

Cereal Systems Initiative for South Asia in Nepal (CSISA-NP)

Agronomy & Seed Systems Scaling

Annual Report October 2018

Submitted to:

Biniam lyob, USAID Washington

Eric Witte, USAID Washington

International Maize and Wheat Improvement Center (CIMMYT)

Period covered: October 1, 2017 to September 30, 2018



BILL & MELINDA GATES foundation





Table of Contents

Acronyms and Abbreviations	3
Program Overview	4
Executive Summary	5
Progress Against the Work Plan	
Objective 1: Seed Systems	8
Objective 2: Lentil and Mungbean	11
Objective 3: Wheat	14
Objective 4: Fertilizer Productivity	19
Objective 5: Mechanization and Irrigation	22
Additional Information	
Key challenges during the reporting period	25
Engagement with Missions, FTF partners and project sub-contractors	26
Appendix 1: Staffing	27
Appendix 2: Project sub-contractors and key partners	28
Appendix 3: Indicators	32
Appendix 4: CSISA-Nepal Scaling and the GFSS	37

Acronyms and Abbreviations

Acronym	Full Name
ADS	Agriculture Development Strategy
CIMMYT	International Maize and Wheat Improvement Center
CSISA-NP	Cereal Systems Initiative for South Asia in Nepal
CSRD	Climate Services for Resilient Development
DADO	District Agricultural Development Office
DoA	Department of Agriculture
FtF	Feed the Future
GoN	Government of Nepal
ha	Hectare
kg	Kilogram
KISAN	Knowledge-intensive Sustainable Agriculture and Nutrition project
NARC	Nepal Agricultural Research Council
NGLRP	National Grain Legumes Research Program
NSAF	Nepal Seed and Fertilizer project
PMAMP	Prime Minister's Agriculture Modernization Project
SEAN	Seed Entrepreneurs Association of Nepal
SQCC	Seed Quality Control Center
USAID	United States Agency for International Development
ZT	Zero tillage

Cereal and pulse yields in Nepal fall well below regional averages and present rates of increase won't meet long-term domestic requirements. Factors that contribute to low staple crop performance in Nepal include scarce farm labor, poor knowledge of best agricultural management practices, insufficient irrigation and mechanization, and farmers' inability to take risks and invest in new technologies. Also, innovative applied research has long been under-funded and research benefits have rarely reached farmers. Nepal's Mid and Far West development regions are most acutely affected by these constraints as these regions have the highest poverty and receive the lowest investment by the private sector. As a result, the Cereal Systems Initiative for South Asia (CSISA) works in Nepal's Terai plains and mid-hills where the scope for improving farmers' lives through agriculture is greatest.

The Government of Nepal's (GoN) 20-year Agriculture Development Strategy (ADS)¹ recognizes the need for new science-led innovations, crop diversification options for income generation, strengthened input systems for seed and fertilizer, mechanization to cope with outmigration and an aging agricultural workforce, and enterprise development to create new jobs and extend essential support services to large numbers of farmers. In support of these priorities, CSISA works with partners who can help to rapidly and broadly increase the adoption of sustainable intensification technologies at scale. CSISA's partners include Feed the Future's KISAN project, government agencies, farmers' groups, service providers, agro-dealers, seed enterprises and private companies.

CSISA's 'Scaling Seed and Sustainable Intensification Technologies in Nepal' project pursues the following objectives:

- 1. Pulse (lentil and mungbean) intensification and diversification, adopted at scale
- 2. Cropping system-based approaches for sustainably intensifying wheat and minimizing terminal heat stress, adopted at scale
- 3. Facilitation of efficient and low-risk strategies for the precise and productive use of nutrients
- 4. Robust seed systems that ensure timely access to elite cultivars and hybrids
- 5. Scale-appropriate mechanization and irrigation (This component received co-funding from USAID India, but that funding ended in September 2017.)

These activities are part of a five-year program funded jointly by USAID Washington and USAID India. USAID Washington has pledged \$3,000,000 over five years (including a no-cost extension to September 30, 2019) to support wheat, lentil and mungbean agronomy; the efficient use of fertilizers; and seed system scaling. USAID India provided \$1,000,000 over the first two years to support CSISA's work in mechanization and irrigation, focusing specifically on increasing the ways in which Indian agricultural technologies can support efficient and climate-resilient agriculture in Nepal. The USAID Washington program runs from October 2014 to September 2019. The USAID India component closed on September 30, 2017.

Note: This report reflects a 12-month period when the project's funding became uncertain and delayed. At one point, it was made clear that there would be no additional funding and that the project should move towards closure. As a result, some activities were thereafter suspended or shrunk as we waited to see if funding for FY18 became available. This report reflects that status, even though FY18 funding came through in August 2018. Successes were achieved through partnerships, carry over funding, and momentum achieved through earlier investments.

¹Agriculture Development Strategy (ADS), 2014

AGRONOMY & SEED SYSTEMS SCALING

Theory of Change and Approach

Cereal and pulse yields in Nepal are well below regional averages, and present rates of increase are insufficient to meet near or long-term domestic requirements. Factors contributing to this underperformance include tightening labor markets, poor knowledge of best management practices, insufficient availability of irrigation water and mechanization, and low appetites for risk and capacity for investment among asset-poor farmers.

CSISA-Nepal Agronomy and Seed Systems Scaling aims to address these constraints by (1) strengthening seed systems so farmers have timely access to improved varieties and hybrids for pulses, wheat and maize; (2) targeting geographic niches and identifying management practices that enable cropping system intensification through the cultivation of lentil and mungbean; (3) recommending best management practices for wheat, including scale-appropriate mechanization technologies that help farmers plant early and avoid terminal heat; (4) facilitating market development for small-scale technologies that enable precise nutrient management; and (5) supporting the expansion of the private sector for sustainable intensification technologies into the Mid and Far West, including the availability of 'spares and repairs,' and expanding the number of service providers so that farmers in rural areas can gain affordable access to new technologies.

Major Activities and Accomplishments

STRENGTHENED SEED SYSTEMS

- Maize hybrids for the hills: On-farm research conducted by CSISA demonstrates that maize grain yields in the mid-hills can increase by 50% through the simple step of planting hybrids. Nevertheless, no hybrids were registered in these geographies by the Government of Nepal in the FtF Zone prior to 2015. In 2015, the legal sale of four hybrid maize varieties – Rajkumar, Nutan, 9220 and TX-369 – was achieved with leadership and data from CSISA. By partnering with the private sector, seed availability of these hybrids reached 184 metric tons in 2018 – more than doubling in a single year period and providing enough seed to sow more than 9,000 hectares.
- Building seed business while scaling elite wheat varieties: With technical and market development support from CSISA, wheat seed sales volumes among the four major seed companies that CSISA is working with have increased by 400% over the last three years. These companies have stocked 2,300 metric tons of seed to be sold during the 2018 growing season – sufficient seed to plant more than 20,000 hectares. And newer varieties with resilience traits are increasingly prioritized: Borlaug 100, a blastresistant wheat variety rich in iron and zinc and introduced by CSISA in 2016, is now being produced by six seed companies.

SUSTAINBLE LENTIL AND MUNGBEAN INTENSIFICATION AT SCALE

Lentil

- Lessons learned for lentil production in Nepal: CSISA organized a stakeholders' meeting to facilitate the sharing of knowledge and lessons learned on lentil cultivation. The meeting aimed to help guide research and development priorities and action plans for combatting the primary threats to lentil production in Nepal.
- Climate services for resilience: CSISA is collaborating with the USAID-funded Climate Services for Resilient Development project and the National Grain Legume Research

Program on a lentil stemphylium disease monitoring study across the mid- and farwestern Terai. Results show the presence of Stemphylium blight in all four districts studied, with the highest incidence in Kanchanpur and Kailali as compared to Bardiya and Banke. This disease also appeared in conjunction with other leaf and root diseases. Such data permit CSISA to better target future research for development efforts and to respond to the disease where it is most severe and problematic. The data from this study are also being used to test the Stempedia model using locationspecific weather during the growing season. The study will be repeated in the 2018– 19 cropping season to generate more data for model testing.

Mungbean

 Market-oriented pulse production for income and nutrition: During 2017–18, GATE Nepal sold 9.5 metric tons of mung bean seeds sourced from 1,187 farmers and grown on around 396 hectares in the mid and far west districts. Although still at a nascent stage, mung provides a resilient alternative to lentil that can be cultivated as an 'opportunity' crop that takes advantage of the fallow period between the winter and summer cropping cycles.

