secretary
1	Social Scientist
1	Student
1	Student Fellow

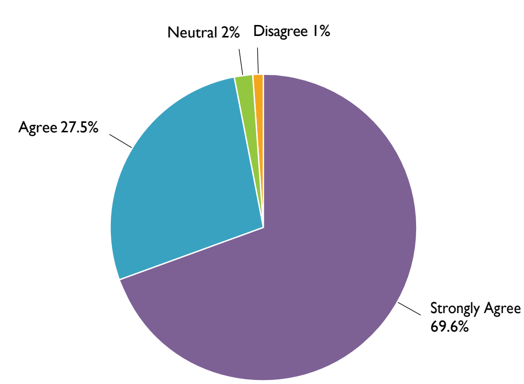
3. Please provide the following details about your role on CSISA.: Institution/Organization

Count	Response
1	Agricultural Engineering Division, NARC
1	Bangladesh livestock Research Institute, Savar, Dhaka-1341
35	CIMMYT
1	CIMMYT-CCDB
1	CIMMYT/CSISA-NP
3	CSISA Nepal
1	CSISA-CIMMYT
2	CSISA-NP, CIMMYT
1	Central Soil Salinity Research Institute, Karnal (Haryana) India
1	Community based Dairy Veterinary Foundation (CDVF)
1	Digital Green
1	District Agriculture Develoment Office Urkhet
1	FORWARD Nepal
1	ICAR-RCER, Patna
1	IFPRI
6	ILRI
17	IRRI
1	ITC Limited
1	International Livestock Research Institute (ILRI)
4	International Rice Research Institute
1	KISAN
1	KVK,Bhojpur
1	Krishi Vigyan Kendra, Bhadrak (OUAT)

Count	Response
1	Michigan State University
1	NARC
1	Nepal Agricultural Research Council, Regional Agricultural Research Station
1	OUAT
5	Orissa University of Agriculture and Technology, Odisha, India
1	PRADAN
2	Raman Ahuja
1	SG Institute of Dairy Technology, Patna
1	SKT Nepal Pvt Ltd
1	SOLIDARITY
1	Sanjay Gandhi Institute of Dairy Technology, Patna
1	Society for UDDOG (PNGO)
1	UC Davis
7	WorldFish
1	Central Soil Salinity Research Institute, Karnal, Haryana
1	CIMMYT
1	Creation Welfare Society
1	Creation Welfare Society
1	Odisha University of Agriculture and Technology, Bhubaneswar
1	OUAT
1	Regional Agricultural Research Station, Khajura

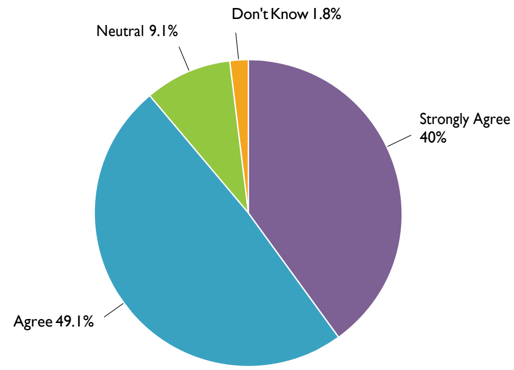
4. The emphasis in the CSISA Project is on increasing production to reduce rural poverty and enhance food security.

Value	Percent	Count
Strongly Agree	69.6%	71
Agree	27.5%	28
Neutral	2.0%	2
Disagree	1.0%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		102



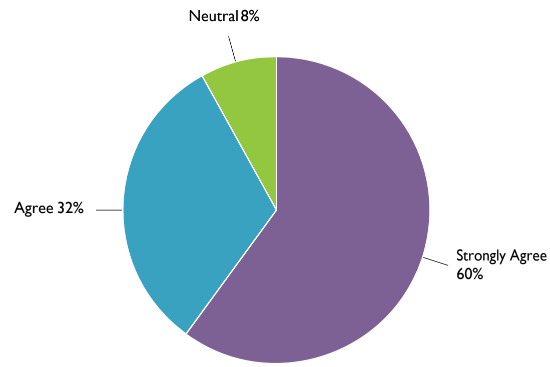
5. The rice-wheat cropping system is the basis for the project activities in research and extension.

Value	Percent	Count
Strongly Agree	40.0%	22
Agree	49.1%	27
Neutral	9.1%	5
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	1.8%	1
Total		55



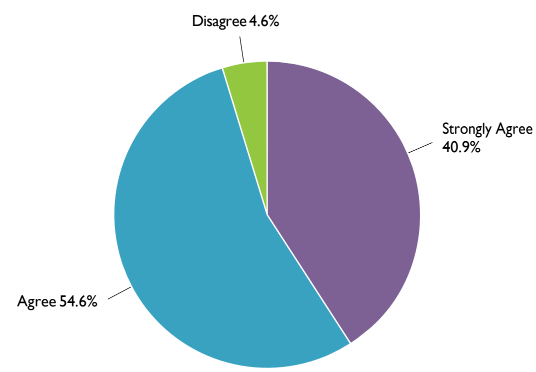
6. In CSISA-BD, diversifying and intensifying the rice-based cropping system is the basis for project activities in research, training, and extension

Value	Percent	Count
Strongly Agree	60.0%	15
Agree	32.0%	8
Neutral	8.0%	2
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		25



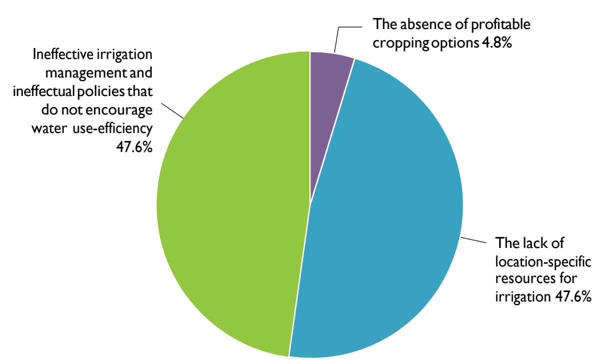
7. In the Odisha Hub, diversifying and intensifying the rice-based cropping system is the basis for project activities in research, training, and extension.

Value	Percent	Count
Strongly Agree	40.9%	9
Agree	54.6%	12
Neutral	0.0%	
Disagree	4.6%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		22



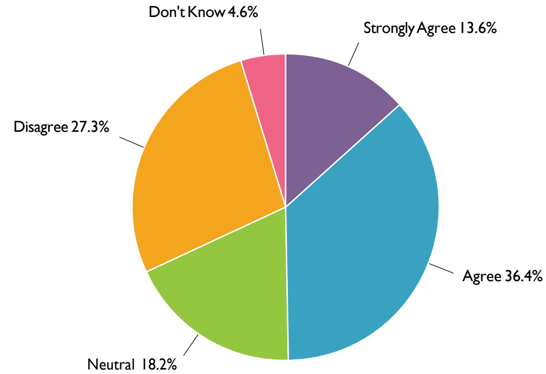
8. The very low incidence of rabi cropping in the coastal lowlands of Odisha is attributable to several factors but the most important is:

Value	Percent	Count
a. the absence of profitable cropping options	4.8%	1
b. the lack of location-specific for irrigation	47.6%	10
c. ineffective irrigation management and ineffectual policies that do not encourage water use-efficiency	47.6%	10
Total		21



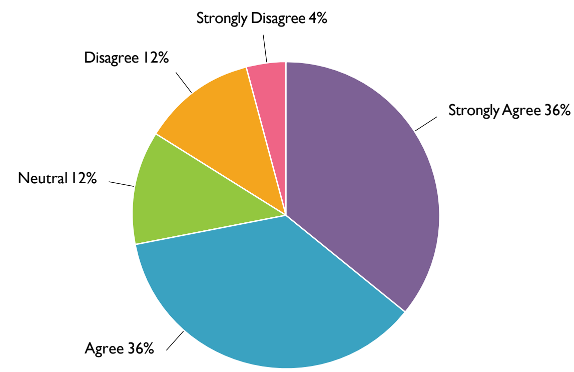
9. Through the use of shorter duration rice varieties, cropping in the rabi season in the coastal lowlands can be substantially increased without expanding the area under irrigation in the post-rainy season.

Value	Percent	Count
Strongly Agree	13.6%	3
Agree	36.4%	8
Neutral	18.2%	4
Disagree	27.3%	6
Strongly Disagree	0.0%	0
Don't Know	4.6%	1
Total		22



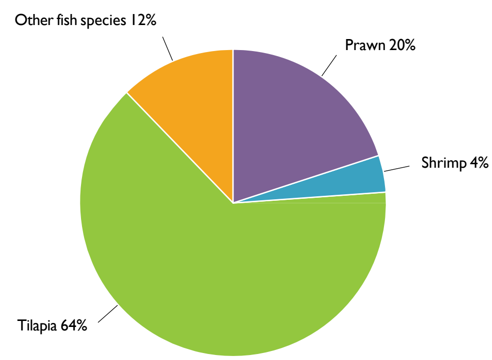
10. The rice-gher farming system that CSISA-BD is promoting can be expanded in most of the six Hubs in Bangladesh.

Value	Percent	Count
Strongly Agree	36.0%	9
Agree	36.0%	9
Neutral	12.0%	3
Disagree	12.0%	3
Strongly Disagree	4.0%	11
Don't Know	0.0%	0
Total		25



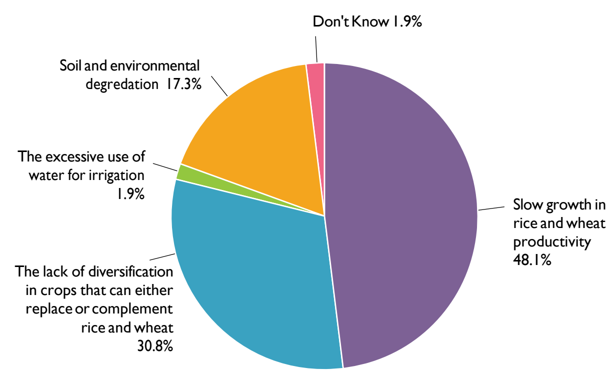
11. In the rice-gher farming system that combines paddy fields with aquaculture, the most promising pond species are:

Value	Percent	Count
Prawn	20.0%	5
Shrimp	4.0%	91
Tilapia	64.0%	16
Other fish species	12.0%	3
Total		25



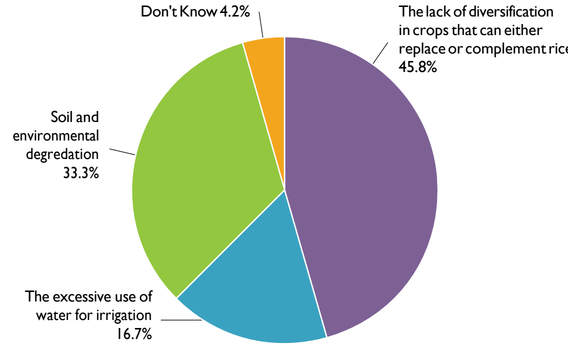
12. In our Hub/Agriculture Research and Training Center (ARTC), the most important agricultural problem is:

Value	Percent	Count
Slow growth in rice and wheat productivity	48.1%	25
The lack of diversification in crops that can either replace or complement rice and wheat	30.8%	16
The excessive use of water for irrigation	1.9%	1
Soil and environmental degredation	17.3%	9
Don't Know	1.9%	1
Total		52



