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CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA (CSISA) PHASE II

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International Maize and Wheat Improvement Center (CIMMYT)

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The Cereal Systems Initiative for South Asia (CSISA) is a research-for-development partnership implemented jointly by CGIAR members—the International Maize and Wheat Improvement Center (CIMMYT), the International Food Policy Research Institute (IFPRI), the International Livestock Research Institute (ILRI), the International Rice Research Institute (IRRI), and World Fish, in close partnership with public and private sector organizations across South Asia. CSISA is funded by the United States Agency for International Development (USAID) and the Bill and Melinda Gates Foundation. CSISA is an integral part of several CGIAR Research Programs (CRPs), connecting and integrating their work in South Asia. These CRPs include: CRP 2: Policies and markets; CRP 3.1: WHEAT; CRP 3.2: MAIZE; CRP 3.3: GRiSP; and CRP 3.7: Livestock and fish. CSISA also has interactions in South Asia with CRPs 1.1: Dryland systems; 1.3: Coastal and aquatic systems; 4: Nutrition and health; 5: Water and land; and 7: Climate change.

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Acronyms and Abbreviations

Acronym	Full Name of Acronym
AFP	Axial flow pump
AIC	Advisory and investment committee
ATMA	Agriculture Training and Management Agencies
AWD	Alternate wetting and drying
BAMETI	Bihar Agricultural Management & Extension Training Institute
BAU	Bihar Agricultural University
BHU	Banaras Hindu University
BMSS	Bihar Mahila Samakhya Society
BSS	Bihar Samakhya Society
CA	Conservation agriculture
CBO	Community-based organization
CCAFS	Climate Change Agriculture and Food Security
CDZ	Cauvery Delta Zone
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CSISA	Cereal Systems Initiative for South Asia
CSISA-BD	CSISA-Bangladesh
CSISA-MI	CSISA Mechanization and Irrigation project
CSISA-NP	CSISA-Nepal
CSO	Community-supported organization
CSSRI	Central Soil Salinity Research Institute
CT	Conventional tillage
DAC	Department of Agriculture and Cooperation
DAO	District Agriculture Officer
DOA	Department of Agriculture
DSR	Direct-seeded rice
EC	Executive committee
EIGP	Eastern Indo-Gangetic Plains
FP	Farmers' practice
FTF	Feed the Future
GCP	Generation Challenge Program
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICAR-RCER	ICAR-Research Complex for Eastern Region
ICT	Information communication technology
iDE	International Development Enterprises
IFPRI	International Food Policy Research Institute
IGP	Indo-Gangetic Plains
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
KVK	Krishi Vigyan Kendra
LLL	Laser land leveling
LSP	Local service provider
LWSIT	Lutheran World Service India Trust
MT	Management team
MTNPR	Machine-transplanted non-puddled rice
MTPR	Machine-transplanted puddled rice
NARC	Nepal Agricultural Research Council

NARES	National agriculture research and extension systems
NGO	Non-governmental organization
NILs	Near isogenic lines
NM	Nutrient Manager
NMR	Nutrient Manager for Rice
NOPT	Nutrient omission plot technique
NREGA	National Rural Employment Guarantee Act
ODK	Open Data Kit
OFSP	Orange-fleshed sweet potato
OMFED	Orissa State Co-operative Milk Producers' Federation
OUAT	Orissa University of Agriculture and Technology
PAU	Punjab Agricultural University
PTR	Puddled transplanted rice
PVS	Participatory varietal selection
RAU	Rajendra Agricultural University
RP	Research platform
RWCM	Rice-Wheat Crop Manager
QTL	Quantity trait locus
SAU	State agriculture university
SHG	Self-help group
SP	Service provider
SSNM	Site-specific nutrient management
TNAU	Tamil Nadu Agricultural University
TRRI	Tamil Nadu Rice Research Institute
UBKV	Uttar BangaKrishiViswavidyalaya
USAID	United States Agency for International Development
VAW	Village agricultural worker
WYCYT	Wheat Yield Consortium Trait Yield Nursery
ZT	Zero tillage

Executive Summary

In recent years, gains in cereal productivity in South Asia have slowed markedly and, simultaneously, issues of resource degradation, declining labor availability, and climate variability pose steep challenges for achieving sustainably intensified cereal systems that meet the dual goals of improving food security and rural livelihoods. To address these challenges, the Cereal Systems Initiative for South Asia (CSISA) was established in 2009 to pursue an interlinked set of research and innovation system interventions to catalyze durable change at scale in South Asia's cereal systems.

Operating in rural innovation hubs in **Bangladesh, India, and Nepal**, CSISA involves partnerships with the public, civil society, and private sectors for the development and inclusive deployment of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems, progressive policies, and strengthened markets. The project is composed of six linked objectives: (1) Catalyzing widespread dissemination of production and post-harvest technologies to increase cereal productivity, resource use efficiency, and income; (2) Process-based research into crop and resource management practices for future cereal-based systems; (3) High-yielding, heat- and water-stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems; (4) High-yielding, heat- and water-stress-tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems; (5) Improved policies and institutions for inclusive agricultural growth; and (6) project management, data management, M&E, and communications.

In the past six months, CSISA has made strong progress towards achieving the goals set out in its **results framework** (Appendix C) and towards the over-arching 10-year vision of success for the initiative. In the heat-prone Eastern Gangetic Plains, fostering the spread of early planting is an important adaptation mechanism for coping with contemporary and projected climate extremes. CSISA has successfully out-scaled key messages on the importance of early wheat sowing by sharing lessons learnt from on-farm experiments and compelling the State Department of Agriculture in Bihar to change its official recommendation in favor of planting before November 15th. With a statewide media campaign that was supported by CSISA, the new state department recommendation reached every corner of Bihar and led to an advancement of planting that ranged from 3 to 10 days. In addition to cost savings and improvements in soil quality, zero tillage is an important entry point for advancing wheat planting. With technical and business development training, CSISA supports a network of more than 1,300 mechanized service providers entrepreneurs who, in turn, provide services to around 20 households each – a core example of CSISA's strategy to achieving sustainable intensification at scale through change agent intermediaries. In Odisha and Bihar, CSISA has taken advantage of the social capital of the many women's self-help groups that have been formed by the government and other civil society partners. These groups have provided 'ready made' entry points for training and social mobilization, while also providing other antecedents for success including access to credit. CSISA has conducted linkage events with these groups to increase connections with knowledge and service provider. And, more fundamentally, conducted participatory assessments of technology options and entrepreneurship opportunities so that CSISA's programming to effectively support women farmers is demand-driven and more likely to succeed.

CSISA continues to strengthen **strategic partnerships** with the state Department of Agriculture, the Krishi Vigyan Kendras (KVKs), state agriculture universities (SAUs), NGOs, and local service providers as needed for the promotion of locally appropriate resource-conserving technologies and better-bet

agronomic practices that can be implemented at scale. CSISA has also formed partnerships with the private sector to support dealer training – an essential activity that supports the most common source of information and advice for most farmers in India. As part of this strategy, CSISA has fostered closer linkages between the state extension system and the private sector so that extension also supports agents of change (e.g. dealers and service providers), which will help ensure that government investments in agricultural development reaches a larger number of farmers through the work of intermediaries.

In **Bangladesh**, an acceleration of adoption rates for key income generating and sustainable intensification technologies were observed including: 3,545 farmers growing maize on previously uncultivated (or extensively cultivated) 'char' lands. 2,825 farmers adopting high value aromatic rice varieties, 3,892 farmers adopting the cultivation of oil seed mustard between monsoon season rice and winter season, and 1,254 farmers adopting improved aquaculture production technology. New survey research has also assessed the capacity for different CSISA activities to generate income among 'indirect' beneficiaries. For example, for every farmer trained by the WordFish Center, approximately 3.6 other farmers learn about the new technology by interacting with the trained farmer and, in turn, adopt it themselves. These insights are being used to assess the efficacy of different approaches to scaling technologies in order to increase the impact of CSISA's activities.

In July, CSISA launched a new initiative in southern Bangladesh (CSISA Mechanization and Irrigation – 'CSISA-M.I.') that focuses on efficient development of surface water resources and precision agriculture with scale-appropriate machinery. In the reporting period, 7,308 farmers worked with service providers to make use of this machinery on their land while 224 of the providers received business development training. For sustainability and success at scale, CSISA-MI is predicated on compelling private investment in the commercialization of both machinery and associated services. As an early indication of the success of the approach, two Bangladeshi companies (ACI and RFL) invested $613,728 of their own funds into the commercialization of the MI's priority technologies during the reporting period.

In **Nepal**, new experiments with bed planting for lentil have introduced a potential mechanism for reducing the risk of stand mortality and fungal disease outbreaks due to the occurrence of winter rains. Managing this risk is a pre-condition for encouraging productivity enhancing investments in this high value crop. On-farm research trials for spring maize have highlighted the importance of sound management to profitability, with profits varying from over $1,000 /ha to loss depending on cultivar selection and irrigation management. CSISA also facilitated access for women farmers to scale-appropriate machinery by working with lenders to provide 'meso credit' loans.

Cross-cutting activities included the field evaluation and fine-tuning of ICT-based decision support frameworks for nutrient and crop management in Tamil Nadu, Odisha, Bihar, Eastern UP, and Bangladesh; dissemination of improved post-harvest practices and associated business models across the CSISA domain; and the efficient deployment of improved livestock feeding practices through innovative partnerships with dairy cooperatives in Odisha.

In aggregate more than 24,000 farmers in CSISA's priority hubs in India and Bangladesh received training from CSISA during the 6-month reporting period. In tandem with market development and other companion measures that are coordinated through impact pathway logic, these efforts have

generated uptake rates for key technologies that suggest that CSISA is well on its way to fulfilling its 10-year vision of success of sustainably intensifying cereal-based systems at scale.

Through research at CSISA's research platforms, **Objective 2** has conclusively demonstrated that system-based yield productivity can be sustainably enhanced while increasing profitability, reducing energy investments, and also markedly reducing irrigation requirement. Core constituents of these future-oriented systems include the integration of diversification, precision management, and conservation agriculture. CSISA recognizes that the challenges of sustainable intensification require an expanded focus that extends beyond research stations. An example of Objective 2's new strategic research activities include exploring the scope and implications of diversifying rice-wheat systems in the northwest Indo-Gangetic Plains by integrating studies on water management and salinity dynamics with maize market demand projections, regional hydrology, and farmer perceptions of risk and willingness to innovate.

Objective 3 has made steady progress towards developing elite rice lines with increased yield potential, improved grain quality and superior feeding value, rice for mechanized direct seeding and water-saving irrigation practices, and high-yielding heat-tolerant rice. In the DSR wide-screen evaluations, hybrids performed best with yield advantages of a few top hybrids in the range of 23-34% in the early, 26–35% in the medium-early, and 16–19% in the medium maturity groups.

Objective 4 has undertaken similar activities—breeding trials and nurseries—in pursuit of high-yielding heat- and water-stress tolerant, and disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems. During the reporting period, Objective 4 work within CSISA has fully come to fruition with 8 new wheat varieties released for different production ecologies in South Asia

Objective 5 continued to address the policy environment needed to remove constraints to the adoption of new technologies and enhance the benefits of improved agricultural growth. CSISA completed studies on the projected demand heterogeneity for drought tolerant rice cultivars in Bihar as a means of improving strategies for reaching vulnerable farmers; the impact of the Mahatma Gandhi National Rural Employment Guarantee Scheme on labor-saving agriculture technology and machinery/equipment adoption; and the influence of gender dimensions of social networks on technology adoption.

Under **Objective 6**, a variety of regional, country-level, and state-level governance and management mechanisms continue to be implemented, including Management Team meetings for India and Bangladesh, and Advisory and Investment Committees for Bihar, Odisha, and Bangladesh. CSISA has strengthened its M&E team and associated systems, and has implemented inference techniques for evaluating outcomes. As part of Objective 1, several 'deeper-dive' studies have been conducted (e.g. direct-seeded rice adoption, zero-tillage adoption, structure and function of service provision markets) that inform these 'quick but credible' inference techniques. CSISA has also launched a new web site (csisa.org), revised its CSISA bulletin, and initiated CSISA Research Notes to better disseminate research findings.

Objective 1: India

- Wheat sowing in 2013–14 advanced by three to ten days across Bihar hub districts compared to 2012–13; the area and the number of farmers who adopted this practice increased significantly.
- Sales volumes of rice hybrids in Bihar increased, which not only increased paddy yields but also helped advance wheat sowing in 2013–14. Rice hybrid yields in EUP were found to be 18% higher than non-hybrids.
- EUP showed that maize grain yields were 50% higher when maize was grown on raised beds compared to conventional flat beds.
- Mechanical paddy threshing in EUP reduced post-harvest losses by 3% compared to manual threshing, helped advance wheat sowing by 9 days.
- In Odisha, grain yields of maize under line sowing and under better bet agronomy (optimum population, line sowing, proper weed management and nutrient management) were 4.5 and 5.2 tonnes/ha, respectively, against an average yield of only 3.0 tonnes/ha under farmers' practice.
- In Haryana, collaboration between the state agriculture universities, state Department of Agriculture, Farmers' Commission and CSISA expanded zero tillage wheat to about 210,000 ha in 2013–14.
- The area under dry-seeded rice in Haryana increased from 226ha in Kharif 2009 to 8,000ha in Kharif 2012 and to 10,800ha in Kharif 2013.
- In Punjab, Punjab Agriculture University, Ludhiana, and CSISA jointly recommended a drip irrigation schedule for spring maize, which has now been included in the package of practices published by PAU Ludhiana.
- In Tamil Nadu, based on their collaborative work with CSISA, the state government has told district agriculture officials that DSR must be rolled out on at least 20% of the total cropped area in the Cauvery Delta Zone, announced a 50% subsidy on seed drills, and announced various input incentives for adopting DSR.
- CSISA and Orissa University of Agricultural Technology showed that chopping fodder more than doubled milk yields and saved straw by reducing the amount pulled onto the ground by animals.
- CSISA partnered with Kushwaha Engineering (a large farm implement manufacturer in Bihar) to modify and field test threshers, resulting in farmers obtaining full length soft straw and service providers receiving Rs.600/hour for their threshing services.
- Nutrient Manager for Rice (NMR) has been developed for the Cauvery Delta of Tamil Nadu, and Rice–Wheat Crop Manager (RWCM) has been developed for EUP and Bihar. Maize Crop Manager is now being drafted and developed for the maize growing areas of EUP and Bihar.

Bangladesh

- CSISA-BD's work expanded to include 3,545 new maize farmers, many of whom began cultivating maize and wheat on sandy soil riverine islands

called Chars; 2,825 farmers who adopted high value aromatic rice varieties; 7,308 farmers who bought planting and irrigation services from local service providers; and 1,254 farmers adopted improved aquaculture production technology.

- CSISA-MI's private sector partners ACI and RFL co-invested in machinery commercialization, totaling $613,728. This is a 3:1 co-investment value compared to CSISA-MI's investment in these companies.

Nepal

- CSISA data suggests consistent advantages of around 1 t ha^{-1} for adoption of new rice varieties of similar maturity class if farmers are growing Bineshwari ('Bind').

Objective 2

- Four years of research results at the Karnal Research Platform have consistently demonstrated that Kharif maize appears to be a suitable and profitable alternative to rice in the rainy season in northwest India to address the issues of rising scarcity of water, labor, and energy.
- Weed problems in zero till wheat reduced over time, and hence herbicide use in continuous ZT wheat with rice residue mulch decreased compared to the conventional system. For the last two years (2012–13 and 2013–14), no herbicide has been applied in ZT wheat plots.

Objective 3

- Under machine-sown, dry, direct-seeded conditions, one hundred entries composed of hybrids from private sector companies, breeding lines and varieties from IRRI, and public sector NARES partners were evaluated at six locations in India. In general, hybrids performed better in terms of rapid germination and emergence, early seedling vigor, fast canopy coverage, better crop establishment and grain yield.

Objective 4

- Eight new wheat varieties released, six identified for release, and more than 700 promoted to national/state/regional trials for further evaluation and subsequent release in South Asia. More than 1,800 new crosses (800 by CIMMYT and 1,000 by NARS) were attempted and >12,000 breeding populations (5,000 by CIMMYT and 7,000 by NARS) exposed to selection under various environments/management conditions.

Objective 5

- Six studies underway, including investigations into drought risk management strategies, impacts of shocks and vulnerability on input use and management practices, organization of agricultural mechanization industry in India, farmers' preferences for drought- and flood-tolerant rice cultivars, and adoption of balanced use of chemical fertilizers.

Objective 6

- CSISA launched its new web site: csisa.org, as well as an e-newsletter for external audiences, and an internal newsletter for the CSISA team.

Objective 1 focuses on achieving both short- and long-term impact on sustained cereal production growth by accelerating the adoption of innovative technologies, forming private- and public-sector partnerships, employing sustainable business models and information systems, and undertaking additional activities such as social marketing campaigns that foster impact at scale.[1] Outputs of Objective 1 include participatory testing and technology refinement for sustainable intensification; translating research into actionable products and insights; mobilizing partnerships for catalyzing impact at scale; and strategic capacity development to support key agents of change.

India

Bihar Innovation Hub

During the reporting period, which touches both the Kharif 2013 and Rabi 2013–14 seasons, CSISA's Bihar hub focused on direct seeded rice (DSR) and machine-transplanted non-puddled rice (MTNPR), hybrid rice, hybrid maize, early wheat sowing and zero tillage wheat. Unfortunately, drought during the early stages Kharif affected the performance of rice, with some areas planted to DSR failing and many areas left fallow that would otherwise been transplanted. Major advances for mechanization in rice were achieved, as well as significant expansion in early wheat planting, diversification from rice to Kharif maize in upland ecologies, improved weed management and site-specific nutrient management.

The hub collaborated with the state Department of Agriculture (DOA) on the dissemination of information about **MTNPR** through joint training and the sharing of CSISA's data and videos, allowing the DOA to encourage farmers to establish community nursery enterprises and become service providers during its Kharif 2013 campaign. Through efficient and precise stand establishment in non-puddled fields, application of this technology simultaneously addresses the pressing issues of labor and water constraints while improving soil quality and creating new opportunities for service provision by small and medium-scale entrepreneurs. Bihar Agricultural Management & Extension Training Institute (BAMETI), one of CSISA's collaborators, also circulated CSISA's video among its field officers and extension workers to raise awareness of this key technology.

Results from the Bihar hub's on-farm research showed that the average paddy yield from **MTNPR** plots (n=59) was 5.1 t/ha, compared with 4.8 t/ha from 35 puddled transplanted rice (PTR), and 3.9 t/ha from 38 plots of direct seeded rice. With CSISA's support, the number of service providers for mechanical transplanting increased from four in 2012 to 22 in 2013. To rigorously evaluate opportunities for yield and profit maximization, collaborative research was conducted at IARI's regional research station in Pusa. Four rice management techniques were compared—MTNPR, DSR, puddled transplanted rice, and the system of rice intensification (SRI). Results show that paddy yields of Arize 6444 were statistically indistinguishable, ranging from 7.3 to 8.5 t/ha with Arize 6444 hybrid. However, the net profits were US$ 1,032, $838, $822, $741 in MTNPR, DSR, SRI and PTR, respectively. This trial provides additional evidence that high yields can be achieved with mechanical transplanting with profitability levels that exceed the alternatives by more than 25%. Crucially, it also confirmed the scientific consensus that that no unique yield advantages are achievable with SRI.

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[1]The Objective 1 priority hubs in India are located in Bihar, Eastern Uttar Pradesh, and Odisha, and the transition hubs are in Haryana, Punjab, and Tamil Nadu; in Bangladesh hubs are located in Khulna, Jessore, Barisal, Faridpur, Rangpur, and Mymensingh Districts; in Nepal, activities are concentrated in Banke, Dadeldhura, Achham, and Surkhet Districts.

Accelerating labor shortages, especially during transplanting time for PTR and SRI, have resulted in a policy shift in the Bihar State Department of Agriculture towards the promotion of MTNPR.

Both MTNPR and **hybrid rice** help optimize cropping systems by allowing the early harvest of rice and the early planting of wheat, and thus higher system productivity. According to a CSISA survey, most dealers in the hub domain reported an increase in sales volume of rice hybrids especially in Samastipur, Vaishalli, and Begusarai districts. This intervention not only increased paddy yield but also helped advance wheat sowing in 2013–14 and intensify cropping systems in these districts.

Dry directly sown rice (DSR) offers considerable scope for reducing labor requirements for rice, especially in areas where the penetration of seed drills for wheat is high and the density of mechanical transplanters is low. Despite continued efforts during the last four years, the expansion of **DSR** in Bihar has been less than expected. During Kharif 2013, the monsoon was erratic, with no rain for 35 days during the peak sowing season, and flooding and cyclone-like weather during crop maturity. To improve the success of DSR, the hub promoted **integrated weed management;** poor weed management has been identified through socio-economic surveys that track the continuous use of this technology as a principal driver of dis-adoption. Complex weed flora in DSR dominated by *Cyperus rotundus* was effectively controlled with a tank mix combination of bispyribac at 80g product/ha with pyrazosulfuron at 80g product/ha applied 20-25 days after sowing. Average paddy yields were 5.0, 4.8 and 4.7 t/ha under bispyribac + pyrazosulfuron, bispyribac alone, and two manual weeding weed control treatments, respectively.

In collaboration with university (i.e. BAU, RAU, BHU) and ICAR partners, an ICT-based **Rice–Wheat Crop Manager ('beta')** decision support system has been developed to provide field-specific fertilizer and crop management guideline for farmers in Bihar and EUP (http://webapps.irri.org/in/brup/rwcm/). Scalable approaches for precision management are of particular importance in the E-IGP where infrastructure for soil testing is either lacking or insufficient. Field evaluations of the Rice-Wheat Crop Manager for wheat were conducted this past season and incorporate potentially important advances in establishing crop yield targets based on planting dates. Additional tool improvements are planned that will incorporate seasonal weather forecast information into the yield target calculations. CSISA is also working with the private sector to develop plans for tool deployment.

CSISA and its partners demonstrated the benefits of **maize bed-planting** in Kharif. Based on 75 on-farm technology evaluation trials with raised beds, maize grain yields were reported to be 50% higher when maize was grown on beds compared to conventional flat planting (3.4 vs. 2.2 t/ha). By reducing the risk of crop failure and low yield due to flooding damage, these demonstrations are helping CSISA and its partners to expand the area under Kharif maize.

The promotion of **early wheat sowing** has continued to be a top priority for the Bihar hub since early sowing reduces wheat's vulnerability to terminal heat stress. Based on a CSISA survey, wheat sowing in 2013–14 advanced by three to ten days across hub districts compared to 2012–13.The total area and the number of farmers who adopted this practice has increased significantly, in large part due to the change in recommendation from the Bihar State Department of Agriculture for farmers to plant before November 15th. This change was enacted as a result of the direct advocacy of CSISA based on the applied research conducted by the project in Bihar since 2009. Early results from jointly sponsored demonstrations with state department staff were impressive with grain yield of wheat in Buxor, Samastipur and Begusarai districts of 5.8, 6.2 and 6.4 t/ha.

