

# Cereal Grain Harvesting and Post-Harvest Machinery in Nepal: A National Value Chain Study

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Cereal Systems Initiative for South Asia



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## A National Value Chain Study

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Cereal Systems Initiative for South Asia

The Cereal Systems Initiative for South Asia (CSISA) was established in 2009 with a goal of benefiting more than 8 million farmers by the end of 2022. The project is led by the International Maize and Wheat Improvement Center (CIMMYT) and implemented jointly with the International Food Policy Research Institute (IFPRI), the International Rice Research Institute (IRRI) and the International Water Management Institute (IWMI). Operating in rural 'innovation hubs' in Bangladesh, India and Nepal, CSISA works to increase the adoption of various resource-conserving and climate-resilient technologies, and improve farmers' access to market information and enterprise development. CSISA supports women farmers by improving their access and exposure to modern and improved technological innovations, knowledge and entrepreneurial skills. CSISA works in synergy with regional and national efforts, collaborating with myriad public, civil society and private-sector partners.

The International Maize and Wheat Improvement Center (CIMMYT) is the global leader on publicly funded maize and wheat research and related farming systems. Headquartered near Mexico City, Mexico, CIMMYT works with hundreds of partners throughout the developing world to sustainably increase the productivity of maize and wheat cropping systems, thus improving global food security and reducing poverty. CIMMYT is a member of the CGIAR Consortium and leads the CGIAR Research Programs on MAIZE and WHEAT. The Center receives support from national governments, foundations, development banks and other public and private agencies.

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Intensive cropping systems that include rice, wheat and/or maize are widespread throughout South Asia. These systems constitute the main economic activity in many rural areas and provide staple food for millions of people. The decrease in the rate of growth of cereal production in South Asia is therefore of great concern. Simultaneously, issues of resource degradation, declining labor availability and climate variability pose steep challenges for achieving the goals of improving food security and rural livelihoods.

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### CSISA Goals

- Facilitate widespread adoption of resource-conserving practices, technologies and services that increase yields with lower water, labor and input costs.
- Support mainstreaming innovations in national-, state- and district-level government programs to improve long-term impacts achieved through investments in the agricultural sector.
- Generate and disseminate new knowledge on cropping system management practices that can withstand the impacts of climate change in South Asia.
- Improve the policy environment to facilitate the adoption of sustainable intensification technologies.
- Build strategic partnerships that can sustain and enhance the scale of benefits accrued through improving cereal system productivity.

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# Executive Summary

## A. Introduction

The agriculture sector in Nepal constitutes almost 30% of the country's GDP and contributes 21% of employment in the country. Rice is the main crop with an average production of 3.4 metric tonnes (Mt) per hectare while wheat averages 1.6 Mt per hectare. The mechanization of harvesting is one of the main policies pursued by the Government of Nepal for agricultural modernization.

This report provides an overview of the value chains of rice, wheat and maize harvesting equipment available in Nepal, from manufacturing and importing of machines to farm-level service provision. It covers a number of grain-harvesting machines and equipment and their use in Nepal's Terai southern plains, particularly in selected districts in Parasi, Rupandehi, Kapilvastu, Banke, Bardiya in Lumbini province and Kailali in Sudurpashchim province and their associated value chains in Kathmandu and abroad.

## B. Agricultural mechanization

The major government program that supports mechanization is the provision of subsidies to buy agricultural machines. Originally these subsidies were channeled through the Department of Agriculture's Engineering Directorate, Prime Minister's Agricultural Modernization Program (PMAMP) and Agriculture District Offices. After decentralization in 2018 the majority of the subsidies are now implemented by local governments. These schemes subsidize 50%–75% of the cost of new machines. Local governments design their schemes based on prioritized crops and the machines needed in their areas.

Crops were traditionally harvested manually in the Terai, that for the average farmer could take month or more to finish. By the 2000s nearly all wheat in the Terai was threshed with powered threshers. Rice threshers came later and by 2015 about 75% of all rice in the Terai was threshed with powered rice threshers. Full mechanization of rice and wheat harvesting by combine harvesters began in Rupandehi and Kapilvastu districts in the late 1990s and by 2015 had spread to neighboring district of Parasi, but also Bara and Parsa Districts with approximately 400 units sold. Straw reapers, which follow combine harvesters to cut and harvest the straw for cattle feed can be found but are much less common.

## C. Agricultural machines

The reaper harvesters come in three types: A fixed self-propelled reaper; as attachments for 2-wheeled tractors (2WTs); and 4-wheel tractors (4WTs). All cut and lay rice and wheat crops in a windrow for drying and collection.

Self-propelled reapers (also known as walk-behind reapers) represent approximately 5-10% of the total reaper sales are reapers that harvest a 1.2 meter wide swath of rice or wheat are permanently attached to two-wheeled mini-tiller and where the operator must walk behind. They are relatively expensive, but their light weight (under 150 kilograms) means they can be easily maneuvered and transported. This also means they can be used in muddy conditions where larger reapers and combines would sink into the mud. This makes self-propelled reapers a favorite of small landholders and hill farmers with sloped land and for farmers to harvest earlier planted or early maturing varieties of rice from not yet dry fields.

2WT reapers cut a swath of grain 1.2 or 1.4 meter wide and has the advantage of higher harvesting speeds and with the operator sitting at the rear of the tractor. This means drivers can work longer hours and leads to larger area harvested each day. These reapers began to spread in 2015, and by 2018 nearly 3,000 2WT had been sold in Nepal, mostly in the mid and far western Terai though eastern Terai markets are now starting.

4WT mounted reaper implements are larger machines (2.0 – 2.4 meters wide) mounted on the front of 4WT and can harvest even more area per day. They too began to spread in 2015, and by 2018 nearly 100 4WT reapers had been sold in Nepal. And again mostly in the mid and far western Terai. Threshers are also common and come in several types and models. Rice and wheat need different types of threshers. But in the last decade multi-crop rice-wheat threshers are available and their sales are increasing, although their 25% higher price than single-crop threshers limits uptake.

The most popular threshers in the Terai are the very mobile and larger horsepower (HP) tractor (PTO) driven threshers that are trailed behind a 4WT. The majority are manufactured in India but there are pockets of manufacturing along the Terai. Their capacity can differ but generally greater than 2 tons per hour.

Popular in the Terai in 1990s and 2000s but now in much less demand are the smaller HP and less mobile or even fixed location threshers. They are manufactured in both India and Nepal and are and have less capacity. They often lack grain sifting or cleaner functions and can be powered by power tiller engines or electric motors.

Manual very light-weight and very portable open-drum threshers are powered using a pedal attached to the machine to drive the rotating open threshing drum. For these threshers, rice panicle (straw) bundles are hand held against the rotating drum to separate grain from straw. For use mostly in the mountains they have been available for decades in Nepal (both locally manufactured and imported) but demand since 2015 has greatly increased.