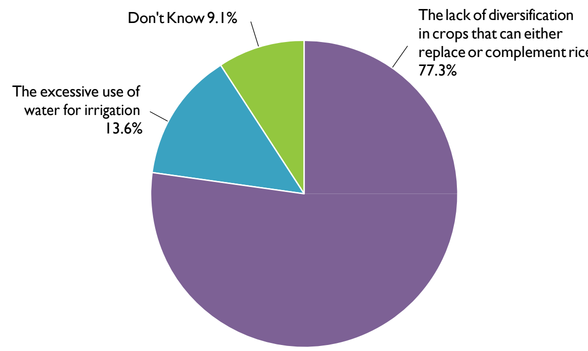
13. In CSISA-BD, the most important agricultural problem is:

Value	Percent	Count
The lack of diversification in crops that can either replace or complement rice	45.8%	11
The excessive use of water for irrigation	16.7%	4
Soil and environmental degredation	33.3%	8
Don't Know	4.2%	1
Total		24



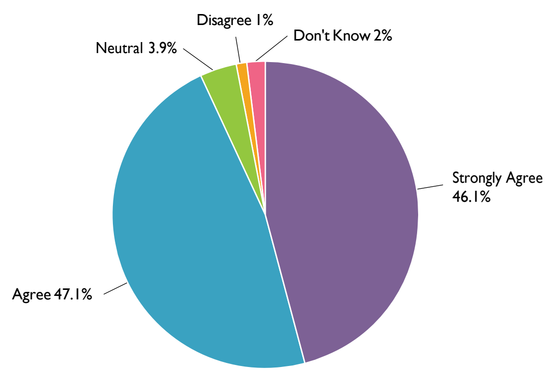
14. In the Odisha Hub, the most important agricultural problem is:

Value	Percent	Count
The lack of diversification in crops that can either replace or complement rice	77.3%	17
The excessive use of water for irrigation	13.6%	43
Soil and environmental degredation	0.0%	0
Don't Know	9.1%	2
Total		22



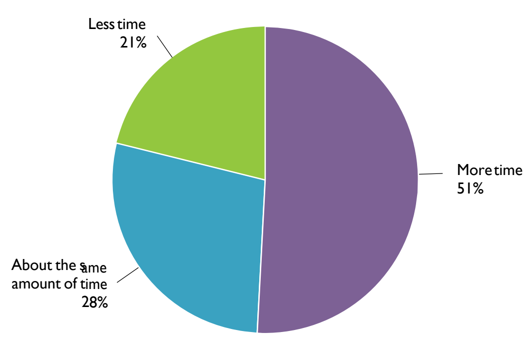
15. The CSISA technologies that are researched and transferred respond well to farmer demand.

Value	Percent	Count
Strongly Agree	46.1%	47
Agree	47.1%	48
Neutral	3.9%	4
Disagree	1.0%	1
Strongly Disagree	0.0%	0
Don't Know	2.0%	2
Total		102



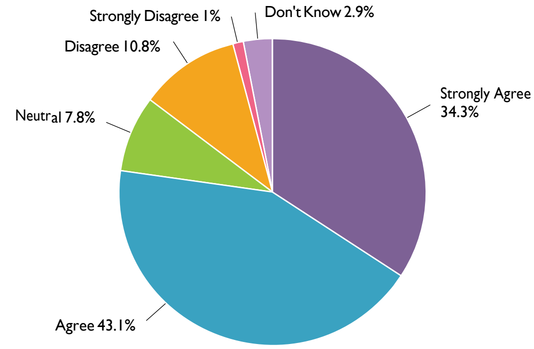
16. Compared to the past, how much time do women now spend in agriculture:

Value	Percent	Count
More time	51.0%	51
About the same amount of time	28.0%	28
Less time	21.0%	21
Total		100



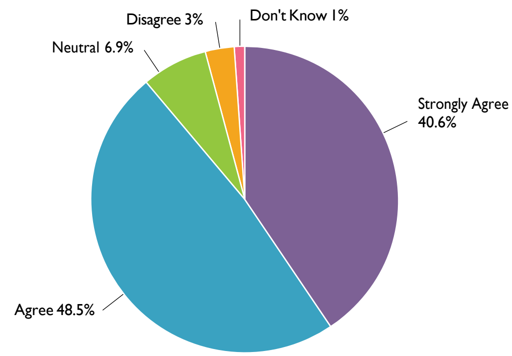
17. Women will benefit as much as men from the technologies that are transferred in the CSISA Project.

Value	Percent	Count
Strongly Agree	34.3%	35
Agree	43.1%	44
Neutral	7.8%	8
Disagree	10.8%	11
Strongly Disagree	1.0%	1
Don't Know	2.9%	3
Total		102



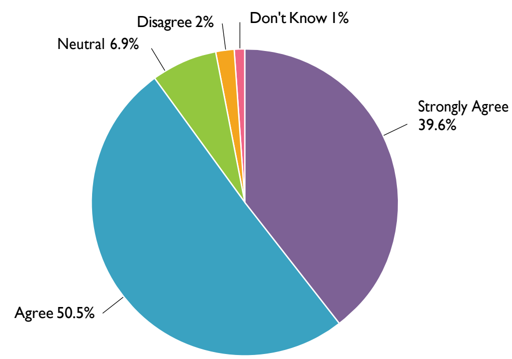
18. A lot of effort is put into field testing technologies prior to extension.

Value	Percent	Count
Strongly Agree	40.6%	41
Agree	48.5%	49
Neutral	6.9%	7
Disagree	3.0%	3
Strongly Disagree	0.0%	0
Don't Know	1.0%	1
Total		101



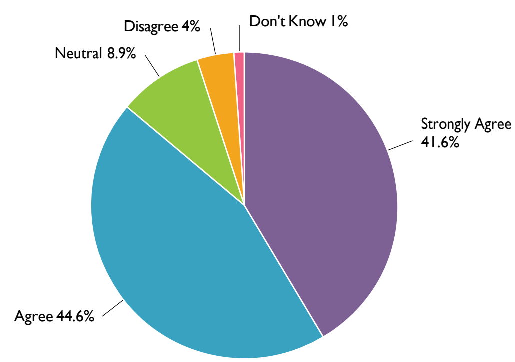
19. The methods used in technology validation are new and highly participatory in the CSISA Project.

Value	Percent	Count
Strongly Agree	39.6%	40
Agree	50.5%	51
Neutral	6.9%	7
Disagree	2.0%	2
Strongly Disagree	0.0%	0
Don't Know	1.0%	1
Total		101



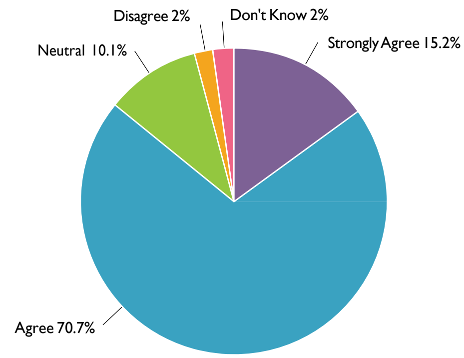
20. The methods used in extension in the CSISA Project are innovative.

Value	Percent	Count
Strongly Agree	41.6%	42
Agree	44.6%	45
Neutral	8.9%	9
Disagree	4.0%	4
Strongly Disagree	0.0%	0
Don't Know	1.0%	1
Total		101



21. We can cite several examples where partners have incorporated into their own activities new methods learned from their work in the CSISA Project.

Value	Percent	Count
Strongly Agree	15.2%	15
Agree	70.7%	70
Neutral	10.1%	10
Disagree	2.0%	2
Strongly Disagree	0.0%	0
Don't Know	2.0%	2
Total		99

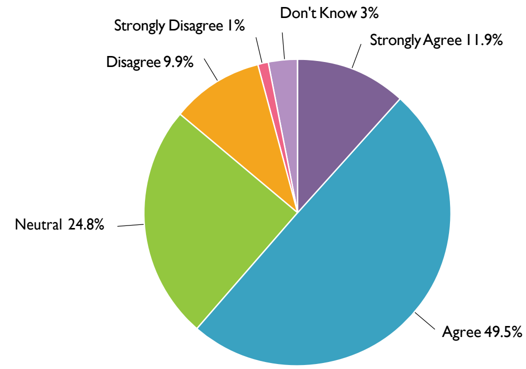


22. Please provide those examples.

Count	Response
1	Feeding of urea treated maize stovers to dairy animals
1	NGOs, Research Organization and farmers community
1	Seed production Seed storage
1	Service provider model
1	Zero-tillage wheat, MTR, Bed planting Maize, Bed planting wheat, DSR
1	• Community Rice nursery in Puri District • Mechanical transplanting under non Puddled condition • Growing Green gram under Zero-Tillage condition in Puri • Growing mustard under Zero-Tillage condition in Bhadrak
1	Maize cultivation, hermetic storage in cocoons, hermetic storage in super bags, ZT, Laser Levelling, using newer paddy varieties, etc.
1	Lesser land leveling, Planting with zero-till machine, mechanical rice transplanting, residue keeping on field instead of burning, short/medium duration rice hybrid use followed by long duration wheat & its early planting, use of potash fertilizer, rice wheat & maize weedicides use & their right methods of application, axial flow rice thresher, high power maize sheller, axial flow low energy consumption irrigation pump best suited for two wheal tractor (demonstrated at many location), women farmer empowerment through SHGs & their active participation in farm decision, feed preparation techniques, sensitization to policy makers and their motivation for agriculture mechanization and many more through different public private partners.
1	Approach to knowledge dissemination is essential part of CSISA impact. CSISA's knowledge bank of field practices and conservation agriculture is used by field partners.
1	Feeding Chopped paddy straw with Mineral mixture in Odisha by OMFED and also government department
1	• Promotion of maize in Southern Bangladesh • NGO programs extending and focussing on agricultural machinery on their own • Private sector partners investing in new agricultural machinery on their own • NGOs making use of CSISA extension material on their own • Farmers and service providers adapting practices to suit their own needs, using trainings as the basis of their learning • Etc.
1	Mechanical transplanting of paddy Direct seeded rice Zero-tillage of wheat, Bed planting maize, Bed planting of wheat
1	There are lots of technologies that CSISA-NP have tested and demonstrated first time in westren Nepal. Laser land leveler, use of bed planting for lentil, power-tiller operated rice reaper. are incorporated in regular programme of RARS, Nepalgunj.
1	Partner like BSSS in Mayurbhanj district has successfully installed several cocoons. Partners like PRADAN and DHAN have successfully incorporated CSISA promoted technologies.
1	Farmers of Bhadrak & Puri District have started to follow AWD (Alternate Wetting & Drying) through Panipipe. Agriculture department is including AWD in their trainings, farmers fare etc. Many service providers have been created o. mechanical transplanting of rice.

23. Most of the technologies being extended in the CSISA Project are new and are not being transferred by the State Departments of Agriculture or other extension agencies.

Value	Percent	Count
Strongly Agree	11.9%	12
Agree	49.5%	50
Neutral	24.8%	25
Disagree	9.9%	10
Strongly Disagree	1.0%	1
Don't Know	3.0%	3
Total		101



24. From the list of technologies, please rank from greatest to least those that you believe will yield the largest impact?

