# USAID/Nepal Digital Agriculture Ecosystem Assessment

## A study on digital technology for Nepal's agricultural input market systems and subsidies

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Prepared through the Digital Frontiers Project



## ABBREVIATIONS

| | |
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| ADS | Agriculture Development Strategy |
| AI | Artificial Intelligence |
| AICL | Agricultural Import Company Limited |
| AKC | Agriculture Knowledge Centre |
| AMIS | Agency-Managed Irrigation Systems |
| CBF | Community-Based Facilitator |
| CHC | Custom Hiring Center |
| CIMMYT | The International Maize and Wheat Improvement Center |
| CSISA | Cereal Systems Initiative for South Asia |
| DAP | Diammonium Phosphate |
| DDC | District Development Committee |
| DESIS | Digitally Enabled Seed Information System |
| DBT | Direct Benefit Transfer |
| DOA | Department of Agriculture |
| DOI | Department of Irrigation |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FMIS | Farmer-Managed Irrigation Systems |
| FMS | Fertilizer Management System |
| FY | Fiscal Year |
| GIS | Geographic Information System |
| ICT | Information and Communications Technology |
| IoT | Internet of Things |
| IP | Implementing Partner |
| ISP | Internet Service Provider |
| IVR | Interactive Voice Response |
| KII | Key Informant Interview |
| LI-BIRD | Local Initiatives for Biodiversity, Research and Development |
| MoALD | Ministry of Agriculture and Livestock Development |
| MEWRI | Ministry of Energy, Water Resources and Irrigation |
| MOP | Muriate of Potash |
| MRP | Maximum Retail Price |
| MT | Metric ton |
| MUS | Multiple-Use Water System |
| NARC | Nepal Agricultural Research Council |
| NeFEA | Nepal Fertilizer Entrepreneurs Association |
| NPK | Nitrogen, Phosphorus, Potassium |
| NPR | Nepalese Rupee |
| NSAF | Nepal Seed and Fertilizer |
| NSCL | National Seed Company Limited |
| NSB | National Seed Board |
| OCN | Organic Certification Nepal |

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|---|---|
| PAN | Permanent Account Number |
| PII | Personal Identifiable Information |
| PMAMP | Prime Minister’s Agriculture Modernization Project |
| POS | Point of Sale |
| QR | Quick Response |
| SMS | Short Message Service |
| SQCC | Seed Quality Control Center |
| STCL | Salt Trading Company Limited |
| SWIFT | Society for Worldwide Interbank Financial Telecommunication |
| UNCDF | United Nations Capital Development Fund |
| VAT | Value Added Tax |
| VDC | Village Development Committee |
| WB | World Bank |

## EXECUTIVE SUMMARY

The U.S. Agency for International Development (USAID)/Nepal commissioned this study to assess the potential to leverage digital technology to support Nepal's agricultural input systems. USAID hypothesizes that digital technology, deployed effectively, can increase cost and productivity efficiencies for public and private input service providers, ultimately leading to a stronger agricultural sector. This study examines the market systems and subsidy programs for the inputs of seed, fertilizer, machinery, and irrigation. Conducted by Strategic Impact Advisors, this work is based on a literature review and key informant interviews (KIIs) that took place in the fall of 2020.

The Government of Nepal is heavily involved in the agricultural input sector through its regulations, subsidies, and other support. This involvement limits the role of the private sector in some areas — especially fertilizer — and makes the Government of Nepal the necessary key component for digital solution development. As the Government of Nepal has undergone frequent structural change in the past few years toward decentralization, so too have many market system and subsidy processes.

Nepal's digital infrastructure and usage have advanced rapidly, but last-mile limitations remain. The majority of fiber-optic cable infrastructure exists in urban centers, while the challenging topography in northern parts of Nepal limits network reach. Mobile phone usage has grown but remains limited in rural areas — smartphone use is particularly limited — and digital literacy is low. A variety of AgTech solutions have emerged in Nepal.

As part of an ID system, a digital database of farmers could unlock huge potential for digital services. The implications for digital financial services, subsidy targeting, and delivery are enormous, in addition to many other areas where accurate data could enable targeted support to farmers. Nepal's Ministry of Agriculture and Livestock Development is building out such a system, called the Kisan ID. USAID should support the Government of Nepal to use the system to target and administer subsidies, which would include integration of a payments platform. Once it is ready, USAID could provide significant value by having its implementing partners (IPs) facilitate registration of farmers in their networks onto the platform. USAID should also ask its IPs to include use of the Kisan ID as relevant in their approaches, and to support the integration of other systems with Kisan ID where possible.

A core digital solution for the seed sector is under development with leadership from USAID's Feed the Future Nepal Seed and Fertilizer Activity. Developed in collaboration with the Government of Nepal's Seed Quality Control Center, the Digitally Enabled Seed Information System (DESIS) aims to serve several purposes in the seed sector. In addition to the core offerings of creating a digital seed balance sheet and a digital catalogue of registered seeds, there will be opportunities to integrate other functionalities — such as an e-marketplace, an electronic tracking system, and digital payments — to reach farmers with the best seed at standard prices. As the Nepal Seed and Fertilizer Activity comes to an end, USAID should ensure a strong sustainability plan that ensures both Government of Nepal capacity to run this important system, as well as avenues for USAID to continue supporting and growing it.

In the Government of Nepal–dominated chemical fertilizer sector, the Fertilizer Management System (also promoted and developed by the Ministry of Agriculture and Livestock Development) is being developed for two primary stakeholders, Agriculture Input Company Limited and Salt Trading Company Limited. The Fertilizer Management System is set to be the core digital platform. Most immediately, the platform will improve tracking of chemical, subsidized fertilizer distribution and field inventory management. Like

DESIS, there will be opportunity for integration with other functionalities, including soil mapping and payments. Though small, the organic fertilizer market may benefit from other, privately led digital solutions. Initial exploration is already underway for electronic tracking to give organic farmers more certainty in the fertilizers they purchase.

Internet of Things (IoT) sensors are central to top digitization opportunities in the machinery and irrigation sectors. Digitization of machinery rental, not yet underway, has potential; successful examples exist in other countries, including India, that could be brought to Nepal. IoT sensors can monitor the location of the machinery, as well as provide alerts for when machinery may need maintenance. An important opportunity for digital solutions in irrigation is the use of sensors to alert farmers when to water — and when not to water — to use often-scarce water resources efficiently. “Smart irrigation” solutions are already beginning in Nepal; some may benefit from USAID’s support to scale.

Needs also exist in the broader, enabling environment – from supporting the expansion of network infrastructure into rural areas to growing digital financial literacy of farmers and cooperatives. In whatever types of digital investment USAID decides to pursue, attention to data protection, cybersecurity, and the digital divide should be considered priorities during the vetting and throughout implementation. The Principles for Digital Development, co-authored by USAID, provide a comprehensive list of recommendations for responsible and effective deployment of digital solutions to achieve development goals.

# 1. INTRODUCTION

Agriculture is critical to Nepal's economy and food security. The sector employs most of the adult population and represents about one quarter of gross domestic product; however, in terms of agricultural production and competitiveness, the sector is not reaching its potential. A primary reason for this shortcoming is farmers' limited access to quality inputs. Strengthening the country's agriculture is a priority for USAID, with Nepal as one of only 12 countries in its global Feed the Future initiative.

Globally, USAID's digital strategy tasks the agency to use digital technology to improve development outcomes while growing the openness, security, and inclusiveness of national digital ecosystems. Digital technologies have strengthened outcomes in many USAID agricultural initiatives – from providing remote advisory services to farmers to enabling new market connections, strengthening supply chain management, and increasing access to agricultural finance.

Under the Digital Frontiers award, USAID/Nepal commissioned this study to assess the potential to leverage digital technology to support Nepal's agricultural input systems. USAID hypothesizes that digital technology, deployed effectively, can increase cost and productivity efficiencies for public and private input service providers, ultimately contributing to a more productive and competitive agricultural sector. Building on the Digital Ecosystem Assessment USAID/Nepal has commissioned, this study looks specifically at the inputs of seed, fertilizer, machinery, and irrigation. The findings are intended to inform USAID's design of a new Feed the Future activity.

Led by Strategic Impact Advisors, the assessment team included both Nepali and international consultants. Following a literature review, 41 interviews took place between September 21 and December 3, 2020. Interviewees included 10 input companies, eight government representatives, four business associations, seven tech companies, five nongovernmental organizations (NGOs), three cooperatives, two financial service providers, two media groups, and one farmer. Due to the COVID-19 pandemic, no international travel occurred, and all interviews occurred remotely – primarily by phone by Nepali team members.

This report examines current systems and digital opportunities within two agricultural input systems: 1) the commercial input market system and 2) Government of Nepal input subsidies. The report then offers a synthesis of recommendations on how USAID can support existing, core solutions as well as additional areas for exploration, followed by strategies to manage risks that accompany digital adoption.

# 2. AGRICULTURAL INPUTS

## 2.1. Nepal's Input Market Systems

### 2.1.1. Overview

The Government of Nepal plays significant roles in the seed, fertilizer, irrigation, and machinery market systems. As a regulator, it creates standards, tests, certifies, and licenses. It also seeks to strengthen the country's agricultural sector, as laid out in several policies and strategies, such as the Agriculture Development Strategy (ADS) 2015 to 2035 and the Prime Minister's Agriculture Modernization Project (PMAMP). The Ministry of Agriculture and Livestock Development (MoALD) may play the greatest role in inputs, but several others are also involved, including the Ministries of Physical Infrastructure and Transport; of Energy, Water Resources, and Irrigation; of Federal Affairs and Local Development; and of

Finance. With myriad departments under the ministries, and multiple layers of government down to the local level, confusion over respective roles is rampant, especially among nongovernment stakeholders. Recent changes under the transition to decentralized governance starting in 2017 — such as two changes to seed subsidy administration structure — compound this uncertainty. Coordination with and within the Government of Nepal did not receive high marks in the KIIs.

The Government of Nepal also engages in commerce, as several state-owned companies play prominent roles in the seed and fertilizer market systems. Other large companies are both Nepali and international; some Nepalese companies import, while others make their own product. Overall, the market systems are import-heavy, with significant reliance on outside technology. The formal import process is widely characterized as bureaucratic and inefficient, while heavy informal trade — especially over the porous border with India — has significant impact on the prices and quality transparency of products in the market.

Private sector actors coordinate in industry associations to advance shared interests. To reach farmers with their products, some companies have regional distribution centers or work with a network of retailers. At these points, small-scale agrovets source their products for sale to cooperatives or individual farmers. While extension agents may play a role in advising farmers on what inputs to purchase, their influence is not widespread; in 2016, only 9 percent of households reported receiving advisory services from government extension agents.[1] Agriculture cooperatives and farmer groups play a much more significant role in influencing farmer's input use, sometimes using the group structure to collectively buy and distribute or share inputs.

**Gender.** More than 80 percent of Nepali women are employed in agriculture,[2] though they participate in parts of the market system at different rates than men. As women make up only 22 percent of students in agriculture-related disciplines,[3] they are under-represented in many professional roles in both the public and private sectors; for example, only 11 percent of public agricultural services staff are women.[4] The ramifications extend to the farmer level, where extension services are a key means for farmers to learn about inputs; in 2015, only 31 percent of female farmers received extension services, compared to 69 percent of male farmers. At the farmer level, men have traditionally led the marketing aspects (purchases and sales), as well as heavy labor activities, such as ploughing. Things are changing as men migrate and women take up their roles, though male and female farmers still often have distinct sets of knowledge.[5] Among agricultural cooperatives, women represent an average of 42 percent of executive members.[6] Given constraints to women's mobility, most agro-dealers are men.

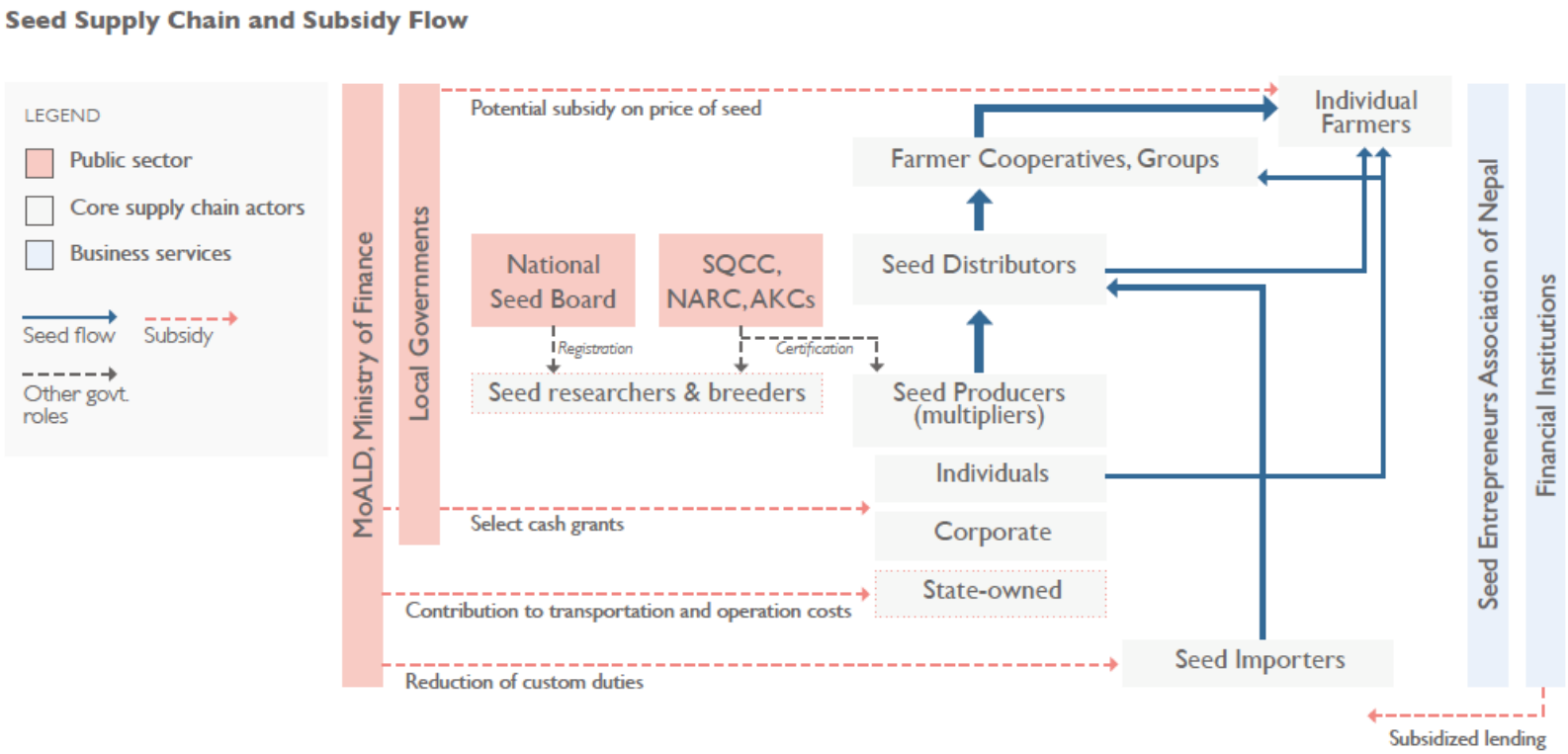
## 2.2. Nepal's Agricultural Input Market System

### 2.2.1. Seed

#### a. Market system overview

[1] Nepal Rural Household Survey 2016.
[2] FAO, *Country Gender Assessment of Agriculture and the Rural Sector in Nepal,* 2019.
[3] Central Bureau of Statistics, 2012.
[4] Ministry of Agricultural Development, "Selected Indicators of Gender and Social Inclusion in Agriculture Sector and related Agriculture Programs," 2017.
[5] FAO, *Country Gender Assessment of Agriculture and the Rural Sector in Nepal,* 2019
[6] Department of Cooperatives, 2016.

**Graphic 1. Nepal's seed market system**



As shown in Graphic 1, Nepal's seed market system includes actors in the private, government, and nongovernment sectors. Actors range from large companies and agencies to individual seed entrepreneurs engaged at various levels in production, processing, and marketing.

Government agencies and projects collaborate with different core actors like individual seed producers, cooperatives, and dealer/agrovets under their activities in various ways. Most vegetable seed is multiplied and transacted through private actors, while two state-owned companies — National Seed Company Limited (NSCL) and Agricultural Input Company Limited (AICL) — dominate the cereal seed market. Bold and dotted arrows of seed flow in the Graphic 1 show commercial and non-commercial (subsidized) channels, respectively. This section describes the commercial seed market system; Section 3 discusses subsidies.

Core value chain actors in the seed market system include:

- **Seed importers:** Private companies[7] or state-owned companies[8] bring seeds from India (majority) and from other countries through standardized import procedures (e.g., opening a letter of credit at banks for international trading). The Government of Nepal, upon the MoALD's recommendation through the Ministry of Finance, provides a reduction or exemption of custom duties on imported seeds. In fiscal year (FY) 2018/2019, Nepal imported 424,333 kg of vegetable seeds worth 553 million Nepalese Rupees (NPR) and 4.22 million kg of maize seeds worth NPR 393 million.[9] Importers sell seeds to cooperatives and farmers through their own distribution channels, which generally comprise dealers, sub-dealers, and agrovets.
- **Seed researchers and breeders:** Seed breeders develop breeder seeds of new varieties to grow in Nepal, which must be certified and registered before they can be sold (see below). Nepal Agricultural Research Council (NARC) and Tribuhuvan University's Institute of Agriculture and Animal Science are the two largest researchers and foundation seed producers. Numerous other breeders exist, especially for cereals.[10] The Seed Quality Control Center (SQCC) lists 35 breeders on their website.[11] Some NGO groups also develop source seeds, such as the Center for Environmental and Agricultural Policy Research, Extension and Development.
- **Seed producers (multipliers):** Ranging from private companies[12] to cooperatives to individual farmers, seed producers use foundation seed to produce large volumes of seed for farmers.
- **Seed distributors (dealers, sub-dealers, agrovets):** Individuals and/or companies sell to individual farmers or farmers' groups, either through cooperatives, dealers/agrovets, or projects, depending upon their market linkages and outreach to production areas. Agrovets are motivated to promote imported hybrids due to higher commission rates.
- **Farmers (seed planters) (individual/cooperative):** Farmers generally access seeds through agrovets or cooperatives. Agrovets receive seed directly from importers or seed-producing companies. Cooperatives access seed either through agrovets, individual seed producers, or government or development projects.

[7] 100% of vegetable seed and some hybrid cereal seed.
[8] Cereal seed only.
[9] The Kathmandu Post, "Nepal's growing reliance on imported hybrid seeds risks devastating consequences", available at: https://kathmandupost.com/science-technology/2019/09/07/nepal-s-growing-reliance-on-imported-hybrid-seeds-risks-devastating-consequences
[10] Bal Krishna Joshi, "Plant Breeding Nepal: Past, Present and Future," *Journal of Agriculture and Urban Forestry,* Volume 1, 2017, pp. 1-33.
[11] "Seed Quality Control Centre", accessed 10 November 2020, available at: http://sqcc.gov.np/
[12] SQCC lists 52 rice seed producers and five for maize on its website.

Additional market system actors include:

- **The Government of Nepal:** The Government of Nepal oversees seed registration and certification and provides technical assistance, research and development, and subsidies (see Section 3.1.2) to support the market system.
- **Seed Entrepreneurs Association of Nepal:** Most seed importers and producers are associated with Seed Entrepreneurs Association of Nepal, which facilitates seed promotion activities and liaises with government agencies for policy interventions to benefit the approximately 600 members currently listed nationwide.
- **NGOs and donor-funded projects:** The seed component of the USAID Feed the Future Nepal Seed and Fertilizer Activity (NSAF) builds the capacity of the public and private sectors on market-oriented variety development, technologies for quality seed production, and seed business development. Other NGOs also facilitate seed production and provide technical facilitation for development of storage facilities and market-linkage activities.

### b. Seed types, certification, and registration

Types of seed in Nepal's formal market system fall into various categories[13], including:

- Breeder seed: Seed whose production is directly controlled by a breeder or a research organization (e.g., NARC) and provides sources to produce foundation seed.
- Foundation seed: Seed grown from the breeder seed that is multiplied to produce larger quantities for distribution.
- Certified seed: Seed that has been grown under the conditions of the certification program as determined by the SQCC.
- Improved seed: Seed of a variety that has been purposefully developed for improved farming outcomes from certified seeds but is not certified.
- Source seed: The original seed that is used to produce seed of the same variety.

Seeds that are sold in the formal market system must be certified and registered. The SQCC develops and directs seed policy for the Government of Nepal on variety certification, registration, and quality control. The SQCC acts as a secretariat of the National Seed Board, which governs the entire process for the procurement of seeds — for which the SQCC provides licenses[14] — to ongoing monitoring of certified seed.

**Seed certification.** Seeds go through certification at the time of the variety's registration, and thereafter continue an ongoing certification process that monitors the seeds' genetic purity and quality. NARC conducts the lab tests of seeds in the country's central lab. SQCC-trained seed officers/inspectors at regional Agriculture Knowledge Centres (AKCs) inspect seed in the field and award certification tags after the seed is bagged. Time spans for new certifications vary; a new hybrid might take around 10 years for initial certification, while imported seed might take three to four years.

**Seed registration.** All new varieties — whether hybrid or inbred — must be registered before they can be legally transacted in Nepal. Seed registration is a complicated process that usually takes several years, from initial application to approval by the National Seed Board. Initial certification occurs within the registration process, with testing conducted by NARC. Once a seed is registered, it can be multiplied and

[13] Government of Nepal, "National Seed Vision 2013-2025".
[14] 47 source seed licenses to date.

sold. While the registration acknowledges intellectual property, private companies do not receive an exclusive license (e.g., patent) for selling the seed.

### c. Challenges

Nepal's seed market system struggles to produce reliable quantities, high qualities, and affordably and predictably priced seed when farmers need them. Nepal's seed replacement rates are quite low, at 13.4 percent for rice, 9.6 percent for wheat, 17.8 percent for maize, and 23.4 percent for potatoes.[15] Private investment in research and development is weak. These shortcomings are primarily due to the following reasons:

**Lengthy seed registration process.** The seed registration process is lethargic and time consuming, as the government mechanism does not operate at full capacity. The registration is long also because the new seeds need to be processed according to respective geographic locations, like Terai, Hills, and Mid Hills. The lengthy process can be costly and discouraging to seed developers.

