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CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA: Agronomy and Seed Systems Scaling

Final Report (2014-2019)



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Cereal and pulse yields in Nepal fall well below regional averages and the present rates of yield increase will not meet long-term domestic requirements. Factors that contribute to the low yields of staple crops in Nepal include scarce and costly farm labor, poor knowledge of best agricultural management practices by smallholder farmers, insufficient irrigation and mechanization to overcome soil moisture and labor deficits, and farmers' reluctance to take risks and invest in new technologies, including diversified cropping systems. These areas also receive limited attention from the private sector in terms of investment in agriculture.

The Cereal Systems Initiative for South Asia (CSISA) has been working in India, Nepal and Bangladesh since 2009 to identify and research technologies for improving the yields of staple crops. Nepal's Terai plains and Midhills are one of CSISA's working areas as there is considerable scope for improving farmers' lives by making agriculture more productive and sustainable.

The Government of Nepal's 20-year **Agriculture Development Strategy (ADS, 2015–2035)** recognizes the need for new science-led innovations, crop diversification for income generation, strengthened input systems for seeds and fertilizer, mechanization to address out-migration and the aging agricultural workforce, and enterprise development to create jobs and extend support services to farmers.

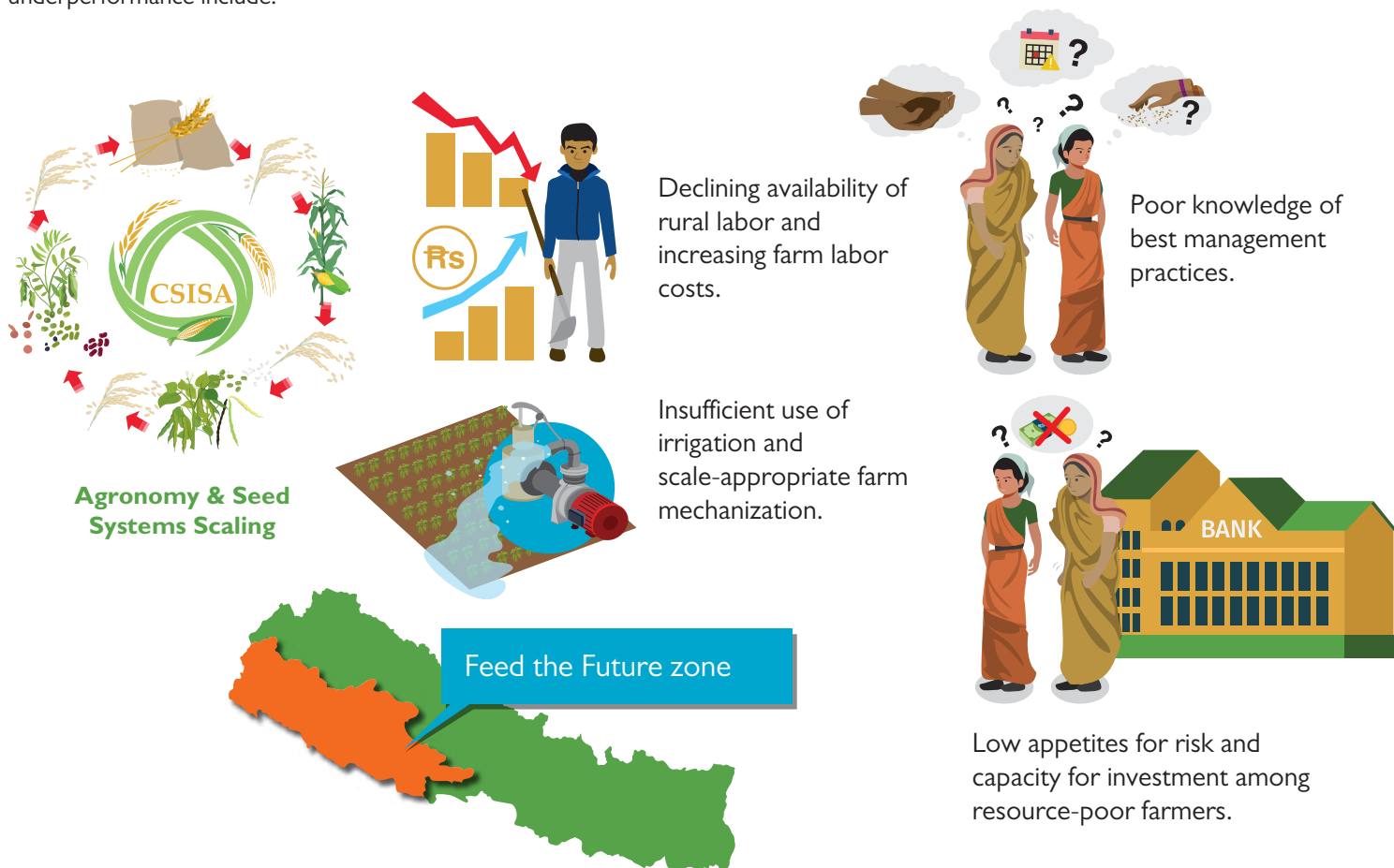


Main working areas of the CSISA Agronomy and Seed Systems Scaling activity and key locations mentioned in this report

THEORY OF CHANGE



In Nepal, current cereal and pulse yields are insufficient to meet near-or long-term domestic requirements. Factors contributing to this underperformance include:



The CSISA Nepal Agronomy and Seed Systems Scaling activity has systematically addressed these issues by:



Strengthening seed systems so farmers have timely access to improved, stress-tolerant varieties and hybrids for pulses, wheat and maize.



Targeting geographic niches and identifying management practices that enable cropping system intensification through the inclusion of lentils and mung beans as new crops cultivable by resource-poor farmers.



Recommending best management practices for wheat, including scale-appropriate mechanization technologies that help farmers plant early and avoid terminal heat while addressing rural labor bottlenecks.



Facilitating market development for small-scale technologies that enable precise nutrient management.



Supporting the expansion of the private sector in the Feed the Future zone of Influence in Nepal, including the availability of appropriate agricultural mechanization options, including spares parts, improved mechanic services, and expanding the number of machinery service providers to facilitate affordable access among farmers for mechanization technologies.

IMPACT



The CSISA Agronomy and Seed Scaling activity has had large-scale and durable impact in Nepal's cereal-based agricultural food systems. The activity had significant impact in wheat, maize and pulse production systems in the Feed the Future zone. Among farmers adopting stress-tolerant varieties, improved seed, and implementing climate-smart and resilient farm management practices.