	Score*	Overall Rank
Mechanical reapers for rice and wheat	139	1
Hybrid maize	126	2
Two-wheel tractors for tillage and other operations	108	3
Direct-seeded rice	97	4
Hybrid rice	96	5
Zero-tillage with improved seeders	90	6
Improved lentil varieties	75	7
Improved lentil production practices	72	8
Strip tillage	61	9
Laser land levelers	60	10
Improved weed management with herbicides	59	11
Mechanical transplanters	46	12
Superbags and improved post-harvest storage	42	13
Total Respondents		12

*Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

170. What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative? Please rank the top five starting with the most important by clicking and dragging.

	Score*	Overall Rank
Early wheat sowing	311	1
Zero-Tillage (ZT)	286	2
Machine transplanting	258	3
DSR	176	4
Laser land levelling	162	5
Long-duration wheat varieties (Super 172, Baaz, HD-2967)	160	6
Balance concentrate feeding	113	7
Residue Management	98	8
Short-duration hybrid rice	88	9
Mineral Mixture feeding practices	66	10
Efficient use of maize stover	61	11
Post-harvest Rice thresher	60	12
Drought-tolerant rice varieties	57	13
Short-duration hybrid maize for grain/fodder	41	14
Spring Maize and crop diversification and intensification in the winter and spring seasons	39	15
Post harvest maize	31	16
SSNM for maize, rice, and wheat	31	17
New Maize Hybrids	25	18
Total Respondents		24

*Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

26. What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative? Please rank the top five starting with the most important by clicking and dragging.

	Score*	Overall Rank
Direct Seeded Rice (DSR)	125	1
Laser Land Levelling (LLL)	119	2
Rice Nursery management	106	3
Mechanical Transplanting	91	4
Site Specific Nutrition Management (SSNM)	63	5
Mechanization with seed drill, garden seeder, spreader, transplanter, etc.	62	6
Improved rice varieties	58	7
Improved storage containers (Super bags, cocoon, painted pots)	52	8
Improved machine threshing	49	9
Zero-Tillage	32	10
Maize Line sowing with seed drill	30	11
Feeding chopped rice straw	26	12
Preparing balance concentrate feed based on local availabe resource and feeding	21	13
Feeding area specific Mineral Mixture	16	14
Feeding area chopped maize stover	15	15
Improved green gram varieties	14	16
Strip tillage in maize	6	17
Short duration hybrid maize	0	19
Total Respondents		21

*Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

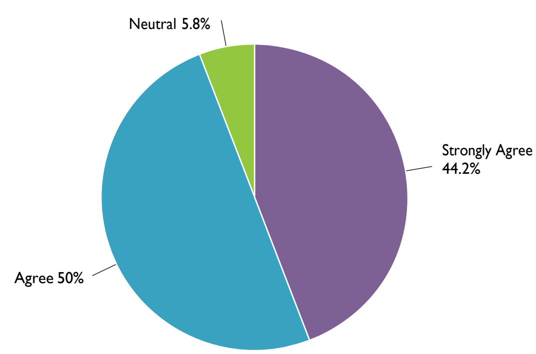
172. What are the five technologies from the following list that you believe will have the most impact in the region as a result of the CSISA Initiative? Please rank the top five starting with the most important by clicking and dragging.

	Score*	Overall Rank
Short duration rice-mustard-rice, rice-maize-mung, rice-lentil-rice, etc., for intensified cropping	113	1
Household-based pond aquaculture and vegetables on the dykes	87	2
Saline-tolerant and Submergence-tolerant rice varieties	81	3
Good agronomic practices in rice (GAP)	63	4
Improved rice-fresh water prawn and carp in gher	58	5
Improved carp polyculture in ponds	54	6
Zero Till, strip tillage, and line sowing in reduced tillage	53	7
Improved farming of rice-tilapia in gher	40	8
Premium quality rice varieties	39	9
New machinery use in rice	38	10
Wheat production for seed and grain	30	11
Bulk storage of maize	10	12
Legume intercropping with maize	6	13
Direct-Seeded Rice (DSR)	6	14
Mechanized chaff cutting of maize, rice, and wheat stover	5	15
Sweet corn production and marketing	5	16
Total Respondents		23

*Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

28. CSISA is investing in opportunities for agricultural diversification of the rice/wheat production systems for income generation, including new crops, aquaculture, feed, and livestock. This work is important for the rural community.

Value	Percent	Count
Strongly Agree	44.2%	23
Agree	50.0%	26
Neutral	5.8%	3
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		52



29. The crops that are most promising for diversification in the rice-wheat cropping system are: Most important

Count	Response
1	Brassica
1	Brassica/Mustard
1	Green-gram (moong)
1	Green-gram
1	Legumes
1	Lentil
2	Maize
13	Maize
1	Maize
1	Maize in place of rice
1	Moong
1	Mungbean
2	Mungbean
1	Mungbean

Count	Response
2	Mustard
1	New crops especially catch crops should be incorporated for spring season in western terai
1	Rice
1	Rice-Potato/Vegetables
1	Rice-wheat-mungbean
1	Summer munbbean
1	Veggies
1	legumes
3	Maize
2	Mungbean
1	Oilseeds
1	Rice – wheat – green-gram
2	Wheat

29. The crops that are most promising for diversification in the rice-wheat cropping system are: Second most important

Count	Response
1	Black gram
1	Cow Pea
1	Feed
1	Fodder
1	Fodder Crops
1	Grain legumes
1	Green Fodder
2	Green-gram
1	Green-gram
1	Legumes
1	Lentil
3	Maize
1	Maize
1	Mungbean
1	Mungbean
1	Mungbean as an additional crop
2	Pulses
1	Pulses (mungbean)
1	Rice

Count	Response
1	Rice-lentil
1	Rice – mustard – maize
1	Sesamum
1	Soyabean
1	Soybean
2	Tora
1	Toria
1	Wheat
1	Horticulture
1	Lentil
1	Maize
1	Mustard
1	Pulses
1	Grapeseed
1	Rice
1	Rice – Indian mustard – green-gram
1	Wheat
1	Winter maize

30. In the lowlands the most promising crops to intensify rice-based systems are: Second most important

Count	Response
1	Urd been
2	Cow Pea
1	Cow Pea
1	Horticultural crops
1	Legumes
3	Maize
1	Maize
1	Maize potato
1	Mungbean
3	Mustard
1	Potato/mustard
2	Pulses
1	Rice – Gram
1	Rice – Maize – Mungbean
1	Soyabean

Count	Response
1	Soybean
1	Wheat
1	Cow Pea
1	Fresh Maize
2	Livestock
1	Maize
1	mustard
1	Oil seeds
2	Peanuts
1	Pigeonpea
2	Rice
1	Rice – Potato – Green-gram
1	Soybean
1	Vegetable crops

30. In the lowlands the most promising crops to intensify rice-based systems are: Most important

Count	Response
1	BRRI dhan34
1	Improved prawn with carp
1	Maize
3	Mustard
1	Rice
1	Rice-fish
1	Rice-prawn with fish
1	Rice-prawn-vegetable
1	Submergence tolerant rice

Count	Response
1	Submergent Rice-Boro Rice
1	Sunflower
1	Maize
2	Rice
1	Submergence rice variety
1	Submerging rice variety
1	Submergence Tolerant Rice Variety in Monsoon season followed by premium quality Boro rice variety in dry season

29. The crops that are most promising for diversification in the rice-wheat cropping system are: Third most important

Count	Response
1	BRRI dhan52
1	Colocasia
1	Early Aman Rice-Mustard-Boro Rice
1	Grass pea
1	Mungbean
1	Pulse
2	Pulses
1	Rice-Mustard
1	Rice-collocasia
1	Rice-Fish

Count	Response
1	Rice-Mustard-Rice
1	Shrimp-rice
1	Maize
1	Rice-mustard
1	Salt-tol boro rice in the dry season
1	Sunflower
1	Short duration Mustard just after drain out of water comparatively upper portion of low land and followed by Premium quality boro rice variety in dry season. OR Sub mergence tolerant rice variety in Jute as relay and followed by premium quality boro rice variet. in dry season

31. In the coastal lowlands the most promising crops to intensify rice-based systems are: Most important

Count	Response
2	Green gram
1	Green gram
1	Hybrid rice
1	Moong
2	Pulses
1	Rice

Count	Response
4	Rice
1	Groundnut
1	Maize
1	Pulses
2	Rice
1	Short duration rice

31. In the coastal lowlands the most promising crops to intensify rice-based systems are: Second most important

Count	Response
1	Black gram
1	Green gram
1	Gram
1	Green Fodder
1	Green gram – Black gram – Horse gram – Mustard – Ground nut
1	Green gram
1	Maize

Count	Response
1	Mung bean
1	Pulses
1	Toria (Short Mustard)
1	Vegetables
1	Cash crops like Jute
2	Green gram
1	Mustard
1	Oilseeds

33. In the plateau region, the most promising candidates include: Most important

Count	Response
1	BRRI dhan56
1	Early Aman Rice-Mustard-Boro Rice
3	Maize
1	Maize/Wheat/Vegitables
1	Mustard in between two rice
1	Mustard – Lentil
1	Rice
1	Rice-prawn-vegetable
1	Rice-pulse-rice
1	Short duration premium quality rice variety in Aman and Aus
3	Wheat
1	Wheat/mustard
2	Maize
1	Wheat

32. In the uplands, the most promising candidates include: Second most important

Count	Response
1	Arometic Rice-Wheat-Aus Rice/Jute
1	In saline area sunflower/salt-tol boro rice/wheat/sesame
4	Maize
1	Mustard
1	Pulse
1	Rice-Maize – Wheat
1	Rice-sunflower – Wheat
1	Sunflower – Mungbean
1	Tilapia/Carps in pond system and Rice
3	Wheat
1	Legumes
1	Mustard
1	Wheat
1	High value crops like maize or soil health enriched pulse crops like lentil after short duration aman season rice followed by Mungbean or Jute

32. In the uplands, the most promising candidates include: Most important

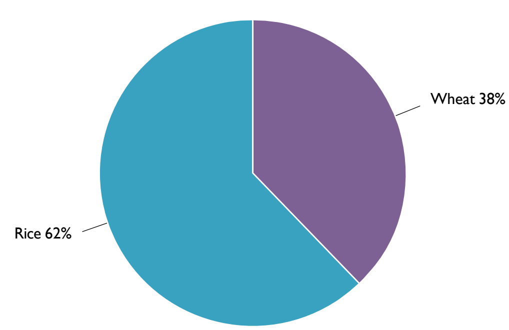
Count	Response
1	Chick Pea
2	Maize
3	Maize
1	Millets
2	Mustard
1	Pulses
1	Rice – Maize – Finger millet
3	Maize
1	Rice

33. In the plateau region, the most promising candidates include: Second most important

Count	Response
1	Black gram
1	Chick pea – Ground nut – Green gram
1	Green gram
1	Maize
1	Mustard
1	Mutard
1	Oilseed
1	Pigeon pea
1	Pulses
1	Sunflower
1	Wheat
1	Ground nut
1	Maize
1	Pulses

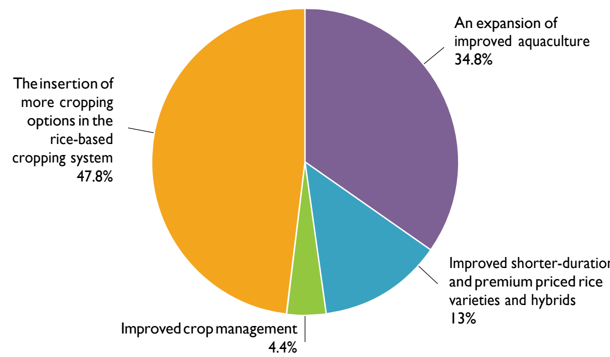
34. In the rice-wheat cropping system in our Hub, which crop requires the most attention from research and extension to increase its productivity and generate more income for farmers?