An ongoing survey in Bihar characterizes the spread **zero tillage** (ZT) wheat, and early results indicate that this technology has already been adopted in 38% of the villages in the Bihar hub domain. As point of contrast, ZT adoption at CSISA's inception in 2009 was essentially non-existent. The primary conduit to facilitate the spread of ZT technology is through service provision. CSISA helped foster the emergence of 421 additional service providers (SPs) during the reporting period resulting in a total

strength 1,012 SPs. CSISA trained them on technical issues and financial management, and connected them to extension services as permanent source of backstopping advice (CSISA also trains extension agents to play this role). In turn, each service provider supplies innovative technology to approximately 20 households and covers nearly 140 acres land with zero-tillage.

CSISA's on-farm experience in the stress prone E-IGP suggests that **the combination of zero tillage and early wheat sowing could a 'game changer' for yield and year-to-year stability,** with the expectation that lower levels of risk will create a virtuous circle and stimulate higher levels of farmer investment in other productivity-enhancing technologies. Apart from the yield gains at the farm level, farmers can earn higher profit margins by providing **custom services** for ZT. Assuming no subsidy for the purchase of machines, the cost and return analysis of zero-tillage and paddy thresher service providers (SPs) showed net profits of US$360 and US$1,036, respectively.

The combination of early sowing and the zero tillage also opens opportunities for planting higher yielding but longer-duration wheat varieties. In a bid to increase wheat yields through this combination of technologies, CSISA and its KVK and DOA partners encouraged the use of **long-duration wheat varieties** like PBW 502, HD 2733, HD 2824, HD 2967 Super 172 and Baaz while also discouraging the use of older and lower-yielding wheat varieties like Lok1, UP262, PBW 373 and HUW 234. Recently completed seed dealer surveys suggest this dual strategy is having a positive effect with many dealers reporting a decline in sales of low-yielding varieties and a significant area expansion of newer, high-yielding varieties that were cultivated on more than 8,500 ha in 2013-14.

The new interventions have been made more effective through **improved weed management**. Access to **new safe and effective herbicides** was increased through CSISA's work with private sector partners. A survey of 39 dealers conducted in March suggested adoption on 15,906 ha (28,000 farmers) of wheat under sulfosulfuron + metsulfuron, carfentrazone and clodinafop across the Bihar hub, strategies that are particularly effective for fields with complex weed flora dominated by *Phalaris minor*.

CSISA's interventions in the areas of **maize based intercropping** (1,202 ha), **ZT in other crops** (240 ha), and **seed sales through service providers** (192 ha) have increased in area, reached 4,532 farmers and allowed the project to support more women farmers. The increased participation of women farmers is emerging through joint activities with the Bihar Samakhya Society (BSS) and other like-minded NGOs that have created and supported women's 'self help' groups for livelihoods improvement. CSISA uses these partnerships as efficient entry points for training and outreach.

During the reporting period, the Bihar Hub conducted trainings for 2,590 farmers and SPs (including 615 women), 1,499 extension staff of DOA, 46 managers and field officers, and 16 members of NGOs.

Eastern Uttar Pradesh (EUP) Innovation Hub

In Eastern UP, the ranks of **new service providers** buying **zero tillage** machines for DSR and **paddy transplanters** grew, a sign that farmers increasingly prefer these technologies over manual transplanting as a means to overcome serious labor constraints.

The average paddy yield from **MTNPR** across varieties and hybrids was 6.1 t/ha compared to 5.9 t/ha from DSR and 5.4 tones/ha from PTR. The good performance of DSR in EUP compared to Bihar can be attributed to the more favorable rainfall pattern in EUP. The average paddy yield for **hybrids** was 6.5 t/ha, 18% higher than the corresponding value of 5.5 t/ha. These yields are achieved at the same level of input use and management intensity, which supports CSISA's strategy to facilitate the expansion of hybrid rice in the hub domain area.

To effectively manage complex weed flora and to reduce the possibility of evolved resistance to herbicides, CSISA encourages its private sector partners to incorporate **herbicide mixtures** in their future planning. A recently concluded CSISA survey of dealers showed that the adoption of sulfosulfuron + metsulfuron or clodinafop + metsulfuron, clodinafop and carfentrazone covered approximately 9,765 ha in 2013 (15,440 farmers).

CSISA experiments also demonstrated that **mechanical paddy threshing** reduced post-harvest losses by 3% compared to manual threshing and, more importantly, helped advance wheat sowing by 9 days by eliminating the need for an extended period of sun drying in the field that is typically employed to facilitate manual threshing. Hence, mechanical threshing is a critical enabling factor for the advancement of wheat sowing by reducing the time the field is occupied by rice.

In preparation for the 2013–14 Rabi season, the EUPH team teamed with the Department of Agriculture at the district level to promote **early wheat sowing**, in conjunction with **zero tillage wheat**, **long duration wheat varieties** and **improved weed management**. Key informant surveys are in process to estimate the impact of these collaborative activities.

With the help of state department partners, the sowing date of old **long duration varieties** like PBW 343 was advanced, and additional long duration varieties like PBW 502, HD 2733, HD 2824 and HD 2967, Super 172 were effectively promoted through seed dealers and general awareness campaigns. These varieties are now replacing shorter duration, low yielding varieties like PBW 154, UP 262, HUW 234 and PBW 373, and data from our dealer survey shows that coverage of the new varieties as quickly expanded to an area of 8,890ha.

CSISA is facilitating the **bed planting of maize** and **short duration maize hybrids** in order to expand the area under **Kharif maize**. Evaluation trials for bed planting demonstrated around a 1 t/ha advantage over conventional planting on the flat (4.8 vs. 3.9 t/ha).

During the period of this report, hands-on technical training was provided to 902 individuals, including 75 women farmers, 173 service providers, 36 extension staff of DOA, and 59 NGO partner staff. The total number of service providers in Bihar and Eastern UP that are supported by CSISA now exceeds 1,300.

In Focus: *Achieving scale with service providers*

During the last two years, CSISA has assisted more than 1,300 farmers in Bihar and Eastern Uttar Pradesh to become service provider entrepreneurs and has built their capacities through trainings on conservation agriculture and small-scale mechanization. For ZT services, each provider reaches approximately 20 households

At the "Showcasing Agriculture Technologies" agri–expo on December 6–7, 2013, ICAR presented an award to seven service providers from Eastern UP and Bihar (see photo). Winners were:

Vijay Singh
Pramod Kumar Singh
Ganesh Singh
Ram Awadh Chaudhary
Brijesh Chaudhary
Arjun Singh
Vimal Kumar

The Eastern Indo-Gangetic Plains (E-IGP), in which CSISA hubs of Bihar and Eastern UP operate, are on the verge of a second Green Revolution, this time driven by agronomic management rather than crop varieties. The pace at which new innovations are reaching farmers has been accelerated through CSISA's support to a network of service providers (SPs), linked with CSISA's partners in the public and private sector and empowered through a variety of tailored capacity-building efforts.

The concept of custom-hire service evolved in the E-IGP as individual farmers began purchasing conservation agriculture (CA) machinery including zero-till seed drills, laser land levellers, rice transplanters, bed planters and threshers. These farmers become SPs when they provide mechanized services to other farmers including smallholder and poor farmers who cannot afford to purchase machines on their own. During the last two years, CSISA has facilitated more than 1,300 farmers to become SPs in the E-IGP and has built their capacities through trainings on agronomy, machinery operation and repair, and basic business skills. Provision of hands-on training has played a pivotal role in broadening their skill sets and expanding business opportunities.

In 19 districts across Bihar and Eastern UP, CSISA has played a critical role in facilitating a shift in the way agricultural technologies reach farmers. After creating a network of SPs, CSISA links them with the Department of Agriculture and a variety of important private sector actors.

CSISA's experience during the last two years shows that a strong network of SPs enables farmers to adopt mechanization not only to address labor constraints but also to improve their productivity by undertaking the timely seeding and harvesting of crops. CSISA expects that in the future, SPs will complement their farm machinery-based services with knowledge-based advisory services. CSISA aims to encourage some SPs to become small-scale rural entrepreneurs providing multiple services through a 'single window'. SPs complement the extension services provided through the state's DOA, and enable farmers to more quickly adopt new technologies and management practices.

In Person: *Promoting innovation to boost yields*

Pankaj Kumar Singh of Muzaffapur district of Bihar sought assistance from CSISA for his 2013–14 wheat crop, and as a result planted his wheat early, used a zero-till seed drill, and applied timely irrigation, fertilizer and herbicides. Unfortunately, his brother Srikant didn't share his enthusiasm for new technologies.

Here Pankaj stands with his lush CSISA-supported wheat field behind him and Srikant's scant field in front of him.

Early wheat sowing is a non-cash input that even smallholder farmers can benefit from, and is one of the most important adaptations to climate change in the Eastern Indo-Gangetic Plains.

In the Eastern Indo-Gangetic Plains, large gaps still exist between the crop yields of farmers within same village. This fact is exemplified by two brothers in the Naropatti village of Muzaffarpur District, Bihar who had substantially different attitudes towards the adoption of new technologies. One brother, Pankaj Kumar Singh, believed that CSISA interventions would fetch him a much higher grain yield than he would get from traditional practices. His brother, Srikant Kumar Singh, did not share his enthusiasm for new technologies. The photograph shown on the left, taken in January 2014, shows the clear contrast between the brothers' wheat fields. Pankaj, shown in the photo, stands with his own field behind him, and his brother Srikant's field in front of him. With help from CSISA, Pankaj's wheat crop was sown in early November using a zero-till seed drill, and was followed by the timely application of irrigation, fertilizer, herbicides. His brother's wheat was sown two weeks later using the broadcast method, and received fewer inputs. The CSISA-supported field has excellent crop growth with full ground cover and exceptional tillering. On the contrary, the adjacent field has very poor growth with lots of open spaces and few tillers per plant.

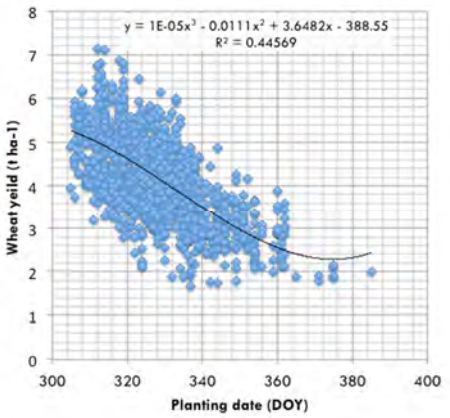
In Naropatti, farmers have had a successful 2013–14 Rabi season, with many farmers adopting early sowing. Early sowing is a non-cash input that even smallholder farmers can benefit from, and is one of the most important adaptations to climate change for wheat in the E-IGP. In the Department of Agriculture's planning meeting in November 2013, CSISA urged the extension agents and farmers to adopt early wheat sowing to compensate for the loss they incurred in rice season due to the 2013 drought. Word spread to adjacent villages, and many farmers in surrounding areas advanced their wheat sowing. With encouragement from CSISA, farmers also practiced good crop management including timely application of fertilizer and herbicides.

The advancement of wheat sowing to the first two weeks of November (from late November or even early December) is a paradigm shift from the practice earlier recommended by the State Department of Agriculture. The excellent crop canopy that can be seen when wheat is sown early serves as an incentive to farmers to also use more inputs like fertilizer, irrigation and herbicides. CSISA's work also suggests that in the future short-duration hybrid rice could be followed by a long duration and high yielding variety of early-sown wheat to improve overall productivity.

In Focus: *Early wheat sowing beats terminal heat*

To convince stakeholders of the benefits of early wheat sowing, CSISA shares data; conducts demonstrations; creates service providers (SPs); partners with government agencies on awareness-raising campaigns; trains private sector actors, and sensitizes field officers and grassroots workers.

In mid-October, 2013, the DOA advised farmers to plant wheat before November 15, which paved the way for the accelerated adoption of early sowing in 2013-14.



Wheat productivity growth in Bihar and Eastern UP is constrained by the combination of late sowing and terminal heat stress during grain filling when temperatures can exceed 35 C. State extension agencies and State Agricultural Universities (SAUs) historically discouraged wheat sowing before November 15, and it generally starts around November 20 and continues until the beginning of January. Late establishment also makes it more difficult for farmers to adopt high-yielding, long-duration varieties. To address these constraints, CSISA has prioritized interventions that can facilitate early wheat sowing, including zero tillage, hybrid rice, and mechanized post-harvest technologies.

To convince stakeholders of the merits of early wheat sowing, CSISA has taken a multi-pronged approach, including:

- data-based policy advocacy,
- demonstrations in farmers' fields
- training service providers (SPs)
- education programs for extension staff (with ATMA and BAMETI)
- awareness raising among input dealers and distributors

CSISA participated in the DOA pre-season planning meetings by sharing data and videos with district agriculture officers, SPs and extension workers. On the basis of this engagement, the DOA in Bihar advised farmers to plant wheat before November 15.

A survey of 7 districts conducted in March 2014 found that wheat sowing was advanced by 3 to 10 days in Bihar. Zero tillage is helping to expand the area under early sowing and has made wheat cultivation more profitable, in part by mitigating the risk of terminal heat and lowering the cost of cultivation. The grain yield of wheat in plots sown in the first week of November ranged from 6.3 to 6.9 t/ha – yield levels that are very respectable in NW India and almost never observed in Bihar. CSISA has offered farmers and officers from DOA to participate in the public harvesting of plots where sowing has been done early.

Odisha Innovation Hub

During the reporting period, the Odisha hub's technical focus was on MTPR, DSR, line sowing of maize, zero tillage for green gram and mustard, and post-harvest processing. Unlike most areas of the IGP, many of these technologies have not been extensively evaluated in Odisha, and awareness among farmers is low. From this base, the Odisha hub made important in-roads for establishing a foundation for long-term success by facilitating 'early' adoption of different CSISA-promoted technologies with more than 1,500 farmers on an area of nearly 572 ha. Most of this spread came through **machine transplanting of rice**, which covered 364 ha. CSISA ensured that all new mechanical transplanting **service providers** received hands-on training on the raising of mat-type nurseries, machinery operation and repair of machines, and better bet agronomy.

In the Odisha hub domain area, paddy yield performance with **mechanical transplanting of rice into puddled soil** (MTPR) averaged 4.8 and 5.2 t/ha in Bhadrak and Puri, respectively. The corresponding paddy yields from **mechanical transplanted non-puddled rice** (MTNPR) were 4.6, 5.6 and 4.0 t/ha in Bhadrak, Puri and Mayurbhanj, respectively. These results demonstrate that the costly, water-consumptive, and soil-damaging impacts of puddling can be avoided without reducing rice yields in mechanically transplanted systems. On an average, the paddy yield from both types of mechanical transplanting were statistically indistinguishable, but were consistently better than manual transplanting with yield gains ranging from 0.5 to 1.0 t/ha.

Odisha has significant area under **direct seeded rice** across CSISA's three current working districts, but farmers use high seed rates and broadcast establishment practices followed by 'beushaning' to thin initially high plant populations. With these practices, costs can be high and yield typically low. CSISA has evaluated the performance of **DSR with line sowing** by drill establishment. In comparison to broadcast methods, DSR with line sowing consistently and substantially improved crop performance: 4.0 t/ha vs. 3.0 to 3.5 t in Bhadrak, 5.1 t/ha vs. 3.5 t/ha in Puri, and 3.3 vs. 2.3 t/ha in Mayurbhanj. In areas with double-cropped rice systems, the CSISA team has observed some problems with weed management from 'volunteer' rice from the previous crop which may limit expansion of DSR in the rabi season.

In Mayurbhanj, grain yields of **maize under line sowing** and **better bet agronomy** (optimum population, proper weed management and nutrient management) were 4.5 and 5.2 t/ha, respectively, against an average yield of only 3.0 t/ha under existing farmers' practice. These results were achieved under rainfed conditions during the Kharif season on the nutrient –depleted, lateritic soils that dominate Odisha's plateau region. These areas are often dismissed as too risk prone and resource degraded to support high crop yields. CSISA's work has opened the eyes of famers and state department partners to the yield and economic returns achievable for rainfed maize in these areas with sound management. These results are also being conveyed to private poultry mill owners who are currently sourcing considerable volumes of maize from outside the state. An increase in market-oriented maize grain production in the plateau region may evolve into a significant income generation source for farmers and CSISA is collaborating with the rural management institute KIIT to characterize and seek opportunities to strengthen **maize value chains** in Odisha.

Inefficient **post-harvest processing** is a notable weakness in the maize value chain. Maize shellers have been introduced to the region through women's self-help groups who collaborate with CSISA. These groups report an increase in their efficiency as well as reduction in drudgery.

CSISA and its partners also initiated line sowing both with and without **zero tillage** in 137ha of green gram, 26ha of mustard and 15ha of maize.

Crop diversification is also a priority, which important niches for crops like wheat and chickpea identified in partially irrigated areas of the plateau. CSISA introduced the wheat variety Baaz to Odisha, and early feedback from farmers suggests that significant yield gains are possible with the

short-duration Baaz that is well-matched to both thermal conditions in the Odisha plateau as well as the limited supplies of irrigation water.

To support the delivery process of successful technologies, more than 900 farmers, service providers, government and CSO functionaries were directly trained by CSISA in Rabi 2013–14. Field days were organized for line sown DSR, improved management practices in maize, weed management and nutrient management in maize.

In addition to direct training programs, CSISA conducted **mass awareness** raising activities by exhibiting and showcasing CSISA technologies through exhibitions and farmers fairs organized across all the three districts in association with partners like KVKs, DOA, CBOs and civil society organizations (CSOs). An exhibition of CSISA technologies was held in the *Mahaadhibesan* of two women's SHG federations, including *Sampurna* in Karanjia and *Swayamsiddha* in Jashipur. Two thousand and 2,500 women SHG members and farmers, respectively, participated in these events. CSISA technologies were also exhibited at the farmers fair organized in Baripada, Mayurbhanj in association with KVK and DOA, at which 800 farmers, including 300 tribal farmers and 200 women farmers, visited the CSISA stall. A consultative workshop on 'Empowering Women in Agriculture through Systematic inclusion in Farming Value Chains' was held in Baripada, Mayurbhanj.

In Focus: *Introducing mechanical rice transplanting to Odisha*

In 2013, CSISA partnered with the Odisha Department of Agriculture to introduce mechanical rice transplanting and community mat nursery production into tribal areas of the state.

Success of the pilot has spread enthusiasm among the community for these technologies, which are new to Odisha and which help to alleviate constraints associated with labor availability, labor costs, and costs of production.

Farmers in the village of Badjod in the Mayurbhanj district of Odisha are fortunate to have access to canal irrigation, enabling them to grow rice during Kharif and Rabi seasons. Labor is scarce during peak times, though, and farming is constrained in part by high labor prices and the high cost of manual cultivation. The multitude of productivity constraints has demotivated farmers here from trying to grow rice more intensively.

In collaboration with the Odisha Department of Agriculture, CSISA has launched an initiative to popularize the mechanical transplanting of paddy in puddled and non-puddled conditions. In late 2013, CSISA and local government extension workers held a meeting to introduce farmers to mechanical transplanting technology, which is completely new to the area. Following this meeting, 40 farmers came forward to adopt mechanical rice transplanting for the first time. Since this technology is also new for government extension workers, CSISA held an on-site training for extension agents and progressive farmers in January 2014.

One of the primary constraints to the adoption of mechanical transplanting is the local availability of the paddy transplanter. Therefore, CSISA supported a progressive farmer, Chinmay Naik, to buy a transplanting machine, and then provided additional support to local farmers and a community resource person for mat nursery preparation. A mat nursery was planted in an area with assured irrigation and level topography, and planting was staggered in order to produce seedlings of different ages. Farmers initially planned to cultivate a community mat nursery for transplanting onto 40 acres of paddy field, but after seeing the ease of preparation and low costs involved, they increased the coverage area to 80 acres. Once mechanical transplanting started, farmers began to see that using 15-day old seedlings and wider plant spacing was resulting in good plant growth and increased tillering, so community demand increased. Chinmay bought an additional transplanter and was able to service 100 acres, an area held by 120 farmers, using his two transplanters and one provided by CSISA.

During the community nursery raising exercise, 7 female farmers and 10 male farmers were trained to serve as nursery providers for the next season. Farmers have provided early feedback that mechanical transplanting has led to good plant populations and easy weeding due to line transplanting. Farmers have indicated that mechanical transplanting can save Rs. 2,500 per acre. Sabirti Nayak, a tribal farmer from Badjod who cultivated a mat nursery and provided transplanting services was able to secure employment continuously for two months and earn Rs. 6,000. She noted that mechanical transplanting and dry mat nursery were good for her health because she could avoid skin disease this season, which she generally suffers after working in wet fields for nursery preparation, uprooting of seedlings and transplanting.

In person: *Farmers experiment in Odisha*

Maguni Srichandan, an early adopter of ZT technology, with his abundant green gram crop

Shankarshan Nanda, whose willingness to diversify has resulted in a bumper maize crop

Intensifying green gram in Puri District

During the 2013–14 Rabi season, CSISA introduced line sowing and zero tillage in green gram in Puri district, which were new technologies to the area. CSISA introduced zero tillage technology because the hub determined that ZT could help farmers take advantage of residual moisture in the soil during planting time. At first, given that zero tillage was an unfamiliar practice, farmers did not have confidence in the technology. However, Maguni Srichandan, who is a smallholder farmer and part-time tractor driver in Talapada village in Kanasa block of Puri, accepted the opportunity afforded by CSISA. With CSISA's help, he implemented both line sowing and zero tillage in his green gram crop, and was able to harvest 0.83 tonnes seed yield of green grain/ha from ZT plots, against 0.58 tonnes/ha from the conventional method of broadcast sowing. He spoke with his fellow farmers in the area about his success, engendering greater confidence among them in the technology. Srichandan has emerged as a champion among the farmers in his community. Now, famers in the area have begun seeking out and adopting zero-tillage technology.

Diversification in Bhadrak District

Shankarshan Nanda is a leading farmer of Chudamani village in Bhadrak district. His household comprises seven members including his wife, two sons and four daughters. He has eight acres of land, of which only four acres is irrigated. During Kharif, floods can wipe out his entire paddy crop, and in Rabi stray animals can destroy his vegetable crop. This four-acre patch has to be fenced off and tended to regularly.

In Rabi 2013–14, Shankarshan was approached jointly by the KVK and CSISA to cultivate maize. The KVK provided seeds and fertilizers, and CSISA provided technical know-how and a tractor drawn seed drill. The maize was intercropped with tomato and capsicum. The lush green crop that now stands in his field gives Shankarshan reason to smile as he expects to harvest a bumper maize crop. While waiting for the maize to mature, he has already earned Rs.25,000 from selling tomatoes and capsicum, significantly more than he earned last year.

In Shankarshan's words, "Mu bohut khushi je mu ehi barsha makka lageili. Makka ru jaha paibi-paibi. Tomato aau capsicum ru 25,000 tanka paisarilini aau ahuri bikiri chalichi. Mu bahut khushi je mu 2 prani ku barsa sara rojgaar deiparuchi." (I am extremely happy that I have taken up maize in my plot. I will get a good amount from maize. I have already received Rs. 25,000 from tomato and capsicum. I am happy that I am able to give employment to 2 people throughout the year.