65,843 FARMERS

have applied improved technologies and/or management practices as a result of activity interventions on 30,811 hectares of crop land.

40% | 26,403 FARMERS

applying improved technologies and resilience-enhancing management practices were women.



45,233

wheat farmers applied improved technologies and management practices in more than 21,000 ha.



10,576

maize farmers also applied improved technologies on 4,421 ha



8,035

farmers adopted mungbean as a new crop in Nepal and grew it on 2,133 ha.



3,910

farmers used climate resilient production methods to grow lentil on 1,459 ha.

Private-sector led development is core to CSISA's strategy for success. The CSISA Agronomy and Seed Systems Scaling activity supported providers to improve their business performance across the Feed the Future zone.

**1,010
PRIVATE
ORGANIZATIONS**



Agricultural input dealers



Machinery manufacturers



Importers and dealers

**2,013
INDIVIDUALS
TRAINED**



Government collaborators



Civil society organization representatives



Private sector and staff

To achieve the above, individuals received enhanced training on seed systems, resilient varieties, better-bet agronomic practices for cereals and pulses, and appropriate agricultural mechanization business models. Trainees cascaded their knowledge to farmers through a variety of intervention pathways tailored to achieve each of the activity's objectives.



20%
of those trained were women.

These activities have led to durable and long-lasting changes and improvements in farmer's access to:



Improved, stress-tolerant varieties and hybrids for pulses, wheat and maize.



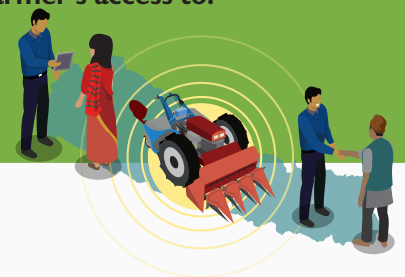
Targeted production of mung beans and pulses among resource-poor farmers.



Viable options for more precise and efficient nutrient management.



Climate-resilient enhancing and affordable wheat production technologies and practices.



Facilitating market development and value chains for scale-appropriate farm machineries that reduce labor-bottlenecks and assist women headed households in efficient farm management.

OBJECTIVES



To address these priorities, USAID's additional investment in CSISA, in the form of the 'Agronomy & Seed Systems Scaling activity' was launched in October 2014 to scale-up and-out the research findings and technologies developed under original CSISA program investments. The activity worked with government agencies, farmers' groups, service providers, agro-dealers, seed enterprises and other development partner-supported activities to scale-up previous achievements, mainly in Nepal's Terai.

The activity's expected outcomes align with those of the Global Food Security Act.

The activity focused on the following objectives and activities to address the activity's theory of change



OBJECTIVE 1

Robust seed systems that ensure timely access to elite cultivars and hybrids.



OBJECTIVE 2

Pulse intensification and diversification, adopted at scale.



OBJECTIVE 3

Cropping systems approaches for sustainably intensifying wheat and minimizing climatic stress.



OBJECTIVE 4

The facilitation of efficient and low-risk strategies for the precise and productive use of nutrients.



OBJECTIVE 5

Scale-appropriate mechanization and irrigation (this component received co-funding from USAID India, which ended in September 2017).



OBJECTIVE 1:

ROBUST SEED SYSTEMS THAT ENSURE TIMELY ACCESS TO ELITE CULTIVARS AND HYBRIDS.

RATIONALE:

Enabling Nepali farmers to adopt improved crop varieties is a fundamental aspect of raising productivity and developing greater resilience to biotic and abiotic stresses. Moreover, planting elite seeds can synergistically generate even higher returns on companion investments in management technologies and production inputs like fertilizer.

Timely access to quality seed with locally-relevant genetic traits (e.g., high yield potential, resilience to biotic and abiotic stresses, nutritional quality) in combination with best agronomic practices and reliable inputs will significantly improve crop productivity, livelihoods, and profit margins of smallholder farmers in the West and Mid-west of Nepal. It is important to note that improved seed distribution must be accomplished through strengthened seed systems – 'one off' interventions such as seed giveaways rarely have lasting benefits. Strengthened seed systems will assure access to elite seeds both today and in the future, and are an important foundation for the near-term realization of the benefits from crop genetic improvement at the farm scale.

TOTAL IMPACT NUMBERS PER INDICATOR:



23,558 FARMERS

gained access to and adopted improved and stress-tolerant varieties of seed as a result of CSISA's strategic and private-sector led interventions in Nepal's seed sector.



Improved and stress-tolerant varieties of seed were grown on

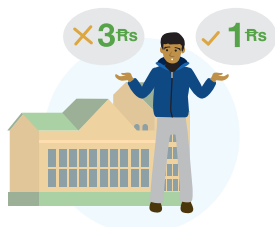
10,312 HECTARES

across the Feed the Future zone.

CHALLENGES ADDRESSED:



Weak private seed sector



Seed companies' and seed growers' lack sufficient capital to grow their businesses



Limited progress on implementing national seed strategies to see large-scale adoption of climate-resilient and stress tolerant varieties



Limited use of yield-enhancing and profitable hybrid seed varieties

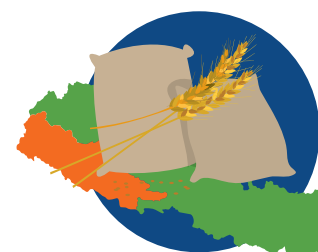
APPROACHES:



Providing evidence for and lobbying for regulatory improvements



Building business and technical capacity of seed companies in Nepal while exposing seed companies improved business principles and international best practices



Expanding farmers' ability to access seed and grow pulses in the Feed the Future zone

PROVIDING EVIDENCE FOR AND LOBBYING FOR REGULATORY IMPROVEMENTS AND EXPOSING SEED COMPANIES IMPROVED BUSINESS PRINCIPLES AND INTERNATIONAL BEST PRACTICES

Seed system summits

In 2014, CSISA participated in the national Seed Summit which aimed to identify how to achieve the goals of the National Seed Vision and the Agricultural Development Strategy (2015–2035) for the emergence of robust seed systems in Nepal. Activities during 2014-2015 systematically responded to weakness in seed systems identified through these engagements and in the National Seed Vision. Later in September of 2019, CSISA convened 150 government and private sector participants in the International Seed Conference and Expert Consultation in Kathmandu. This event provided a forum to exchange ideas and share knowledge and international good practices and innovations on the development of Nepal's seed sector.