Value	Percent	Count
Wheat	38.0%	19
Rice	62.0%	31
Total		50



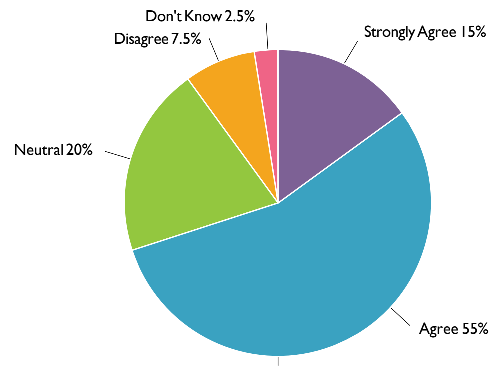
35. The largest economic benefits from CSISA-BD will come from:

Value	Percent	Count
An expansion of improved aquaculture	34.8%	8
Improved shorter-duration and premium priced rice varieties and hybrids	13.0%	3
Improved crop management	4.4%	1
The insertion of more cropping options in the rice-based cropping system	47.8%	11
Total		23



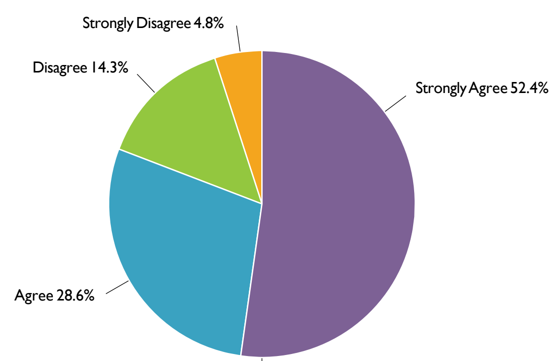
36. Adoption of ZT (zero tillage) makes it much easier for farmers to realize early planting (before 15 November) in appreciable areas in most of the Hub districts?

Value	Percent	Count
Strongly Agree	15.0%	6
Agree	55.0%	22
Neutral	20.0%	8
Disagree	7.5%	3
Strongly Disagree	0.0%	0
Don't Know	2.5%	1
Total		40



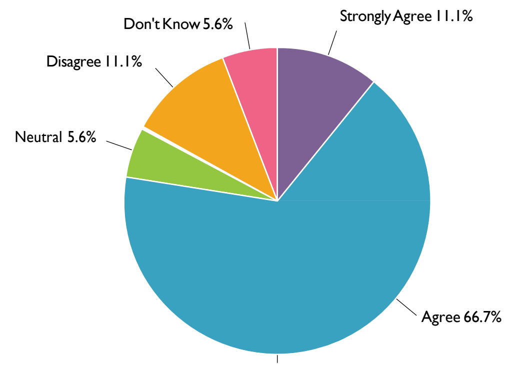
37. Inserting crops and increasing intensity in the uplands is more promising than increasing cropping options in the lowlands in most of the Hubs of CSISA-BD?

Value	Percent	Count
Strongly Agree	52.4%	11
Agree	28.6%	6
Neutral	0.0%	0
Disagree	14.3%	3
Strongly Disagree	4.8%	1
Don't Know	0.0%	0
Total		21



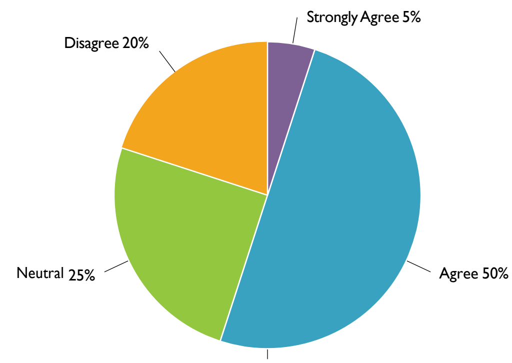
38. Inserting crops and increasing intensity in the coastal lowlands is more promising than increasing cropping options in the plateau uplands in the Odisha Hub.

Value	Percent	Count
Strongly Agree	11.1%	2
Agree	66.7%	12
Neutral	5.6%	1
Disagree	11.1%	2
Strongly Disagree	0.0%	0
Don't Know	5.6%	1
Total		18



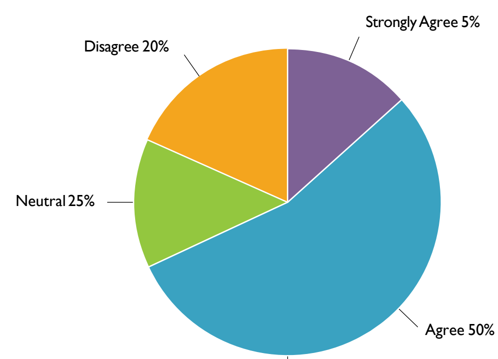
39. The extent of conservation agriculture that uses large amounts of crop residues as mulch is constrained in Odisha by the high demand for fodder.

Value	Percent	Count
Strongly Agree	5.0%	1
Agree	50.0%	10
Neutral	25.0%	5
Disagree	20.0%	24
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		20



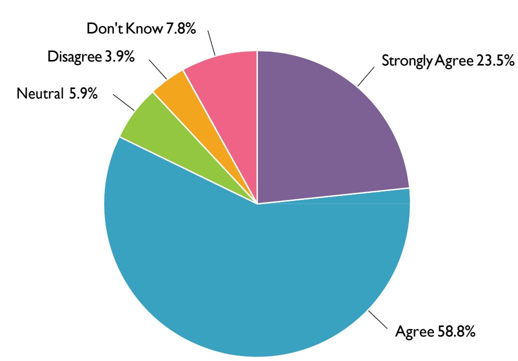
40. By 2030, mechanization in the districts covered by CSISA-BD will rely more heavily on four-wheel tractors than on power tillers.

Value	Percent	Count
Strongly Agree	13.6%	3
Agree	54.6%	12
Neutral	13.6%	3
Disagree	18.2%	4
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		22



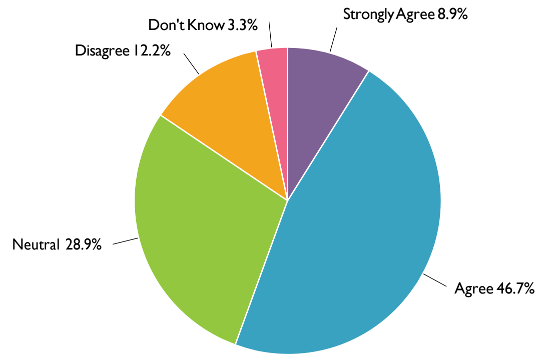
41. The early planting of wheat, using full-season wheat varieties, is likely to be widely adopted.

Value	Percent	Count
Strongly Agree	23.5%	12
Agree	58.8%	30
Neutral	5.9%	3
Disagree	3.9%	2
Strongly Disagree	0.0%	0
Don't Know	7.8%	4
Total		51



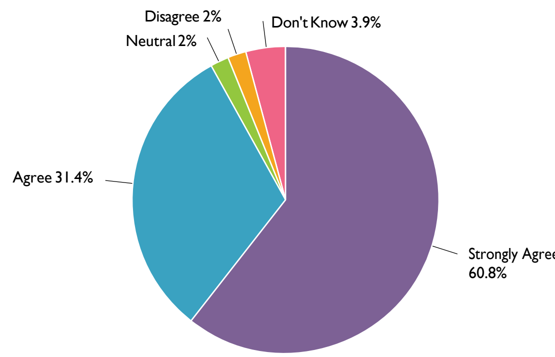
42. Cultivation on raised beds is an improved practice that will be widely adopted by farmers.

Value	Percent	Count
Strongly Agree	8.9%	8
Agree	46.7%	42
Neutral	28.9%	26
Disagree	12.2%	11
Strongly Disagree	0.0%	0
Don't Know	3.3%	3
Total		90



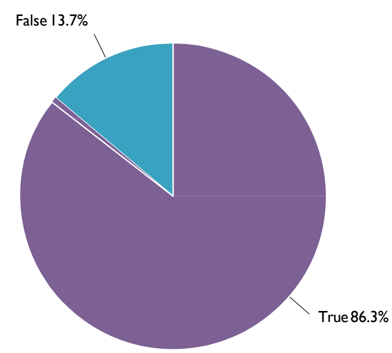
44. Adoption of ZT wheat makes it much easier for farmers to realize early planting (before 15 November)?

Value	Percent	Count
Strongly Agree	60.8%	31
Agree	31.4%	16
Neutral	2.0%	1
Disagree	2.0%	1
Strongly Disagree	0.0%	0
Don't Know	3.9%	2
Total		51



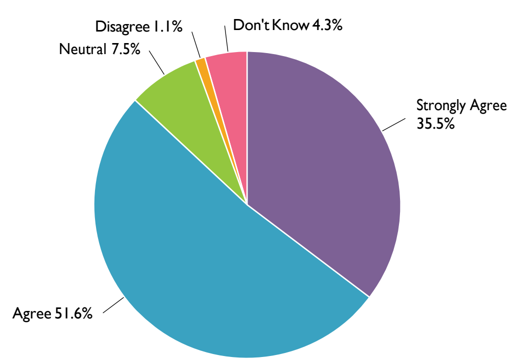
45. Planting maize instead of wheat in the dry season is likely to be adopted where there is a stable demand for maize for feed.

Value	Percent	Count
True	86.3%	44
False	13.7%	7
Total		51



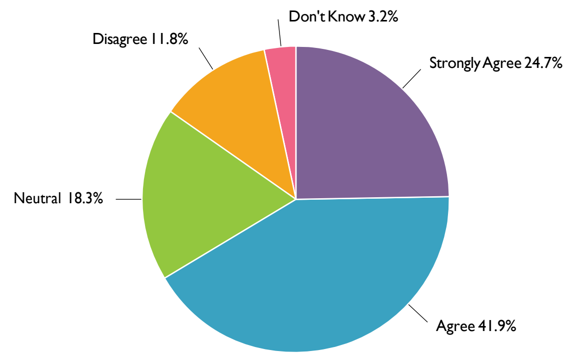
46. Getting the rice harvested from the fields early in order to sow wheat early may require early harvest and threshing of rice without sun dry-down. Farmers and Service Providers are likely to adopt this combined innovation of short-duration rice and new mechanical threshers.

Value	Percent	Count
Strongly Agree	35.5%	33
Agree	51.6%	48
Neutral	7.5%	7
Disagree	1.1%	1
Strongly Disagree	0.0%	0
Don't Know	4.3%	4
Total		93



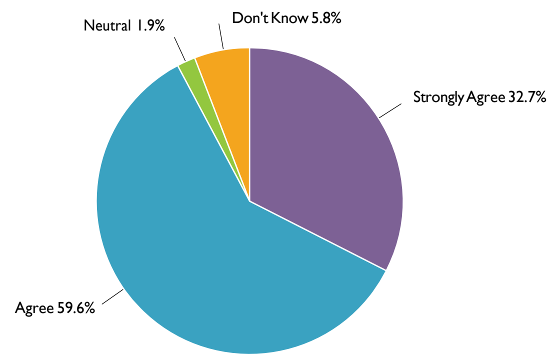
47. Hybrid rice has bright prospects and will be adopted on 50% of rice-growing area by 2030.