Haryana Innovation Hub

CSISA Haryana hub continues to disseminate **conservation agriculture** based crop management practices in collaboration with public and private sector partners. These partners include state agricultural universities, state department of agriculture, ICAR's research centers, KVK's, NGOs, private sector companies and farmer cooperatives. CSISA staff showcased and disseminated technologies through the creation and capacity building of service providers, field demonstrations, field days, travelling seminars, videos, and training courses. As a result, awareness and adoption of CA-based crop management practices in rice–wheat cropping systems of Haryana are growing. During the reporting period, the hub promoted **zero-tillage** and **residue management in wheat** and **diversification** through intensification of rice-based cropping systems. The hub also evaluated the performance of the **dry seeded rice** that was promoted by CSISA in 2013. The farmers' cooperatives model has been doing extremely well in disseminating and refining technologies.

Zero-tillage and residue management in wheat: CSISA has made significant contributions towards the large-scale dissemination of ZT wheat in Haryana. With the efforts of SAU, State Department of Agriculture, Farmers' Commission and CSISA, ZT wheat was adopted in about 210,000 ha in 2013–14. Turbo happy seeder technology provides an alternative to rice residue burning by enabling direct drilling of wheat into standing or loose residue of a previous rice crop. During the Rabi 2013–14 season, the Department of Agriculture implemented 260 ha of demonstrations on residue management in wheat through the Turbo Happy Seeder. More than 350 ha have been planted using the Turbo Happy Seeder this year, as compared to 180 ha in 2012–13. CSISA directly contributed towards 125 demonstrations covering 220 ha on residue management in wheat across the hub domain.

Diversification through intensification of rice-based cropping systems: As compared to rice-wheat systems, short duration rice followed by potato followed by spring maize has emerged as a profitable system in potato growing areas of Haryana. The results of CSISA's demonstrations on planting spring maize after potato are very encouraging. With CSISA's efforts, in close collaboration with state department and SAU, the area under spring maize after potato has increased to 10,000ha.

Dry seeded rice (DSR): The area under dry-seeded rice in Haryana has increased from 226 ha in Kharif 2009 to 8,000 ha in Kharif 2012 and to 10,800 ha in Kharif 2013. Based on data from 86 crop cuts in 2013, it was found that DSR provides multiple benefits to farmers compared to conventional puddled transplanted rice. Benefits include a reduction in cultivation costs by US$ 90/ha (Rs. 5,400/ha), higher net income up to US$ 80/ha (Rs. 4,800/ha) with similar grain yields. DSR also provides savings in irrigation water.

Trainings/field days/events: During the reporting period, there were 10 trainings/ travelling seminars/events organized to build the capacity of the stakeholders. These events included 1,471 farmers, 81 extension officers and 87 scientists.

Recognition and awards to CSISA farmers: Multiple farmers associated with the Haryana hub are being honored at different platforms for their significant contribution to CA. Two farmers from farmer cooperatives closely working with CSISA were awarded Rs. 51,000 each from the Chief Minister of Punjab state. One of the above two farmers got Rs. 100,000 for the development of his village by the Chief Minister of Haryana. Five CSISA farmers also received "best farmer" awards from Central Soil Salinity Research Institute during the Rabi Kisan Mela. The work of some of CSISA's farmers on CA technology has been recognized at the national level also.

In Focus: *Transition strategy for Haryana*

As a priority hub in CSISA's Phase I, and a transition hub in CSISA's Phase II, the Haryana Hub will transition its activities to partners by September 30, 2015.

Conservation agriculture practices are being widely adopted in CSISA's Haryana Hub domain

To sustain the progress and gains made by CSISA's Haryana Hub, the following strategies form the basis of its transition strategy:

1. **CSISA research platform as innovation platform**: CSISA's strategic research platform at CSSRI Karnal will continue and will act as an innovation platform for Haryana as well as for eastern India. The RP will continue playing its role in refining technologies like DSR, residue management, weed management and will bridge the key knowledge gaps in improved irrigation system design for direct-seeded systems, scope and implications of diversifying rice with maize, adaptive strategies for terminal heat stress and climate change, cropping system optimization for maximizing yields and water productivity, and crop modelling. The RP will also play an important role in capacity building and technical backstopping for public and private sector partners through trainings and exposure visits, travelling seminars, and field days.
2. **Haryana Agricultural University**: CSISA will work closely with HAU to address emerging researchable issues and to refine potential technologies through the involvement of masters and PhD students. This approach will develop the capacity of young future scientists. A memorandum of agreement will be developed with HAU to sustain the gain achieved during CSISA Phase-I and II.
3. **State department and service providers**: CSISA will assist in capacity building and technical backstopping of state department personnel and service providers to sustain the impact of technologies adopted at scale and to expand other technologies that are picking up (e.g., DSR and turbo happy seeder) at scale. New technologies or crop management practices that emerge from collaborative research will also be shared for promotion in the region.
4. **Other CIMMYT projects**: Activities like the capacity building of public and private sector partners, technical backstopping, and the dissemination of key technologies, in which CSISA has been heavily involved, will also be supported through other projects of CIMMYT (e.g. CCAFS, CIMMYT-CRPs, etc.).

Punjab Innovation Hub

CSISA's Punjab operations have targeted (i) **strategic research** for the sustainable intensification of rice–wheat, cotton–wheat and maize–based systems (emerging and future-oriented crop rotations), (ii) **smart mechanization** options, (iii) **capacity development** for a new generation of researchers, and (iv) **strategic partnerships** for linking CSISA's research outputs to wider audiences. During the reporting period, the key activities undertaken by CSISA in Punjab include, (i) two strategic research trials for improving water and nutrient use efficiency, profitability and soil properties in rice–wheat rotation; (ii) four strategic research trials in maize-based systems focused on improving nutrient and water use efficiency, soil health and farm profitability; and (iii) one on-station and 10 on-farm research trials for the sustainable intensification of the cotton–wheat system.

One of the key achievements is that PAU, Ludhiana and CSISA have jointly recommended a **drip irrigation schedule for spring maize** for saving irrigation water and increasing water productivity. This recommendation has now been included in the package of practices published by PAU Ludhiana for wide-scale adoption by farmers. The **relay planting of wheat in standing cotton** has gained the attention of many farmers in Punjab and will be adopted on a large scale in northwest India, which is a significant achievement by CSISA and PAU. Based on the initial results of CSISA trials, it appears that precisely defining component technologies for water and nutrient management in CA-based rice–wheat and maize–wheat systems is critical not only for sustainable intensification but also for acceptance of CA-based management practices by farmers in the northwest IGP.

Evaluation and refinement of **CA machinery** in collaboration with BISA and other stakeholders is continuing. A large number of local stakeholders (farmers, extension agents, researchers, and service providers) were exposed to new technologies/practices undertaken by CSISA in Punjab to create awareness and accelerate widespread adoption of these technologies. In addition, CSISA research sites were visited by large numbers of international and national research and development leaders. Some of the other strategic research undertaken at the Punjab hub has been analyzed during the reporting period, and key results are listed below:

Crop and water productivity of spring maize–Kharif maize–vegetable peas as influenced by crop residue and irrigation methods under permanent bed planting:

- **Spring maize:** Maize grain yield was nearly similar under farmer practice (FP), alternate furrow irrigated (-45kPa SMP) and drip irrigation (with residue mulch) irrigated at -45 kPa SMP. The irrigation water requirement was however, much lower (1981-2732 m^3/ha) in drip irrigated maize than in FP (5806-6642 m^3/ha) and each furrow irrigation (4448-5701 m^3/ha) treatment. Irrigation water use efficiency was 16.9% and 129.7% higher under each furrow irrigation and drip irrigation method compared with FP.
- **Kharif (summer) maize**: The experiment on summer maize was carried out by MSc student from PAU Ludhiana as a part of his MSc Thesis research and financial support was provided from CSISA. Key results showed that there was no significant effect of crop residue mulch and soil moisture tension based irrigation scheduling on grain yield of summer maize. It was observed that all the summer maize received sufficient amount of rainfall during its growing season, which masked the effect of different treatments on grain yield. Residue mulch on an average reduced irrigation water use by 6 mm only. The water use under drip irrigation ranged from 20-32 mm compared with 113 mm for farmer practice, 65-96 mm for each - furrow flood irrigation and 39-54 mm for alternate furrow irrigation.

Sustainable intensification of cotton–wheat systems through conservation agriculture: Mean seed cotton yield was 73.8% higher on 102 cm wide raised beds compared with FP and 9.9% higher than 67.5 cm wide raised beds. Intercropping of summer mungbean reduced the seed cotton yield by 34.8% compared to the pure cotton crop due to its competition for light with the growing cotton crop. Mungbean yielded 1287 kg grains/ha.

In Focus: *Transition strategy for Punjab*

CSISA's Punjab activities were carried over into Phase II in order to close key knowledge gaps. Punjab will transition its activities to partners by September 30, 2014.

Since its inception in 2009, the Punjab hub has developed, adapted and delivered several technologies, practices, modules, and innovations related to sustainable intensification including residue management, mechanization, and nutrient and water management. The Punjab hub also has focused on capacity development of a range of stakeholders.

The exit strategy of CSISA in Punjab involves the following elements:

- Synthesize the results of key technologies/practices and share these with key stakeholders (PAU, state department of agriculture, PACS, service providers, farmer organizations and farmers) for their uptake
- The key results of collaborative research with PAU will be included in the Package of Practices released by PAU and shared with the State Department of Agriculture for promoting these practices under different government schemes.
- The research on sustainable planting of the cotton–wheat system, undertaken jointly with PAU, will be further continued by PAU through front line demonstrations on relay planting for large scale promotion of relay planting technology. (PAU has also submitted a proposal to the Ministry of Agriculture, Govt of India, to continue this work.)
- The key results of diversification opportunities in rice–wheat rotation (DSR and maize, etc.) will be shared with the State Department of Agriculture through PAU so that these practices can be included in the special scheme on diversification supported by the Government of India.
- The on-going capacity development efforts for PhD students will be continued until the already-engaged students complete their research. Later these results will be replicated further by the respective universities.
- The capacity development and awareness creation efforts related to sustainable intensification, CA, and precision input management will be continued through on-going CIMMYT projects other than CSISA (for example CCAFS, ICAR-CA, BMZ-wheat, WHEAT, etc.) for a continuum of technologies/practices promoted through CSISA's efforts and supporting partners.

Tamil Nadu Innovation Hub

During the reporting period, which covers the Samba and Thaladi seasons, the hub focused on **dry-direct seeded rice using seed drills**, **machine transplanted non-puddled rice**, **laser land levelling** under dry conditions, and **mat nursery** preparation. In areas where, and at times when, labor is scarce in the Cauvery Delta Zone (CDZ), DSR is helping farmers eliminate the labor needed to prepare and maintain nurseries, and to pull, transport, and transplant seedlings. DSR in non-puddled soils also has a relatively low water requirement for crop establishment, which is important in the CDZ, where irrigation water is increasingly limited.

By providing technical and business development services support, the hub supported twelve local farmers to purchase seed drills and become local **service providers**. These farmers then provided custom hiring DSR services in nearby farmers' fields. Service providers associated with CSISA have sold tray and mat nursery for 1,100 acres of machine-transplanted rice in the Cauvery Delta Zone. The state agriculture engineering department also purchased 30 seed drills and is planning to procure more in order to promote DSR. The state government has communicated to the district agriculture officials that **DSR** must be rolled out on at least 20% of the total cropped area in the CDZ region, announced a 50% subsidy on seed drills, and announced various input incentives for adopting DSR. CSISA also collaborated with the state government to develop a video on DSR and has uploaded it onto the TNAU Agritech Web Portal for wider dissemination: http://agritech.tnau.ac.in/direct_seedling/directseedling_ta.html.

During the reporting period, CSISA's demonstrations and areas covered by service providers reached 194 villages. Major rice varieties that performed well under DSR were CR1009, BPT 5204, ADT 49, ADT 38, ADT 39, ADT 46. Demonstration results shows that under DSR, ADT 49, CR 1009, and BPT 5204 had 8% higher grain yields when compared to farmers' conventional practices.

During the Thaladi season, strong, early monsoonal rains can undermine the establishment of a DSR crop, making MTNPR a more attractive option. **MTNPR** also eliminates the water requirement and land preparation costs for puddling. CSISA carried out 50 acres of demonstrations during the 2013 Thaladi season in Thanjavur district. Results showed that MTNPR saves about INR 7,500 per hectare. CSISA identified 48 rice transplanter owners in the area and provided them technical backstopping to support them becoming service providers.

The hub established 40 **Nutrient Manager for Rice** evaluation trials during the Samba season and 40 during the Thaladi season to help close knowledge gaps regarding the soil supplying capacity, benefits of added K fertilizer, as well as K inputs through irrigation. The hub also provided assistance for conducting a water management experiment at Soorakkottai, Thanjavur, and conducted on-farm experiments looking at different rice establishment methods in head and tail end areas in the lighter-textured soil of the New Delta. Diversification and intensification of production technologies—inclusion of pulses in the current rice-based cropping systems—in the project areas are targeted wherever feasible and acceptable to farmers. Therefore, farmer participatory trials are been conducted based on the layering of components of CA technologies.

CSISA works with a variety of **partners** in Tamil Nadu, including Tamil Nadu Agriculture University; Department of Agriculture Thiruvarur; Tamil Nadu Rice Research Institute in Aduthurai; KVK Sikkal and Needamangalam; the Soil and Water Management Research Institute, Thanjavur; MSSRF Thiruvaiyar; Thanjai Jana Sewa Bhavan Thanjavur; and SASTRA University in Vallam. Need-based interventions like DSR, LLL, MTNPR, farmer's participatory trial of proven technologies, demonstrations of new machines and techniques were conducted with all of the above-mentioned stakeholders.

In Focus: *Transition strategy for Tamil Nadu*

CSISA's activities in Tamil Nadu's will be transition to partners by September 30, 2015.

The following activities form the basis of CSISA's transition strategy in Tamil Nadu:

- Intensify technical assistance given to the state DOA, service providers, and the expanding network of project partners.
- Provide training to state DOA extension workers on dry seeded rice, non-puddled machine transplanted rice, and Nutrient / Crop Manager for Rice.
- Increase field days during crop establishment and harvest times, as well as exposure visits to CSISA field sites by scientists, extension workers, students and farmers from different areas of the Cauvery Delta.

These activities will be complemented by strategic tie-ups:

TEGRA: Support the expansion of the TEGRA model through joint field days aimed at the integration and promotion of a video on non-puddled land preparation, which Syngenta can distribute to its farmers when they sign up for the TEGRA services.

MSSRF: Include junior MSSRF staff in IRRI's "Rice: Research to Production" course; integrate technical staff and junior management staff into CSISA hub until the end of the project; assist in the development of modules and materials for "Farmer Schools" in areas of crop management including water, soil, nutrients, pests and diseases; and develop content on CSISA technologies for MSSRF's Text Messaging Information system for farmers.

Reliance Foundation: Support the Foundation to disseminate information about dry-seeded rice and non-puddled crop establishment through their agricultural TV channel and text messaging service.

Tamil Nadu Agricultural University: Develop modules and provide initial hands-on and classroom training dry-seeded rice for Tamil Nadu Agricultural University's eight diploma courses (2-year duration). Work with the university to have non-puddled mechanical transplanting endorsed at the end of the project. Develop modules on non-puddled mechanical transplanting and dry-seeded rice for Tamil Nadu Rice Research Institute's weekend course (for 2 year duration) for farmers.

Tamil Nadu government: Provide assistance in capacity building through "Training of Trainers," technical backstopping and suitable technical content in order to expand CSISA technologies beyond the current three districts.

Bangladesh

CSISA-Bangladesh

The Cereal Systems Initiative for South Asia in Bangladesh project (CSISA-BD) is implemented through a partnership between 3 CGIAR centers, IRRI, CIMMYT and WorldFish. CSISA-BD is funded by USAID's Feed the Future (FtF) initiative, and aims to test and disseminate new cereal system-based technologies that will raise family incomes for 60,000 farming families. It is anticipated that a further 300,000 farmers will adopt new technology through participation in field days and farmer to farmer information and technology transfer. CSISA-BD has, to date, trained 101,903 farmers and in this 6 month reporting period trained 18,364 farmers and conducted 7,754 trials and demonstrations.

As a general rule in CSISA-BD, IRRI is responsible for implementing activities related to rice production, CIMMYT to wheat and maize production and WorldFish to aquaculture and pond bank vegetable production.

During this reporting period the scale out of a number of proven technology packages to a significant number of farmers has been achieved. These have included:

- 3,545 new maize farmers. The biggest successes have occurred on sandy soil riverine islands (Chars) where wheat and maize adoption has been rapid.
- 270 farmers adopting maize / vegetable (garden pea, green bean, amaranthus) intercropping systems.
- 2,825 farmers adopting high value aromatic rice varieties
- 3,892 farmers adopting the cultivation of oil seed mustard between monsoon season rice (Aman season) and winter season rice (Boro season) bringing the total number of farmers who have adopted this system to 9,874.
- 759 farmers growing sunflower after Aman season rice on saline soils using dibble planting into rice stubble.
- 7,308 farmers buy planting and irrigation services form Local Service Providers. Much of these services would have been for planting maize and wheat using power tiller operated seeders for strip till planting and bed planting following conservation agriculture principles.
- 1,254 farmers trained and adopt improved aquaculture production technology

Aquaculture programs, run by WorldFish, continue to train farmers in fish and shrimp production. CSISA's technology adoption survey showed that fish farmers trained by CSISA-BD passed what they learned onto 3.59 other farmers. This very impressive number perhaps reflects the quality of training given by aquaculture staff and their emphasis on farmer mentoring, refresher training and provision of fish production guides to all farmers who receive training in fish farming.

The aquaculture teams continue to instigate innovative, practical and focused research. Trials have started to find the best way of managing the many ponds that are classed as challenged. These are often shaded by valuable fruit and timber trees or may only have water for part of the year. The trials are designed and managed by farmers including the collection of data. Results from this trial will be available during the next 6 month reporting period but have already shown that important research can be done by farmers and that this could be an approached followed by other organizations wanting to conduct on-farm, farmer participatory research.

This reporting period has seen the completion of the Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh (SRSPD) project (project to distribute seed of new varieties of rice with special emphasis on stress tolerant varieties) and the start of field activities of the CSISA-MI

project. The SRSPD project began in October 2011 and, after two no cost extensions, was completed in December 2013. The project distributed seed packs of new rice varieties to just under one million farmers, established a network of seed growers working through two SW Bangladesh based associations and resulted in 9% of rice growing farmers in southwest Bangladesh growing the varieties distributed by the project.

Following the successful establishment of a flatbed grain dryer near Jessore, a project in collaboration with the newly established USAID funded Post Harvest Innovation Lab, began testing the use of the drier for drying parboiled rice. Two batches were dried in March during a field day attended by 15 owners of rice parboiling and milling companies. The millers were impressed by the results and 8 expressed an interest in building their own driers. The project will develop the capacity of local companies to build driers and will begin testing the drier to dry maize and other crops.

The project provides women with support through training in crop production and post-harvest technology and through participation in field day events. Aquaculture and the related vegetable production programs attract the greatest participation from women. The project has now begun to consider developing the business capacity of women. In November a workshop funded in partnership with UN Women was held in Khulna for women who have already initiated micro and small businesses. Many of these businesses were related to seed production, particularly of rice, fish farming and handicraft production. The workshop had two objectives: to identify constraints faced by women in establishing and expanding a business and to link women managed businesses in SW Bangladesh with supermarket chains, food processors and women enterprise associations.

Another approach to the development of women entrepreneurship has been the initiation of a program to test the concept of "InfoLadies". In this program women are provided with bank loans to buy laptops and internet connections. They use these to sell web based services to rural communities such as applications for passports, school exam results, Skype connection to relatives working outside Bangladesh. In the context of the CSISA-BD project the aim is to determine if InfoLadies can also sell agricultural information services to farmers such as fertilizer recommendations generated from the Rice Crop Manager web site, crop production technology through viewing on line videos and links to buyers. Using funds from the IRRI GRISP program and CSISA-BD staff 9 InfoLadies are to be trained by two local NGOs, Pride from Jessore and Dnet from Dhaka.

In December 2013 the project implemented, through a local firm of consultants, a "Technology Adoption Survey". The key question posed by the survey is what percentage of farmers continue to use technology a year after they first adopted it and how many passed this technology onto other farmers. A follow up survey will ask those farmers who learned about a new technology from a CSISA-BD farmer what technology they adopted and if they will continue to use the technology. Preliminary results indicate the continued adoption of key CSISA-BD technologies and that scale-out to other farmers was between one to 1.52 farmers for rice technology, 1.95 for maize technology and 3.59 for aquaculture technology.

As a result of nationwide strikes (Hartals) the project lost 41 working days out of a potential 88 working days in the 4 months from October 2013 to January 2014. Despite this and due to the innovative use of public and private transport by project staff most trial and demonstration targets were met. However, the ability of the project to train staff, supervise activities and conduct large events such as field days and exchange visits was severely compromised by the Hartals.

The project had the pleasure of hosting two visits by the US Ambassador, Dan Mozena, during the reporting period. One was to Sutarkhali in October 2013 (see USAID Frontline article www.usaid.gov/news-information/frontlines/extreme-poverty/weathering-storm-rice-lifts-bangladesh-village-saltwater) and the second to two sites in Barisal District during the Ambassador's visit to FtF projects in Barisal Division in February 2014.

CSISA-Mechanization and Irrigation (CSISA-MI)

The Cereal Systems Initiative for South Asia - Mechanization and Irrigation (CSISA-MI) project is a new CIMMYT-led initiative operational in southwestern Bangladesh. CSISA-MI is funded by the USAID Mission in Bangladesh under President Obama's Feed the Future (FtF) initiative. In CSISA-MI, CIMMYT partners strongly with International Development Enterprises (iDE) and works to transform agriculture in Bangladesh's FtF 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. As an initiative of the wider CSISA Program in Bangladesh (CSISA-BD), CSISA-MI started in July of 2013.

The core of CSISA-MI is local service provision: CSISA-MI is an applied research-for-development program that focuses on building public-private partnerships and science-based technology targeting to boost agricultural productivity in the FtF zone. Using science to guide the geographic scope of our interventions, and to assure the right agricultural machineries are used in the right environments to optimally boost productivity, CSISA-MI also address the key components of the machinery supply chain, and leverages private sector investment to commercialize efficient and resource-conserving technologies that enable farmers to cultivate successful dry season crops using better-bet agronomy. To assure sustained delivery, CSISA-MI concentrates on strengthening the enterprises of Local Service Providers (LSPs) who purchase agricultural machineries and provide services to farmers at scale using fee-for-services models.

Above: A local service provider (LSP) demonstrates use of a self-propelled multi-crop reaper that reduces labor bottlenecks during harvest time. CSISA-MI partners with ACI to commercialize reapers in the FtF zone.

CSISA-MI supported technologies: To drive more precise and resource conserving agriculture through precision equipment, CSISA-MI currently promotes these keystone technologies – the fuel saving Axial Flow Pump (AFP) for surface water irrigation, and bed planters and seeder-fertilizer drills that can be used for line-sowing and conservation agriculture. Bed planters help to save farmers on irrigation water volume and cost, while reapers address labor bottlenecks at harvest and speed up the time between harvest and the planting of the next crop. These machineries help boost yields by maximizing the productive use of soil moisture, fertilizer, and seed, while saving farmers' time, labor, and money. Through public-private partnerships with machinery manufacturers and importers such as ACI and RFL Group, CSISA-MI is working to commercialize and catalyze the wide-availability of these machines the FtF zone.

Above: A local service provider with his newly purchased axial flow pump.

