

Cereal Systems Initiative for South Asia



Agronomy and Seed Systems Scaling

Semi-Annual Report
October 1, 2018 to March 31, 2019



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Abbreviations

2WT	two-wheeled tractor
4WT	four wheeled tractor
ACIAR	Australian Centre for International Agricultural Research
AMPC	Agricultural Machinery Promotion Centre
BMGF	Bill & Melinda Gates Foundation
BRACED	Building resilience and Adaptation to Climate Extremes and Disasters (UK Aid)
CIMMYT	International Maize and Wheat Improvement Center
CSISA	Cereal Systems Initiative for South Asia
CSISA-MI	CSISA Mechanization and Irrigation
CSRD	Climate Services for Resilient Development
DADO	district agricultural development office
DAP	diammonium phosphate
DoA	Department of Agriculture
DSR	direct-seeded rice
FTF	Feed the Future
GATE	GATE Nepal Seed Company
GCAN	Gender, Climate Change and Nutrition Integration Initiative
ha	hectare
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
kg	kilogram
KISAN	Knowledge-intensive Sustainable Agriculture and Nutrition project
KSC	Kalika Seed Company
LSC	Lumbini Seed Company
MoP	muriate of potash
NAMEA	Nepal Agricultural Machinery Entrepreneurs Association
NAMTRC	National Agricultural Machinery Testing Centre
NARC	Nepal Agricultural Research Council
NCE	no-cost extension
NGLRP	National Grain Legumes Research Program
NSAF	Nepal Seed and Fertilizer project
PMAMP	Prime Minister Agriculture Modernization Project
PSC	Panchashakti Seed Company
SRFSI	Sustainable and resilient farming systems intensification in the Eastern Gangetic Plains
Mt	metric tonne
USAID	United States Agency for International Development
USC	Unique Seed Company

Executive Summary

Project Rationale and Objective

Cereal and pulse yields in Nepal are well below regional averages, and the present rates of increase are insufficient to meet near and long-term domestic requirements. Major causes of this are tightening labor markets, poor knowledge of best management practices, insufficient availability of irrigation water and mechanization, and the low appetite for risk and low capacity for investment of the many asset-poor farmers.

The CSISA Nepal Agronomy and Seed Systems Scaling project (the project) 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 lentils and mung beans;
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 in the Feed the Future Zone of Influence in Nepal,¹ including the availability of spares parts, improved mechanic services, and expanding the number of scale-appropriate machinery service providers so that farmers can gain affordable access to new technologies.

MAJOR ACTIVITIES AND ACCOMPLISHMENTS

1. Strengthened Seed Systems

- Through interactions with private sector partners, the project supported a 400% jump in sales of domain-expanded maize variety seeds (from 44 metric tonnes [Mt] in 2016 to 164t in 2018).
- Four seed companies prepared their five-year business plans with project support. Analyses indicate that these companies are poised to grow with 16% growth planned in overall seed sale volume across multiple crops.
- The project facilitated multiple awareness-raising events in the seed sector, including a visit of 45 agricultural secretaries, provincial planning commission members, media and local government representatives to demonstrations and trials of newly released and pipeline improved and bio-fortified wheat varieties in Kailali and Rupandehi districts.
- The improved capacity of four seed companies to produce foundation seed has increased the availability of base seed stock, which can be used to multiply seed and increase availability for farmers. In particular, wheat foundation seed production increased from 2 Mt in 2014 to more than 100 Mt in 2018. The project played an important technical advising and facilitating role in this achievement, alongside national seed sector partners.
- Five partner seed companies conducted 11 varietal trials and 86 demonstrations supported by the project for the popularization and registration of new wheat varieties.

¹ Note that since 2016 Nepal has been divided into seven provinces instead of the previous five development regions (including the Mid-western and Far Western regions). These two erstwhile regions are now covered by all of the Sudarpasshim (Far Western) and Karnali provinces and the western Terai part of Province 5.

- With technical advice from the project, a new participatory market coordination mechanism was piloted between the Nepal Agricultural Research Council (NARC), mung bean grower cooperatives, food processors and local governments. The results of this initiative will be discussed in the project's annual report, as the mung bean harvest will happen after this reporting period.
- Three project seed company partners started the testing and maintenance breeding of new wheat varieties on 4 ha of land.
- The project provided technical advice to support two wheat management training events held by the Prime Minister's Agriculture Modernization Project (PMAMP) in Kailali district.

2. Sustainable Lentil and Mung Bean Intensification at Scale

Lentils

- *Stemphylium* blight is a potentially devastating crop disease that threatens lentil yields in Nepal's Terai. Weather conditions directly affect disease incidence and severity. The project is supporting the development of a predictive model, which will be developed into an early-warning system for farmers on when and where fungicide application may be rational and economically feasible to apply to lentil crops in Nepal.

Mung beans

- Mung beans are a leguminous crop that is not widely grown in Nepal, but has the potential to offer farmers dividends when connected to markets. Mung beans can fit well into cropping patterns in Nepal's Terai, where the land is often left fallow for 80–90 days after the harvesting of wheat when mung beans can be planted and harvested. The project is supporting PMAMP to expand mung bean cultivation in Kailali and Kanchanpur. Through project support, farmers in these districts produced nearly seven tons of quality mung bean seed that will be used to scale-out mung cultivation next year.

3. Sustainable Wheat Intensification at Scale

- Surveys conducted by the project with 1,684 wheat farmers found that 43% of them had adopted longer duration wheat varieties, and on average, the adoption of these varieties had increased productivity by almost 0.5 Mt/ha. When combined with early sowing practices, farmers using long-duration varieties can avoid the significant loss of 20 kg/ha/day of yield due to terminal heat stress in the Terai. Project efforts to support earlier sowing through zero-tillage service provision is resulting in increasing successes through ongoing and new collaborations with PMAMP and provincial agriculture ministries in the Terai.

4. Precision Nutrient Management

- This workstream had fewer achievements in this reporting period because funding delays and opportunities to pursue precision nutrient management in other projects, which were not facing delays, led to work in this area being scaled back. Key activities included collaboration with the USAID funded Nepal Seed and Fertilizer (NSAF) project to identify the potential for unsubsidized diammonium phosphate (DAP), urea, and muriate of potash (MoP) distribution and sales by the private sector, and to identify high potential areas for business investments in custom and regional fertilizer blends. In particular, project staff are supporting NSAF in discussions with Adventa Export Pvt. Ltd., a company interested in expanding custom fertilizer blends to the Terai to apply to cereals and other crops.

5. Mechanization and Irrigation

- The project made significant progress on i) supporting policy makers and governance structures to facilitate farmers' increased access to scale-appropriate farm machinery by supporting the development of a diverse and integrated machinery value chain, ii) supporting the development and availability of scale-appropriate farm machinery (as opposed to inappropriately sized or expensive equipment); iii) raising awareness on the many benefits of farm mechanization; and iv) building capacity on operating and maintaining farm machinery.
- The project's collaboration with the new provincial governments has created awareness of the benefits of using knapsack spreaders to apply fertilizers efficient and precisely. As a result of work done by project staff, since March 2019, the Far Western and Province 5 governments have begun to provide a 50% subsidy for smallholder farmers to purchase spreaders through provincial agricultural machinery and input dealer-suppliers. In addition, the project has supported other USAID Nepal funded initiatives by training them 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 at 10 sites in Kailali and Kanchanpur.
- A major project achievement was the participation of more than 40 international experts and project 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.
- The project engineered and field tested a mini-tiller side-dressing attachment for maize in Dang. Preliminary evaluations indicate its use can dramatically increase the efficiency of inter-cultural operations for maize farmers.
- In 2017/18, the project 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 project, 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.
- The project's stall at four agricultural fairs (Butwal in Province 5, Khajura in Banke, Rajapur in Bardiya and Dhangadhi in Kailali) raised awareness on scale-appropriate machinery technologies to the 10,000 visitors to the stalls.

Project Overview and Theory of Change

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 among 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. Also, innovative applied research has long been under-funded and research benefits have rarely reached farmers. The Far Western and Mid-Western areas of Nepal are acutely affected by these constraints: They are among Nepal's most poverty-dense regions in the Terai (agricultural plains below the Midhills). These regions 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 the project'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.

To address these priorities, USAID's additional investment in CSISA in the forms of the 'Agronomy & Seed Systems Scaling project' (hereafter referred to as 'the project'), was launched in October 2014 to scale-up and -out the research findings and technologies developed under original CSISA program investments. The project is funded by USAID and is due to run until September 2019. The project works with government agencies, farmers' groups, service providers, agro-dealers, seed enterprises and other development partner-supported projects. It is working to scale-up the following results mainly across Nepal's Far Western and Mid-Western Terai (see Figure 1). The project's expected outcomes align with the Global Food Security Act (GFSA; Appendix 3).

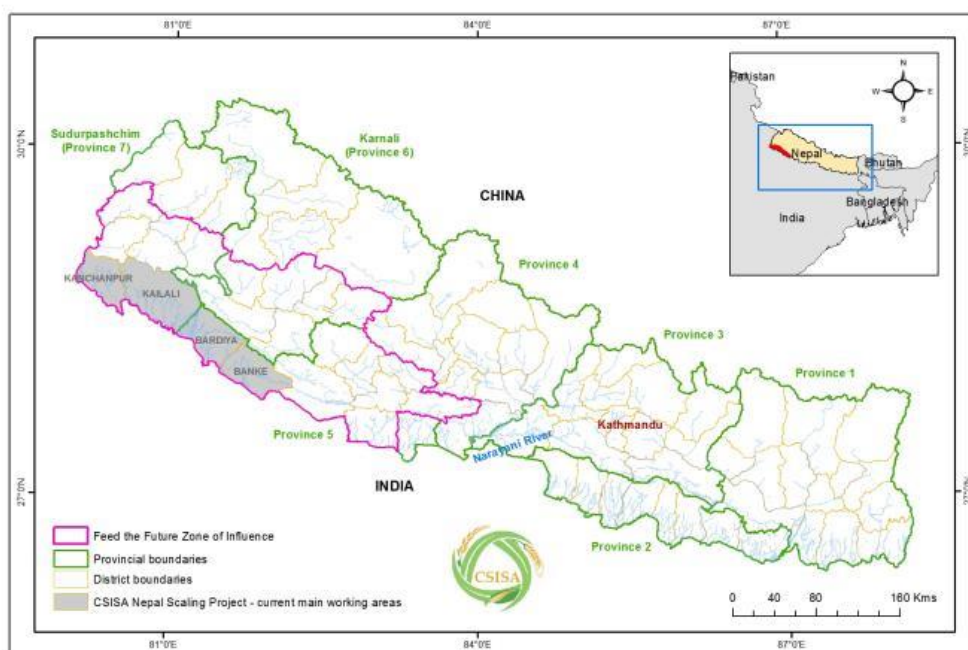


Figure 1: Main working areas of the CSISA Agronomy and Seed Systems Scaling project and key locations mentioned in this report

The project focuses on the following objectives and activities to address the project's theory of change (Figure 2):

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

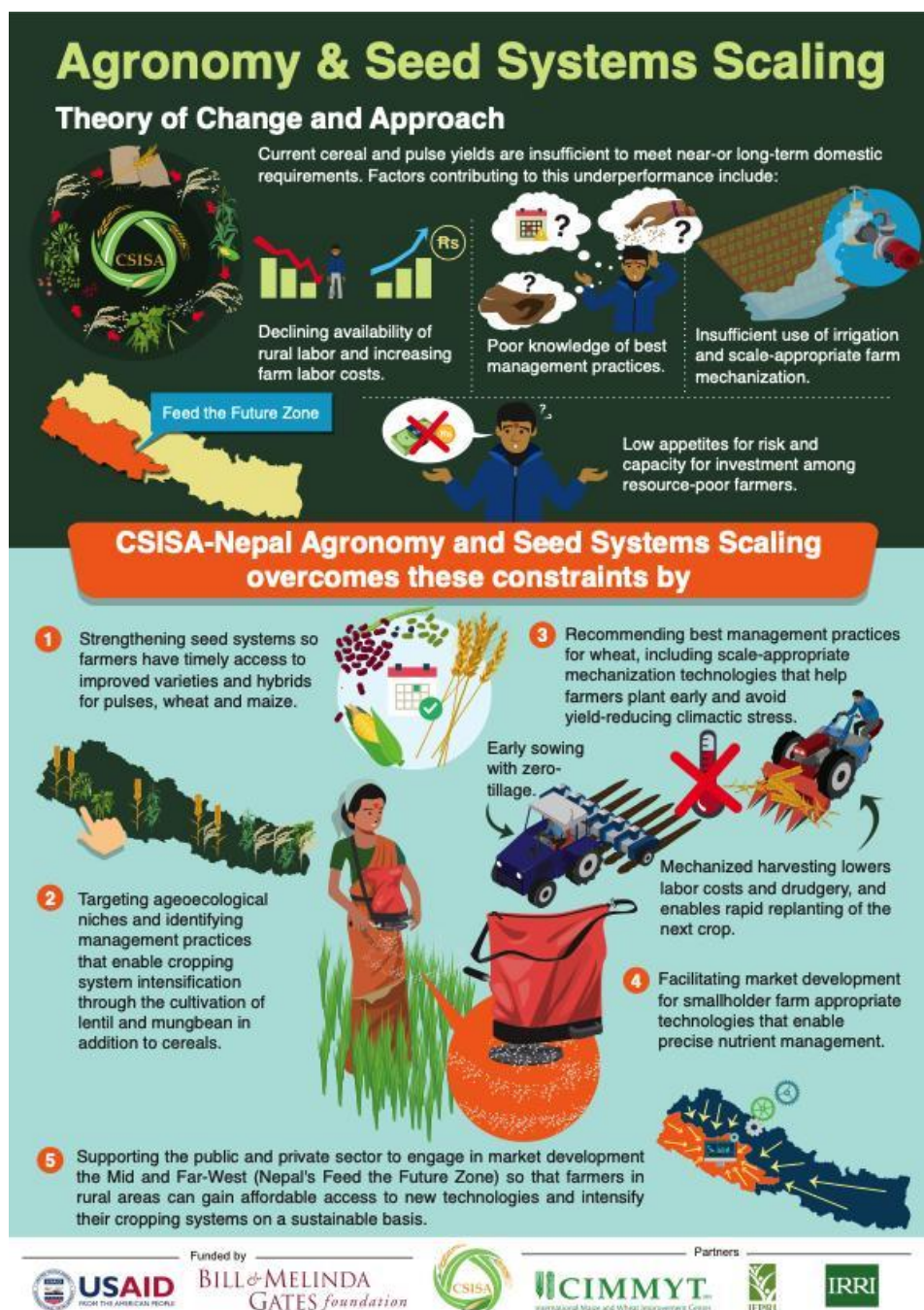


Figure 2: CSISA Nepal Agronomy and Seed Systems Scaling theory of change

Progress During the Reporting Period October 2018 – March 2019

OBJECTIVE I: STRENGTHENED SEED SYSTEMS

Enabling Nepali farmers to adopt improved crop varieties is fundamental to raising productivity and developing greater resilience to biotic (pests and diseases) and abiotic (drought and high temperature) stresses. This is because rain-fed subsistence farming is common in Nepal and also because farmers only replace about 15% of the seed of major cereal crops in each cropping cycle with quality-controlled seed, with the rest coming from home-saved seed, seed exchanged with neighbors and relatives and other informal channels. Although the latter is important for maintaining indigenous biodiversity, the lack of seed replacement means increased potential for yield loss and in some cases pests and diseases. The national seed industry is at a nascent stage, most crop varieties respond poorly to biotic and abiotic stresses, and farmers have little awareness of the economic benefits of adopting new varieties. The CSISA Nepal Agronomy and Seed Systems Scaling project (the project) has been working since 2014 to develop robust seed systems for cereals and legumes in Nepal by supporting seed enterprises to become technically stronger, more market-oriented, professionally organized, and strategically linked with the actors along the value chain. Activities take a public–private partnership approach to strengthen the capacity of stakeholders in the wheat and mung bean value chains. These stakeholders include seed companies, dealers, producer groups, food processors, cooperatives, research and development organizations and other development partners.