Value	Percent	Count
Strongly Agree	24.7%	23
Agree	41.9%	39
Neutral	18.3%	17
Disagree	11.8%	11
Strongly Disagree	0.0%	0
Don't Know	3.2%	3
Total		93



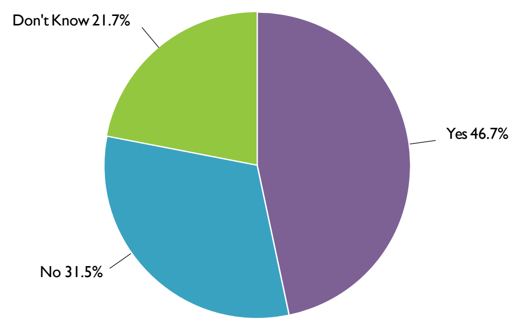
48. Adoption of short duration 'catch crops' such as mung bean, mustard, cowpea, fresh maize etc. is likely to expand in the rice/wheat systems as reduced tillage and early maturing rice become popular.

Value	Percent	Count
Strongly Agree	32.7%	17
Agree	59.6%	31
Neutral	1.9%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Don't Know	5.8%	3
Total		52



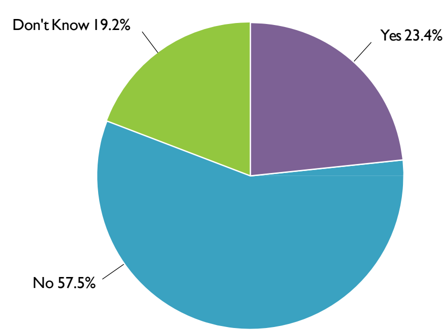
49. In rice systems where water for flooding is limiting, weed control can be realized if herbicides are used. Are the right herbicides available?

Value	Percent	Count
Yes	46.7%	43
No	31.5%	29
Don't Know	21.7%	20
Total		92



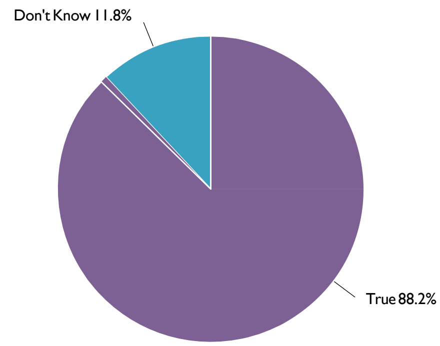
50. Are they already frequently used?

Value	Percent	Count
Yes	23.4%	22
No	57.5%	54
Don't Know	19.2%	18
Total		94



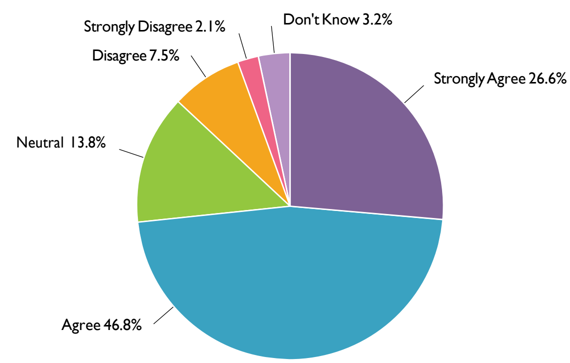
51. Fertilizer, including manuring, is an expensive input, especially necessary for good rice, wheat and maize production. CSISA's work to help farmers use plant nutrient inputs efficiently and minimize risks is important and well done.

Value	Percent	Count
True	88.2%	82
False	0.0%	0
Don't Know	11.8%	11
Total		93



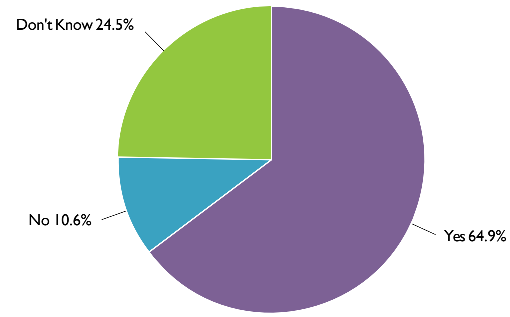
53. Laser Land Leveling can improve water use efficiency. It is likely to be widely adopted by farmers through Service Providers.

Value	Percent	Count
Strongly Agree	26.6%	25
Agree	46.8%	44
Neutral	13.8%	13
Disagree	7.5%	7
Strongly Disagree	2.1%	2
Don't Know	3.2%	3
Total		94



54. Grain drying remains a serious problem at the farm level, resulting in crop losses and income loses. Are the grain drying and storage options from the project likely to be adopted and to solve the problems at the farm and farm-community levels?

Value	Percent	Count
Yes	64.9%	61
No	10.6%	10
Don't Know	24.5%	23
Total		93

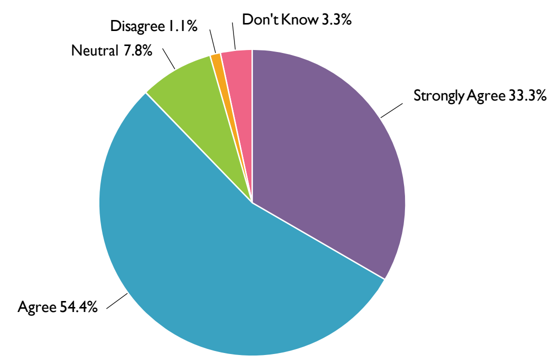


55. Why not?

Count	Response
1	It is not sufficient at community level.
1	this is going to have to happen at the middle man or at the mill. not at the household level.
1	Though the initiative of the organisation is good, it has not been proven sufficient enough for the whole community
1	After harvest of rice and wheat, usually farmer sale the produce to market. There is a need to dry the maize produce before sale to market.
1	EVEN THOUGH FARMERS METHOD OF GRAIN DRYING RESULTS IN CROP LOSSES, FIELD SUN DRYING REMAINS TO BE THE CHEAPEST DRYING METHOD FOR GRAIN AND STRAW AS WELL WHICH THEY NEED FOR MULTIPLE USES. SECONDLY, NO TECHNOLOGY TESTED AT FARM LEVEL AS ALTERNATE DRYING OPTION. THIRD, STORAGE OF GRAINS ARE NOT A PRACTICE SINCE THERE IS PROCUREMENT POLICIES OF THE GOVERNMENT FOR RICE.
1	For maize, we are working to shift burden of drying from farmers to the millers, which have better scope for drying more easily (more capital and machinery). For other crops, community drying and adoption is more realistic.
1	The grain drying equpment - flat bed drier, bubble drier, cyclone driers - currently available are too expensive for farmers. They are targetted at millers and traders. We have yet to evaluate mobile driers that could be used by LSPs to provide drying services. I doubt farmers will pay for them.
1	Centralized drying is far off as is small localize driers....and we do'nt really promote either ...yet. Improved local grain storage bins are available and you can see them in the market but many many more needed to make an impact. I am still not convinced super bags will spread but needs to be tried...pushed.
1	It will solve at small scale for farmers in terms of grain drying and storage. Still CSISA-BD needs to work for establishing economic drying facility to community and larger storage system accessible to community.
1	CSISA seems to be investing little in drying and storage technologies, partly (and maybe rightly) because they are beyond project scope, and partly because storage is a more complex issue because it involves pricing, procurement, and commodity market dynamics.

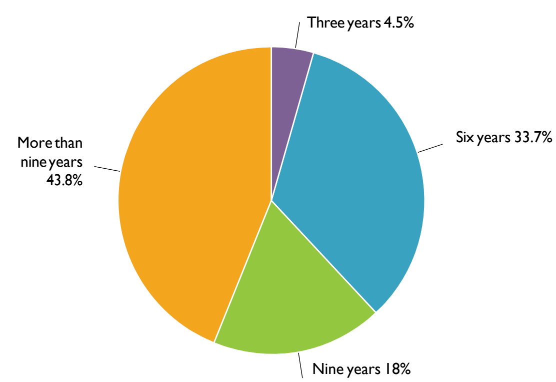
56. Impact will be substantial from the CSISA Project and will be reflected in district-wise production statistics by 2020.

Value	Percent	Count
Strongly Agree	33.3%	30
Agree	54.4%	49
Neutral	7.8%	7
Disagree	1.1%	1
Strongly Disagree	0.0%	0
Don't Know	3.3%	3
Total		90



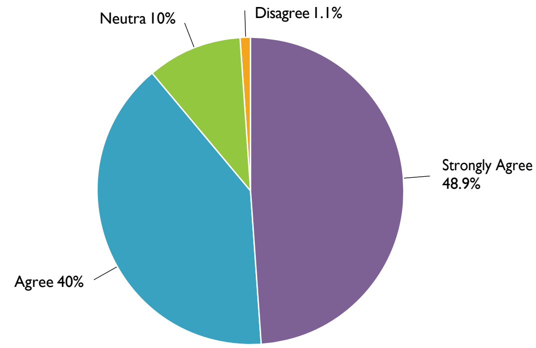
57. The minimum time for a project like CSISA to achieve widespread impact is:

Value	Percent	Count
Three years	4.5%	4
Six years	33.7%	30
Nine years	18.0%	16
More than nine years	43.8%	39
Total		89



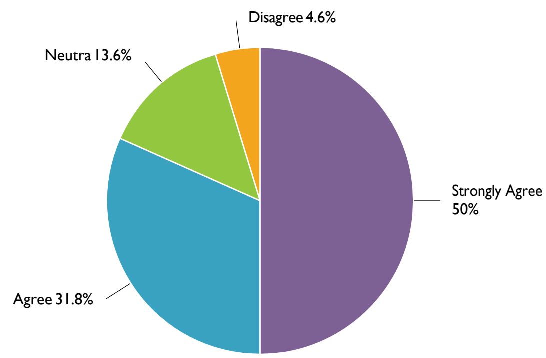
58. The research and extension activities are well coordinated.

Value	Percent	Count
Strongly Agree	48.9%	44
Agree	40.0%	36
Neutral	10.0%	9
Disagree	1.1%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		90



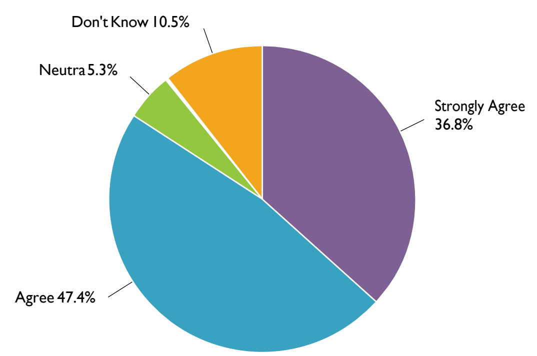
59. In CSISA-BD, the institutional interactions among IRRI, CIMMYT, and WorldFish have been productive and synergistic in all the Hubs.

Value	Percent	Count
Strongly Agree	50.0%	11
Agree	31.8%	7
Neutral	13.6%	3
Disagree	4.6%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		22



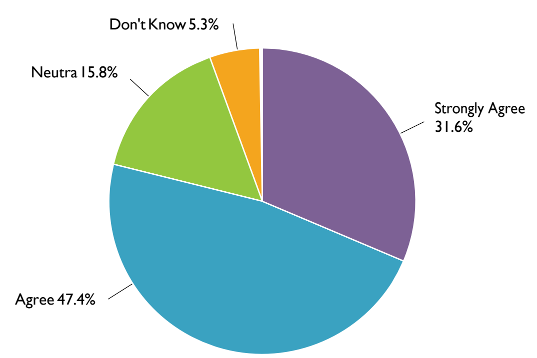
60. In the Odisha Hub, the institutional interactions among IRRI, CIMMYT, and ILRI have been productive and synergistic and all three CG partners have contributed meaningfully to the six objectives of the CSISA Initiative.