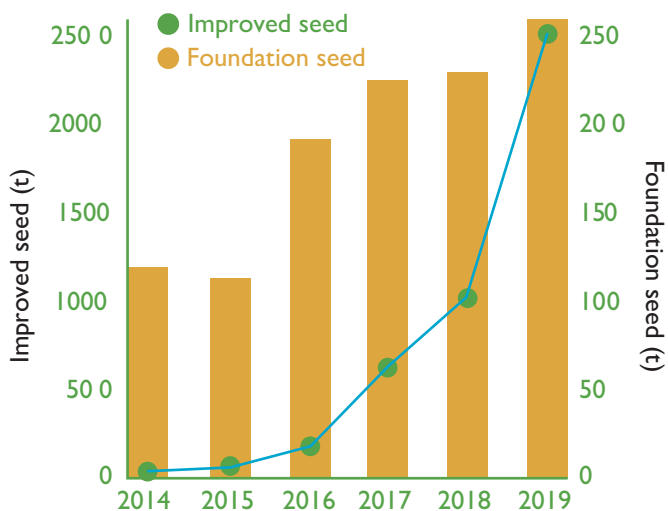
Building seed businesses

Nepal's seed growers are constrained by their lack of capital. Activity support for the piloting of a lending model for wheat seed growers in Kailali district in partnership with Laxmi Bank and Panchashakti Seed Company led to 20 farmers receiving \$10,000 of loans for wheat seed production sector.

BUILDING BUSINESS AND TECHNICAL CAPACITY OF SEED COMPANIES IN NEPAL:

INCREASED PRODUCTION OF FOUNDATION SEED

CSISA improved the capacity of five primary seed company partners to produce foundation seed. This has increased the availability of base seed stock, which can be used to multiply seed and increase availability for farmers. Wheat foundation seed production increased from 2 tons in 2014 to more than 100 tons in 2018. The activity played an important technical advising and facilitating role in this achievement, alongside national seed sector partners.



KEY SEED COMPANY PARTNERS



Global Agritech Nepal Pvt Ltd, Banke



Kalika Seed Company, Kathmandu



Lumbini Seed Company, Rupandehi



Unique Seed Company, Kailali



Panchashakti

Volume of improved and foundation wheat seed sold by the activity's five partner seed companies (2014–2019)



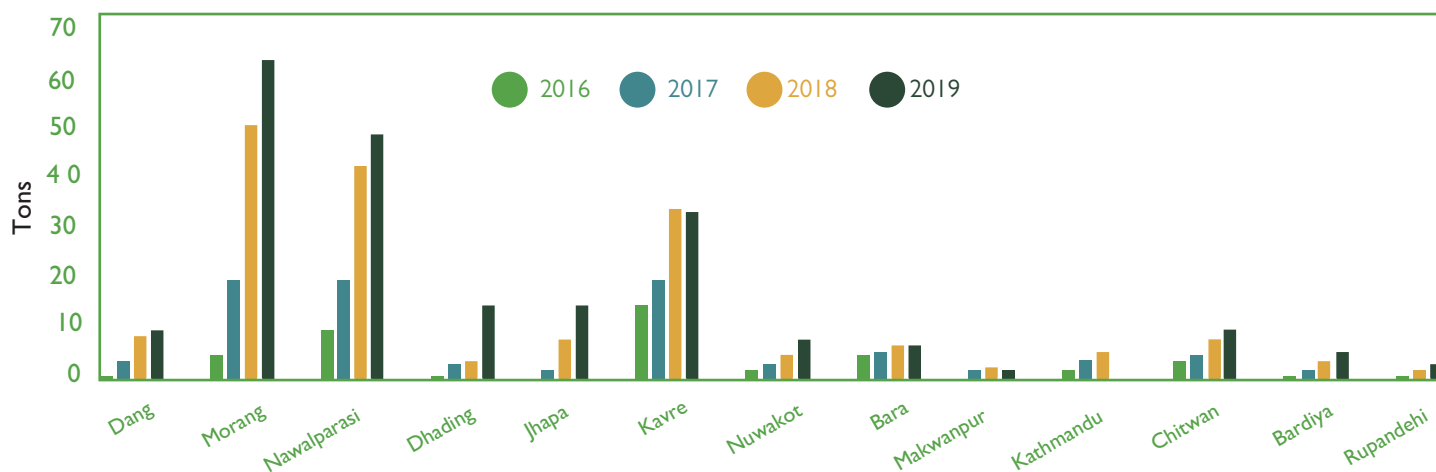
HYBRID MAIZE FOR INCREASED YIELDS

CSISA's on-farm research in the mid-hills of Nepal conclusively demonstrates that the simple step of planting maize hybrids instead of open-pollinated varieties can increase grain yields by 50% with no other changes in management. Despite these advantages, before 2015 no hybrids were registered for cultivation in the FtF zone and very few farmers were growing them. After helping the National Maize Research Program formally register four adapted hybrids for cultivation in the Feed the Future zone, CSISA has intensively worked with private sector partners to bring these hybrids to market while building awareness among farmers of the benefits of cultivating hybrids.

Low maize yields in the Midhills of the Feed the Future zone as no hybrid maize varieties were officially registered for planting in this area.

Activity research that demonstrated increased yields of 50% when planting hybrids and activity advocacy resulted in the registration of the Rajkumar, Nutan, 9220 and TX-369 hybrid maize varieties in the FtF zone.

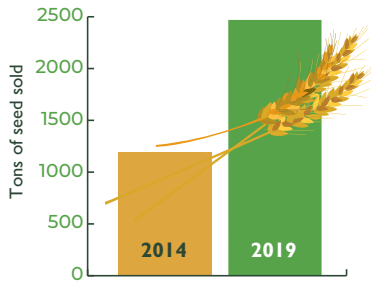
Activity partnerships with private seed companies led to 184 tons of these hybrids being available/sold – more than doubling the availability of hybrid seed and enabling farmers to sow more than 9,000 hectares.



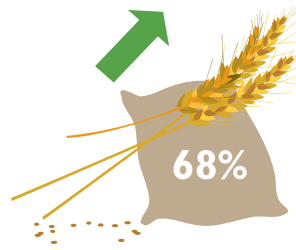
Sales of the three maize hybrids imported from CSISA's partner company Bioseed (2016–2019 actuals) indicate steady growth in market development and sustained access to farmers in much of the Feed the Future zone.