Combine harvesters are multi-function machines that harvesting, thresh and separate chaff from grain from standing crops. They are gaining popularity especially in the plains near the Indian border where the flatness of the land means that combines can large areas in a short time to produce large piles of clean ready-to-sell grain. With minor adjustments, standard combines can harvest both rice and wheat. The addition of maize headers enables the harvesting of row-planted maize.

Older models of shellers were of smaller 5-8 HP and the maize needed to be dehusked first (the husks cover the maize grains). Newer models of maize shellers in the Terai much larger, driven by 4WT PTPs and some models can both separate the husks that cover cobs, while shelling or separating grains from cobs. The very small 1-3 HP, electric powered Chinese machines are either de-huskers or shellers.

## D. Value chain actors

Thirty-eight study respondents owned between 1.33 to 5 hectares of farmland Their main crops were rice, wheat, maize, mustard, potato, pigeon pea, vegetables (mostly red gram and lentils with rice and wheat). They kept 30-50% of their rice and 10% of wheat for household consumption.

Among the value chain actors, importers play a vital role with most machines in Nepal imported overland from India or from China via Indian seaports to Nepal. Many larger importers are based in Kathmandu, though more and more are based in market towns of the Terai. The majority are selling four-wheeled tractors but also equipment like tractor implements, 2WTs, threshers pumpsets, etc are also in high demand.

There is only a small agricultural machinery manufacturing sector in Nepal because of the many challenges including the high cost of raw materials, lack of modern production technology, limited financing and competition from foreign machines. Threshers and trailers and trolleys for two and four wheeled tractors are manufactured in Nepal.

Machine distribution centers are set up by importers to display their machines. These machine distribution centers (branches) act as the point of sale for importers and to provide after-sales services and spare parts.

Independent local distributors set up shops to distribute machines with their inventory sourced from importers. Local distributors supply all except the largest agricultural machines like combine harvesters, 4WTs etc.

There are also independent dealers and agents who sell machines from various importers. Their advantage is that they can overcome the common problem of the delayed delivery of machinery by supplying more than one brand of machine. The more trusted dealers and agents can get machinery and necessary spare parts advanced to them by importers with payment only due on sale.

Many large farmers provide hire services with their machines after they have finished harvesting their own crops.

## E. Support services

Machine distributors also provide repair and maintenance especially for under warranty machines. Distributors employ mechanics. Owners usually turn to local mechanics after their warranties expire and when machines have to be repaired on farms. Local mechanics are located nearer and are usually cheaper than distributors' repair services.

The International Wheat and Maize Improvement Center (CIMMYT), and its Cereal Systems Initiative for South Asia (CSISA) project is the main international organization supporting farm mechanization in Nepal.

The Nepal Rastra Bank (NRB) has mandated banks to set aside 10% of their loan portfolios to agriculture. However, banks are reluctant to channel their resources to the sector as they consider smallholder farmers to be high-risk clients. Farmers are generally not given special treatment and often find it difficult to access bank loans.

The government's Prime Minister Agriculture Modernization Project (PMAMP) promote new technologies in specific crop zones and super zones to increase farm productivity.

The Nepal Agricultural Machinery Entrepreneurs Association (NAMEA) is the industry association for the importers and distributors and agricultural machinery in Nepal. It facilitates annual exhibitions that showcase the latest in agricultural machines to service providers and training technicians on maintaining and repairing machines.

## F. Value chain influencers

The government is committed to promoting agricultural mechanization but has only limited resources to enable the full mechanization of agriculture. Government programs may not be enough to fast track mechanization, but are good building blocks for the more sustained growth of the industry.

Outside tractor and thresher markets, the agricultural machinery business is growing but will take more time for it to mature. This condition happens when the machines become widely accessible to the farmer-users by reason of more service suppliers. The number of suppliers may increase when more importers venture into the business or there is an increase in the number of local manufacturers who can produce and compete in the market. With more suppliers and more machinery models to choose from, the price of machineries is expected to go down. Making agricultural machineries accessible and affordable to small landholding farmers will motivate them to acquire machineries and provide more machineries.

## G. Conclusions

### The market for grain-harvesting machines in Nepal

1. Nepal's grain-harvesting machinery business is a 'seller's market' in that consumers have limited influence on the available products. It is importers, distributors and dealers who control the types, quality, price, and other components of grain-harvesting machines sold in Nepal.
2. However, importers, distributors and dealers have little control over the types and the technological features of the machines they import from China and India as they are designed for Indian and Chinese conditions.
3. The market for grain-harvesting machines in Nepal is composed of farmers with small landholdings averaging 0.67 hectares, and with fewer farmers with large landholdings averaging 15 hectares.
4. The main factors that cause respondent-farmers to use agricultural machineries are shortages of farm labor, more efficient harvesting, affordable rental service, and time saved.
5. Current users of grain-harvesting machines can be segmented into three: farmers with farm lands in flat areas; farmers with farm lands in flat areas and with livestock; and farmers with farm lands in hilly areas. These farmers use small reapers and threshers; and bigger machines like combine harvesters and manual hand harvesting.

### Value chain actors

1. The industry's level of cooperation with other market stakeholders is limited to discussions about advocacy for government policies and programs.
2. There are very few professional publications to discuss and share the problems faced in the agri-machinery value chain.
3. Importers are the dominant actors in the agri-machinery value chain as they are the gatekeepers of machines that enter into Nepal.
4. Most dealers and independent sales agents are not tied to specific importers, enabling them to offer ranges of agricultural machines.
5. Most rental service providers of small grain-harvesting machines are passive operators with no systematic plan for their businesses.
6. There are very limited opportunities for local manufacturers to produce competitive harvesting machines. The main opportunities are to manufacture threshers, shellers, tractor trailers, cage wheels and hand tools. However, it is evident from other smaller South Asia countries like Bangladesh and Sri Lanka who also rely on imported agricultural machinery indicate they have a lively and growing small and medium sized manufacturing sub-sector in the above machinery but including centrifugal

irrigation pumps, and fast wearing spare parts of the more complicated machines like single cylinder diesel engines and two and four-wheel tractor transmissions, etc.

7. Most machines are bought based on their price with the government as one of the main 'buyers' under its subsidy schemes, leading to many inexpensive, lower quality machines.
8. World class machinery from Europe (German Claas combines, Italian BCS reapers, and Japanese Mitsubishi and Kubota 2 and 4-wheeled tractors) are finding niche markets in Nepal with large and mid-sized farmers.