Value	Percent	Count
Strongly Agree	36.8%	7
Agree	47.4%	9
Neutral	5.3%	1
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	10.5%	2
Total		19



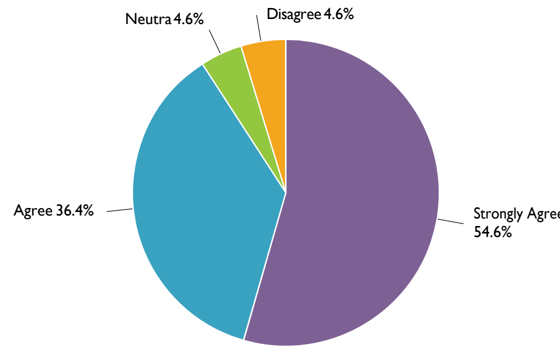
61. The prospects for the adoption and diffusion of Direct-Seeded Rice (DSR) are more promising in Odisha than in other States in East India.

Value	Percent	Count
Strongly Agree	31.6%	6
Agree	47.4%	9
Neutral	15.8%	3
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	5.3%	1
Total		19



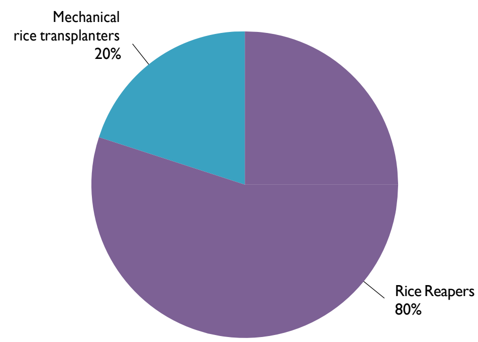
62. In the future, separate projects by IRRI, CIMMYT, and WorldFish in Bangladesh will not be as effective as CSISA-BD because the scope for productive interactions will be limited.

Value	Percent	Count
Strongly Agree	54.6%	12
Agree	36.4%	8
Neutral	4.6%	1
Disagree	4.6%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		22



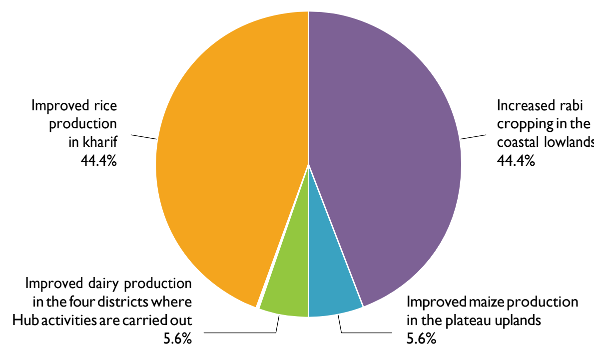
63. By 2030, which machines will be most visible in the districts presently covered by CSISA-BD?:

Value	Percent	Count
Rice Reapers	80.0%	16
Mechanical rice transplanters	20.0%	4
Laser land levelers	0.0%	0
Total		20



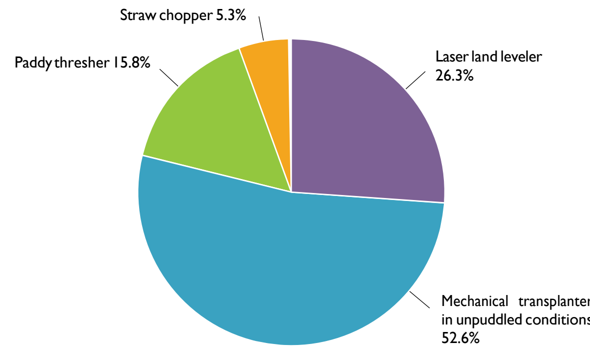
64. By the end of the next phase, the largest economic impact in the CSISA Project will come from:

Value	Percent	Count
Increased rabi cropping in the coastal lowlands	44.4%	8
Improved maize production in the plateau uplands	5.6%	1
Improved dairy production in the four districts where Hub activities are carried out	5.6%	1
Improved rice production in kharif	44.4%	8
Total		18



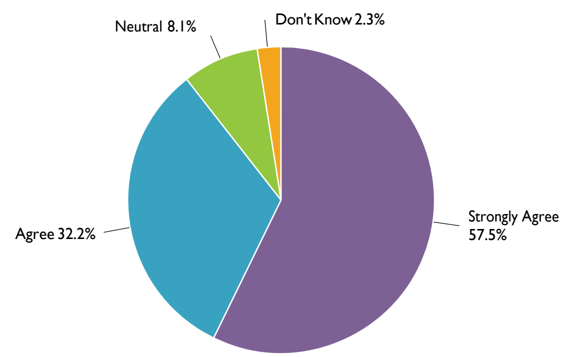
65. Based on the research and extension of CSISA scientists and partners in the Odisha Hub, the mechanical intervention that will have the most impact is the:

Value	Percent	Count
a. Laser land leveler	26.3%	5
b. Mechanical transplanter in unpuddled conditions	52.6%	10
c. Paddy thresher	15.8%	3
d. Paddy reaper	0.0%	0
e. Straw chopper	5.3%	1
Total		19



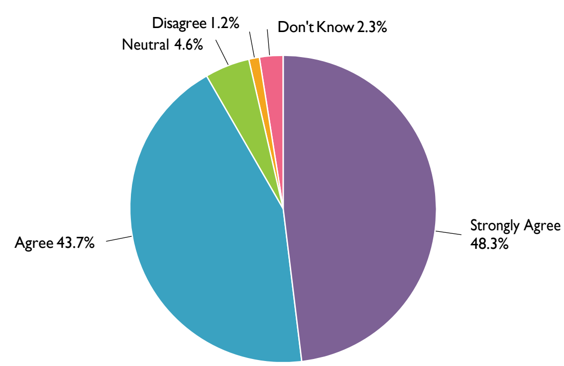
66. The project management and administration in our Hub are effective and efficient.

Value	Percent	Count
Strongly Agree	57.5%	50
Agree	32.2%	28
Neutral	8.1%	7
Disagree	0.0%	0
Strongly Disagree	0.0%	0
Don't Know	2.3%	2
Total		87



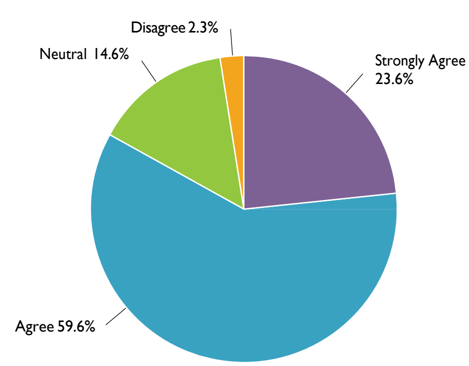
67. In our Hub, all partners both contribute to and benefit from the CSISA Project.

Value	Percent	Count
Strongly Agree	48.3%	42
Agree	43.7%	38
Neutral	4.6%	4
Disagree	1.2%	1
Strongly Disagree	0.0%	0
Don't Know	2.3%	2
Total		87



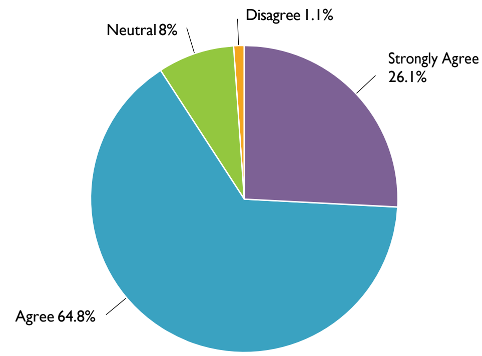
68. Government research and extension agencies are well-represented and participate actively

Value	Percent	Count
Strongly Agree	23.6%	21
Agree	59.6%	53
Neutral	14.6%	13
Disagree	2.3%	2
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		89



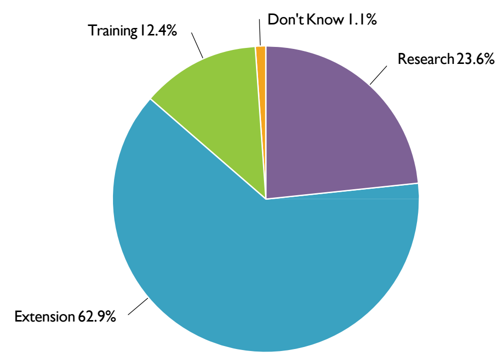
69. The private sector can effectively participate in the transfer in most of the technologies recommended by the CSISA Project.

Value	Percent	Count
Strongly Agree	26.1%	23
Agree	64.8%	57
Neutral	8.0%	7
Disagree	1.1%	1
Strongly Disagree	0.0%	0
Don't Know	0.0%	0
Total		88



70. In the next phase of three years more emphasis should be placed on:

Value	Percent	Count
Research	23.6%	21
Extension	62.9%	56
Training	12.4%	11
Don't Know	1.1%	1
Total		89



71. In the next three years, what are the research areas that warrant most attention in our Hub? (please write in on following lines): Most important research area

Count	Response
1	AWD technology in water management in rice
1	Agricultural Mechanisation
1	Appropriate rice varieties to increase production and productivity
1	Best feasible way(s) to intensify rice-based cropping system in Odisha
1	CA-based Mechanization
1	Catch crop for spring season, after wheat and beofore rice farming
1	Crop Manager in Rice-Wheat crop
1	Crop Diversification
1	Crop Intensification
1	Crop Management
1	Dairy Value Chain
1	Development of high yielding short duration rice varieties
1	Development of private sector service provision over time
1	Development of technology option for climate change and validation of new technologies
1	Different variety of fodder crops and avilability
1	Dinajpur

Count	Response
1	Fallow land
1	Farmer demand for new technologies
1	Fish seed improvement
1	Fodder
1	Gender based equility through farm mechanization
1	How to reduce the water and nutrient requirment to decrease the cost of cultivation
1	I think will have to provide more emphasis to DSR
1	I thinkweed management in DSR should more focuse
1	Increase income through animal husbandry
1	Innovative Technologies
1	Integrated gher farming system (Rice-Prawn-fish farming)
1	Introduce salt-tolerant crops(rice/wheat) through validation and adoption
1	Irrigation
1	Irrigation and Water Management in northern Bangladesh.
1	Irrigation Management
1	Livestock
1	Long-term effects of conservation agriculture on saving natural resources
1	Mechanisation
1	N/A
1	New Modern Variety
1	Nutrient Management
1	Nutrient Management in Rice, Wheat & Maize
1	Participatory Trial on New HYV of cereals and aquaculture with premium price
1	Preparation of concentration mixture for dairy cows
1	Quality fish seed production
1	R-W Cropping system under diverisified conditioninclusive of Machines and cultivars
1	Rabi paddy cultivation
2	Residue management in rice-wheat cropping system
1	Site specific nutrient management studies for rice HYV and hybrids
1	Salt tolerance Rice/Vegetables/Fish in Saline Gher system in southern hubs
1	Soil salinity management
1	Sustainability of cropping system
1	Technology Targeting and Policy
1	Tillage option
1	Varietal Development
1	Varietal development