**Bureaucratic delays in seed import.** The certification/approval process for imported seeds is criticized for being overly bureaucratic and lengthy, as importers need to work with different agencies to get certification and approval.

**Seed infiltration.** Infiltration of seeds, particularly from India due to open borders, is a longstanding issue given the prevalence of unauthorized suppliers. The legal import of seed has an estimated value of NPR 1.5 billion per year – half of what government officials estimate the value of the illegal seed trade to be. No transparency on quality exists on infiltrated seeds; their presence in the market sows distrust among farmers and agrovets. Infiltrated seed also creates challenges for seed producers; not only does it complicate their forecasts for demand of their seed – they must also compete with a lower price.

**Poor tracking through the supply chain.** Whatever the source of seed, by the time seed reaches farmers, it generally has passed through multiple intermediary hands and may be mixed or mis-labeled along the way. Tagged certified bags may be opened and mixed, and poor quality seed may be misrepresented as something else. Varieties recommended for certain regions may end up in locations where climatic conditions are not ideal, leading to poor harvest[16] As a result, farmers' trust in the seed market systems deteriorates.

**Subsidy distortion.** Some stakeholders argue that the government's subsidies on seeds — improved varieties — distort the market by making other seeds less competitive and creating farmer dependency on subsidy. However, the long-term market impact may not be negative, as incentives for improved varieties grow. Section 3 further discusses subsidies.

**Confusion in government coordination.** Coordination with, between, and within government agencies is a challenge, compounded by the transition to the newly introduced federal system. With a lack of clear policy and directives on roles of each level of the government, stakeholders are often unclear on the level (e.g., central, provincial, or local) at which they should address their issues. Meanwhile, ministry departments have functional linkages with the central government, whereas their financial resources to work on the ground are allocated by provincial governments, leading to disjointed and unpredictable implementation.

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[15] World Bank, "Nepal: Agriculture and Food Security Project (TF13719) Implementation Support Review", available at: http://pubdocs.worldbank.org/en/185751500444044483/AM.pdf

[16] The Kathmandu Post, "Nepal's growing reliance on imported hybrid seeds risks devastating consequences", available at: https://kathmandupost.com/science-technology/2019/09/07/nepal-s-growing-reliance-on-imported-hybrid-seeds-risks-devastating-consequences

**Slow process to measure seed demand.** No common understanding exists among the government and seed producers regarding the demand and supply of seeds. The government generally makes projections for time spans of three to 10 years based on its Periodic Plans or Agriculture Development Strategies. No scientific demand forecasting system is in place; this issue is particularly problematic for open pollinated varieties and legume crops. Currently, local entities like AKC create demand forecasts by contacting agrovets and producers' groups locally. In the case of private seed companies and entrepreneurs, they estimate seed demand on an annual basis based on sales from the previous year and specific growth assumptions based on trends from several years in the past and other factors.
**Insufficient intellectual property rights.** While Nepal has a basic intellectual property rights regime, and the 1988 Seed Act gives some recognition of developers' ownership rights to their product, it has not yet instituted a Plant Variety Protection Act. Without it, private sector incentives to invest in research and development of new seed varieties remain limited, as protections of their intellectual property rights to developed varieties are weak.

**Inadequate public and private manpower.** Seed company partners often lack adequate technical, production, and sales capacity. On the government side, monitoring the flow of uncertified seeds is weak, with a lack of enforcement due to insufficient staff and other resources.

#### d. Digital overview

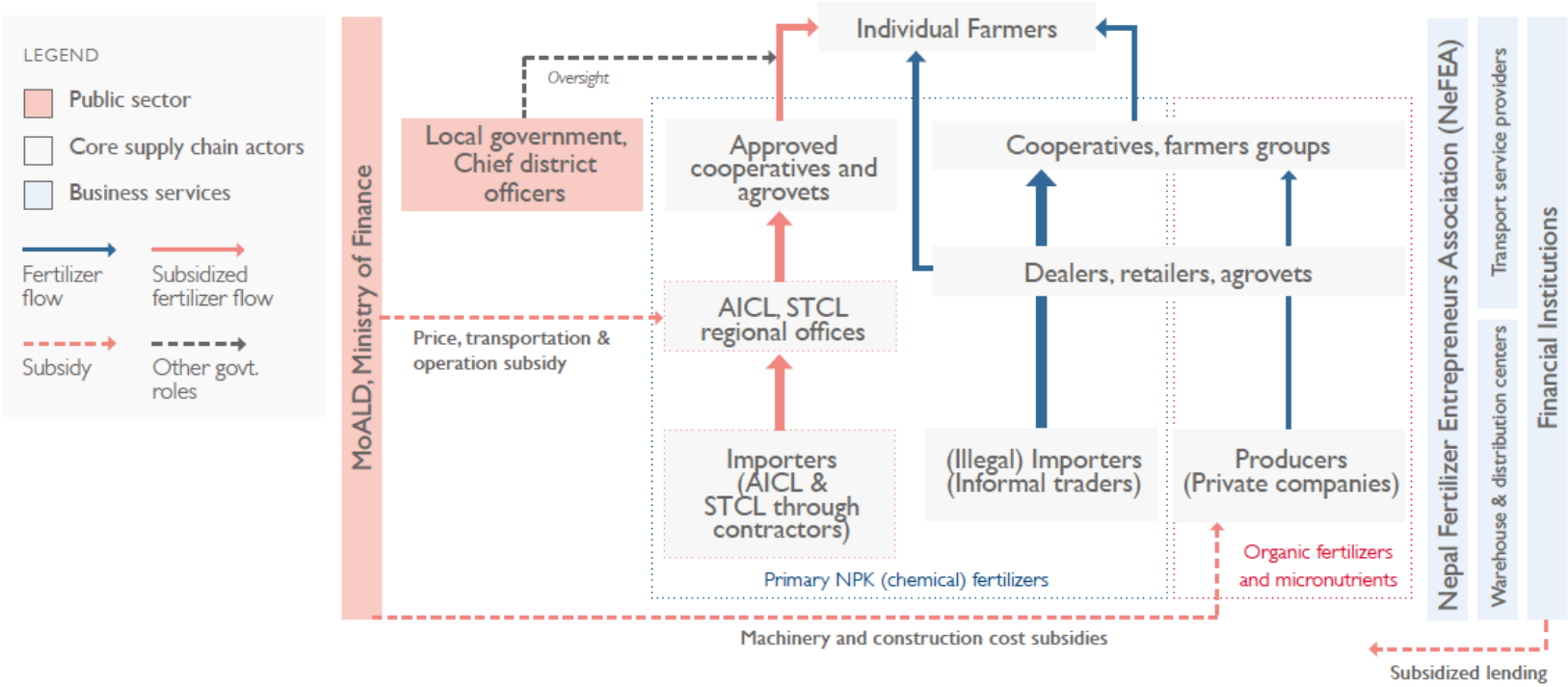
Discussed in detail in Section 2.3.4, the SQCC and the Feed the Future NSAF Activity have developed the Digitally Enabled Seed Information System (DESIS), due for impending roll-out. DESIS includes the SQCC's seed balance sheet as well as a catalogue of registered seeds. The system is intended to dramatically improve the efficiency of seed demand collection. DESIS could serve several other purposes for the seed market system in the future, including a digital marketplace and offering a digital credit product.

### 2.2.2. Fertilizer

#### a. Market system overview

**Graphic 2. Nepal's fertilizer market system**

**Fertilizer Supply Chain and Subsidy Flow**



Minimal use of fertilizers is considered to be one of the major factors for low crop productivity, which has significantly affected agriculture commercialization in Nepal.[17] Nepal suffers from a significant fertilizer shortage, with substantial gaps between demand and supply. Almost all of the country's chemical fertilizer is imported. Since the 2009 enactment of the Chemical Fertilizer Subsidy Policy, which set directives for fertilizer import, chemical fertilizer (urea, potash, and ammonium phosphate) imports have increased from 22,484 metric tons (MT) in FY 2008/2009 to 307,771 MT in FY 2017/2018.[18] Chemical fertilizers are imported from India,[19] Turkey, China, and Egypt. Domestic consumption has grown with the increased import volumes, but it is still far below the target set by the Nepal Agriculture Perspective Plan; current supply equals approximately 20 percent of the country's demand.[20]

The formal Nepalese chemical fertilizer market is highly regulated and subsidized. The entire procurement and distribution process of NPK-based fertilizers (e.g., urea, diammonium phosphate [DAP], Muriate of Potash [MOP]) are carried out by two authorized parastatal companies: AICL and Salt Trading Company Limited (STCL). AICL controls about 70 percent of the stock, and STCL the other 30 percent. All the imported, chemical fertilizer is subsidized. While procurement, management, and distributor certifications are under the purview of the central government, subsidized fertilizers are distributed through local field offices of AICL, STCL, and cooperatives.[21] Recently, some private sector partners (e.g., agrovets) have engaged in subsidized fertilizer distribution, qualifying through a competitive bidding process. In each district, a Fertilizer Supply and Distribution Management Committee is formed and is chaired by Chief District Officers. This committee manages fertilizer distribution at local levels. Presently, more than 5,000 cooperatives retail and distribute subsidized fertilizers.

The private sector is largely crowded out of the chemical fertilizer market, as they cannot compete with subsidized fertilizers. The private sector is largely relegated to importing secondary NPK sources (e.g., Ammonium nitrate - NH4NO3), organic fertilizers, and micronutrients, which are not subsidized.[22] The Government of Nepal has been promoting organic fertilizers through subsidy programs under several policies.[23] The research wing (NARC) must first validate organic fertilizers. Then, with results from their trial, parties approach the Department of Agriculture for further certification. A survey of organic fertilizers on the market found them all to be of poor quality.[24] Though the country has potential for organic agriculture, still less than 0.5 percent of the land area is labelled as organic.[25]

It has been estimated that only 25 percent of Nepal's fertilizer use is covered by formal supply,[26] with much of the remainder coming over the porous border with India into the Terai region. Demand for additional fertilizer is high, given how little of the demand the formal imports can meet; supply is

[17] Nepal Agricultural Development Strategy 2014-2024.
[18] Panta, H. "Supply Chain of Subsidized Chemical Fertilizers in Nepal". *Journal of the Institute of Agriculture and Animal Science*, Vol. 35, no. 1, Dec. 2018, pp. 9-20, available at: https://www.nepjol.info/index.php/JIAAS/article/view/22509
[19] Import points from India are Dhangadi, Nepalgunj, Bhairahawa, Birgunj, and Biratnagar.
[20] Bista et al., 2016.
[21] Bista et al., 2016.
[22] Panta, 2018.
[23] Including the National Agriculture Policy, 2006; Agribusiness Policy, 2006; National Standards of Organic Agriculture Production and Processing, 2007.
[24] Panta, 2018.
[25] ANSAB, 2016.
[26] Pandey 2013 in Kyle, J, Resnick, D and Karkee, M, "Improving the equity and effectiveness of Nepal's fertilizer subsidy program," IFPRI Discussion Paper, 2017.

considered a much more significant determinant of fertilizer use than price.[27] Compared to regulated imports, the illegally traded fertilizer is generally inferior in quality.

NARC conducts research around soil health and fertilizers. Few present initiatives from both government and nongovernment institutions relate to soil health and sustainable management. PMAMP under MoALD is conducting several soil-testing campaigns in various locations within the country. Similarly, other donors support fertilizer, including the Food and Agriculture Organisation of the United Nations (FAO), International Center for Integrated Mountain Development, USAID, and Japan International Cooperation Agency since the 1970s. Funded through USAID, the International Maize and Wheat Improvement Center (CIMMYT) in collaboration with International Fertilizer Development Center focuses on fertilizer and integrated soil fertility management and is strengthening the institutional capacity of the recently established (2017/2018) Nepal Fertilizer Entrepreneurs Association (NeFEA). The NeFEA was originally registered and established as the Fertilizer Association of Nepal. It is a non-profit and non-trading association representing the fertilizer manufacturers, distributors, importers, equipment manufacturers, research institutes, and suppliers of inputs. Seventeen nominated executive committee members representing various interests of constituent member units manage the NeFEA.[28]

Private fertilizer sector actors report an absence of coordination with the public sector.

### b. Challenges

**Insufficient supply.** The demand-supply gap has been largest in the Far Western Development Region, where in 2016, 90 percent of households reported an inability to access the volume of fertilizer they sought.[29] Due to the recent introduction of hybrid and improved seeds, demand has increased astronomically; industry players estimate the nationwide demand to have increased from 700,000 tons a few years ago to around 1.3 million tons per year currently. Several causes contribute to this gap. Logistical restrictions limit the quantities of fertilizer that can be imported at a time. During the current year (2020/2021), the national plan was to import 500,000 tons of chemical fertilizers. Unfortunately, the Nepalese contractors failed to supply the fertilizers to AICL.[30] Procurement policy is also complicated under the public procurement act, adding to inefficiencies.

**Inadequate soil information systems.** Soil information at the local level is either not available or not well coordinated to help cooperatives and farmers determine the types and amounts of fertilizers required, as well as to support demand forecasting.

**Low quality informal trade.** To address the supply gap, farmers in the Terai region rely significantly on informal markets across the Indian border for their fertilizer needs. However, these fertilizers are of very poor quality.

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[27] Pandey 2013 in Kyle, J, Resnick, D and Karkee, M, "Improving the equity and effectiveness of Nepal's fertilizer subsidy program," IFPRI Discussion Paper, 2017.
[28] IFDC, "Fertilizer Association of Nepal Honors IFDC and CIMMYT as Implementers of Nepal Seed and Fertilizer Project", available at https://ifdc.org/2017/09/06/fertilizer-association-of-nepal-honors-ifdc-and-cimmyt-as-implementers-of-nepal-seed-and-fertilizer-project/
[29] Kyle, J., Resnick, D., and Karkee, M., "Improving the Equity and Effectiveness of Nepal's Fertilizer Subsidy Program," IFPRI Discussion Paper 01685, December 2017.
[30] *Republica,* "Govt scraps contracts with companies failing to import much-needed chemical fertilizer on time," 7 September 2020, available at: https://myrepublica.nagariknetwork.com/news/govt-scraps-contracts-with-companies-failing-to-import-much-needed-chemical-fertilizer-on-time/.

**Lack of field inventory management.** Once fertilizer is distributed to the respective regions, AICL and STCL have little insight into where it goes – including how full the warehouses are getting. In the past, this lack of knowledge led to challenges, e.g., subsidized fertilizer that could not be stored being sold to dealers, who would resell it at a mark-up.

**Minimal private sector involvement.** The "crowding out" of the private sector in the chemical fertilizer market has impeded the scaling up of fertilizer technologies. Recent directives have allowed the private sector to qualify as distributors, presumably to alleviate the storage problem mentioned above; however, according to the 2020 revisions to the Fertilizer Policy, These directives apply only to areas without cooperatives. Ultimately, until the private sector is once again permitted to engage in fertilizer sourcing, the supply constraints are likely to remain. This constraint would require a change in the government subsidy program and/or state licensing and permit requirements, while the private sector would likely struggle to compete with subsidized prices in the more remote regions of the country.[31]

**Obstacles to certification.** The certification process is long and cumbersome for companies in micronutrient and liquid-based fertilizer. A Nepalese fertilizer interviewee noted that the Government of Nepal easily accepts reports from imported product labs, while Nepalese producers must complete a litany of steps to certify their products. A lack of lab capacity also prevents new products. One interviewee noted he had wanted to produce potassium humate (potash + humic acid) locally, but no labs could certify humic acid, so he did not implement this idea.

**Inadequate support for organic fertilizer.** There are subsidy programs from the government for the organic fertilizer companies, but performance is not satisfactory due to lack of 'nutrient value base' and inadequate production volume.[32] Organic fertilizers are mostly used for low-volume, high-value crops (e.g., vegetables), given that impractical amounts would be needed for crops like rice. Research stations do not have defined certification guidelines/standards on the production and use of organic fertilizer, which has created some quality issues based on crops and soil health conditions. Farmers are also hesitant pursue organics because there are limited price incentives to grow. The National Coordination Committee for Organic Agriculture Production and National Organic Agriculture Accreditation Body are the primary agencies that enable organic production in Nepal.[33] Organic Certification Nepal is the national-level, in-country organic certification body that inspects and certifies production at the local level.[34]

**Opaque sources of organic fertilizer reaching farmers.** Given that multiple levels of intermediaries may handle products between organic fertilizer producers and organic farmers, fertilizer may be mixed or mis-labeled, leaving farmers with reason to question what they are buying at the retail level.

### c. Digital overview

Several applications (e.g., Krishi Guru, Smart Krishi, Geo Krishi, and e-Sewa) provide information related to soil fertility and fertilizers, including weather forecast, cropping patterns and fertility management, input prices, and payment services. NSAF has also collected soil information, currently available here.

[31] NSAF evaluation, 2018.
[32] Amgai et al., 2017.
[33] Kaini, Bhairab Raj, "Is Nepal ready for organic farming?", My Republica, available at: https://myrepublica.nagariknetwork.com/news/is-nepal-ready-for-organic-farming/
[34] Organic Certification Nepal (OCN), "Organic Certification Nepal", available at: http://ocn.com.np/

A MoALD program is underway to digitize AICL and STCL distribution with the Fertilizer Management System. The platform will provide real-time information on the amount of chemical (subsidized) fertilizers distributed and to whom. It will facilitate stock availability and price information and provide information about all the fertilizer transactions. Potential exists for integration with other functions, including soil mapping and payments.

### 2.2.3. Machinery

The ability to access and use machinery can save farmers significant time and labor. With increased access to finance and increase in purchasing capacity of the farmers, the use of agricultural (agri)-machinery is on the rise. Table 1 shows usage trends across two decades of a broader selection of machinery[35] – some showing exponential growth.

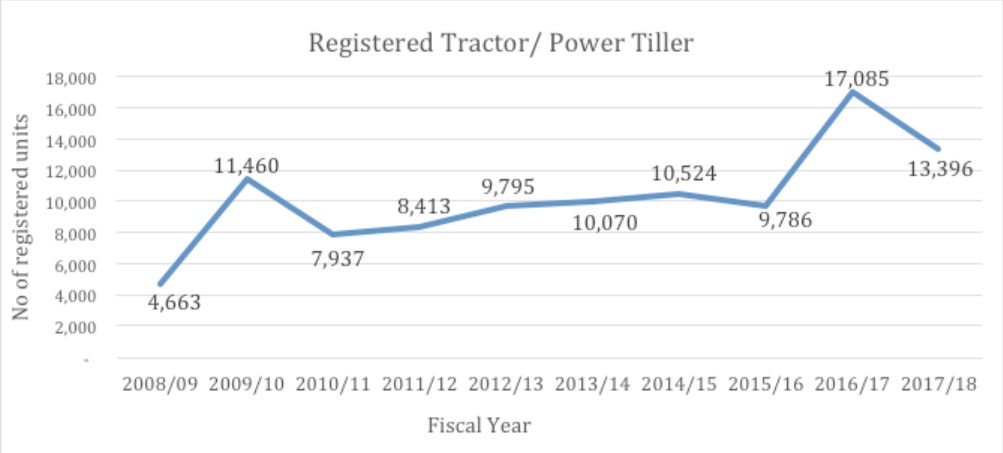
**Table 1. Changes in agri-machinery use from 1991/1992 to 2011/2012[36]**

| Type of equipment | # of agricultural holdings using equipment ('000) | | | Change 1991/1992 to 2011/2012 |
|---|---|---|---|---|
| | 1991/1992 | 2001/2002 | 2011/2012 | |
| Iron ploughs | 315.1 | 870.3 | 1073.4 | 240.7% |
| Power tillers | 5.6 | 15.6 | 75.7 | 1251.8% |
| Shallow tube wells | 50.9 | 119.7 | 367.7 | 622.4% |
| Deep tube wells | 20.1 | 58.6 | 159.7 | 694.5% |
| Rower pumps | 3.5 | 22.7 | 79.1 | 2160.0% |
| Tractors | 35.2 | 272.9 | 844.7 | 2299.7% |
| Threshers | 85.6 | 249.5 | 803.1 | 838.2% |
| Pumping sets | 81.1 | 210.4 | 548.2 | 576.0% |
| Animal drawn cart | 204.6 | 226.4 | 335.0 | 63.7% |
| Sprayers | 50.2 | 203.0 | 547.0 | 989.6% |

Table 1 shows growth in all types of equipment, though growth is slowest in the traditional, non-mechanized animal-drawn carts, while usage of most others has increased dramatically. Growth rates have been very high for mechanized machinery, especially tractors and power tillers, as seen in more detail in Graphic 3. Data is not included on mini tillers, which were added to machinery trader product lines in 2005/2006 and now have total annual sales of around 10,000;[37] their smaller size and ease of handling make them especially popular among women farmers.

[35] Some irrigation equipment is also categorized as machinery. Irrigation is discussed in the next section.
[36] Data from National Sample Census of Agriculture, CBS; available at http://www.un-csam.org/PPTa/1911RF7_ROK/28th/PDF/5.%20Country%20Presentation_Nepal_Mr.%20Basynat.pdf
[37] Nepal Agricultural Machinery Entrepreneurs' Association.