Applied research for real-world impact: Science-based interventions form the core of CSISA-MI's work. Within the project, CIMMYT scientists are leading on applied research to develop appropriate irrigation and nitrogen regimes for maize grown in the FtF region. Further research uses remote sensing and GIS to identify the appropriate environments and soils on which bed planters can be used, and where AFPs can be employed to bring dry season fallow and poorly productive land into intensified cropping. These efforts are combined with applied econometric analyses to identify the factors that influence LSP's investment in agricultural machinery, and to uncover the predominant

structure of irrigation water pricing in southern Bangladesh to develop improved business models to facilitate affordable surface water irrigation. Additional research considers the trade-offs between crop residue use for livestock vs. conservation agriculture, and in partnership with Wageningen University, CSISA-MI is supporting one PhD and one MS student using advanced crop and farming systems design models to propose solutions to these pressing issues.

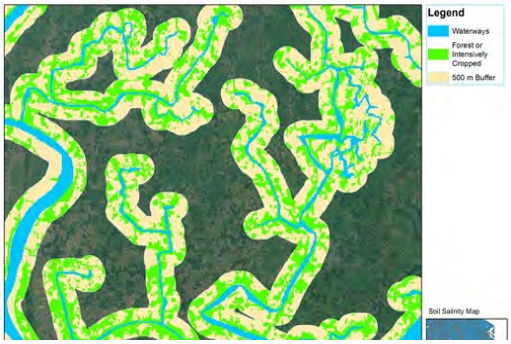
Progress during October 2013–March 2014: As a result of the project's interventions, a total of 2,578 were brought under these technologies, 1,747 ha of which were irrigated with AFPs. 611 ha were planted with bed planters and seeder-fertilizer drills, and 220 ha were harvested using the reapers. 7,308 farmers worked with LSPs to make use of this machinery on their land. An additional 5,473 farmers received short-term practical training on agricultural machinery and conservation agriculture, while 224 entrepreneurs received business development services training. CSISA-MI's private sector partners ACI and RFL also co-invested in machinery commercialization, with a value totaling $613,728. Out of this investment, which when compared to CSISA-MI's investment in these companies, resulted in more than a 3:1 co-investment value. This demonstrates the importance of the machinery commercialization market, and distinguishes CSISA-MI as a project that is able to leverage considerable private sector investment to foster sustainable intensification in Bangladesh.

Facilitating access to finance: The machinery supported by CSISA-MI differs from regular agricultural inputs because they are capital cost intensive. To provide access to finance, CSISA-MI recently signed an MoU with Jagorani Chakra Foundation, an NGO partner to ensure that LSPs' can have easy access to micro-loans for the purchase of reapers. CSISA-MI is working to provide broader access to credit for LSPs to purchase additional machineries.

In Focus: *Geospatial analysis for technology targeting*

Official statistics on crop land coverage, crop production, and yield generally lack detailed spatial information. However, proximity of farmland to water ways, roads, or other infrastructure is an important decision factor for technology targeting, especially where irrigation is concerned.

In South Asia, most of the wheat and maize are grown under irrigation in the dry season. Hence, production of these two crops can be analyzed with optical remote sensing data, while radar would be more suitable for monitoring rice crops during monsoon. Similarly, spatial tools can be used to improve the targeting of particular agronomic practices for the right soils and landscapes.



Land classified as highly suitable for sustainable intensification is shown in yellow. It meets the following criteria: It is currently used as crop land and is close to a perennial waterway. Moreover, it has a maximum EVI below 0.35 during the winter months.

CSISA has been using remote sensing to quantify the following information products and layers:

Actual yield estimates for yield gap analyses: With the aid of yield data from farmer's fields and a high resolution satellite image acquired during the tasseling period of maize, it was possible to generate a map of actual yield of farmers' fields for an area of more than 500 km2 in Bangladesh. Potential yield was estimated with a crop simulation model. Knowledge of the size of the yield gap, i.e., the difference between potential and actual yield, can be used for subsequent yield gap remediation analysis.

Identification of water ways and presence of water in the winter months: In southern Bangladesh, meandering waterways tend to change their paths. Historical maps are therefore of limited accuracy. We identified major water ways with Landsat images acquired at the end of the rainy season. In addition, we were able to determine if and by when water ways run dry on a monthly basis during the winter of 2014.

Identification of cropland: In order to determine locations best suited for the deployment of fuel efficient axial flow pumps, we developed an inventory of crop land using a segmentation approach with subsequent supervised classification.

Identification of cropping intensity. In some regions, farmers are using ground water for irrigation, while in other ones, farmers leave their land fallow or plant a low input legume crop. Based on remote sensing derived ground cover estimates, we were able to determine cropping intensity.

For CSISA-MI, we used knowledge on the proximity of fallow or low intensity crop land to water ways which carry water throughout the month of February to identify the most promising regions for the deployment of the axial flow pumps. In addition, we excluded some areas with high levels of surface water or soil salinity.

Finally, additional work is ongoing through CSISA-MI to assess the landscapes and soils that are best suited to the use of resource-conserving machinery, most specifically bed planters, which can be used to save irrigation water while improving crop productivity.

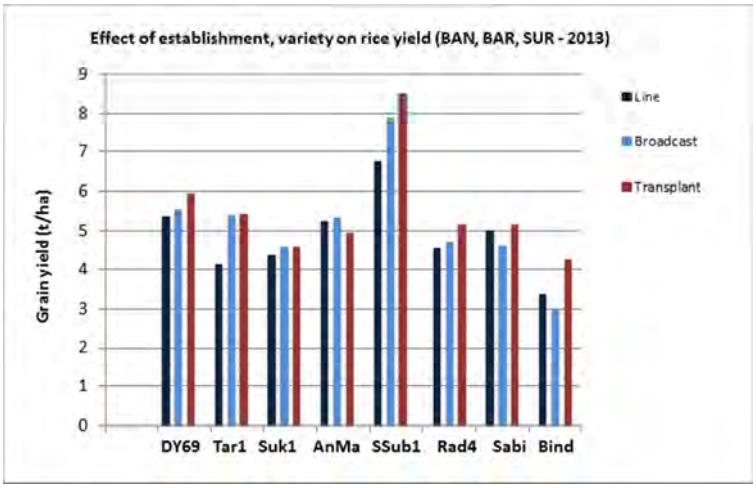
Nepal

CSISA-Nepal

CSISA in Nepal (CSISA-NP) receives funding support from the USAID-Nepal mission with a co-investment from USAID-Washington. Unlike the broader mandate for CSISA's programs in Bangladesh and in India, the focus in Nepal is primarily on participatory technology development and verification, inclusive of insights into business and market development for machinery and seeds. Disseminating technologies first vetted by CSISA is the responsibility of the Winrock-led KISAN initiative, which is the largest Feed the Future project supported by USAID in Nepal. KISAN and CSISA work in close partnership, and this arrangement provides an alternative model for scaling based on activity integration between a CG institute and development partner.

Program highlights during the reporting period include:

Rice genotypes and crops establishment methods: out with the old, in with the new? Field trials in the Terai (Banke, Bardiya) and mid-hills river valley (Surkhet) evaluated newly released varieties and and one hybrid against commonly planted 'old' rice varieties that were released years or decades earlier. Improved rice varieties included: Tarahara-1, Hardinath-2, Sukha Dhan-1 and -3, Anmol Mansuli, and Swarna Sub-1 (for low-lying, flood-prone areas with heavier soils in Bardiya). The hybrid used was the relatively short-duration, high yielding DY69. Farmer varieties varied depending on location, but include: Radha 4, Sarju-52, Bindeshwari, and Sabitri). Planting methods (i.e. dry broadcast, dry directing sowing in lines, and conventional transplanting – 'TPR') were also evaluated to assess crop performance and farmer preferences for labor and cost saving technologies. Across the evaluation sites, our data suggests consistent advantages of around 1 t ha^{-1} for adoption of new varieties of similar maturity class if farmers are growing Bineshwari ('Bind'), but little advantage otherwise. Large gains in yield potential are possible with hybrids and also longer duration material like Swarna-Sub1, but farmer acceptance appears to be mixed due to quality considerations with hybrid grain and the long duration of Swarna that may delay winter planting.



In general, yields were similar across planting methods for each rice variety. Surprisingly, broadcasting performance equal or slightly better than line sowing. Both dry establishment methods significantly reduce production costs for labor, diesel, and machinery. With yields on par with transplanting, cost savings potentially make these novel establishment methods very attractive options for the relatively impoverished western regions of the country where CSISA works.

Maize hybrids for the hills? Farmers in the rainfed hill regions of Nepal typically grow maize for household consumption as well as for livestock feed. Despite the importance of maize to food

security and livelihoods in the hills of Nepal, very few farmers are growing hybrids and the relative performance of different hybrids under varying levels of management intensity have not been well-characterized, particularly in western Nepal. Trials were conducted in Surkhet (1300+ masl), Achham (600 masl) and Dadeldhura (1300+ masl) to determine the effect of variety and management intensity. Hybrids and varieties evaluated against the 'local' farmer check at each site included the hybrids Dekalb Double and Kanchan and the improved open-pollinated varieties Deuti and Arun-2.

Dekalb Double had the highest yield, producing over 6 t/ha under good management. Deuti was relatively high yielding (5.5 t/ha), but also had the longest duration by 20 days, making it a poorer fit for double-cropping systems. The farmer checks in both locations were short duration, white grain varieties, with yield of 2–4 t/ha. All varieties yielded more at the recommended fertilizer (120:60:60 NPK) than at the 'average' farmer level of fertilizer use (i.e. 28:16:0 NPK for Surkhet; 0 NPK for Dadeldhura and Achham). Based on our data, the prevailing view that maize hybrids are ill suited for rainfed hills ecologies where low or no input use is common is a misconception.

Reducing risk to promote lentil intensification Demand for lentil across South Asia is strong, and farmers stand to gain by efficiently producing more for home consumption and for market. Nevertheless, farmers in Nepal typically manage lentil as a 'takings' crop with almost no investment in inputs or management. CSISA is working to close key knowledge gaps in order to define better-bet agronomic practices for lentil with interventions such as relay planting and balanced fertilization. Just as crucially, we are evaluating adaptation strategies such as bed planting that may reduce the risk of disease and stand mortality when winter rains occur at sensitive growth periods (e.g. 2012–13).

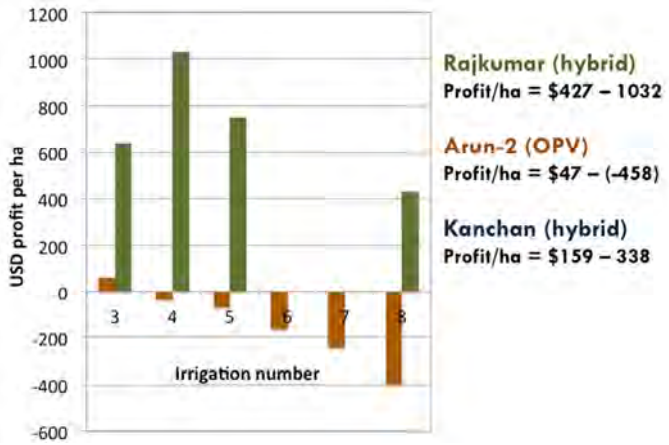
Credit for innovation and inclusive growth

Dr. Sumitra Gurung recently established one of the first for-profit banks in Nepal providing rural women micro- and meso-credit. The bank is headquartered in Chitlang, Makwanpur, with one of the five branches located in Rolpa district in the mid-west. Dr. Gurung approached CSISA-NP to explore the possibility of demonstrating and training hill women to enable them to effectively own and operate small machinery. With logistics help from the project, the bank provided a 4 HP mini tiller to Mr. and Mrs. Saligram Adhikari of Chitlang in October 2013. This was the first mini-tiller in this small valley, reachable only by long and difficult roads from Kathmandu. Both husband (67 years) and wife (58 years) have used the mini-tiller to prepare just under one hectare of their land for vegetables and wheat, showing that not only are women capable of using such machinery but older women and men too. Based on their experience, two other Chitlang valley farmers have bought mini-tillers. A catalog of small farm agro-machinery tools and equipment especially suitable for Nepali women entrepreneurs is being prepared that contains a list of women-friendly machinery, its description and use, and business model guidance.

In Focus: *Funds from fallows with maize triple cropping*

In the western Terai plain of Nepal, farmers typically grow no more than two crops per year and there is a spring fallow period in-between winter crop harvesting and rice planting that remains fallow. This fallow period is particularly long in areas where potato is cultivated. Where there is irrigation water and timely harvest of the winter crop takes place, maize can be grown and marketed either as 'green cob' for fresh market or, in cases, grown to maturity to produce dry grain. Since no crops are displaced when transitioning from double to triple cropping systems, the income generated by this third season is purely profit.

Nevertheless, cropping in this period is uncommon and better-bet management recommendations for promising crops like maize are lacking. Starting in 2013, CSISA-NP initiated a series of participatory research trials in farmer's fields to determine optimum management practices for maize in order to encourage triple cropping and to generate income.



On-farm trials demonstrate that spring maize can be immensely remunerative, with returns exceeding $1,000 /ha. Nevertheless, profitability is highly dependent on irrigation investments and farmers can incur losses with excess application of irrigation water. Returns are also highly dependent on the selection of the right cultivar, with maximum profits declining to less than $50/ha with open-pollinated varieties.

In addition to sound agronomic advice, expansion of spring maize area in the Nepali Terai will be bolstered by closer linkages between maize processing mills and small famers as well as the introduction of labor saving technologies such as maize shellers to reduce drudgery. CSISA is working with the KISAN project to commercialize small-scale machinery and to improve linkages between farmers and markets.

Cross-cutting Objective 1 Themes

A. Livestock

The livestock component of CSISA aims to increase the productivity of dairy production, mainly through improvements in residue-based feeding regimes. The approaches taken and the improvements identified and promoted vary amongst ILRI's four sites. However, in all four sites important lessons have been learned and progress has been made in regards to achieving sustainable impact at scale.

Bihar

In Bihar, our focus has been on capacity and business development regarding **dairy nutrition and feeding**, with a special emphasis on supplementing residue-based diets with improved concentrates. The trial and training activities have been extended to further blocks within Samastipur district and into Muzzafapur district, reaching 540 for trainings and 240 with trials. To assess the impact of previous activities an impact assessment study has been initiated; data has been collected and is currently being analyzed. Initial results indicate that general single-session trainings without further involvement show only limited effects. On the other hand, more intensive trainings with subsequent follow-ups have shown to lead to changes with individual farmers. These have started producing improved concentrates with their own resources and some of them are also supplying neighbors. The efforts to support self-help groups in establishing mini feed mills to supply a larger number of households with improved concentrates are still ongoing. Progress has been slowed by the difficulties in establishing how much financial support these groups would require and how far such support would jeopardize the sustainability of such a business model.

Odisha

In Odisha our initial emphasis was on establishing an appropriate and effective group of institutions with an interest in implementing dairy development activities. The institutions with the greatest interest were Orissa State Co-operative Milk Producers' Federation (OmFed), Lutheran World Service India Trust (LWSIT) and the Odisha University of Agriculture and Technology (OUAT). Together, they have initiated pilot trials in Puri district to establish an approach to introducing **feeding innovations** to small-scale rural producers. OmFed provides the entry points to villages through their primary milk collection co-operatives while LWSIT has the capacity for community mobilization. OUAT is supporting the process by ensuring accurate documentation and providing the technical knowledge on dairy nutrition and feeding. During these pilot trials 100 farmers experimented with chopping their rice straw before feeding–a technology hardly found in Odisha–and with the supplementation of mineral mixture. Chopping more than doubled milk yields, albeit at very low levels, and saved straw by reducing the amount pulled onto the ground by animals. Providing mineral mixture had a similar effect on milk yields. Currently, efforts are underway to make fodder choppers and mineral mixture more widely available by involving the private sector and government development programmes.

Bangladesh

In Bangladesh CSISA's livestock activities have been strongly integrated into the hub programs. Starting with the Rangpur hub, where most of the livestock activities had already been concentrated, **trainings and other capacity development events** have been coordinated in villages targeted by the hub. Similarly, the development of local service providers, providing residue chopping services to poor dairy producers, as well the farmer experiments with underutilized crop residues (mainly maize and wheat) are supported by the hub, for instance through establishing links between service providers and machine manufacturers. Following the CSISA evolution towards a focus on southwest

Bangladesh livestock activities are being developed in Khulna and Jessore hubs. Both major topics, chopping and residue diversification are also pursued here. In addition, molasses blocks have been identified as effective supplements to rice straw-based dairy rations and have been introduced to hub target farmers.

Nepal

In Nepal, field activities in the new CSISA action site for livestock activities, Kailali district, are now well established. Field staff have initiated dairy development activities with 700 farmers in 27 groups within five Village Development Committees of the district through the mobilization of existing and the initiation of new producer groups. A focus has been on the training on and demonstration of alternative feeds (fodder crops, concentrates, mineral mixtures) and chopping. However, critical management and health issues are also covered (e.g., shed improvement, deworming, vaccination). In contrast to Chitwan, where CSISA's activities were located in phase I of the program, milk marketing institutions are not very developed in Kailali. However, efforts are underway to establish dairy co-operatives. Because of the strong tradition of self-organization in Nepal, changes and innovations appear to be far easier to experiment with than in other CSISA action areas. Thus, although livestock is not a major development focus in Nepal, within the CSISA program, Nepal provides a very good opportunity to experiment with a wide variety of innovations in order to promote successful options on a wider scale.

Genetic improvement of rice and maize in view of fodder quality

The ILRI feed group in Hyderabad has investigated both widely grown varieties (30 rice varieties) and hybrids (106 maize hybrids) and advanced breeding cultivars (81 rice cultivars, 48 advanced maize pipeline hybrids) in regard to their nutritional quality traits of residue and their relationship to grains yield. The results of the widely grown varieties and hybrids will provide a basis for an initial assessment emerging cultivars and pipeline hybrids. Also, the most promising varieties, cultivars and hybrids of both rice and maize have been selected for cultivation at CSISA hubs during Kharif 2014 to and CSISA has been able to compare their performance alongside other promising material within the respective production environments. In Odisha, straw from seven popular rice varieties has been analyzed in preparation for livestock productivity trials which will provide important localized data on the comparative impact of genetically determined nutritional quality variation in residue feed.

Concentrate quality investigation

Concentrate feed samples from the Bihar and Odisha hubs have been analyzed in order to support the work on improving feeding systems through the development of concentrate production and dissemination models. The results from Bihar show a great variability in nutrient contents which will have to be further investigated.

B. Business models and the dynamics of technology adoption

In Bihar, two interlinked studies were conducted that focus on **zero-tillage service provision as a business opportunity** (N = 270) and on **ZT adoption patterns and welfare impacts** (N = 1,000). The objectives of the two studies are to (1) assess the economic viability of ZT service enterprises and constraints to further business expansion; and (2) assess farmers'/service providers' resource endowment, risk exposure, and risk preferences as they condition willingness and ability to innovate. Results are being used to identify the factors that influence the emergence and expansion of ZT service provision entrepreneurs and, on the technology demand side, what factors compel ZT adoption.

At the same time the data are being used to characterize different audiences relevant to CSISA to enhance the targeting efficiency of awareness raising and training interventions. While data analysis

is still in progress, results show a **clear upward gradient with respect to farm size, wealth, and education between (i) farmers who are not aware of the ZT technology, (ii) farmers who are aware of ZT, but choose not to use it, (iii) ZT users, and (iv) ZT service providers**. For instance, 55% of farmers who are unaware of ZT belong to the poorest tercile of the sample households, and only 9% belong to the wealthiest tercile. Among ZT users, 28% each are part of the poorest and wealthiest terciles, whereas 93% of ZT service providers belong to the wealthiest tercile and none to the poorest.

ZT adoption rates for wheat vary widely between the surveyed districts and also between villages within districts. However, **two out of three sampled farmers who are aware of the technology chose to use it, and the majority of them rapidly expanded the practice to 100% of their wheat area**. Hence, **lacking awareness of ZT is likely to be a major inhibiting factor to the adoption of the practice**. The study found that respondents largely depend on fellow farmers as information source for new agricultural practices, and that their individual information networks tend to be confined to their own social stratum. Consistent with the socioeconomic gradient described above, results further show that the probability of having a ZT user among one's information network is significantly higher for wealthier than for poorer farmers. Hence, **CSISA will target ZT awareness raising interventions especially at poorer farmers**, who are currently less aware of the practice and less likely to learn about it via their personal information networks.

The **ZT service providers** surveyed are generally larger farmers who have taken up service provision as a side business since 2010 or later. The study found that there is a felt need among the service providers for more technical training on how to properly operate the ZT drill. CSISA is currently developing respective training materials and works on identifying suitable partners for training larger numbers of service providers. **With an average increase of 14.4 clients** (median 10) **and 111.6 acres serviced** (median 35)**, ZT service providers expanded their businesses considerably from 2011 to 2012** to an average total of 19.8 clients (median 15) and 137.2 acres serviced (median 50). Hereby, **farmers' engagement in providing ZT services is inversely related to the productivity of their own farm operations**: whereas service providers in the lowest productivity tercile expanded their ZT business by 252 acres between 2011 and 2012 on the average (median 60), the increase was only 41 acres for service providers in the middle and highest productivity terciles (median 32.5 and 30, respectively). Since there is a strong positive association between agricultural productivity, i.e., returns per acre, and household income, it is the relatively poorer service providers who appear to be most interested in expanding their ZT business. This is plausible as comparatively low returns from agriculture make the engagement in service provision as additional income source more attractive. Similar to the targeting of awareness raising activities elaborated above, **CSISA will use this information for an efficient targeting of potential service providers and business development training interventions** to those strata that are most likely to engage in the provision of ZT and other mechanized services at a sizeable scale.

Apart from ZT related information, the survey captured the adoption of other agricultural technologies, such as improved seed varieties and post-harvest and marketing practices. Across the whole sample of 1,000 randomly selected farm households located in six districts, merely 38% and 31% have ever switched the **wheat and rice varieties** they use. Only five wheat varieties and four rice varieties are grown by at least 10% of respondents, whereby **the use of varieties that were released several decades ago is still commonplace**; some districts are dominated by only one or two (outdated) varieties. Although approx. 85% of respondents reported to have purchased fresh wheat and rice seed both in 2011 and 2012, 70% of respondents indicate that it was fellow farmers who informed them about the variety they are currently using. In conclusion, **CSISA plans to conduct training activities to enhance seed dealers' advisory skills on varietal replacement**. At a higher level, **CSISA will bring together major seed system players at a 'Seed Summit' on May 14-15, 2014, in Patna, Bihar,** to identify actionable solutions that will help in improving the delivery of improved rice and wheat varieties to farmers.

C. Post-harvest Technologies and Business Development Services

CSISA's postharvest component aims to create awareness of improved postharvest options, establish local stakeholder partnerships, and follow a business ecosystem approach to adoption and delivery. An initial postharvest field assessment with local partners helped identify and define entry points for planning and learning activities for the Kharif season.

In Bihar and Odisha, CSISA engaged with ICAR RCER, state agriculture universities (RAU, BAU, OUAT), Department of Agriculture district heads and field staff in Odisha (Puri, Bhadrak and Mayurbhanj districts) and Bihar (Bhojpur district) to generate awareness on postharvest issues and options. Postharvest options were also showcased at DoA sponsored agriculture fairs.