SUSTAINABLE WHEAT INTENSIFICATION AT SCALE

- Entry points for closing yields gaps: CSISA conducted a production practice and cropcut survey in the mid- and far western Terai to determine attainable and potential yields and profit gaps under farmers' conditions. The results showed achievable and potential yield gaps of 1.3 t/ha and 4.5 t/ha, respectively, with an attainable profit gap of US\$ 360/ha. These results were communicated to public and private stakeholders in the wheat sector and are used to shape how programs like the Prime Minister's Agricultural Modernization Project (PMAMP), as well as the new Provincial Governments, are shaping their agricultural development programs.
- Outreach for impact: The government-implemented Wheat Super Zone program used their own funds to print and disseminate 9,000 'tips for wheat intensification', a practical, research-based guide for agronomic management developed by CSISA in conjunction with the National Wheat Research Program.

PRECISION NUTRIENT MANAGEMENT

- Balanced crop nutrition: 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.
- Affordable mechanization for smallholders: CSISA conducted awareness-raising and market facilitation activities to continue incentivizing uptake of the precision spreader, a simple low-cost tool that significantly increases fertilizer use efficiency. To date, more than 2,000 precision spreaders have been sold through private sector partners. The first commercially-available spreaders were introduced into Nepal by CSISA in 2016. To understand users' perceptions of the precision spreader, CSISA conducted a survey of 80 spreader users across the six western Terai districts. Users reported that the spreader is less hazardous, easy to operate, reduces drudgery, saves cost, and facilitates the uniform spread of seed and fertilizer thereby increasing yields compared to manual broadcasting.

MECHANIZATION AND IRRIGATION

- Investing in critical infrastructure: 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 establishment of this new center fulfills USAID Nepal's investment in establishing to establish 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.
- 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 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.

OBJECTIVE 1: STRENGTHENED SEED SYSTEMS

Enabling Nepali farmers to adopt improved crop varieties is considered fundamental to raising productivity and developing greater resilience to biotic and abiotic stresses. This is because rain fed subsistence farming is common and seed replacement rates of major cereal crops is quite low (around 11%). The national seed industry is at a nascent stage and most of the crop varieties are obsolete, and farmers are also not aware of the economic benefits of varietal replacement. CSISA has worked to develop robust seed systems for cereals and legumes by enhancing the technical and business management capacities of seed enterprises to make them technically stronger, market-oriented, professionally organized, and strategically linked with various actors along the value chain.

To address the aforementioned challenges and opportunities, CSISA adopted a public–private partnership approach to strengthen the capacity of stakeholders involved in wheat, maize and pulse (i.e., lentil and mungbean) value chains. These stakeholders include seed companies, dealers, producer groups, cooperatives, research and development organizations and development partners. CSISA is facilitating the partners to close knowledge gaps about the yield performance of lentil and mungbean, wheat cultivars and registered maize hybrids, through networks of community-based evaluations that provide crucial science-led insights and generate demand for seed companies, dealers, and among farmer-clients for these businesses. For mungbean, evaluations have been co-sponsored by seed companies, the Department of Agriculture, and the Nepal Agricultural Research Council.

Input dealers stock and market registered maize hybrids

Nepal imports 400,000 metric tons of maize grain from India, at a value of US\$ 100 million, largely to support the poultry feed industry. This trend is increasing at 10% per annum (National Feed Association, 2017). The Nepal government, through its Seed Vision document and Agriculture Development Strategy, has decided to promote hybrid maize production to address the poultry sector's demand. Over 40 imported hybrid varieties have been registered so far, but >90% are legally recommended for use only east of the Narayani river – outside the FtF Zone. Traders and retailers consider it risky to sell seed west of the Narayani, where the opportunity for maize commercialization has increased with the establishment of new feed mills.

To address this issue, CSISA collaborated with the National Maize Research Program and District Agricultural Development Offices to evaluate available maize hybrids, organize monitoring visits for traders and policy makers, and develop proposals to expand the geography of proven hybrids. As a result, the domains of four hybrid maize varieties – Rajkumar, Nutan, 9220 and TX-369 – were expanded in 2015. NIMBUS, the importer of these hybrids, was awarded an exclusive license for the import of Bioseed products (TX 369, Bioseed 9220 and Rajkumar) in 2015, and the availability of the seeds of these hybrids has continuously increased over the years, especially in newly recommended domains. Trader estimates show that sales reached 184 metric tons 2018 – more than doubling in a single year. These varieties were sold through 40 dealers across 11 districts in 2018. Drawing on the lessons from this initiative, the Seed Quality Control Center has started recommending and releasing varieties based on altitude and not on political boundaries.

Private seed companies expand businesses for wheat and pulses

Since 2014, CSISA has provided mentoring support to emerging Nepali seed companies for business planning, technical guidance and market development.

Company-led market development: To generate demand among farmers, four of the top performing and most proactive companies (GATE Nepal, Panchashakti, Unique, and Lumbini), mentored by CSISA, implemented field demonstrations of recently released and pipeline wheat varieties in collaboration with seed producers' groups in new areas using the companies' own resources.

During the 2017–18 wheat season, the four companies conducted more than 50 demonstrations, including of the varieties Banganga, NL 971, Sworgadwari, Munal, Cyakhura, and BL 4341 in new areas where those varieties have not yet been adopted at scale.

Company-led market development: Feedback from the seed companies

Large plot demonstrations of new and pipeline varieties under best management practices were implemented by four seed companies in collaboration with seed producers' groups. These demonstrations were helpful for generating demand among farmers for new varieties. Mr. Laxmi Kant Dhakal, president of the Seed Entrepreneurs' Association Nepal and proprietor of Unique Seed Company, explained that such initiatives have increased confidence among seed company personnel and seed growers to increase the volume of new varieties as the demand for those varieties has increased producer-farmers significantly. Seed have learned best management practices so the quality of seed has also improved. This type of initiative will help speed up the dissemination of high-performing varieties at scale.

The seed companies estimated that about **4,000 households visited these demonstrations during the growing season, and about 10 tons of seed will be collected** from the demonstration for next year's planting.

Technical advances: Following technical trainings, the aforementioned companies started maintenance breeding for wheat in 2016 to enhance the quality of source seed used for 'truthfully labeled' seed production. Building markets in regions like Nepal where farmers do not regularly purchase seed is a challenge. Maintenance breeding helps maintain seed quality and therefore develop trust among farmers that they are purchasing a reliable product, worth their investment.

The varieties undergoing maintenance breeding are recently released varieties, pipeline varieties, and a variety called Borlaug 100. Borlaug 100 is from Mexico, introduced by CIMMYT in 2016 in coordination with the National Wheat Research Program in response to the emerging threat of wheat blast in South Asia. In addition to resilience traits, four of the newer wheat varieties prioritized for the Nepal market are comparatively rich in iron and zinc. These companies produced around nine tons of source seeds from maintenance breeding efforts in 2018. Using the participatory variety selection trials carried out by seed companies in farmers' fields and on NARC research stations, the National Wheat Research Program is preparing to submit a proposal for the release of wheat variety BL 4341.

Financing for growth: A core component of CSISA's mentoring efforts for companies has been the creation of business plans that are based on a vision for growth that is specific to each company. Having a convincing business plan is an important component of securing financing to drive expansion, and the companies supported by CSISA have tapped into loan programs funded by the International Fund for Agricultural Development and the Asian Development Bank. These sources of capital have allowed the 11 seed companies to expand their facilities to include seed storage buildings, processing plants and laboratories. CSISA is also working to facilitate commercial lending between the companies and banks that are backed by USAID's Development Credit Authority as part of the Nepal Seed and Fertilizer program, which is also implemented by CIMMYT with support from USAID-Nepal.

Accelerating seed sales: The rapid growth of seed sold to farmers by our private sector partners is

strong evidence that CSISA is contributing to the emergence of strong, sustainable, and market-oriented seed systems in Nepal. Since the base year of 2014, prior to the inception of CSISA-Nepal Scaling, wheat seed sales volumes of the two major seed companies (Unique and Lumbini) in particular, as well as the total seed from the four major seed companies that CSISA is working with in general, have increased significantly. Over a three-year period the total volume of seed sold by the four most ambitious companies increased by 400% (Figure 1) suggesting an increase of 4,300 hectares planted in newer



FIGURE 1. SEED SOLD VOLUME BY SEED COMPANIES OVER A 4-YEAR PERIOD

wheat varieties and quality seed in 2017–18. These companies have stocked 2,300 metric tons of seed to be sold during the 2018 growing season. Also, bolstered from the on-farm data developed by seed companies and on-station data from the National Wheat Research Program, the new wheat variety BL 4341 has been approved for release in 2018. Seed companies have already stocked 5 metric tons of seed of this variety and are actively engaged in its market promotion. Similarly, Borlaug 100, the blast-resistant wheat variety introduced by CSISA in 2016, is under seed production by six seed companies. This has created strong incentives for the Nepal Agricultural Research Council to fast track registration.