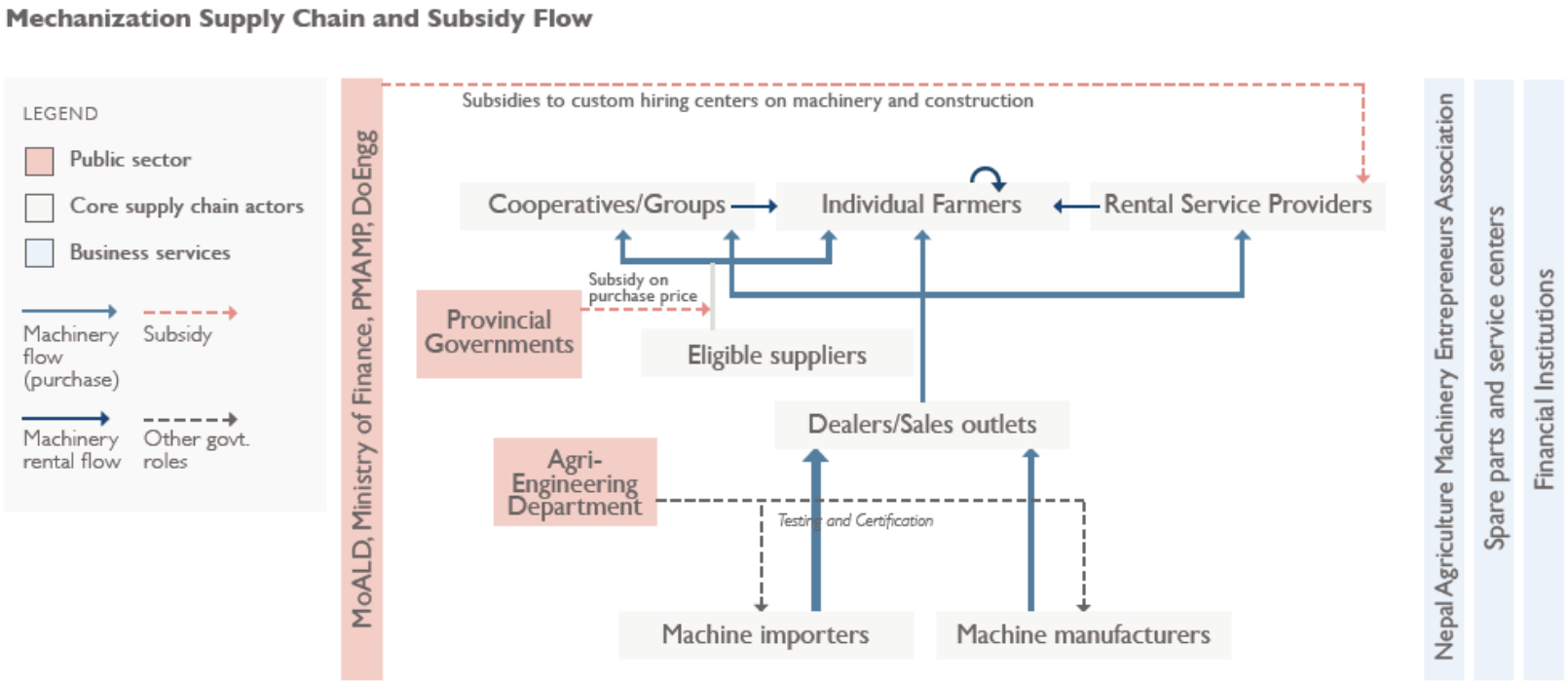
**Graphic 3. Registered tractors / power tillers**[38]




## a. Market system overview

[38] https://dotm.gov.np/MainData/OldStatistics

Graphic 4. Nepal's agricultural machinery market system



The agri-machinery market system has a short supply chain with involvement from limited actors as compared to other input systems, like seeds and fertilizers. The supply chain starts with two categories of actors: importers and manufacturers. Of the two, machine importers are the largest in terms of transaction volume. Nepalese machine manufacturers are small companies that tend to produce less heavy machinery, with operations confined to certain geographical locations. Dealers act as credit officers as well as sellers, as most of the machines and tools are sold on credit from the larger companies. Agri-machine producers, importers, and dealers have formed the Nepal Agriculture Machinery Entrepreneurs' Association for coordination and collaboration for promoting and commercializing agriculture through use of machinery. The end buyers are individual farmers and cooperatives/groups, with larger and more expensive machinery more likely to be shared among a group. Individual smallholders may rent such equipment, either from cooperatives or from larger-scale farmers.

The Government of Nepal regulates and supports this sector. The Agricultural Engineering Department under NARC tests, certifies, and promotes subsidies of agri-machines. The government has a minimal tax rate for agri-machinery imports (1 percent to 5 percent) and provides several subsidies, as discussed in Section 3.1.4. To support smallholder demand for machine rentals, the Government of Nepal had planned to import equipment to be distributed to municipality hiring centers; however, this vision has not yet been implemented.

Several donor-funded projects collaborate with manufacturers, suppliers and farmers for promotion and increased use of machines at the farm level. For example, the Cereal Systems Initiative for South Asia (CSISA) initiative engages private sector suppliers and the Nepal Agricultural Machinery Entrepreneurs' Association and networks of machinery importers, traders, and dealers to ensure availability of machines by increasing stocks at the local level.

Because most farmers in Nepal are smallholders with modest size plots, it is not economically efficient for many individual farmers to purchase their own machinery – especially the more expensive tools. Shared ownership and rental models can offer efficient solutions. Some cooperatives and farmers groups share machinery among their members and may rent them out to others. Larger-scale farmers may also rent out machinery when not in use. Custom Hiring Centers (CHCs) are a subsidized model that the Government of Nepal has promoted in recent years. CHCs are private-sector led but benefit from significant government support that allows them to rent machinery at below-market prices. As of late 2018, 40 CHCs were operational, with many more in the process of establishment.[39] CHC subsidies are described further in Section 3.1.4.

### b. Challenges

**Credit management.** As most of the machines and tools are supplied on credit, the machine suppliers report a huge challenge in credit recovery. There are issues related to timely payment from machine dealers who do not have their own investment capital in the business and lack financial discipline, using money for other purposes.

**Limited coordination.** Private sector actors operate in their own capacity, with limited coordination with the public sector.

[39] Mr. Surya Prasad Paudel, MoALD Director General, Presentation at the 6th Regional Forum for Sustainable Agricultural Mechanization in Asia and the Pacific, 25 October 2018; available at http://www.un-csam.org/ppta/201810RF/Session1/4.%20Nepal.pdf

**A one-size-fits-all approach.** Almost all agricultural tools come from abroad and are not necessarily optimized in accordance with the specific needs of a particular location's landscape and topography.

**Difficulties in acquiring new clients.** Machinery sellers report that the user acquisition cost is high, while also observing a trend that many farmers hold out on machinery purchases until they can acquire a subsidy.

**Limited access to repair and maintenance services.** Business support services like repair and maintenance of machines are not easily accessible to farmers in some locations. Technicians are generally based at regional centers, while there is need at more local levels. It is expected that improved access to repair and maintenance would further popularize machine use at the farm level.

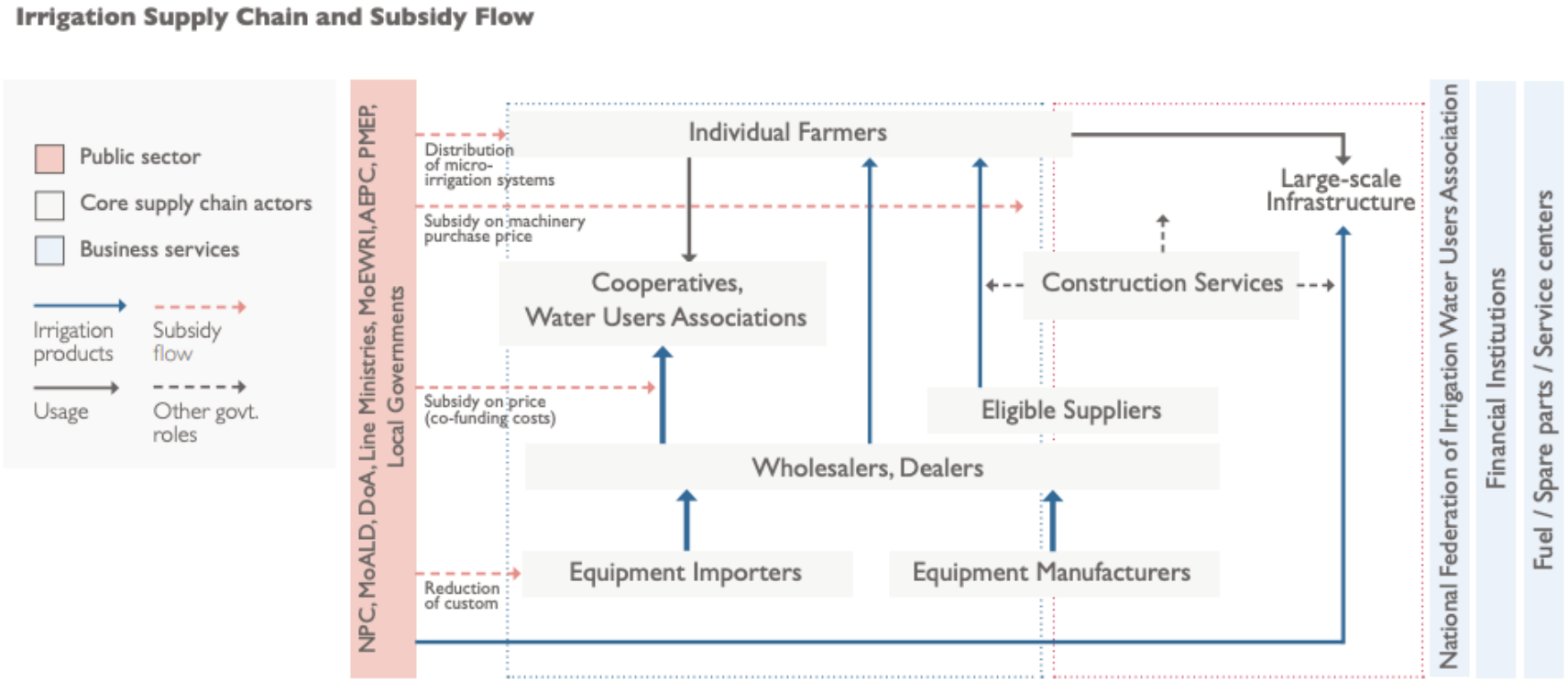
#### c. Digital overview

The strongest opportunities for digital solutions may be in the machinery rental market. A rental application with a vehicle tracking component would connect machinery owners with those who would like to hire and help owners to track their assets.

### 2.2.4. Irrigation

#### a. Market system overview

Graphic 5. Nepal's irrigation market system



In Nepal, less than 50 percent of the 2.64 million ha of cultivable land has access to irrigation.[40] Nepal is relatively rich in water but faces geophysical challenges posed by the mountainous terrain. While surface irrigation systems are common in the Terai, year-round irrigation is challenging, as water sources usually dry up in summer and winter. Consequently, only 17 percent of overall cultivated land is irrigated during the dry seasons.[41] Expensive energy (diesel or electricity) costs limit farmers' ability to pump groundwater. The Government of Nepal started promoting non-conventional irrigation systems (e.g., pond, rainwater harvesting, drip, sprinkler, paddle pump) along with surface and groundwater irrigation systems. These small irrigation systems have potential to increase the amount of land irrigated during the dry season and increase production on each irrigated hectare. There has been a large increase in use of pumps, particularly in Terai.[42] Low-cost drip systems and sprinkler irrigation are used mostly for vegetable cultivation and protected agriculture.

Compared to other agriculture inputs, irrigation is often a shared good; it is less a standalone *product* and more a *system*, dependent on external factors like water availability. Collective ownership and management are the norm. A diverse array of equipment makes up irrigation systems – from sprinklers to massive dams.

Surface water irrigation systems are categorized as farmer-managed irrigation systems (FMIS) or agency-managed irrigation systems (AMIS). Most irrigated land in Nepal gets water through FMIS, built based on farmers' demand and administered through a Water Users' Association as per the Irrigation Policy guidelines. FMIS tend to be traditional methods that use gravity distributional systems to divert water through open canals from permanent and seasonal water sources (e.g., rivers and streams). AMIS, in contrast, are big irrigation projects that are centrally managed and use heavier infrastructure.

The Department of Irrigation (DoI) under the Ministry of Energy, Water Resources and Irrigation (MEWRI) and the Department of Local Infrastructure Development and Agriculture Roads under the Ministry of Local Development (MoLD) are in charge of most large irrigation projects — such as surface irrigation systems, ground water, lift irrigation systems, and deep tube wells — including their operation, construction, and maintenance.[43] The Department of Agriculture (DoA) under MoALD has been given responsibility for smaller FMIS and non-conventional irrigation systems, including drip, pond irrigation, rainwater harvesting, treadle pumps, electric pumps, and sprinklers. DoA's province-level offices facilitate and monitor commercialized agriculture irrigation systems, including high-tech tunnels, solar irrigation, and lift irrigation; small irrigation systems like irrigation canals and pumps are under the purview of the local-level government structures (e.g., AKC, Village Development Committees [VDCs], and District Development Committees [DDCs]). For small FMIS, cooperative members contribute labor to the project, while multiple local-level government bodies may provide co-funding.

Some international NGOs (INGOs; e.g., iDE) and NGOs (e.g., Support Activities for Poor Producers of Nepal [SAPPROS]) are actively involved in development and promotion of micro/small irrigation systems. Several donor agencies — including Agricultural Development Bank Ltd. Nepal (formerly ADBL), the

[40] ADB, 2018.
[41] Poudel, K., Sharma, S., Small Irrigation Systems in Nepal: An Analytical preview from Irrigated Agricultural Development Perspective of Batch I Irrigation Sub-projects under Community Managed Irrigated Agriculture Sector Project, 2012, available at: https://www.researchgate.net/publication/267509584_Small_Irrigation_Systems_in_Nepal_An_Analytical_preview_from_Irrigated_Agricultural_Development_Perspective_of_Batch_I_Irrigation_Sub-projects_under_Community_Managed_Irrigated_Agriculture_Sector_Proj
[42] Takeshima and Bhattarai, 2017.
[43] Pradhan and Belbase, 2018.

World Bank, USAID, and UK Aid — have invested regularly in irrigation projects. Since 1970, ADBL has had a prominent role in creating irrigation facilities (shallow tube wells, rower and treadle pumps, artesian wells, etc.) through government subsidy programs. NARC and a few educational institutes (e.g., Institute of Agriculture and Animal Sciences, Institute of Engineering) are important players contributing to research and development to enhance irrigation system performance. Several private companies (e.g., Nepal Krishi Company, BTL Pvt. Ltd., and Nepal Thopa Sichai) provide irrigation solutions and technologies (e.g., solar irrigation, drip, sprinkler, and pond plastic). However, distributors of these irrigation technologies are small and primarily located in district capitals and major regional cities; their marketing is passive, with little to no investment in promoting products or providing technical support to customers.[44]

iDE is promoting a multiple-use water system (MUS) in a partnership model among local government agencies, Water Users' Associations, and farmer groups.[45] The project pays around 50 percent of the cost, with the remainder coming from other sources, including VDCs, AKC, and DDCs; local forestry offices; forest user groups; and MPs Level Development Partnership ProgramFund (Samsad Bikash Kosh). Local Initiatives for Biodiversity, Research and Development (LI-BIRD) piloted a solar irrigation system in a few western districts, with 75 percent of the funding coming from the project; farmers secured 25 percent of the funding through local government.[46]

### b. Challenges

**Non-resilient irrigation systems.** Both the FMIS and AMIS regularly suffer from water shortages and flood damage. A lack of financial resources limits regular maintenance and repair.[47]

**Varying quality of imported irrigation systems.** Drip systems produced within Nepal are still very rudimentary, whereas the imported systems (e.g., from Hazel Azud, Netafim) are technically superior and more efficient. However, there are concerns over the quality of some imported irrigation pumps. Several stakeholders see Chinese pumps as having lower quality and less durability as compared to pumps from India; however, many importers and distributors prefer them because of their lower cost. As the technical specifications of these products are not monitored or presented to buyers, farmers may select cheap but inferior systems. Most of the systems are not optimized based on specific local needs (e.g., climate and topography).

**Lack of repair infrastructure.** Most of the non-conventional irrigation systems (e.g., drip, irrigation pumps) are imported and lack a local support system of knowledgeable repair and maintenance services.

**Coordination between and within government ministries.** With several ministries involved in the irrigation sector (e.g., MoALD, MEWRI), coordination presents challenges, particularly due to a weak link

[44] iDE, 2019.
[45] iDE Nepal, "Multiple Use Water System (MUS)", 2020, available at: https://www.idenepal.org/Mus.html.
[46] LI-BIRD, "Solar based Irrigation System: A boon to farmers in enhancing their livelihood, resilience and adaptive capacities", 2019, available at: http://www.libird.org/app/news/view.aspx?record_id=72
[47] World Bank, "Nepal: Irrigation and Water Resource Management", 2014, available at: https://www.worldbank.org/en/results/2014/04/11/nepal-irrigation-and-water-resource-management#:~:text=Some%20of%20the%20key%20challenges,weak%20institutional%20capacity%3B%20weak%20linkages

between agriculture and irrigation activities.[48,49] Even within a single ministry (e.g., MoALD) there are three layers of government (central, regional, and local) and they usually work independently. For this reason, irrigation activities are not well coordinated but rather planned on an ad-hoc basis, resulting in inefficiencies and repetition.

**Agriculture credit.** Financial institutions and banks mostly finance large expenditures, while very little credit goes to smaller investments like micro-irrigation systems.[50]

#### c. Digital overview

A pay-as-you-go solar pumps solution links the provision of SunFarmer's irrigation infrastructure with digital financial services provided by Prabhu, with its vast rural network. The United Nations Capital Development Fund (UNCDF) has supported the solution, which is expected to be part of a broader, community-owned contract farming model driven by digital innovations.[51] Sensors offer significant potential toward smart irrigation; when connected with communications systems, they can enable farmers to make more accurate decisions about when to water crops, reducing water wastage.

## 2.3. Digital potential for input market system

### 2.3.1. Digital access and use among Nepalis

Nepal's digital infrastructure and usage have been advancing rapidly, but limitations remain, especially at the last mile. Globally, Nepal is assessed to be in the bottom quarter of countries in terms of connectivity.[52] It is estimated that 95 percent of Nepalis now live in the range of a mobile tower. Like the population, network access is concentrated in the southern two-thirds of the country, while access is still extremely limited in the north, which is mountainous but also contains farmland. Graphic 6 shows the network coverage of NCell (in purple), which is the most extensive in the country.

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[48] World Bank, "Nepal: Irrigation and Water Resource Management", 2014, available at: https://www.worldbank.org/en/results/2014/04/11/nepal-irrigation-and-water-resource-management#:~:text=Some%20of%20the%20key%20challenges,weak%20institutional%20capacity%3B%20weak%20linkages

[49] Pradhan, P., "External Challenges in Irrigation sector in Nepal: Benefit sharing between Hydropower and Irrigation in Nepal", 2018, available at: https://prachandashare.wordpress.com/2018/03/05/external-challenges-in-irrigation-sector-in-nepal-benefit-sharing-between-hydropower-and-irrigation-in-nepal/

[50] Bhairab Raj Kaini, "Five policies for agriculture," *Republica,* 6 June 2020.

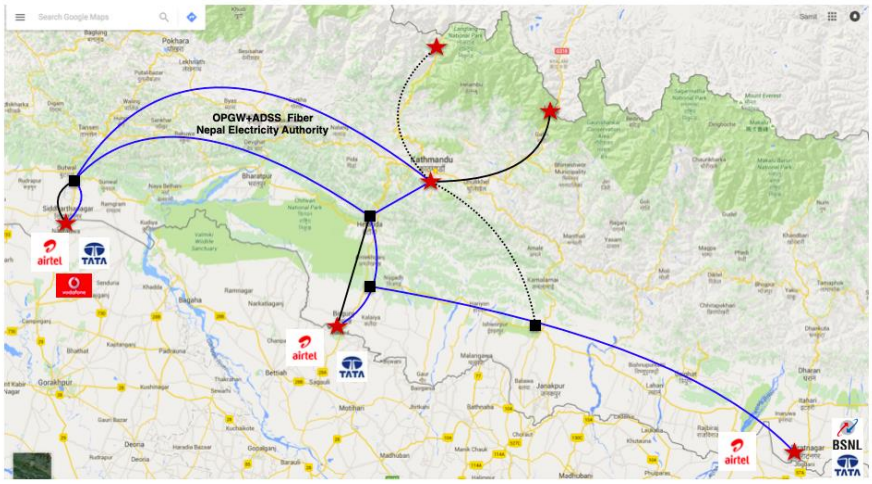
[51] UNCDF, "UNCDF-MM4P, SunFarmer and Prabhu Partner to transform agriculture in Nepal with digital technology," 11 April 2018, available at: https://www.uncdf.org/article/3493/uncdf-mm4p-sunfarmer-and-prabhu-partner-to-transform-agriculture-in-nepal-with-digital-technology

[52] ITU, GSMA, and World Economic Forum in DAI research for USAID/Nepal Digital Ecosystem Country Assessment, Spring 2020.

**Graphic 6. Map of NCell Mobile Network Coverage[53]**


Internet speeds are significantly lower in rural areas as compared to urban.[54] As is normal with all telecommunications infrastructure, the majority of fiber optic cable infrastructure exists in urban centers, primarily Kathmandu. Nepal is landlocked and has no direct access to submarine cables, meaning internet service providers (ISPs) must purchase bandwidth mainly from India and China wholesale. Currently only four ISPs manage the international connectivity gateways, which may be too few, leading to less competition and higher costs for Nepalese citizens. The following map shows entry points for fiber cable and the primary fiber backbone for Nepal[55].

**Graphic 7. Map of Primary Fiber Backbone for Nepal**




[53] "Network Coverage Maps", available at: https://www.gsma.com/coverage/#788.
[54] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018, available at: https://lirneasia.net/wp-content/uploads/2018/10/LIRNEasia-AfterAccess-ICT-access-and-use-in-Nepal-and-the-Global-South.pdf
[55] Jana, Samit, "Internet Backbone Infrastructure in Nepal", available at: https://sanog.org/resources/sanog27/SANOG-Conference_Internet_Backbone_Infrastructure_of_Nepal.pdf

While the ISP Worldlink made an announcement they would bring 10,000 residential fiber-to-the-home connections into Nepal, this type of internet access is not relevant to rural farmers.[56] Mobile broadband will be the primary source for Nepalese farmers to access digital agriculture services. As it stands, Nepal's mobile backhaul infrastructure will not likely be sufficient to meet the growing demand for mobile broadband. There should be a focus on funding initiatives like the Rural Telecommunications Development Fund to support the build out of fiber backhaul networks where topography allows. Mobile backhaul networks connect mobile tower sites to wireline networks that move information to data centers. Improving the backhaul infrastructure in rural areas by providing access to fiber wirelines will improve the quality of mobile broadband.[57]

Mobile phones are prolific in Nepal, outnumbering the total population. Mobile penetration, which measures the number of active SIM cards vs. population, is 151 percent,[58] though the unique subscriber rate is a more modest 55 percent.[59] Rural Nepalis are 15 percent less likely than urban residents to own a mobile phone, with only 65 percent of rural adults owning a phone.[60] Forty percent of mobiles in Nepal are basic phones,[61] while about half of Nepalis use smartphones to access the internet;[62] however, smartphone usage is much lower in lower-income, rural areas. Internet penetration stood at 35 percent — or 10 million people — in January 2020;[63] internet usage is 32 percent lower in rural areas compared to urban areas, and 84 percent lower among those without secondary education.[64]

Smartphones are used primarily for social media and entertainment. The number of social media users is roughly equal to the number of internet users.[65] Projects that distributed smartphones to farmers so they could benefit from AgTech have found that farmers do not use the phones for their intended purpose. Because farmers tend to have low levels of digital literacy, tech firms have found that they may not fully utilize AgTech tools. At the same time, as use of digital technology increases and expands for social connections — especially during the COVID-19 pandemic — improved confidence in and ability to use digital tools might also expand.