1.1 Strategic investments and enhanced coordination among seed system actors

The project team works with policy makers, research scientists in the Nepal Agricultural Research Council, USAID supported development projects and other wheat and mung bean value chain actors to strengthen Nepal's seed systems. For example, CSISA has worked with the Nepal Seed and Fertilizer (NSAF) project to develop a Digitally Enabled Seed System (DESS) to make the national seed balance sheet that can be used by the public and private sector to assess seed replacement rates and potential seed markers. CSISA has also worked to strengthen seed company capacity including on hybrid maize development, business plan development and national seed sector policy advocacy. The five seed companies that the project worked with in this period are listed in Appendix 2. In this reporting period, the project began to work with the new 'middle tier' of government officials in Nepal's newly formed federal provincial system, who are now responsible for overseeing agricultural development in their areas. The project carried out three major activities in this period to support the Far Western provincial government to promote wheat and mung bean cultivation, as described below:

Mung bean action plan – An action plan was developed by the project in collaboration with the Ministry of Land Management, Agriculture and Cooperatives of the Far Western Province². The action plan also involved in-depth consultation with seed traders and millers to increase mung bean production in the province. The plan grew out of the CSISA's research and development activities carried out in the Far West since 2015 including participatory varietal selection, market networking (linking market actors to farmers), and methods to improve agronomic practices and make use of scale-appropriate farm mechanization. The plan was developed through the steps shown in Figure 1.1.

² Note that until recently this province was called Province 7. Its current name in Nepali is Sudurpashchim Pradesh (= Far Western Province)

The following main components of the plan were agreed upon and formalized in February of 2019:

- CSISA will provide mung bean knowledge products (a video, technology tips and informational sheets, and profiles of seed drill service providers and their business plans) and technical training to local government staff and farmers across the province. The project will also collaborate to strengthen market linkages by facilitating contractual agreements between mung bean producers and cooperatives, and cooperatives and millers.
- The Ministry of Agriculture will provide improved mung bean seed and irrigation facilities to farmers to assist in intensified cultivation of the crop.
- The Ministry will collaborate with CSISA to implement monitoring visits at field sites and a knowledge sharing workshop in the Far Western province

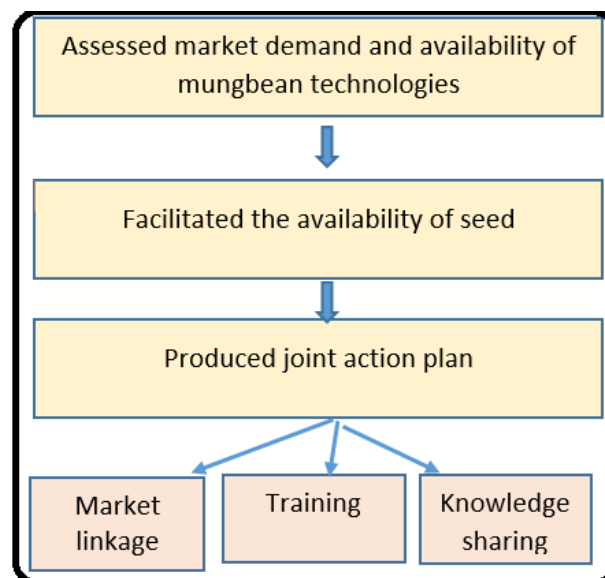


Figure 1.1: Sequence of events in development of the mung bean action plan

At the action plan discussion meeting on 27 February 2019, Secretary of Agriculture Rabendra Pradhan, said:

“We highly value the activities of the CSISA Scaling project and CIMMYT to strengthen the mung bean value chain, especially in our province. The action plan will amplify our impacts.”

In addition, Navaraj Joshi of Pathak Food Industries, Kanchanpur highlighted his interest in promoting mung bean cultivation to increase the year-round productivity of his contract rice growers by facilitating a second crop in addition to rice. He indicated that he hopes to see contract rice farmers also become involved in mung bean marketing. He verbally committed to enter into agreements to buy mung beans from farmer groups and cooperatives. CSISA is now following up to formalize these

commitments and assure fair markets for farmers growing mung bean for the first time.



Photo 1.1: The project handing over informational ‘tips’ for mung bean producers to the Secretary of the Far Western provincial agricultural ministry (Suman Khanal)

Multi-stakeholder meetings – During January 2019, the project organized mung bean review and planning meetings in Dhangadhi, Kailali and Nepalgunj, Banke, which were attended by participants from across the value chain in addition to the provincial agricultural ministry. The millers informed participants about the size of the mung bean market and quality requirements for successful sale, while farmer cooperative participants discussed their experiences of the benefits of growing mung beans. The meetings built the Ministry’s interest to support farmers to commercialize this crop in the Far Western Province. In addition, at the meeting, the

project shared the mung bean variety performance data with provincial Ministry and linked Ministry officials with the Panchashakti Seed Company to promote the availability of mung bean seeds in the Far West of the Feed the Future (FTF) zone.

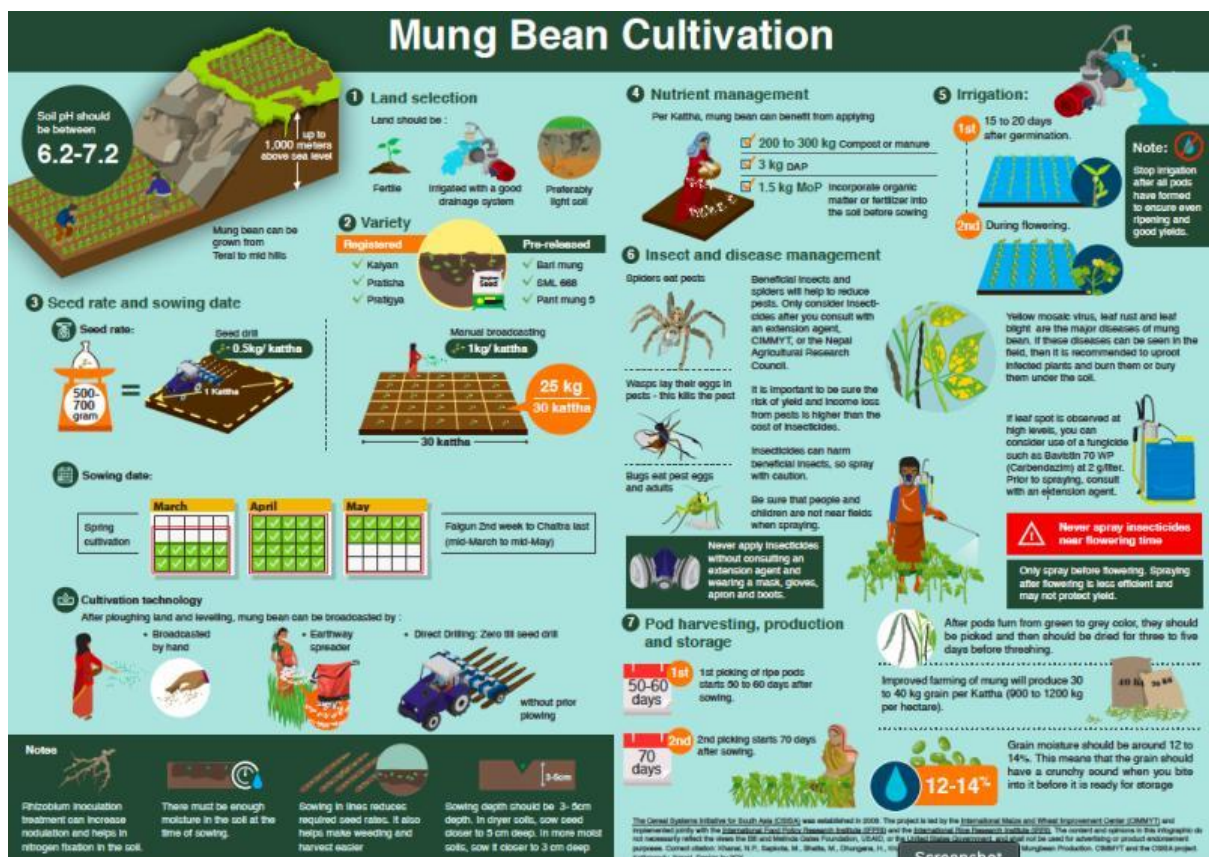


Figure 1.2: Infographics developed by CSISA that provide recommendations for mung bean cultivation in Nepal's Feed the Future Zone

Mung bean on-farm experiment observations – In March 2019, 45 agricultural secretaries, provincial planning commission members, media and local government representatives visited and observed demonstrations and trials of newly released and pipeline improved and bio-fortified wheat varieties in Kailali and Rupandehi districts (Photo 1.2). During the trip, provincial and local



Photo 1.2. Observation of wheat demonstration by wheat stakeholders, March 2019, Kailali (CSISA archive)

governments committed to promote the bio-fortified varieties in their forthcoming plans. Four newspapers and three television channels covered the event and stakeholders' perception about the new project-promoted wheat varieties. The millers also committed to buying bio-fortified wheat grain at premium prices once it becomes available in sizable volumes.

1.2 Input dealers stocking and selling registered maize hybrids

Extended the domain of hybrid maize – In 2018, Nepal imported 493 million metric tonnes (Mt) of maize grain from India at a cost of \$122 million, mainly for poultry feed. As per the National Feed Association this

amount is increasing by about 10% per year. The Government of Nepal, through its [Seed Vision document \(2013–2025\)](#) and its Agriculture Development Strategy (2015–2035), is promoting hybrid maize production to boost the in-country production of maize. Over 40 imported hybrid varieties have been registered so far, but more than 90% are only legally recommended for use east of the Narayani river; i.e. in the central and eastern parts of the country. Traders and retailers knew it was illegal to sell this seed west of the Narayani.³

To address this pressing issue, the Seed System component of the CSISA Nepal Scaling project has facilitated stakeholders, including the Seed Quality Control Centre (SQCC), the Nepal Agriculture Research Centre (NARC) and seed companies, to test the performance of market available hybrids in areas west of the Narayani. The CSISA team has also helped develop proposals to extend the geography of the tested and proven hybrids. As a result, the officially recognized domains for four hybrid maize varieties (Rajkumar, Nutan, 9220 and TX-369) were officially expanded at the end of 2015.

This has resulted in much greater use of this hybrid seed that continues to have impact to today. At the beginning of 2019, 14 agro-dealers in 13 Terai districts were stocking 229 Mt of the seed of these four hybrids – an increase of 420% since 2016. These agro-dealers estimate that about 30% of this seed will be sold in 2019 during the spring season in the Terai (in irrigated production areas), and the rest across the hills (where rainfed farming dominates).

Promoting new maize hybrids – Leading on from the extension of the domains of the four hybrids, the Nepali feed mill company NIMBUS imported the varieties TX 369, Bioseed 9220 and Rajkumar from the multinational company Bioseed. Since then, the project has provided strategic guidance to NIMBUS and its dealers to market these domain-expanded hybrids.

Marketing then new hybrids – Since 2015, the project team has been guiding NIMBUS and its retailers to develop marketing plans for the domain-expanded hybrids to help them meet the increased demand. The expansion of the domains and the marketing plans have resulted in the sales of the seeds of the three imported hybrid maize varieties (plus the Nutan variety) substantially increasing with the rate of increase accelerating in 2018 (Figure 1.3).

Encouraging adoption of hybrid maize – Where appropriate, the project is also encouraging the

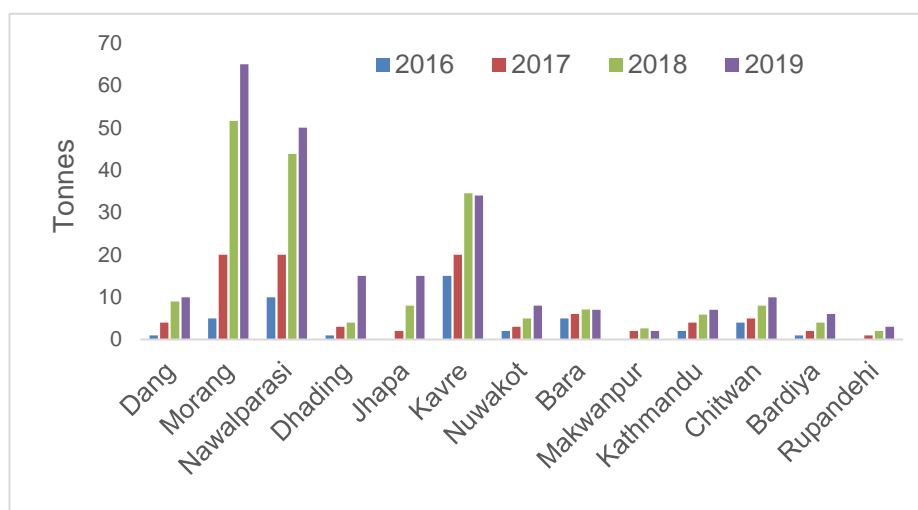


Figure 1.3: Sales of the three maize hybrids imported from Bioseed (2016–2018 actuals, 2019 estimated)

uptake of hybrid maize by farmers. The project supported the production of a jingle to promote the use of registered hybrid maize varieties, which was broadcast on a Banke district FM radio station from late 2018. The radio jingle publicized the names of hybrid varieties, their

³ See Figure 1 for location of the Narayani river

domains and levels of productivity in both the Nepali and Awadhi languages and mainly focused on spring maize.

1.3 Private seed companies expand their wheat and pulse seed businesses

Millions of resource-poor farmers in South Asian countries derive their livelihoods from growing wheat and pulses. However, in Nepal, the seed systems of these crops have been poorly organized and the absence of suitable business models has meant that farmers have been unable to access the elite germplasm developed by agriculture research stations. To address this, since 2014, the project has mentored emerging Nepali seed companies on business planning, quality seed production, and the market development of wheat and mung bean varieties. The sections below summarize recent achievements.