Replacing old varieties with newly released ones

CSISA's household survey results showed that 45% of farmers are using old varieties highly susceptible to pests and diseases. CSISA is contributing to the emergence of strong, sustainable, and marketoriented seed systems by strengthening the capacity of the Seed Entrepreneurs' Association of Nepal (SEAN). CSISA is working with the four largest seed companies -Unique, Panchashakti, Lumbini, and GATE Nepal – to increase the share of newly released varieties that are replacing old ones. For example NL-297, a 35-year old variety, occupied the largest share (35%) of seed production in 2014, but declined to



FIGURE 2. PERCENT SHARE OF SEED OF DIFFERENT VARIETIES PRODUCED BY THE FOUR LARGEST SEED COMPANIES IN 2014 AND 2017 IN WESTERN TERAI, NEPAL

19% in 2017 (Figure 2). Nepalese seed companies have now started to produce seed for recently released and pipeline varieties in collaboration with seed producers' groups.

Strategic investments and enhanced coordination among seed system actors

Linkages to policy innovations and development programs: At the invitation of our government partners, CSISA participated in three key strategy meetings: Seed Vision Review, Regional Seed Balance Sheet Development, and Orientation for Zone and Super Zone Leaders under the Prime Minister's Agriculture Modernization Project (PMAMP). In these platforms, CSISA shared information about opportunities for scaling new wheat, maize, and legume varieties, as well as information on inclusive business models for reaching relatively poor farmers.

PMAMP is envisioned as a 10-year, US\$ 100 m investment, and strategic coordination with this program is a top priority for CSISA. CSISA organized national-level rice, wheat, maize, and mechanization thematic working group meetings in partnership with PMAMP, and detailed action plans have been developed. This initiative has been useful not only in institutionalizing CSISA's innovations and findings but also in designing approaches that are market-oriented among our government partners.

CSISA also helped strengthen the Seed Entrepreneurs' Association of Nepal and National Seed Producers' Association by updating their vision for government engagement and improving the types of services provided to members. Consequently, the associations jointly requested the government to withdraw existing seed subsidies that do not facilitate the development of markets for new elite varieties. In response, the Ministry of Agricultural Development formed a three-member committee composed of SEAN, Seed Quality Control Center (SQCC) and District Agriculture Development Offices to make recommendations for seed subsidy revisions. Encouragingly, the subsidy for NL 297, a 35-year-old wheat variety, was removed at the request of SEAN and SQCC.

OBJECTIVE 2: SUSTAINABLE LENTIL AND MUNGBEAN INTENSIFICATION AT SCALE

Lentil

Lentil is a prioritized value chain for Feed the Future in Nepal. However, the intensification possibilities for this crop have proven difficult to identify because lentil is highly susceptible to drought, excess soil moisture and disease – especially *Stemphylium*, a fungal disease that can cause total crop failure in high rainfall years. Survey data suggests that more than 60% of lentil-growing farmers in the FtF Zone incur financial losses from lentil cultivation in such years. Also, simulation results using long-term weather data from the western Terai suggest that more than 73% of all years are expected to have high disease severity resulting in significant productivity losses.

Can better genetics reduce risks to lentil cultivation?

Since 2015 CSISA has been collaborating with the National Grain Legume Research Program (NGLRP), and ICARDA to evaluate 100 lentil genotypes from the Mediterranean region for broad-adaptability to drought and excess moisture conditions. Among the genotypes tested, five lines were observed to be resilient to drought in a year without winter rainfall. Out of those five lines, three lines performed well in the 'normal' rainfall conditions observed in 2016–17. With the current uncertainty of CSISA funding, NGLRP is continuing to further evaluate those lines under dry and wet conditions using their own resources.

Stakeholders meeting on lessons learned for lentil production in Nepal

CSISA organized a meeting to facilitate the sharing of lessons learned on lentil cultivation in October 2017 in Kathmandu. Major stakeholders working on lentil production including the National Grain Legume Research Program, Nepal Seed and Fertilizer (NSAF), and Knowledge-Based Integrated Sustainable Agriculture in Nepal (KISAN II) participated in the meeting. The meeting provided information essential to establishing research and development priorities and action plans for combatting the primary threats to lentil production in Nepal. Also, CSISA shared a disease management guideline jointly developed with NGLRP in 2016 to reach a large number of farmers with practical management advice through the KISAN and NSAF networks.



STAKEHOLDERS' MEETING FOR SHARING KNOWLEDGE AND LESSONS LEARNED



TIPS FOR STEMPYLIUM BLIGHT DISEASE MANAGEMENT IN LENTIL

Building coalitions for lentil intensification: Refining the Stempedia weather-based disease forecasting model and early warning system

Lentil stemphylium blight disease, caused by *Stemphylium botryosum*, undermines lentil production in Nepal. Research conducted in different regions shows that stemphylium blight can cause complete crop failure, but that severity varies significantly across years and locations. In this context, CSISA is collaborating with the USAID-funded Climate Services for Resilient Development (CSRD) and the National Grain Legume Research Program on a lentil stemphylium disease monitoring study across the mid- and far- western Terai districts.



ELIGHT

Stemphylium was first reported in Nepal in 1993, and the disease has become widespread in all major lentil-growing

areas in Nepal (Bayaa et al., 1998). CSISA and CSRD project conducted a survey in Banke, Bardiya, Kailali and Kanchanpur Districts. The purpose of the survey was to generate field data to be used for calibrating and validating the Stempedia model (Salam et al., 2016) in order to correctly predict the onset and severity of lentil Stemphylium blight based on weather. The ultimate aim of this study is to increase the productivity and profitability of lentil by developing a forecast-based alert system so that farmers can control the disease effectively when and where required. This effort is part of a broader research program concurrently being carried out in Nepal, Bangladesh and India.



FIGURE 3: INCIDENCE OF STEMPHYLIUM BLIGHT AND OTHER DISEASES RECORDED IN LENTIL IN FOUR DISTRICTS OF NEPAL DURING THE 2017–18 CROPPING SEASON.

The survey was conducted from January to April in 40 farmers' fields in each of the above-mentioned four districts (altogether 160 farmers) in close collaboration with National Grain Legume Program of the Nepal Agricultural Research Council. In addition to recording disease data at three crop growth

stages, the study included crop-cuts in the respective fields (for yield estimation), recording photos of disease symptoms, laboratory identification of the disease, and a farmer survey.

The disease data, presented in Figure 3, shows the presence of Stemphylium blight in all four districts. However, its incidence was much higher Kanchanpur and Kailali as compared to Bardiya and Banke. This disease also appeared in conjunction with other leaf and root diseases. Results further reveal that a significant proportion of root diseases appeared in all the surveyed districts, where its dominance was especially noted in Bardiya and Banke districts. Such data permit CSISA to better target future research for development efforts and to respond to the disease where it is most severe and problematic. The data from this study are being used to test the Stempedia model using location-specific weather during the growing season. The study will be repeated in the 2018–19 cropping season to generate more data for model testing.



STEMPHYLIUM BLIGHT FIELD OBSERVATION AND VERIFICATION BY FIELD STAFF IN KAILALI DISTRICT OF NEPAL IN JANUARY 2018

Mungbean

Expanding mungbean cultivation through market facilitation

As a short-duration crop that can be cultivated during the hot 'summer' period before the arrival of monsoon rains, mungbean can be cultivated without displacing existing crops while generating significant economic, nutritional and soil health benefits. Since 2015, CSISA has played an active role in commercializing mungbean production in the Feed the Future Zone through the development of market-oriented public-private partnerships. CSISA's major role in this process



included: facilitating contractual arrangements FIGURE 4. MUNGBEAN SEED SOLD/ STOCKED IN FTF DISTRICTS

between the seed companies and agriculture cooperatives for seed production, coordinating clusterbased grain production between traders and farmers' groups, and providing technical training to millsupported technicians, extension staff, and to lead farmers through government cooperatives.