Nepali women are 19 percent less likely than men to own a mobile phone.[66] Among farming households, it has been observed that females in the family may get smartphones only after males buy a new handset and give them their old one. In 2018, 41 percent of Nepali men used the internet, as compared to 27 percent of women.[67]

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[56] Lightwave, "WorldLink brings 100-Gbps fiber-optic network capabilities to Napal", available at: https://www.lightwaveonline.com/network-design/high-speed-networks/article/16673847/worldlink-brings-100gbps-fiberoptic-network-capabilities-to-nepal
[57] ITU, "Wireless broadband masterplan for the Federal Democratic Republic of Nepal", available at: http://www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/WBB_MasterPlan_Nepal.pdf
[58] Number of SIM cards divided by population; GSMA, 2020, available at: https://www.mobileconnectivityindex.com/#year=2019&zoneIsocode=NPL
[59] GSMA Intelligence through DAI research for USAID/Nepal Digital Ecosystem Country Assessment, Spring 2020. (Proprietary source not for public distribution.)
[60] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018.
[61] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018.
[62] Prahlad Rijal, "Half of Nepal's population use smartphones to access the internet," *The Kathmandu Post,* 11 July 2019.
[63] Kepios, "Digital 2020: Nepal", available at: https://datareportal.com/reports/digital-2020-nepal
[64] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018.
[65] Kepios, "Digital 2020: Nepal", available at: https://datareportal.com/reports/digital-2020-nepal
[66] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018.
[67] After Access and LIRNEasia, "ICT access and use in Nepal and the Global South," 4 October 2018.

Beyond geography, education level, and gender, other factors create differences in digital access and use. Network coverage and cost of handsets and data are the most obvious constraints to digital access, creating a "digital divide" between those with and without access, while an in-between population has access to mobile phones and basic network but does not regularly use the internet. Usage numbers are also affected by personal decisions to opt in (or not) to digital engagement – a choice influenced by perceptions of the relevance, value, and security of digital use, as well as personal confidence and skills in using digital tools like mobile phones.

### 2.3.2. Agtech landscape

#### a. Landscape overview

Nepali-grown solutions populate Nepal's AgTech landscape, in addition to solutions from other countries. Some digital tools are developed inside a single organization, whereas others are built or adapted across teams of stakeholders. Common developers and co-developers of AgTech solutions include technology companies, private agribusinesses, financial service providers, government agencies, donor-funded and social enterprise NGOs, and scientists.

The country's tech startup landscape is nascent but vibrant; many entrepreneurs are attempting to enter the market, and a few have succeeded to reach scale.[68] Overall, the tech sector has limited human resources upon which to draw; only 20 percent of graduates from computer science and information and communications technology (ICT)-related courses in Nepal stay in-country, as software developers can make more than twice local salaries elsewhere in the region.[69] Nonetheless, employment in IT services is growing 15 percent to 20 percent annually.

#### b. Types of AgTech in use

Many types of AgTech solutions have been adopted and developed in Nepal. The below list of common types of AgTech contains examples of solutions used in Nepal.

**Information services.** Traditional media still play a role in growing smallholder farmer knowledge at scale, with radio and television programs (e.g., Krishi FM, Krishi TV). General agricultural recommendations and announcements are also made via short message service (SMS) and interactive voice response (IVR) systems (e.g., Viamo[70]). Online training (e.g., Shreenagar Agro Farm, Smart Krishi) has increased during the COVID-19 pandemic. Other solutions enable location- or farmer-specific recommendations — from weather forecasts to digital soil maps, to photo queries that returned customized advice (e.g., NSAF/ Plantix, Krishi Guru) — all of which can support precision agriculture.

**Tracing.** AgriClear is a blockchain-based traceability solution for sharing information on food sources and their production process. The solution allows customers to scan labels with smartphones to access detailed information on the item's supply chain, seed plantation, fertilizers used, harvesting process, and origin. Smart devices can strengthen

[68] DAI research for USAID/Nepal Digital Ecosystem Country Assessment, Spring 2020.
[69] World Bank Group / International Finance Corporation, *Creating Markets in Nepal: Private Sector Diagnostic,* November 2018, available at: https://www.ifc.org/wps/wcm/connect/cf66e8dc-f7c0-42b9-80ef-fc13920f89dd/CPSD_Nepal_Oct18_2_Web.pdf?MOD=AJPERES&CVID=msllQer
[70] Previously known as VotoMobile.

traceability, such as for maintaining quality control during storage and transport by monitoring temperature and moisture. Beyond tracing food products, the advent of vehicle tracking can support agricultural input distribution as well as equipment hire. The Government of Nepal's digital Vehicle and Consignment Tracking System, linked with the Department of Customs, is intended to support buyers with the up-to-date location of their cargo and decrease smuggling.[71]

**Market connections.** From inputs to farm produce, multiple platforms based on advisory services have integrated buyer and seller connections. Viamo and CIMMYT developed a market linkage tool that integrates with Viamo's IVR service; registered farmers and buyers — matched based on product supply/demand, geography, and price — contact each other to negotiate.[72] Krishi Guru built an input shopping feature into their advisory-focused app; input sellers pay a small fee to participate. Currently under development, Krishi Bajar will allow farmers and input sellers from across the country to transact directly on its virtual marketplace, where farmers can order inputs such as machinery[73] using digital payments.

**Management information systems**. Nepal Krishi Company has developed a database of farmers, including the geographic information system (GIS) location of their homes and agricultural fields, dedicated rice plot, and so on. They have a web portal, titled Agri-digital, where the farmers can log in and share their needs. The main reason for maintaining the database is to identify the farmers who are involved with the company. By maintaining the database, the company makes a projection of required inputs and plans for production in line with their target. It also helps them to monitor farmer activities and plots whenever needed. The Kisan ID is expected to include information like landholding, cultivable land, production, livestock, and other sources of income and expenditure. Some of this information will be challenging to manage and update.

**Financial services.** Digital payments solutions are popular – most immediately for remittances (e.g., Prabhu Pay), though mobile money has started to enable digital supply-chain transactions. Nevertheless, the limited transaction amounts allowed through mobile money payment gateways[74] deter some supply chain actors from integrating them into their business. Some platforms have developed solutions to support farmer lending in the absence of credit histories, and may use artificial intelligence (AI) to determine credit worthiness and approve loans (e.g., eDheba iPay). The Kisan Card is a prominent emerging solution for farmers (see textbox). Because primary access to finance for many Nepalis occurs through financial cooperatives, AgTech administrators may engage

[71] *Nepal 24 Hours,* "Nepal Begins Vehicle and Consignment Tracking System," 17 July 2019, available at: https://nepal24hours.com/nepal-begins-vehicle-and-consignment-tracking-system/

[72] Initial data from the tool showed that 50 percent of the transactions made through the matches resulted in higher profit for the farmer, while 76 percent of participating buyers reported higher profits from using it. (Sources: Viamo, "Creating Sustainable Market Linkages Via Mobile", available at: https://viamo.io/newsletter-archives/sustainable-market-linkages/; CGIAR, "Connecting farmers to better information in Nepal", available at: https://www.cgiar.org/food-security-impact/photo_stories/connecting-farmers-to-better-information-in-nepal/).

[73] http://krishibajar.com/

[74] The central bank, Nepal Rastra Bank regulates the transaction limits. Amid the COVID-19 pandemic, the Bank raised the limits in March 2020. (Source: Tech Sathi, "Nepal Rastra Bank Increases Limits On Digital Transactions in The Wake of COVID-19", available at: https://techsathi.com/nepal-rastra-bank-increases-limits-on-digital-transactions).

cooperatives and merchants as key users, while working to digitize their records and integrate their systems.

**Kisan Card**

Tech firm R&D Innovations developed the **Kisan Card** in collaboration with banks to facilitate subsidized loans to farmers. The bank disburses the subsidized loan against simple documentation and has no charges or processing fees. The farm does not even need to be registered (an individual's permanent account number [PAN] is accepted). Personal profiles of the listed farmers and vendors are stored in the quick response (QR) code of the card. To date, Mega Bank has launched this solution with Mega Kisan Card.

### c. AgTech learnings in Nepal

Developers of AgTech solutions reported the below learnings.

**Need to plan for limited digital literacy.** The most frequently cited challenge for rolling out AgTech solutions was the limited ability of farming populations to use digital tools. Initiatives have had to allocate more manpower than they expected to help farmers and cooperatives with successful uptake. Another adaptation is to integrate the Facebook chat box, a user interface that is better known and used.

**Maintaining a digital platform requires ongoing work.** Some AgTech developers have been surprised by the amount of work needed after the launch to address bugs and regularly make updates.

**Need to improve identity verification.** The use of fake names may not pose a significant problem on some platforms, but accurate identification is critical on others, such as those dealing with finance. As a result, solutions have been developed that scan government IDs or use facial recognition.

**Seed funding too early.** Having seen a high proportion of tech projects abandoned after receiving seed money, a funder-supporter of emerging tech changed strategy to provide funding later in the development phase, once founders had more at stake.[75]

## 2.3.3. Potential for market-wide solutions

Data is fast emerging as a driving force for economic growth and social progress. A quality source of data and a clear packaging of that information into a database that enables data-driven decision making are the most important elements of any digital agriculture solution, whether it be a management information system, digital payment product, or weather information service. Information on farmer plot size, location, phone number, ID, types of inputs used, soil tests, and many other data points can help reduce asymmetric information and enable smallholders to access a wide range of services that were previously out of reach.

A common issue with data, especially in markets with relatively nascent digital economies, is that datasets are often incomplete, not standardized, and spread across many different actors. This issue leads to different information existing on different platforms, with no ability for collaboration or aggregation of data sources. Agricultural data in Nepal currently resides in a variety of silos within a variety of government stakeholders (e.g., NARC, STCL) and private stakeholders (e.g., seed entrepreneurs).

[75] Some of the tech projects were agriculture-focused. Microsoft Innovation Center.

Cooperatives, which have great potential for aggregation of data on member farmers, often keep important data in paper ledgers or lack any type of record keeping at all. A crucial first step in tapping the potential of data-driven agriculture in Nepal will be to improve the quality and interoperability of agricultural datasets across the various input market system stakeholders. The below table provides a high-level overview of the different types of data sources and data across the input market system in Nepal.

**Table 2. Examples of Key Data Sources Across the Nepalese Input Market System**

| Input Area | Data Source | Data Description |
|---|---|---|
| Seed | DESIS Platform (via NARC, SQCC, seed producers); AKC | Data on seed variety demand by municipality, data on seed catalog, data on seed distribution, subsidy data |
| Fertilizer | STC, AICL, agrovets, cooperatives | Fertilizer distribution, fertilizer costs, subsidy data |
| Seed, Fertilizer, Irrigation, Machinery | MoALD, AKC, line ministries | Distribution data, supply data, subsidy data |
| Seed, Fertilizer, Irrigation, Machinery | Cooperatives and agrovets | Fertilizer purchase/distribution by farmer, seed purchase/ distribution by farmer, subsidy data, irrigation distribution data, mechanization usage |
| Irrigation | Solar pump companies | Irrigation pump usage |

The following section explores three digital trends that have implications for all four input areas, and provides key digital building blocks that can unlock digital transformation for the agricultural sector in Nepal.

### a. Digital identification

The ultimate database is a country's identification system, where a variety of key data points associated with a fixed and verifiable identity can sit. In India, the government has rolled out the largest digital ID system in the world, recording more than 1 billion biometrically enabled digital IDs under the Adhar program. Having a strong ID system can unlock potential for many digital services. As of now, MoALD does not have a comprehensive database for Nepal's farmers, which makes digitizing agricultural services difficult. To remedy this problem, MoALD is working with the European Union (EU) to roll out a digital ID for farmers in Nepal called the Kisan ID. While this type of sector-specific ID system cannot replace the value of a good national ID system, it has the potential to become a key enabler for digitization in the Nepalese agriculture sector, including the inputs market system. The EU is currently providing technical support to MoALD in the design of system requirements that include the digital data collection tools for registration, verification, and authentication services, as well as key details around data backup, contingency planning, and data security/protection.

Being able to register for the Kisan ID will strengthen the ability of farmers in Nepal to participate in the digital economy. With a single identification for farmers, a variety of other platforms can associate the farmer with that specific ID number, as data that exists in a variety of places can have an identifier that links back to a single farmer. The ID will be a crucial factor in the government's ability to digitize subsidies, making the application and fulfillment processes more efficient and reducing potential for fraud. Having an ID that financial service providers accept will open up access to digital wallets and bank accounts that were previously out of reach, as they could not provide requisite 'Know Your Customer' information. The ID will also enable digital agriculture services linking farmers to input providers (seed, fertilizer, irrigation, machinery) to identify and manage customers more easily. Platforms such as DESIS, GeoKrishi, and other digital agriculture services can use ID numbers to ensure a farmer's data can be linked to a single identity source, which has the potential to empower a farmer to access and aggregate their data when it exists across various platforms.

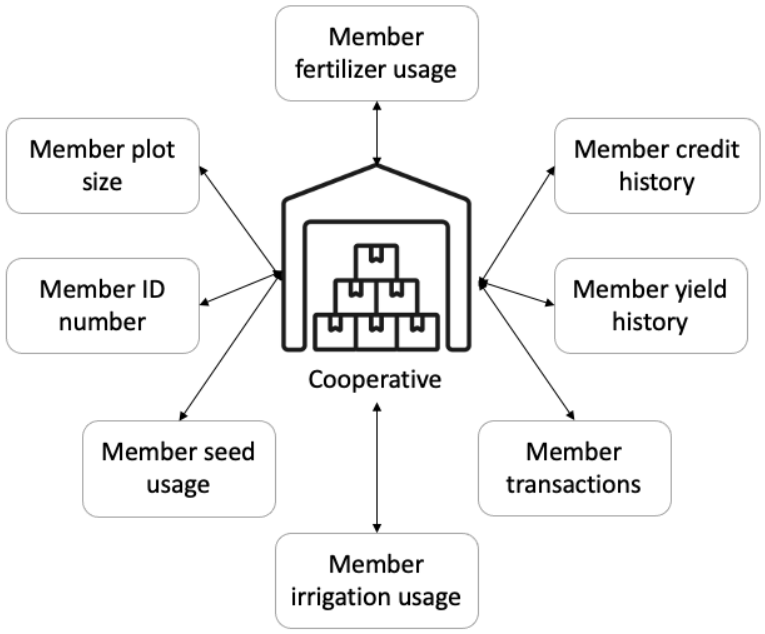
As of January 2021, rollout of KISAN ID has commenced, as final approvals are pending. MoALD has commenced provincial-level KISAN ID orientation and training; provincial ministries will train the municipal level. More than NPR 300 million has been allocated for KISAN ID implementation. MoALD is awaiting approval of the implementation plan from the Prime Minister's Cabinet before formally launching.

While details on how data will be protected and how Kisan IDs will be rolled out are still pending, the solution has the potential to become the largest enabler for digital transformation and expansion of digital agriculture services in Nepal. All future USAID activities that seek to identify and deliver digital services to farmers should consider how they can ensure that the Kisan ID plays a central role in verifying a farmer's identity. Doing so will provide a pathway to more organized and actionable data that will benefit farmers' access to inputs in Nepal.

### b. Digitizing cooperatives and agrovet retailers

Agricultural cooperatives and agrovets play a key role in aggregating and delivering services to farmers in Nepal. Based on our analysis, they are the most important element in the digital transformation process for the inputs market system, serving as gatekeepers to most of the information on smallholder farmers. As shown above in Table 2, cooperatives and agrovets are a point of aggregation for most inputs that reach smallholder farmers; they are a common gateway for farmers' access to seed, fertilizer, some irrigation projects and equipment, and some machinery. While many Feed the Future activities and other development programs have focused on building cooperative and agrovet capacity in inventory management, warehouse management, and bookkeeping, there has been little capacity building on digitizing their manual processes. Digitizing these information gatekeepers' internal processes around input distribution and other parts of their work could significantly improve the availability of farmer data in Nepal. Graphic 8 examines the different types of data points that cooperatives likely already collect in paper form for farmers.

**Graphic 8. Typical information collected by agricultural cooperatives**




Digitizing cooperatives and agrovets could help bring valuable data already being collected onto a more formal and organized platform. This data can be used to streamline processes, such as informing demand forecasting for seed and fertilizer, accessing new credit products based on alternative data sets, and aggregating demand for irrigation and mechanization services. While the potential is high for the broader ecosystem, cooperatives and agrovets must see a value proposition for digitizing their manual record keeping systems. Three value propositions usually incentivize digital transformation for cooperatives and agrovets: 1) the potential for additional grant funding based on better record keeping and the ability to provide clean datasets on members; 2) the potential for expanded access to credit; and 3) a reduction in operational costs. While these incentives provide some value proposition, they do not always overcome a variety of negative incentives that cooperatives and their members face, like the potential for more taxation, a reduced opportunity for profitable informal transactions (leakage), and additional costs.

In Nepal, we found very few initiatives that focused on the digital transformation of agricultural cooperatives and agrovets. UNCDF has been working with 20 dairy value chain cooperatives to help them move away from cash, toward digital payments for their farmers. To do this, they first had to digitize the milk ledger bookkeeping system that participating cooperatives used. They worked with Prabhu Management Ltd., a digital wallet provider, to design the digital ledger that allows cooperatives to capture a farmer's milk delivery onto a cloud-based database. This step allowed the cooperatives to then integrate with Prabhu Pay, the digital payment product of Prabhu Management. The pilot has 20 cooperatives who have digitized their milk ledgers and are now making payments to more than 1,500 dairy farmers, with an additional 3,500 farmers registered but not yet using their wallets to receive payment. UNCDF's next steps will be to partner with a firm that specializes in developing digital credit products, and to provide support in the roll-out of a digital credit product based on farmer transactional data. Eventually, if farmers become more comfortable with digital payment, they may start using their digital wallets to reserve and make payments for the procurement of inputs.

Building digital capacity and literacy at the cooperative and agrovet level is one of the most crucial building blocks for digital transformation. Improving the way these actors process and record information will contribute to a wide variety of data needs across the agricultural market system. Cooperatives and agrovets are also a crucial stakeholder in helping establish more trust in digital solutions at the farm level. They have strong relationships with farmers and can provide trusted guidance around digital solutions that will be better received than the same guidance from a technology company or central government.

### c. Digital payments

Like many places around the world, Nepal is still a cash-first economy, with 95 percent of all transactions occurring in cash. Access to formal financial services in Nepal is at around 45 percent, which is lower than neighbors India (80 percent), China (80 percent), and Bangladesh (50 percent). Digital payment usage is even lower; as of 2017, only 16 percent of the population had made a digital payment (WB Findex, 2017). The Government of Nepal has enacted a variety of regulatory changes meant to incentivize the digital payments sector. First, they provided a regulatory framework and licensing procedure for non-bank institutions to offer e-money (digital money) services, which allows them to give customers a prepaid digital wallet and a network of agents to support different transactions, such as depositing and withdrawing funds from the system. Six mobile wallet providers compete for customers in Nepal within this framework, as shown in Table 3. Additional regulatory frameworks, such as the Payment and Settlement Act 2075, have provided additional clarity and stability in the digital payment space in Nepal.

**Table 3. Primary mobile wallet providers in Nepal**

| Name | Number of customers (registered) | Number of Agents | Specific Agricultural Services? |
|---|---|---|---|
| eSewa | 3.5 million | 80,000 | No |
| Prahbu Pay | 300,000+ (includes 100,000 farmers) | 16,000+ merchants (including 4,000+ cooperatives) | Yes[76] |
| IME Pay | 1 million+ | 25,000+ agent network. | No |
| Khalti | 1 million+ | 8,000 (point of sale [POS] and agent network) | No |

The most common transactions on Nepalese mobile wallets are airtime top-up and post-paid mobile bills.

The digital payments infrastructure in Nepal has yet to scale to a point where it is highly accessible to rural customers like farmers; active users are typically based in urban areas. According to the World Bank, Nepal is in the bottom five countries globally for the number of agents per 100,000 people – 5 agents per 100,000 people in 2017. A weak agent network makes the use of mobile wallets very difficult for poor rural customers who often depend on agents to navigate the services. Many of the service providers in the mobile wallet space provide their services either via web or smartphone; most mobile wallet providers in Nepal do not provide a strong user experience for customers without a smartphone.

[76] Payment system digitization and digitization of farmers' record system and accounts at their institutional level, working with UNCDF.

This means clients with basic phones likely depend more on agents, making agent infrastructure even more crucial to the success of mobile wallets among rural populations in Nepal.

It should be noted the above data on digital payments and financial inclusion comes from 2017. In this space there have been reports of more recent growth, especially in 2020. Digital payment providers in Nepal are reporting better-than-expected customer growth, mainly due to mobility restrictions associated with COVID-19. In addition, the central bank has lifted daily transaction limits on mobile wallets from an exceedingly small NPR 15,000 in May 2019 to NPR 100,000 at time of writing. As the mobile wallet ecosystem grows, there is more opportunity for the digital agriculture space to leverage digital payments to reduce operational costs and enable payment flows to new customers.