Wheat

There have been substantial increases in source seed production, seed sales volume, and the variety diversity of wheat as a result of project interventions. Support from CSISA is enabling the project's five partner seed companies (GATE Nepal Seed Company [GATE], Kalika Seed Company [KSC], Lumbini Seed Company [LSC], Panchashakti Seed Company [PSC] Unique Seed Company [USC]) to provide new useful varieties for farmers. See details of these companies in Appendix 2.

Increased sales of seed and hybrid seed – The amount of wheat seed sold by the above five seed company partners almost doubled from 1,194 Mt in 2014 to 2300 Mt in 2018 – a 92.6% increment. This has been due to i) the adoption of good business practices such as varietal demonstrations in potential market segments, and ii) technical advances in source seed cleaning by maintaining the breeding of elite wheat germplasm in partnership with seed companies and the National Wheat Research Programme. Each of these efforts were supported technically by CSISA in Nepal. This has led to the increased production of source seed (see Figure 1.4) and a 68% increase in the number and share of new improved wheat varieties (<10 years old) sold by partner seed companies between 2014 and 2018 (Figure 1.5). For example, the share of NL 297 (a 35-year-old wheat variety) which accounted for 35% of partner seed company sales in 2014 is projected to only account for 12% of

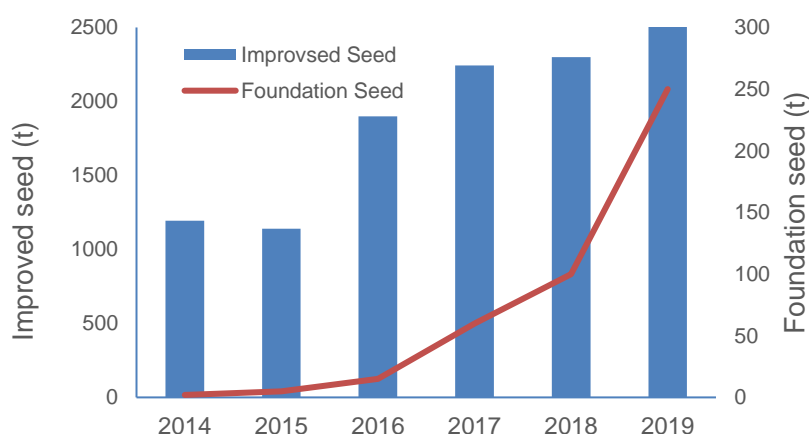


Figure 1.4: Volume of improved and foundation wheat seed sold by the Scaling Project's five partner seed companies (2014–2018 actuals and 2019 estimates)

sales in 2019, while the sales of the new Vijaya and NL 971 varieties are projected to increase. Also, many new varieties have been introduced in the seed production chain.

Increased production of foundation seed –

There has been also a substantial improvement in the foundation seed production of wheat varieties. Before 2015, CSISA's partner companies used to buy all

of their foundation seed from NARC stations; but from 2017, they have started selling foundation seed to other agencies as per the provision in the National Seed Balance Sheet, the development of

which was supported technically by CSISA. This initiative is important to increase the seed replacement rate by farmers of wheat. In 2018, the replacement rate was only 15%, but is projected to reach 25% by 2025.

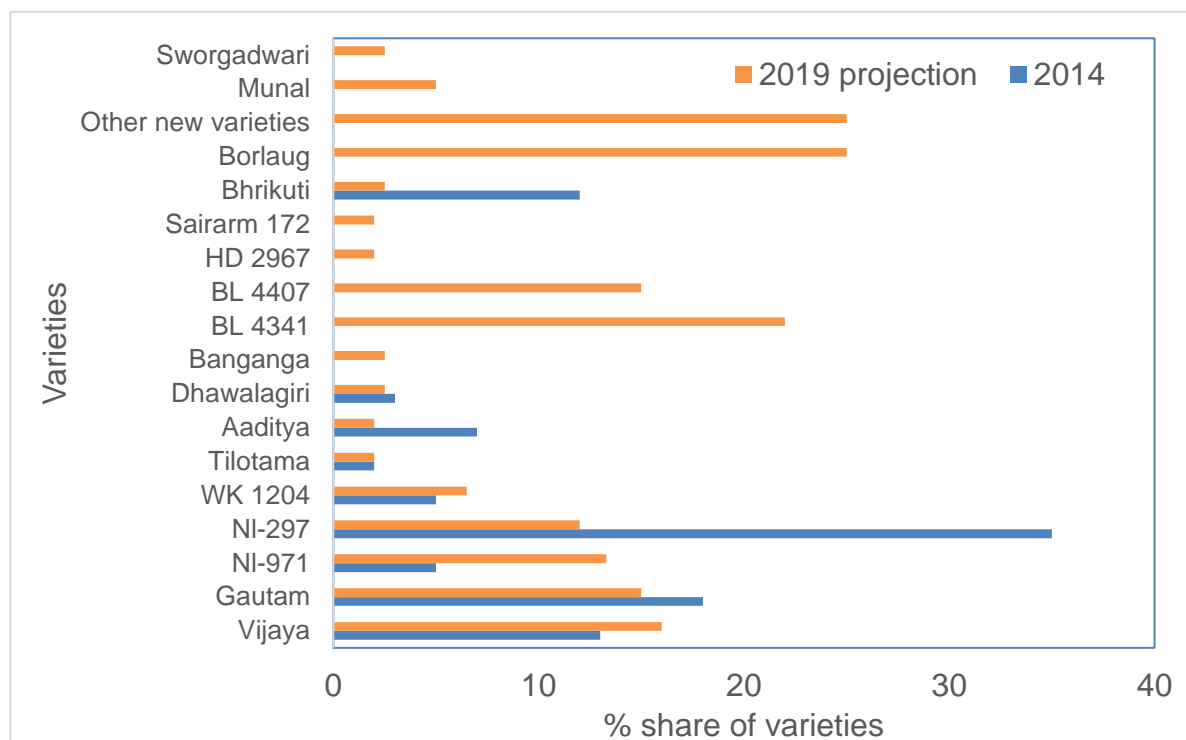


Figure 1.5: Share of increasingly diverse wheat seed varieties anticipated in partner seed company sales in 2014 (actual) and 2019 (estimated)

Other project wheat activities in the reporting period assessed seed value chains, mentored seed companies to develop and operationalize their business plans, and popularized bio-fortified wheat varieties through capacity building, seed company-led demonstrations, and strategic partnerships with the Prime Minister Agriculture Modernization Project (PMAMP),⁴ the National Wheat Research Programme (NWRP) and local governments.

Research support in trials of new varieties – To popularize new wheat varieties, in October 2018 the project met partner seed companies, and the NWRP and PMAMP to finalize the protocol for running participatory variety selection (PVS) trials-demonstrations (hereafter ‘trials’) in large plots (1,350 m² each) in farmers’ fields. CSISA staff subsequently trained company personnel to run the trials of newly released and pipeline wheat varieties, including bio-fortified varieties. The trials were carried out in the winter growing season on 84 plots in potential growing areas of Banke, Bardiya, Kailali and Kanchanpur in the western Terai. Performance is being evaluated at farmer field days and joint monitoring visits. Harvesting is ongoing at the time of writing at all the sites to compare grain yields with currently grown varieties. Statistical analysis will then identify the most stable varieties by location to support NWRP to support the registration and release of these new varieties, which will be reported in the project’s annual report.

⁴ The Prime Minister Agriculture Modernization Project is a 10-year project of the Ministry of Agriculture and Livestock Development

Other accomplishments – The main other accomplishments in encouraging improved seed systems for wheat in the reporting period were as follows:

- Four partner seed companies (GATE, LSC, PSC and USC) prepared their five-year business plans, which plan for a 16% growth in their volumes of seed sales.
- The five partner seed companies (GATE, KSC, LSC, PSC and USC) carried out 14 participatory variety selection trials of eight wheat genotypes, including 3 Fe and Zn fortified varieties and one wheat blast resistant variety (Borlaug 100), across the Terai districts of Banke, Bardiya, Kailali and Kanchanpur, and the hill districts of Surkhet, Doti and Arghakhanchi. The results should facilitate their fast track release and registration.
- The maintenance breeding of eight wheat varieties (Borlaug 100, Banganga, Zincol, Miyale, Dhawalagiri, BL 4406, BL 4407 and BL 4341) was started by the five partner seed companies with technical facilitation from the project. An estimated 10,000 wheat spikes will be selected at harvest for planting to build up quality stocks for next year.
- One hundred and fourteen farmers and seed company, cooperative, retailer and government personnel were trained at four training events on improved wheat production technology including the importance of variety and seed replacement and the potential of bio-fortified wheat varieties.
- With technical advising from CSISA staff, seed grower lending model was piloted for wheat seed producers in Kailali district in partnership with Laxmi Bank and the Panchashakti seed company. Twenty farmers have so far received loans under Laxmi Bank's agriculture lending scheme for wheat seed production at a reduced 8% interest rate.

Mung beans

The role of mung beans in the sustainable intensification of rice-wheat based cropping systems is well understood. This crop was previously only grown in the Eastern Terai, but now, due to project interventions it is also being grown in the western Feed the Future (FTF) Zone of Influence districts of Banke, Bardiya, Kailali and Kanchanpur. In previous years, the project validated its technologies for improving mung bean yields by engaging private seed companies, millers (who dehusk and clean the beans) and NARC. The area where mung beans are grown has increased as a result as reflected in the increased volume of mung bean seed sales by partner seed companies (for example, GATE Nepal) since 2014 (Figure 1.6).

Framework for mung bean market development –

Linking mung bean farmers to markets is challenging as most production occurs on small parcels of land, many of which are remote and poorly

linked to markets, with little commercialized production. A market-based strategic framework was developed by the project in 2018 to address these issues (Figure 1.7). The project is facilitating contractual agreements between i) mung bean growers and cooperatives for production and stocking (horizontal contracting), and ii) cooperatives and millers/seed companies for marketing (vertical contracting). This should create trust between the parties to implement best crop management practices and produce more competitive products for the market.

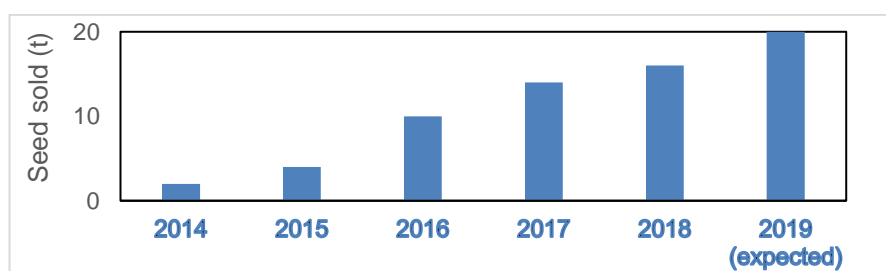


Figure 1.6: Volume of seed sales of partner seed companies (2014–2018 actuals & 2019 estimate)

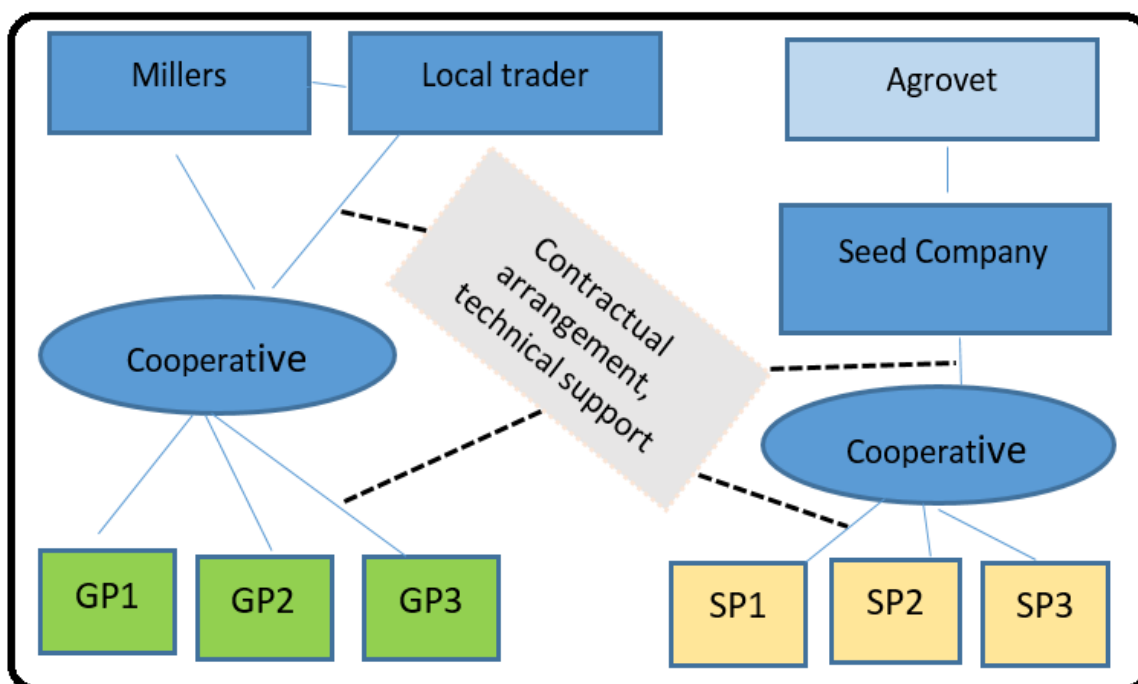


Figure 1.7: Strategic framework for mung bean market development (GP = grain producer, SP = seed producer)

Implemented activities – The following framework activities were accomplished in the reporting period:

- The project's study of the mung bean value chain continued. It should be completed by September 2019.
- Technical facilitation was and is being provided to Panchashakti and Gate Nepal seed companies to carry out participatory variety selection demonstrations in newly released (Pratigya) and pipeline varieties (SML 668 and Pant Mung 5).
- 127 stakeholders, including mung bean growers, seed companies, cooperatives and millers, were trained at six training events run by the project in partnership with partner seed companies and millers on improved mung bean technologies, and trainees were supported to implement what they learned.
- Encouraged the growing and improved management of mung bean cultivation by preparing and distributing 200 copies of a flex poster showing the benefits of growing mung beans to agrovets (Figure 1.8 and Photo 2.3) and by distributing 3,000 copies of improved mung bean production tips to farmers, cooperatives, seed companies, NARC stations, NGOs, millers and local governments.
- Two partner seed companies (GATE Nepal and PSC) were supported to prepare radio jingles about seed availability and critical mung bean farming issues, which were broadcast on two local FM radio in the Mid and Far Western Terai.



Figure 1.8: The benefits of growing mung beans

OBJECTIVE 2: SUSTAINABLE LENTIL AND MUNG BEAN INTENSIFICATION AT SCALE

Shifting from seed systems to agronomy, Objectives Two through Five of the CSISA Nepal Scaling project aim at improving farmers' access to, and use of, resource-conserving and climate resilient technologies and management practices in the Feed the Future Zone of Nepal. Key activities in the first half of the 2018/2019 project year are highlighted below.