SCALING WHEAT PRODUCTIVITY THROUGH IMPROVED VARIETIES:

Activity support led to:



The volume of wheat seed sold by the five seed company partners more than doubling from 1,194 tons in 2014 to 2,450 tons in 2019.



A 68% increase in the number and share of new improved wheat varieties since 2014 resulted from the activity's interventions alongside an increase in the rate of wheat seed replacement.



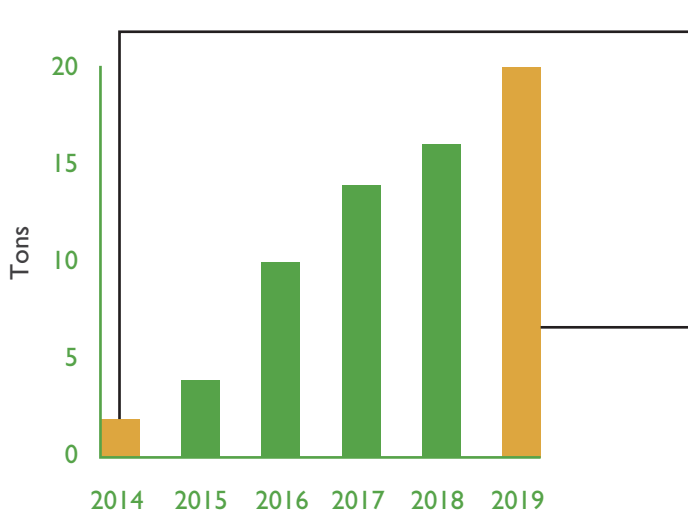
The spread of newer varieties of wheat with resilience traits including Borlaug 100, a blast-resistant wheat variety rich in iron and zinc, which is now being produced by six seed companies.

Out-crossing and genetic drift are major impediments to seed sector commercialization, and seed companies supported by CSISA have started maintenance breeding to improve the quality of source seed while new elite varieties BL 4341 in wheat.



MAKING MONEY WITH MUNG BEAN:

Although farmers have little awareness of this innovation, mung beans are a high potential crop for Nepal, which can be grown on fallow land before monsoon rice. Activity support brought together the Nepal Agricultural Research Council (NARC), mung bean grower cooperatives, food processors and local governments to pilot a market coordination mechanism for mung bean.



In 2014

Almost no mung beans were grown in the Feed the Future zone

- CSISA encouraged maintenance breeding to improve the quality of mung bean seed, including Pant Mung 5 which was registered with the government in part due to CSISA's efforts

By 2019

3,100 resource-poor farmers in the western Terai grew mung beans using low-cost production methods as advised by CSISA and realized substantial profits.

Volume of mung bean seed sales of Panchashakti Seed Company Pvt. Ltd. and Global Agritech Nepal Pvt. Ltd., both of whom partnered with CSISA in improving seed systems in the Feed the Future zone



The area where mung beans are grown has increased as reflected in the increased volume of mung bean seed sales by partner seed companies since 2014



OBJECTIVE 2:
**PULSE INTENSIFICATION AND
DIVERSIFICATION, ADOPTED AT SCALE.**



RATIONALE:

USAID has historically focused on pulse production – both for potential nutritional benefits in rural communities, and as a prioritized value chain – in Nepal. At the start of the activity, despite considerable development efforts, farmer investment pulses remained low with average yields stagnating and below 1 ton/ha in most locations in the Terai. Research conducted by CSISA prior to 2014 suggested that adoption of improved varieties may improve yields by 0.1 tons per hectare, but results are inconsistent with strong site and year interactions. More promising was the potential role of management interventions such as precision sowing and judicious use of fertilizers to complement the adoption of improved varieties. Research suggested that yields can be doubled (e.g., 0.6 to 1.2 tons/ha) when better-bet management is combined with improved varieties.

TOTAL IMPACT NUMBERS PER INDICATOR:



Prior to CSISA's interventions, few if any farmers in Feed the Future zone had knowledge that mung bean could be a successful crop. They also struggled with a complex of diseases that reduced lentil productivity.



Moving research into impact, a total of

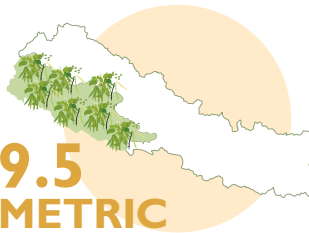
**11,946
FARMERS**

predominantly resource poor – in Nepal's Feed the Future zone intensified their cropping systems by combining improved varieties with sound agronomic practices to grow mung beans and lentils on 2,113 & 1,459 hectares, respectively.

MARKET-ORIENTED PULSE PRODUCTION FOR INCOME AND NUTRITION:



Between 2014-2016, CSISA continued to focus on generating research evidence on pulse productivity while also sensitizing farmers on the benefits of mung bean cultivation through the former Department of Agriculture.



**9.5
METRIC
TONS**

After this period, CSISA mobilized its research evidence to show that mung bean could be profitably grown to seed companies across the Feed the Future zone. Through collaborative actions to develop successful business models with Gate Nepal Pvt. Ltd. paid off, as the company sold 9.5 metric tons of mung bean seeds sourced from 1,187 farmers in the Mid and Far-West districts. Since then, more than

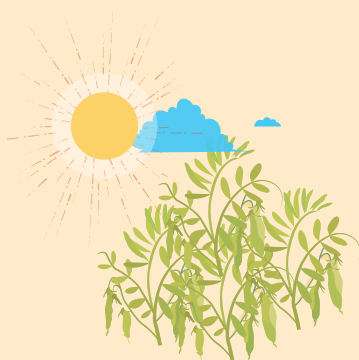
1,500 farmers were newly engaged with mung bean grain production in 2017 and in aggregate produced more than 600 tons of grain.



**\$2.5
MILLION
MUNG
BEAN**

Farmers' enthusiasm for mung bean grew exponentially since then, with more than 8,000 farmers cultivating mung bean in place of fallow land in the early Kharif season in Nepal's Terai, with a market value of over US \$2.5 million of mung bean produced.

CLIMATE SERVICES FOR RESILIENCE:



CSISA collaborated with the USAID-funded Climate Services for Resilient Development activity and the National Grain Legume Research Program on a lentil stemphylium disease monitoring study across the Mid and Far-Western Terai. Stemphylium blight is a potentially devastating crop disease that threatens lentil yields in Nepal's Terai. Weather conditions directly affect disease incidence and severity. In response, the activity has been supporting the development of a weather forecast based predictive model. Preliminary results indicate a strong fit between model outputs and field observations, indicating substantial potential for use as a disease early warning and forecasting system in Nepal.