### d. Additional human networks that can support digitization

In addition to cooperatives and agrovets, other people working directly with farmers should be considered as potential partners in digital transformation. In Nepal, extension services are delivered through the government but suffer from a lack of resources. There is meant to be one extension agent per municipality, but this goal has yet to be achieved by the MoALD. iDE's country director estimated there to be 1 extension agent per 1,300 farmers, which makes it difficult to support farmers. Project-based extension services have supplemented government extension in Nepal, but they also lack numbers. iDE's community-based facilitator (CBF) model has attempted to establish sustainable means of income generation for a human network of extension agents that serve as sales agents for agrovets. CBFs work with agrovets to extend their sales reach into more rural communities and get a commission from those sales. iDE CBFs are also working with Muktinath Development Bank to serve as loan officers who receive a commission and small stipend from the bank to source new credit customers. iDE CBFs additionally work with insurance companies as sales agents. These human networks can be important bridges between the agrovets/cooperatives and farmers. They are also closer to communities and can serve as digital champions to increase farmers' trust in technology.

### e. Alignment with Digital Nepal Framework's Agriculture Focus

Led by the Ministry of Communication and Information Technology, the Government of Nepal has developed the Digital Nepal framework for growth through digital transformation. Agriculture is the first highlighted sector in the 2019 framework, which lays out initiatives in that sector focusing on 1) technology and infrastructure; 2) entrepreneurship and private/public partnerships; and 3) talent and skills development. Several areas of alignment between USAID Nepal's digital agriculture efforts and those of the Government of Nepal could be ripe for deepened impact through collaboration:

1) **The E-Haat Bazaar**, an online commodity-trading platform, seeks to better link farmers to markets. This product plans to deploy agricultural market information services to users. The DESIS platform, particularly the seed catalog, could be a good addition to this service.
2) **Precision agriculture** is an effort to improve the use of technologies, such as soil sensors and satellite imagery, to improve farm productivity. The NSAF activity has created a soil map that could contribute to the Government of Nepal's efforts to roll out more precision agriculture tools.
3) **Agricultural tools-sharing** involves more efficient use of farm machinery assets through a digital platform that can organize and enable activities such as tractor-sharing (similar to a ridesharing platform). India has several examples of services like this, but none exist in Nepal. The Government of Nepal's new Vehicle and Consignment Tracking System could potentially be leveraged and used on tractors, but this effort would require significant investment.

4) **Digital disbursement of subsidies** is another proposed effort. The DESIS system could eventually play a role in the digitization of subsidies, and the roll-out of the Kisan ID will be an integral step in enabling digital disbursements of subsidies.
5) **The Smart Irrigation Project** would involve deploying IoT sensors to measure factors such as humidity, temperature, and soil moisture – similar sensors to those deployed to support precision agriculture. These sensors would help suggest specific volumes of water for irrigation and increase the efficient use of water.

### 2.3.4. Seed

#### a. Key challenges in the seed sector

Section 2.2.1 above describes an array of challenges within the seed system in Nepal. While not every issue can be addressed by digitization, several challenges are already being addressed and could be addressed further by introducing digital solutions. Below is summary of those challenges within the seed system.

1) The existing manual seed forecasting system is cumbersome and presents major delays in forecasting demand, which results in constant misalignment between demand and supply of quality seeds for farmers and seed producers.
2) The multiple levels of intermediaries that exist between seed producers / importers and farmers reduce farmers' certainty around what they are getting and affect their ability to determine if those products are right for them.

Both challenges involve asymmetry of information, which leads to a lack of coordination between stakeholders. As is common with inputs in Nepal, many of the seed systems challenges result from a lack of transparency and clean data. The NSAF activity under USAID has recognized these issues and is working to digitize the seed system in Nepal.

#### b. Existing digital solutions

This section discusses the Digital Enabled Seed Information System (DESIS) currently in development.

NSAF, in collaboration with SQCC, has developed a digital seed management system to digitize demand and supply forecasting while providing a comprehensive seed catalog. The current demand and supply forecasting process can take up to a year to complete in Nepal, as SQCC and its data partners collect data manually. This timing leaves room for data entry error. DESIS has the potential to streamline many of the time-consuming manual data collection and entry processes through digitization, helping to accelerate forecasting such that there would be ample time to match supply with demand.

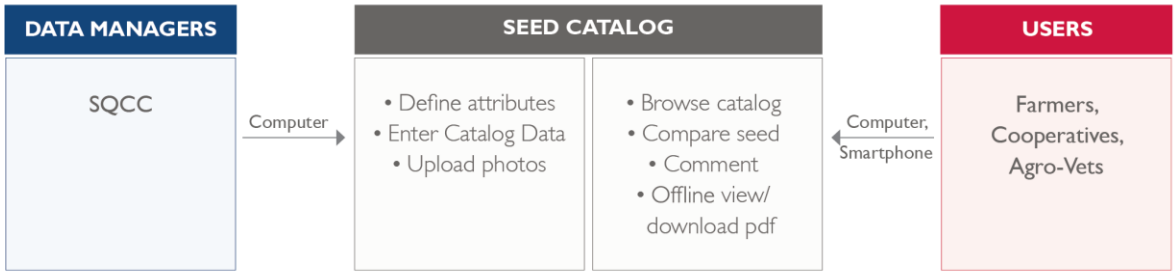
The minimum viable product being launched soon (there have been delays due to COVID-19 lockdowns) will include a digital seed balance sheet that supports demand/supply forecasting and a seed catalogue that enables cooperatives and farmers to browse the characteristics and sources of all registered varieties of available seed. Digital solutions often require a network of humans to run smoothly. DESIS is no different, as the same network of data collection stakeholders will need to fill out the digital seed balance sheet instead of the paper form. Data collection stakeholders are local AKCs, local wards and municipalities, agrovets, and cooperatives. Thoughtful incentives and training will be needed to support a smooth transition for the digitization of data collection. It is crucial that these stakeholders also have

access to the right hardware – mainly smartphones and tablets, as well as network connectivity. In addition, it may be necessary to incorporate some digital literacy instruction to drive digital transformation at the field level.

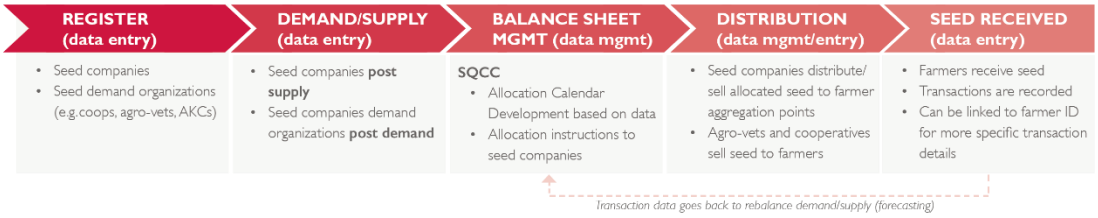
In addition to data collection stakeholders, DESIS will need to create a strong human network of data users. While data collectors support gathering information onto the system, aggregated and cleaned information must be disseminated to data users to make it actionable. Data users, such as agrovets, cooperatives, seed producers, and government entities, will also need training on how to use the system and operationalize the information available to them to support data-driven decisions on seed supply and sales. Outreach and ongoing support/feedback loops from data users should be built into the roll out of DESIS and should form part of SQCC's long-term scope.

This key interaction between these human networks and DESIS appears in Graphic 9. This data flow chart maps how information will be aggregated and fed into DESIS, as well as how information flows back out to users.

**Graphic 9. DESIS Information Flow Chart: Seed Catalog**




**Graphic 10. DESIS Information Flow Chart: Seed Balance Sheet**




While DESIS is launching, roll out should focus on the minimum viable products of the seed balance sheet and catalog. Training at the data entry points, such as cooperatives, agro-input dealers, and seed companies, is critical for the high quality of data that will drive the success of the platform.

### c. Potential digital solutions

While the minimum viable product for DESIS will focus on demand forecasting through the digital balance sheet and basic seed information through the digital seed catalogue, the system can form a strong

foundation for digital solutions to solve other challenges. This section discusses the variety of additional solutions that can be built on top of DESIS's minimum viable product.

***Digital seed tracking for certification and supply chain logistics***

Under its balance sheet digization component, DESIS will work with the same stakeholders responsible for seed certification. SQCC runs the country's central certification program and lab, while the AKCs support certification at the field level. As AKCs and cooperatives grow more accustomed to data collection and the use of digital hardware such as smartphones, DESIS can roll out an electronic tracking system for certified seeds in the supply chain. Currently the entire seed certification process is paper based, as both farmers and inspectors use paper forms to collect data. DESIS could develop an additional element of the platform dedicated to seed certification and inspection procedures that provides an app or web-based digital form that replaces paper during the inspection process. Giving inspectors a digitally enabled data collection tool would resolve complaints expressed during interviews that inspectors fill out their forms at home rather than making field visits. Geolocation data could be captured to ensure that data collection occurs on site. CIMMYT is working with a similar application in Eastern and Southern Africa called SeedAssure[77]. SeedAssure is a data collection app and database that helps digitize the seed inspection and certification process, linking inspector data directly to regulatory oversight for seed quality controls. CIMMYT can consider bringing a similar technology either as part of DESIS or another app that can integrate with DESIS when needed. Developing a way to replace paper data collection along the seed certification process can help accelerate certification timelines and improve the quality of the inspections leading to certification through more transparent inspector visits.

An electronic tracking system could use the same smartphones used to fill out the seed balance sheets to scan QR codes that would be on tags labeling certified bags of seed. Currently, when AKCs tag bags of seed after certification, the records are kept in paper. Like the paper-based seed balance sheet, these physical forms would be digitized. The system could also track factors such as whether varieties are going to regions where they will thrive.

While a tracking component is planned as a second phase for DESIS, some solutions in Nepal already offer traceability and tracking services through the use of QR codes. E-Satya recently won UNCDF's digital agriculture challenge for their solution, AgriClear. AgriClear uses QR codes and blockchain technology to improve Nepali organic food producers' ability to trace the origin of their inputs. This product is still young, but its technology also has the potential to support a digital seed certification process. Once DESIS has rolled out and perfected the minimum viable product, it may be worth discussing the possibility of using AgriClear as the QR code tracking solution instead of building out something from scratch. Cost will be a factor, as a partnership with AgriClear may increase costs long term, versus the large capital investment upfront but lower ongoing operational expenses over time. Additional details on best practices for tracking systems can be found in the section on fertilizer (section 2.2.5) below.

***Digital seed marketplace***

If DESIS can better align supply and demand of seeds, it will be well positioned to create a digital seed marketplace as planned. This marketplace will provide a more robust set of information around the availability and price of seeds in Nepal while giving seed producers an additional sales channel to capture

[77] CIMMYT, "Seeds go digital", available at: https://www.cimmyt.org/news/seeds-go-digital-faster-and-better-quality-certification-a-game-changer-for-african-farmers/

customers. Bringing producers and buyers onto a digital platform could create the opportunity for farmers to access both better prices and better information, as it would reduce the number of mid-stream stakeholders upon whom farmers and sellers depend to make market linkages.

The Digital Nepal Framework 2019 suggests the development of an online marketplace focused on commodity sales and the output side of the agricultural market system. Yet there could be an opportunity to discuss a partnership between the E-Haat Bazar concept and DESIS. Online marketplaces are difficult to execute, as they depend on transportation and distribution networks to ensure order fulfillment. The online marketplace will also likely require digital payment functionality – a feature that will need to be integrated into the DESIS platform and will require staff time to determine terms with digital payment gateway providers, such as ConnectIPS.

Another consideration for the online marketplace is the role SQCC would have in this capacity. The current minimum viable product of DESIS aims purely to improve coordination and information flows between key actors with which SQCC already coordinates around demand forecasting and seed certification. The online marketplace represents a commercial venture that will require a higher operating cost and will also likely need to seek a viable business model[78]. The e-commerce market in Nepal is new but growing, with a current market value of USD 25 million and an estimated growth rate of 300 percent annually for the foreseeable future[79] . DESIS may be able to partner with existing e-commerce platforms — such as Krishi Bajar, Muncha, or Thamel — to incorporate seed sales into their online marketplace offering.

***Digital credit product***

According to our interview with the Seed Entrepreneurs Association Nepal, the seed industry operates almost entirely on credit, with more than 90 percent of seeds sold through loans. Most of this credit is facilitated through informal value chain loans whereby agrovet retailers provide their customers with loans typically not recorded in a shared system. However, farmers' repayment performance on this credit provides valuable information on their ability to repay debt. Repayment history is the first and most important datapoint financial institutions observe when assessing credit worthiness. If the online marketplace helps digitize transactions between farmers or cooperatives and seed vendors, it could potentially create a repayment history based on digitized sales and credit ledgers[80].

So far, digital credit products in agriculture have had little success for several reasons. First, most banks do not want to use third-party data, as they do not trust the source or security around the information and prefer to use their own loan officers to collect data. Secondly, most digital credit products are developed for microloans, which may not be enough to cover the typical loan needs of a smallholder farmer. Additionally, there is a lack of historical data; most digital agriculture services that have data on farmers are nascent. Banks often like to see several years of data before making a lending decision. Some of these issues can be alleviated by piloting and attempting to create proofs of concept for digital credit products. Aria Group, a local Nepali fintech company, has developed an agricultural lending product

[78] While there is potential for the monetization of demand forecasting data to sell to interested seed producers, the seed producers themselves are crucial data providers for the supply side of the system. By charging for access to data, there is a risk of losing a robust data ecosystem for DESIS.
[79] World Bank Group, "Nepal Development Update", available at: http://documents1.worldbank.org/curated/en/485591576101383264/pdf/Nepal-Development-Update-Envisioning-a-Future-Data-Ecosystem-in-Federal-Nepal.pdf
[80] CGAP, "5 Insights into Credit Scoring for Smallholders", available at: https://www.cgap.org/blog/5-insights-credit-scoring-smallholders

called Mizani. The product is new, but they are engaged in conversations with two financial institutions to pilot their credit-scoring algorithm. DESIS is not at a stage where they have this type of data on hand, but it is something they should consider in the long term. Like the marketplace, this manifestation of DESIS would be a commercial one requiring partnerships.

The below DESIS long-term product roadmap graphic discusses additional concepts:

**Graphic 10: DESIS Product Roadmap**


### d. Recommendations to USAID and NSAF for supporting digital solutions for Nepal's seed systems

1) Ensure clear incentive structures for data-collection stakeholders such as AKCs and cooperatives.
2) Ensure that necessary hardware, such as smartphones and tablets, are available in the field. If not available, find other strategies for driving smartphone ownership.[81]
3) Ensure access to affordable network connectivity to enable data collectors to access the DESIS platform.
4) Include digital literacy trainings as part of the DESIS rollout with data collectors and data users.
5) Support training and marketing activities targeting the data users and data collectors of DESIS to ensure that aggregated information is used properly and improves access to quality seeds for farmers in Nepal.
6) Encourage NSAF to begin conversations with the Kisan ID implementers to determine potential areas of collaboration.
7) Encourage other USAID implementing partners to coordinate datasets with DESIS.
8) Encourage coordination with QR Code tracking services that already exist in Nepal to weigh the options between building out a system from scratch or customizing an existing one.
9) Develop a commercial viability study for a seed marketplace and engage with the E-Haat Bazar program to identify opportunities for collaboration. Develop business model and roadmap for marketplace.
10) Coordinate discussions with Aria Group and explore the opportunities for supporting digital credit services to improve access to seed and other inputs.
11) Ensure a strong sustainability plan for DESIS after the NSAF project ends in 2021, focused on government capacity, continued engagement of private stakeholders, and the possibility of involvement from new USAID projects.

[81] GSMA suggests three potential methods for driving smartphone ownership: 1) Grants that either pay for the phones entirely or reduce the price significantly; 2) enabling asset financing or instalment payment plans to reduce the upfront costs; and 3) providing access to lower-cost smartphones through more efficient supply chains and wholesale pricing arrangements.

12) Explore integration of seed-specific content (e.g., proper multiplication methods) in information services platforms – ideally on pre-existing platforms that have demonstrated success among farmers.

### 2.3.5. Fertilizer

#### a. Key challenges in the fertilizer sector

As discussed in Section 2.2.2, the fertilizer sector in Nepal faces a wide range of challenges. While digital solutions cannot address all of these problems, digital solutions might help to resolve the following challenges:

1) The supply of fertilizers (chemical) is insufficient to meet farmer demand.
2) There is a lack of transparency at the field level regarding warehouse inventory.
3) Soil information at the local level is either not available or not well coordinated to help farmers determine more efficient application of fertilizer and strengthen demand forecasting.
4) Farmers trying to farm organically may struggle to verify the source of their fertilizer.

These challenges are similar to those faced by the seed system, with a lack of coordination and ability to use information to properly link supply to demand for fertilizer. We will explore a variety of solutions that could support these issues. Some of these solutions are currently in the market, while others could be introduced to it.

#### b. Existing digital solutions

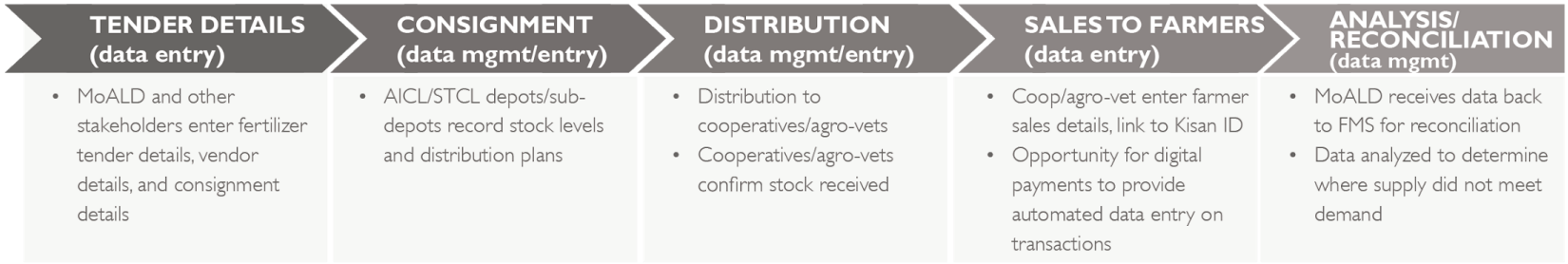
***AICL/STCL Fertilizer Management System***

AICL and STCL have begun digital transformation for fertilizer distribution management to better track sales and stock. The old paper-based system for tracking sales and forecasting demand was slow and lacked transparency. Data collected at the field level would not make its way back to AICL or STCL headquarters for many months. There is an obvious need to digitize the sales and stock data collected by cooperatives, warehouse, and distribution centers.

The first iteration of a digital solution is a Google Sheet that is updated daily, bringing in data from the field on daily sales and supply to districts, and shared with MoALD. Rara Information Technology, a local IT consulting and development firm, is developing software that will replace the Google Sheet with a system called the Fertilizer Management System (FMS). As with DESIS, this system depends on data entry from primary stakeholders in the field who are storing and distributing fertilizer. In this case, the primary data collectors are cooperatives and warehouse managers who will compile demand, manage stock, and update distribution status of fertilizer. The system will initially be used as an inventory management system that enables AICL and STCL to better track and MoALD to better monitor the distribution of chemical fertilizers.

FMS will enable tracking throughout all stages of the chemical fertilizer supply chain, beginning with the tender process and ending with sales and distribution data to the end user (farmers). The figure below highlights the key supply chain nodes where FMS enables data entry, availing real time data for better decision-making around procurement and distribution.

**Graphic 11. FMS Information Flow Chart**



Again, it will be imperative for key data stakeholders, such as cooperatives and depots, to have the proper hardware and network connection to enable daily entry of data into the system. Both STCL and AICL are now testing FMS, but the resources to deploy proper training and hardware to the data collection stakeholders may not be in place. Data coming from the field through the Google Sheet is sporadic, and not all stakeholders provide data through the digital channel. As all data entry is manual within FMS, it is crucial that the roll out of the solution incorporate proper data-entry training.

Currently, the Google Sheet only goes to the cooperative level in terms of distribution and sales. The long-term vision of the software roll-out sees cooperatives also developing profiles for their farmers. This is an excellent opportunity to coordinate with the Kisan ID initiative in farmer data collection, which can be costly and time consuming. If cooperatives can provide fertilizer sales data linked to farmer profiles, there will be more transparency on who is receiving fertilizer. Enabling better feedback loops between cooperatives and government stakeholders can provide insights into the levels of unmet demand, which could be coupled with the distribution data to map where supply falls short. This type of data will help improve the issues between supply and demand by providing more detail on historical demand and needs of farmer members of each cooperative.

Ideally, FMS would be expanded in the future to include fertilizer outside of the subsidized stock that STCL and AICL manage. This expansion may first require the Government of Nepal to allow formalization of the currently informal trade of non-subsidized chemical fertilizer.

### c. Potential digital solutions

***Payments integration***

One way to reduce the burden on manual data entry will be to incorporate a digital payment integration into the system for sales of fertilizer down the value chain. Though not perfect, accurate historical sales data can offer a good benchmark for forecasting future demand. As discussed above, digital payments can be an excellent way to collect data on transactions and sales, avoiding the need for manual data entry. Nevertheless, a transition to digital payments requires strong digital payment services, with a close and convenient network of agents that can help customers withdraw funds and facilitate other transactions with their digital wallets. Similar to a seed marketplace through DESIS, payments integration should come as part of a second or third product rollout.

***Soil-mapping integrations***

There have been several initiatives to map soil morphological, texture, PH, and other characteristics – and to digitize that data for broader use. NSAF has mapped soil characteristics in 20 project districts across Nepal, which can be accessed here. In addition to these larger efforts, commercial farmers (mostly around Kathmandu Valley) are using small digital testing kits. These kits test pH and NPK levels; while they have digital elements, they are not connected to any IoT device and do not have a way to connect to a larger cloud server. For this reason, the data collected by digital soil testers remain analog and are not connected to a broader database for sharing. Soil sensors that have IoT capabilities are discussed in the text box at the end of this section.