2.1 Lentils

Refining the Stempedia disease forecasting model – *Stemphylium* blight is a potentially devastating crop disease that threatens lentil yields in Terai. Weather conditions directly affects disease incidence and severity. As such, the disease occurrence varies regionally and seasonally. The disease is being addressed by the USAID supported Climate Services for Resilient Development (CSRD) in South Asia project, which is developing an early warning system based on the Stempedia forecasting model, and which partners with CSISA to facilitate field data collection that is being used model validation and re-calibration.

2018/19 data collection – The second year of data collection for lentil disease observations was carried out in the November 2018–March 2019 lentil growing season. The project helped measure the status of *Stemphylium* blight and other diseases three times on lentil crops in 160 farmers' fields – 40 in each of Banke, Bardiya, Kailali and Kanchanpur districts (Photo 2.1). Field enumerators were trained on data collection by NARC's National Grain Legume Research Program (NGLRP). They then scored the occurrence of the disease, recorded phenology and other crop management perspectives, measured yields in the 160 fields and carried out household surveys to investigate the management of the crops. This work remains on-going at the end of this reporting period.



Photo 2.1: Disease monitoring in Bardiya (Sagar Kafle, CIMMYT)

Use of the data – Once data collection is completed, information will be used to calibrate, validate and fine tune the Stempedia model. Contrary the 2017/18 findings, the preliminary data for 2018/19 shows less disease infestation. Data will ultimately be used to develop an early warning system on the occurrence of *Stemphylium* in lentils, which will help farmers decide whether or not and when to apply fungicide to their crops. The system will be delivered under the CSISA Phase III project that the CSISA Nepal Scaling project supports.

Presentation of 2017/18 results – The results from the 2017/18 field data were presented to the Nepal Seed and Fertilizer (NSAF, a USAID/Nepal Mission funded initiative led by CIMMYT) supported National Training Workshop on Seed Quality and Productivity Enhancement Technologies in Lentils on 17–18 February 2019 in Nepalgunj. The analysis showed that financial gains from blanket applications of fungicide vary depending on field-specific yields and disease status (see Figure 2.1). For example, in Kanchanpur district, gains ranged from \$955 ha⁻¹ to only \$19 ha⁻¹, while in Kailali district the maximum gain was \$268 ha⁻¹ although in many situations farmers would have lost money. The use of the early warning system should reduce the uncertainties in the financial outcome of applying fungicides to lentil crops.

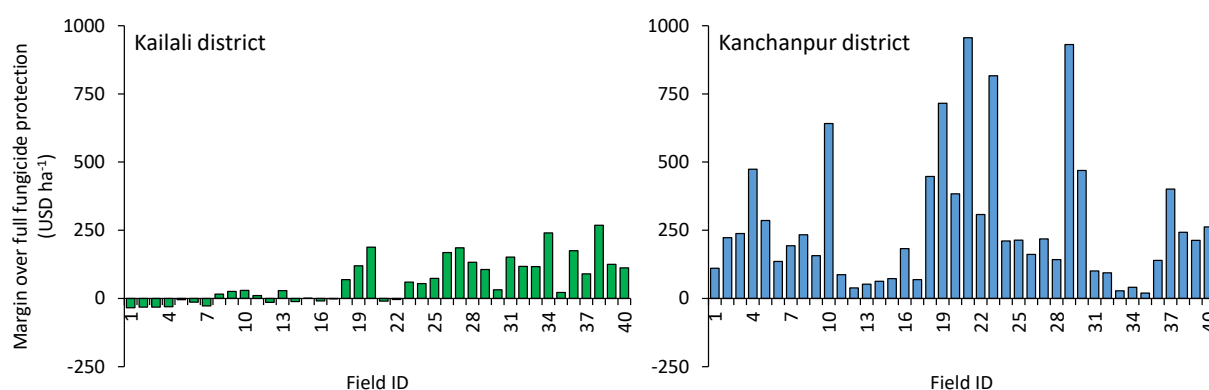


Figure 2.1: Estimated margins of full fungicide protection to control *Stemphylium* disease in lentils in 40 farmers' fields in each of Kailali and Kanchanpur districts in 2017/18 growing season.
Note: Calculation is based on measured yields, estimated yield losses, farm gate price (\$0.73 kg⁻¹) and costs of fungicide application (\$36.36 ha⁻¹)

Joint monitoring visit to lentil fields – On 10-12 February 2019, the project organized a joint monitoring visit to observe work on *Stemphylium* disease and estimate the effect of excessive winter rainfall on lentil crops in the Mid-Western and Far Western Terai (Photo 2.2). The visit team comprised a crop modeler from CIMMYT, and a legume breeder, legume pathologist, and agronomist from the Nepal Agricultural Research Council. The team observed disease incidence and severity in lentil fields especially in relation to the excessive winter rainfall that had occurred in the 2018/19 growing season.

The team also identified potential research issues including i) modeling the lentil root rot complex, which is widespread in lentil fields in Nepal, and ii) growing lentils in raised beds to reduce the negative impacts of excessive winter rainfall on productivity. The visit observed that the continuous rainfall during the 2018/19 lentil growing season had affected the crop in lowland areas with heavy soils, but had less effect in upland areas especially in drier areas where it contributed to higher yields.



Photo 2.2: Monitoring team discussing *Stemphylium* disease in a lentil field in Kailali district (Ashish Chaudhary)

Radio jingles – Between December 2018 and February 2019, the project supported the broadcast of radio jingles on local FM radio stations advising Mid-West and Far West lentil farmers to consider applying fungicides against *Stemphylium* disease as soon as initial symptoms were spotted in farmers' fields.

2.2 Mung beans

Mung beans are a leguminous crop that improve soil fertility and provide valuable human nutrition (Figure 2.2) and cash incomes. It is a short duration crop (~ 90 days) that can easily fit into different cropping patterns. In Nepal's Terai, the land is usually left fallow for 80–90 days after the harvesting of wheat during which time mung beans can be planted and harvested. Nearly 70% of Far Western Terai wheat fields could be brought under mung bean cultivation.

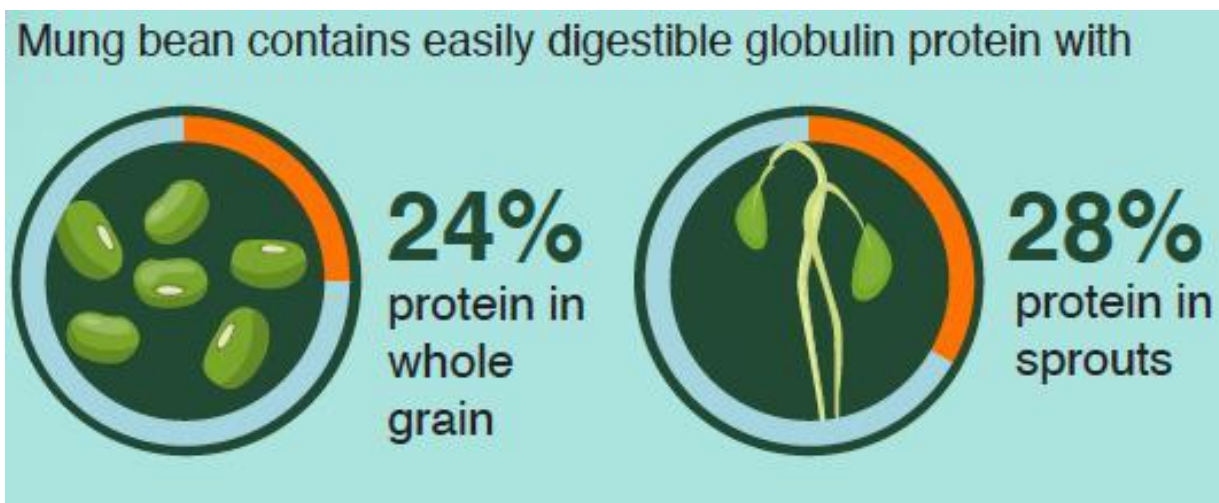


Figure 2.2: Expanding mung bean cultivation through market facilitation

Mung beans are a newly introduced crop in Mid-Western and Far Western Nepal. Project efforts since 2014 have led to seed companies and cooperatives beginning to produce and collect mung bean seeds in bulk. Later on, since 2017 the offices of PMAMP's Kailali Wheat Super Zone, Kanchanpur Rice Zone and Kailali Oilseed Zone have begun promoting mung bean cultivation. In addition, since 2018 the Far Western provincial government prioritized mung bean cultivation by placing the crop in its subsidy program to make available cheaper seeds and pesticides to farmers.⁵

The project had made a large contribution to the increasing numbers of farmers who have started to grow mung beans. In Kailali and Kanchanpur alone nearly seven tonnes of mung bean seeds were sold by agrovets and seed companies to farmers during the reporting period (October 2018 to March 2019).

Building capacity on mung bean cultivation

Mung bean cultivation training – In March 2019, the project supported four hands-on training events and demonstrations of mechanized mung bean cultivation for 88 farmers and service providers in Kanchanpur, Kailali, Banke and Bardiya districts in partnership with farmers' cooperative, seed companies and local governments. These events raised farmers' awareness about the importance of mung bean cultivation for human nutrition, soil fertility and intensifying cropping systems and trained seed drill service providers and farmers on how to use seed drills and troubleshoot their operation. The participants were trained on seed rates, spacing, plant protection, irrigation and nutrient management. Mung bean production tips, which were developed by the project in 2017 and were recently updated, were distributed to participants.

⁵ Note a PMAMP super zone covers 1,000 ha while a zone covers 500 ha.



Photo 2.3: An agrovet in Kailali displaying the information on mung beans developed by the project (Lokendra Khadka, CIMMYT)

OBJECTIVE 3: SUSTAINABLE WHEAT INTENSIFICATION AT SCALE

3.1 Background

Wheat is a major cereal crop in Nepal, but its yield is lower than other countries in the region. Since its inception, the CSISA Nepal Scaling project, in coordination with public and private organizations, has striven to promote and scale-up climate-resilient agricultural technologies. Earlier efforts of project concentrated on the Feed the Future Zone. However, the changed structure of governance under the new federal constitution means that understanding the drivers for wheat intensification across multiple locations is a priority for providing science-based recommendations that can be applied by farmers to improve wheat productivity.

3.2 Evidence to inform the closing of the wheat yield gap

The project is providing evidence to inform how to close the yield gap between what the highest yielding wheat farmers achieve and the yields of other farmers.

Wheat production survey – Between May and August 2018, the project conducted a wheat crop-cut and production practices diagnostic survey (hereafter called ‘the wheat production survey’) in six districts in the FTF Zone of Influence and other areas (Figure 3.1). The aim was to understand the technological changes from the project’s interventions and identify priorities for intensifying wheat production. The sowing time, yield and fertilizer results from the 2018 survey were released in this reporting period and inform the sustainable intensification of wheat production in Nepal’s Terai. The 2019 survey was ongoing at the end of the reporting period with wheat crop cut activities started in five districts following the standard sampling procedures.

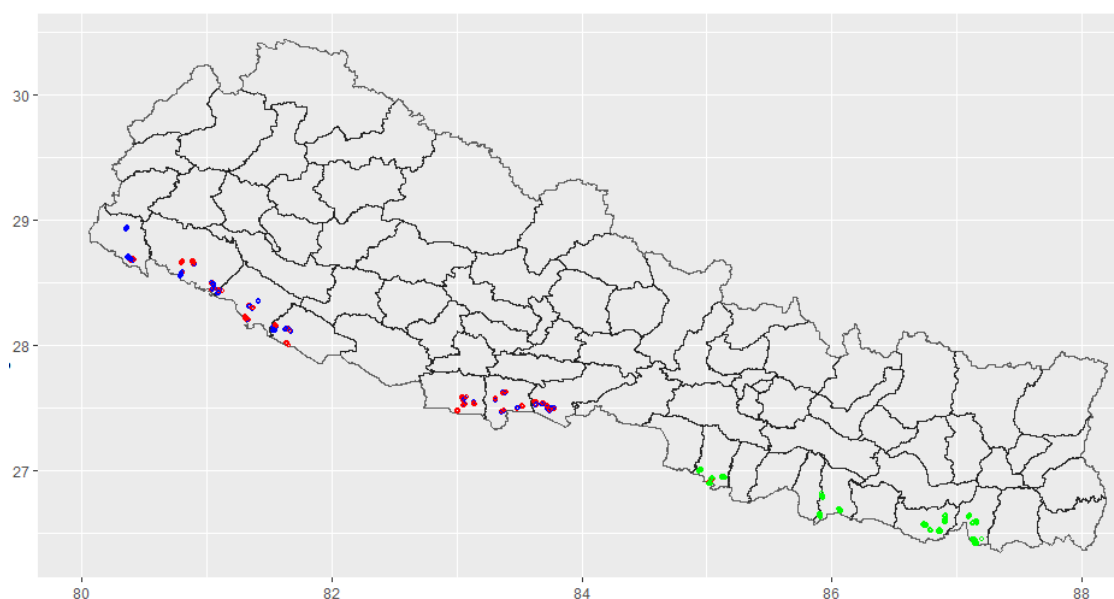


Figure 3.1: Wheat production survey locations in Nepal’s Terai, 2018. The colors represent different management practice clusters formed from k-means clustering

Sowing time results – The following results of ongoing wheat crop cut surveys were shared with province level Agricultural Ministry representatives and the PMAMP in January 2019. Presentations focused on showing how combining the use of long duration wheat varieties and early sowing can lead to significant productivity increasing outcomes in the Terai.

- The early sowing of wheat enhances productivity. A one-day delay in sowing after 21 November decreases yield by 20 kg/ha/day (see Figure 3.2 for trend of sowing time and yield).

- Early sowing should be coupled with longer duration wheat varieties to escape the terminal stress that is a major threat from the changing climate in the Indo-Gangetic Basin. Note that the project is facilitating Nepalese seed companies to register elite Indian long duration varieties in Nepal.

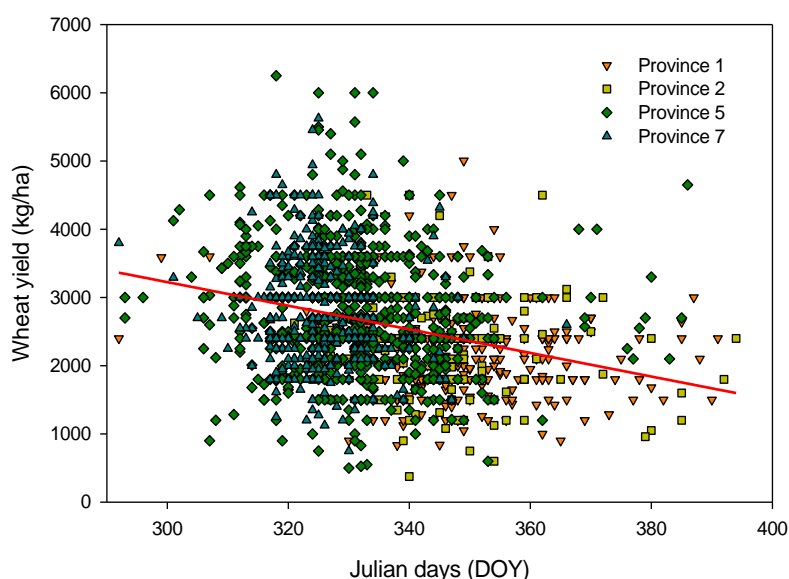


Figure 3.2: The downward sloping line shows that the late sowing of wheat decreased wheat yield in Nepal's Terai overall and province-wise (CSISA-NP wheat production survey, 2018)

Forty-three percent of the 1,684 surveyed farmers had adopted longer duration wheat varieties and on average, the adoption of these varieties had increased productivity by almost 0.5 Mt/ha (Figure 3.3). These results indicate the importance of varietal length and sowing date for optimizing wheat productivity, and provide a strong foundation for further awareness raising and scaling efforts that will be passed on in the CSISA Phase III project after the CSISA Nepal Scaling project ends.