Many farmers lack awareness about postharvest technologies and alternatives to labor-intensive manual practices (which are often done by women). Therefore, CSISA is working with NGOs and government extension agencies to introduce mechanization options such as portable diesel-powered open drum threshers. This technology reduces drudgery and losses (compared to manual threshing) and provides village service providers with income earning opportunities in the form of contract services. In partnership with Durga Engineering (a medium-sized farm implement manufacturer in Bihar), CSISA facilitated five NGOs in Bihar and Odisha to test and adapt a variety of mechanical threshing options. Presently, a few community-based organizations such as farmers' federations and farmers' associations are providing threshing services, who are paying for the services.

In Bhojpur and Patna districts of Bihar, some better-off farmers use combine harvesters, which leave residual straw standing in the field (unusable for fodder), which is then burnt in the field. Marginal farmers, on the other hand, usually harvest and thresh manually to get full-length straw for fodder. Manual threshing involves significant drudgery, creates bottlenecks for planting the next crop, and generates losses from delayed processing. Although conventional tractor PTO (power take-off) axial flow threshers are available in some areas, farmers tend to reject them because they chop straw into pieces that are too small to hold and chop. To address this issue, CSISA partnered with Kushwaha Engineering (a large farm implement manufacturer in Bihar) to modify and field test threshers with a select group of service providers. The response has been overwhelming, with farmers obtaining full length soft straw and receiving Rs.600/hour for their threshing services. From January to March, over 180 farmers in 13 villages have received threshing services, netting the service provider a profit of approx. Rs. 110,000 (~USD $1,833; i.e. 60% return).

CSISA has also demonstrated a variety of improved storage options, including painted pots and hermetic storage mechanisms such as IRRI Superbags and Cocoons. As a result of CSISA's collaboration, Catholic Relief Services is testing painted pots in Odisha, and IRRI Superbags have been trialed for lentils by ICAR RCER Patna (findings show an increase of 5% in seed germination) and for paddy (by Catholic Relief Services, PRADAN, PRAN and GDS). ICAR has now submitted orders for additional Superbags for storing Kharif paddy. A few NGOs have similarly followed suit and procured Superbags for seed storage. Cocoons are currently being piloted for wheat seed storage with VASFA (a Vaishali, Bihar based NGO) involved in seed multiplication. All interested partners have been linked with Pest Control of India (the India distributor for Grainpro Inc.) for the purchase of Superbags. PCI has also supported CSISA training and strategic marketing efforts.

CSISA has built the capabilities of partners (at the policy and field levels) through several field trainings, demonstrations, handholding sessions and sharing of technical material (print and video). For wider scale dissemination, a collection of fact sheets on options have been translated into Odiya. CSISA's Business Development Services (BDS) team has been developing BDS training modules to support the adoption and scaling out of technologies among CSISA's growing ranks of service providers, particularly in Bihar, and more recently in Odisha. Three modules are under development: 1) selecting, matching and costing the use of farm equipment; 2) laser land leveling; and 3) axial-flow threshing. These modules will be shared with training institutions for adapting to the needs of service providers. Additional modules are being planned for the second half of the year.

D. Participatory Gender Assessments and Planning

CSISA believes in empowering women in agriculture by ensuring their access and exposure to modern and improved technological innovations, knowledge, and entrepreneurial skills that can help them become informed and recognized decision makers in agriculture. During Rabi season 2013–14 in the tribal-dominated districted of Mayurbhanj in Odisha, CSISA undertook participatory knowledge dissemination and technology adoption activities with women farmers. This work involved qualitative research to understand, identify and assess a variety of women's knowledge and technology needs; the facilitation of farmer-to-farmer learning; and participatory planning of upcoming Kharif season activities.

In April 2014, CSISA organized three events in the plateau and plain ecologies of Mayurbhanj—two in Jashipur and one in Badasahi—that exposed women to a variety of technologies relevant to their production ecologies. These events that brought together a variety of key potential stakeholders and grassroots partners, including women involved in agriculture; members of women's self-help groups and federations; members of community based organizations (CBOs), cooperatives, and farmers' clubs; and field-level staff / community resource persons from various CSOs active in the area and involved in promoting women's livelihoods. The technologies demonstrated for and trialed with the attendees included: direct seeded rice technology, mechanized line sowing for maize, stress tolerant rice varieties, and improved storage and post-harvest practices and technologies. These events were followed up by several interactive sessions and consultations to solicit feedback from the participants.

These participatory research and knowledge-building events gave us a much clearer understanding of women's roles in agriculture, their interest in a variety of agricultural technology and mechanization options, and their priorities among these options. The women farmers we spoke with were keen to become early and first-time adopters of various CSISA technologies as they now realized that these interventions could have direct and positive impacts on their livelihoods. Starting with Kharif 2014, CSISA and its local partners are optimistic to carry forward the enthusiasm and energy generated by the community events into field-based activities. Further information-gathering activities include: knowledge needs assessment through score cards, focus group discussions, and field days to other CSISA farmers' fields for practical exposure and farmer-to-farmer learning.

"Brothers, if you are farmers, so are we"

In April 2014, CSISA's Bihar hub, representatives from USAID and the Gates Foundation, and the hub's partner agency, Jyoti Mahila Samakhya Federation, met with local farmers, including 345 women, in Muzzafapur, Bihar, to discuss their ongoing collaboration, as well as opportunities for women's empowerment and agricultural development in the region. The women opened the gathering strongly by thundering: *Bhaiya hum hiye kisani tu kisan banihan na* ("*brothers, if you are*

farmers, so are we.") The crowd responded in appreciation with elated applause and whistles. In response, CSISA rechristened their entity *Kisan Sakhi* ("friend of farmers").

In six blocks of Muzzafapur, CSISA's Bihar Hub and the Bihar Mahila Samakhya Society (BMSS) have introduced women's groups to new technologies such as improved weed management, maize intercropping, intensification of cropping systems with summer green gram, machine transplanting of rice under non-puddled conditions and nursery management. The groups select the technologies and management practices they would like to adopt. Women expressed that during the Rabi season, they benefitted most from improved weed management in wheat and cropping system intensification through spring maize and summer green gram. Also, zero tillage technology helped them reduce cultivation costs.

Looking forward to the Kharif season, a number of women articulated a strong interest in machine transplanting of rice due to health problems caused by manual transplanting, including backache, fever, stomach problems, dizziness, fatigue, nausea, rotting of fingers and feet, and pain in the thumb. CSISA will also provide information and technical support for technologies such as hybrid rice and direct-seeded rice, among other better-bet management interventions for the Kharif season.

During the meeting, about 15% of the women indicated that they owned land in their name. Discussions also revealed that these women are involved in decision making by taking land on rent and carrying out a variety of farming operations. For many in the group, their male family members are working outside Bihar, and the women are investing their own savings in agriculture. When asked "do you keep a record of your spending in agriculture", they unanimously said yes, and also broke into a few lines of a song in the local dialect, which says "*hum hisaab kariye na,*" meaning that they also make records of their investment in farming. When asked about the need for scaling out new technologies among women farmers, one of the group members stated "for spearheading the benefits of new innovations, the development of knowledge and skill is more important than providing short-term monetary support from the project."

E. Crop Manager decision support framework for precision management

Nutrient Manager for Rice (NMR) has been developed for the Cauvery Delta of Tamil Nadu, and CSISA is working in Thanjavour District for field testing the application. We are also collaborating with TNAU-TRRI KVKs for field testing NMR in non-CSISA districts (Nagapattinum & Thiravarur). On-farm field evaluation trials were conducted in three cropping seasons—60 trials in Kuruvai, 40 in Sambha and 60 in Thaladi, and now the Nutrient Manager program is being upgraded to Crop Manager to include components of field-specific crop management. Recently, a proposal has been submitted to the Tamil Nadu government for collaboration on Nutrient Manager. The workplan includes field testing of NMR by staff of the Department of Agriculture and Cooperation (DAC), interfacing NMR with the existing TN agro-advisory portal and finally endorsement by the state government.

Through the Odisha hub, CSISA is working in collaboration with OUAT, CRRI & DoAC, Odisha for the development and refinement of **Rice Crop Manager** (RCM). Nutrient Omission Plot Technique (NOPT) trials were conducted in four districts—Puri, Bhadrak, Mayurbhanj and Cuttack. Pilot testing of RCM tool has been completed in Puri district. The RWCM recommendations are being refined based on the analysis of NOPT data. Maize Crop Manager has been drafted for the maize growing areas of the state.

Nutrient Manager presentation at KVK Sikkal

Application of fertilizer in Tamil Nadu

In EUP and Bihar, CSISA has conducted NOPT trials in five districts of EUP (Sant Kabir nagar, Sidhharth nagar, Gorakhpur, Maharajganj, and Kushinagar) and eight districts of Bihar (Ara, Patna, Buxar, Mujaffarpur, Vaishali, Samastipur, Begusarai, and Lakhisarai). The data generated from these NOPT trials has been used for fine-tuning the recommendations for a **Rice-Wheat Crop Manager** (RWCM), which accounts for system interactions and carry-over effects between season.. Pilot field testing of RWCM has been conducted in four districts of EUP (Kushinagar, Maharjganj, Devariya, Sidhharth nagar), and three districts of Bihar (Ara, Buxar, and West Champaran). **Maize Crop Manager** is being drafted and developed for the maize growing areas of EUP and Bihar. CSISA team, along with technical specialists from IRRI, visited Banaras Hindu University (BHU), Varanasi, Bihar Agriculture University (BAU), Bhagalpur and Rajendra Agriculture University (RAU), Samastipur, Bihar, to discuss probable collaborations with these universities, to give presentations on Nutrient Manager, and to discuss the frameworks with the faculty. Following these visits, proposals have been submitted to BHU and BAU for collaboration on development of a Rice–Wheat Crop Manager for EUP and Bihar. The workplan includes field-testing of Crop Manager by the universities, the sharing soil data collected/ generated by the universities, and finally endorsement by the universities.

In the process of participatory development and out-scaling of new technologies for sustainable intensification (Objective 1), problems as well as new opportunities emerge that necessitate rigorous, process-based inquiry. Because cereal productivity growth in South Asia is constrained by resource degradation, rising scarcity of labor, water, and energy, the growing cost of cultivation, and climate variability, CSISA has focused its strategic research on sustainable intensification through conservation agriculture-based best crop management practices. Strategic research is conducted at three platform sites representing distinct agro-ecologies: Karnal, Haryana; Patna, Bihar; and Gazipur, Bangladesh. Four cropping system scenarios are explored at CSISA's research platforms: business as usual—conventional farmers' practices (scenario 1); established 'better-bet' management practices (scenario 2); labor-, energy-, and water-saving practices based on conservation agriculture (scenario 3); and diversified systems (CA 'plus') (scenario 4).

In Phase II of CSISA, more emphasis has been given to on-farm strategic research outside of the experimental platforms as well as interdisciplinary work. Selected aspects of the broader Objective 2 work program are presented here.

Major findings and progress of Objective 2 during the reporting period are as follows:

Karnal Research Platform

The results of four years of research at the Karnal Research Platform consistently demonstrate that Kharif maize appears to be a suitable and profitable alternative to rice in the rainy season in northwest India to address the issues of rising scarcity of water, labor, and energy in the region. In 4th year, ZT maize provided a higher yield (9.36 t/ha rice equivalent yield) than rice (8.0 t/ha), using 90% less irrigation water. Despite these benefits, there are a few unanswered questions associated with diversifying rice with maize, keeping in mind the history of these soils as reclaimed salt-affected soils. Unanswered questions include the probability of secondary salinization by the replacement of rice with maize, market volatilities and economic risks associated with large-scale adoption of maize, a commodity not procured through the government procurement system (unlike rice). Therefore, a new study has been initiated from 2013–14 at CSSRI, Karnal, to explore the scope and implications of diversifying rice with maize in northwest India by closely monitoring these risks.

Kharif maize under ZT at CSISA Research Platform, Karnal, Haryana. Based on 4 year results, kharif maize appears to be an economical viable diversification option for rainy season rice in Northwest India.

Zero-till wheat sown in full rice residue (retained on soil surface as mulch) at Karnal platform. Continuous ZT with residue mulch helped in almost eliminating weed problem in wheat. No herbicide has been applied in these plots since last two years.

Platform research has also showed that the yield of dry seeded rice remained at par with puddled transplanted rice for the initial three years but decreased in 4th year, in part due to severe iron deficiency. Weed problems in zero till wheat reduced overtime, and hence herbicide use in continuous ZT wheat with rice residue mulch decreased compared to the conventional system. From last two years (2012–13 and 2013–14), no herbicide has been applied in ZT wheat plots for weed control. ZT and residue retention also increased soil C content in the upper 15 cm soil layer. After 3 years, soil C increased by 22 and 26% in zero till rice-wheat-mungbean and zero till maize-wheat-mungbean systems, respectively, compared to the conventional rice-wheat system.

In wheat, component studies focused on studying the effects of planting dates, tillage, and residue amount on weed suppression, terminal heat stress, moisture conservation and yield. Full results are awaited but initial observation showed that early planting, ZT and residue mulch ≥ 4 t/ha suppresses weeds and mulching helps conserve soil moisture.

Results of on-farm research showed that the improved irrigation system in DSR (border irrigated DSR) provided irrigation water savings, improved crop establishment and hence grain yield. Similarly in wheat, border irrigation with a slope of 0.08% saved more than 50% of the water in the first irrigation, and is expected to increase yield (results awaited).

Patna Research Platform

At the Patna Research Platform (RP) in Kharif 2013, machine transplanted rice in non-puddled conditions generated the highest yields, followed by puddled transplanted rice and DSR. In the diversified cropping system scenario (scenario 4), some changes were made and mustard was included in the system after shorter duration rice followed by spring maize. Data are sparse on the comparative performance of hybrids or varieties of mustard in terms of yield. In a field study conducted in 2013–14 at Patna RP, it was found that the yield ranged from 1.8 to 2.8 t/ha with a difference of 7 days in maturity duration. Hybrids outperformed inbreds; all hybrids yielded > 2 t/ha, whereas all inbreds were in the range of 1.7 to 2.0 t/ha. Hybrids from Pioneer (45J21) yielded the highest, followed by other hybrids from JK, Mahalaxmi and Mahyco.

In a study initiated in 2013–14 at IARI, Pusa, to evaluate alternate tillage and crop establishment methods in the rice-wheat system for yield maximization and efficient resource use, it was found that yields of all rice crop establishment methods tested [puddled transplanting, machine transplanted non-puddled rice, system of rice intensification, and DSR] were similar. Yield ranged from 7.9 to 8.6 t/ha for the medium duration hybrid (Arize-6444) and 6.5 to 7.0 t/ha for the short duration hybrid (PRH-10). However, the net income of MTNPR was highest, $300/ha higher than PTR, and about $200/ha higher than SRI and DSR, mainly because of savings in labor and land preparation costs. In another trial on cropping system optimization/intensification through hybrids/varieties of different maturity classes, it was found that short (120 days) to medium duration (135-140 days) hybrids (Arize-6129 and Arize-6444) can produce equivalent higher yields than the long-duration variety MTU-7029 of 155-160 days duration. Short to medium duration rice hybrids enabled wheat planting on time and are expected to yield more than wheat planted after the long duration rice variety (yield awaited). A shorter duration rice hybrid also enabled cropping system intensification from 200% (rice-wheat) to 300% (rice-mustard-spring maize/or mungbean).

Cropping system optimization by rice hybrids/variety of different maturity class in Bihar. Hybrids like arize-6129 and 6444 can be as productive as long duration variety MTU-7029 and enable wheat planting early leading to higher system productivity.

Two new on-station trials were started in collaboration with Borlaug Institute for South Asia, PUSA, Bihar during Rabi-2013–14 on developing strategies to overcome terminal heat stress in wheat (results awaited). In the first trial, we screened 183 lines to identify cultivars suitable for early wheat planting (terminal heat stress escaping strategy). The other trial assessed the role of other innovative practices such as tillage, residue and water management, and cultivar in beating terminal heat stress.

Research in Odisha and Tamil Nadu

In the plateau region of Odisha, CSISA focused on maize on the following topics: site-specific nutrient management, crop establishment methods, yield gap evaluations, and the evaluation of maize hybrids of different maturity classes. Based on an average of 9 locations, last year results revealed that optimum plant population (75,000/ha), optimum fertilization (140:50:75 kg N, P_2O_5, K_2O/ha), and improved weed management contributed 800, 660, and 170 kg/ha increased in maize yield over farmer's practice (55,000/ha plant population and 80:40:40 kg N, P_2O_5, K_2O/ha). When all these interventions were layered (best bet agronomy), grain yield increased from 3.0 t/ha (farmers practice) to 5.2 t/ha. In hybrid evaluation, maize yields decreased in the following order: long duration hybrids (6.8-7.4 t/ha) > shorter duration hybrids (6.0 t/ha) > high yielding long duration inbred (3.5 t/ha). Experiments are being implement in Kharif 2014 to establish the trade-offs and system optimization strategies for attaining high maize yields while ensuring strong performance of the second crop through maize cultivar selection and management interventions that ensure timely establishment.

Soil fertility issues in the plateau are very different than in the alluvial soils in the coastal belt, and NOPT trials in maize revealed 4.7, 4.9, and 1.4 t/ha yield response to non-limiting levels of N, P and K, respectively, over yields achieved with indigenous sources of each nutrient only. These results demonstrate the depleted condition of the soils in the plateau, but also dispel the myth that these soils do not respond to fertilizer inputs. Phosphorous nutrition is commensurately important to nitrogen in these ecologies.

In rice, the focus was on efficient use of irrigation water and optimization of weed management and potassium. On-station experiments at OUAT, Bhubaneshwar, evaluating different cultivars under different establishment methods and irrigation schedules is on-going. Preliminary results indicate better growth of early duration inbreds and hybrids under water stress conditions. Among all cultivars, US-323 had high early vigor. On-farm testing of alternate wetting and drying (AWD) is also on-going in Puri and Bhadrak districts of Odisha. The receptivity of AWD varied based on ownership of pumps, distance from the pump, levelling of the fields etc. For optimization of weed control in DSR, three field experiments are on-going including testing of different herbicide molecules, optimization of pre-emergence herbicide efficacy under different establishment methods. A trial on optimization of K supply and plant nutrition through different K management practices has been established at OUAT.

Figure 4: Efficient irrigation system with 0.1% slope in a DSR field in Tamil Nadu. Slope will increase water advancement rate and hence reduce drainage losses at head end, thereby reduces irrigation water application.

Figure 5: Nutrient omission plot technique (NOPT) trial in maize to estimate yield response of nutrients in plateau of Odisha. Results shows that P is equally or more important than N in these soils for high maize productivity.

In the Cauvery Delta region of Tamil Nadu, the adoption rate of DSR is increasing. Therefore, the focus of our strategic research was on improving irrigation and N use efficiency in DSR. The water advance rate in the farmers' field is generally very low because of the flat configuration, which results in high rates of drainage below the root zone, more so at the head end of the field than at the

tail end because of the longer period of flooding of the soil surface at the head. Therefore, research activities were initiated in 2014 in both sandy loam and clay soil to evaluate the performance of different degrees of slope for increasing the water productivity of rice grown in non-puddled soils. The initial findings indicated big differences in irrigation times and amounts even with a small (0.1%) slope. The experiment on N dynamics in relation to different crop establishment methods and residue management indicated better yield with basal dose of nitrogen in the residue retention scenario.

Exploring the scope and implications of diversifying the rice-wheat system

In northwest India (i.e., Haryana, Punjab), government agencies are becoming increasingly interested in promoting Kharif maize as an alternative to rice in an attempt to arrest declining groundwater tables. Results of four years' of research at the CSISA Karnal Research Platform show that Kharif maize appears to be a suitable and profitable alternative to Kharif rice. Rice equivalent Kharif maize yields were either similar to or higher than rice, while using almost 90% less irrigation water. Despite these benefits, some questions associated with diversifying rice into maize remain unanswered, particularly with regard to the implications of the fact that most of these soils are reclaimed salt-affected soils. Some areas of uncertainty include the probability of secondary salinization by the replacement of rice with maize, market volatilities and economic risks associated with large-scale adoption of maize, a commodity not covered by the government procurement system (unlike rice).

CSISA initiated a new study in 2013 at CSSRI, Karnal to explore the scope and implications of diversifying rice with maize in NW IGP in reclaimed salt-affected soils by closely monitoring the risks and effects on system productivity and economics. In this experiment conventional the rice-wheat system will be compared with the maize-wheat system on beds and on flats under different tillage and residue management systems. Data will be used to calibrate cropping system models and then for risk analysis based on climate, resources, and long-term implications on water balance components. In another study, simulations were run for NW India using long-term weather data (at Ludhiana, Punjab) to explore the various options for maximizing land and water productivity in the rice-wheat system and to study the effects of adopting conservation agriculture on system productivity and ground water depletion. An APSIM model has been calibrated for various cultivars of rice, wheat, mungbean, and maize crops and is being calibrated for other potential crops which can replace rice in Kharif season (e.g., cotton, soybean). After calibration, simulation scenarios based on resource, policy and technology implications will be run to study the effect of replacing rice and wheat with other crops on system land and water productivity, and the impact on declining ground water tables.

In the northeastern Indo-Gangetic Plains (NE IGP), the thermal window for wheat production is already short and is expected to shrink further with climate change, including terminal heat stress leading to low wheat productivity in the region. Therefore, there is growing interest to look for alternatives to Rabi-season wheat. The most promising staple alternative in the NE IGP is also maize or maize-based intercropping (maize+potato) which can be tremendously high-yielding in the winter months. At CSISA's Patna research platform, wheat equivalent maize+potato yield was 15.3 t/ha compared to 4.9 t/ha wheat yield in Rabi-season but with more investment in irrigation water (417 mm versus 190 mm/ha). Another diversification option could be mustard after short duration rice followed by either maize or mungbean in spring. To explore this option, CSISA has started new experiments at IARI, Pusa and ICAR-RCER Patna in Bihar in 2013–14. Nevertheless, some of the same considerations on market dynamics need to be explored in the NE along with risks to individual producers from price perturbations caused by factors such as bird flu. Substituting maize for wheat in the NE IGP establishes a scenario where the relatively small and impoverished farmers would shift from a lower input 'food security' crop with higher biophysical risk of failure to a higher input commodity crop with significant market-based risks and investment requirements for fertilizer,

irrigation, and energy. Understanding the risk-bearing and investment capacity of different groups of farmers is an essential consideration for shaping progressive policies that would facilitate diversification for meeting food and livelihoods objectives in the NE IGP. A linked simulation model approach will be used for broadly establishing trajectories of change and multi-criteria outcomes under different policy investment, socioeconomic, and technological change scenarios.

Objective 3: *High-yielding, stress-tolerant rice varieties for current and future cereal and mixed crop-livestock systems*

Objective 3 develops a new generation of rice varieties and hybrid parental lines for the target regions of South Asia. The target trait specifications used in the variety development pipelines emphasize higher yield potential, adaptation to dry direct seeding and water stresses (partial/non-flooded irrigation), heat tolerance, grain quality, and straw fodder value. The following information summarizes the advances in Objective 3 during the reporting period.