There are two key possible use areas for the soil characteristics data that NSAF collects and collates. The first links this data to information services like Viamo (Voto), Krishi Guru, Smart Krishi, or GeoKrishi. These products strive to deliver relevant and customized information to farmers. Linking the soil data NSAF has collected to advisory services can make it more actionable. The second use would be to

integrate this information into the MFS platform. If the platform reaches a point where individual farmer data is collected, a key piece of information would be the farmer's plot location. Overlaying the soil data around that specific plot location with the farmer's profile would create a more realistic and useful projection of fertilizer type and amount. This step would make for more accurate demand forecasting and would help farmers purchase the correct amount of fertilizer – potentially saving them money while leaving additional supply for other farmers.

***Organic fertilizer tracking***

Many farmers who cultivate organic produce have a difficult time proving they are doing so. The ability to track and certify their organic produce in part comes from being able to prove they are using organic fertilizers. Organic Certification Nepal (OCN) is the national-level organic certification body in the country. OCN inspects and certifies production at the local level.[82] The AgriClear solution mentioned earlier could play a role in improving transparency around the use of organic fertilizers. While the current solution only considers forward-linkages (aggregators, distributors, and end consumers), there could be value in encouraging systems like this to begin their tracing at the input level. We encourage a discussion with solutions like AgriClear to determine the feasibility of a similar QR code tracking system so farmers can demonstrate their use of organic fertilizers.

***Best practices in quality assurance through improved traceability***

Traceability is a crucial part of any supply chain – especially so for food systems. Improving the traceability of inputs such as seed and fertilizer can help reduce counterfeiting and increase source and quality confidence. Digital solutions have helped significantly reduce the paperwork required to track inventory across a food supply chain. Applying simple scanning technologies like QR codes, barcodes, or Radio Frequency Identification (RFID) tags can automate inventory tracking into central databases or decentralized blockchain databases.

Below are some critical best practices to consider when digitizing traceability for input supply chains.

1) Digital solutions can only augment and support traceability. Standard operating procedures for tracking must already be in place for a digital solution to help. The movement of seed or fertilizer should already have a paper system that allows for tracking inventory along the supply chain.
2) Knowing the strengths and weaknesses of the other primary scanning technologies- barcodes, QR codes, and RFID- is essential. Additional information on these technologies can be found in the call out box below.
3) The implementation of traceability requires various stakeholders across a supply chain to buy into procedures and data standards that enable identification and tracing of the bag of seed or fertilizer at each production and distribution stage. This effort includes integrating with traceability systems used by exporters from which Nepal imports a variety of inputs.
4) Ensure strong training efforts at each check-in point throughout the distribution of inputs. The staff who work in warehouses, logistics, and cooperatives should have the technical capacity, hardware, and network connectivity to capture and scan information on input inventory as it moves along the supply chain.

[82] OCN, 2020.

Scanning Technologies: Barcodes, QR Codes, and RFID

Barcodes are an older technology providing a basic level of data linked to a product. QR codes are similar to barcodes but can hold more data, such as website links, pictures, and around 4,000 characters of text. They are more appropriate for tracking greater detail on products across the supply chain. QR codes are also much more durable. If a barcode is damaged, it likely won't scan, whereas only 30 percent of the QR code needs to be intact for it to function. QR codes and barcodes are both cheap and can be printed by the user. Smartphones can scan both barcodes and QR codes, so no additional hardware is necessary. RFID tags are more expensive but can conduct mass scans, as the scanning device does not need a line of sight. The radiofrequency allows for items to be scanned in masse, saving significant time. The negative aspects of RFID tags are their cost and the requirement for RFID-specific scanners.

#### d. Recommendations to USAID for supporting digital solutions for Nepal's fertilizer systems

1) Support cooperatives' digital capacity and literacy to promote quality data sources by funding initiatives like iDE's Community-Based Facilitator model.
2) Support clear incentive structures, similar to the recommendations in the seed section, that ensure that data collectors like cooperatives are motivated to provide good data.
3) Encourage implementing partners to consider different ways to get smartphones and tablets into the hands of data collectors, either through direct funding, payment plans, or credit solutions.
4) Encourage AICL and STCL to coordinate their software roll out with that of the Kisan ID, to reduce data collection costs and time. Provide support for this coordination.
5) Support the integration of soil data information developed by NSAF with information services – particularly those that reach smallholders, such as IVR-based information services like Viamo and radio.
6) Coordinate discussions with tracking systems and organic fertilizer producers and organic farmers to determine whether more transparency can be achieved across the organic produce supply chains.

### 2.3.6. Machinery

#### a. Key challenge

As discussed in Section 2.1.4, machinery use is growing; however, many smallholders lack access to machinery of all kinds, from basic tillers and precision planters to larger tractors. Digital solutions can support one main challenge in Nepal's efforts to increase access to machinery for smallholders: the prohibitive costs that prevent many households from purchasing machinery outright. This limitation applies to many important machines like tills, threshers, and tractors, which do not make economic sense for individual household purchase. Thus, we focus on supporting rental solutions.

#### b. Potential digital solutions

#### Machinery rental system

Several products around the world have deployed IoT technologies to manage fleets of tractors in a more efficient way. These sensors, placed on a tractor, can support a rental system solution in several ways:

- measuring emission levels and monitoring the mechanical health of machinery, particularly tractors;
- tracking field activity and delivering detailed location coordinates of farmer plots;
- linking to apps that enable machinery owners to rent their resources to farmers; and
- providing data on use of machinery in the context of renting, which can open new access to finance for machinery owners.

Around the globe, such technology has been used to establish effective rental services. Examples include Hello Tractor in Nigeria, TroTro tractor in Ghana, and Trringo (a Mahindra company) in India. These solutions mostly focus on tractors, but their core concept is the same and could be applied to other lighter machinery. The sensor is the data collector in this instance, enabling machinery owners to efficiently rent their resources to farmers who need them. In the case of tractors, farmers book a tractor for a certain amount of time, and an operator will come and perform necessary tasks[83].

Being in India, Trringo is likely the best potential market entrant for Nepal. Trringo works through partners, using a franchise model to expand their business. A first step in exploring a potential market entry for Trringo would be a conversation with them about partnerships and their ability to enter the Nepalese market. A next step would be to establish a stronger understanding of potential partners in Nepal – perhaps a group of cooperatives that already distribute machinery to their members for temporary use. Ideal partners would also have direct links to maintenance and repair shops that would ensure upkeep of the machinery. IoT sensors such as Trringo's monitor the time the engine has been working and can provide suggestions to owners regarding preventative maintenance, which can link to maintenance schedules and shops. Before digital solutions can support more streamlined repair scheduling, the shortage of maintenance shops in rural areas must be addressed. Finally, Trringo and potential partners need to have direct conversations about market entry requirements, and USAID via grants or technical assistance could provide incentives for market entry.

There should be additional due diligence on demand for this kind of service before taking any of the above actions. In addition, Trringo would need to integrate with some of the payment gateways in Nepal to enable digital payments – a core part of the booking feature.

**Sensors & IoT**

The Internet of Things (IoT) refers to how 'things' — like sensors — can be packaged with hardware that connects with the internet and transmits collected data, which can be used to make decisions. The number of IoT devices in the world is growing quickly, with more and more physical things being connected to the digital cloud. While IoT and the sensors that collect the data hold great potential for improving farmer productivity and livelihoods, many challenges remain. A summary of key challenges in rolling out and scaling IoT devices in emerging markets follows:[84]

1) Energy requirements of sensors vary greatly; however, all sensors need energy sources, which can be problematic in rural settings.

[83] Watch a video from Trringo on how their smart tractor system works, at: https://www.youtube.com/watch?v=rbK3Wh5Gzoc

[84] ITU, "Harnessing the Internet of Things for Global Development", available at: https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf

2) When connectivity is lacking, sensors cannot communicate with the cloud, making the data they collect unusable.
3) Costs can be prohibitive – not only for the sensors but the ongoing network data costs.
4) There is still inadequate human capacity to manage and maintain IoT devices, especially those located in more difficult areas, such as farm fields. Technical issues may arise that farmers simply do not have the capacity to solve.

Repair and Maintenance Advisory – Machinery

Solutions abound to provide information and advice to farmers and, in some cases to intermediaries like extension agents and rural para-veterinarians.[85] As remote Nepalis struggle to access machinery repair services, it is possible that expanding access to information on machinery repair could have impactful results. A digital information services solution could allow users to access how-to visuals and videos (bandwidth allowing) for common problems, or potentially even connect them to custom expert advisory by sending pictures to Maintenance Service Centers for response. Before designing any solution, a deeper assessment of demand and supply of repair services is necessary to confirm whether and how expanding access to repair and maintenance information could translate into expanded service provision in remote areas. The assessment should also determine the types of actors a digital solution should target. Additional interventions might be needed beyond the digital solution to achieve impact – for example, fostering emerging rural repair entrepreneurs. A business model would also need to be developed to explore the financial sustainablity of the solution.

#### c. Recommendations to USAID for supporting digital solutions that increase access to machinery in Nepal

1) Encourage deeper due diligence on the viability of IoT sensors on machinery in Nepal, with reference to the above Sensors & IoT text box.
2) Explore potential demand for digital pay-as-you-go services that add efficiencies and access of farmer machine rental and that facilitate mid- to large-size farmers, farmer groups, and cooperatives across the country to make rental income from their machinery.
3) Discuss the potential transactional and usage data produced from a machinery booking service with financial institutions to determine their appetite for using it as a credit-scoring consideration.
4) Facilitate conversations between Trringo and key stakeholders in Nepal.
5) Assess demand for information around machinery maintenance and repair in remote areas, determining which actors would use digital advisory services.

### 2.3.7. Irrigation

#### a. Key challenges

Many challenges prevent a majority of Nepal's cultivable land from having access to irrigation. Two of those challenges can be overcome through digital solutions:

[85] Developed under USAID Feed the Future in Bangladesh, the Shurokkha app allows rural para-vets to connect with professional veterinarians to share cattle symptoms and photos; the veterinarian remotely provides a diagnosis and prescribes treatment to the para-vet, who then communicates with the farmer.

1) Both farmer- and agency-managed irrigation systems suffer from water shortage, and many farms that have irrigation systems lack water, which limits their useability during dry seasons..
2) Pumps run on expensive energy (diesel or electricity), which makes them too expensive for many farming households.

### b. Existing digital solutions

Not many digital solutions apply to issues of irrigation in Nepal, but solar water pumps are becoming more popular. Projects like USAID's Accelerated Commercialization Solar Photovoltaic Water Pumping have improved the availability and cost of solar water pumps. Solar water pumps can help reduce expensive energy costs, but they can be relatively expensive to install. UNCDF and Sunfarmer, a solar company with a solar pump offering in Nepal, have set up a pay-as-you-go solar pump system that enables farmers to purchase solar pumps as part of a contract farming scheme between Sunfarmer and farmers. This model not only supports an increase in irrigated land, but also gives farmers access to markets, as Sunfarmer becomes the aggregator and off taker for their contract farmers. Sunfarmer had to become more involved as an aggregator when they saw their simple pay-as-you-go solar pump solution was not getting much traction. This model may be difficult to scale, as Sunfarmer is not an off taker in general, but the product concept of pay-as-you-go solar pumps may grow in popularity as digital payment systems improve.

### c. Potential digital solutions

***Smart irrigation sensors***

To deliver more efficient irrigation systems, the same soil sensors used in soil mapping to improve efficient fertilizer and hybrid seed usage can be used for irrigation. Soil sensors measure soil moisture, which can provide farmers with precise information on when it is time to water certain areas of their crops. These sensors can either link directly to an irrigation system and automatically release water when needed, or link to a mobile phone or device that sends an SMS or IVR message informing the farmer that soil moisture levels are low. Using soil sensors to inform farmers when water is needed can increase the efficiency of irrigation systems in Nepal; watering only when prompted would alleviate some of the water shortages that farmers face.

Repair and Maintenance Advisory – Irrigation

As with machinery, irrigation users in remote areas can struggle to access repair and maintenance services. In the United States, an irrigation equipment provider administers a website to help non-experts manage their equipment; https://www.irrigationrepair.com/ includes repair how-to videos and a community discussion forum. An adaptation of such a solution in Nepal would need to consider limited bandwidth and smartphone ownership in many areas but could target rural repair entrepreneurs, if not farmers directly. While common social media platforms like Facebook may be attractive due to their existing user base, the variety of irrigation solutions in use in Nepal would probably necessitate the creation of multiple groups for different types of products. While the National Federation of Irrigation Water Users Association could potentially create and administer the pages, a business case would need to be made for private actors to contribute advisory content.

Most of Nepal's irrigation sources surface water; the country would benefit from increased sourcing of groundwater. Satellite imagery is a key resource for mapping surface water; such images inform hydrologic models, which support watershed management decision-making. Watersheds and important locations for water management can be visualized on GIS maps. IoT sensors may provide critical, real-time data on changing levels of surface water (e.g., as snow melts). IoT sensors are also commonly used to measure changing groundwater levels; often they are placed in boreholes. Anchored in satellite technology, SERVIR is a joint development initiative of USAID and NASA that develops solutions for specific projects, including around watershed management.[86]

#### d. Recommendations to USAID for supporting digital solutions that improve irrigation in Nepal

1) Support financing models like Sunfarmers that enable farmers to pay for pumps over a longer period of time.
2) Conduct an assessment and recommendations on how to improve the presence of IoT-enabled devices in Nepal, with reference to the above Sensors & IoT text box.
3) Consult with the National Federation of Irrigation Water Users Association on the demand for and viability of an irrigation repair and maintenance advisory service.
4) Consider connecting with SERVIR to explore using technology to inform watershed mapping and management.

# 3. AGRICULTURAL SUBSIDIES

## 3.1. Subsidies for Agricultural Inputs

### 3.1.1. Overview

Governments can influence the direction of agricultural development and food systems through regulations, and through targeted incentives and financial support to correct market failures and exclusion. These contributions of public funds, subsidies, can compensate for disadvantages – such as low amounts of capital and remote locations – that would otherwise lead market actors to participate less. Subsidies can also temporarily compensate unfavorable terms of trade or relatively high costs of production. Priorities for the directions of subsidies may vary over time but usually include vulnerable populations as well as producer and consumer groups in specific sectors that the government aims to support.

International trade agreements generally agree that subsidies include 1) a financial contribution from the public sector; and 2) a benefit to market actors. Depending on the subsidy, the financial contribution may be made as a direct payment to the market beneficiary or as a matching payment to a participating seller. In other cases, the subsidy benefits will be realized as lower prices on products that have received financial support along the value chain. The government's financial contribution can even come in the form of foregone public revenue, such as with tax deductions.

[86] Servirglobal.net features multiple examples of initiatives related to watershed management, such as using satellite imagery to map and monitor changing river courses in Myanmar (https://servir.adpc.net/tools/dancing-rivers).

Nepal's Constitution of 2015 envisages access to agricultural inputs by Nepalese farmers "at fair prices". In addition to other types of support it provides to the market system, the Government of Nepal has subsidy programs to cut the high costs of fertilizer, certified high-yielding seed, small-scale irrigation, and mechanization. This section examines three major types of subsidies around inputs, with a focus on the first two:

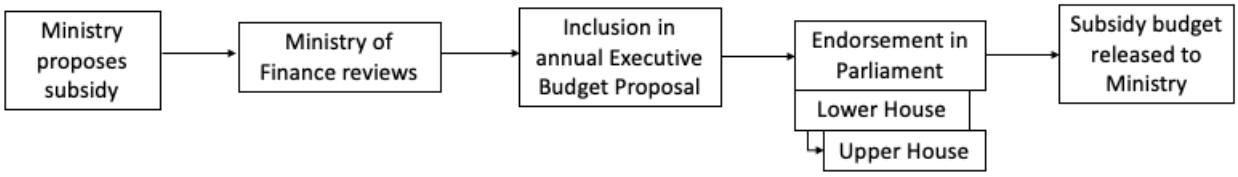
1. Farmer-facing subsidy on the retail price (e.g., eligible farmers only pay 50 percent of the retail price)
2. Products that are subsidized throughout the supply chain (e.g., chemical fertilizer)
3. Subsidies issued to other actors in the supply chain (e.g., matching grants for investments, subsidized transportation, tax exemptions and deductions)

The Government of Nepal also regulates and subsidizes financial services related to agriculture, which affect input production and access. The Priority Sector Lending Programme requires financial institutions to allocate 10 percent of their loan portfolio to the agricultural sector, with a subsidized interest rate of 5 percent for such loans. However, the requirements to access these loans are too cumbersome for many individual farmers; the loans may be more accessible to agribusinesses. The Government of Nepal also subsidizes agriculture insurance, making public payments to partially cover individual premiums.

The general process for initiating, approving, and implementing subsidy programs in Nepal follows:

- MoALD identifies a specific subsidy requirement and proposes to the Ministry of Finance to allocate essential budget provisions in the annual budget.
- The Government of Nepal announces each type of subsidy in its annual Executive Budget Proposal.
- Parliament endorses the subsidy provision (first the Lower House, then the Upper House).
- After approval and release of the subsidy-specific budget, respective ministries — often MoALD — implement the subsidies.
- Generally local governments target farmers for subsidies.
- The Central Bank regulates agriculture loan interest subsidies, and commercial banks implement them.

Graphic 12. Flowchart of subsidy approval




Aside from this general structure, it is noteworthy that the structures and processes of subsidy administration undergo frequent change in Nepal. This dynamic may be important in considerations of where to digitize.

As do other governments, the Government of Nepal faces significant challenges in administrating subsidies, including:

- ***Changing and inadequate government roles.*** Recent years have seen significant changes in the structure and administration of subsidies, as policies shift and the whole of the Nepalese government must manage the move to federalism and decentralization. Resulting processes

remain nascent as government agencies are given new roles in administering subsidies, including those at the local level. An enduring challenge is insufficient human resources for monitoring subsidy payouts.

- ***Ineffective targeting.*** As demand for subsidies is generally higher than government budget allows, rationing mechanisms are necessary and often result in sub-optimal resource allocation. Nepal's subsidy programs receive criticism for corruption and privileging those close to government officials, while many of the most vulnerable farmers remain unreached. Reaching such farmers with subsidy information and ensuring that they can complete the application requirements (e.g., proposal, permanent account number, local ward office recommendation, proposal) remain challenging. Subsidies disproportionately reach large and better-informed farmers as a result.
- ***Market distortions.*** Some private actors lament that subsidies make farmers and cooperatives hesitant to purchase agricultural inputs, as they prefer to wait to see if they can get a subsidy. Additionally, service providers receiving government or NGO grants may increase staff salaries and decrease the input sales price — making it more difficult for other companies to compete — while not taking the hoped-for action of building sales in rural areas.
- ***COVID-19 Pandemic.*** It is worth noting that, amid the COVID-19 pandemic, some subsidy funds have been diverted to other programs, which has created challenges for farmers.

Digital technology has the potential to address some of these challenges and more sector-specific bottlenecks, as discussed in the following sections.

### 3.1.2. Seed subsidies

Nepal's primary farmer-facing seed subsidy program has seen multiple changes in structure and administration in recent years. From 2012 to 2017, parastatal National Seed Company Limited (NSCL) led the MoALD program and provided subsidized wheat and paddy seed to farmers. NSCL's own production comprised approximately 40 percent of the 30,000 tons of subsidized seed supplied during this period, while the remainder was procured from the private sector. The system was criticized for creating a difficult environment for private seed producers to compete, while NSCL had a limited infrastructure of dealers. In 2017, MoALD significantly changed the program to provide a price subsidy on improved seeds of cereals, pulses, oilseeds, and vegetables, to be sold by approved private sector and farmer group suppliers, giving more choice to farmers. In line with the country's decentralization agenda, administration duties were assigned to District Agriculture Development Offices (now AKCs), with central budget allocation and monitoring from MoALD. Approximately 4,000 tons of seed were purchased under this new system, which lasted only a year; in 2018, the seed subsidy program was reassigned to local governments that could choose to use their own resources and policies to administer it.[87] Not all local governments have done so — or they may target their subsidies elsewhere — and a uniform farmer-facing seed subsidy is absent.

[87] Dinesh Babu Thapa Magar and Yuga Nath Ghimire, "Reflections of seed subsidy program implemented by the government of Nepal," June 2018, available at: https://www.researchgate.net/publication/342888011_Reflections_of_seed_subsidy_program_implemented_by_the_government_of_Nepal

These frequent changes and lack of uniform approach may be an obstacle to the creation of a digital system for seed subsidies – especially one with farmers as direct subsidy recipients.

**Example: Gandaki province's seed subsidy**

In recent years, Gandaki province has been providing 50-percent subsidies to seed-production groups (farmers groups, cooperatives, and private firms). Requirements include a permanent account number (PAN) and a recommendation from the local ward office, so individual farmers generally do not access these subsidies. The province also provided an 85-percent subsidy to districts for construction of seed-storage facilities. The current year's budget is still under discussion at the time of writing.

Other subsidies exist in the seed market system:

- For the upcoming fiscal year budget, cash subsidies are included for farmers producing improved seeds. The government must still issue directives, but PMAMP provides subsidies of up to 85 percent in the form of cash grants to address seed supply-side constraints. The grant is used to purchase agriculture inputs for farms located in special pockets, blocks, zones, and super zones. Similarly, subsidies are also provided for setting up collection centers.
- For recovering transportation and distribution losses, particularly in remote areas, the government provides a fixed-amount grant to state-owned companies (STCL and AICL).
- The Government of Nepal reduces or provides exemptions for customs taxes for certain types of seed importers – with even higher reductions during the COVID-19 pandemic. This is a 'negative' financial contribution from the Government of Nepal for a subsidy; rather than spending money, it foregoes revenue to benefit the sector.
- Occasional distribution of free seed to farmers (generally in emergency recovery situations).

Some stakeholders interviewed during this assessment also argue that the government's subsidies on inexpensive seeds distort the market by making other seeds less competitive while creating farmer dependency on subsidies.

Coordination with, between, and within government agencies for the purposes of monitoring is a challenge, compounded by the transition to the newly introduced federal system. With a lack of clear policy and directives on the roles of each level of the government, stakeholders are often unclear on the level (e.g., central, provincial, or local) at which they should address their issues. Meanwhile, ministry departments have functional linkages with the central government, whereas provincial governments allocate their financial resources to work on the ground, leading to disjointed and unpredictable implementation.