Mungbean cultivation has increased significantly over the years (Figure 4) and the government has prioritized mungbean as a green manure crop, providing subsidy for seed and irrigation costs to encourage farmers to take up mungbean cultivation. Due to CSISA's continued efforts, PMAMP units have started promoting mungbean as dual purpose crop (grain and green manure) through their support programs. Prior to CSISA's efforts, this low risk and high return pulse crop was not cultivated at scale in the Feed the Future Zone of Nepal.

In 2017–18, 935 farmers of Banke and Bardiya sowed mung bean on 312 hectares and 252 farmers of Kailali and Kanchanpur sowed 84 hectares, selling their produce to the seed company GATE Nepal. During 2017–18, GATE Nepal was able to sell 9.5 metric tons of mung bean seeds sourced from 1,187 farmers and grown on around 396 hectares in the mid and far west districts.

OBJECTIVE 3: SUSTAINABLE WHEAT INTENSIFICATION AT SCALE

Wheat is the third most important crop staple in Nepal, following rice and maize. In the Terai, where production is concentrated, wheat productivity is threatened by shorter winters and terminal heat stress during grain filling – a worsening scenario with progressive climate change. In the mid-hills, wheat is vulnerable to damaging drought conditions if planted after the last monsoon rains. To assist farmers to better cope with rising temperatures and variable rainfall patterns, CSISA collaborates with the Nepal Agricultural Research Council to conduct applied research into how agronomic practices can build resilience. In turn, CSISA aligns with government, civil society, and private sector partners to take these insights to scale.

Domain-specific recommendations for management practices that will enable early wheat establishment

Introduction of elite wheat varieties suitable early seeding from Eastern UP, India

Most of the released wheat varieties available in Nepal fall within the same medium duration (130–135 days) maturity class. Studies conducted by CSISA in India have demonstrated that long-duration wheat varieties have significantly enhanced yield potential for timely planting together with no yield penalty compared to shorter duration varieties with later planting – i.e. broad adaptability, which is a very important trait since many farmers do not know when they will be able to plant in any given year. CSISA-Nepal collaborated with



FIGURE 5. YIELD (Kg ha⁻¹) PERFORMANCE OF WHEAT VARIETIES UNDER DIFFERENT SEEDING DATES

CSISA-India to bring in seven promising wheat varieties of different maturity durations. Those varieties were evaluated in on-station trials in collaboration with the National Wheat Research Program and on-farm in collaboration with the Unique and Lumbini seed companies. Results confirm that longer-duration varieties NL-971, HD-2733, HD-3086, and HD 2824 provide a promising pathway for increasing yields across planting dates (Figure 5).

Social marketing approaches utilized to 'get the word out' on the importance of early planting

See below on strengthened collaborations with government partners like PMAMP to mainstream methods and messages.

Wheat crop cut and production practice survey

To capture changes in management practices and to estimate benefits of technology adoption, a 'crop cut and production practices' survey was conducted in April 2017, after wheat harvest and high-level insights from advanced analyses were produced during this reporting period. The survey was intended, in part, to capture changes in management practices associated with CSISA interventions, including our social marketing campaigns such as radio jingling on the importance of early wheat

sowing, increasing irrigation when winter rains are absent, and gains in yield potential that can be achieved by planting longer duration varieties.

For the survey, we used remote sensing data to develop a representative sampling scheme that captures gradients in wheat productivity levels at the regional scale. The survey was developed in Open Data Kit (ODK) and deployed via smart phones.

From this survey we also derived the attainable and potential yield gaps for six FtF Terai districts and one non-FtF major wheat-growing district, Rupandehi. It was found that the average attainable yield gap (difference between top 10th percentile mean and population mean) ranges from 1.2 to 1.5 t/ha and the climatic potential yield gap (difference between climatic potential yield and population mean) ranges from 4.4 to 4.9 t/ha (Figure 6). The top performing farmers applied more fertilizer, incorporated balanced fertilization, applied more irrigation, planted earliers and also participated in trainings.

Similarly, the net profit of the individual wheat growing farmers were calculated from the total production cost and total income from grain and straw. In the surveyed region, the average profit gap in wheat production is US\$ 360/ha (difference between top 10th percentile and population mean). Moreover, 11% of farmers are in loss from wheat production and around 20% of farmers are earning a net profit of less than US\$ 100/ha (Figure 7). These results showed that there is ample opportunity for closing the yield and profit gaps through better agronomic practices for sustainable wheat intensification in the region. These outputs were communicated to different wheat sector public and private partners including the government-led Wheat Super Zone program.



FIGURE 6. ATTAINABLE AND CLIMATIC POTENTIAL YIELD GAP IN WHEAT IN DIFFERENT DISTRICTS OF NEPAL



FIGURE 7. ATTAINABLE PROFIT GAP (A) AND DISTRIBUTION OF NET PROFIT (B) OF THE WHEAT PRODUCING FARM IN THE SURVEYED REGION

Partnering with the Nepal government to guide new investments for wheat intensification

In 2016, the Government of Nepal endorsed a new 20year agriculture development strategy that charts a progressive course of action to revitalize agriculture as an engine for economic growth and domestic food security. At the center of this strategy is the Prime Minister's Agriculture Modernization Project. The project will be implemented over the next decade and has research and development mandates for productivity enhancement and commercialization of major cereals, fisheries, fruits and vegetables.



PMAMP emphasizes wheat production in the western Terai region as a food security priority and

PARTICIPANTS AT THE WHEAT FORUM ORGANIZED BY CSISA

endeavors to achieve national self-sufficiency in wheat within the next three years. Meeting this extremely ambitious goal will require an unprecedented increase in average yields of 10% per year, and necessitates a high level of strategic coordination among organizations contributing to agricultural development in Nepal. PMAMP has recognized CSISA as a technical advisor and strategic partner to design and implement programs for staple crop production, including mechanization and seed systems. Going forward, CSISA sees the PMAMP as a key mechanism for scaling up sustainable intensification technologies in Nepal.

Following up on the work plan jointly developed by wheat sector stakeholders in the national wheat forum meeting organized by CSISA and PMAMP in July 2017, CSISA provided technical guidance to the Wheat Super Zone program for implementing the action plan for 2017–18. Despite uncertainty in funding, CSISA continued to support the Wheat Super Zone in following areas:

- Trainings-of-trainers for the Wheat Super Zone technical staff and operational committee members on best management practices for wheat. Examples include the importance of better crop establishment methods, balanced fertilizer management, weed and water management, and mechanized harvesting.
- Technical support for organizing zero tillage (ZT) wheat demonstrations in strategic lowland areas where farmers have to delay wheat seeding by conventional tillage method due to high soil moisture in the fields. Potentially, ZT wheat can flourish in such type of land when sowing is conducted on time.

- Cross-border visit for key farmers, service providers, and Super Zone technical staff to CSISA India's sites in Gorakhpur in Eastern Uttar Pradesh, where they interacted with CSISA-India scientists and staff.
- Technical support for developing effective, action-oriented extension messages
- Guidance for developing on-farm research protocols, especially on crop establishment methods and integrated weed management
- Market facilitation by linking machinery importers with local traders for the timely supply of appropriate machinery.
- Support to custom hiring centers to reach greater number of households with resource conserving machineries like seeders and reapers.

Social marketing through established and emerging communications channels

Collaborations with development partners: In collaboration with the National Wheat Research Program, CSISA developed factsheets for better-bet agronomy for wheat from seeding to harvesting to storage based on research outcomes from different areas. Six thousand factsheets were already deployed prior to the start of the 2015–16 and 2016–17 wheat season through public and private partners such as District Agriculture Development offices, Improved Seed for Farmers project, KISAN, and NIMBUS. Seeing its importance and usefulness to the technicians and farmers the government-implemented PMAMP project (i.e. Wheat Super Zone) printed and disseminated 9,000 factsheets of different types (2,000 of ZT wheat, 2,000 of fertilizer management, 3,000 of weed management, 2,000 of best management practices) using their own resources during the 2017–18 wheat season. Key messages, including the importance of timely irrigation, fertilizer and weed management, were also broadcast through local FM radio in the Wheat Super Zone command area in local languages during the 2017–18 wheat season.

Building a service economy for zero tillage wheat

Zero tillage can facilitate timely sowing while also reducing crop establishment costs, but is a completely new technology in the FtF Zone. Initially, CSISA began a market development collaboration for zero-till drills and planters with The Habi, a 4-wheel tractor trader. The Habi, with CSISA backstopping, began marketing zero-till drills from National Agro Industries (Ludhiana, India) during the 2014–15 wheat season. CSISA supported by providing technical training for service providers on how to calibrate and operate ZT seed drills.