### Support services

1. Government agencies particularly the Inland Revenue Department and the Department of Customs require more harmonization on codes for agricultural machinery and agricultural machinery spare parts to ensure such machines are characterized as agricultural and meet with rules targeting finance.
2. Local government units have different policies in selecting machineries and identifying suppliers that make it prone to solicitation of 'commission.' Corruption is not tolerated but instances of solicitation reflect that it is not addressed effectively.
3. As a relatively new professional organization (est. in 2015) NAMEA has grown to become the apex organization for the agri-machinery industry. It functions mainly as a spokesperson of the association but with limited program to improve the capacities of its members.
4. Most financial service see the agricultural sector as a high-risk area to provide loans to. The Nepal Rastra Bank have not fully address the issue of risk to motivate financial service providers to direct services to the industry.
5. International organizations support government efforts for agricultural mechanization by providing opportunities to experiment and consider the possibilities of machines in the country.

### Policy environment

1. Although the policy framework for agricultural mechanization is quite established more policy and regulatory interventions are needed i) for the enabling environment for local manufacturers, ii) to review of import duties and taxes on raw materials for domestic machine manufacturers and iii) on standards to ensure the safety and quality of imported machines.
2. The subsidy programs have contributed much to the adoption of agricultural machineries in Nepal.
3. Government and other program support for professional custom hiring centers is expected to increase.

4. Improvements in farm irrigation and rural roads will increase demand for farm mechanization.
5. Nepal's banks provide limited finance to Nepal's agriculture sector.

### The main bottlenecks to further agricultural mechanization

1. The main bottleneck to agricultural mechanization in Nepal is that machines, fuel and spare parts almost all come across the border from India and that this border can be choked off as happened in the 2015/16 blockade resulted in an economic crisis in Nepal.
2. The environment for the production of machines in Nepal is hampered by lack of information and data about successes and failures, the very few manufacturers, inaccessible and high cost raw materials, the low number of technically-skilled workers and limited access to financing.
3. The market for agricultural machines is 'weak' as the number of people who can afford them are small as most Nepali farmers own small areas of land.

## H. Recommendations

A systems-approach can be adopted in developing the value chain of grain-harvesting machines in Nepal. This means intervention in all areas—the market, value chain actors, support services and the environment.

### Continue to develop the 'market' for agricultural machinery

1. The market for grain harvesting machines in Nepal can be described as 'weak' because of the prevalence of small farmers. The subsidies and custom hiring centers, which address capacity (affordability), and road and irrigation development, which address willingness (incentives), should be continued.
2. The strategy to expand uptake should not be limited to establishing new custom hire centers. Cooperatives and even farmer groups are designed to share resources, and therefore should also be mobilized to purchase and rent out machines to their members. These organizations exist all over Nepal. Building their capacity to manage machinery rental may be faster and less expensive than building new custom hire centers.
3. Another approach to increase uptake would be to organize the large farmers who rent machines into associations so that they have a forum to share information and receive skills training.
4. More detailed studies on the market segments identified in this study (examples include 2 and 4WTs, Mini-tillers and milling, fodder machinery, etc.) would help inform extension-related training as well as marketing campaigns.

### Improve product promotion

1. The demand for the grain-harvesting machines can be determined by juxtaposing the market segments identified with the current types of farmers.
2. There are three main buyers of machines:
  - formal custom hire centers (both private and cooperative based);
  - less formal but still registered as well as unregistered farmer groups or associations (water user associations big and small set up by district irrigation office, KGKs, PMAMP and various other agencies and projects) who share agricultural machinery resources among their members informally.
  - then there are the informal sector. The largest by far (>90% of all service provision) made up of mix of small, medium and large entrepreneurial farmer families who purchase machines to use for themselves but especially to hire out as a side activity, and less often as a primary business (e.g. 2 and 4WTs owners who also provide transport services) .

All three of these groups receive varying governmental (central, provincial and municipality and rural municipality assistance in form of grants, subsidies etc.

3. The needs and expectations of these two segments differ, and distributors should tailor their marketing and support services accordingly.
4. This approach to segmenting the market can also help better understand and gauge demand. Currently, importers and distributors carry a wide variety of machines in order to meet all possible needs. A more targeted approach can help reduce inventory costs.

### Improve organizational capacity of value chain actors through business development

1. The business management systems of importers and distributors are outmoded and inefficient. Modern business tools and practices would make their operations efficient and increase profit.
2. For example, the effectiveness of maintaining company-owned branches versus affiliated distributors versus independent sales agents is unknown. A research initiative to study the costs and benefits of each will help promote sectoral efficiency.
3. Most value chain actors also lack a systematic approach to promotion. Using the "4 Ps" framework, they need support in the following areas:
  - **Product:** Customer satisfaction survey to determine if the product meet the users' expectations.

- **Price:** Sensitivity study to check on the competitiveness of the price and the factors that affects price determination.
  - **Promotion:** Customer profiling to determine the most appropriate marketing strategy. For e.g. up-selling and cross-selling techniques (encouraging customers to purchase a comparable higher-end product than the one in question, and also inviting customers to buy related or complementary items).
  - **Place:** Review of current distribution arrangements.
4. Value chain actors are also not skilled in conducting internal performance reviews to understand what is working or not in their business. A performance review is an input into a strategic marketing plan. One of the most common tool or technique is the Ansoff matrix that allows the actors to narrow define their products and the reach of its marketing efforts. The defined products and reach will give the idea of the strategy that can be employed .

### **Improve the capacities of institutions delivering support services to the value chain**

1. Develop NAMEA to make it a true professional organization that promotes value chain development. It can share knowledge, help expand networks by bringing in members from outside Kathmandu, and offer technical and business development support to its members.
2. Many rural youth refer to migrate than become a farmer, and few realize that there is technical work in agriculture. A technical-vocational (techvoc) approach to improving the skills of the youth with emphasis on agricultural machinery could provide some youth to an alternative to migration.
3. Importers should also increase the frequency of their technical training about their machines and involve more youth participants in order to develop a pool of technically-skilled youth in the community.
4. Banks, with support from Nepal Rastra Bank, should investigate ways to mitigating the risks of lending for agriculture. For example, a guarantee mechanism securing the loans of farmers borrowing from banks to purchase machines has been effectively implemented in Myanmar by the Livelihood and Food Security Trust Fund (LIFT) with private banks. The Agricultural Guarantee Fund Pool (AGFP) in the Philippines secures high-risk loans made by banks to farmers.