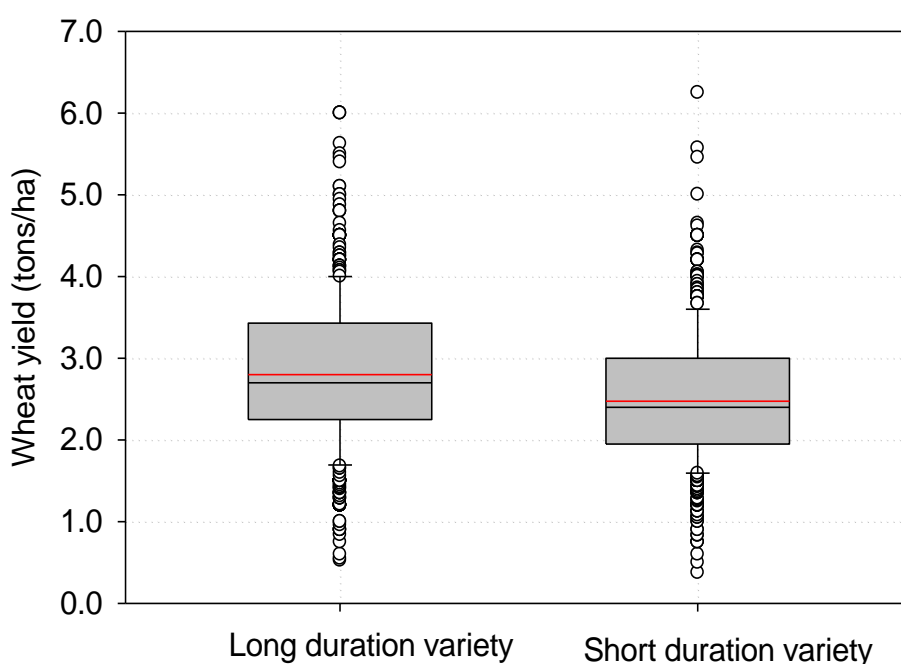


Figure 3.3: The 0.5 Mt/ha greater yield of long duration than short duration wheat (CSISA-NP wheat production survey, 2018)

Yield gap results – Wheat productivity in Nepal is around 2.6 Mt/ha with a current yield gap (the gap between the average and attainable yield) of around 1.5 Mt/ha. This indicates substantial remaining room for improvement. The results of the 2018 wheat production survey also showed that:

- the 10% of farmers with the highest yields produced an average of 4.2 Mt/ha;
- the 10% of farmers with the lowest yields harvested only 1.2 Mt/ha.
- The 80% of farmers with the middle yields harvested about 2.6 Mt/ha (Figure 3.4, Nepal Terai).

This suggests that the use of improved agronomic practices has the potential to enhance yield of wheat by an additional 1.6 Mt/ha if the middle 80% farmers (in terms of yield) employ similar management practices to those being used by the top 10%. Similarly, the bottom 10% of farmers can enhance their yields by 3 Mt/ha if they are able to make use of similar management practices as the top 10%. This highlights the potential for intensifying wheat production in Nepal, and provides a roadmap by which productivity can be increased.

The pattern of the yield gap between the highest yielding and lowest yielding farmers was similar in the Terai areas of all four provinces covered by the survey (Provinces 1, 2, 5 and 7⁶) (Figure 3.4). This highlights the need to increase the recommended fertilizer rates and improve agronomic management practices to enhance wheat productivity and close the yield gaps in Nepal across Nepal's Terai.

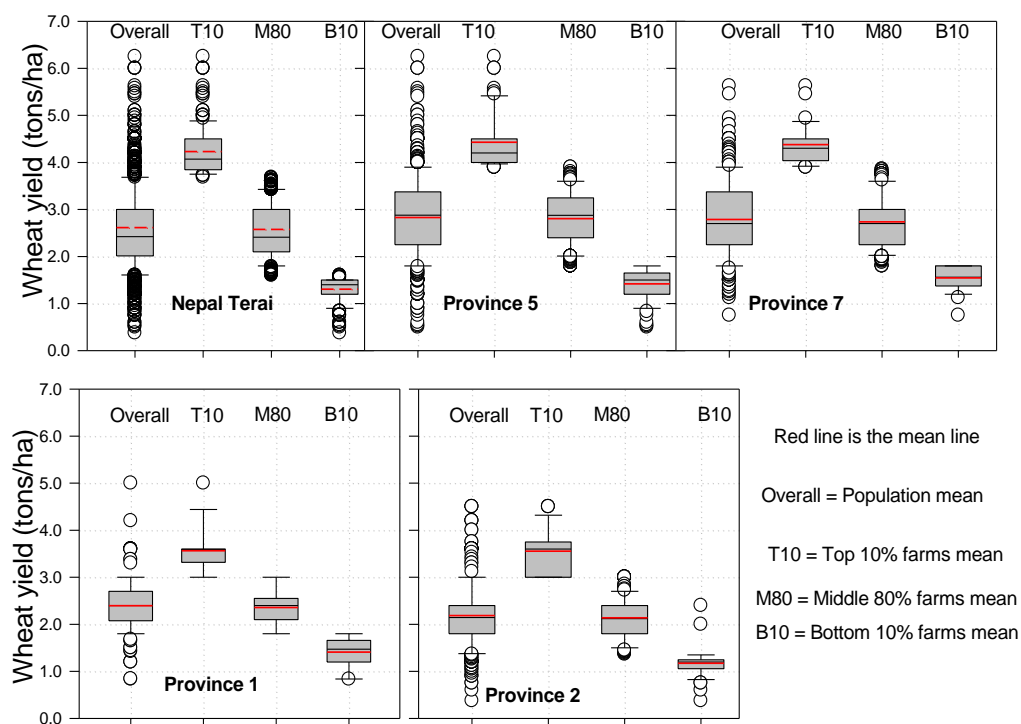


Figure 3.4: Closing wheat yield gaps through better bet agronomy in Terai areas (districts) of Nepal (CSISA-NP wheat production survey, 2018)

Fertilizer response results – The project works with the National Wheat Research Program (NWRP) and the USAID funded Nepal Seed and Fertilizer (NSAF) project to review and revise the recommended doses of fertilizers for wheat in Nepal. The data from the 2018 wheat production survey shows that the current levels of application of nitrogen and potassium (88 kg/ha N and 11 kg/ha K) are below the government's recommended rates, while the response of wheat is optimum at around 150 kg/ha nitrogen and 50 kg/ha potassium per hectare (see Figure 3.5).

⁶ Province 7 = Far Western Province

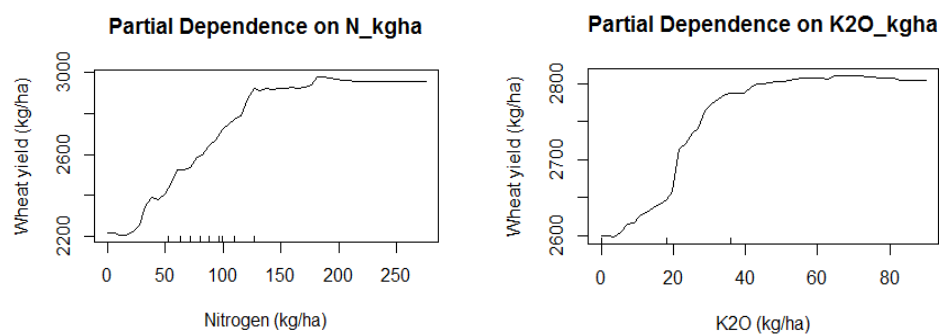


Figure 3.5: Results from surveys used predict responses of nitrogen and potash fertilizer on wheat yields in Nepal's Terai (CSISA-NP wheat production survey, 2018)

The province-wise application rates varied for nitrogen and potassium (Figure 3.6). In coordination with NSAF, the project is working on area-appropriate recommendations to inform the revision of the recommended doses of nitrogen and potassium on wheat in Nepal. If successful, deployment of these recommendations in the 2019/20 wheat season will show the continued impact of research conducted in the CSISA Nepal Scaling project to affect large-scale change in wheat growing areas before the decade ends.

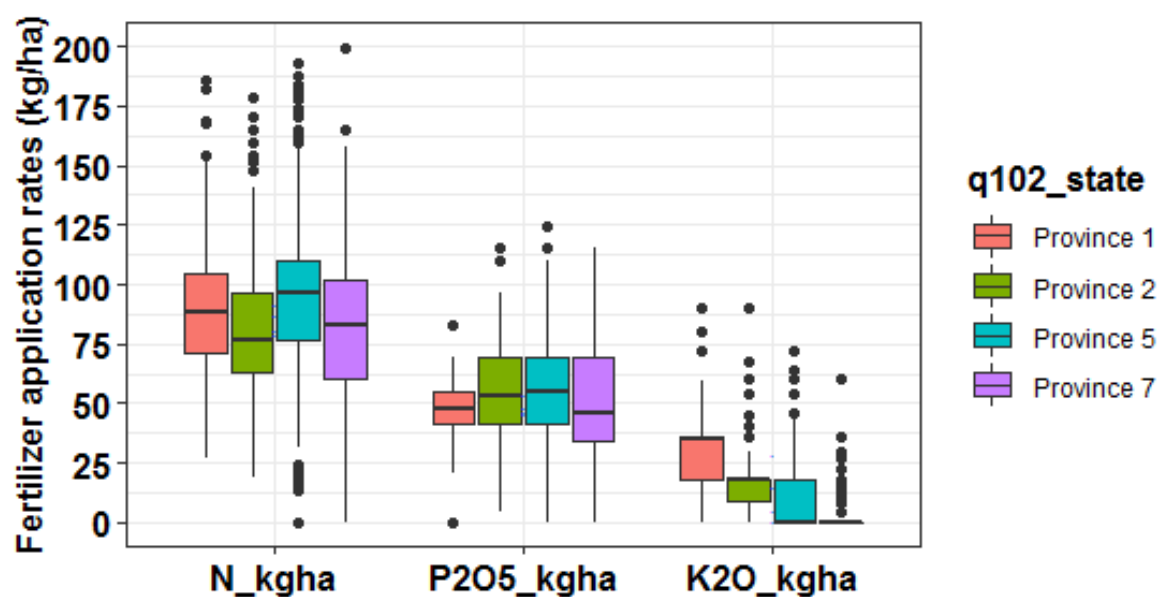


Figure 3.6: Province level fertilizer applications rates on wheat (CSISA-NP wheat production survey, 2018)

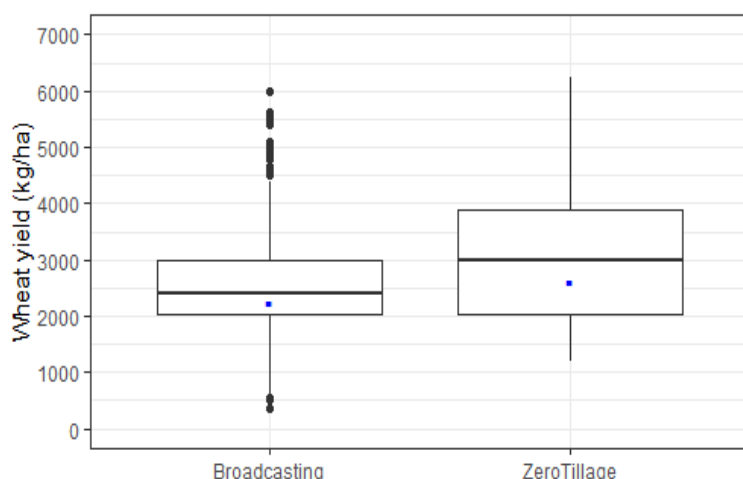


Figure 3.7: Yield advantage of zero tillage wheat over conventional tillage of 0.5 Mt/ha from even in farmer managed fields, 2018

Zero tillage wheat

demonstrations – The previous year's zero tillage demonstrations conducted by the project on wheat showed that early sowing led to higher yields in the mid and far-western Terai districts (Figure 3.7). Observations in 2018/19 are ongoing to provide further information about the implications of changing sowing patterns. In November 2018, the project established large demonstration plots of zero tillage wheat managed using improved agronomic practices in collaboration with the Ministry of Agriculture and Livestock Development's demonstration

Farm in Kanchanpur, the office of the Kailali Wheat Super Zone and one local government in Bardiya. In the lower elevation fields, the high soil moisture content at sowing meant that farmers had to sow the wheat later than the optimum time. At the same time, ploughing the fields two or three times prior to sowing would not only have increased the cost of cultivation but would have decreased productivity. The results from the plots show that wheat sown using seed drills and zero tillage facilitates timely sowing that enhances wheat productivity.

3.3 Building a service economy for zero tillage wheat

Project campaigns through PMAMP and provincial governments on the benefits of early wheat sowing continued in the reporting period (see section 3.5 below). However, early sowing is made most easily possible when farmers use zero tillage seed drills, but these drills still have limited availability in the Terai. The project and PMAMP are working to develop and strengthen the availability of these drills through service providers. Between 2015 and 2019, the project and PMAMP have supported the development of 101 seed drill service providers with 185 seed drills now in operation in farmers' fields across the Terai. There has been a resulting large increase in the number of seed drills in the Mid-West and Far Western Terai (see Box 3.1).

Box 3.1: The increasing number of seed drills

Since it began, the project's regular technical backstopping and other support to governmental partners, private machinery dealers and other stakeholders on crop establishment issues has brought about a large increase in the availability of four- and two-wheel tractors (4WTs and 2WTs) seed drills in the FTF Zone of Influence. The number purchased and in operation in the Mid-Western and Far Western Terai increased from only 10 in 2015 to 135 by the start of 2019 (Figure 3.8). And the area seeded mechanically in the two Far Western Terai districts has increased from 250 ha in 2014 to 700 ha in 2018 (Figure 3.9). The increasing number can be correlated with their increased availability. Around 12 local machinery dealers in the Mid-West and Far Western Terai now sell these drills and have good relations with national importers and manufacturers.