OBJECTIVE 3:

CROPPING SYSTEMS APPROACHES FOR SUSTAINABLY INTENSIFYING WHEAT AND MINIMIZING CLIMATIC STRESS.



RATIONALE:

Wheat productivity growth in the Indo-Gangetic Plains is constrained by the combination of late sowing and terminal heat stress during the grain filling period when temperatures can exceed 32°C. Such high temperatures are common in Nepal’s Terai and the adjacent Indian states of Bihar and (Eastern) Uttar Pradesh.

In these environments, typical wheat planting dates range from the third week of November until the end of December.

Although extension services tend to recommend sowing before December 10th, most important adaptive response to build farmers’ resilience and cope with contemporary threats of heat stress as well as the projected shrinking of the thermal ‘window of opportunity’ for wheat with projected climate changes is to encourage farmers to plant before in mid- and at the latest in late-November.

KEY IMPACTS:



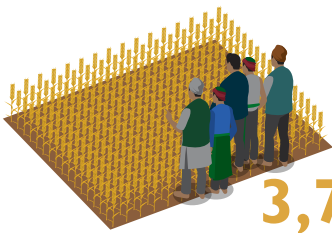
CSISA scientists determined that sowing date recommendations in Nepal are in urgent need of revision. Earlier sowing of wheat allows farmers to escape from the yield-reducing effects of high temperatures late in the growing season. When sowing earlier, farmers can gain nearly 0.5 tons/ha compared to when sowing late. Farmers who also sow early and use longer-duration cultivars achieve additional yield gains.



As a result of collaborative research and the generation of data through CSISA and the National Wheat Research Program (NWRP) partnership, the Ministry of Agricultural and Livestock Development instructed the National Seed Corporation to stop producing an old variety (NL 297) that was particularly susceptible to heat stress and that had poor yields.



CSISA assisted the NWRP in the registration of elite long duration varieties, including NL 1327 and Borlaug 100 in Nepal.



3,700 ha



>5,300 FARMERS

adopted timely wheat seeding over 3,700 ha in the Feed the Future districts as a result of CSISA’s efforts. Approximately 5,000 farmers also applied supplemental irrigation based on agro-advisories provided by CSISA through radio media campaigns.



By forgoing repetitive plowing to prepare the field for sowing, farmers can advance wheat seeding dates. CSISA therefore continued to support zero-tillage equipment and mechanization solutions to achieve earlier sowing. More than 150 service providers purchased zero-tillage seed drills and are now offering services to farmers across the Feed the Future Zone from a base near zero in 2015 – establishing a critical mass of machinery to assist farmers in adapting to climatic stresses. Activity efforts to support earlier sowing through zero-tillage service provision is resulting in increasing successes through ongoing and new collaborations with the Prime Minister Agricultural Modernization Project and provincial agriculture ministries in the Terai. Since 2015, the area under mechanized wheat establishment has nearly tripled, in large part due to activity interventions.



CSISA'S DATA-DRIVEN CAMPAIGNS FOR EARLIER WHEAT SOWING OF YIELD IMPACTS:



Surveys conducted in FY 2019 by the activity with 1,684 wheat farmers found that 43% who had been exposed to radio jingles and information campaigns facilitated by CSISA had adopted longer duration wheat varieties, and on average, the adoption of these varieties had increased productivity by almost 0.5 tons/ha⁻¹. When combined with early sowing practices, farmers using long-duration varieties can avoid the significant loss of 20 kg/ha⁻¹ day⁻¹ of yield due to terminal heat stress in the Terai. These findings led the activity to facilitate the National Wheat Research Program to register elite long duration varieties, including NL 1327 and Borlaug 100, for sustained cultivation by smallholder farmers in Nepal.

INFLUENCING VARIETAL REPLACEMENT POLICY:



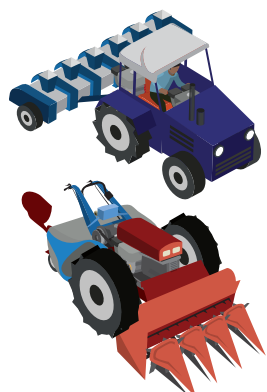
With the National Wheat Research Program, CSISA conducted varietal evaluations of released and pipeline wheat varieties to assess yield potential and stress tolerance. Newer long-duration wheat varieties (e.g., NL 971) had superior performance across environments and planting dates, suggesting broad adaptability. As a consequence of these evaluations, the Ministry of Agricultural and Livestock Development (MoALD) instructed the National Seed Corporation (NSC) to stop producing an old variety (NL 297) that did not perform well in these evaluations. Since NSC is the largest wheat seed producer in Nepal, this policy change promises to have a marked impact on adoption rates of elite wheat cultivars in the coming season and beyond.

PARTNERSHIPS AND MEDIA CAMPAIGNS ENCOURAGE TIMELY WHEAT SOWING TO BEAT THE HEAT IN WHEAT:

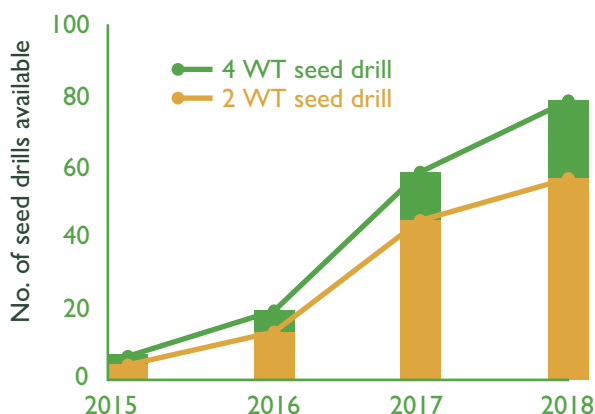


The government-implemented Prime Minister Agricultural Modernization Project (PMAMP) used their own funds to print and disseminate 9,000 informational leaflets – practical, research-driven guides for improved agronomic management – developed by CSISA in conjunction with the National Wheat Research Program. All leaflets were distributed to farmers as part of CSISA, and the Nepal Wheat Research Program's informational campaigns in the Feed the Future (FtF) zone. CSISA also worked closely with radio stations throughout the FtF zone to broadcast short 'jingles' – entertaining audio clips with key messages on the benefits of earlier sowing of wheat.