### **Enhance the enabling environment to develop the growth of agricultural machinery in Nepal**

A review of the current policies should be conducted to identify the gaps in the framework and existing policies. Among the areas to be reviewed are:

1. Support current efforts by the government to establish national standards and set up the National Agri-Machinery Testing and Research Center (NAMTRC) facility in Nawalpur, Sarlahi district to ensure better quality and improve safety of imported machines.
2. Review intellectual property rights to enhance branding of agricultural machinery products and to ensure that any local designs and innovations are protected.
3. Review agriculture risk mitigation programs to identify ways to encourage banks to lend more to the agriculture sector, particularly actors in agricultural machine value chains.
4. Review policies on chattel mortgage to increase the use of machines as collateral for bank loans.
5. Review taxes and custom duties on agricultural machineries and spare parts and raw materials especially for the emerging strategic initiative (the Ministry of Agriculture and Livestock Development's Agricultural Mechanization Operation Strategy) for development of local manufacturing.
6. Review the subsidy program to focus support to geographic areas where the use of agricultural machines is limited, reduce support for large machines that are not affordable to most farmers, and increase transparency in the management of the program.
7. Enhance technical and vocational education and training (TVET) system in Nepal to include courses with emphasis on agricultural machineries, their operation, repair, and maintenance.
8. Review the relevance of educational systems like family farm school (FFS) and its adoption in Nepal.
9. Formulate policy guidelines to build larger and stronger cooperatives and enable them to assume more complex functions, especially the capacity to manage enterprises such as custom hire centers.



# Abbreviations

2WT	2-wheeled tractor
4WT	4-wheeled tractor
CAIDMP	Centre for Agricultural Infrastructure Development and Mechanization Promotion
CIF	cost, insurance, and freight
CIMMYT	International Maize and Wheat Improvement Center
CSISA	Cereal Systems Initiative for South Asia
FGD	focal group discussion
GDP	gross domestic product
ha	hectare
hp	horsepower
JICA	Japan International Cooperation Agency
KISAN	Knowledge-Based Integrated Sustainable Agriculture in Nepal
Mt	metric tonnes
NAMEA	Nepal Agricultural Machinery Entrepreneurs' Association
NARC	Nepal Agriculture Research Council
NPR	Nepalese rupee
PMAMP	Prime Minister's Agriculture Modernization Project
PTO	power take-off
RPM	revolutions per minute
SWOT	strengths, weaknesses, opportunities and threats
USD	United States Dollar
VAT	value added tax

# 1 Introduction

## 1.1. Research rationale and objectives

In the plains area of Nepal's Terai and in larger valleys in the hills, many parts of rice and wheat grain production process are nearly 100% mechanized. The second half of wheat and rice harvesting—threshing and cleaning—was mechanized as early as the 1960s. By the mid-1990s nearly 100% of wheat in the Terai was being threshed mostly by stand-alone threshers that were powered by 5-8 horsepower (HP) diesel pumpset engines. Rice threshing began first in the far eastern Terai in early 2000s with similarly small-sized rice threshers with pumpset engines. However, by the 2010s as 4WTs became ubiquitous in the Terai, the larger horsepower tractor power take-off (PTO) driven wheat and rice threshers became prominent.

However, one of the main parts of the production process, the field harvesting of grain, is still not yet fully mechanized even though it has one of the largest labor requirements. Grain harvesting machinery entered Nepal from India in the late 1990s with the introduction of large 90+ horsepower self-propelled combines in central Terai (Parasi, Rupandehi and Kapilvastu Districts), mainly for wheat. Machines for rice harvesting were introduced in the Western Terai by the 2010s. In the last decade, the types and numbers of powered or mechanized harvest technologies in Nepal has greatly increased in size. With advent of many new machines from China and elsewhere, the market for grain harvest machinery has become very dynamic. Nevertheless, various bottlenecks limit access and usage far below demand.

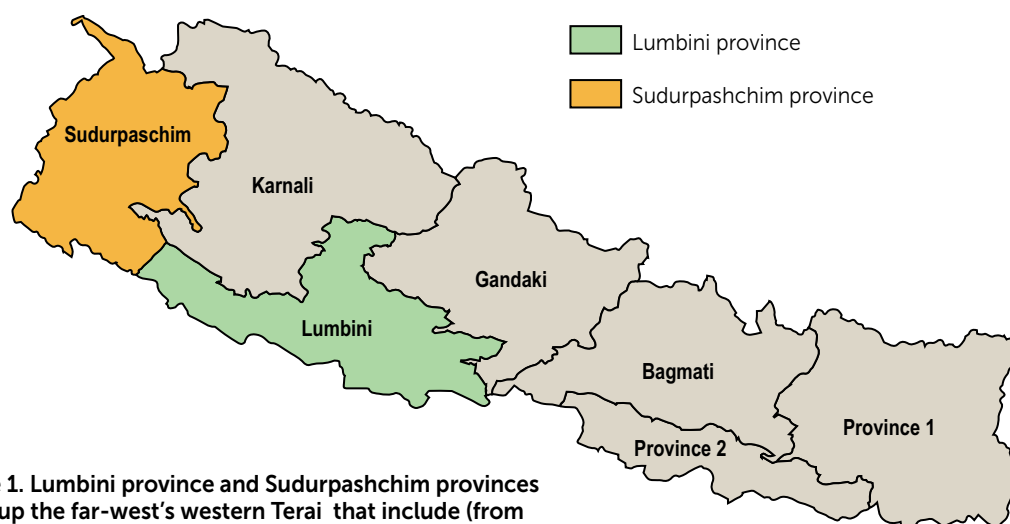
This report provides the results of a study on the value chains of rice, wheat and maize harvesting equipment that are used in Nepal by farmers and service providers. It documents the movement of

the various new technologies into the value chain, characterizing the whole harvesting machinery market. It provides a detailed value chain map of the various reaper-harvesters, threshers, shellers and combine harvesters that are now widely available for sale in Nepal with the overall goal of providing recommendations for policy makers and development agencies to promote greater access to and usage of such machinery.

The main objectives of the study were as follows:

- ♦ To analyze the value chain of grain-harvesting machines in use in Nepal and the various stakeholders in the value chain.
- ♦ To identify issues related to the use of grain-harvesting machines; and in particular:
  - The quality of harvested grain and the condition of soil after using heavier machines.
  - Seasonal differences that affect service providers.
  - Secondary product streams.
  - Gender related issues.
- ♦ To identify the factors that have contributed to the adoption, expansion and use of grain-harvesting machines by Nepali farmers
- ♦ To draft recommendations for value chain actors, government agencies, other stakeholders and supporting institutions to boost agricultural mechanization, particularly for harvesting crops.

This study covers the main types of grain-harvesting machines and equipment and their use in Nepal's southern plains Terai region, particularly in Parasi, Rupandehi and Kapilvastu, Banke and Bardiya in Lumbini province and Kailali in Sudurpashchim province as well as their associated value chains in Kathmandu and abroad.



**Figure 1. Lumbini province and Sudurpashchim provinces make up the far-west's western Terai that include (from east to west) Parasi, Rupandehi and Kapilvastu, Banke, Bardiya, Kailali and Kanchenpur districts.**



## 1.2. Study framework

Value chain analysis is a framework for evaluating all the activities necessary to bring a product or service to market (Porter 1985). Value chain development involves activities that strengthen the actors and the chain as a whole in order to add more value and/or rebalance the distribution of profits in the chain.