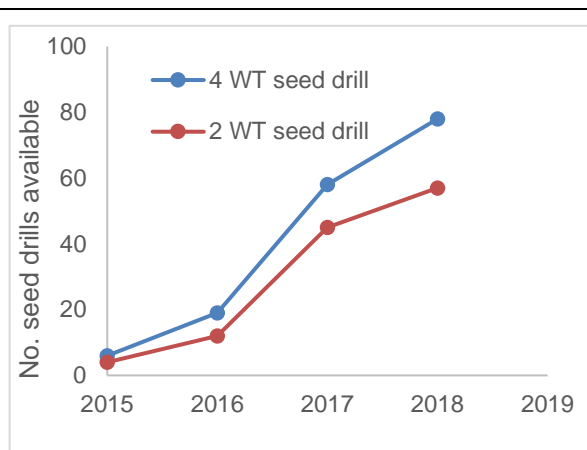


Figure 3.8: Increase in number of seed drills in the 5 Mid-West and Far Western Terai districts, 2015–2018

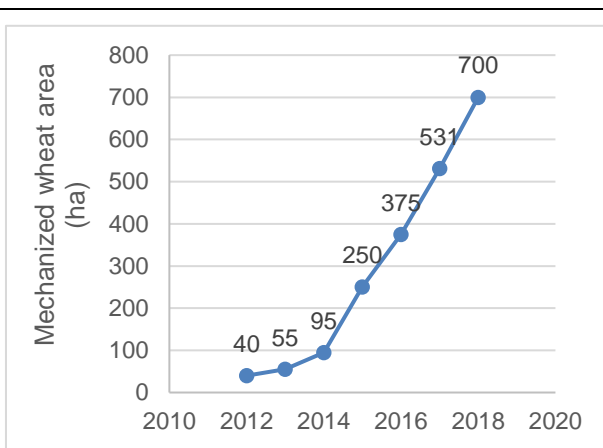


Figure 3.9: Area of wheat sown using seed drills in Kailali and Kanchanpur, 2011–2018

Demonstrations and farmer field days – In November of 2018, the project, in collaboration with seed drill service providers, machinery traders and local governments established 15 zero-tillage wheat demonstration plots to raise the awareness of farmers and government personnel about this technology across the Terai. In the period, two farmer field days were held at different wheat growth stages to acquaint farmers with the technology (Photo 3.1).

Plans to diversify seed drill use – Most seed drills are owned by individual service providers with a few owned by cooperatives and farmers' groups. Efforts are being made by the project and PMAMP to increase the utility of the machines year-round to be used for seeding most types of cereals and pulses.

This is being achieved through interactions between CSISA's engineering staff members working on a regular collaborative basis with PMAMP field staff in the Terai. The growing availability of multi-crop seeders (seed drills) is in turn facilitating the mechanized seeding of rice, maize, lentils, mung beans, black gram and other crops. Where needed the project also supports emerging service providers working with farmers who are innovating to establish these crops with seed drills.



Photo 3.1: Farmer's field day in Udasipur, Kailali in a zero tillage wheat field (Lokendra Khadka, CIMMYT)



Photo 3.2: KISAN and NSAF technicians receiving hands on training on how to operate seed drills (Lokendra Khadka, CIMMYT)

Identified machine needs – In January of 2019, the project provided technical guidance to the Ministry of Land Management Agriculture and Cooperative of the Far Western Province to prepare a priority list of scale-appropriate machinery for the province’s proposed custom hiring centers, which in turn can assist farmers seeking zero-tillage establishment services. This center plans to start operating in 2019 as a public-private partnership. Further details can be found in Objective 5.

Other initiatives – Other related initiatives were the project i) linking 19 dealers with seed drill service providers in Kailali, Kanchanpur and Bardiya and ii) using the KISAN II network of agro-dealers to disseminate information about sustainable wheat growing technologies.

3.4 Wheat production related training

In the reporting period the project trained governmental agricultural technicians and farmer groups to enable them to in turn train wheat farmers on improving their management practices and productivity:

- In November of 2018, the project provided a training of trainers on best wheat production management practices to farmer groups and cooperatives in coordination with the Kailali Wheat Super Zone (Photo 3.3).

- On 27 February 2019, the project and the Ministry of Land Management Agriculture and Cooperatives of the Far Western Province trained 20 government technicians, lead farmers, and representatives from seed companies, a seed producing farmers group and cooperatives on wheat production intensification technologies. The training covered

suitable varieties, seeding times, best management practices, and disease and pest management. It also informed trainees about zero tillage and minimum/strip tillage practices in wheat and conservation agriculture machines such as 2WT and 4WT drawn seed drills.



Photo 3.3: Training on improved wheat production technology, Dhangadhi, Kailali, November 2018 (Pradip Chaudhary, CIMMYT)

3.5 The social marketing of early planting

Encouraging early sowing – During the reporting period, the project and PMAMP conducted a mass advertising campaign on the early sowing of wheat in the FTF Zone of Influence and Nepal's other wheat production domains. The project provided the script and the radio stations produced short dramas to convey the main messages on the early sowing of wheat. They were produced in Nepali and Tharu to reach farmers with Nepali and non-Nepali mother tongues. These 'jingles' were broadcast by eight FM stations broadcast across the four Mid-West and Far Western Terai districts in October and November just before the wheat sowing time. There are signs that these campaigns have encouraged farmers to start sowing the right varieties at the right time using long duration varieties for early planting and short duration varieties for late planting. FM radio stations were also used to broadcast the names of trained service providers across the project's working areas of Kailali, Kanchanpur, Banke and Bardiya; with lists distributed to local and provincial governments for dissemination.

OBJECTIVE 4: PRECISION NUTRIENT MANAGEMENT AT SCALE

In Nepal, fertilizer use is well below the officially recommended application rates on all staple crops. Also, these rates are outdated and apply to very broad areas with few guidelines to improve the efficiency of use. These recommendations were developed at experimental stations under conditions that don't reflect on-farm conditions and domain-wise variations.

As such, this work stream has had fewer achievements in this reporting period because funding delays and opportunities to pursue precision nutrient management in other projects not facing similar delays led to work in this area being scaled back. For example, as nutrient management is a major component of the NSAF project, which is also funded by the USAID/Nepal Mission, the CSISA Nepal Scaling project reduced emphasis in this area. Note that the wheat fertilization findings from the wheat production survey are given in the Objective 3 writeup above.

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

Domain specific fertilization trials – The project is carrying out trials to identify domain and crop-specific fertilizer blends. In 2016/17 and 2017/18, in collaboration with the NSAF project, the CSISA Nepal Scaling (the project) established and conducted fertilizer response trials on wheat, lentils and maize. The third year of on-farm field trials (2018/19) are being conducted in coordination with the PMAMP and NARC governmental programs. The project also held discussions with representatives from the fertilizer industry, including Adventa Export Pvt. Ltd. (of Gujarat, India) to stimulate demand in the western Terai for new fertilizers and blends via demonstrations with farmers. These trials are focusing on generating demand for new fertilizer products and fertilizer management techniques via field demonstrations.

Planning the logic for scaling-up fertilizer and agronomy packages – The project is collaborating with NSAF to create business logic maps that identify subjects with good economic returns for business investments in new and existing fertilizers and integrated agronomy products (seed varieties and production practices). Examples include new fertilizer blends and region and crop-specific application rates. This work requires integrating advanced spatial analytics (e.g. machine learning and geospatial statistics) with causal inferences from the project's nutrient response trials. This exercise is expected to:

- identify unsubsidized diammonium phosphate (DAP), urea, and muriate of potash (MoP) distribution and sales by the private sector as high potential areas for business investments related to positive fertilizer response and high farmer population densities; and
- identify high potential areas for business investments in custom and regional fertilizer blends that are region and crop specific.

4.2 Raising awareness of the yield and economic benefits of judicious fertilizer application

Raising awareness on precision spreaders as tools for precision fertilizer placement – This activity coincides with and supports work conducted in Objective 5, but differs in the ways that the project has worked to highlight the use of knapsack spreaders for fertilizer application, in addition to seed. From January to March 2019, the project, in coordination with local suppliers, broadcast radio jingles at a large-scale on four FM stations in the Far Western and Mid-West Terai districts. The jingles provided easy to understand and amusing messages that appeal to farmers about the benefits of using precision urea spreaders to improve the precision of fertilizer management and nutrient use efficiency. These metrics are important as they directly affect farmers' 'bottom-line' in terms of generating profit from their crops. 900 factsheets on how to use spreaders were distributed to farmers.

Rupandehi. Some traders also printed this information to communicate the technology to their farmer clients.

Training of trainers on spreaders – In the reporting period, the project ran three training of trainers events in Bardiya on the use of fertilizer and seed spreaders for agrovetts and lead farmers from other synergistic USAID funded projects including NSAF and KISAN II. Three community volunteers from NSAF, two PMAMP technicians and 20 agrovet agents took also part. Two agrovet trainees in Bardiya subsequently conducted 45 trainings for 450 farmers on the use of spreaders during the 2018/19 wheat season. These trainings also led to the sale of 48 spreaders by four local suppliers. Note that other spreader-related achievements are given in the Objective 5 writeup.



Photo 4.1: Fertilizer being applied with a seed and fertilizer spreader at a demonstration in Bardiya by SK Suppliers and Agrofirm for potential clients in January 2019 (Subash Adhikari, CIMMYT)

4.3 Policy initiatives

Leveraging public sector support for fertilizer spreaders – The new provincial governments of Nepal are responsible for overseeing the agricultural development in their areas. In this period, the project began to support them to identify activities to encourage farmers to make use of resource-conserving technologies and crop management practices. As a result, since March 2019 the Far Western and Province 5 governments started to subsidize the cost of the project-backed use of technologies of fertilizer spreaders with important policy initiatives. Farmer groups, cooperatives and private firms now get 50% subsidies on the cost of these machines.

4.4 Accessible technologies commercialized for more efficient fertilizer use

Women-friendly farm machinery – As women play a lead role in Nepalese agriculture, the project is promoting women-friendly farm machinery such as jab planters, precision urea spreaders, mini-tillers and weeders. These machines save money and time by facilitating the timely operation of seeding, weeding and fertilization. Urea spreaders are easily operated knapsack fertilizer and seed spreaders (see Photo 4.1). In January 2019, the project facilitated the NSAF project to train 10 community volunteers and demonstrate the use of urea spreaders to women at 10 sites in Kailali and Kanchanpur.

Fertilizer spreader demos and training – The hand broadcasting of fertilizer is common in Nepal, but it is difficult to uniformly apply fertilizer in this way thus leading to inefficient uptake by crops. Since 2014, the project has promoted the use of precision spreaders including through NAMEA. The project has observed that, most farmers like this technology, although participatory evaluations have pointed to minor technical modifications that are needed and that the project is working with machinery importers to address. These spreaders also enable inexperienced farmers to broadcast fertilizer efficiently. In January 2019, the project ran training events and demonstrations on the use of fertilizer spreaders (Photo 4.1).

Twelve traders in the Mid-West and Far West Terai and Dang now regularly sell these spreaders. PMAMP's Kailali Wheat Super Zone, Banke Maize Zone, Dang Maize Super Zone, Kanchanpur Rice Zone and Kailali Oilseed Zone are promoting these spreaders through their subsidy schemes. And one seed company and four other projects (KISAN II, BRACED, NSAF and Suaahara) have been demonstrating the spreaders.

Additional precision fertilizer application trainings – In February 2019, the project facilitated an agriculture knowledge center fair in Kanchanpur and PMAMP to conduct hands on trainings on the use of fertilizer spreaders and to demonstrate the stages of wheat growth when applying fertilizer is most beneficial. A total of 485 farmers participated in the five one-day trainings at locations in Kailali and Kanchanpur and became more knowledgeable about the growth cycle of wheat. A representative from Manjari agro traders took part in the training.

OBJECTIVE 5: SCALE-APPROPRIATE MECHANIZATION AND IRRIGATION

5.1 Background

Most of the work of the CSISA Nepal Scaling project under its Objective 5 is aimed at encouraging scale-appropriate mechanization in Nepal's agricultural systems. The project is scaling-up the technologies that CSISA has conducted research on and developed over the past 10 years, including two-wheel tractor (2WT) power tillers and attachments like seed drills and reapers (harvesters), four-wheel tractor (4WT) seed drills and reapers, and knapsack seed and fertilizer spreaders. Most of the project's work is concentrated in the FTF Zone of Influence districts in the western Terai.

The farmers in Nepal's Midhills increasingly rely on low horsepower mini-tillers to prepare their fields (see Photo 5.1). In the unique environments of the Midhills and Terai, widespread adoption of scale-appropriate technologies by CSISA has been driven by the following factors:

- The main push factor is the shortage of agricultural labor in rural, which is due to the out-migration of many working age men for employment. This has increased the cost of labor resulting in farmers abandoning cropping due to the high costs of cultivation, especially in the Midhills.
- The main pull factor has been the efforts of the project and its partners (including from the private sector), and aligned initiatives to promote the use of mini-tillers for preparing fields and also for powering irrigation pumps. And the number of farmers using mechanized seed drills and other technologies is increasing as they become aware about the benefits of farm machinery.

Project work has learned from its various interactions in India, including the design sprint, which developed seeder prototypes and multi-crop seeder attachments for four-wheel tractors. In Nepal, the project has concentrated collaborative efforts with the Prime Minister's Agriculture Modernization Project (PMAMP) and the Nepal Agricultural Machinery Entrepreneurs Association (NAMEA) to promote appropriate farm mechanization that can offset labor scarcities and substitute for draft animals. PMAMP is a government project that aims to increase the productivity of selected crops in designated production blocks – 500 ha 'zones' and 1,000 ha 'super zones'. The project sees collaboration with the PMAMP as a key means of scaling-up and institutionalizing sustainable intensification technologies and improved crop management practices. It has therefore been assisting it to promote mechanized seeding, planting, weeding, and harvesting, and other crop management practices since 2016.

An important early project activity was a survey on the potential demand for mini-tillers in areas where they hadn't yet reached, and the productivity gains from using them to grow rice (see results in Box 5.1). The Nepal Agricultural Machinery Entrepreneurs Association (NAMEA) facilitated the survey of 1,004 farmers in the Midhills farmers in 2017. Key results are given in Box 5.1.

Box 5.1: Results of project mini-tiller studies

1: Study on demand for mini-tillers

- Many surveyed farmers were willing to buy or hire mini-tillers to prepare terraced fields.
- Labor availability, increasing labor costs, small farm size and farmers' links with cooperatives and credit were the main factors driving demand.
- The demand for mini-tillers was inversely related to the number of draft animals farmers owned or could access.

2: Mini-tiller impact on productivity study

- Rising rural wages and the declining availability of draft animals are driving the adoption of mini-tillers.
- The use of mini-tillers can increase rice productivity by an average of 1,110 kg/ha (27%);
- Mini-tiller non-adopters could increase their rice productivity by 1,250 kg/ha (26%) by adopting them.
- Very small farms (≤ 0.25 ha) would have the most rice productivity gains from adopting mini-tillers.

The studies' findings support the government's policy of promoting farm mechanization to offset the shortage of labor faced by Midhills farmers and informed the project's approach for supporting scale-appropriate mechanization on Nepal's farms. The main recommendations were that the government and the private sector work together to reduce the price of mini-tillers to increase adoption and that a service provider model be fostered for Midhills farmers to hire in tillers and operators.