The genetic yield potential of four elite varieties (viz., NSIC Rc82, NSIC Rc158, NSIC Rc222, and NSIC Rc238) of IRRI and three mega varieties (Swarna, Samba Mahsuri and MTU1010) is being enhanced by incorporating three cloned genes viz., high grain number (*Gn1a*), bigger panicle size (*Spl14*) and strong culm (*SCM2*). SNP marker assays for a large number of candidate genes and cloned QTLs for key traits, including yield components, have been designed for running as 24-SNP sets on the Fluidigm EP1 system in the Genotyping Services Lab at IRRI. These trait-specific SNPs will enable rapid marker-assisted selection and QTL pyramiding to develop high yield potential rice varieties. Bi, tri and multiple parent recurrent selection has been taken up to enhance genetic yield potential and 200 lines are in observational yield trials. In IR 36 background recessive GMS gene (ms ms) was fine mapped on chromosome 2 and 30 new GMS lines are in an advanced stage of development. Of the 58 entries tested in multi-location trials conducted at four locations, 12 promising entries were identified. Straw quality of 100 entries was tested and five mapping populations are being developed. An array of new breeding lines with varied plant types and maturity groups with different grain types, such as medium and short slender, long slender and long bold and medium bold, suitable for diverse market segments of northern, southern and eastern parts of India, were developed. Many entries are in national level multi-location trials.

Under machine-sown, dry, direct-seeded conditions one hundred entries composed of hybrids from private sector companies, breeding lines and varieties from IRRI, and public sector NARES partners were evaluated at six locations in India. In general, hybrids performed better in terms of rapid germination and emergence, early stage seedling vigor, fast canopy coverage, better crop establishment and grain yield. Yield advantage of a few top hybrids was in the range of 23-34% in the early, 26–35% in the medium-early, and 16–19% in the medium maturity groups. Among the breeding lines the yield advantage was in the range of 9–17%, 14–27% and 9% in respective maturity groups. Many promising entries for DSR were identified in Nepal and Bangladesh. Through marker assisted back cross breeding IR64-Pup1-AG1, Ciherang-Sub1-Pup1-AG1 and Samba Mahsuri-Sub1-AG1-Pup1 are being developed. An array of new breeding lines having varied plant types with high grain yield potential, tall stature (>100 cm), early stage seedling vigor; lower panicle position with strong culm; erect, dark green & prominent top leaves with slow leaf senescence, long and heavy panicles, prolonged grain filling duration, lower grain shattering with low to intermediate threshability, biotic stress tolerance i.e BLB, Blast, BPH, desirable grain quality as per region specific requirements and varied maturity groups to suit different cropping systems were developed. Many promising entries are in national multi-location trials.

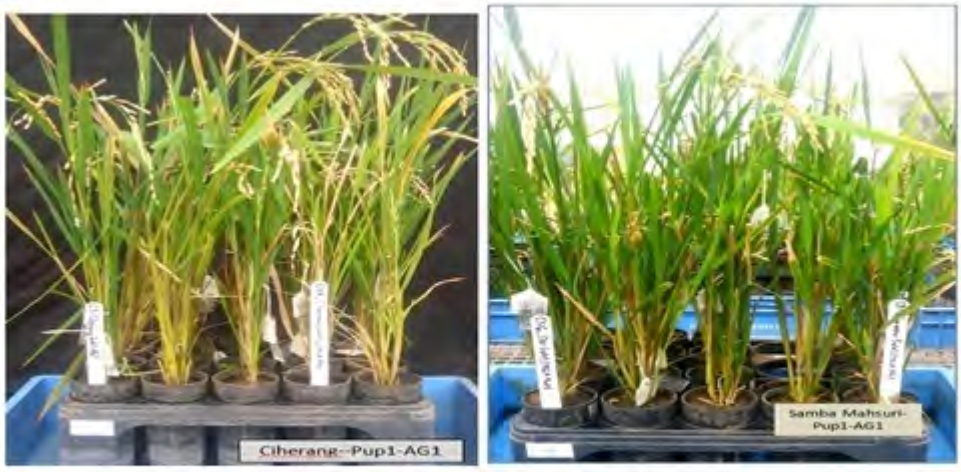


Fig. 1 Ciherang-(Sub1)-Pup1-AG1 (left) and Samba Mahsuri-(Sub1)-Pup1-AG1 (right) BC1F1 plants using the new crossing system at IRRI.

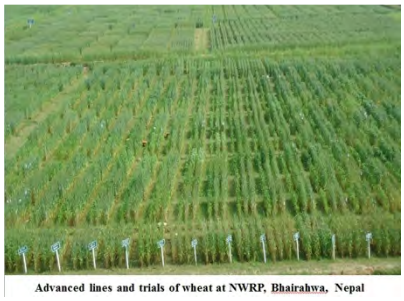
The heat tolerance QTL qHTSF4.1 was fine mapped to 5 cM region. PCR based markers and protocol for marker-assisted selection of qHTSF4.1 were developed. Near isogenic lines (NILs) with N22 introgression in IR64 background were developed and BC5F3 lines were evaluated in the field along with the early morning flowering NILs. A recombinant inbred line population consisting of 246 F7 lines was developed and is being used for high night temperature QTL mapping and other heat tolerance studies. A greater respiratory loss in response to high night temperatures was documented in susceptible genotypes compared to the tolerant cultivars with a much larger loss after flowering than before flowering stages, quantified under realistic field conditions using unique field based tents. An array of new breeding lines with reproductive stage heat tolerance was developed. Ten advanced heat-tolerant lines were nominated to MET and 17 lines for international heat tolerant nursery during 2013. One entry viz.,I R10C146 is in advanced stage of testing (MET-2).

New breeding lines with tall stature ,erect plant type, MS grain type and early maturity

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

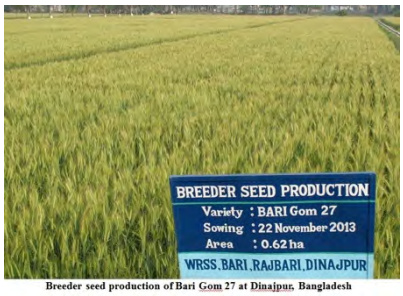
Objective 4 strives to develop bread wheat varieties that have higher yields (>5% than current varieties by year 5 and an additional 15% higher by year 10), are well buffered against the vagaries of climate change, and have preferred end-use qualities. Objective 4 aims to develop input-responsive varieties that also have greater resistance to biotic stresses such as leaf, yellow, and stem rusts, and spot blotch/leaf blight, adaptability to CA practices, and have consumer preferred end-use qualities.

This objective made steady progress during the reporting period. Eight new wheat varieties were released, six identified for release, and more than 700 promoted to national/state/regional trials for further evaluation and subsequent release in South Asia. In addition, more than 1,800 new crosses (800 by CIMMYT and 1000 by NARS) were attempted and >12,000 breeding populations (5000 by CIMMYT and 7,000 by NARS) were exposed to selection under various environments/management conditions. Around one thousand advanced lines and segregating (F3/F4) generations from South Asia were evaluated in Kenya for screening against Ug99 resistance. Three hundred sixty-eight participatory varietal selection (PVS) and adaptive trials were planted in farmers' fields by collaborators in Nepal, India and Bangladesh. Seed growers and farmer groups initiated seed dissemination of superior lines. A former CSISA fellowship holder (Chhavi Tiwari) from India was awarded "Women in Triticum" award by Borlaug Global Rust Initiative, Cornell. Likewise CSISA wheat breeder (Arun Joshi) was awarded the 4th WIT Mentor award by BGRI.



Advanced lines and trials of wheat at NWRP, Bhairahwa, Nepal

CSISA trials at PAU, Ludhiana, India



Breeder seed production of Bari Gom 27 at Dinajpur, Bangladesh

Major accomplishments of the project:

1. Eight outstanding wheat varieties released for different environments/management conditions of South Asia.
2. Six varieties identified for release in different environments of South Asia.
3. One hundred sets of trials/nurseries from Mexico planted at different sites of India (66), Nepal (13), Bangladesh (14) and Pakistan (13).
4. More than 1,800 lines promoted to various national/state trials for evaluation and release.
5. NARS collaborator planted around 500 advanced lines in stations trials from their own breeding program while around 3,000 lines planted in replicated trials at Mexico.
6. Around 11,000 breeding lines attained advanced stage of evaluation.
7. More than 1,800 crosses/backcrosses and 12000 segregating populations were exposed to selection by breeding teams in different locations of South Asia, Mexico and Kenya.
8. One thousand advanced lines/segregating populations from South Asia planted at Kenya for evaluation of resistance to Ug99.
9. More than 50 spot blotch resistant lines identified in good agronomic background and 4 mapping populations phenotyped.
10. A panel of new advanced lines comprising high yield and/or biomass; based on strategic crosses to combine complementary source-sink traits were identified.
11. 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.
12. Results of multi-location yield trials of the 1st WYCYT provided a first proof of concept that yield potential can be increased through strategic physiological trait (PT) crossing. Averaging over

CSISA sites, yield and biomass of the best new PT lines were expressed at 7% and almost 20% over local checks, respectively in the 2013 spring wheat cycle.

13. More than 350 PVS and adaptive trials were planted in Nepal, India and Bangladesh for evaluation and delivery of most recent varieties.
14. Seed of newly released varieties was multiplied by collaborators and also through CSISA HUBs and delivered to around 6000 farmers.
15. Number of private sector companies doubled from 4 in 2012–13 to 8 in 2013–14
16. Molecular mapping for heat tolerance was achieved and robust markers were identified.
17. Linkage with HarvestPlus was strengthened to delivery agronomically superior biofortified lines to farmers in India and Pakistan.
18. Around 5000 t seed of latest varieties was multiplied and disseminated by public and private sector in south Asia.
19. Seven publications in peer reviewed journals published.

Objective 5 continues to address the policy environment needed to remove constraints to the adoption of new technologies and enhance the benefits of improved agricultural growth. Objective 5 specifically explores strategies to catalyze durable change at scale through improvements in technology development and delivery, private investment in inputs and services, and public-private partnerships. The two main research areas under Objective 5 are improved policies and incentives that encourage private investment and public–private partnerships in pro-poor technology development and delivery.

Research in progress

- "Complementarity and Substitutability of Abiotic Stress-Tolerant Cultivars and Weather Index Insurance: Evidence on Farmers' Drought Risk Management Strategies from Bangladesh." Study design and implementation is in progress in Bogra with support from Gram Unnayan Karma (GUK), materials from BADC, advice from IRRI, and input from several other partners.
- "Measuring the impacts of shocks and vulnerability on input use and management practices in South Asia." Data analysis in progress.
- "The effect of social interactions on the resolution of ambiguity with heterogeneous learning heuristics and learning environments: Evidence from Bihar." Study implementation in progress.
- "The organization of the agricultural mechanization industry in India: A structure, conduct and performance analysis." Study design is in progress in collaboration with Vijay Sharma, Indian Institute of Management, Ahmedabad.
- "Eliciting farmers' preferences for drought- and flood-tolerant rice cultivars in Odisha." Data analysis and write-up are in progress with Sangeeta Bansal and Anchal Arora, Jawaharlal Nehru University, New Delhi.
- "Adoption of Balanced Use of Chemical Fertilizers: Understanding Farmers' Response to Scientific Evidence and Social Learning in Bihar, India." Study implementation in progress.

New research under development

- "Complementarity and Substitutability of Abiotic Stress-Tolerant Cultivars and Weather Index Insurance." Possibilities being explored for replication in Odisha with support from CSISA hub.
- New research is being explored on policies designed to encourage small-scale mechanization in the CSISA countries, with particular emphasis on Bangladesh and Nepal.
- New research is being explored on the potential gender and labor effects of various rice establishment technologies, with particular emphasis on Bihar.

Communications

IFPRI has taken the opportunity to communicate findings from several recent studies, including work on the following (see appendix for precise event details).

i. Evidence on demand heterogeneity for DT rice cultivars in Bihar as a means of improving strategies for reaching vulnerable farmers, which was presented at an Agricultural Sector Council seminar in Washington, DC in February, to the Indian Econometrics Society in March, and to CSISA colleagues in several hub and management meetings.
ii. Impact of the Mahatma Ghandi National Rural Employment Guarantee Scheme on labor-saving agriculture technology and machinery/equipment adoption, which was presented at national conference on MNREGA in Mumbai in March.
iii. Gender dimensions of social networks on technology adoption, based on evidence from a study of laser land levelling in eastern Uttar Pradesh, which was presented at a practitioners' workshop on gender, agriculture and assets in New Delhi in March.

Planning for communications events include:

- Support in the design of a series of state- and national-level “Seed Summits” being organized by IRRI and partners as part of CSISA in 2014.
- Collaboration with the Indian Federation of Chambers of Commerce and Industry and other private sector entities to organize an industry-government roundtable on policy reforms on agriculture, seed, and mechanization.
- Collaboration with the Institute of Economic Growth, New Delhi on an international conference slated for late 2014 on “Innovations in Indian agriculture.”
- Presentation of CSISA research at national, regional and international economics conferences slated for late 2014, including the Indian Society of Agricultural Economics, Asian Society of Agricultural Economist, and the 4th International Rice Congress.
- Preparation of a series of CSISA Research Notes to highlight results of completed research.

Objective 6: *Project management, data management, monitoring & evaluation and communications*

Governance and project management in CSISA Phase II are designed to (i) enable better linkages with national and regional stakeholders, (ii) simplify reporting and ensure clear lines of accountability, (iii) enable better teamwork and synergy across Objectives and CG partners, (iv) build a more inclusive model for outreach and research that leverages the strengths and addresses the needs of key partners. The section below highlights some of the key activities and advancements achieved under Objective 6 during the reporting period.

Governance: The CSISA **Executive Committee (EC)**, which meets quarterly, is composed of senior representatives of the CGIAR Centers in South Asia. The EC monitors project progress and work plan development, approval of fund allocation for regional investments, integration with other activities of the Centers/CGIAR Research Programs in the region, and harmonization of administrative processes and staff policies. A small **Management Team (MT)**, which meets monthly, has been composed in India and Bangladesh to lead strategy development, activity planning, and to provide comprehensive technical oversight for the non-breeding objectives of CSISA. The MT is composed of the Country Coordinator (chair) and scientists from each of the CGIAR Centers that lead the activities in Objectives 1, 2, 5 and 6 in that country. To reach CSISA development goals and to align the project with government priorities, policies and investments, and to provide new mechanisms for catalyzing partner-driven delivery activities at each hub, CSISA has created **Advisory and Investment Committees (AICs)** for Bihar, Odisha, and Bangladesh consisting of NARES leaders and other representatives from the public, private, or civil society sectors. Advisory and Investment Committees have funds to allocate to partner-driven activities that are aligned with CSISA's goals.[2] Funds are allocated on a commissioned and a competitive grants basis, and are managed by the Advisory and Investment Committee in consultation with the CSISA management team.

Semi-annual Planning and Evaluation Meetings: Each year, country-specific and objective-specific meetings are held in advance of the Kharif and Rabi seasons to evaluate the past season's work and plan for the coming season's activities. Meetings are followed by staff work plans, proposals, and funding requests. The approval of activities and subsequent allocation of funds is done by the Management Team at the subsequent MT meeting. The Rabi planning meeting was held in September 2013 in Kathmandu, and the Kharif planning meeting was held in March 2014 in Odisha. Objective 2 planning meeting was held in Kathmandu.

Data Management: CSISA is continually upgrading its data management protocols and procedures, and improving the ways in which data is collected and shared. In India CSISA's four CGIAR partners continue to use Surveybe software and portable netbook computers to streamline field-based data collection. CSISA uses simple surveys using Open Data Kit (ODK) for regular activities such as trainings and short surveys with known groups of beneficiaries such as service providers. Every sample point is automatically geo-referenced, and ODK can be synced to a server in real-time, and data easily mapped for quick visualization. The CSISA Bihar and EUP hubs have provided data logbooks to service providers, and have begun standardizing templates across hubs. An Access database has been created to compile and generate both indicator numbers and results framework updates.

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[2] Total funding support to the AIC's during Phase II is $1.2 million USD.

These tools and processes are documented in CSISA's M&E Handbook. Standard Operating Procedures for CSISA data management have been developed, including the basic metadata schema to be included with every data set, file-folder naming and organization protocols, data storage guidelines, and data-related roles and responsibilities of staff at each CSISA hub.

Enabling wider access to CSISA data: Several CSISA data sets have been uploaded into AgTrials (http://agtrials.org), a global repository developed by the CGIAR Research Program on Climate change, Agriculture and Food Security (CCAFS), with eight current CGIAR partners. However, while the AgTrials database is powerful, the user interface could use improvement. A CSISA/CIMMYT-CIAT collaboration has been cemented to further develop AgTrials, with current work plans focusing on usability-interface issues, metadata schema and forms, optimizing the search functionality, and making further refinements following user testing. Agronomic trial traits have been developed to enhance the agronomic content in the Crop Ontology (http://www.cropontology.org) used by both AgTrials and the Generation Challenge Program's (GCP) Field Book. A former GCP consultant will work with CSISA/CIMMYT's data management team and the Bioversity-based GCP semantics and ontology expert to add these traits to the Crop Ontology and to develop an Agronomy Field Book. CSISA agronomists will use this online Field Book and those working in other projects/centers to standardize data collection templates, facilitate meta-analyses, and better integrate breeding and agronomy data. The Agronomy Field Book will also allow users to analyze data using pre-loaded R scripts, and to store data sets. Via another new collaboration between the GCP and AgTrials, the Field Book will also enable a one-click upload of data from the Field Book into AgTrials. An instance of DataVerse(http://dvn.iq.harvard.edu/dvn/dv/IFPRI) has been installed on a CIMMYT server, and is being evaluated for use as a repository for CSISA's survey and technology tracking data.

Communications: CSISA has made great strides in its communications efforts recently. The new web site, **csisa.org**, has been launched, and features an overview of CSISA's activities in Bangladesh, India and Nepal, as well as publications, data sets, videos, photos, and job opportunities. CSISA is also in the process of linking data gathered through Open Data Kit to a mapping program on the web site so that the geographic spread of our activities can be better displayed. The web site is accompanied by a quarterly newsletter for external audiences. We now also have an internal monthly newsletter for CSISA Phase II staff, called *CSISA Magazine*, which provides helpful information about meetings, new staff, hub and research platform updates, and other important information that the full team should know. The CSISA Phase II communications team has also designed a template for CSISA Research Notes, which essentially serve as briefs for the research coming out of CSISA (including Bangladesh and Nepal). Notes will be reviewed by a technical committee and an editorial committee, and then will be made public through the web site, the bulletin, and any other mechanisms that the relevant researchers choose.

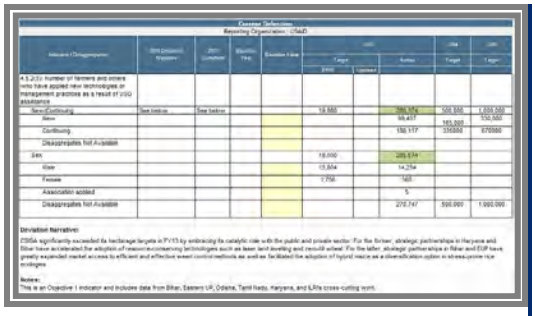
Monitoring and Evaluation: CSISA has a fully-staffed M&E team, with team members overseeing cross-cutting evaluation activities, as well as hub-based activities monitoring. Individual staff are also responsible for the USAID indicators as well as the results framework. The team is complemented by efforts of the socioeconomic team, and the M&E activities are identified seasonally during the impact pathway planning process. We are also striving to include indicator numbers into our semi-annual reports.

CSISA is one of the first agricultural R for D projects the emerged after the food price crisis of 2007-8 to endeavor to achieve sustainable development at scale (i.e. outcomes focused). CSISA does not transfer assets, but rather seeks to play a catalytic and supporting role with other actors in the innovation system. As such, the geography and magnitude of success is difficult to predict a priori and difficult to measure ex post. Further, CSISA supports several major classes of technologies, all with distinct impact pathways. These factors necessitate non-classical and mixed methods approaches for assessing project-supported impacts on the rapid timescales required to both make

adjustments within the project as part of 'ME&L' as well as to give stakeholders updates on project progress on an annual or sub-annual basis.

One example of a rapid and credible inference method pertains to our work on zero-tillage that primarily reaches farmers through mechanized service providers. We've equipped each service provider supported by CSISA with logbooks so that we can record the number of farmers reached per season and the total land areas for which the technology has been deployed. By coupling this information with year-specific cost and returns studies on sub-samples of adopters, we can make reliable estimations of the major outcomes indicators of interest: number of farmers adopting, land under new technology, and the yield and economics benefits associated with the new technology.

In Focus: *A snapshot of our M&E indicators*



In addition to our semi-annual progress reports and results framework updates, CSISA reports annually on a limited set of indicators, which are submitted to USAID's Feed the Future online monitoring system. The following gives a snapshot of how CSISA compiles its numbers.

4.5.2(2) Number of hectares and 4.5.2(5) Number of farmers

These two indicators help CSISA show the increasing scale of our work. Compiling these two indicator numbers is a challenge, though, because they lend themselves more easily to the tracking of pre-defined populations of direct beneficiaries rather than CSISA's model of working through intermediaries and allowing technologies to spread based on emerging ground realities. Through our trainings, demonstrations, work with service providers, collaborations with government agencies, and partnerships with private sector dealers, CSISA's work expands. To capture our numbers, CSISA uses a mixed-methods approach that includes direct data collection, service provider log books, targeted surveys, dealer sales records, and other credible inference methods.

Activities that contribute to these indicators include: improved varieties, new herbicides, maize intercropping, weed management, laser land levelling, direct-seeded rice and mechanical transplanting. Because of the timing of this report, the numbers for two of CSISA's wide-scale interventions—early planting and zero tillage of wheat—are not yet ready for this report. They will be included with the Kharif activities in the annual report.

4.5.2(7) Number of short-term trainings

CSISA collaborates with a wide variety of partners, including especially the state departments of agriculture and the KVKs to provide technical and business development services trainings to farmers and intermediaries, including government partners, extension agents, service providers and input dealers. During the reporting period, CSISA provided trainings on early wheat sowing, zero till wheat, conservation agriculture, maize production, post-harvest technologies, weed management, direct seeded rice, diversification and intensification of cropping systems, residue management, bed planting, line sowing, rice mat nurseries, balanced concentrate feeding, and straw chopping,

4.5.2(11) Number of organizations and enterprises

To scale technologies and management practices over a large area within a limited period of time, CSISA forms partnerships with a wide variety of governmental, non-governmental, and private organizations, and cultivates a large number of individual entrepreneurs to become service providers. Some of our key partnerships captured by this indicator include: ICAR, state agricultural universities, government research institutes, KVKs, NGOs, NABARD, Digital Green, input supply companies, seed companies, women's self-help groups, farmers' associations, and a

large number of individual service provider entrepreneurs.

4.5.2(12) Number of public-private partnerships (PPPs)
In certain key areas, CSISA has facilitated collaborations between public and private agencies, partnerships that are intended to be supported by, but not dependent on, CSISA. Examples of PPPs reported under this indicator include: the Department of Agriculture of Tamil Nadu and the M.S. Swaminathan Research Foundation; the Soil and Water Management Research Institute and Syngenta; the Department of Agriculture of Odisha and Digital Green; KVKs of Puri and Bhadrak in Odisha and Grain Pro.

4.5.2(39) Number of technologies
CSISA works with a wide range of agricultural technologies, which range from agricultural management practices to specific types of mechanization to breeding technologies. Technologies reported under this indicator include: improved wheat and rice varieties, maize hybrids, direct-seeded rice and mechanical rice transplanting, zero tillage wheat, laser land levelling, intercropping, bed planting, site-specific nutrient management, improved weed management, improved irrigation scheduling, post-harvest processing, improved storage methods, balanced feed concentrates, and molecular genetic markers.