Data is available on Government of Nepal investment in the former subsidized seed system that NSCL implemented. During its active period, Government of Nepal investment was NPR 636 million (USD 6.2 million at late 2017 conversion rates) for a quantity of approximately 30,000 tons of subsidized wheat and paddy seed.[88] Thus, the cost of subsidy per ton of seed was NPR 21,200, or USD 206.

### 3.1.3. Fertilizer subsidies

[88] Dinesh Babu Thapa Magar and Yuga Nath Ghimire, "Reflections of seed subsidy program implemented by the government of Nepal," June 2018, available at: https://www.researchgate.net/publication/342888011_Reflections_of_seed_subsidy_program_implemented_by_the_government_of_Nepal

Almost all fertilizer in Nepal is subsidized. Most fertilizer is chemical (primary NPK), which is fully procured and distributed across the country by state-owned AICL and STCL, sold at fixed prices set by the Subsidy Allocation Management Committee led by MoALD. As directed by the 2009 Chemical Fertilizer Subsidy Policy, prices are set 20-25 percent higher than the import prices at the Indian border. MoALD subsidizes transportation expenses for delivering to all areas of the country, meaning remote and difficult-to-access regions of the country receive fertilizer at the same price as others. Overall, STCL and AICL are reimbursed for annually agreed-upon operational costs as well as the difference between the actual cost of fertilizer and its subsidized purchase price. Subsidized fertilizers have been distributed through local field offices of AICL and STCL, as well as by cooperatives. More than 5,000 cooperatives retail and distribute subsidized fertilizer; generally, there is one cooperative distributor in each ward, which has applied to and been approved by AICL. Recent directives also allow private agrovets to apply to become approved dealers for the subsidized fertilizer. The 2009 Policy specified that individual farmers can purchase subsidized fertilizer for up to 0.75 ha and 4 ha in the Hills and Terai, respectively, for three crops a year – though targeting rules were relaxed in 2011/2012. As supply is insufficient to meet demand, chief district officers are responsible for setting any local targeting."[89]

Through 753 local governments, government-authorized agencies distribute most of the fertilizer in the country. Local governments decide how much fertilizer should be allocated to a particular ward through the cooperatives and other dealers. They also have a monitoring role to ensure fair distribution.

Since 2009, when the most recent version of the chemical fertilizer policy was enacted, only 20 percent of fertilizer demand has been met, and there is no data on supply from the private sector.[90] The demand-supply gap has been biggest in the Far Western Development Region, where in 2016, 90 percent of households reported an inability to access the volume of fertilizer they sought. Industry players estimate the demand to have increased from 700,000 tons a few years ago to around 1.3 million tons per year now. The gap persists because of budget constraints, logistical bottlenecks, and lack of clarity as to the extent of fertilizer entering the country illegally. A quarter of the chemical fertilizer used is formally imported, and the remaining 75 percent is acquired through informal trade.[91] During this current year (2020/2021), the national plan was to import 500,000 tons of chemical fertilizers. Unfortunately, the Nepalese contractors failed to supply the fertilizers.

Subsidized fertilizer distribution is criticized for being ineffective and insufficiently targeted to needs. For instance, compared to the mid and western regions, the central region around Kathmandu receives more subsidized fertilizers in proportion to the number of marginal farmers and the poverty level.[92] Procurement and distribution of fertilizers are also not based on appropriateness for the local context, including crops grown, soil, and weather conditions. The move to allow private dealers to participate in local sales may strengthen the distributor network, but it does not resolve the main challenge of inadequate supply quantities. Cooperatives and local government usually perform hard copy data collection on demand, and then share that data with AICL.

[89] Kyle, J., Resnick, D., and Karkee, M., "Improving the Equity and Effectiveness of Nepal's Fertilizer Subsidy Program," IFPRI Discussion Paper 01685, December 2017.
[90] Panta, 2018.
[91] Bista et al., 2016,
[92] Kyle, J., Resnick, D., and Karkee, M., "Improving the Equity and Effectiveness of Nepal's Fertilizer Subsidy Program," IFPRI Discussion Paper 01685, December 2017.

**Table 4. Details on imported subsidized fertilizers from 2008/2009 to 2016/2017[93]**

| Year | Import (MT) | Cost (NPR) | Sell (MT) | Subsidy (NPR) | Subsidy (%) |
|---|---|---|---|---|---|
| 2008/ 2009 | 22,484 | 688,087,000 | 7,090 | 366,812,126 | 53.30 |
| 2009/ 2010 | 81,594 | 2,819,139,000 | 81,845 | 1,370,518,260 | 48.61 |
| 2010/ 2011 | 149,907 | 6,195,372,000 | 110,031 | 2,526,380,818 | 40.78 |
| 2011/ 2012 | 112,126 | 5,415,758,000 | 144,813 | 3,129,947,630 | 57.79 |
| 2012/ 2013 | 220,544 | 11,468,933,000 | 176,963 | 5,171,837,181 | 45.09 |
| 2013/ 2014 | 273,239 | 12,786,106,000 | 232,879 | 5,308,772,649 | 41.51 |
| 2014/ 2015 | 281,000 | 12,919,793,000 | 298,677 | 5,324,806,353 | 41.21 |
| 2015/ 2016 | 287,430 | 12,236,820,000 | 259,061 | 5,665,075,000 | 46.30 |
| 2016/ 2017 | 307,771 | 12,238,376,000 | 324,977 | 4,743,900,000 | 38.76 |
| Total | 1,736,095 | 76,768,384,000 | 1,636,336 | 33,608,050,017 | 43.78 |

***Other subsidies.*** To promote the use of organic fertilizer, the Government of Nepal provides a subsidy of NPR 10/kg or 50 percent of sales price to farmers, whichever is lower. Similarly, private companies receive a 50-percent subsidy in the purchase of machinery. This program has not been highly effective; some feel that newly established private manufacturers aim to exploit government subsidy programs, given the lack of monitoring and tracking.[94]

As shown in Table 4 above, fertilizer imports from 2008/2009 to 2016/2017 totaled 1.74 million MT, at a total cost of NPR 76.77 billion. Government of Nepal subsidy — the difference paid to STCL and AICL between fertilizer purchase and sales price, plus transport and administrative costs — averaged 44 percent of this cost, at NPR 33.61 billion, with an annual average of NPR 3.73 billion. In 2016/2017, formal imports were 0.3 million MT, at a cost of NPR 12.24 billion; NPR 4.74 billion was spent on subsidies, working out to NPR 19,000 per MT.

[93] MoALD, 2018.
[94] Bista et al., 2016

In its 2020/2021 budget plan, the Nepali government has allocated NPRs 11 billion (USD 93 million) for fertilizer subsidies. A small amount will subsidize domestic production of organic fertilizers, and the vast majority will be directed to the import and transportation of chemical fertilizer.

### 3.1.4. Machinery subsidies

This section describes subsidies around agricultural mechanization in Nepal.

***Price subsidies to farmers/cooperatives in purchasing machinery.*** Until 2019, the Government of Nepal, through the Directorate of Agricultural Engineering (DoAEngg), offered subsidies of up to 50 percent of the total price of machinery to eligible farmers and cooperatives.[95] The subsidy could be used to purchase tractors, power tillers, and mini tillers through approved retailers. The private sector credits the program with increasing sales and cash flow in the agri-machinery sector. The central government's support for the subsidy ended in 2019, but some provincial governments continued it.[96] In general, regional offices run subsidies for larger machinery, and local offices run subsidies for smaller machinery; however, duplication of subsidies between levels of government remains an issue.

Effective farmer targeting remains an issue. Government bodies may advertise subsidies on radio, but most farmers remain unaware – except for those with relationships to government representatives. As a result, subsidies are criticized by news oulets and the general public for going disproportionately to wealthier, male[97] farmers, who tend to be better connected with government. In addition, the requirement for a permanent account number requires a recommendation from the local ward office and a thorough application process, which may dissuade farmers from applying. As a result, farmer identification remains a key problem for subsidy distribution.

The Government of Nepal also lacks adequate staff for monitoring. As a result of this shortage, farmers who have less than 5 to 10 ha of land are not prioritized for monitoring. In some cases, the project asks the grantee to upload photos to Facebook to ensure proper use of funds.

***Subsidies to custom hiring centers (CHCs).*** Through PMAMP, DoAEngg provides significant subsidies to firms to develop CHCs. The subsidy co-funds infrastructure development (e.g., garage construction) up to 85 percent and machinery up to 50 percent. The requirement is that machines should be rented out below market rate. As of late 2018, 40 CHCs were in operation and 160 were in the process of development.[98]

Some other subsidies should apply to machinery but are not currently functional:

- The Government of Nepal reduces custom duties for farmers importing farm equipment – they pay only 1 percent, compared to the custom duty rates of 38-40 percent levied on traders;

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[95] Surya Prasad Paudel, "Subsidy in Agricultural Mechanization in Nepal", available at: http://www.un-csam.org/PPTa/1911RF7_ROK/28th/PDF/5.%20Country%20Presentation_Nepal_Mr.%20Basynat.pdf

[96] Surya Prasad Paudel, "Subsidy in Agricultural Mechanization in Nepal", available at: http://www.un-csam.org/PPTa/1911RF7_ROK/28th/PDF/5.%20Country%20Presentation_Nepal_Mr.%20Basynat.pdf

[97] *Technology in Society,* "Gender differentiated small-scale farm mechanization in Nepal hills: An application of exogenous switching treatment regression," May 2020, available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7249500/

[98] Surya Prasad Paudel, "The role of the public sector for Enabling Environment for the Private Sector in Nepal", available at: http://www.un-csam.org/ppta/201810RF/Session1/4.%20Nepal.pdf

however, the government made a Letter of Credit a requirement, so farmers have stopped importing farming equipment themselves.[99]

- Businesses in agri-machinery are often unable to access subsidized loans. Nepal Rastra Bank does not currently include agri-machinery as an activity that qualifies as an agriculture priiority sector, which limits the agri-macinery sector's acess to subsidies credit.[100]

Table 5 shows the annual amount allocated to agricultural machinery subsidy through DoAEngg before the program ended.

**Table 5.**[101]

| Fiscal year | Subsidy Amount (NPR) |
|---|---|
| 2013/2014 | 40,000,000 |
| 2014/2015 | 70,000,000 |
| 2015/2016 | 120,000,000 |
| 2016/2017 | 180,000,000 |
| 2017/2018 | 90,000,000 |

### 3.1.5. Irrigation subsidies

There has been a remarkable expansion of irrigated areas in the past few decades, largely due to the success of government initiatives to increase surface and groundwater irrigation. The total irrigated area in 1979/1980 was 2,670,400 ha; it was estimated at 1.8 million ha in 2018/2019.[102,103] Ongoing irrigation subsidy programs contribute to this success. While large irrigation projects tend to be government funded and managed under MoEWRI, the Government of Nepal has subsidy programs targeted for FMIS. Annually, MoEWRI and MoALD propose to the Ministry of Finance a specific subsidy budget related to irrigation infrastructure. Following approval in both houses of Parliament, local agencies including AKCs and Irrigation Development Divisions implement the subsidies. Subsidies generally take the form of cost-sharing, with the Government of Nepal often contributing 50-75 percent of total costs. Districts are usually selected based on local need, geographical and administrative representation, type of irrigation systems,[104] and involvement of relevant agencies (e.g., DOI, DOA, ADBN). The Government of Nepal often supplements the subsidies with agriculture extension services, including improved technologies and quality seeds for agriculture development.

Water users' associations comprise beneficiary farmers who actively participate in subsidy project planning, development, monitoring, and regular maintenance. Subsidized small-irrigation systems (e.g., surface canals, pumps, drip, and sprinkler) are usually administered at the local level (e.g., through AKC, VDC, and municipalities), and the more high-tech irrigation systems (high-tech tunnels, solar irrigation, and lift irrigation) are often administered through regional offices of the Ministry of Land Management, Agriculture and Cooperatives. Under the partnership model, agriculture cooperatives can apply for local government co-funding to subsidize the cost of irrigation solutions. For example, AKC Tanahun provided

[99] My Republica, "Farm equipment rental service to be started in all provinces", available at: https://myrepublica.nagariknetwork.com/news/farm-equipment-rental-service-to-be-started-in-all-provinces/
[100] https://hr.parliament.gov.np/uploads/attachments/qlyt5ivy9wkabp2s.pdf
[101] http://www.uncsam.org/PPTa/1911RF7_ROK/28th/PDF/5.%20Country%20Presentation_Nepal_Mr.%20Basynat.pd
[102] Biswas, A.K., "Irrigation in Nepal: Opportunities and Constraints", 1986, available at: https://thirdworldcentre.org/wp-content/uploads/2016/08/Irrigation-in-Nepal-.pdf
[103] ADB, "Sector Assessment (Summary): Irrigation", 2019, available at: adb.org/sites/default/files/linked-documents/38417-02-nep-ssa.pdf
[104] For example, Inner Terai areas were selected for projects related to groundwater development.

an 85-percent subsidy (a maximum of NPR 300,000) for an irrigation canal to successful cooperatives last year (2019/2020); the beneficiaries cover the remaining 15 percent with cash and in-kind contributions. AKC also provides co-funding to set up model agriculture farms with small irrigation systems (e.g., drip, sprinkler). PMAMP also offers subsidies (50-85 percent co-funding) for plastic-lined ponds, water pumps, solar/lift irrigation, and high-tech tunnels with drip and plastic mulching.[105] There are also small grants for renovations of irrigation canals and building water ponds (PMAMP, Dhading). For irrigation systems and machinery, the government usually selects machine-selling companies (through tendering) where farmers can buy the system of their choice with a subsidy.[106]

In some cases, local governments (AKC, VDC, municipalities) distribute free micro irrigation systems (e.g., low-cost drip and sprinkler) to select farmers as part of their regular annual programs. For expensive irrigation systems and projects, partnership and grant models between development and private sector institutions can support further expansion of irrigation coverage. .

Provincial governments also issue capital subsidies (usually 50 percent) on agriculture machinery (e.g., pumping sets, shallow tube wells), as discussed in Section 3.1.4.[107]

Tax subsidies also play a role. Value-added tax (VAT) does not apply in irrigation-related machineries (e.g., pumps, solar panels), which carry only a 5-percent custom duty. Import duties also do not apply in the import of heavy machinery related to the management and construction of irrigation and field channels.[108]

Government of Nepal representatives we spoke with considered the subsidy program in irrigation one of most effective in the agriculture landscape. They believe that, because farmers see regular sources of irrigation as a way to improve crop productivity, they are willing to contribute more of their own resources than what is usually required for the government grant programs to build canals and ground water irrigation systems. The subsidized, community-owned irrigation projects are viewed by the government as more effective than subsidies provided to individual farmers or firms.

Challenges in the area of irrigation subsidies include rapidly ageing infrastructure, lack of coordination between agriculture and irrigation agencies, and limited institutional capacity.[109] Subsidy programs change regularly; with various agencies providing subsidies, problems arise. There are instances of duplication in the programs as well as in recipients, while information about current opportunities often fails to reach the more remote farmers. Application processes — which often require registration, recommendation letters, and proposals — are too complicated for most farmers. Some private companies allege that the subsidies create market distortions — especially around the capital subsidies for irrigation machinery — as farmers and cooperatives wait for subsidies before purchasing. The prices of irrigation equipment administered through subsidy programs vary; in some cases, they are higher than market value. Finally, limited staff are available to monitor and evaluate subsidy programs at the local level.

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[105] Subedi, A., "As rains falter, water harvesting quenches Nepal's thirst for irrigation", Reuters, 2019, available at: https://www.reuters.com/article/us-nepal-water-climate-change/as-rains-falter-water-harvesting-quenches-nepals-thirst-for-irrigation-idUSKCN1U41YL

[106] Paudel, S.P.; Basnyat, M.S., "Subsidy in Agricultural Mechanization in Nepal", 2019, available at: www.un-csam.org/PPTa/1911RF7_ROK/28th/PDF/5.%20Country%20Presentation_Nepal_Mr.%20Basynat.pdf

[107] Paudel and Basnyat, 2019.

[108] Irrigation Policy, 2003.

[109] World Bank, “Nepal: Irrigation and Water Resource Management”, 2014, available at: https://www.worldbank.org/en/results/2014/04/11/nepal-irrigation-and-water-resource-management#:~:text=Some%20of%20the%20key%20challenges,weak%20institutional%20capacity%3B%20weak%20linkages

## 3.2. The case for digitizing the subsidy system

Digitizing agricultural subsidy programs can help improve the effectiveness and efficiency of subsidy programs around the world. In India, transitioning to the Direct Benefit Transfer (DBT) system has prevented more than USD 23 billion from going into the wrong hands.[110] Digitization enables governments to disintermediate many stakeholders along the subsidy supply chain, decreasing the number of individuals handling subsidy funds and the leakage that traditionally occurs.

Governments usually cite the following primary reasons for the digitization of subsidies:

1) ***Increased transparency:*** Tracking cargo from point of origin or import into the country up to the final use level increases transparency. Possibilities for intermediaries to substitute cargo with lower quality supplements are reduced, as is the potential to tamper with transacted volumes and associated prices. The automated fertilizer distribution system in India is a case in point. Real-time information flow is one of the key benefits of digitization for individual farmers and service providers and creates potential benefits at various layers of agricultural supply chains. Digitization also allows for greater accountability, enabling improved oversight that helps to ensure subsidies reach their intended users.
2) ***Efficiency gains:*** Digitization can support the streamlining of processes such as subsidy recipient targeting and streamlining of subsidy distribution. A robust registry of beneficiaries, typically linked to a foundational ID system, can enable subsidies to reach beneficiaries directly, disintermediating mid-stream stakeholders that add to costs. Digitization can also build efficiencies in the monitoring and reporting of subsidy programming, enabling real-time tracking of distributions and faster budget reconciliation processes.
3) ***Medium- to long-term cost savings:*** Digitization of subsidy systems generally follows similar expenditure patterns to other areas of ICT development and establishment: Initial investment costs (for technology and related training and capacity building) are high. Cost savings generated by automated business processes follow and reduce operating costs only in the medium to long term, but can be significant overall. This expenditure pattern — high initial investment and higher maintenance and system operating costs with significantly reduced general operating costs — may appeal to the central government. Investment costs need to be budgeted only once and can be shared with international development partners keen to invest in this segment of modernizing farm sector operations. Cost reductions then occur in the medium to long term through reduced loss and wastage, as well as savings in monitoring and supervising subsidy flows to the farming sector.

**Case example: Digitization of India's nutrient-based fertilizer subsidy scheme**

To promote the balanced use of fertilizers in Indian agriculture, the comprehensive Indian fertilizer subsidy scheme allows manufacturers, marketers, and importers to fix the maximum retail price (MRP) of NPK fertilizers at reasonable levels. The subsidy that the Indian government provides is based on the total nutrient presence in the fertilizer. The scheme ensures that adequate quantities of fertilizer are available to farmers at a controlled price. The Government of India pays the difference between the delivered cost of fertilizers at farm gate and MRP payable by the farmer, as a subsidy to the fertilizer

[110] Mint, "Govt saved ₹1.7 trillion via direct transfer of subsidies, says President", available at: https://www.livemint.com/news/india/govt-saved-rs-1-7-trillion-via-direct-transfer-of-subsides-says-president-11580457232905.html

manufacturer or importer.[111] Subsidy payments are released to the fertilizer companies and dealers on based on actual sales made to beneficiaries.[112] As a result of the scheme, the application of NPK portions of a balanced fertilizer dose have increased significantly.

The fertilizer subsidy system was automated to increase its efficiency, with the fertilizer shops (agrodealers) as the lynchpin. These retail shops are licensed by state governments and sell fertilizer on a commission basis. The Mobile Fertilizer Management System was introduced by MoALD to digitize the fertilizer distribution supply chain. In 2016 it took its most significant step when it piloted a DBT system to pay the subsidy. The pilot was followed by a pan-India rollout in 2018. The DBT system enabled end-to-end automation of the system, significantly improving efficiency. Farmers must prove their eligibility through their identity at time of purchase – usually through the nationwide identity card, Aadhaar, and via fingerprinting on the point-of-sale machine. Once the point-of-sale machine verifies the buyer's identity, the retailer sells them the fertilizer at the subsidized price, the sale is recorded in the fertilizer management system, and the subsidy is remitted to the manufacturer.[113]

### 3.2.1. Enabling Environment Requirements

To smoothly digitize subsidy programs, a variety of enablers should be in place first. It is rare for a digitization effort to work well without the below key elements.

1) **Infrastructure:** All digital transformation initiatives rely on two infrastructure elements to function: a) network connectivity; and b) access to energy. Without network connectivity, digital services remain locked on local hardware devices, and data cannot reach the cloud where the intended parties can reliably access and use it. Energy is crucial for network connectivity, enabling mobile towers to provide a connection – and for hardware on the ground (e.g., a mobile phone, tablet, IoT sensor, or computer) to operate.
2) **Hardware:** As mentioned above, hardware such as mobile phones are the gatekeepers between the physical and digital world. They enable digitization and storage of information for future use. For subsidy programs, specific types of hardware have been used for tracking subsidy voucher transactions and providing places for beneficiaries to store their subsidy information securely:
    a) Basic mobile phones can receive digital money on an e-wallet or receive a voucher code and password to reimburse the subsidy; and
    b) Point-of-sale devices can be used to record transactions and reconcile subsidy disbursements.

    These point-of-sale devices can take a variety of forms, including basic card readers that enable data entry, biometric (finger or facial recognition) devices, or a smartphone that can act as a point of sale with QR codes and biometric verification.
3) **Foundational ID system:** Section 2.3.3 discussed the importance of IDs, describing the Kisan ID. The absence of a foundation ID system makes direct distribution to beneficiaries nearly impossible. An ID system allows subsidy programs to better organize beneficiaries, provides easier subsidy application and registration processes, and enables more transparent distributions of subsidies that reduce occurrences of duplication.

[111] Byju's, "Nutrient Based Subsidy Scheme [Fertilizer Policy] - UPSC Notes", available at: https://byjus.com/free-ias-prep/nutrient-based-subsidy-scheme/
[112] The Economic Times, "Urea may come under NBS before direct cash transfer", available at: https://economictimes.indiatimes.com/news/economy/policy/urea-may-come-under-nbs-before-direct-cash-transfer/articleshow/73408682.cms?from=mdr
[113] Microsave, 2020.