In this reporting period, a paper on productivity impacts was accepted for publication in [Land Use Policy](#), while a [paper on the demand study](#) was presented to the annual meeting of the Southern Agricultural Economics Association (SAEA), USA in February 2019.



Photo 5.1: A service provider preparing a small terraced field in Nepal's Midhills with a mini-tiller for planting rice. Larger machinery is not feasible in this environment, and so the project has focused on expanding markets for scale-appropriate machinery like mini-tillers (Peter Lowe, CIMMYT)

Overall, in this period the project made significant progress on i) supporting policy makers and governance structures for extending access to scale-appropriate farm machinery, ii) supporting the development and availability of scale-appropriate farm machinery; iii) raising awareness on the benefits of farm mechanization; and iv) building capacity on operating and maintaining farm machinery.

5.2 Supported policy makers and governance structures for extending access to scale-appropriate farm machinery

The project supported several government initiatives to foster and support farm mechanization and helped build the knowledge of government decision makers about farm machinery innovations.

Support to machinery testing center – In 2017/18, the project supported NARC to establish the National Agricultural Machinery Testing Centre (NAMTRC) in Nawalpur, Sarlahi district. In this reporting period, NARC followed on by independently investing in establishing the center's main office building, equipment shed and officers' quarters. In March 2019, the project placed an agricultural engineer at NAMTRC to oversee forthcoming project support for the center's testing of irrigation pumps.

Support to farm machinery promotion center – In 2017/18 the project supported the Department of Agriculture to establish its Agricultural Machinery Promotion Centre (AMPC) at Naktajhij, Dhanusha. The transition to a federal system of governance in 2017/18 saw the DoA's Agri Engineering Directorate and being restructured and some powers and resources devolved to provincial governments. This delayed DoA's plans to turn AMPC into a central agriculture and mechanization training facility. The project looked at ways of supporting AMPC in the interim period, and on 20 December 2018 held a training of trainers event for AMPC staff on the use of laser levelers to prepare rice fields. The agricultural engineer placed at NAMTRC is supporting the training of trainers program to enable AMPC technicians to provide farm machinery training programs.

Traveling seminar – More than 40 international experts and project partners, including private sector partners, the Director General of the Department of Agriculture (DoA) and the PMAMP chief attended the 25–29 March 2019 Traveling Seminar on Scale-appropriate Machinery for Cereal Crop Harvesting in South Asia. The seminar provided a platform to share and learn about cereal harvesting technologies in Asia. The delegates visited project sites and partners across the Terai and informed government participants about the site-specific options for farm mechanization in Nepal.

Delegates witnessed technologies in use and discussed the mechanization of Asian cereal production. They saw Nepal's scale-appropriate, private sector-led mechanization in action including large combine harvesters and self-propelled reapers and the recent spread of more than two thousand 2WT reapers (Photo 5.2). Delegates discussed issues with farmers who employ machinery service providers, service providers, machinery importers and sales agents. Delegates also listened to experts from China, Bangladesh, India, Sri Lanka and Vietnam who discussed the the use and potential of scale-appropriate farm machinery.



Photo 5.2: Travelling seminar delegates discuss the use of combine harvesters with farmers in Rupandehi (left) and 2WT mounted reaper-harvesters in Kailali (right). (Dakshinamurthy Vedachalam, CIMMYT)

Support for provincial governments – The new middle tier of government, Nepal's seven provinces have been given considerable responsibilities for overseeing agricultural development initiatives, with emphasis on cereal-based farming systems. The project has strongly supported this work with the following activities carried out to interact with and support provincial agriculture ministries on farm mechanization issues:

- In January 2019, the project held a discussion meeting with the secretary and staff of the agriculture ministries of the Far Western Province and Province 5 (Photo 5.3). At these meetings the provincial governments identified activities for project support and involvement in 2019 including on identifying appropriate farm machinery for the provinces to promote and support.

- In February 2019, the project participated in Province 5's agricultural fair at Butwal to demonstrate scale-appropriate farm machinery options and to direct agricultural fair participants towards private sector machinery suppliers. The project and its business partners demonstrated seed and fertilizer spreaders, and safety equipment and flat fan nozzles for spraying herbicides.

5.3 Supporting the development and availability of scale-appropriate farm machinery in the Feed the Future Zone

The project continued to develop and encourage market systems to expand the availability of scale-appropriate farm machinery to smallholder. See Box 5.2 for one impact of the project's promotion of the weeding of maize using mini-tillers.



Photo 5.3: Project meeting with Far Western Province agricultural officials from the Prime Minister's Agricultural Modernization Project in January of 2019 (CSISA archive)

Box 5.2: Demonstrating the weeding of maize using mini-tillers fuels demand for drills

Since 2017, the project has worked with the Dang Maize Super Zone to promote the weeding of maize crops with mini-tillers. The reported savings of more than \$80/ha on weeding costs are driving demand not only for mini-tillers but also for maize planter (seeding) attachments on 4WTs, as maize must be line sown to enable mini-tiller inter-cultivation weeding. This increases the utility of mini-tillers, is replacing labor intensive manual weeding and is transforming maize production in Dang. Mahesh Regmi, the Chief of Dang Maize Super Zone, formally recognized the project's valuable contributions in a meeting with senior project staff in January 2019:

"The great promise of mini-tiller weeders in the Maize Super Zone is credited to the technical works of CSISA. CSISA's team started it for the first time with modification to the mini-tiller. This has helped farmers to weed and earth up at the same time. The technology is emerging rapidly with more and more demand from farmers."

Development of fertilizer applicator attachment – The tens of thousands of mini-tillers across the Midhills can be used to mechanically weed the spaces between line-sown crops. They can also be used for pumping water and planting seed. The project is working to engineer and expand the use of attachments for carrying out some of these tasks. In the reporting period, the project developed an attachment to side-dress apply urea fertilizer to maize at the same time as weeding the spaces between maize crop rows (Photo 5.4). This can dramatically increase the efficiency of inter-cultural operations for farmers growing maize. The prototype attachment is being tested in Dang Maize Super Zone in coordination with PMAMP. It saves the labor of applying urea by hand to each plant, while the additional use shortens the repayment time for mini-tillers. Collaborative research under the CSISA Phase III project in the next winter season will systematically study how this operation increases nitrogen use efficiency and yield vis-à-vis manual weeding and fertilizer placement. The results of this study will supply 'business intelligence' that can be used by private sector machinery dealers to drum-

up sales of this machine, and to encourage manufacturers to kick-start local production of attachments.

Maize seed drill testing –

In February of 2019, a performance test of maize seed drills was conducted in Dang Maize Super Zone with PMAMP and its farmer groups. Of the seven maize seed drills tested, most participants preferred the 4WT Chinese seed drill (Model-2BMZJ-3) because of the resulting uniform emergence of plants. There

are two of these machines in Dang and one service provider who has received technical support from the project plans to purchase another. They have been used to plant about 120 hectares in the past two maize seasons, indicating the strong potential for expanded use of seed drills to benefit labor-constrained maize farmers.



Photo 5.4: Field testing mini-tiller side-dressing attachment for maize in Dang. Preliminary evaluations indicate that this attachment can dramatically increase the efficiency of inter-cultural operations for maize farmers. (Hari Prasad Acharya, CIMMYT)

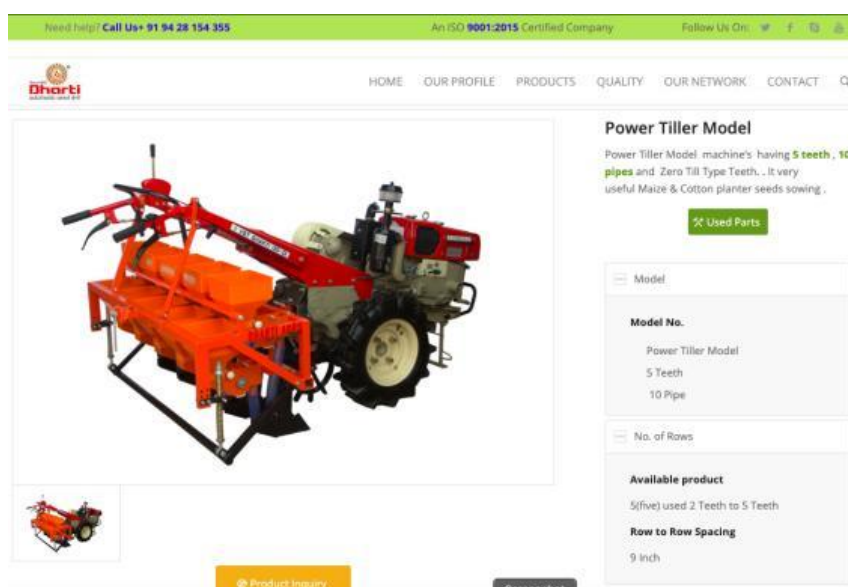


Photo 5.5: The improved Dharti 2WT seeder planter with a new easily adjustable integrated row unit is now being sold online and in machinery dealers in Nepal

Encouraging farmers to make use of preferred seed drills –

In 2017/18, the project supported three Indian seed drill manufacturers to participate in CSISA's Mechanization and Irrigation Design Sprint.⁷ This activity has continued to yield benefits in the current reporting period. One of these companies, Dharti Agro from India, subsequently began selling its new 2WT seed drill (seeder-planter) in Nepal in mid-to-late 2018. This planter has is less heavy

and is easier to use in the field, and has an added bracket for a rear tire, and a seat to facilitate road transportation (Photo 5.5). It also has lowered seed meters attached to the row opener shanks. These engineering advantages have resulted in equipment that enables quick adjustments to improve seed-to-seed placing. The same seeder can be adjusted to plant up to five rows of wheat or rice or two rows of maize at a time. The Nepal sales agent, Kuber and Sons, received seven of these planters (seed

⁷ Design sprints provide the opportunity for farm machinery manufacturers to modify their machines to better suit the needs of potential buyers.

drills) began to sell these seed drills on the open market in March of 2019, providing clear evidence of project impact and the potential to scale-out use of appropriate agronomy and crop establishment through commercial pathways and mechanization.

Post-harvest dryer network – The attendance of project and PMAMP representatives at the Feed the Future Innovation Lab for Nutrition Scientific Symposium (27–29 November 2018, Kathmandu) revealed PMAMP’s interest to promote cereal grain dryers, particularly for spring rice whose harvesting coincides with the pre-monsoon rainfall that can make drying difficult. Leading on from the workshop an informal network was established by the project with members of PMAMP’s zones and super zones and the Department of Agriculture’s Post Harvest Section for sharing information on the subject, especially on adapting rice grain dryers to also dry maize, which should greatly reduce the incidence of aflatoxin. This network is expected to lead to the development and increased use of post-harvest crop driers and has led to PMAMP showing interest to import a grain dryer for spring rice for market testing by one of its farmer cooperatives.

5.4 Raised awareness on the benefits of farm mechanization

Project-supported demonstrations, awareness campaigns, farmer field days, presentations at agricultural fairs and interaction programs raised awareness about and have encouraged the use of scale-appropriate farm machinery in Nepal’s Feed the Future Zone.

Seed drill demonstrations – The awareness of traders and local governments was raised on the use of seed drills via project-supported demonstrations of zero tillage wheat in Banke, Bardiya, Kailali and Kanchanpur in October and November 2018 in coordination with local and provincial government agriculture sections.

Project support has led to the number of seed drills in Dang district increasing to more than a dozen, most of which are owned by farmer cooperatives, with the cost of buying them subsidized by PMAMP. In the past year, with technical support from the project, PMAMP has doubled the area of maize under it to 2,200 ha. In the reporting period, at the request of PMAMP, the project helped extend the area of maize planted by seed drill in Dang Maize Super Zone by supporting demonstrations at new sites in November 2018 and February 2019, and by running a promotional campaign.



Photo 5.6: A four-wheel tractor with the 2BMZJ-3 Chinese-made precision multi-crop planter sowing maize (Hari Prasad Acharya, CIMMYT)

Also, on 22 November 2018 and 24 February 2019, the project conducted demonstrations for 150 farmers and other stakeholders to promote mechanized maize seeding in Banke Maize Zone using the most popular seeding machine from PMAMP Dang (Photo 5.6). Around the same time, awareness raising rallies were held across the zone to disseminate information on seed drills. Subsequently, 19

more farmers hired in seed drills to drill 4 ha of maize in new parts of Dang in the February 2019 planting season.

Reaper awareness campaign – In November 2018, an awareness raising campaign was carried out in Kapilvastu district in collaboration with the Kapilvastu Rice Super Zone. A reaper campaign was also carried out to encourage the use of reaper harvesting of cereals (rice and wheat) in Banke (Photo 5.7). Soon thereafter, the super zone included reapers in its machinery promotion program and the number of reapers increased from 2 to 18 across the Super Zone.



Photo 5.7: Project campaigns using mobile advertising and distribution of leaflets to encourage awareness and encourage the use of reapers in Kapilvastu (left) and the use of seed drills in Banke (right). (Subash Adhikari, CIMMYT)

Farmer field days – The Modern Agriculture Farm in Bardiya, which has been developed by the Guruchan Custom Hiring Centre as an agri-machinery service center and demonstration site, held a farmer field day on 8 October 2018 to show directly seeded rice to new and potential customers. Thirty-five farmers from eight farmer groups listened to experiences of growing direct-seeded rice and



Photo 5.8: Farmers learning about i) farm machinery, ii) opportunities to hire service providers on an affordable basis, and iii) direct-seeded rice at a farmer field day at the model farm of Guruchan Hiring Centre in October 2018 (Subash Adhikari, CIMMYT)

had their questions answered (Photo 5.8). Three media persons reported the program on national TV and in newspapers. The program is thus motivating more farmers to use direct-seeded rice technology.

Agricultural fairs – In this period the project had a stall at the agricultural fairs at Butwal in Province 5, Khajura in Banke, Rajapur in Bardiya and Dhangadhi in Kailali to raise awareness of scale-appropriate machinery technologies. The stalls were visited by about 10,000 visitors (Photo 5.9).

Increasing use of spreaders – As described in Objective 4, in the reporting period, three private sector partners were helped to promote fertilizer and seed spreaders, with Jay Laxmi Traders

of Bardiya subsequently ordering 20 spreaders to sell after the demonstration at Rajapur fair. It also sold one 2WT seed drill at the fair.

Rice field day and interaction

program – On 6 October 2018, a field day and stakeholder interaction program was held in Jhapa by the project and Jhapa Rice Super Zone. The field visits demonstrated resource-conserving technologies including dry and wet direct-seeded rice, harvesting by reaper, and machine transplanted rice. The program also helped stakeholders identify cost-saving technologies for other crops. The formal program discussed the activities of Jhapa Rice Super Zone with:

- Basanta Baniya, MP for Province I, praising the initiatives to introduce cost-saving technologies in the area;
- Laxman Prasad Paudel, Director of PMAMP, thanking CIMMYT for supporting PMAMP activities;
- Benu Prasai, Director of Province I Agriculture Development Directorate thanking CIMMYT for facilitating PMAMP activities; and
- the chief of Rice Super Zone, Megnath Timilsena calling for local governments to promote farm mechanization.