CSISA continued to monitor the market for 4-wheel tractor seeders and noted that prices of The Habi's machines remained high and that the company was not following through with its marketing strategy that should have included farmer field days, adding new sales outlets and pursuing competitive pricing. To increase market availability and to drive down prices, CSISA facilitated business tie-ups with other Indian manufacturers (linking India's Khedut Agro and Dharti Agro with Nepal's BTL and



FIGURE 8. SEED DRILL MODELS AND COMPANIES COMMERCIALLY AVAILABLE IN NEPAL

Kubier and Sons) and even facilitated China's first four-wheel tractor seed drill entry into Nepal with an innovative maize planter that uses a precision vertical plate seed meter.

Sales were also bolstered by CSISA's government partners, Department of Agriculture's (DoA) Directorate of Agricultural Engineering, NARC, and most recently the PMAMP 'buying into' the technology and starting their own promotion activities, including subsidies from DoA, with stronger links forged with the private sector so that markets and repair networks are also emerging to support the sustained spread of the technology (Figure 8). This is evident from the tendency of dealers to keep large numbers of seeders, both two-wheel tractor-type and four-wheel tractor-type, in stock to meet and stimulate demand. Earlier, dealers used to import seeders only after they received orders from clients. With CSISA's encouragement, SKT Nepal has started importing spare parts for two-wheel tractor seeders, which has been a major bottleneck to the adoption of the machine in smallholder communities.

CSISA has also aired radio jingles on local FM radio stations about the benefits ZT along with contact information for service providers. At the dealer level, CSISA has placed additional of four-wheel tractor ZT drills and two-wheel tractor reduced till drills in machinery showrooms on a consignment basis so that market availability increases in areas in the Feed the Future Zone where machinery retail networks are comparatively weak. CSISA also facilitated the establishment of two machinery-hiring centers in Bardiya, which are providing different machinery-based services, including ZT wheat, on a custom-hire basis.

With technical and market development support from CSISA, more than 200 service providers purchased seed drills across the Terai by the end of 2017. A recently conducted survey in four Terai districts (Banke, Bardiya, Kailali and Kanchanpur) showed that in the 2017–18 wheat season, service providers seeded wheat on more than 700 ha, benefiting around 1,545 households.

The increasing number of importers and seed drill models shown in Figure 8 and the increasing sales of seed drills in the FtF Zone in Figure 9 indicates a close correlation of the increasing number of private sector importers with overall sales. There were no four-wheel tractor seed drill importers until CSISA made the first linkage between National Agro and The Habi in 2013. Prior to that, the few four-wheel tractor drills in country came through projects and other nonmarket channels. In the last two years, annual sales have increased significantly, drill indicating signs of a maturing market for 2wheel and 4-wheel tractor seed drills and planters.



FIGURE 9. NUMBERS OF SEED DRILLS AND PLANTERS SOLD IN NEPAL'S MID AND FAR WEST REGIONS

Another clear change is in the emerging collaborations between private sector machinery suppliers and government partners like District Agriculture Development Offices and PMAMP, where the private sector is providing demonstrations and training at government events. Seeing the benefits of ZT wheat, as well as rising demand from farmers, most of the District Agriculture Development offices and the PMAMP wheat super zone program have included ZT wheat technology in their own programs. Farmers' interest in having seed drills that can sow multiple crops is increasing and farmers have started to request subsidies on seed drills from government support programs.

CSISA has also developed business-to-business linkages in which private Nepalese seed companies, in an attempt to improve their seed growers' yields and quality, have invited private machinery suppliers for demonstrations and trainings given to their seed growers. CSISA has not only played a market

facilitation role by linking machinery importers with local traders but also public–private and business-to-business partnerships that further sustain the markets for agricultural mechanization and conservation agriculture technologies.

Yet, even as the sales markets continue to grow, work remains as CSISA has found that the use rates of both the two-wheel and four-wheel tractor seeders and planters are low – with two-wheel tractor seeders averaging under 3 ha per season and four-wheel tractor seeders averaging under



ZERO TILLAGE WHEAT ESTABLISHMENT

15 ha per season. In both cases the potential is 2 to 3 times this use rate. CSISA is trying to technically backstop local stakeholders (mostly government projects) to identify the right models of ZT seed drills so that the service providers who operate seed drills can use the machine throughout the year for multiple crops. This includes informal exposure visits to local traders where such machines are available.

OBJECTIVE 4: PRECISION NUTRIENT MANAGEMENT AT SCALE

In Nepal, fertilizer use is far below the state recommendation for all staple crops. Also, current fertilizer use recommendations 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.

Evidence from the central hills of Nepal demonstrates the power of 'getting it right', with net returns from maize increasing by approximately US\$ 400/ha 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.

Domain- and-situation specific soil fertility management strategies developed for wheat, lentil and maize

CSISA staff were instrumental in securing funding for the USAID mission-supported Nepal Seed and Fertilizer (NSAF) project. Our staff helped design and implement strategic soil fertility management field trials for wheat, rice, lentil, and maize that were implemented in 2017. Leadership of this research stream has now been handed over to NSAF staff. CSISA staff shared their experience with lentil by participating in a national-level workshop organized by NSAF in Nepalgunj. CSISA's experience with lentil has been useful for developing the strategies for NSAF, which is working in lentil to improve the different cultivars that can tolerate abiotic and biotic stresses.

Broad-scale awareness of the yield and economic benefits of judicious fertilizer application

A household survey conducted for rice and wheat in the Feed the Future zone showed under-fertilization and imbalanced application are major reasons for low crop productivity in Nepal. On average, farmers apply nitrogen and phosphorus fertilizer at rates less than 50% of the national recommendations. Only 13% of farmers apply potassium.



TULSIPUR, DANG.

Several on-farm and on-station experiments conducted in collaboration with the National Wheat Research Program and farmers' groups for different production environments showed that wheat yields can be doubled through balanced fertilizer application. CSISA continued to communicate research findings in coordination with the Nepal Seed and Fertilizer project, the government-led zones and super zone programs, seed companies, farmers' co-operatives and through trainings to District Agriculture Development Offices. Communicating the importance of fertilizer management through co-operatives is the most effective pathway as these entities also supply fertilizer to farmers in their command areas.

CSISA also developed posters showing the importance of fertilizer and placed them in co-operatives. Partially because of CSISA's efforts, technicians and farmers are well sensitized to the importance of balanced fertilizer application. This is reflected in increased demand for potassium fertilizer, as well as the rising number of co-operatives stocking it, since they previously only sold urea and DAP fertilizer. For example, sales of potassium fertilizer by the Agriculture Input Company Limited, Tulsipur, Dang, increased significantly where sales were 28.6 t in 2015 and reached to 51.05 t in 2017 (Figure 10), while sales were similar across years for urea and DAP fertilizer. Unfortunately, in 2018 AIC did not provide figures of their fertilizer sales.

Policy-level initiatives

As a result of collaborative research conducted with CSISA, the National Wheat Research Program suggested that the current recommended fertilizer rate for wheat (100:50:25 kg NPK/ha) be updated to 150:50:50 kg NPK/ha. They also committed to reflecting additional factors of production (e.g., variety and time of establishment) into further revisions of the official recommendations for wheat. New recommendations will be scaled through the Department of Agriculture.

Accessible technologies commercialized for increasing the efficiency of fertilizer use

Low-cost spreaders efficiently bring precision management to smallholders

Hand broadcasting of seed and fertilizer is common in Nepal and results in patchy distribution and inefficient uptake of nutrients by plants, leading to a significant reduction in crop yields compared to those achievable under better management. To minimize the variability associated with hand broadcasting, CSISA introduced mechanical seed and fertilizer spreaders into its working domains in Nepal in 2014. Mechanical spreaders can be used for broadcasting seed such as rice, wheat, lentil, mungbean and granular fertilizer such as urea and DAP. Research shows that the use of a precision spreader improves yields by 7–10% and generates 50% savings in labor costs and time involved for fertilizer application.



FARMER USING PRECISION FERTILIZER SPREADER

Users' perception on precision spreader

In Nepal, farmer adoption of new agricultural technologied can be very slow. To facilitate the adoption of spreaders, CSISA has worked with manufacturers, importers, local distributers, DistrictAgriculture Development Offices, farmers' cooperatives, USAID-funded projects such as and Nepal Seed and KISAN Fertilizer project and seed companies to evaluate and facilitate the testing and uptake of these compact tools.