This study analyzed the value chains of grain harvesting machines most commonly used in Nepal. The research was focused on Provinces 5 and 7, although conditions in other crop production areas of Nepal were also investigated. The study identifies and analyzes the various actors in the chain, the support services provided to them, and the overall business environment that facilitates or hinders the promotion and use of harvesting machines. The study framework is presented in Figure 2.

The main outcome of the study is a series of recommendations that are presented in Chapter 7:

- ◆ Recommendations to enable actors in the value chain to deliver better products and services to final users.
- ◆ Recommendations to improve the business environment to make actors more productive and efficient, which will result in better products and services delivered to final users.

The study findings and recommendations were shared with more than 100 stakeholders at a workshop organized by NAMEA on 23<sup>rd</sup> November 2019 at the 4<sup>th</sup> National Agricultural Mechanization Exhibition and in a high level USAID program review at Chitwan and 27<sup>th</sup> February 2020 at Club Denovo Hotel in Butwal.

## 1.3. Methodology

The study gathered quantitative and qualitative data by administering stakeholder questionnaires, holding key informant interviews and focus group discussions (FGDs), observing the market, and reviewing secondary data. The specific research activities were as follows:

**Identification of machines** – The terms of reference (ToR) called for analyzing 16 different types of harvest machines and equipment.

**Secondary data review** – The research team reviewed published and unpublished reports about agriculture and crop production, agricultural mechanization, and agricultural machines used in Nepal. The main sources of secondary data are:

- ◆ National and local-level government reports.
- ◆ Published materials from bilateral and multilateral agencies and organizations that work on agricultural mechanization in Nepal – particularly the International Maize and Wheat Improvement Center (CIMMYT) and the Cereal Systems Initiative for South Asia (CSISA).
- ◆ Publications by international and local NGOs that have worked in Nepal on harvesting activities.
- ◆ Relevant news and feature articles in newspapers and magazines.

A list of the secondary materials referenced in this report are listed in the Annex.

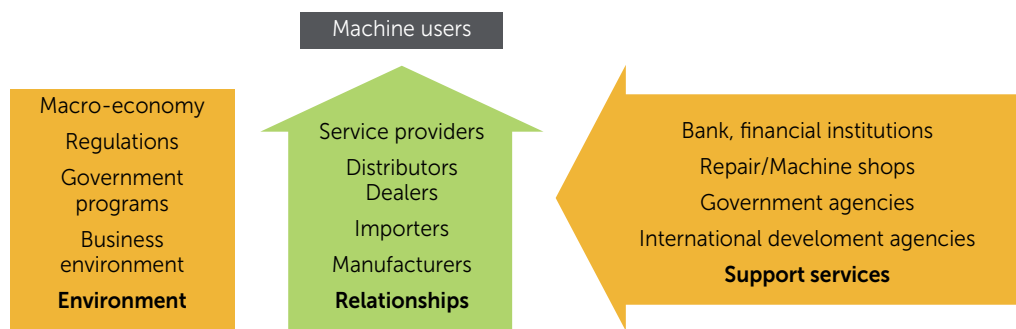


Figure 2. Framework of Nepal National Value Chain Study on Grain Harvesting Machinery.

**Primary data gathering** – Four methodologies were employed to collect primary data:

- ♦ *Direct observation* – The research team observed the physical features of the machinery and more than thirty places where they are sold, rented, used, and repaired, not only in Lumbini province and 7 but elsewhere in Nepal as well.
- ♦ *Key informant interviews* – Thirty key informant interviews were carried out with the range of actors involved in the value chain:
  - Nepal-based manufacturers and importers.
  - Machinery dealerships partially or fully owned by importers and independent distributors, dealers, and sales agents (selected from among the members of the Nepal Agricultural Machinery Entrepreneurs' Association, NAMEA); The distributors and dealers in Lumbini province and Sudurpashchim province were identified through various contacts and a search in the bazaars for showrooms etc.
  - Mechanics and spare parts providers.
  - Rental service providers (identified through referrals from CSISA and CIMMYT contact persons).
  - Government agriculture personnel.
  - The key informant interview questionnaires were drafted for each type of value chain actor and shared with the CIMMYT team to ensure they covered all required information.
- ♦ *Focus group discussions* – Ten focus group discussions were held with farmer-users who rent machines from owners to corroborate the findings from the other research methods. The participants were referred by CSISA and CIMMYT personnel and distributors and dealers in Lumbini province and Sudurpashchim province.

**The administration, translation, and analysis of questionnaires** – Separate questionnaires for manufacturers, importers, distributors, repair and maintenance shops and government agencies and were produced in English, as well as an FGD guide. The questionnaires were administered to 30 informants and ten FGDs were conducted in Nepali. The responses were written in Nepali and afterwards translated into English as the official data product. The information was then encoded in Excel for use in analysis.

The schedule of activities conducted by the research team are listed in Table 1.

**Table 1. Activities conducted by the research team.**

Date	Activities and areas
15 July 2019	Orientation of the team by Gokul Paudel (CIMMYT)
16-19 July 2019	Team preparation and coordination and review of secondary materials
18-19 July 2019	Interviews with Kathmandu-based stakeholders
22-23 July 2019	Field data gathering: Bharatpur and Parasi
24-25 July 2019	Field data gathering: Rupandehi
26 July 2019	Field data gathering: Kapilvastu
28 July 2019	Field data gathering: Dang
29 July 2019	Field data gathering: Banke
30-31 July 2019	Field data gathering: Bardiya
1-2 August 2019	Field data gathering: Kailali
5-9 August 2019	Interviews with representatives of Kathmandu based banks, government agencies and other stakeholders. Tabulation and analysis of field data
12-21 August 2019	Report writing
22 August 2019	Submission of first draft study report.

## 1.4. Limitations of the study

The main limitations of the study are as follows:

- ♦ The study mainly used qualitative methods to generate data and conclusions rather than conducting a quantitative survey with a large sample.
- ♦ Respondents were selected based on their availability and willingness to share information about the subject of the study rather than through a statistically rigorous selection process.
- ♦ The short timeframe for the study meant that the number of respondents was smaller than required for a statistically rigorous study.
- ♦ The FGDs and key informant interviews depended on the recollections of participants, which may not always be accurate.

The research team used data triangulation methods to address the limitations of the study by comparing answers from different stakeholders and different data gathering methods to validate information. Despite these limitations, the volume of information generated provided a good understanding of the dynamics of the grain-harvesting machine value chain and enabled the drawing of conclusions and recommendations to achieve the study's objectives.