An important issue raised participating farmers was the high price of machines and the need for improved subsidies and/or market mechanisms to reduce costs and barriers to entry. They also voiced concerns that seed drills might not be not worthwhile investments as they are only needed for a few weeks a year when crops were established. In reply project representatives drew attention to multi-crop seed drills that can sow different crops including wheat, maize, beans and lentils throughout the year, thereby expanding the business portfolio of service providers and presenting extended opportunities to generate income by assisting farmers with crop establishment.

Wheat management training – In February 2019, the project held 11 training events attended by 194 women and 148 men farmers from Banke and Bardiya on wheat management and spring maize and mung bean production. The project used these events to introduce trainees to project-supported farm machinery and their benefits.

5.5 Built capacity on operating and maintaining farm machinery

With support from the project, the number of agricultural machines is growing in Nepal, with the concomitant need to increase knowledge on where and how to access spare parts and repairs. However, the pace of mechanization is still constrained by the lack of operation and maintenance training for farmers and service providers and inadequate servicing and repair facilities. In the reporting period the project therefore supported four types of farm machinery training:

- **Operation and maintenance** – In October 2018, the project assisted PMAMP's farm machinery-training program in the Banke Maize Zone and the Kapilvastu Rice Super Zone by training 55 service providers on operating and maintaining farm machinery.



Photo 5.9: Informing farmers about improved agronomic practices at Province 5's agriculture fair, Butwal (Subash Adhikari, CIMMYT)

- **Calibration training** – On 26 and 27 November 2018, 77 service providers and 61 government technicians were trained on the use and maintenance of agricultural machines. The training focused on calibrating seed and fertilizer application in seed drills and precision spreaders and the use of spreaders. It also sought to influence local and provincial governments to include seeding machinery in their subsidy programs and annual development plans.
- **Reaper maintenance** – In March 2019, the project, in coordination with Dahit Traders in Gulariya and Swastic Traders in Rajapur, trained 124 service providers and trader technicians from Banke and Bardiya districts on maintaining reapers at five training events (Photo 5.10). At the same time the project published 1,000 copies of the project's repair and maintenance guidelines for multi-crop reapers and is distributing them to service providers.
- **Seed drill maintenance** – On 13 February 2019, the project trained the mechanics of Jay Laxmi Traders, Bardiya on power tiller operated seed drills for seeding maize and direct-seeded rice to enable them to assist Rice Super Zone and other stakeholders to maintain their machines.



Photo 5.10: The project-supported training of 2WT reaper service providers at Dahit Traders in Gulariya, Bardiya in March 2019 (Subash Adhikari, CIMMYT)

5.6 Irrigation

Research conducted by the wider CSISA Projects second and third phase on irrigation has shown that rice and wheat yields in Nepal's Terai can be substantially improved by applying additional irrigation. However, inefficient groundwater use burdens risk-averse and resource-poor farmers because of the high price of irrigation water and the untimely delivery of water. This inhibits farmers from applying adequate irrigation, thus reducing their resilience to climate variability and increasing the uncertainty of returns on investments.

Research to reduce irrigation bottlenecks – In this reporting period the project established a partnership to carry out research on the more efficient use of groundwater. The groundwork was laid in January 2019 when researchers from Manchester University and project personnel toured farms in Banke and Bardiya and the AMPC and NAMTRC centers in the eastern Terai to establish the research and development agenda. The aim of the research, which will go ahead in 2019, is to identify ways of sustainably increasing groundwater use to bolster farmers' resilience and the sustainable intensification of agricultural systems.

Scaling technologies – In this period the project also worked with local partners to further develop irrigation technologies previously developed in the second and third phase of the broader CSISA project. It continued to support a private manufacturer of agriculture machinery in Kanchanpur to develop a more affordable type of solar powered irrigation system and worked with two well-boring technicians on the development of a 2WT powered attachment to drill shallow tube wells.

Additional Information

CHALLENGES FACED DURING THE REPORTING PERIOD

Lack of clarity regarding officially responsible personnel in local and provincial governments – A key challenge faced by the project in this reporting period has been the lack of permanent technical agriculture staff in provincial and local governments. Nepal's new federal constitution, ratified in 2015, began to come into full force with the election of the three new tiers of government – federal, provincial and local governments in 2017 and 2018. The devolution of responsibilities has meant that provincial and local governments are now responsible for agriculture support and development that previously came under the central ministry of agriculture and its district agriculture offices. Box 1 summarizes the changed situation.

Box 1: The new federal structure governing Nepal's agriculture

Until 2017/18, Nepal's 75 district agricultural development offices (DADOs) were the main avenue for the Ministry of Agricultural and Livestock Development (MoALD) and Department of Agriculture (DoA) to implement the government's agricultural development programs at the field level. These offices ceased to exist in 2017/18 because of federal restructuring.

The new middle tier of government, the seven provincial governments now have ministries of land management, agriculture and cooperatives. These ministries are responsible for setting province level policies and overseeing local governments. And as the DADOs phased out, 55 new agricultural knowledge centers (krishi gyan kendras) were established under provincial governments to provide advisory support to farmers and service providers. Many DADO administrators and technical staff were shifted to these centers. This has meant that the project has had to react and build new relationships with new staff in each of these offices.

The third tier of government, local governments, are responsible for implementing agricultural development programs and have their own budgets for this purpose. They can also appoint technicians to agricultural knowledge centers.

The new system is in transition and faces the following challenges:

- The staff of the agricultural knowledge centers, who mostly came from DADOs, are having to adjust from previously running programs to the more low-key role of providing advice.
- The lack of adequate agricultural technicians or sufficient knowledge in provincial and local governments and the knowledge centers. This however offers opportunities to intervene and improve collaborations in support of government and CSISA's objectives
- The lack of coordination, and in some cases overlapping and unclear responsibilities, between the three levels of government for agricultural development.
- The generally low level of priority given to agriculture development activities by local governments remains a challenge.

Uncertain funding – As mentioned in the FY18 annual report, FY18 funding was carried over to support FY19 activities, which will focus on project closure. The delays and uncertainty in funding during the project period meant that a number of key staff lost their positions and key activities were temporarily put on hold or modified. The project continues to recover from these problems in the current reporting period.

ENGAGEMENT WITH THE MISSION AND FTF PARTNERS

The CSISA Nepal Scaling project (the project) has good working relations with other USAID funded agriculture projects in Nepal and South Asia. In Nepal, it continues to work closely with two projects supported by the USAID Mission in particular, including:

- KISAN II – a \$20 million five-year project under USAID’s global Feed the Future initiative that is working to advance food security in Nepal by increasing agricultural productivity; and
- The Nepal Seed and Fertilizer project (NSAF) – a five-year project to strengthen Nepal’s seed and fertilizer systems.

In particular, the partnership between CSISA and these projects is paving the way for scaling-up the cereal-system based technologies in the region:

- The two CSISA projects in Nepal (the base and Nepal scaling project) provide technical and extension materials and advice to KISAN II beneficiaries to improve the uptake of better-bet sustainable agriculture production and post-harvest practices and technologies for targeted cereals. KISAN II is reaching hundreds of thousands of farmers, who have been exposed to CSISA information, materials, and technologies through this partnership.
- The project provides technical backstopping support to KISAN II’s technical staff on agriculture and marketing and to private dealers and firms who have received USAID grants through KISAN II. One specific input in November 2018 was the project holding a hands-on training on seed drill operation and maintenance in Dhangadhi for agriculture technicians, KISAN II area coordinators and community volunteers from NSAF’s partner farmer cooperatives.
- CSISA’s technical backstopping of KISAN II private firm grantees to promote improved agricultural practices, including the mechanized seeding of lentils and maize, helps grantees achieve their targets. These grantees are making use of the services provided by the seed drill service providers which were developed by CSISA. This promotes both the service providers and the use of agricultural machinery.
- The project continues to provide research results that are used by the NSAF project, and to support the development of seed systems for crops not covered by the NSAF project. In this way, the CSISA Nepal Scaling project fills gaps left by this investment and provides an opportunity for solid- and all-around emphasis on agricultural systems development to overcome productivity and resilience constraints in Nepal.

Appendix 1: Project staffing

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Moin Salam	Consultant	CIMMYT	Dhaka, Bangladesh	--	--

Appendix 2: Project partners

Partner	Partnership objective	Alignment with themes	Leveraging opportunity	Status of Partnership
Government of Nepal				
Ministry of Agricultural and Livestock Development (MoALD)	Technical guidance for Government of Nepal investments in agricultural development	All	The new Agriculture Development Strategy was approved by the government in late 2015. CSISA acts as a technical partner to shape the loan and investment programs associated with the strategy, which may exceed \$100 m.	Active and sanctioned by CIMMYT's host country agreement
Nepal Agricultural Research Council (NARC)	Strategic and applied research on sustainable intensification technologies	Innovation towards impact	NARC is responsible for providing the scientific basis of all state recommendations; their endorsement and the ownership of emerging sustainable intensification technologies.	Active and long-standing
Department of Agriculture (DoA)	Front line extension and support to farmers, service providers, and the 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
Provincial governments	To strengthen provincial level policies and provincial government support for agricultural development activities	Achieving impact at scale	Provincial governments are the middle tier of government under the federal constitution and have a large degree of independence to exercise financial powers and formulate province level policies. They have important policy making and oversight roles on agricultural development. In this period the project engaged and supported the Province 5 and Far Western Province governments.	Active and new
Local governments	To strengthen local government support for agricultural development activities	Achieving impact at scale	Local governments are the local tier of government under the new constitution. They have significant roles for implementing agricultural development in their areas and are important stakeholders that the project seeks to engage.	Active and new

Partner	Partnership objective	Alignment with themes	Leveraging opportunity	Status of Partnership
Nepali private feed companies, machinery importers and machinery companies				
NIMBUS (Nepali feed mill company), Kathmandu	Introduction and market development for new crop varieties and hybrids	Achieving impact at scale	Registration and market development of crop hybrids in the FTF Zone of Influence from a base of zero in 2015	Active since 2015
Adventa Export Pvt. Ltd. (Gujarat India)	To test new fertilizers and scale up their use	Achieving impact at scale	Is a leading manufacturer of fertilizers in India	Partnership being formed
Dharti, (Gujarat India)	To test different seed drills and scale up use	Achieving impact at scale	Is a leading manufacturer of new designs of 2-wheel tractor seeders-planters in India, with local dealers in Nepal.	Active since 2015
Kuber and Sons, (Itahari, Sunsari)	To introduce and scale up the use of appropriate farm machinery	Achieving impact at scale	This company has many dealers across the country.	Active and long-standing
Nepali private seed companies				
GATE Nepal Seed Company, Banke	Demonstration and seed production of new and nutrient enriched wheat varieties	Achieving impact at scale	Pipeline and Zn and Fe enriched wheat varieties are being released combining seed company and NARC station data through fast track approach	Active since 2015
Kalika Seed Company, Rupandehi	Demonstration and seed production of new and nutrient enriched wheat varieties	Achieving impact at scale	Pipeline and Zn and Fe enriched wheat varieties are being released combining seed company and NARC station data through fast track approach	Active since 2018
Lumbini Seed Company, Rupandehi	Demonstration and seed production of new and nutrient enriched wheat varieties	Achieving impact at scale	Pipeline and Zn and Fe enriched wheat varieties are being released combining seed company and NARC station data through fast track approach	Active since 2015

Partner	Partnership objective	Alignment with themes	Leveraging opportunity	Status of Partnership
Panchashakti Seed Company, Kailali	Demonstration and seed production of new and nutrient enriched wheat varieties	Achieving impact at scale	Pipeline and Zn and Fe enriched wheat varieties are being released combining seed company and NARC station data through fast track approach	Active since 2015
Unique Seed Company, Kailali	Demonstration and seed production of new and nutrient enriched wheat varieties	Achieving impact at scale	Pipeline and Zn and Fe enriched wheat varieties are being released combining seed company and NARC station data through fast track approach	Active since 2015
Trade associations				
Nepal Agricultural Mechanization Association (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 the private sector as Agriculture Development Strategy support programs take shape	Active since 2014
Seed Entrepreneurs Association of Nepal (SEAN)	Trade association strengthened with the help of CSISA to create an enabling environment and policy dialogue for seed system strengthening and small and medium enterprises in Nepal	Systemic change towards impact	Important voice for private sector as Agriculture Development Strategy support programs take shape	Active and long-standing
Universities				
Wageningen University	The role of livestock and value chains in farmers' willingness to invest in maize intensification	Innovation towards impact	Collaboration with advanced research institutions increases the quality of science conducted in Nepal and national partners learn new research methods and contribute to the formulation of new research questions.	Active

Partner	Partnership objective	Alignment with themes	Leveraging opportunity	Status of Partnership
Manchester University	To identify ways of sustainably increasing groundwater use to bolster farmers' resilience and the sustainable intensification of agricultural systems. The research will start in 2019.	Innovation towards impact	Collaboration with advanced research institutions increases the quality of science conducted in Nepal and national partners learn new research methods and contribute to the formulation of new research questions.	Partnership formed in January 2019
Projects				
Knowledge-based Integrated Sustainable Agriculture and Nutrition (KISAN)	Strategic partnership to co-support 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 \$20 million 5-year program to advance food security by increasing agricultural productivity. It uses CSISA's technical and extension materials, and advice, to improve the uptake of better-bet sustainable agriculture production and post-harvest practices and technologies for cereals. It reaches hundreds of thousands of farmers meaning they are exposed to CSISA information, materials, and technologies.	Active for more than 3 years
Nepal Seed and Fertilizer Project (NSAF)	Strategic partnership to co-support the large-scale deployment of extension information and technologies	Achieving impact at scale	The USAID Nepal-funded NSAF project (\$15m for 2016–2021) focuses on the applied science-to-development continuum, including market facilitation to expand private sector-led fertilizer and seed sales. CSISA is disseminating the better-bet technologies at scale through NSAF networks.	Active for more than 3 years
Sustainable and Resilient Farming Systems Intensification in the Eastern Gangetic Plains (SRFSI)	Extending CSISA technologies to areas of eastern Nepal	Achieving impact at scale	CSISA's experiences in scaling up resource conserving technologies in western Nepal are an asset to jump start technologies in eastern Nepal. The ACIAR funded SRFSI is scaling up these activities. CSISA is supporting NARC and other SRFSI partners to spread its technologies.	Active for more than 3 years

Appendix 3: Expected outcomes of CSISA-Nepal scaling project related to the objectives of the Global Food Security Act (GFSA)

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

GFSA Objective 1
Inclusive and sustainable agricultural-led economic growth

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 enable early wheat establishment

Wheat: Social marketing approaches '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 identified for overcoming energy and cost bottlenecks to **irrigation expansion**

Mechanization and irrigation: Physical and operational models of **land aggregation** identified 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 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 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 two-wheel tractor and mini-tiller platforms

Mechanization and irrigation: Improving capacity for machinery evaluation and design improvement among National Agriculture Research and Extension Systems (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