FIGURE 11: COMPARISON BETWEEN PRECISION SPREADER AND BROADCASTING METHOD OF FERTILIZER (N=81)

To understand users' perceptions of the precision spreader, CSISA conducted a survey of 81 farmers across six Terai districts on the use of the precision spreader. More than 90% of these users reported that the spreader is easier to operate, reduces drudgery, saves costs, and facilitates uniform spreading of seed and fertilizer compared to manual broadcasting (Figure 11). CSISA also asked users about problems with the spreader. Thirty-five percent of farmers reported that they had no problems with using the spreader, while 22% of farmers reported problems with calibration to adjust the seed and fertilizer rates, 13% of farmers reported the seed and fertilizer holding bag is too small in the currently available unit, 10% of farmers reported the machine is only useful for granular fertilizer (not seed), and another 10% reporting higher dropping rates (of seed fertilizer) at the start. The outcomes of the survey will be communicated to different public and private stakeholders including the manufacturers for generating awareness about the spreader and for further improvement of the machine.



FIGURE 12. USERS' PERCEPTIONS OF (A) USING PRECISION SPREADERS FOR SEED AND FERTILIZER BROADCASTING COMPARED TO HAND BROADCASTING AND (B) PROBLEMS ASSOCIATED WITH THE PRECISION SPREADER

Since 2014, CSISA has also provided training to cooperatives, extension personnel and agro vet technicians to help facilitate the uptake of spreaders across a wide geography. To date, CSISA has trained more than 250 service providers, over 1,300 farmers, and more than 250 agricultural technicians from the public and private sectors. In 2015, CSISA produced a user-friendly guide for the precision spreader, covering handling guidelines for both seed and fertilizer broadcasting. These guides were distributed to farmers' co-operatives, agro vets, other USAID-funded projects, District Agriculture Development Offices, and the government-led Prime Minister's Agriculture Modernization Project, all of which are interested in supporting the deployment of precision spreaders. Also, the guidelines were adopted by the major importers – SK Traders and BTL Traders – printed them at their

own cost and supplied them with every spreader sold. These attempts helped expand the technology's reach, which is evident from the increased demand for spreaders in the eastern Terai districts.

Given the high level of farmer acceptance and the identification of a low-cost regional manufacturer, three major importers – SK Traders, AMC and BTL Traders – have started importing and selling precision spreaders through more than 20 dealers across the country. **To date, more than 2,000 units have been imported and sold commercially. Traders have also placed an order for > 1,200 more units.** If used for spreading wheat and lentil seed, this quantity has the potential to cover more than 4,000 ha in a season. In 2017–18, many of the District Agriculture Development Offices in the Terai have included the precision spreader in their machinery subsidy programs, allowing farmers to procure the equipment at a reduced price from local suppliers. Recently, many PMAMP units such as zones and super zones based in the Terai have also realized the significance of the seed and fertilizer spreader and included it in their subsidy programs. CSISA demonstrated the precision spreader in the PMAMP command areas in coordination with their project implementation units, which generated awareness among farmers, service providers, government staffs and private traders.

CSISA is optimistic about market-led expansion precision spreading technology in Nepal due to the initial support that the technology enjoys across the value chain. The increasing number of importers and dealers selling the spreaders at the local level signals that the private sector sees value in the technology and expects a robust market to emerge. DADOs embedding precision spreaders into their subsidy schemes reflects local public-sector responsiveness to farmer demand, and farmers procuring the technology shows that farmers believe the technology will be remunerative, despite the initial investment cost. The sustainable intensification of cereal systems in Nepal will, indeed, depend on farmers adopting affordable, scale-appropriate technologies such as precision spreaders to generate higher yields from small landholdings in the face of labor constraints common in Nepal's agricultural areas.

OBJECTIVE 5: Scale-appropriate mechanization and irrigation

The scale-appropriate mechanization and irrigation investment, funded originally by USAID India, officially ended in September 2017. Yet, much of the work in the three preceding objectives – lentil and mungbean intensification, sustainable wheat intensification and precision nutrient management – have agricultural mechanization and machinery not only as a cross-cutting theme but also as a core component of the crop and agronomy-based CSISA objectives. CSISA-Scaling has continued to advise the Government of Nepal in support of their alignment with the country's Agriculture Development Strategy, as well as the 2018 National Agricultural Mechanization Promotion policy. CSISA also continued to support a variety of scaling efforts for innovative machinery. Some notable examples are given below.

Advances in establishing national-level advisory committee on agricultural mechanization

In February 2018, CSISA, the DOA and PMAMP held a mechanization forum in Kathmandu that discussed, among other things, the immediate need for a permanent national agricultural mechanization forum. This national forum had been stalled by a few months because a planned reorganization of DOA's Engineering Directorate coincided with Nepal's newly established federal structure. In mid-August the Engineering Directorate became the Center for Agricultural Mechanization and Farm Structures. In September, CSISA met with Nepal's Secretary of Agriculture, who requested that CSISA consider further backstopping government efforts for this newly renamed DOA center, as well as two additional, new agri-engineering sections that were established through the reorganization. He noted that the Agricultural Mechanization and Small Irrigation Section will facilitate and house a new national agricultural mechanization advisory committee that will monitor and periodically advise both the Central- and Provincial-level Ministries and other line agencies on the nation's agricultural mechanization process. CIMMYT has been invited as the only international organization to be a member of this committee.

Establishment of DOA's National Center for Agricultural Machinery Promotion

While the Nepal Agricultural Research Center's Agricultural Machinery Testing Center was inaugurated nearly a year ago, DOA's planned national agricultural machinery training center had been delayed while the DOA (along with many other government departments and agencies) went through the above-described reorganization. Once this was completed in mid-August, the Ministry of Agriculture immediately selected and re-designated the Janakpur Agriculture Development Project's Farm as the National Agricultural Machinery Promotion Center. This large 20+ ha facility aims to strengthen the newly renamed Agricultural Mechanization and Farm Structure Center's capacity to conduct training



ATTENDEES AT THE LAUNCH OF THE NEW NATIONAL AGRICULTURAL MACHINERY PROMOTION CENTER

programs on agricultural machinery operation and maintenance for farmers and service providers, and for agricultural machinery repair for mechanics. The establishment of this new center fulfills USAID Nepal's investment in establishing these two new agricultural mechanization centers and partly fulfills Nepal's Agriculture Mechanization Promotion Policy, as well as the larger Agricultural Development Strategy.

Stacking of agricultural machinery: Mini-tillers increasing demand for maize planters

CSISA has credited the successful spread of tens of thousands of mini-tillers in the mid-hills of Nepal with reduced drudgery and increased ontime planting. But a new CSISA study on minitillers (Paudel et al, forthcoming) suggests significant positive impacts of mini-tiller adoption on rice productivity (>1,100 kg) and technical efficiency (>12%) of even the smallest rice farmers in the hills (≤ 0.25) ha.

In India, mini-tillers are also successful but they are mainly used by larger farmers in flatland areas for weeding in row crops. In 2016 CSISA began initial testing and test marketing of



MINI-TILLER BEING USED FOR WEEDING MAIZE PLOT

various mini-tillers in Dang's inner Terai (flatland) areas for inter-cultivation and earthing up. 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 of land in the same time. By renting in a mini-tiller from a service provider a farmer can save over NRs 10,000 in a single weeding. The support of CSISA and the maize super zone there are now nine mini-tillers in the maize super zone's area being used for weeding by the owners and their neighbors. The maize super zone informed CIMMYT that there was an immediate additional demand for another seven mini-tillers. The cost and time savings and the ease that farmers experienced by weeding with mini-tillers on flat lands drove demand higher for line-sowing maize planter services in both spring and summer maize. This wholly new application domain for mini-tillers in Nepal's Terai should offer service providers opportunities to provide mini-tiller inter-cultivation and tillage services to an under-served market of small and large farmers, as well as an opportunity to build a service market to women and women-headed households in the Terai.

Machinery trainings for the Prime Minister's Agriculture Modernization Project (PMAMP), Maize Super Zone and Rice Super Zone

CSISA-NP has been supporting PMAMP's machinery training program, Maize Super Zone in Dang and

Rice Super Zone in Bardiya, training service providers in Dang and service providers in Bardiya as well as PMAMP technical staff on different attachments for the twowheel tractor and four-wheel tractor. Since farmers have identified a lack of training on the operation and maintenance and inadequate facilities for servicing and repair of farm machinery as constraints to the adoption of agricultural machinery, CSISA also provided practical training on these aspects.