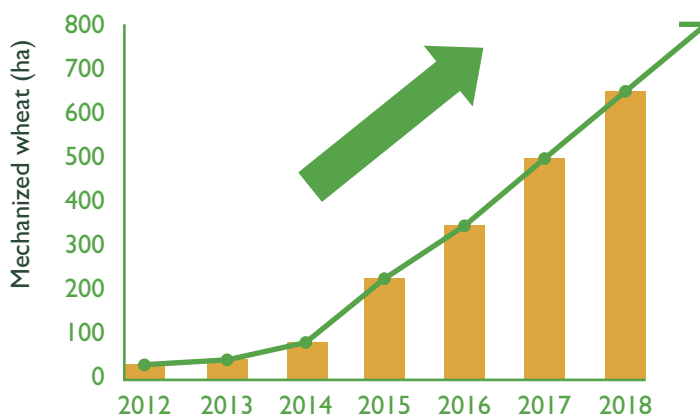
PUBLIC-PRIVATE PARTNERSHIPS IN APPROPRIATE PLANTING MACHINERY FACILITATE TIMELY WHEAT ESTABLISHMENT:



Since it began, the activity's regular technical backstopping and other support to government partners, machinery dealers and other stakeholders on crop establishment issues has brought about a large increase in the availability of four- and two-wheel tractor (4WTs and 2WTs) seed drills in the FtF zone. The number purchased and in operation in Sudurpashchim province and Province 5 increased from only 10 in 2015 to 135 at the start of 2019. And the area seeded mechanically in the two province's Terai districts has increased from 250 ha in 2014 to 700 ha in 2018. The increasing number is correlated with their commercial availability through dealers and also through entrepreneurial service providers working with farmer-clients. Around 12 local machinery dealers in the Terai areas of Sudurpashchim province and Province 5 now sell these drills.



Increase in number of seed drills in Sudurpashchim province and Province 5, 2015–2018¹

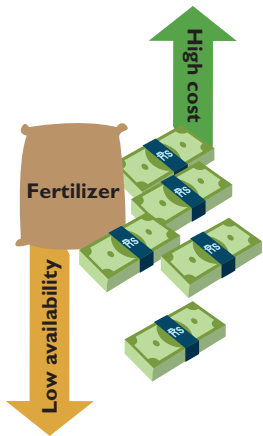


Hectares of wheat sown using seed drills in Kailali and Kanchanpur, 2011–2018

¹ Note that 2018 captures FY 2019.



OBJECTIVE 4: THE FACILITATION OF EFFICIENT AND LOW-RISK STRATEGIES FOR THE PRECISE AND PRODUCTIVE USE OF NUTRIENTS.



RATIONALE:

Poor availability and high prices of fertilizer pose a binding constraint to improving agricultural productivity and rural livelihoods in Nepal. Estimates are that the Government of Nepal are generally able to supply less than 30% of current demand for nutrients, and that the partial subsidy program coupled with black market imports from India and insufficient knowledge (i.e., demand) of the value of fertilizers have constrained private investment in import and distribution.

As a consequence, insufficient access to fertilizer constitutes a severe threat to national-scale food security and household-level welfare. This has contributed to a significantly negative balance between cereal supply and demand, and, in many years, places Nepal in the financially precarious position of importing grain staples at international market prices. More progressive policies are essential (e.g., voucher-based approaches to the partial and insufficient subsidy scheme), but there are several pathways for improving the present scenario based on better management that will also serve to build demand and compel private investment. Current fertilizer use recommendations in Nepal are outdated and applied across very broad areas of the country with few guidelines in place to improve the efficiency of use (e.g., nutrient balance, timing, placement, formulation). Further, existing recommendations were developed on experiment stations under conditions that have very little to do with the realities of on-farm production and the variation that exists at nested scales from the village, to landscape, to region.

Farmers in the FtF zone use less fertilizer than elsewhere in Nepal. CSISA data demonstrates that the simple step of investing US\$60 ha⁻¹ in fertilizers can improve wheat yields by 1 t/ha⁻¹ while boosting profitability by US\$140 ha⁻¹. Evidence from central hills of Nepal demonstrates the power of ‘getting it right’, with net returns from maize increasing by approximately US\$400 ha⁻¹ with sensible investments in fertilizer. Three factors play a dominant role in determining how much fertilizer is required to optimize crop growth and economic yield: attainable yield potential at the farm level, indigenous soil fertility, and the efficiency of use of applied nutrients.

KEY IMPACTS:



In the Feed the Future districts only 13% of farmers are applying potassium fertilizer. CSISA continued to communicate the importance of balanced fertilization for increasing crop yield and improving

soil health by conducting trainings, on-farm demonstrations, and distributing factsheets. These efforts have contributed to increasing sales of potassium fertilizer through the Agriculture Input Company Limited, which sold 51.05 t in 2017 – almost double the level from 2015.



To provide a low-cost and woman-friendly pathway for increasing management precision, CSISA introduced and facilitated the uptake of the mechanical ‘hand-crank’ spreader for fertilizer in Nepal. Spreaders are an alternative to laborious hand-broadcasting of fertilizers that aid in the even distribution of nutrients across fields and can increase cereal yields in Nepal by 7–10% while saving 50% in labor costs. Through activity campaigns and partnership with agricultural machinery importers and dealers, more than 2,000 precision spreaders have been sold and are used by farmers in the Feed the Future zone.

AFFORDABLE FERTILIZER SPREADERS FOR SMALLHOLDER AND WOMEN FARMERS:

The first commercially-available spreaders were introduced into Nepal by CSISA in 2016. Following national elections and governmental restructuring, the activity’s collaboration with the new provincial governments has created awareness of the benefits of using hand-crank spreaders to apply fertilizers efficient and precisely. In March 2019, the Sudurpashchim and Province 5 governments began to provide a 50% subsidy for smallholder farmers to purchase spreaders through provincial agricultural machinery and input dealer-suppliers. In addition, the activity has supported other USAID-Nepal funded initiatives by training them on how to use spreaders through a training of trainer program. Program graduates have trained and demonstrated the use of urea spreaders to women farmer groups across Kailali and Kanchanpur.