4.5.1(24) Number of policies
Currently, CSISA's policy research team is exploring issues in several new areas that require analysis, for example, appropriate-scale mechanization and industry structure; rural social protection and technology adoption; and gender and social capital dynamics in technology adoption. The policies reported for this indicator include

- *Nepal*: fertilizer and seed
- *Bangladesh*: mechanization, seed and private R&D priorities and incentives
- *India*: public and private R&E priorities and incentives, mechanization, biotechnology, rural social protection, and gender and social capital

Looking ahead to Kharif 2014

Impact pathways for Bihar, EUP, and Odisha

Mat-type rice nursery

Kharif maize cultivation

Machine transplanted rice

The foundation of CSISA's seasonal planning process for Bihar, Eastern UP, and Odisha is the development of seasonal impact pathways, which identify the primary outcomes, intermediate outcomes, activities, geographies, timelines, and partners needed to achieve our goals for the upcoming season. These documents are drafted at the hub level and then discussed with the CSISA Management Team so that ideas are vetted, activities are coordinated, and resources are deployed accordingly. The final documents are then used by the M&E and Communications teams to plan for the data collection, knowledge management, and communications needs of the project.

Looking ahead to Kharif 2014, these are the primary outcomes that form the foundation of the impact pathways for Bihar, Eastern UP, and Odisha. Intermediate outcomes and activities are defined for each primary outcome, and then the work is monitored and the plan is updated on a monthly basis. Each activity plan is tailored to the needs of the specific hub domain.

- Laser land levelling is seen as an important component of cropping system planning and is adopted by farmers
- Where risks and economics are favorable, farmers adopt machine-transplanted non-puddled rice
- Farmers widely adopt direct seeded rice in lowland ecologies where irrigation is available
- Farmers widely adopt improved weed management practices in paddy cultivation
- Cropping systems are diversified and intensified through the cultivation of Kharif maize
- Post-harvest management practices in rice are widely adopted
- Women farmers use new technologies for cropping system intensification, leading to socioeconomic empowerment
- Crop Manager-based recommendations are made available to farmers
- Nursery enterprises are developed to hedge against the production risks that result from variable monsoon rains and the transplantation old seedlings

Annex 1. New Papers, presentations, and outreach activities

(in chronological order)

Objective 4:

Mondal S., Singh R.P., Crossa J., Huerta-Espino J., Sharma I., Chatrath R., Singh G.P., Sohu V.S., Mavi G.S., Sukaru V.S.P., Kalappanavar I.K., Mishra V.K., Hussain M., Gautam N.R., Uddin J. , Barma N.C.D., Hakim A. and A. K. Joshi. 2013. Earliness in wheat a key to adaptation under terminal and continual high temperature stress in South Asia. Field Crop Research. 151: 19-26

Tiwari C., H. Wallwork, U. Kumar, R. Dhari, B. Arun, V.K. Mishra, M.P. Reynolds, A.K. Joshi. 2013. Molecular mapping of high temperature tolerance in bread wheat adapted to the Eastern Gangetic Plain region of India. Field Crops Research 154: 201-210

M. Eisa, R. Chand, A.K. Joshi. 2013. Biochemical and histochemical traits: a promising way to screen resistance against spot blotch (*Bipolaris sorokiniana)* of wheat. European Journal of Plant Pathology 137:805–820

M. Eisa, R. Chand, A.K. Joshi. 2013. Biochemical and histochemical factors associated with slow blighting to spot blotch in wheat. Zemdirbyste-Agriculture, 100 (2):191–198

Paliwal R., B. Arun, J.P. Srivastava and Arun K Joshi. 2013. Inheritance of terminal heat tolerance in two spring wheat crosses. Cereal Research Communications. 41(3):400–408

Pask, A.J.D., M.P. Reynolds, I. Sharma, R. Chatrath, G.P. Singh, V.S. Sohu, G.S. Mavi, V.S.P. Sukaru, I.K. Kalappanavar, V.K. Mishra, A. Balasubramaniam, Y. Mujahid, M. Hussain, N.R. Guatam, N.C.D. Barma, A. Hakim, A.K. Joshi. 2013. The CSISA wheat phenotyping network. *In* Reynolds M.R., Braun H., (Eds.). Proceedings of the 3rd International Workshop of the Wheat Yield Consortium. CENEB, CIMMYT, Cd. Obregón, Sonora, Mexico, 5-7 March 2013. Mexico, DF.: CIMMYT.

Mondal S., A.K. Joshi, Huerta Espino J. and R. P. Singh. 2013. Early maturity in wheat for adaption to high temperature stress. 12th International Wheat Genetics Symposium. Book Chapter (Submitted).

Objective 5:

Peer-reviewed journal articles, book chapters, and books

Spielman, D. J., D. E. Kolady, A. Cavalieri, N. C. Rao. 2014. The seed and agricultural biotechnology industries in India: An analysis of industry structure, competition, and policy options. *Food Policy* 45: 88-100.

Dey, M.M., D.J. Spielman, A.B.M. Mahfuzul Haque, M.S. Rahman, and R. Valmonte-Santos. 2013. Change and diversity in smallholder rice-fish systems: Recent evidence from Bangladesh. *Food Policy* 43: 108-117.

Discussion/working papers

Magnan, N., D. J. Spielman, T. J. Lybbert, and K. Gulati. 2013. *Leveling with Friends: Social Networks and Indian Farmers' Demand for Agricultural Custom Hire Services*. IFPRI Discussion Paper 1302. Washington DC: International Food Policy Research Institute.

Ward, P. S., D. L. Ortega, D. J. Spielman, and V. Singh. 2013. *Farmer Preferences for Drought Tolerance in Hybrid versus Inbred Rice: Evidence from Bihar, India.* IFPRI Discussion Paper 1307. Washington DC: International Food Policy Research Institute.

Ward, P.S. and V. Singh. 2014. Risk and Ambiguity Preferences and the Adoption of New Agricultural Technologies: Evidence from Field Experiments in Rural India. IFPRI Discussion Paper 01324. Washington DC: International Food Policy Research Institute.

Policy briefs, research notes, and other publications

Magnan, N.M, D.J. Spielman, K. Gulati, and T.L. Lybbert. Gender dimensions of social networks and technology adoption: Evidence from a field experiment in Uttar Pradesh, India. In *Gender, Agriculture, & Assets Project (GAAP): Learning from Eight Agricultural Development Interventions in Africa and South Asia*, A. Quisumbing, R. Meinzen-Dick, J. Njuki, and N. Johnson, eds. GAAP Note. Washington, DC: IFPRI. http://www.ifpri.org/sites/default/files/publications/gaapcollection2013.pdf, November 23.

Spielman, D.J. 2013. Making sustainable intensification work on sound evidence. *Scidev.net* opinion/editorial article. http://www.scidev.net/global/sustainability/opinion/making-sustainable-intensification-work-on-sound-evidence-1.html, October 16.

Project documents

Magnan, N., D. J. Spielman, K. Gulati, and T. J. Lybbert. 2013. Gender dimensions of social networks and technology adoption: Evidence from a field experiment in Uttar Pradesh, India. In *Gender, Agriculture, & Assets Project (GAAP): Learning from Eight Agricultural Development Interventions in Africa and South Asia*, A. Quisumbing, R. Meinzen-Dick, J. Njuki, and N. Johnson, eds. GAAP Note. Washington, DC: IFPRI.

Conferences, workshops and seminars

Singh, V. 2014. Lessons from the CSISA project: Implications for project design and gender dimensions of social networks and technology adoption in eastern Uttar Pradesh, India. Presentation given at a seminar on “Addressing Gender, Agriculture and Assets in Agricultural Development Projects” organized by the International Food Policy Research Institute under the GAAP Project, India Habitat Center, New Delhi, March 26.

Bhargava, A. 2014. Agriculture technology adoption and the MNREGA Scheme in India. Paper presented at a conference on “The MNREGA in India: Taking Stock, Looking Ahead” organized by the International Food Policy Research Institute, Cornell University and Indira Gandhi Institute of Development Research (IGIDR), IGIDR, Mumbai, March 26-28.

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Awards

The paper by P.S. Ward and V. Singh (2014) titled "Risk and ambiguity preferences and the adoption of new agricultural technologies: Evidence from field experiments in rural India" was awarded Best Paper from a total of 86 presentations at the Fourth International Conference on Applied Econometrics, IBS-Hyderabad, March 20-21, 2014.

Appendix B: USAID Indicators

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

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance							
Technology type	See below	See below	30,000	66,682	120,000	59,578.7	250,000
crop genetics				896		0.0	
pest management						0.0	
disease management						0.0	
soil-related				64		12.8	
irrigation				22,534		28.4	
water management				784		40.6	
post-harvest handling and storage						1,200.0	
processing						257.6	
climate mitigation or adaptation				7,780		553.0	
other				34,624		57,486.3	
total w/one or more improved technology							

Disaggregates Not Available							
New/Continuing			30,000	66,682		59,578.7	
New				35,368		1,675.5	
Continuing				31,314		187.0	
Disaggregates Not Available						57,716.3	
Sex			30,000	66,682		59,578.7	
Male				21,152		1,776.3	
Female				711		74.2	
Association-applied				42		12.0	
Disaggregates Not Available				44,777		57,716.3	

Deviation Narrative:
This is the first year that CSISA Phase II is trying to include indicator numbers in its semi-annual report. The timing of this report has allowed us to capture some of our numbers, but has not allowed us to capture some of our most important contributors, including early sown wheat and zero till wheat, which are not yet available. These two very important numbers, along with the disaggregates for the numbers included above, will be submitted at the time of annual reporting.

Comment:
This is an Objective 1 indicator and includes data from Bihar, Eastern UP, Odisha, Tamil Nadu, Haryana, and ILRI's cross-cutting work.

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

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		**2014**		2015
			Target	Actual	**Target**	**Actual**	Target
					PPR		
4.5.2(5): Number of farmers and others who have applied new technologies or management practices as a result of USG assistance							
New/Continuing	See below	See below	19,800	285,574	500,000	73,994	1,000,000
New				99,457	165,000	2,064	330,000
Continuing				186,117	335,000	384	670000
Disaggregates Not Available						71,546	
Sex			19,800	285,574		73,994	
Male			15,804	14,254		1,564	
Female			1,756	568		147	
Association applied				5		9	
Disaggregates Not Available				270,747	500,000	72,274	1,000,000

Deviation Narrative:

This is the first year that CSISA Phase II is trying to include indicator numbers in its semi-annual report. The timing of this report has allowed us to capture some of our numbers, but has not allowed us to capture some of our most important contributors, including early sown wheat and zero till wheat, which are not yet available. These two very important numbers, along with the disaggregates for the numbers included above, will be submitted at the time of annual reporting.

Comment:

This is an Objective 1 indicator and includes data from Bihar, Eastern UP, Odisha, Tamil Nadu, Haryana, and ILRI's cross-cutting work.

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

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
4.5.2(7): Number of individuals who have received USG supported short-term agricultural sector productivity or food security training							
Type of individual	See below	See below	20,000	12,126	15,000	9,343	15,000
Producers			7,079	9,401		7,106	
People in government			2,360	1,372		1,799	
People in private sector firms				243		77	
People in civil society				911		247	
Disaggregates Not Available				199		114	
Sex			20,000	12,126		9,343	15,000
Male			8,449	9,995		8,151	
Female			990	2,131		1,192	
Disaggregates Not Available							

Deviation Narrative:

This semi-annual report has captured the trainings conducted between October 1, 2013 and March 30, 2014.

Note:

This is an Objective 1 indicator and includes data from Bihar, Eastern UP, Odisha, Tamil Nadu and Haryana. It also includes numbers from ILRI's work in CSISA.

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 community-based organizations (CBOs) receiving USG assistance

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
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 community-based organizations (CBOs) receiving USG assistance							
Type of organization	See below		20	919	1,200	1,470	1,500
Government organization				30		37	
Private enterprises (for profit)			2	820		1,312	
Producers organizations			2	6		21	
Water users associations			2	0		1	
Women's groups				35		62	
Trade and business associations			2	4		4	
Community-based organizations (CBOs)			2	24		33	
Disaggregates Not Available				0		0	
New/Continuing				919		1,470	
New				607		612	

Continuing				312		858	
Disaggregates Not Available				0		0	

Narrative:
This indicator is where we capture the number of organizations that we work with, but also the service providers that are generated by CSISA, who are reported as "private enterprises." CSISA has thus far created over 1,300 service providers in Bihar and Eastern UP for zero tillage and laser land levelling. The number of service providers created for mechanical transplanting of rice into non-puddled soil will be captured in the annual report.

Comment:
This is an Objective 1 indicator and includes data from Bihar, Eastern UP, Odisha, Tamil Nadu, and ILRI's cross-cutting work.

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

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
4.5.2(12): Number of public-private partnerships formed as a result of FTF assistance	See below		6	29	6	26	6
Agricultural production				17		8	
Agricultural post harvest transformation				1		1	
Nutrition						0	
Multi-focus				11		9	
Other						8	
Disaggregates Not Available						0	

Deviation Narrative:
CSISA formed more PPPs than expected this year.

Note:
This is an Objective 1 indicator and includes data from Bihar, Eastern UP, Odisha, Haryana, and Tamil Nadu.

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)

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
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)							
Sector				10		11	
Inputs				7		8	
Outputs							
Macroeconomic							
Agriculture sector-wide				2			
Research, extension, information, and other public service							
Food security / vulnerable						2	
Climate change adaptation or natural resource management				1		1	
Disaggregates not available							
Stages of Development				10		11	
Stage 1 of 5			3	7	3	10	3
Stage 2 of 5			1	1	1		1
Stage 3 of 5			1	1	1		1
Stage 4 of 5			1	1	1	1	1
Stage 5 of 5			1	0	1		1
Disaggregates Not Available				0			

Deviation narrative:
CSISA's work on policy research has expanded at the behest of project management and hub staff, as well as several key stakeholders. The policy research team is exploring issues in several new areas that require analysis, for example, appropriate-scale mechanization and industry structure; rural social protection and technology adoption; and gender and social capital dynamics in technology adoption.

Comment:
This is an Objective 5 indicator. Data is provided by IFPRI. The following policies were analyzed: **Nepal:** fertilizer and seed; **Bangladesh:** mechanization, seed and private R&D priorities and incentives; **India:** public and private R&E priorities and incentives, mechanization, biotechnology, rural social protection, and gender and social capital.

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

Current Selection							
Reporting Organization : USAID							
Indicator / Disaggregation	2014 Mid-Year Deviation Narrative	2014 Mid-Year Comment	2013		2014		2015
			Target	Actual	Target	Actual	Target
					PPR		
4.5.2(39): Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	See below						
Phase 1 Number of new technologies or management practices under research as a result of USG assistance			13	47		35	30
Phase 2 Number of new technologies or management practices under field testing as a result of USG assistance			25	80		18	94
Phase 3 Number of new technologies or management practices made available for transfer as a result of USG assistance			26	55		63	65
Disaggregates Not Available							

Deviation Narrative:
For this semi-annual reporting we have put all of the Objective 3 and 4 technologies in Phase 1, Objective 2 technologies in Phase 2, and Objective 1 technologies in Phase 1. This can be reevaluated for the annual report.

Note:
This indicator includes data from Objectives 1 (hubs), 2 (research platforms), 3 (rice breeding), and 4 (wheat breeding).

Appendix C: Results Framework

Key Milestones	Period One			Period Two		
	Oct 1, 2012 to Mar 31, 2013	*Apr 1, 2013 to Sept 30, 2013*	**Period one update in annual report, Nov 2013**	*Oct 1, 2013 to Mar 31, 2014*	*Apr 1, 2014 to Sept 30, 2014*	**Period two update in semi-annual report, May 2014**
	Target at period end			**Target at period end**		
Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income						
Sub-objective 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						
1.1.1.1. Road map for transitioning existing hubs in Punjab, Haryana, Tamil Nadu, and Pakistan implemented.	Strategy to transition hubs while continuing to ensure impact of CSISA investments is developed and initiated.		Transitions to other aligned projects completed in Nepal and Pakistan. Exit strategies defined for Haryana, Tamil Nadu, and Punjab.	Strategy revisited and the merit of continued CSISA support evaluated. Begin transition of hubs. Implement options for partial self-sufficiency. Hubs should provide half of their own support by Jan. 2014.		New potential funding sources to continue work in Punjab and Tamil Nadu identified. Haryana operations will be limited to strategic research only after rabi 2014. Support for Punjab will terminate after rice harvest in Q3, 2014.
1.1.2.1. Primary impact pathways for each hub domain defined to provide a goal-oriented road map that combines innovation, product development, and strategic partnerships.	In consultation with core partners, primary impact pathways defined and prioritized for action in order to accelerate the out-scaling of key CSISA-supported technologies.		Impact logic mainstreamed into activities planning at twice-annual evaluation and planning meeting held at the country level in Bangladesh and India (started in Bangladesh in 2011). Concepts and implementation mainstreamed with the India hubs in January 2013.	1 million farmers reached through change agents supported by CSISA's impact pathway logic. Impact pathway assumptions and efficacy re-assessed and adjusted (if needed) in advance of the rabi and karif cropping seasons.		Impact pathways developed for priority hubs for Rabi and Kharif seasons. Rabi impact pathways developed at planning & evaluation meeting in Sept 2013 and Kharif impact pathways developed at planning & evaluation meeting in March 2014.

Key Milestones	Period One			Period Two		
	Oct 1, 2012 to Mar 31, 2013	*Apr 1, 2013 to Sept 30, 2013*	**Period one update in annual report, Nov 2013**	*Oct 1, 2013 to Mar 31, 2014*	*Apr 1, 2014 to Sept 30, 2014*	**Period two update in semi-annual report, May 2014**
	Target at period end			**Target at period end**		
Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income						
Sub-objective 1.2. Participatory technology testing and adaptation for sustainable intensification						

1.2.1.1. Production and livestock feed technologies that address key knowledge gaps and specifically address the needs of women.	At least 10 adaptive research trials addressing prioritized knowledge gaps conceived and implemented in each hub, including 6 that meet women's needs during the principal growing seasons.	Targets exceeded in priority hubs in Bihar, EUP, Odisha, and Bangladesh. Many assess labor-saving interventions that are particularly germane to women farmers. Most have been implemented with partner organizations, including KVKs, OUAT, DoA in the new CSISA hub in Odisha.	At least 10 adaptive research trials addressing prioritized knowledge gaps conceived and implemented in each hub, including 6 that meet women's needs during the principal growing seasons.	In India alone, more than 40 types of agronomic research trials implemented in the past year. Nine socio-economic surveys have been completed to complement the agronomic trials. Gender aspects of HH welfare outcomes as well as enabling factors such knowledge networks have been evaluated.
1.2.2.1. Prioritized production and livestock feed technologies that have been tested and improved in the context of communities to match the needs of different regions, farmer groups, and women.	At least 25 participatory technology verification trials or demonstrations, and animal feed development groups active in at least 4 hubs, with innovative feed strategies defined and tested during principal growing seasons.	Targets exceeded in priority hubs in Bihar, EUP, Odisha, and Bangladesh for crop production demonstrations and verification trials. New partner (dairy) organisations in Odisha mobilize animal feed development groups through existing milk supplier networks.	At least 25 participatory technology verification trials or demonstrations, and animal feed development groups active in at least 4 hubs, with innovative feed strategies defined and tested during principal growing seasons.	Target exceed, with more than 20 types of technology demonstrations conducted at over 3,000 locations in India alone.
	Partial budget analyses of three key technology interventions conducted in each hub.	Completed as planned for technologies such as zero-tillage wheat, directly sown rice, mechanically transplanted rice, laser land levelling, options for integrated weed management, and site-specific nutrient management.	Partial budget analyses of three key technology interventions conducted in each hub.	Completed as planned for technologies such as zero-tillage wheat, directly sown rice, mechanically transplanted rice, laser land levelling, options for integrated weed management, pathways for maize intensification, and site-specific nutrient management.

1.2.4.1. Strategies to overcome principal gender-differentiated causes of postharvest cereal losses in each hub domain.	Gender-differentiated extent and prime causes of postharvest losses determined with men and women in at least four hubs.	PRA and key informant interviews completed in Bangladesh, Bihar, and Odisha to characterize PH losses and key intervention points.	Options to overcome primary causes of postharvest losses adopted by men and women in at least four hubs.	Mechanized threshing and innovative drying and storage technologies adopted in Bangladesh, Bihar, and Odisha.
1.2.5.1. Strategies to overcome biophysical, socioeconomic, and policy-related constraints to farmer adoption of key production, livestock feed, and postharvest technologies.	Constraints to the acceptance of key technologies documented in at least four hubs, and strategies to overcome these identified.	Adoption studies completed for ZT wheat, directly sown rice, maize intercropping, and laser land levelling. PRA and key informant interviews completed in Bangladesh, Bihar, and Odisha to identify key entry points and potential bottlenecks for crop production, post-harvest, and livestock innovations.	Strategies to overcome adoption constraints implemented as part of the impact pathway-driven planning process.	Adoption constraint studies inform activity planning and implementation for DSR, mechanical transplanting, and ZT wheat.

Key Milestones	**Period One**			**Period Two**		
	Oct 1, 2012 to Mar 31, 2013	***Apr 1, 2013 to Sept 30, 2013***	**Period one update in annual report, Nov 2013**	***Oct 1, 2013 to Mar 31, 2014***	***Apr 1, 2014 to Sept 30, 2014***	**Period two update in semi-annual report, May 2014**
	Target at period end			**Target at period end**		
Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income						
Sub-objective 1.3. Translating research into actionable products and insights.						
1.3.1.1. Web and mobile-phone based applications to aid decision-making by men and women farmers at large scale but with context-specific information, including site-specific nutrient management for different crops, cropping systems, and regions.	Requirements and interest of men and women farmers for real-time and site-specific information on agronomic best practices assessed within the context of technical feasibility along with ex-ante and ex-post evaluations.		User testing of the Crop Manager tool for rice in Bangladesh conducted in kharif 2013, and will be extended in the boro season. Field testing in India initiated in rabi 2013-14 with beta version release of rice-wheat tool.	The utility of different 'real time' recommendation dissemination platforms (e.g. SAU agro-advisories, private sector ICT) to meet the identified needs of smallholders assessed, and recommendations derived for improving existing tools in consultation with partners.		Consultations with NARES and private sector partners on tools design and deployment ongoing for Crop Manager deployment.