At present, most farmers are using power tillers and tractors only for tillage, so the Maize Super Zone has developed four machinery custom hiring service centers to provide different machinery services on about 1,000



SERVICE PROVIDERS LEARNING ABOUT TILLING MACHINERY IN MAIZE SUPER ZONE, DANG DISTRICT

hectares of land cultivated by hundreds of smallholder farmers. Similarly, the rice super zone has developed one custom-hiring center to facilitate service provision on same-sized area. From the custom hiring center, farmers will be able to access seed drill, reaper, thresher and rice transplanterbased services. CSISA also covered the economics of using different machines in maize and rice production, from planting to harvesting, including weeding and earthing up.

A similar training was also given to rice block program under PMAMP in Banke district. The block covers 100 hectares under the farmers' cooperative, *Siddeswori*. Twenty-seven participants were trained on machines like the laser land leveler, rice transplanter, manual weeder, seed and fertilizer spreader, and reaper.

Key challenges faced during the reporting period

Evolving process of political devolution:

- Nepal recently entered in the complicated effort of building a federated structure with more
 regional autonomy. One result is that the agricultural budget that used to be with the District
 Agriculture Development Offices has been diverted to new, local administrative units. As there
 is no clear-cut breakdown of local budget by sector, many agricultural development support
 programs have been deferred or otherwise delayed.
- Also, many of the district level DADO staff as well as offices have been shifted to provincial government control. While this devolution is likely to be beneficial in the long-term, the system as a whole is facing 'growing pains' as new institutional and staffing arrangements emerge.
- The government has decided to form new structure under the provincial government called Krishi Gyan Kendra (KGK), or Agriculture Knowledge Center. Still being established, these centers have no immediate technical plan of action except some administrative adjustments. It could prove difficult to collaborate with these structures, especially for the time-bound projects like CSISA.
- These changes have temporarily disrupted CSISA's partnerships at the national and local levels.

Weather and markets:

- Rainfall during the wheat harvesting period in the Far West interrupted the wheat harvesting operation and also affected grain and seed quality.
- The mungbean production area is increasing due to CSISA's interventions in coordination with other stakeholders. However, market problems still exist because of the porous border between Nepal and India. Processing industries in Nepal are less likely to accept mungbean from Nepalese farmers as they have established networks with Indian marketing agencies and also they also receive mungbean at cheaper prices due to lower production cost in India.

Funding uncertainty:

- In September 2017, it became clear that FY18 funds for this project were expected to be delayed, greatly reduced and/or zeroed out.
- In response to funding uncertainty and delays, CSISA had to reduce its staff strength by around 75% to conserve funds.
- FY18 funding was received in August 2018 and will be carried over to support programming during FY19

Engagement with Missions, FTF partners and project sub-contractors

USAID Missions

In Nepal, the KISAN II project, part of USAID's global Feed the Future initiative, is a \$20 m fiveyear program working to advance food security objectives by increasing agricultural productivity. KISAN II works collaboratively with CSISA by utilizing technical and extension materials and advice to improve the uptake of better-bet sustainable agriculture production and post-harvest practices and technologies for targeted cereals. KISAN II has a reach of hundreds of thousands of farmers, who have been exposed to CSISA information, materials, and technologies through this partnership.

CSISA and KISAN II have:

- Produced accessible guides for **better bet agronomy for rice and maize** information that is generally not available to smallholders. KISAN has reproduced these guides with their own resources and they provide the backbone of their technical training programs for maize and rice, the two core staple crop value chains for the project.
- Developed a factsheet on *Stemphylium* management for lentil and provided training to technicians from DADOs, KISAN, seed companies and some key farmers in different districts with the objective to disseminate the information to additional farmers

Appendix 1 – Staffing

Name	Role	Institution	Address	Phone (+977)	Email
Andrew McDonald	Project Leader	CIMMYT	Kathmandu, Nepal	9808757832	a.mcdonald@cgiar.org
Cynthia Mathys	Project Manager	CIMMYT	Kathmandu, Nepal	9808040992	c.mathys@cgiar.org
Mina Devkota	Obj 1, 2, 3, 4 Theme Leader	CIMMYT	Kathmandu, Nepal	9851197994	<u>m.devkota@cgiar.org</u>
Scott Justice	Obj 5 Theme Leader	СІММҮТ	Kathmandu, Nepal	9851027678	s.justice@cgiar.org
Gokul Paudel	Socio-economist	СІММҮТ	Kathmandu, Nepal	9845089438	g.paudel@cgiar.org
Ashok Rai	Data Specialist	CIMMYT	Kathmandu, Nepal	9808939798	a.rai@cgiar.org

Appendix 2 – Project subcontractors and key partners (have been a collaborator at some point during the project; some, but not all, have received funds from the project)

NEPAL				
PARTNER	PARTNERSHIP OBJECTIVE	ALIGNMENT WITH THEMES	LEVERAGING OPPORTUNITY	STATUS OF PARTNERSHIP
Government of Nepal				
Ministry of Agricultural Development	Technical guidance for GoN investments in agricultural development	All	New Agriculture Development Strategy approved by GoN in Fall of 2015. CSISA acts as a technical partner to shape the loan and investment programs associated with ADS, which may exceed \$100 m USD.	Active and sanctioned by CIMMYT's host country agreement
Nepal Agricultural Research Council (NARC)	Strategic and applied research on SI technologies	Innovation towards impact	NARC is responsible for providing the science basis of all state recommendations; their endorsement and ownership of emerging sustainable intensification technologies is essential.	Active and long-standing
Department of Agriculture (DoA)	Front line extension and support to farmers, service providers, and private sector	Achieving impact at scale	DoA has staff at the district level across Nepal and considerable budgets to support programming; CSISA assist in improving the quality of extension messaging and works to deepen linkages to private sector.	Active and long-standing
Nepali private sector	·			
Machinery importers (BTL, SK Traders, Dhahal, etc.)	Introduction and market development for scale- appropriate machinery	Achieving impact at scale	Rapid expansion of investment in scale-appropriate machinery and support for emerging service provision markets.	Active and long-standing
NIMBUS	Introduction and market development for new crop varieties and hybrids	Achieving impact at scale	Registration and market development for hybrids in the Feed the Future zone from a base of zero in 2015.	Active since 2015
NGO				

NAMEA	Trade association formed with the help of CIMMYT to create an enabling environment and policy dialogue for scale- appropriate mechanization in Nepal	Systemic change towards impact	Important voice for private sector with GoN as the Agriculture Development Strategy support programs take shape.	Active since 2014
SEAN	Trade association strengthened with the help of CSISA to create an enabling environment and policy dialogue for seed system strengthening / SMEs in Nepal	Systemic change towards impact	Important voice for private sector with GoN as the ADS support programs take shape.	Active and long-standing
Universities				
University of Illinois	Strategic research and landscape diagnostics to uncover patterns of spatial variability in crop performance and the contributing factors for yields gaps in Nepal cereal crops	Innovation towards impact	Collaboration with advanced research institution increases the quality of science conducted in Nepal; national partners learn new research methods and contribute to the formulation of new research questions.	Active
University of Nebraska	Opportunities for agronomic practices to conserve water, reduce risk, and enhance yields in maize-based systems in the hills of Nepal	Innovation towards impact	Collaboration with advanced research institution increases the quality of science conducted in Nepal; national partners learn new research methods and contribute to the formulation of new research questions.	Active