Count	Response
1	Water Management
1	Water Management in rice for increasing water use efficiency
1	Weed Control
1	Women farmers
1	Animal husbandary
1	Balanced concentrate animal feed
1	Conservation agriculture
1	Crop diversification
1	Cropping system productivity
1	Dairy value chain
1	Effective water management in Rabi crops
1	Efficient machinery
1	Livelihood
1	Productivity enhancement
1	Scale up the appropate machanization
1	Suitable crop variety for different agro-ecosystem
1	System productivity
1	System research
1	Water management in rice and crop diversification
1	Weed management in new system
1	Component trials on system productivity with less resource use, to address labor scarcity, weedicide & its different combinations, heat stress addressing research, water balance & its better use in agriculture, crop diversification & farmer income enhancement
1	Technology development for shrimp-prawn mix culture in gher, low cost shrimp feed development, year round dike cropping on saline gher dikes, effective rotation of shrimp-rice in saline gher
1	Technologies for combating Climate change, Soil salinity & fertility management, Water Management, Cropping systems,

71. In the next three years, what are the research areas that warrant most attention in our Hub?:
Second most important research area

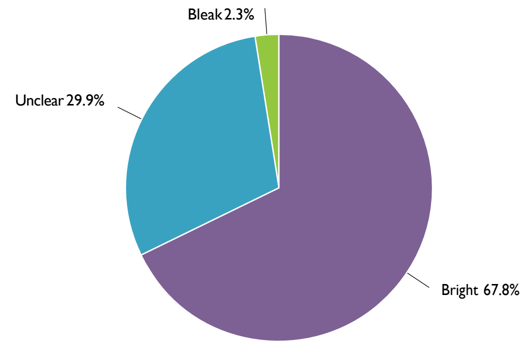
Count	Response
1	Agril machinaries and conservation agriculture
1	Aman rice yield gap
1	Area specific technology and nutrition management
1	Better and Refined DSR
1	Cost effective minimum/reduced tillage with new machinery and fine tuning it
1	Crop diversification
2	Crop diversification
1	Diversification as a remunerative option and control for new emerging weeds in CA system

Count	Response
1	Diversification of rice-wheat cropping systems
1	Diversification within rice
1	Early sowing of Wheat & Timely Sowing of Rice & the sowing & Transplanting Methods
1	Effective Sludge remover and sludge management of Commercial aquaculture
1	Effective control measures for weed as well as insectpest and diseases.
1	Effective weed control for maize
1	Efficient utilization of cereal crop residue for livestock feed
1	Extension
1	Extension activity through service providers
1	Extensive cropping system s survey and of th. whole area and introduce suitable crops
1	Far west
1	Feed
1	Fish
1	Genytpe x environment x tillage method
1	Givin. chopped green as well dry fodder with mineral mixture
1	HIGH YIELDING CROP
1	Hybrid wheat varities
1	Integrated water Management
1	Intensification of cropping systems
1	Intensification of rice fish
1	Low cost production system (eg. Low cost feed production in fish culture)
1	Mat type nursery build up easily
1	Mechanization
1	More research is required for crop diversification
1	N/A
1	New machine use
1	Nilphamari
2	Nutrient management
1	Paddy versus Livestock
1	Postharvest
1	Profitable crops during post-kharif (water scarce situation)
1	Promotion of suitabl. hybrid rice
1	Residue Management in Wheat crop
1	Resource conservation through efficient utilization of inputs
1	Short duration Rice and wheat variety validation
1	Short duration improved rice varieties

Count	Response
1	Short duration variety
1	Soil organic matter management
1	Strip Tillage and Bed Planting Technology in the nor thern Bangladesh.
1	Varietal selection/identification
1	Varietal suitability for Odisha
1	Water Management
1	Weed Management specially for DSR
1	Weed and Residue Management in Wheat crop
1	Weed mangement
1	Agriculture
1	Control of infectious diseases
1	Coping strategies for variable monsoon
1	Disease and pest management
1	Efficient use of maize residues
1	Feminization of agriculture
1	Marketing linkages of agricultural products
1	Need-based farm mechinery for small and marginal farmers
1	New technology
1	socio-economic dimensions
1	Technology transfer
1	Varietal suitability in Odisha Condition
1	Water managment research for winter and spring crops
1	Work with rice varieties for tidal/submergence prone areas
1	Optimizing cropping systems diversification to reduce spring (mostly) and winter fallow (eg., maize/mungbean incorporation)
1	Options of zero till planting under rainfed situation for intensifying rabi cropping, development of package of practices for zero till and effect on soil health and quality
2	Effective and efficient nutrient management with the help of SSNM and RWCM in Maize/rice-wheat cropping system
1	Time to time tecnical training of the farmers in the different improved techniques to enhance their production
1	Mechanization for sluge removal from gher bottom, necessity and type of fertilizer use in gher for rice production after shrimp or prawn
1	Mechanization & post harvest techniques enhancement, rural youth motivation towards profitable agriculture

72. When the CSISA ends, the prospect for sustaining the work from other resources by other institutions are:

Value	Percent	Count
Bright	67.8%	59
Unclear	29.9%	26
Bleak	2.3%	2
Total		87



73. The biggest advantage of the CSISA Project is:

Value	Percent	Count
It's abundant resources to carry out field days, demonstrations, and farmer training.	22.5%	20
Its solid research-extension linkages and innovative methods to test technology.	41.6%	37
Its multiplicity of partners who can discover technology internationally for regional adaptation and local transfer.	36.0%	32
Total		89

Responses"Other"	Count
Left Blank	164

ANNEX M: TRAVEL ITINERARY

Itinerary details of CSISA/ USAID Evaluation team in Kathmandu, Nepal		
Date/Day	**Time**	**Activity**
Sunday February 1 (Arrival and informal discussion with Dr. Lal P Amgain)		Evaluators arrive in country on Saturday, 31 January Accommodation: Stay at the Summit Hotel Discussion: Introduction of Dr. Lal P Amgain, facilitator. USAID Evaluation team, Nepal and brief discussions on different perspective and scenarios of agriculture in Nepal throughout the days, managing the basic needs to the team by facilitator
Monday, February 2 (Day 1)	08:30 am	Travel: Summit to USAID
	9:00 am – 11:00 pm	Evaluators' visit to USAID Nepal Mission
	11:00 am – 11:30 am	Travel: USAID to Summit Hotel
	11:30 am – 12:30 pm	CSISA overview with CSISA team, Paper presentation by Mina Wosti in TV room inside Hotel Summit
	12:30 pm – 1:30 pm	Lunch at Summit
	1:30 pm – 4:00 pm	Discussion with Lucy Lapa. and Nils Teufel about ILRI work in CSISA
	4:00 pm – 6:00 pm	Meet with David Spielman and Patrick Ward of IFPRI to discuss Objective 5 / policy work within CSISA at Summit
	Accommodation: Summit Hotel	
Tuesday, February 3 (Day 2)	9:00 am – 11:00 am	Travel: Fly to Nepalgunj
	11:00 am – 12:00 pm	Discussion with KISAN Project staff (Harish Devkota and Ram Lal Shrestha)
	12:00 pm – 1:00 pm	Lunch break
	1:00 pm – 3:00 pm	Travel: Bhurigaun, VIA Mainapokhar, Bardiya with CSISA ARTC Nepal staffs
	3:00 pm – 5:00 pm	Field visit and discussion with farmers group
	5:00 pm – 7:00 pm	Travel: Bhurigaun to Nepaljung
		Accommodation: Travelers Lodge – Nepalgunj
Wednesday, February 4 (Day 3)	8:00 am – 11:00 am	Travel: Drive to Surkhet
	12:00 am – 1:00 pm	Discussion with DADO Surkhet
	1:00 pm – 2:00 pm	Lunch break
	2:00 pm – 3:00 pm	Travel. From Surkhet to Gaddi
	3:00 pm – 4:00 pm	Discussion with farmers in (Gaddhi)
	4:00 pm – 5:00 pm	Travel. Back to Surkhet (centre)
	5:00 pm – 6:30 pm	Discussion with Sahara Agri. Mechanization Sell Shop, Surkhet
	Accommodation: Stay in Shani Village Resort Surkhet	

Itinerary details of CSISA/ USAID Evaluation team in Kathmandu, Nepal		
Date/Day	**Time**	**Activity**
Thursday, February 5 (Day 4)	7:00 am – 11:00 am	Travel: Drive to Nepalgunj and visit lentil and wheat trials in farmers' field in Banke
	11:00 am – 2:30 pm	Discussion with Regional Agriculture Research Station (RARS), Nepalgunj, Agriculture Research Station (ARS), Dasarathpur, Surkhet and field visit to on-station field trial inside RARS
	2:30 pm – 4:00 pm	Lunch Break
	4.30 pm – 5:30 pm	Travel: Summit Hotel
		Accommodation: Summit Hotel
	10:30 am – 12:30 pm	Travel: Agri-engineering Division (AED) NARC, Meeting with Shreemat Shrestha Engg Div. Visit to AED
	12.30 pm – 2:00 pm	Discussion with Dr. Renuka Shrestha Chief Agronomy Division, NARC, Field visit John's experiment in Khumaltar
	2:00 pm – 3:30 pm	Travel: DOA Harihar Bhawan and discussion with Dr. Birendra Hamal (DDG) and Madhusudhan Basnet, Chief Engineering Division, Harihar Bhawan and discussion with Niru Dahal Pandey, Chief, Agricultural Extension Division, DoA
	3:30 pm – 5:30 pm	Launch at Jwalakhel with Scott and Andrew Mc Donald
	Accommodation: Summit Hotel	
Saturday February 7 (Day 6)	8:00 am – 8:30 am	Meeting and discussion wit. Dr. Vrigu Rishi Duwadi, Country Director, Winrock Internationa. F2F program, Nepal
	9:00 am – 11:30 am	Meeting and discussion wit. Dr. Arun K Joshi, Plant Breeder, CIMMYT, International, South Asia Office, Kathmandu
	11:30 am – 2:30 pm	Meeting and discussion with Andy and Cynthia on various issues of CSISA Nepal, Bangladesh and India hubs
	2:30 pm – 4:30 pm	Launch break
	4:30 pm – 6:30 pm	Meeting of Dr Lal P Amgain with Evaluation team to discuss th. overview of the Nepal visit
Sunday, February 8 Travel day	Team's travel t. New Delhi, India and Facilitator's travel to Lamjung, Nepal	