## 2 Background

### 2.1. Economic and political profile

Nepal is a landlocked country that lies between two Asian giants—China and India. The 2011 census recorded a population of 28.7 million (CBS 2018). Agriculture remains a very important part of the country's economy and contributed 26.98% to gross domestic product (GDP) in 2018/19. In 2018/19, remittances from overseas Nepali workers contributed 9.1% to GDP. Another key source of foreign exchange is the tourism sector. In 2017, 800,000 tourists generated about USD 551 million in revenue for the country.

After the monarchy was dissolved in 2008, the current form of government is a republic. The country's continued transition to a democratic republic has not been without challenges. A communist insurgency that raged for ten years was settled in 2006 when a peace agreement was signed. A new constitution became effective in 2015, which ushered the start of federal decentralized governance through seven provinces and 753 local governments. The current national government has a clear majority in parliament and great expectations of being able to move the country towards progress and development.

### 2.2. Nepal's agricultural sector

A mountainous country, only 21% of Nepal's 147,181 km<sup>2</sup> are suitable for cultivating crops. The country's ecological regions are shown range from the southern Terai plains in the south to the high Himalayas in the north (Figure 3).

Nepal's estimated 2.5 million hectares (25,000 km<sup>2</sup>) of agricultural land is farmed by 3.8 million households. Agriculture provides 21% of employment in the country (CBS 2014). The average holding

size is only 0.67 hectares (or one *bigha*, the unit used in Nepal's Terai). In other words, landholding is fragmented. Moreover, most cultivable land is rain-fed. Only about 66% (1.7 million ha) is irrigable, of which 78% (1.3 million ha) is actually irrigated (MoAD 2018/19).

Nepalese agriculture faces a number of challenges. One local observer recently summarized the major problems that plague Nepal's agriculture sector:

*"Low capacity of production, increasing gap between the farmer and agricultural market, underdeveloped irrigation channels, dependence on traditional techniques along with unavailability of fertilizers, seeds, and research and technology." (Angbo 2019).*

The agriculture sector constitutes almost 27% of GDP,<sup>1</sup> with rice, wheat, and maize as the main crops.<sup>2</sup> The rice-wheat system dominates, with rice grown in the wet (monsoon) season and wheat in the dry (winter) season. The yield of the main crop, rice, averages 3.4 metric tonnes (Mt) per hectare<sup>3</sup> and wheat averages 1.6 Mt/ha.<sup>4</sup>

<sup>1</sup> Basnyat, Madhusudan, *Nepalese Agricultural Mechanization Policy and Strategy*, powerpoint presentation during the 5<sup>th</sup> Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific, December 2017, Sponsored by UN-ESCAP and CSAM

<sup>2</sup> Ibid

<sup>3</sup> Takeshima, Hiroyuki, *Overview of the Evolution of Agricultural Mechanization in Nepal: A Focus on Tractors and Combine Harvesters*, International Food Policy Research Institute, July 2017

<sup>4</sup> Devkota, N. and Phuyal R.K., *Climatic impact on Wheat production in Terai of Nepal*, The Journal of Development and Administrative Studies, Vol. 23, 2015

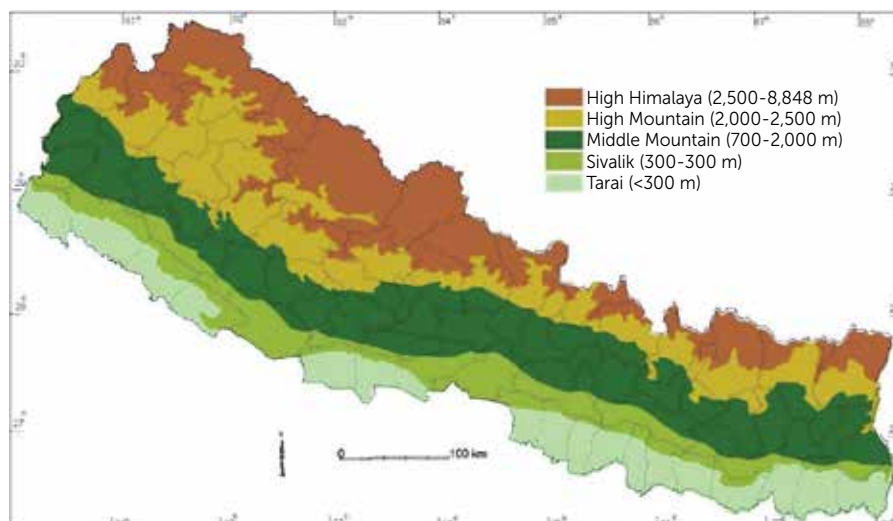


Figure 3. Ecological regions of Nepal (Source: Basnyat 2017).

## 2.3. Agricultural mechanization in Nepal

The following timeline lists key milestones, events, processes, policy changes, and the introduction of major machinery technologies in the national agricultural mechanization process of Nepal. Various policies and initiatives by the government of Nepal took place in the late 1980s, but policy responses vanished from the 1990s and mid 2000s. Biggs and Justice (2014) describe the period between 1990 – 2007 as the time that

donors and the academy shut down the debates on mechanization in developing countries and left this mechanization in the care of the private sector. Debates and interest in programming only picked up when during the economic crisis when agricultural wage rates doubled and labor started becoming scarce even in highly populated developing countries like Bangladesh as migration accelerated. After a slow start after the world financial crisis of 2007–08, a flood of new policies, activities and even new government agricultural mechanization offices and centers were established.