**OBJECTIVE 5:
SCALE-APPROPRIATE MECHANIZATION
AND IRRIGATION**



RATIONALE:

Many sustainable intensification technologies that increase productivity and profitability while also reducing environmental externalities are increasingly machinery based in South Asia, and the only way to achieve broad-scale access among small and medium holders is by encouraging the emergence of mechanized service provision models and the market-based supply and repair chains required to support them. At the same time that the need for rural entrepreneurship is increasing, Nepal is experiencing a mass exodus of young people (over 300,000/year) who seek economic opportunity outside the country. Service provision has the additional benefit of creating legitimate jobs in rural areas, perhaps particularly among migrant returnees who are seeking productive uses for earnings gained overseas that, at present, are mostly used for consumptive (non- income generating) purposes.



Precision agriculture and the broad-scale adoption of innovative crop-management technologies require specialized equipment that is not commercially available for small and medium-scale farmers in South Asia who rely on low horsepower four-wheel tractors, two-wheel ‘hand tractors’ or more recently their even smaller ‘mini tiller’ counterparts as their primary sources of traction. Many promising rural and agro-machinery programs have failed due to a lack of repair facilities and spare parts availability. In many areas in Nepal established agro machinery technologies like two and four wheel tractors, pump sets and threshers have a vibrant maintenance, repair and spare part provision system via both small, rural mechanics and workshops, as well as larger district center workshops.

Yet at the start of this activity, these networks were sparse and capacity low in the Feed the Future zone. Objective 5 of the CSISA Agronomy and Seed Scaling leveraged USAID/India funds to support activities from 2014-2016, with USAID/Washington used from 2017-2019 to ensure continuity and impact from this work package.

KEY IMPACTS:



**13,051
FARMERS**
**5,233
WOMEN**

13,051 farmers – 5,233 of whom are women – have gained affordable access to and benefited from scale-appropriate machinery for crop establishment on 7,257 hectares, largely through rural entrepreneurs offering planting services in the FtF zone.



**6,945
FARMERS**
**2,785
WOMEN**

Another 6,945 farmers – 2,785 of whom are women – are now able to access resilience-enhancing irrigation on 2,187 hectares through CSISA’s work on irrigation and pump value chains in Nepal.



**8,919
FARMERS**
**3,568
WOMEN**

8,919 farmers - 3,568 of whom are women - now have regular access to affordable crop harvesting services through value chains for mechanical rice and wheat reapers developed by CSISA in Nepal.

ENCOURAGING MECHANIZATION FOR SMALLHOLDERS:

Nepal has one of the highest out-migration rates in the world, which has led to a rapid feminization of the agricultural workforce. Dr. Sumitra Gurung established in 2014 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 to explore the possibility of demonstrating and training hill women to enable them to effectively own and operate small machinery. A catalog of small farm agro-machinery tools and equipment especially suitable for Nepali women entrepreneurs has been completed by CSISA in consultation with Dr. Gurung and her colleagues. This catalogue helped guide policies and lending practices for banks that are unfamiliar with loans for agricultural machinery, including scale-appropriate options for women and smallholders, thereby enabling more women to purchase machinery and to form small business.



TRAVELING SEMINAR:

A major activity achievement was the participation of more than 40 international experts and activity partners, including private sector partners, the Director General of the Department of Agriculture (DoA) and the PMAMP chief at a 'Traveling Seminar on Scale-appropriate Machinery for Cereal Crop Harvesting in South Asia'. The 25–29 March 2019 seminar provided a platform to share across countries and the public and private sector and to learn about cereal harvesting technologies in Asia.

PARTNERSHIPS AND MEDIA CAMPAIGNS ENCOURAGE TIMELY WHEAT SOWING TO BEAT THE HEAT IN WHEAT:

The government-implemented Prime-Minister's Agricultural Modernization Project (PMAMP) used their own funds to print and disseminate 9,000 informational leaflets – practical, research-driven guides for improved agronomic management – developed by CSISA in conjunction with the National Wheat Research Program. All leaflets were distributed to farmers as part of CSISA and the Nepal Wheat Research Program's informational campaigns in the Feed the Future zone. CSISA also worked closely with radio stations throughout the Feed the Future zone to broadcast short 'jingles' – entertaining audio clips with key messages on the benefits of earlier sowing of wheat.



NEW AVENUES FOR SCALE-APPROPRIATE MECHANIZATION:

CSISA's discussions with farmers indicate that in line-sown maize, a mini-tiller can weed 0.66 ha of land in one day (8 hours). Farmers stated that it would take over 15 laborers to weed same area. By renting in a mini-tiller from a service provider, a farmer can save over NRs 10,000 (~US\$ 80) in a single weeding. These savings are increasing interest in line-sown maize, including in reduced or no-tillage system with the new planters emerging from CSISA design 'sprint' with Indian manufacturers to improve the performance and ease of operation of planters for the two-wheel tractor platform.





\$300,000 INVESTMENT +



\$100,000 INVESTMENT

\$400,000 INVESTMENT

INVESTING IN CRITICAL INFRASTRUCTURE:

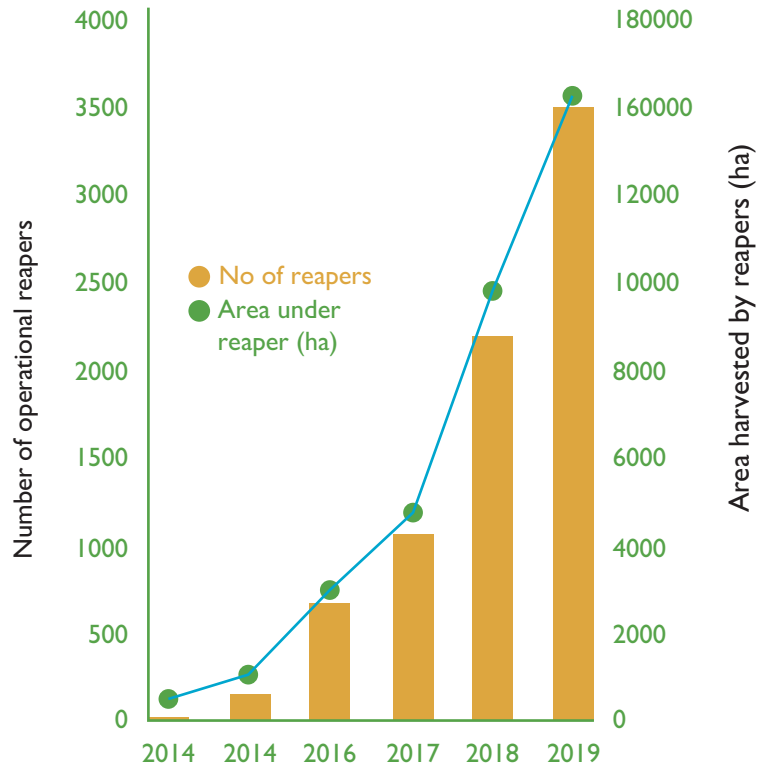
In FY18, with funding from CSISA, the Government of Nepal, Ministry of Agriculture, established the National Agricultural Machinery Promotion Center in Janakpur, Nepal. This large >20 ha facility aims to strengthen the government’s capacity to conduct training programs on agricultural machinery operation and maintenance for farmers and service providers, and for agricultural machinery repair for mechanics. The creation of this new center fulfills USAID Nepal’s investment in establishing two complementary centers: this center (run by the Department of Agriculture) and the Agricultural Machinery Testing Center (run by the Nepal Agricultural Research Center), and partly fulfills Nepal’s Agriculture Mechanization Promotion Policy, as well as the larger Agricultural Development Strategy. As evidence of the Nepal Government’s commitment to these centers and to the growth of agricultural mechanization, NARC announced a US\$ 100,000 co-investment in the Agricultural Machinery Testing and Research Center, complementing USAID’s nearly US\$ 300,000 investment already made through CSISA.