Bangladesh Itinerary				
Date	**Time**	**Place**	**Activities**	**Remarks**
21st February, Saturday	6:30 pm	Arrived in Hotel Sarina in Dhaka from Dhaka Airport	Reviewed progra. with team by Tim & Mashihur	Hotel Sarina did pick up team from Dhaka Airport & dropped to hotel Sarina at Banani
22nd February, Sunday	9:30 am – 10:45 am	Bangladesh Agricultural Research Council (BARC)	Meeting with Dr. Abul Kalam Azad, Executive Chairman of BARC	6 officials from BARC participated in the discussion
	11:15 am – 12.30 pm	USAID Office	Discussion held with donor officials	
	2:00 pm – 5:30 pm	CSISA-BD Office	CSISA-BD presentation at CSISA-BD office at Banani	About 20 staff were participated in the presentation meeting
23 February, Monday	9:30 am	Fly to Jessore from Dhaka	Observing CSISA-BD Hub activities	
	11:30 am – 1:00 pm	Shantola village	Observed Rice Fish demonstration and held discussion with farmers	About 20 farmers were participated in the discussion meeting
	2:30 pm – 5:30 pm	Jessore Hub Office	Presentation by Jessore Hub team and meet with partner NGOs, government officials and private sector partners	About 39 participants were participated in the discussion meeting
24 February, Tuesday	9:00 am – 10:30 am	Gobila village under Jessore Sadar Sub-district	Field visit on maize, rice based cropping system	Company hired a Vehicle
	10:50 am – 11:30 am	Jagahati village under Jessore Sadar(Sub district)	Visit farmer's field on cereal and aquaculture systems	
	11:30 am – 12:00 pm	Same area	Meet with IPM/ICM rice farmers & visit to wheat field	
	12:00 pm – 2:00 pm	Jagahati village under Jessore Sadar(Sub district	Focus group discussion (divided into small groups) held with farmers, traders, LSPs, millers & food processors came from CSISA-BD project area of Jessore Hub	About 100 participants were participated in the meeting
	3:30 pm – 4:40 pm	Rural Reconstruction Foundation(RRF) training center	Discussion held with CSISA-MI Business Plan trainees and Facilitators	About 31 participants were there
	7:00 pm – 9:00 pm	Fly for Dhaka	Team arrived in Dhaka & stay at Hotel Sarina at Banani	

Bangladesh Itinerary				
Date	**Time**	**Place**	**Activities**	**Remarks**
25 February, Wednesday	10:15 am – 11:00 am	AC. Corporate office, 24. Tejgaon Industrial Area, Dhaka	Meeting held with Dr. F.H. Ansarey, Executive Director	4 Officials from ACI were participated in the discussion meeting
	11:30 am – 12:30 pm	Department of Fisheres (DoF), Matshya Bhaban, Romna, Dhaka	Meeting held with S.. Mostafizur Rahman, Senior Principle Officer(Director), DoF	4 Officials from DoF were participated in the discussion meeting.
	2:00 pm – 3:00 pm			Meeting cancelled due to request of Rangpur Foundry Limited (R FL)
	5:00 pm – 6:00 pm	Department of Agricultural Extension(DAE) Office , Khamerbari, Farmgate, Dhaka	Meeting held with Mr. A.Z.M. Montajul Karim, DG, DAE	4 Officials from DAE participated in the discussion meeting
	11:00 pm	Team report to Dhaka Airport to fly USA		Flight departure time was 2:00 am on 26 February

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ANNEX O: FEED THE FUTURE INDICATOR TABLE

FTF INDCATORACHIEVEMENTS ACROSS Nepal, INDIAand BANGLADESH						
Indicator	2013			2014		
	Target	Actual	Percent Achieved	Target	Actual	Percent Achieved
4.5.2 (2): Number of hectares under improved technologies or management practices as a result of USG assistance (RIA) (WOG)	31,003.66	115,139.62	371%	121,893	217,181.38	178%
4.5.2 (5): Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance (RIA) (WOG)	25,848.00	635,309.00	2458%	518,740	422,393.81	81%
4.5.2 (7): Number of individuals who have received USG supported short-term agricultural sector productivity or food security training (RIA) (WOG)	68,584.00	46,157.00	67%	34,149	54,605.00	160%
4.5.2 (13): Number of rural households benefiting directly from USG interventions	23,036.00	365,665.00	1587%	16,150	36,319.00	225%
4.5 (16, 17, 18): Gross margin per hectare, animal or cage of selected product **	-	-	-	14,291	1,793.00	13%
4.5.2 (42): Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations and CBOs that applied improved technologies or management practices as a result of USG assistance	10.00	11.00	110%	50	42.00	84%
4.5.2 (11): Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations and CBOs receiving USG assistance (RIA) (WOG)	20.00	919.00	4595%	1,200	1,472.00	123%
4.5.2 (12): Number of public-private partnerships formed as a result of FTF assistance (S)	6.00	29.00	483%	6	19.00	317%
4.5.1 (24): Number of policies/ regulations/ administrative procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1, 2, 3, 4, 5)	-	10.00	-	7	13.00	186%
4.5.2 (39): Phase I: Number of new technologies or management practices under research as a result of USG assistance	13.00	47.00	362%	35	83.00	237%
4.5.2 (39): Phase II: Number of new technologies or management practices under field testing as a result of USG assistance	25.00	80.00	320%	87	88.00	101%

FTF INDCATORACHIEVEMENTSACROSS Nepal, INDIAand BANGLADESH						
Indicator	2013			2014		
	Target	Actual	Percent Achieved	Target	Actual	Percent Achieved
4.5.2 (39): Phase III: Number of new technologies or management practices made available for transfer as a result of USG assistance	26.00	55.00	212%	60	74.00	123%
4.8.2 (26): Number of stakeholders with increased capacity to adapt to the impacts of climate variability and change as a result of USG assistance	15,000.00	172,017.00	1147%	300,000	226,487.05	75%

ANNEX P: PREVIOUS REVIEW RECOMMENDATIONS

Mid-Term Evaluation of the Cereal Systems Initiative for South Asia (CSISA)

Prepared by: John DeBoer, Ph. D. and Sieglinde Snapp, Ph. D.

Prepared for: the Bill & Melinda Gates Foundation and the United States Agency for International Development

Submitted: June 15, 2011

We recommend that institutional roles be clarified and that institutions be responsible for specific regions; HUB budgets and staff be supervised by the designated institution for the region. It will be important to minimize undue competition between regions, but it is recommended that project activities, funding and staff supervision (e.g., hiring/assessment/reporting/reward structure) be harmonized with one reporting line per site.

Increase overall allocation to hubs but reduction of resources for ARTs dramatically or consider eliminating ARTs altogether. Similarly, we recommend shift resources away from on-farm monitoring and on-farm trials by research platform staff, to instead expand platform data analysis and simulation modeling and to the integration of findings to contribute to policy and extension outputs.

Shift focus away from multiple, extensive data collection exercises to instead support an iterative learning process at each site, capacity building among farmers and agro-services providers, for greatly expanded adaptation and adoption. This includes innovation networks, attention to a diversity of technologies that address female and the poorest farmer's priorities and outsourcing business development services. Impact assessment activities are currently being considered and it is planned that this work will be finalized during the Phase II planning meeting at the end of May 2011.

The business services coordinator is used to develop sub-contracts with local providers of Business Development Services (BDS) as set out in the report so each hub will have access to firms experienced in the BDS approach that can work with local service providers and farmer group to identify value chain interventions needed and help put together the deals required overcome these constraints.

In the breeding components, retain the ILRI related work on genetic variation in feeding value of crops by products. Expand access to improved seeds and herbicides and integrate varieties and conservation technologies, for participatory extension.

ILRI should prepare a proposal to Gates Foundation for a more focused livestock feeding program using their own hubs in countries and areas they feel would provide more impact.

The focus on any hub expansion effort should be for a country managed program such as has been developed in Bangladesh with additional USAID funding and allowed expansion to 6 hub sites. In India, the chances of getting substantial USAID/New Delhi mission funding is very low; however, USAID/India has promised $1 million/annum for the next few years to support hub operations and this could help a well planned expansion of hub activities. More USAID/Washington central funds would also be very difficult to get for India since India's Feed The Future strategy is not consistent with what CSISA is doing in India. If some Gates Foundation funding could be committed for CSISA in India, CSISA or the CGIAR could approach ICAR for co-funding under their National Food Security Fund as a way of contributing to a specific CGIAR activity in India. ICAR would have to be given more ownership of CSISA, probably similar to their role in the RWC. This would result in an India-focused program and allow hub expansion with substantial ICAR inputs, direction and collaboration since they would be co-funding the program. The team is not able to assess if funds from the India Food Security Fund would be available for this or if guidelines have even been developed yet.

Pakistan – Continuation and expansion would be dependent on USAID/Pakistan Mission funding. The Pakistan Feed the Future strategy is now under development but hub expansion there would also be dependent on security concerns.

Nepal – We should know within a few months if the Nepal Feed the Future (FTF) Strategy will provide funds to continue the current program or provide funds for hub expansion. The FTF strategy covers only 4 crops (rice, lentils, maize and vegetables) and focuses on the western regions of Nepal so hub expansion would be limited in flexibility and scope. If this funding is not available, India could also be approached to fund this hub as part of the India CSISA program. Otherwise, this hub will need to be phased out.

Hub Communications Platform. We recommend terminating the aWhere contract at the end of Phase I for reasons explained earlier in the report. Several CSISA staff have developed a more appropriate model for tracking impacts based on user inputs and participation which will allow hub managers and CSISA management easier access to adaptation and field activities on a spatial basis. This uses existing GIS platforms and open communications algorithms. The table below summarizes management recommendations for phase two Objectives 1, 2 and 6. We recommend that institutional roles be clarified and that institutions be responsible for specific regions. HUB budget and staff would thus by supervised by the designated institution for the region. If staff are required with expertise from another center, they could be 'seconded' to the lead institution following procedures discussed earlier. This would develop a clear 'line of command' in terms of who is responsible for which outputs, supporting the desired outcomes.

Mid-Term Performance Evaluation of CSISA-BD

Prepared by: Dexis Consulting Group

Prepared for: International Rice Research Institute (IRRI)

Submitted: June 13, 2014

The project is making excellent progress in achieving appropriate development of agricultural technology and/or management practices. Preliminary estimates provided by Technology Adoption Survey show a very high uptake by both direct and indirect participants. Therefore, we recommend USAID/Bangladesh consider continued funding for the current project to avoid any uncertainties and premature cutting back of field activities in the near future.

Many of the Add-on/Scale-up options require strengthening private sector participation in order to create the necessary value chains before the project encourages farmers to make risky decisions or before the project expands to more remote areas or areas with more marginalized farmers. We recommend setting up a "Seed Unit" to help, as well as contracting with specialized local firms/NGOs/consultants to help with market development as needed for maize and sunflowers in particular.

In Section 6.5, we made technological recommendations that require either expansion or testing. For seeds, we recommended creating a seed unit to help with specific problems in seed supply. For the work on gher systems, we recommend one more year of work to determine if it is worth larger efforts in the new areas near the Rangpur and Mymensingh hubs. For cage culture, we recommend continuing ARTs to determine where this should receive more project inputs. For ARTs, we recommend expanding work on fertilizer practices since farmers identified this as a major project benefit.

During both the National Stakeholders Workshop and the Hub Stakeholder Workshop, participants mentioned the need to merge some of the CSISA-BD research programs with the Institutes. Such a process could allow for sharing of costs and joint credit for research and joint publications. It would also allow for more research that focused on hub needs and would continue even after the CSISA-BD project closes. We anticipate this linkage would help the Institutes expand the supply of the breeder seed varieties that farmer's desire. A project-based Seed Unit could help with this.

As part of the process of gradually merging project approaches and activities into the GoB Extension Services (agriculture and fisheries), we recommend the project initiate agreements with some donor-funded projects and NGOs working with DOA and DOF extension units. These partnerships would then try to provide CSISA-BD content to get more results to farmers in the FtF zones. To help ensure more private sector participation, we recommend the project hire a business manager who can help farmer's organizations develop business links with buyers. This would involve increasing the number and quality of farmer's organizations (similar to what CIMMYT has done). A business manager and better business linkages would get more private sector involvement in input supply, finance, farmer training and value chain improvements through better marketing channels and improved processing. The current project structure with CSISA-BD CG partners working together is sound; we recommend maintaining this structure and the current distribution of hubs. The current project structure was robust enough to allow continuation of normal operations despite the extensive time lost due to the political disruptions noted above.