**Table 2. Key Milestones in Agricultural Mechanization in Nepal.**

Year	Key
1953:	The first modern farm equipment was imported for government agriculture and livestock farms.
1959:	The Agriculture Equipment Research Unit was established at Ranighat, Birgunj for researching and promoting agricultural equipment in the Terai. It developed iron ploughs and rice threshers. It is now under the Nepal Agricultural Research Council (NARC).
1964:	The Agriculture Tools Factory was established at Birgunj with support from the Soviet Union (USSR). It manufactured iron ploughs, pedal threshers, corn threshers, wheelbarrows, wheat threshers, pump sets and tractor trailers.
1970:	The importation of the first 2-wheeled tractor from Japan into Nepal. <sup>5</sup>
1971:	A JICA-funded project (Janakpur Agriculture Development Project [JADP]) promotes the use of deep tube-well irrigation, power-tiller and modern agriculture equipment
1973:	Nepal's Agriculture Development Bank (ADB), a government bank, starts to prioritize the loans for farmers to buy tractors and pumpsets. A German Technical Cooperation Agency (GTZ) program promoted the use of forage harvesters, incubator, hatchery and equipment to prepare silage.
1980:	The importation of the first Korean and Chinese 2-wheeled tractors. <sup>6</sup>
1985:	The use of wheat threshers began to spread from India into Nepal's Terai.
1990:	The sale of four wheeled tractors (4WTs), which had been stagnant in Nepal for about 20 years, began to increase in the Terai.
1991:	The Agriculture Engineering Division of NARC was established for testing and developing agricultural machinery.
1997:	First combine harvester service providers begin coming across from India to harvest crops in Rupandehi and Kapilvastu districts.
2000:	Stand-alone and PTO-driven rice threshers began to spread in eastern Terai.
2000:	The use of two-wheeled tractors (2WTs) begins to spread across Nepal's Terai.
2000:	The Institute of Engineering's Eastern Campus at Dharan started a bachelor degree course on agricultural engineering with about 48 students graduating each year
2004:	The Directorate of Agricultural Engineering (DoAEngg) of the Department of Agriculture (DoA) was established for agricultural engineering extension and training services. It no longer exists under the new federal system of government.
2005:	The purchase and use of Chinese diesel and petrol-powered pumpsets begin to spread in Nepal
2010:	The purchase and use of 2WT mini-tillers begin to spread outside the Kathmandu Valley.
2014:	The Agricultural Mechanization Promotion Policy, 2071 (2014) approved and the government started its subsidy program for farmers to buy agricultural machines.
2014:	The first National Agricultural Mechanization Exhibition was held at Narayanghat, Chitwan with more than 500 modern farm tools, equipment and machines displayed from 16 countries
2015:	The number of combine harvesters in Rupandehi, Kapilvastu and Parsa districts reaches 150 with their use spreading to Chitwan, Bara and Parsa districts.
2015:	The Nepal Agricultural Machinery Entrepreneurs' Association (NAMEA) was established
2015:	Initial subsidized sales of 20 2WT reapers in mid and Far Western Terai
2016:	The second National Agricultural Mechanization Exhibition held at Kohalpur, Banke
2017:	First International Agricultural Mechanization Exhibition held in Kathmandu
2018:	<ul style="list-style-type: none"> <li>Agricultural engineering and small irrigation sections established under provincial ministries of land management, agriculture &amp; cooperative (MoLMACs).</li> <li>Centre for Agricultural Infrastructure Development and Mechanization Promotion (CAIDMP) established</li> <li>Agricultural Engineering and Post-Harvest Section (AEPHS) set up under CAIDMP at Department of Agriculture (DoA)</li> <li>Agricultural Mechanization Promotion Center (AMPC), at Janakpur Agricultural Development Program</li> <li>Agricultural Mechanization and Small Irrigation Section established in all seven provinces under MoLMACs' Agricultural Development Directorates.</li> <li>2WT reapers overall sales total (2015–18) reach 2,800 in Mid-West and Far Western Terai</li> </ul>

<sup>5</sup> Biggs, Stephen and Justice, Scott, *Rural and Agricultural Mechanization: A History of the spread of Small Engines in Selected Asian Countries*, International Food Policy Research Institute (IFPRI), May 2015

<sup>6</sup> Biggs, Stephen and Justice, Scott, *Rural and Agricultural Mechanization: A History of the spread of Small Engines in Selected Asian Countries*, International Food Policy Research Institute (IFPRI), May 2015

## 2.4. Types of users

There are four types of owners of harvest machinery in Nepal:

**Farmers.** Some farmers acquired machines that they use on their own farms. Those with small machines usually do not rent them out to other farmers as it is only useful for their own farm.

**Rental service providers.** Farmers, usually those with large land holdings, often purchase large machines like combine harvesters and rent out their units to nearby smallholders after the crops have been harvested from their own farms.

**Cooperatives and farmers groups.** Organized groups acquire machines that can service the needs of their members. The machines are not owned individually by members but by the organization. The use of the machineries is scheduled by mutual agreement.

**Custom hire centers.** The custom hires centers are similar to cooperatives and farmers' groups in that the machines are not owned by any individual but an organization. The difference is that there is no membership requirement; anyone can walk in and be a customers of a machine hire center.

## 2.5. Policy framework for mechanization

Nepal's constitution and two major policy documents make agricultural mechanization a priority of the Government of Nepal. Additionally, tariff policies for importing agricultural machinery were set in the early 1990s to near zero percent, reflecting the government's early prioritization of mechanization under the Ministry of Agriculture and Livestock Development's Agricultural Mechanization Operation Strategy.. These low tariffs have had obvious benefits for sales, but when combined with tariffs of 26% on imported sheet metal and angle iron--key raw materials for most agri-machinery--the impact on domestic manufacturing has been very negative.

**The constitution** – "Protecting and promoting the rights and interests of peasants and using the land use policy of increasing production and productivity of agriculture and for commercialization, industrialization, diversification and modernization of agriculture" – Part 4, Article 51, Section e: Policies regarding agriculture and land reform.

### Agricultural Development Strategy (2015–2035)

– Agricultural mechanization is one of the outputs and core priorities for achieving higher productivity target under Nepal's overall agriculture development strategy. The strategy highlights the role of the private sector in mechanization, particularly for creating awareness, stimulating demand, concessionary financing, and building a dealer network.

**Agricultural Mechanization Promotion Policy, 2071 (2014)** – The goal of this policy is "to research, develop, adopt, extend, and promote agricultural machines, implements and equipment to increase agricultural productivity and make it sustainable and competitive."<sup>7</sup>

## 2.6. Current level of mechanization

As mechanization levels have grown in Nepal in the last 15 years, Nepal's farmers adopted a wider range of sizes and types of farm machinery. Today, many farmers in Nepal are beginning to demand or use new and specific machines for the many phases of production and harvesting (Figure 4).

CIMMYT, working in partnership with the Government of Nepal, has been one of the main support agencies for the spread of agricultural technology in Nepal (Figure 5).

Most of the threshers, shellers and two-wheel tractors used by Nepal's farmers are imported from India or China. Agricultural machinery and transport equipment worth NPR 1,451.7 million (USD 12.7 million) was imported into Nepal in fiscal year 2017/18 (CBS 2018).

<sup>7</sup> Government of Nepal (2014), "Agricultural Mechanization Promotion Policy, 2071"

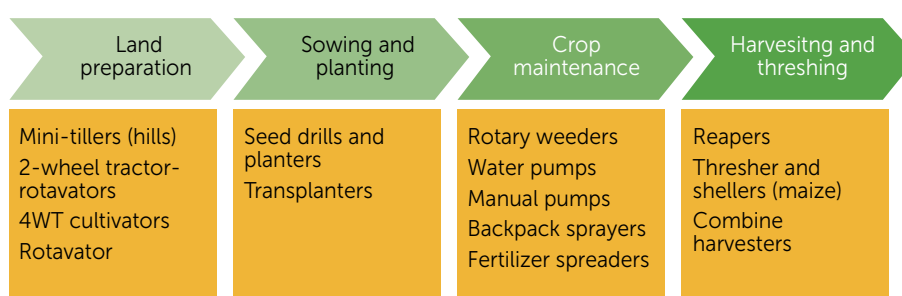


Figure 4. Machines currently in use in various phases of production.