	Nutrient management software validated for different crops, cropping systems, and regions (Web and mobile-phone applications), and Crop Manager application designed based on user requirements.	V.1.0 rice and maize tools released in Bangladesh; rice tool released in Tamil Nadu. Beta testing of rice-wheat tool in Bihar and EUP ongoing for rabi 2013-14 season.	At least three versions of Nutrient Manager (NM), NM Mobile, or Nutrient Expert (NE) software piloted in Bangladesh, India, or Nepal; Crop Manager application validated in farmers' fields design refined based on feedback from men and women farmers.	Advanced user testing of maize and rice Crop Managers completed in Bangladesh. Beta-testing of new tool for rice-wheat systems completed in Bihar and EUP, and also completed for rice in Odisha. Initial tool evaluations for maize in Odisha planned for Kharif 2014.
1.3.2.1. Strengthened and diversified dissemination pathways for agricultural knowledge and technologies using traditional approaches and ICTs.	At least 6000 farmers and partners exposed to new technologies through community-based demonstrations, trainings, and at least 10 cross-hub exposure visits.	Targets exceeded in India alone with 9,401 famers receiving short-term training, including 2,131 women.	At least 8000 farmers and partners exposed to new technologies through community-based demonstrations, trainings, and at least 10 cross-hub exposure visits.	Target exceeded with more than 24,000 farmers, service providers, extension, and partner staff trained on CSISA-supported technologies in the prioritized hubs in Bangladesh, Bihar, EUP, and Odisha.
	Instructional videos developed and deployed to more than 250 villages; uptake following exposure to videos assessed.	332 villages reached in Bangladesh alone for 'Save More, Grow More' video, with an ex post assessment of efficacy and how to layer communication and training approaches recently completed. Videos distributed through intermediaries in Bihar, EUP, and Tamil Nadu have reached hundreds more.	Instructional videos developed based on uptake assessment, and deployed to more than 700 villages; uptake following exposure to videos assessed.	In India, videos developed and delivered at the community level through State Department partners on mechanical transplanting, early wheat planting, and DSR. Farmer-to-farmer knowledge exchange facilitated through participatory video production in collaboration with Digital Green, with uptake metrics being assessed in Odisha. Thousands of villages reached.

	User assessment performed, and CKB design/content plan refined based on assessment; at least 10 new entries incorporated, and at least 10 hub staff and partners in each hub introduced to/updated on CKB.	CSISA calendar for 2013 produced and distributed. Reprints of other useful material being ordered. Knowledge mapping exercises for Odisha initiated and completed for one district in Odisha. Partnership mapping exercises for content development and dissemination completed for Odisha, planned for Bihar. Pilot for video content production with Digital Green initiated in Odisha, ongoing in Bihar. 2 video produced in Bihar, 5 planned for Bihar and 10 for Odisha.	At least 25 new entries incorporated, and at least 10 hub staff and partners in each hub introduced to/updated on CKB.	New outreach material developed for DSR, AWD, mechanical transplanting, and better-bet agronomy. CKB updated accordingly.

1.3.4.1. Identify and facilitate dissemination of superior dual-purpose rice, wheat, and maize breeding lines and hybrids in South Asia through breeding networks, farmers, and fodder traders.	Released or near-release rice, wheat, and maize lines/ hybrids with superior 'dual purpose' traits identified, characterized, and matched to prioritized production ecologies.	Progressing as planned.	High-performing dual-purpose rice, wheat, and maize promoted through breeding networks, seed companies, fodder traders, and for demonstration in hubs.	Rice and maize varieties from public and private sector were routinely investigated from breeding and cultivar release work and superior dual purpose cultivar were jointly identified. Reaction in terms of seed multiplication and promotion was very quick with hybrids, i.e. maize, but delayed with rice. Major demonstration in CSISA hubs have been arranged for maize in Kharif 2014. Maize stover trading was actively promoted but un-chopped stover trading (preferred for distances of 80 to 120 km) saw maize stover disadvantaged compared with sorghum stover (DCM load capacity of 2.4 tons of sorghum stover compared to 1 ton of maize stover). Chopping decreased this ratio to 1.5. For where straw trading difference in digestibility of 3 percent units (43 vs 40%) were found to be associated with price premiums of about 8%. Superior cultivars were identified from drought resistant wheat cultivar with 46% digestibility.

	At least 30 promising rice lines/hybrids in multi-location replicated yield trials evaluated for straw fodder traits.	Progressing as planned.	Varietal release committees are apprised of the fodder traits of promising rice lines.	Variety release committees were engaged for maize and rice by investigating released and pipeline cultivars to determine the exploitable variation in straw and stover traits mans trade relationships. The maize committee in its April 2014 meeting in Udaipur decided to accept maize stover traits as a special criteria and the case for rice will be presented end of the year with the Directorate of Rice Research whose cultivars were investigated.
	Promising heat and disease-resistant maize cultivars tested in hub domains with partners, including breeders from national programs.	Progressing as planned.	Heat and disease-resistant maize cultivars with superior grain and stover yields, and good fodder quality promoted with input from partners and national programs including through the IMIC network.	Cultivars have been identified from maize, rice and wheat. For maize and rice cultivars disseminated for pilot testing has been arranged for Kharif 2014 in CSISA sites. As an observation, dissemination of identified superior dual purpose types in CSISA needs to be better organized in that the crop breeders are better linked to crop agronomist in the hubs.

1.3.5.1. Business models targeting men and women entrepreneurs for sustaining change through private enterprise and investment.	Gender-based and other constraints to the initiation of agricultural businesses evaluated, and at least 5 business models developed or strengthened that incorporate technologies recommended by CSISA.	Progressing as planned with service provider business models assessed for ZT, mechanical transplanting, axial flow pumps, reapers, and threshers. New businesses for small tools (e.g. fertilizer spreaders, hand seeders) under assessment.	At least 5 business models developed or strengthened; 2 new types of businesses initiated or existing ventures strengthened by SMEs in hubs; challenges to business development addressed as possible.	New business opportunities for small machinery (power tillers, hand seeders, precision fertilizer applicators, weed control) and post-harvest activities (e.g. rice husk dryers) identified and assessed. Business model logic for laser levelling, DSR, mechanical transplanting, and ZT wheat strengthened.

Key Milestones	**Period One**			**Period Two**		
	Oct 1, 2012 to Mar 31, 2013	***Apr 1, 2013 to Sept 30, 2013***	**Period one update in annual report, Nov 2013**	***Oct 1, 2013 to Mar 31, 2014***	***Apr 1, 2014 to Sept 30, 2014***	**Period two update in semi-annual report, May 2014**
	Target at period end			**Target at period end**		
Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income						
Sub-objective 1.4. Mobilizing partnerships for catalyzing impact at scale.						
1.4.1.1. Advisory committees and partnerships to help define research and development directions, link other players to hub activities, and promote CSISA technologies and out-scaling methodologies.	Technical Working Groups (TWGs), Advisory + Investment Committees (AIC) constituted; meetings held in each hub.	TWG, AIC meetings held in each hub to revise workplans in light of learning and new partnership opportunities.	Advisory and Investment Meetings held in Bihar, Odisha, and Bangladesh. TWG concept has been revisited, and constituted as on-going interactions with specific partners for specific technical themes rather than a general standing committee.	TWG, AIC meetings held in each hub to revise workplans in light of learning and new partnership opportunities.	TWG, AIC meetings held in each hub to revise workplans in light of learning and new partnership opportunities.	Advisory and Investment Meetings held in Bihar, Odisha, and Bangladesh. TWG concept has been revisited, and constituted as on-going interactions with specific partners for specific technical themes rather than a general standing committee.

	At least 5 major partnerships established or strengthened each year in the priority hubs with support from the TWG/AIC.	Targets exceeded with a strong mix of public (e.g. JEEViKA, State Departments in India), private (e.g. RFL in Bangladesh), and NGO (e.g. Digital Green in Odisha) partners. Crucially, we are also catalyzing partnerships among our core partners.	At least 5 major partnerships established or strengthened each year in the priority hubs with support from the TWG/AIC.	Focus during the reporting period is on consolidating progress and strengthening relationships with existing partners.

Key Milestones	Period One			Period Two		
	Oct 1, 2012 to Mar 31, 2013	*Apr 1, 2013 to Sept 30, 2013*	**Period one update in annual report, Nov 2013**	*Oct 1, 2013 to Mar 31, 2014*	*Apr 1, 2014 to Sept 30, 2014*	**Period two update in semi-annual report, May 2014**
	Target at period end			**Target at period end**		
Objective 1. Widespread dissemination of production and postharvest technologies to increase cereal production, resource efficiency, and income						
Sub-objective 1.5. Strategic capacity development to support key agents of change.						
1.5.1.1. Capacity development for men and women CSISA staff and public and private sector partners/actors to play leading roles in accelerating impacts at scale for farmers.	"Training of trainers" (ToT) course for senior and junior CSISA hub staff and selected partners, including social and gender issues developed and conducted.		Initial focus has been on increasing the technical competencies of new staff. ToT has been reframed as a second-order priority.	Trainings for hub staff and partners conducted, with modules on participatory technology development, user-driven communication strategies, gender in agricultural development.		Direct mentorship of project staff on these subjects has been prioritized over formal training.
	Leadership course conducted for at least 20 women engaged in agricultural research, development, and extension.		Activity has been re-oriented to target women entrepreneurs. Training and linkage workshop between new women entrepreneurs, banks, and mentors held in Bangladesh in Q4 2013. A similar event is planned for Bihar in December 2013.	Leadership course conducted for at least 20 women engaged in agricultural research, development, and extension.		Activity has been re-oriented to target women entrepreneurs. Training and linkage workshop between new women entrepreneurs, banks, and mentors held in Bangladesh in Q4 2013. Similar event were held in Bihar and Odisha during Q1 / Q2 2014.

	Training course with modules covering at least 5 animal husbandry topics prepared and conducted for staff and partners at prioritized hubs.	Efforts to harmonise and document current training activities are on-going. Links between farmer groups and existing training institutions (e.g. NDRI) are being developed.	Training course with modules covering at least 5 animal husbandry topics conducted for staff and partners at prioritized hubs.	Focus on remained on training at NDRI with, farmers returning to serve as local resource persons at the community level.
	Demand-driven trainings developed and conducted for at least 300 local service providers to improve mechanized, better-bet agronomy and business development skills for new and existing entrepreneurs.	Targeted exceed with 750 service providers trained in Bihar and EUP alone. BDS aspects in the process of being strengthened.	Demand-driven trainings conducted for at least 300 local service providers to improve mechanized, better-bet agronomy and business development skills for new and existing entrepreneurs.	Targeted exceed with over 1,300 service providers trained in Bihar and EUP alone. BDS aspects strengthened with a business training modules under development.
	Dealer training programs and certification examinations designed, agronomy extension leadership program piloted in two hubs, and program requirements and business plan developed.	Dealer training program launched in Bihar and EUP. Decision on certification still pending partner feedback. Extension agent training program imitated in Bihar and EUP, with over 1,300 extension personnel trained in India in 2013.	Two exams administered to about 100 and 250 agro-dealers, student performance reviewed, and successful candidates certified.	Dealer training program strengthened with BAMITE and private sector partners (e.g. UPL). Decision on certification program has been deferred until the potential 'phase III' of CSISA.
1.5.3.1. Next generation of cereal systems scientists and development professionals, especially women, strengthened.	Thesis research conducted in collaboration with CSISA and partner institutions by at least 20 MSc students of which at least 30% are female.	Student recruitment on-going.		Student research on-going through a strong mix of national (e.g. OUAT, RAU, BAU) and foreign (e.g. University of Nebraska, Wageningen University) institutions.

	Training modules developed and short-term advanced courses conducted for hub staff (including animal husbandry) and at least 75 young male and female scientists.	Training modules develop for DSR, seeder maintenance, mat nurseries, and the fundamentals of site-specific nutrient management.	Training modules developed and short-term advanced courses conducted for hub staff (including animal husbandry) and at least 75 young male and female scientists.	Completed for site-specific nutrient management, advanced statistical analysis, and the fundamental of machinery use and operation.
	At least 30 interns (30% female) placed in CSISA hubs and partner institutions.	15 interns were place in 2013, including three females. Additional recruitment is ongoing with an emphasis on attracting more women candidates.	At least 30 interns (30% female) placed in CSISA hubs and partner institutions.	14 interns placed in India alone during the reporting period, including 6 female interns.

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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.	Four research platforms established, strengthened, or continued with new and on-going experiments that address key opportunities to optimize sustainability and profitability based on feedback from farmers and hub-based socio-economics and biophysical scientists.		New and on-going experiments conducted in Bihar, Bangladesh, and Haryana. Platform activities in TN continued through March 2013.	Four research platforms continued with appropriate changes to assess and optimize technologies for greenhouse gas (GHG) emissions of different crop rotations × management systems.		Platform-based research continued in Bangladesh, Bihar, and Haryana. New strategic research trials initiated in Odisha.

	In collaboration with NARES partners, identify and communicate constraints associated with CA-based systems and develop hypotheses to inform process-based research trials that will lead toward system refinements.	New experiments devised in Haryana, Bihar, Tamil Nadu, and Bangladesh on topics such as managing secondary salinization with CA and precision water management under crop diversification scenarios.	In collaboration with NARES partners, CA-based systems evaluated with process-based research trials that will lead toward system refinements.	On-farm and on-station CA-based research continued across all CSISA hub domains.
2.2.1. Models for assessing cropping system performance under different agro-ecological conditions and climate-change scenarios.	Evaluate and improve modeling tools such as APSIM, DSSAT, ORYZA 2000, and DNDC	CSISA has joined the AgMIP (model intercomparison and improvement) initiative and is working with the APSIM, DSSAT, and TOA-D development teams to assess and improve simulation performance at locations across the IGP.	Apply improved validated crop-livestock systems models to exploring new cropping systems and crop management options for at least 4 hubs, and generate scenarios for further field evaluation in Objective 1.	CSISA continues simulation work through AgMIP (model intercomparison and improvement) initiative and is collaborating with the APSIM, DSSAT, and TOA-D development teams to assess and improve simulation performance at locations across the IGP.
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 inform the design of on-farm trials for multi-locational testing.	Joint planning and evaluation meetings held between Objective 2 and Objective 1 teams twice a year.	Dedicated Objective 2 meeting held in October 2012 and September 2013. Integrated planning with Objective 1 conducted in Haryana, Bihar/EUP, and Bangladesh twice annually.	Joint planning and evaluation meetings held between Objective 2 and Objective 1 teams twice a year.	Integrated planning meetings held in September 2013 (Kathmandu) and March 2014 (Odisha), with dedicated follow-up meetings conducted for Objective 2.

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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.	Selected breeding lines evaluated through public- and private-sector breeding network, dissemination of superior dual-purpose breeding lines and hybrids facilitated through breeding networks, farmers, and fodder traders.	Fifty breeding lines were evaluated in multilocation trials conducted during the wet season 2012. Six promising lines along with 60 new breeding lines will be evaluated in MET during Kharif season 2013.	Selected breeding lines evaluated; trait-based selection for high yield potential (HYP) conducted on germplasm and elite lines, yield and fodder quality-related genes/QTLs genotyped.	Fifty eight entries were tested in multi-location trials conducted at four locations and 12 promising entries were identified. Straw quality of 100 entries was tested and five mapping populations are being developed. SNP marker assays for a large number of candidate genes and cloned QTLs for key traits, including yield components, have been designed for running as 24-SNP sets on the Fluidigm EP1 system. Cloned yield enhancing genes are being transferred to four IRRI varieties and three mega varieties of India.

3.2.1. Rice for mechanized direct seeding and water-saving irrigation practices developed and released.	At least 25 new lines/hybrids in different maturity groups tested under mechanized DSR and CA at 4-6 locations; at least 10 new hybrids/breeding lines entered in national varietal testing programs.	Ninety entries involving breeding lines and hybrids were evaluated in MET conducted during wet season 2012.Nine promising entries were identified for second year of testing in 2013.	Precise plant development and growth stages described for DSR in 3 contrasting locations; ***Pup1*** introgressed into at least 2 mega-varieties and pyramided with anaerobic germination in IR64; promising lines evaluated in network trials, hubs, and platforms.	Precise plant development and growth stages for DSR being studied. Through marker assisted back cross breeding IR64-Pup1-AG1, Ciherang-Sub1-Pup1-AG1 and Samba Mahsuri-Sub1-AG1-Pup1 are being developed. 100 entries comprising of hybrids and new breeding lines were evaluated at six locations. In general hybrids performed better under DSR. Six hybrids and five inbreds were identified for large scale testing and state level multi-location trials. A few promising hybrids and varieties were tested in CSISA hubs and research platforms.

3.3.1. At least two heat-tolerant rice varieties nominated for national varietal testing.	Reliable field phenotyping facilities and protocols established in CSISA hubs;	Established 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	QTL high day temperature (HDT) tolerance mapped and flanking markers developed; promising entries for high night temperature (HNT) tolerance identified; donors for early morning flowering (EMF) identified and evaluated	The QTL qHTSF4.1 was fine mapped and PCR based markers and protocols for marker assisted selection were developed. Near isogenic lines (NILs) with N22 introgression in IR64 background were developed and BC5F3 lines were evaluated in the field along with the early morning flowering (EMF) NILs. A recombinant inbred line (RIL) population consisting of 246 F7 lines was developed and is being used for high night temperature (HNT) QTL mapping and other heat tolerance studies. Out of a large number of diverse accessions evaluated under the field conditions, a NERICA (New Rice for Africa) line showed promising levels of HNT tolerance.

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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.	30 lines each of early, medium, and normal-maturing HYP wheat that is heat, drought, and disease-tolerant tested; at least 200 segregating breeding populations selected; new crosses made at CIMMYT and by NARES; 5 best lines evaluated in multilocation yield trials.	Achieved as planned, including 64 different bread wheat nurseries planted across South Asia in 2012-13.	30 lines tested; at least 200 breeding populations selected; new crosses made; 5 best lines evaluated under CA in multilocation yield trials; at least 3 new varieties released by NARES and private-sector partners.	Achieved through 100 bread wheat trials planted across south Asia in 2013-14 cycle. More than 1800 new crosses made and >12000 breeding populations selected. Superior lines evaluated under CA in multilocation trials. Eight new wheat varieties were released, six identified for release while more than 700 promoted to national/state/regional trials.
4.2.1. Spot blotch-resistant wheat germplasm and molecular markers for resistance to the disease.	Resistance to spot blotch characterized through annual screening in Mexico and hot-spots in South Asia; capacity of spot blotch screening in Mexico and hot spots of S. Asia enhanced.	Around 1000 genotypes planted at Agua Fria (Mexico) for evaluation. In addition, around 2000 lines are being evaluated by collaborators in India.	Resistance to spot blotch characterized; 3 RIL/DH populations phenotyped/genotyped, and preliminary flanking markers for resistance identified.	Resistance to spot blotch characterized by evaluating around 2000 genotypes at Mexico. In addition, 2200 lines were characterized by collaborators in South Asia. Four mapping populations were again phenotyped. Genotyping done. Mapping underway.
4.3.1. Improved heat and drought tolerance in wheat.	Physiological and environmental limitations to yield established; conceptual models for heat- and drought-adaptive traits refined to increase yield potential; phenotyping manual developed and trainings conducted for hub staff and partners.	Progress as planned.	Potential parents characterized and early-generation breeding progeny selected.	A panel of new advanced lines comprising high yield and/or biomass characterized based on strategic crosses to combine complementary source-sink traits. Lines with suitable physiological traits providing adaptation to heat stress were determined.

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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.	Concrete strategies developed to: a) achieve the policy changes required for improved delivery of seeds and other inputs b) unite public and private partners in delivery of CSISA technologies, including specification of appropriate incentives for market segmentation and implementable agreements for Public/Private Partnerships.		Strategies under development, in publication, and under discussion; continuing communications efforts planned to bring public and private partners together.	a) Survey and data collection completed and published to public site. b) Assists the project to catalyze at least one Public/Private Partnership MOU or contract signed by each Hub.		Survey and data collection completed; Publication to public site completed. Assistance to hubs and CSISA management on PPPs ongoing.
5.2.1. Improved policies and incentives that address changing labor, gender, assets, and migration dynamics related to pro-poor technology development and delivery.	a) Study methodology developed to assess gender-differentiated access to and control of key assets, the role of women in agricultural technology adoption decisions, and the role of rural employment schemes on adoption of resource-conserving technologies.		Efforts still ongoing: Specific study objectives and methodologies under development.	Recommendations for Hubs and for policymakers developed for improving women's access to key assets and for increasing technology adoption by women.		Initial recommendations for hubs and policymakers communicated, further research and communications activities envisioned in subsequent periods

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Objective 6. Project management, data management, communication, evaluation, and decision support.						
Sub-objective 6.1. Project management						

6.1.1.1. Effective and efficient project management.	Hold monthly and quarterly meetings with CSISA objective leaders and institutional partners; biannual meetings with advisory and investment committees, annual forum with key NARES representatives from across S. Asia.	Country-based 'MT' and project-wide 'EC' meetings conducted as planned. Regional forum deferred while country-specific consultations with NARES partners are prioritized.	Hold monthly and quarterly meetings with CSISA objective leaders and institutional partners; biannual meetings with advisory and investment committees, annual forum with key NARES representatives from across S. Asia.	Country-based 'MT' and project-wide 'EC' meetings conducted as planned. Regional forum deferred while country-specific consultations with NARES partners are prioritized.

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Objective 6. Project management, data management, communication, evaluation, and decision support.						
Sub-objective 6.2. Data management and communication						
6.2.1.1. Standardized data collection across project, minimum data set characterized by consistent metadata schema for ease of reuse, data easily retrievable, mined across project.	SOPs for data collection optimized and data training held, agronomy module designed for Integrated Breeding Platform (IBP), AgTrials, DataVerse customized, Surveybe, OpenDataKit operational, Google Fusion implemented for analysis, visualization, mapping. Minimum meta-data requirements implemented by 12/2012 by CSISA-funded partners.		Data standardization protocols completed; good progress on developing and deploying electronic mobile data collection platforms in ODK and Surveybe; data portals with strong meta-data standards and open public access supported and utilized.	SOPs, IBP regularly used, biannual training on data management held.		Good progress on developing and deploying electronic mobile data collection platforms in ODK and Surveybe.

6.2.1.2 Key CSISA datasets made widely available through public access data repositories.	Regionally and globally important datasets from Phase I of CSISA (i.e. strategic research, socioeconomic studies, and multi-location screening trials) are made publically available in well-documented formats.	Data from experimental platforms uploaded into AgTrials. CSISA HH survey baseline data released on IFPRI's dataverse instance during Q2 2013.	Important CSISA datasets are updated every quarter into publically available data repositories as a regular business practice for the project.	Dataverse and AgTrials used as public repositories for most important CSISA datasets.
6.2.2.1 Improved communication across project personnel and locations, shared learning, record of project, and accountability, improved PR and dissemination of information about CSISA.	CSISA Wiki/group communication platform created; project personnel and hub staff trained to add project documents and materials; CSISA Web site created, tested, refined, and frequently updated.	Beta launch of new website in Q3 2013. Internal communications platform established and functional.	Continued maintenance of communication platform and web site.	New web site (csisa.org) has been launched, with an accompanying quarterly e-newsletter. A monthly staff newsletter (***CSISA magazine***) has also been launched.

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Objective 6. Project management, data management, communication, evaluation, and decision support.						
Sub-objective 6.3. Project evaluation of outcomes and impacts						
6.3.1.1. Comprehensive assessment and continual refinement of project processes, outcomes, and impacts, with lessons learned incorporated and communicated to partners, donors, and stakeholders.	Implement M&E system, collect and upload disaggregated (by hub, gender) data for outputs that are tied to intermediate outcomes		New inference techniques devised and implemented to assess progress towards intermediate outcomes for Rabi 2012-13. Techniques have been customized and matched to different project interventions.	At least 1 qualitative case study conducted in each of the hubs around key innovations, collect and upload disaggregated (by hub, gender) key indicators, draw out lessons and implication from these, and report on them to relevant stakeholders.		New and standard inference techniques used to track progress against reported and internal progress indicators compiled for annual and semi-annual report.