4) **Institutional buy-in:** The digital transformation of subsidy programs also requires buy-in from the institutions responsible for implementing it. Most governments around the world understand the need for digital transformation, but this need may not manifest into investment and commitment. Corruption thrives where there is a lack of transparency and poor accountability. Digital transformation's primary goal is to improve on these two factors, which may lead to pushback and less buy-in from key stakeholders who previously benefitted.

### 3.2.2. Nepal's enabling environment

Nepal's enabling environment for the digital transformation of subsidies has both strengths and weaknesses. Due to the current transition to federalism, many subsidy programs are becoming less centrally managed, making it more difficult to deploy a nationwide solution. Nevertheless, regardless of who implements the subsidy program, the enabling environment for digital transformation must be in place. The below analysis examines the current enabling environment elements in Nepal.

**Infrastructure:** 3G network connectivity in Nepal is fairly strong, with 73 percent of the population covered;[114] 93.9 percent of the population has access to electricity.[115] While these national indicators suggest fairly good connectivity and energy infrastructure, it is crucial to assess local infrastructure when planning the rollout of a digital subsidy program and to ensure that these enablers do in fact exist in target areas. In addition to access, mobile internet is relatively affordable in Nepal, which is ranked in the top 10 developing countries within the Affordable Internet Inde.[116] Despite these promising underlying infrastructure indicators, mobile broadband penetration is only around 40 percent, and is much lower in rural areas. Digital subsidy data entry points, such as cooperatives in rural areas, may run into connectivity and energy issues.

**Hardware**: While unique mobile penetration is at 55 percent, the lack of smartphones in target areas continues to create issues. iDE references their survey showing a wide disparity of smartphone penetration between regions in Nepal, with the west having the lowest. Point-of-sale devices are also very rare in Nepal; credit and debit card penetration is around 9 percent of the population.[117] Point-of-sale terminals are mostly an urban phenomenon, and there is a very low likelihood that agrovets and other relevant retailers for subsidy programs will have a point-of-sale device. Smartphone penetration is growing — a report by mobile network operator Ncell has smartphone penetration growing from 15 percent in 2013 to 60 percent in 2020[118] — and this growth will likely continue as the cost of smartphones and data decrease over time. Smartphones will likely be the better option for point-of-sale hardware to track subsidy transactions.

**Foundational ID:** Nepal does not yet have a foundational ID, but the EU-funded Kisan ID initiative discussed above promised to provide one in the future. The Kisan ID project plans to begin registering an initial group of farmers who qualify for subsidies. This first step in establishing a foundational ID for

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[114] GSMA, "GSMA Mobile Connectivity Index", available at: http://www.mobileconnectivityindex.com/#year=2018&zoneIsocode=NPL&analysisView=NPL
[115] World Bank, Sustainable Energy for All (SE4ALL) database.
[116] A4AI 2020 Affordability Report, available at: https://a4ai.org/affordability-report/report/2020/#what_is_the_state_of_internet_affordability_and_policy?
[117] The Global Economy, "Nepal: Percent people with debit cards", available at: https://www.theglobaleconomy.com/Nepal/people_with_debit_cards/
[118] Nepali Telecom, "Smartphone penetration in Nepal and the impact", available at: https://www.nepalitelecom.com/2018/03/smartphone-penetration-nepal-and-the-impact.html

farmers can link to a digital subsidy system that helps to better organize and distribute subsidies directly to farmers who meet the respective criteria.

**Institutional buy-in:** The Government of Nepal, and specifically MoALD, recognize that digitization needs to occur within the inputs market system generally in Nepal. For this reason they have been pushing initiatives such as the Fertilizer Management System, their work on the Kisan ID, and their support of the DESIS platform. All of these digital initiatives also support the Digital Framework Nepal 2019's recommendations for the agriculture sector. Nevertheless, these initiatives lack a cohesive organizing mechanism that can ensure their similar objectives benefit a broader digitization effort of government subsidy programs. There should be high-level coordination, ideally between the different actors within MoALD responsible for initiative oversight.

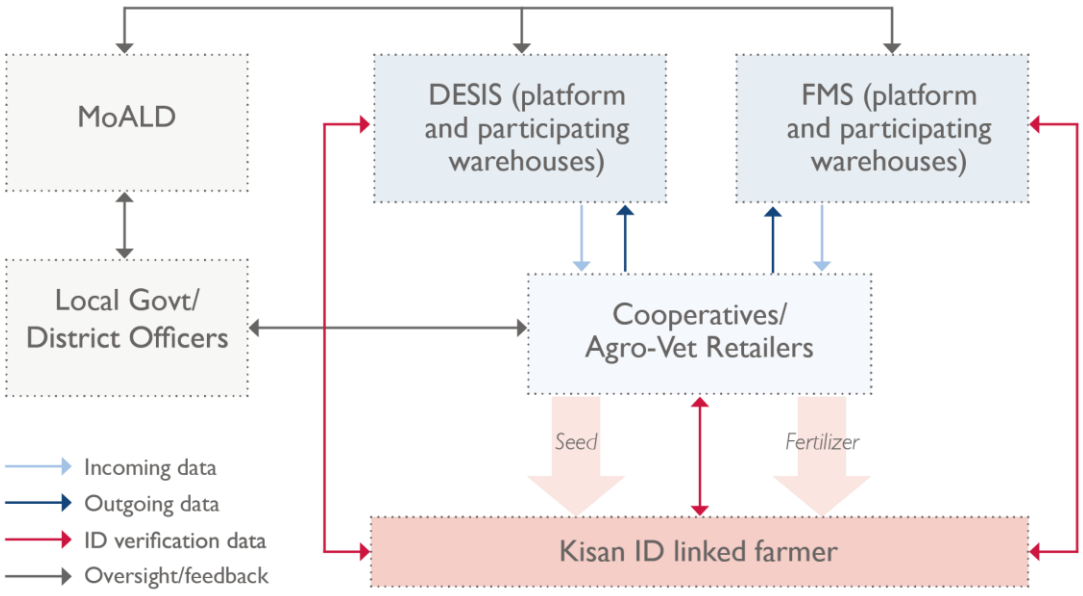
### 3.2.3. Coordinating digital transformation initiatives to benefit subsidies

Based on our analysis of the input market systems in Nepal, three existing digital transformation projects will support the more efficient and transparent distribution of future subsidies:

1) The Kisan ID national farmer registry
2) AICL and STCL's Fertilizer Management System (FMS)
3) The DESIS seed demand forecasting system

The stakeholders involved in these digital transformation projects are often similar and include the organizations closest to the farmers, such as cooperatives and agrovet dealers. Supporting coordination between DESIS, the FMS, and the Kisan ID system will deliver platforms that enable more oversight and analytics on subsidy supply chains, leading to increased transparency, efficiency, and cost savings in the long term. The below figure displays the ways in which DESIS and FMS are linked through similar stakeholders and information flow.

**Figure 12. DESIS and FMS stakeholder information flow**



While the information that DESIS and FMS collect and distribute is different, linking their platforms to Kisan ID would enable sharing of data on seed and fertilizer subsidies awarded to the same verified farmer to local and national government actors. This sharing would help government stakeholders track who is receiving subsidies and enable a way for farmers, cooperatives, and agrovets to provide feedback. Feedback will support a more accountable subsidy system, leading to further efficiencies.

Integrating with the Kisan ID system will allow local government stakeholders, such as AKC staff, to establish a database of farmers who qualify for subsidies. This effort will initially involve a significant time investment, but the database would streamline the paper-based application processes and help reach farmers with subsidies who might not have been aware of their existence. An agricultural officer in the Gandaki province cited a lack of local staff to manage all projects.[119] This shortage led to officers mainly working on administrative issues in-office, instead of monitoring and providing support to farmers. Automating some elements of subsidy application processes through data linked between FMS, DESIS, and the Kisan ID platforms could reduce the time needed for administrative tasks and free officers to work more at farmgate.

Finally, improving digital literacy and capacity at the cooperative or agrovet level would improve the likelihood of digital transformation success. Digital literacy will be crucial for farmer-facing organizations to both use the new applications as well as become digital champions in their communities, helping to increase trust in technology. Digital capacity will also require the right hardware and connectivity for these organizations to access digital platforms. For both DESIS and FMS, the preferred hardware is a desktop or laptop computer that allows for web browsing and access to online portals for data entry. This assistance can be provided through direct grants for the hardware, or through subsidized financing that allows cooperatives to purchase hardware through a payment instalment plan.

### 3.2.4. Digitizing subsidy finance

The Kisan Credit Card, a new financial product targeted to the commercial farming segment in Nepal, offers potential inroads for delivering subsidies to the farming community. It provides a flexible line of credit for the purchase of agricultural inputs and small-scale investment items. The principal subsidy element is the reduced rate of interest of the open line of credit; other item-specific subsidies could also be channeled through this bank card. While the Kisan Credit Card has plans to target smallholder farmers, some bank partners may not feel comfortable extending lines of credit to farmers without considerable collateral, which will exclude many farmers that subsidies should target. For this reason, the Kisan ID initiative should be a priority in efforts to support the digital transformation of Nepal's agricultural subsidy programming.

### 3.2.5. Establishing the business case for digitization of subsidies: AKCs

As subsidies are highly political — and often the subject of criticism in Nepal — it was difficult to find data or extract cost information from interviews. For this study, we use information from two AKCs to examine ways digitization could improve efficiencies and save costs. Nepal's decentralization movement has put AKCs on the front lines of administration of multiple subsidies — including subsidies on planting materials, small irrigation, agriculture infrastructure, organic fertilizers, and agricultural machinery — making these units worthy of study. However, because AKCs determine many of their own subsidy

[119] Interview, Mr. Mohan Shrestha, Agri Officer, Agricultural Knowledge Center (Tanhun).

administration processes, it is still difficult to quantify the implications of potential digitization with much precision.

Despite the extensive list of subsidies they are tasked to administer, AKCs generally do not have a database or registry of farmers in their area. They rely on individual phone calls and field visits to collect information. Paperwork consumes a lot of staff labor; AKCs make no secret of having overstretched staff, who are unable to spend as much time monitoring in the field as they would like.

The primary advantages of digitizing subsidy administration at the AKC level follow:

- **More effective subsidy targeting**. With a dynamic database of farmers and their basic information — as promised by Kisan ID — AKCs could spend less time contacting farmers and determining eligibility, while improving access by farmers they know less well. Such a change could dramatically improve the reputation of agriculture subsidies in Nepal.
- **More staff time**. Agricultural officers within the AKCs spend a lot of time on paperwork. One AKC officer estimated that staff spend 80-90 percent of their time processing subsidy and grant programs for cooperatives and farmer-based organizations. An annual staff budget at an AKC is estimated at NPR 48,00,000. If a digitized system automated much of the record keeping needs, AKC staff could spend more time ensuring proper use of subsidy funds.
- ***Cost reduction. In addition to decreasing inefficient use of staff time, digitization could reduce mistakes that can have costly implications. Digital systems can also directly reduce other costs, including of paper and photocopiers.***

While we were unable to find studies detailing cost savings for digitizing subsidies, we can use cost savings from digitization of Mexican social safety programs as a proxy. In this case, the Mexican government saved 3.3 percent of their total expenditure by centralizing and digitizing their social protection and pension payments.[120] Using this figure, digitizing information required by the grant process could reduce staff time by an estimated 4 percent of total AKC staff expenditure in Nepal. This step would save an estimated NPR 192,000 per AKC per year. There are currently 51 AKCs in Nepal, leading to an estimated savings of NPR 9.8 million. While these savings do not necessarily reflect a reduction in budget, as described above it would enable agricultural officers to focus their time on other matters, including monitoring subsidies and demand forecasting, while making subsidy targeting more efficient. The AKC budgets are a very finite part of the entire subsidy system, so NPR values of savings would increase if one were to apply the 4-percent figure across the supply chain.

# 4. RECOMMENDATIONS

## 4.1. Recommendations to USAID

Potential digital strategies have been discussed in detail in the preceding sections for both the overall market system and subsidies. Here we list all our recommendations to USAID, grouped into three categories.

### 4.1.1. Support three core digital solutions

[120] Babatz, Guillermo. Sustained Effort, Saving Billions: Lessons from the Mexican Government's Shift to Electronic Payments. Better than Cash Alliance, 2013.

As discussed in this report, three developing digital solutions — Kisan ID, DESIS, and FMS — will provide immediate value to the input market systems, with potential to incorporate additional components to become core, multi-functional platforms that support subsidy programs.

The Government of Nepal owns all of these solutions, with varying degrees of leadership from the donor and NGO sector (including NSAF's significant role in DESIS). Given the significant role that the Government of Nepal plays in the agriculture market system, this involvement may be appropriate; however, Government of Nepal structures and processes go through frequent change. It may be necessary to help all three solutions adapt to those changes. We have made various recommendations to strengthen impact for the three solutions, though USAID should also directly consult the respective agencies to mutually agree on types of support that USAID and its implementing partners (IPs) will provide. The recommendations for DESIS are most specific, as NSAF currently plays a central role.

***Cross-solution recommendations***

- Facilitate leadership-level coordination among the three digital solutions to maximize data-sharing and leverage mutual purpose, including for subsidies.
- Encourage continued consultation with market system actors during the development and refinement of solutions, building buy-in and incentives for a full range of data collectors and users. Engaging industry associations could also add value.

***Recommendations for supporting DESIS (owner: SQCC)***

- Ensure that clear incentive structures are in place for data collectors.
- Ensure that essential data collectors and users have access to the necessary hardware, e.g., smartphones.
- Support training and marketing activities targeting the data users and data collectors of DESIS to ensure proper use of aggregated information – and that this information improves farmer access to quality seeds.
- Ask IPs to share their relevant datasets.
- Support or facilitate conversations for integration with:
    - Kisan ID;
    - electronic tracking solutions, such as AgriClear; and
    - an e-marketplace, most likely the Government of Nepal's e-Haat Bazaar.
- Explore and support potential development of a component using digital forms for the seed registration and/or certification processes.
- Ensure the creation of a sustainability plan after the NSAF project ends — one focusing on Government of Nepal ownership but leaving open the door for future USAID involvement.

***Recommendations for supporting FMS (owners: STCL and AICL)***

- Offer to help define and realize incentives for data collectors.
- Offer to support or facilitate conversations to encourge integration with:
    - Kisan ID;
    - payment systems; and
    - soil-testing data.
- Ask IPs to share their relevant datasets on soil health (e.g., NSAF).
- Support expansion to non-subsidized fertilizer trade, if possible (may be contingent on its formalization).

***Recommendations for supporting Kisan ID (owner: MoALD)***

- Support the Government of Nepal to use Kisan ID for targeting subsidies to farmers. Eventually, this effort should include integration of a payments platform and efforts to subscribe as many farmers as possible onto the service.

- Ask Ips to support their networks of farmer groups in facilitating farmer registration on the.
- Encourage any USAID activities that collect data on farmers and perhaps run their own farmer databases to consider ways to integrate or share this data with the Kisan ID rollout.
- Encourage IPs to integrate Kisan ID into their approaches.

### 4.1.2. Support exploration and development of other, sector-specific solutions

Beyond the three core solutions already in development, we recommend that USAID explore additional solution areas to support the inputs. More scope for private sector leadership may be found in market systems where the Government of Nepal plays a less central role – organic fertilizer, machinery, and small-scale irrigation.

- Explore potential to integrate priority content regarding agricultural inputs into digital information and advisory services. Such content could include instruction on selecting inputs, proper use of inputs, maintenance, and specialized topics like seed multiplication. Ideally, integrate on platforms that already have demonstrated success with target users.
- Hold discussions with electronic tracking system providers, organic fertilizer producers, organic farmers, and Organic Certification Nepal to assess demand for and feasibility of digital solutions that offer traceability.
- Commission deeper exploration on the viability of IoT sensors for precision agriculture and smart irrigation, in alignment with the Digital Nepal Framework. Support subsequent solution testing and development.
- Explore and facilitate the development of a digital machinery rental system. Start by convening conversations between existing (international) providers and stakeholders. Though the private sector would likely lead the digital solution, engage DoAEngg as a key stakeholder supporting custom hiring centers.
- Support the growth and reach of private-sector smart irrigation systems.

### 4.1.3. Support the broader enabling environment

USAID's investment could increase uptake and affect digital solutions for agricultural inputs in broader areas:

- Support the development of digital finance solutions, expanding access to finance — subsidized or not — to supply chain actors, including farmers. Facilitating integration with Kisan ID is a key area where USAID could contribute to success.
- Encourage data-sharing across the agricultural landscape, acting as a role model through IPs.
- Support the expansion of network access in rural Nepal, such as through initiatives like the Rural Telecommunications Development Fund. Where topography allows, building out of fiber backhaul networks will improve the quality of mobile broadband.
- Fund initiatives that support the growth of digital capacity and literacy among cooperatives to support quality data sources. Grow the digital literacy of additional stakeholder populations, from government officers to individual farmers.

## 4.2. Managing risks

As USAID supports digitization in the input market systems and subsidy schemes, it must do so with awareness of risks that digitization can bring, as well as strategies to mitigate or manage them.

### 4.2.1. Data protection and cybersecurity

### a. Data protection

As digital transformation continues to progress in Nepal, exponentially more data will be produced. Article 28 of the new constitution states the right to privacy, and protection of information is a fundamental right. The Individual Privacy Act (2018) gave a legal framework for protecting this fundamental right as stated in the constitution. The Act defines what is considered personal identifiable information (PII) and sets guidelines on how the public and private sectors can use this data. In addition to protecting the use of personal data, the Act also aims to ensure that all data collection is facilitated through consent of the individual providing the data. This requirement puts a larger, and needed, burden on digital service providers, who collect data from their customers on a regular basis. As many of the digital solutions we discuss require collecting PII, it is crucial to understand how they adhere to the Privacy Act, and to ensure that they provide requisite opportunities for consent at the customer level. Adhering to data protection laws is relevant for ensuring the responsible implementation of data sharing between Kisan ID and other platforms like DESIS and FMS.

### b. Cybersecurity

The COVID-19 pandemic has been a major driver of digitization in Nepal and around the world. The increased use of digital services also has led to an increase in cyber-attacks. The largest and most notable cyber-attacks in Nepal have occurred around ATM heists during the last two years and the hacking of the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system in 2017. Smaller data breaches — ones that result in the loss of PII, debit-card skimming, and money laundering — are either unresolved or unreported and ongoing.[121] Nepal Telecommunications Authority passed a new cybersecurity bylaw in 2020. The bylaw is meant to protect ICT systems in Nepal from attack and requires all ISPs and telecommunication companies to use a national cyber risk sharing platform. In addition to establishing a cybersecurity community that collaborates on prevention, the bylaws will also require audits of their systems, as well as protection measures set by international standards.

Most cyber-attacks target Nepal's digital payment ecosystem, so most of the cyber risk for agriculture lies within financial service delivery. Ensuring that any payment service providers working with farmers adhere to the new bylaws and participate in IT audits will help to mitigate risk. Additionally, it will be important to educate farmers on the risks associated with digital wallets and other cases of data breaches. Digital literacy trainings should include modules on misinformation and common fraudulent schemes meant to convince users to disclose private information such as pin codes.

## 4.2.2. Digital divide

Without attention to the digital divide, the implementation of digital solutions risks exclusion of populations that may need the most support. The non-connected may lose access to information and opportunities. If they are already worse off, the result will be exacerbation of existing inequalities. A multi-pronged approach to manage this risk could include efforts to both narrow the divide and to ensure continued inclusion of the non-connected. Suggested components of such an approach follow:

1. *Expanding digital access and literacy.* Investments could include supporting expansion of mobile network coverage into yet unreached parts of the country, subsidizing smartphones or airtime for low-income households, and sponsoring initiatives to increase digital literacy.

[121] The Kathmandu Post, "Cybersecurity: A strategic imperative for Nepal", available at: https://kathmandupost.com/columns/2019/10/18/cybersecurity-a-strategic-imperative-for-nepal

2. *Enhancing relevance and usability for underrepresented groups.* Designers of digital tools tend to focus on the needs and preferences of their highest-value users, but USAID can use its position to support inclusion of less commercially attractive potential users in design considerations. As a result, such populations find the tool relevant and easy to use. Tech developers we consulted hypothesized that digital tools that offered quick types of engagement on basic phones — at least in the short term — would attract more women users who are busy and may not have a smartphone. Including groups with lower levels of education might point designers toward simpler interfaces with less complex text to read and more audio – and lead to these users' increased engagement with the final product.
3. *Supporting the continuation of non-digital options.* To prevent harm to populations that are excluded from or opt out of digital engagement, options should remain for farmers and others to access information and resources non-digitally. This effort must be thoughtful and still ensure the realization of efficiency gains of digitization.

### 4.2.3. Economic losers

While the increased transparency that can come with digitization may lead to a more efficient market and lower prices for farmers, it will also create losers who become worse-off. It is important to understand these stakeholders and the effects of this dynamic on the market system. Some losses may be intended – e.g., corrupt officials can no longer line their pockets. This outcome can fan resistance to digitization within government. Separately, many retailers currently earn a significant portion of their income from the difference in their purchase price and sale price, while playing valuable market roles – including transporting goods, educating farmers on proper use of inputs, and in some cases, offering financing options to buyers. E-marketplace systems that sell directly to farmers with fixed prices could put such actors out of business – or they could engage them in similar, paid roles, thereby earning the support of actors that farmers trust.

## 4.3. Concluding thoughts

Several opportunities exist for USAID to support the digitization of Nepal's agricultural input market systems and subsidies, toward objectives of greater efficiencies and increased farmer uptake. Digitization strategies will occur in complex systems that undergo frequent change and face challenges. Digital alone will not be able to solve these challenges – and it cannot replace sound policies, structures, and other enabling environment factors.

The Principles for Digital Development, co-drafted by USAID, offer important guidelines for strategic development of digital solutions. While some digital development in Nepal will necessarily be led by the government, given the heavy role it plays in the market system, USAID can be a leader in convening stakeholders for design and collaboration and modeling data-sharing (as privacy rules permit). We have recommended that USAID focus on building on existing digital platforms for most areas. When USAID offers support to new idea development, having a plan for sustainability from the beginning is important; even if the plan changes, digital tools should not be built with a dependence on USAID funds.