LARGE-SCALE COMMERCIAL EXPANSION AND AFFORDABLE AVAILABILITY OF HARVESTING SERVICES:

Prior to CSISA’s efforts, reaper attachments for the 2-wheel tractor were not available in the Feed the Future zone despite the high costs, delays, and drudgery associated with manual harvesting. By emphasizing private sector-led market development, growth in reaper sales continued at an impressive pace, and is now well over 1,100 in the last two years. Reaper service providers are now reaching approximately 5,500 ha per year in rice–wheat cropping systems, increasing average farm-level profitability by US\$ 120 when used for both crops.

The number of reapers in use in Nepal’s Terai has increased from 22 in 2014 to almost 3,500 in 2019, including self-propelled and commercial expansion beyond the FtF zone without CSISA support. This indicates substantial evidence of reaching scale, with strong spill-over effects beyond intervention areas.



Number of 2-wheel tractor-attachable reaper-harvesters operational through service providers in Nepal’s Terai, 2014–2019 (source: activity surveys of importers, NAMEA)

FOUR-WHEEL TRACTOR ZERO-TILL DRILLS SUCCESSFULLY SCALED-OUT THROUGH PRIVATE SECTOR PARTNERSHIPS:

CSISA helped establish a market for four-wheel tractor (4WT) seeders. Two and a half years ago there were no commercial suppliers of four-wheel tractor seeders. As of writing, there are over 150 4WT seeders sold through three Nepali importers from four primary private sector suppliers coached by CSISA and given technical and business model support. Recently, two of the Indian 4WT seed drill manufacturers also started shipping two-wheel tractor seeders, mini-tiller seeders and hand-drawn planters to their agents in Nepal.

INNOVATIONS IN SEED DRILL DESIGN CONTINUE TO YIELD BENEFITS:

In 2017/18, the activity supported three Indian seed drill manufacturers to participate in CSISA’s Mechanization and Irrigation Design Sprint. This activity has continued to yield benefits. Dharti Agro, a leading Indian manufacturer subsequently began selling its new 2WT seed drill (seeder-planter) in Nepal in mid-to-late 2018. The Nepal sales agent, Kuber and Sons, received a number of units of these planters (seed drills) and began to sell them in March 2019. This activity, which is no longer directly facilitated by the activity, provides clear evidence of ongoing impact and the potential to scale-out the use of appropriate agronomy and crop establishment through commercial pathways and mechanization.



REFLECTING ON THE LEARNINGS AND SUCCESSES OF THE CSISA AGRONOMY AND SEED SCALING ACTIVITY

Learning from the partnerships and activities implemented during the CSISA Agronomy and Seed Scaling Activity, the main areas of success include the effective scaling-out of better-bet agronomic management for pulses and wheat, advances in precision nutrient management, and the development and wide-scale adoption among farmers of new varieties and hybrids for pulses, wheat and maize. Key among the Activity's achievements is the ways in which women's empowerment and facilitating women's groups was embedded in the commercial expansion and use of precision seed and fertilizer spreaders. This simple-to-use and affordable technology facilitates the uniform application of seed and fertilizer, thereby increasing the efficiency of input resource use efficiency while also reducing drudgery and the need to handle fertilizers with bare hands. Interest in using precision spreaders as the basis for small enterprises and custom-hire services began to develop as part of the Activity among women farmers and groups in the Feed the Future zone in Nepal.

For most of the implementation period, one of the key challenges was the evolving process of political decentralization in Nepal, along with a new federal structure governing agriculture in the Feed the Future zone. Nonetheless, these changes also created opportunities to intervene – particularly with new extension activities led by Nepal's new government – and improve collaboration in support of both governmental and USAID objectives. Some of the 'best' achievements of the activity, for example out-scaling of mung bean to replace fallow land by women farmers' groups, and key research into development activities have now also been taken forward under the CSISA Phase III Activity, which will continue to grow and out-scale the benefits of the Activity to more people and in wider geographies.

The Activity's accomplishments could have not been achieved without the engagement of the USAID/Nepal mission, FtF partners and collaborators. CSISA engaged with the USAID/Nepal in distinct core areas, such as jointly implementing an Earthquake Recovery Support Program - this program leveraged CSISA work on mechanization value chains to bring scale-appropriate small tractors and attachments to hill communities that lost draft animals and agricultural labor in the devastating earthquakes that affected Nepal in April and May of 2015. As well, CSISA and FtF partners (namely KISAN I, KISAN II and the Nepal Seed and Fertilizer Activity, or NSAF) have synergistically tackled the uptake of better-bet sustainable agriculture production and post-harvest practices and technologies for targeted cereals. These and other initiatives are now working to raise awareness and commercial demand for scale-appropriate machinery service providers and rural entrepreneurial businesses in the Terai. Governmental partners also played an important role, helping to develop and extend training materials and trainings for trainers, as well as service providers, repair technicians, and blacksmiths, in addition to the testing of machinery. In sum, the CSISA Agronomy and Seed Scaling Activity was largely successful in accelerating the adoption of high-yielding and stress tolerant seeds, encouraging the intensification of cropping systems and value-addition of pulses through integrated market systems, and by dramatically increasing smallholder's access to appropriate machinery in the Terai.





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