Wageningen University	Role of livestock and value chains in farmer willingness to invest in maize intensification	Innovation towards impact	Collaboration with advanced research institution increases the quality of science conducted in Nepal; national partners learn new research methods and contribute to the formulation of new research questions.	Active
Projects				
Knowledge-based Integrated Sustainable Agriculture and Nutrition (KISAN)	Strategic partnership to co- support on the large scale deployment of extension information and technologies	Achieving impact at scale	The KISAN project, part of USAID's global Feed the Future (FTF) initiative, is a US\$ 20 million five-year program working to advance food security objectives by increasing agricultural productivity. KISAN works collaboratively with CSISA by utilizing technical and extension materials, and advice, to Improve the uptake of better-bet sustainable agriculture production and post-harvest practices and technologies for targeted cereals. KISAN has a reach of hundreds of thousands of farmers, who have been exposed to CSISA information, materials, and technologies through this partnership.	Active for 3+ years
Nepal Seed and Fertilizer Project (NSAF) -USAID	Strategic partnership to co- support on the large scale deployment of extension information and technologies	Achieving impact at scale	USAID-Nepal funded NSAF (Nepal Seed and Fertilizer, \$15 m from 2016–2021) project, an initiative with a focus that spans the applied science-to-development continuum, inclusive of market facilitation efforts to expand private sector-led fertilizer sales. CSISA is taking advantage to disseminate the better-bet technology at scale through the NSAF networking	New
Building Resilience and Adaptation to Climate Extremes and Disaster (BRACED)- DFID	Opportunistic partnership to take advantage of value chains, entrepreneurial skills and collections centers created by BRACED partners	Achieving impact at scale	DFID-UK funded BRACED project prioritizes 'Developing Climate Resilient Livelihoods for local communities through public-private partnership for 500,000 poor people in western Nepal that suffer from climate extremes and disasters'. CSISA is taking advantage to disseminate the better-bet technology,	Active for 2+ years

			farm mechanization at scale through the BRACED networking	
Seed For Farmer Project (KUBK) - IFAD	Opportunistic partnership to take advantage of their net-working for the dissemination of appropriate farm mechanization and best bet technologies	Achieving impact at scale	IFAD-funded Government led seed project with the objective to Support Extension of the Formal Seed Sector and Entrepreneurship and Institutional Development. CSISA is taking advantage to disseminate the better-bet technology, strengthening seed systems at scale through their networking	New
Sustainable and Resilient Farming Systems Intensification in the Eastern Gangetic Plains (SRFSI)	Spreading out the technologies in eastern districts	Achieving impact at scale	CSISA's experiences in scaling resource conserving technologies in western Nepal can be an asset for jumpstart the technologies in eastern Nepal. ACIAR funded SRFSI has also opting for scaling activities now onwards. CSISA can support NARC and other SRFSI partners to spread out the technologies.	New

Appendix 3 – Indicators

Indicator / Discongregation	20	2019	
indicator / Disaggregation	Target	Actual	Target
EG.3.2-1: Number of individuals who have received USG- supported short-term agricultural sector productivity or food security training [IM-level]	0	167	698
Type of Individual	0	167	698
Producers	0	143	460
Male		92	262
Female		51	123
Disaggregates Not Available	0		75
People in government	0	11	105
Male		11	67
Female			35
Disaggregates Not Available	0		3
People in private sector firms	0	7	68
Male		7	46
Female			22
Disaggregates Not Available	0		
People in civil society	0	6	65
Male		6	33
Female			22
Disaggregates Not Available	0		10
Disaggregates Not Available			
Male			
Female			
Disaggregates Not Available			
EG.3.2-4: Number of for-profit private enterprises, producers organizations, water users associations, women's groups, trade and business associations, and community based organizations (CBOs) receiving USG food security related organizational development assistance [IM-level]	0	31	221
Type of organization	0	31	221
For-profit private enterprises	0	17	75
Producers organizations	0	9	95
Water users associations			
Women's groups	0	4	43
Trade and business associations	0	1	8
Community-based organizations (CBOs)			
Disaggregates Not Available			
Duration	0	31	221
New	0	17	74
Continuing	0	14	147
Disaggregates Not Available			

EG.3.2-17: Number of farmers and others who have applied improved technologies or management practices with USG assistance [IM-level]	0	11,641	17,325
Producers	0	11,641	17,325
Sex	0	11,641	17,325
Male	0	3,363	11,211
Female	0	8,278	6,114
Disaggregates Not Available			
Technology type			
crop genetics	0	570	1,000
cultural practices	0	3,950	6,260
livestock management			
wild fishing technique/gear			
aquaculture management			
pest management			
disease management			
soil-related fertility and conservation	0	1,788	4,795
irrigation	0	2,299	900
water management (non-irrigation)	0	323	2,020
climate mitigation			
climate adaptation			
marketing and distribution			
post-harvest - handling and storage	0	2,711	2,350
value-added processing			
other			
Disaggregates Not Available			
Commodity			
Lentil (NRVCC)			
Maize		629	953
Mung Bean (NRVCC)		1,806	2,685
Wheat		9,206	13,687
Disaggregates Not Available or Other			
EG.3.2-18: Number of hectares of land under improved technologies or management practices with USG assistance [IM-level]	0	5,039	7,620
Technology type			
crop genetics	0	184	850
cultural practices	0	2,197	2,245
pest management			
disease management			
soil-related fertility and conservation	0	865	1,475
irrigation	0	179	900
water management (non-irrigation)	0	209	1,010
climate mitigation			

climate adaptation			
other		1,405	1,140
Disaggregates Not Available			
Sex	0	5,039	7,620
Male	0	1,803	4,970
Female	0	3,236	2,650
Joint	0		
Association-applied	0		
Disaggregates Not Available			
Commodity			
Lentil (NRVCC)			
Maize grain		380	1,192
Mung Bean (NRVCC)			50
Wheat		3,434	5,903
Disaggregates Not Available or Other		1,225	475
EG.5.2-1: Number of firms receiving USG-funded technical assistance for improving business performance [IM-level]	0	89	460
Type of Firm	0	89	460
Formal	0	23	395
Informal	0	66	65
Disaggregates Not Available			
Duration	0	89	460
New	0	80	260
Continuing	0	9	200
Disaggregates Not Available			

Appendix 4 – CSISA-Nepal Scaling and the GFSA

Global Food Security Act Goal: Sustainably reduce global hunger, malnutrition, and poverty

Seed systems: Input dealers stock registered maize hybrids

Seed systems: Private seed companies expand businesses for wheat and pulses

Seed systems: Strategic investments & enhanced coordination among seed system actors

Pulses: New **low-risk opportunity crops** promoted by government and private sector, along with economic and nutritional messaging

Wheat: Domain-specific recommendations for management practices that will enable early wheat establishment

Wheat: Social marketing approaches utilized to 'get the word out' on better-bet agronomy for wheat

Precision Nutrient Management: Domain- and situation-specific soil fertility management strategies developed for wheat, lentil and maize

Precision Nutrient Management: Broad-scale awareness of the yield and economic benefits of judicious fertilizer application

Mechanization and Irrigation: Appropriate technologies for overcoming energy and cost bottlenecks to **irrigation expansion** identified

Mechanization and Irrigation: Identification of physical and operational models of **land aggregation** to permit inclusive access to innovative mechanization technologies

Mechanization and Irrigation: New business opportunities for laser land leveling, zero tillage, & mechanized harvesting defined with expected returns for all value chain actors

Mechanization and Irrigation: Advancing attachment design and commercial availability for the two-wheel tractor and mini-tiller platforms

Mechanization and Irrigation: Market development for importers and manufacturers of agricultural machinery

←

←

Cereal Systems Initiative for South Asia (CSISA) in Nepal, Agronomy and Seed Systems Scaling Interventions

Pulses: Production targeting and innovative agronomy to enhance yields and reduce risk of lentil failure

Pulses: New **low-risk opportunity crops** promoted by government and private sector, along with economic and nutritional messaging

Wheat: Domain-specific recommendations for management practices that will enable early wheat establishment

Precision Nutrient Management: Accessible technologies identified and commercialized for increasing the efficiency of fertilizer use

Mechanization and Irrigation: Appropriate technologies for overcoming energy and cost bottlenecks to **irrigation expansion** identified

Mechanization and Irrigation: Advancing attachment design and commercial availability for the two-wheel tractor and mini-tiller platforms

Mechanization and Irrigation: Improving capacity for machinery evaluation and design improvement among NARES partners

Mechanization and Irrigation: Strengthened training facilities and programs for rural and urban-based agro-machinery repair

Mechanization and Irrigation: Market development for importers and manufacturers of agricultural machinery

Pulses: New **low-risk opportunity crops** promoted by government and private sector, along with economic and nutritional messaging

Seed systems: Input dealers stock registered maize hybrids

CSISA-Nepal activities also map against the following Intermediate Results:

- IR 1: Strengthened inclusive agriculture systems that are productive and profitable
- IR 2: Strengthened and expanded access to markets and trade
- IR 3: Increased employment and entrepreneurship
- IR 4: Increased sustainable productivity, particularly through climate-smart approaches
- IR 7: Increased consumption of nutritious and safe diets

As well as these Cross-Cutting Intermediate Results:

- CC IR 3: Increased gender equality and female empowerment
- CC IR 4: Increased youth empowerment and livelihoods

←

Cereal Systems Initiative for South Asia (CSISA) in Nepal, Agronomy and Seed Systems Scaling Interventions

←