**Figure 5. Agricultural machinery promoted by CIMMYT and their users and service providers in Nepal. Refers to seed drills, combine harvesters, reaper harvesters, mini-tillers, rice transplanters, spreaders and solar pumps. (Source: CSISA Project and Google Maps 2019).**

The cheaper Chinese machines are imported directly and via India by Indian importer-exporters to Nepal. Note that the latter are classified as international distributors, and they play an important role in the harvest machinery value chain. Presenting these product as made in India is technically disallowed, but even so such machines are sold in Nepal as made in India. It is also important to note that Indian manufacturers and international distributors are beyond Nepal's policy framework governing the industry.

In 2015, the importers and distributors of agricultural machinery in Nepal formed their industry association – the Nepal Agricultural Machinery Entrepreneurs' Association (NAMEA), which currently has 74 active members. The association holds exhibitions and training activities to promote the proper use of agricultural machines and lobbies the government to improve the policy environment for farm mechanization.

## 2.7. Main government programs

Although there were government-to-government programs to import Indian 4WTs and Japanese 2WTs in the 1960s and 70s the Government of Nepal has not been directly involved in importing farm machines in recent years. Instead, the government has partnered with CIMMYT and other international organizations for training and introducing innovative technologies to enhance agricultural productivity in Nepal. The main on-going

agricultural mechanization programs are CIMMYT's Cereal Systems Initiative for South Asia (CSISA, 2009-present), the Agricultural Development Strategy implementation project of the International Food Policy Research Institute (IFPRI), and several Food and Agriculture Organization (FAO) programs that are promoting conservation agriculture seeders and solar irrigation.

### 2.7.1 Subsidy program

One of the main government programs supporting agricultural mechanization is the provision of subsidies by the Directorate of Agricultural Engineering (DoAEngg in MoAD to support farmers to buy agricultural machines. Starting with the adoption of a new constitution in 2015 that emphasized decentralization, the national government devolved the program to local governments to implement. Local government design their subsidy programs based on the crops they prioritize and the machines needed in their areas and provide between 50% and 75% subsidies to farmers and other users to buy the machines.

Companies who supply the machines have to undergo a complicated process of being accredited to the subsidy program (see Box 1). Although this process can be unwieldy and opaque, many farmers have acquired their machines through this program. The study found that some government personnel request 'commissions' for accrediting suppliers.

### **Box 1. The 10 steps from accreditation to payment of the government's farm machinery subsidy program**

- Step 1:** Local governments determine the budget allocated to the subsidy program.
- Step 2:** Local governments decide on the machines that will be included in the program.
- Step 3:** Local governments solicit expressions of interest from distributors (with minimum qualification of being in the distribution business for at least three years).
- Step 4:** Interested suppliers submit quotations and other requirements to local governments.
- Step 5:** Local governments evaluate bidding companies, with the following factors considered:
- legal status of the company (yes or no)
  - technical capacity of the company (70% of score)
  - financial capacity of the company (30% of the score)
  - capacity to provide spare parts (measured by amount of spare parts in companies' stock in Nepali rupees)

A company must score 60% or higher to qualify as a supplier.

- Step 6:** A list of the machines, categorized based on use and price and accredited suppliers is released by local governments.
- Step 7:** Interested farmers go to the nearest local government agriculture office to apply and submit requirements.
- Step 8:** Applications are processed based on the priorities of the local government on the areas, specific crops and available machines.
- Step 9:** Upon approval, farmers go to the accredited companies, present their approval papers and pay the cost less the subsidy amount. The farmer can then take the machine away.
- Step 10:** The company submits the details of the sales and bills to the local government to claim the subsidy amounts. In some local governments, the subsidy is provided to farmers who use it to pay the suppliers.

Source: Interview with M. Basnyat, Chief of Agricultural Productivity Division, Department of Agriculture



# 3 Mechanization of harvesting processes in rice, wheat, and maize

## 3.1. Nepal's grain crops

Rice-maize farming predominates in Nepal's hills, whereas in the Terai rice is grown in the wet season and wheat in the dry winter season. Many farming systems also include livestock production, particularly dairy cows.

Rice is Nepal's staple crop and is the grain grown on the largest area and with the highest volume of production in the country (Figures 6 and 7). Families set aside a large portion of their rice harvests for personal consumption and sell the rest. Standard rice crops are planted at the start of the monsoon rainy season in June/July and are harvested by October/November.

Maize ranks second in terms of production, and while in the hills it is primarily a subsistence crop, in the Terai it is a commercial commodity, mostly sold to animal feed manufacturing companies. Its high value and high demand make maize one of the most produced crops in the country. Planting starts in March/April and harvest is in June/July.

Wheat ranks third in production in Nepal. Considered a secondary crop, farmers set aside a small portion of their harvested wheat for family consumption, with the larger portion sold commercially. Planting starts in December/January and harvest takes place in February/March. The earlier the rice harvest is concluded, the faster farmers can start preparing their fields to sow wheat.

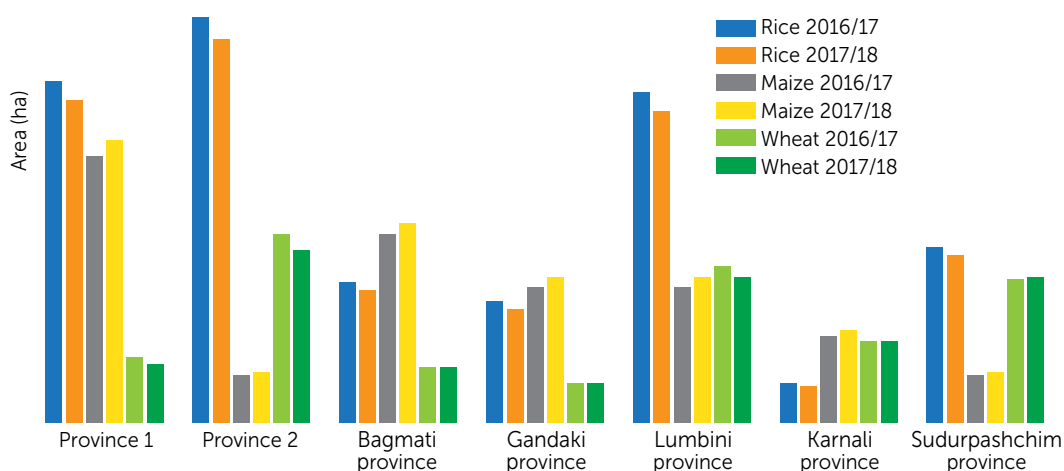


Figure 6. Area of rice, maize and wheat grown by Nepal's provinces in 2016/17 and 2017/18.

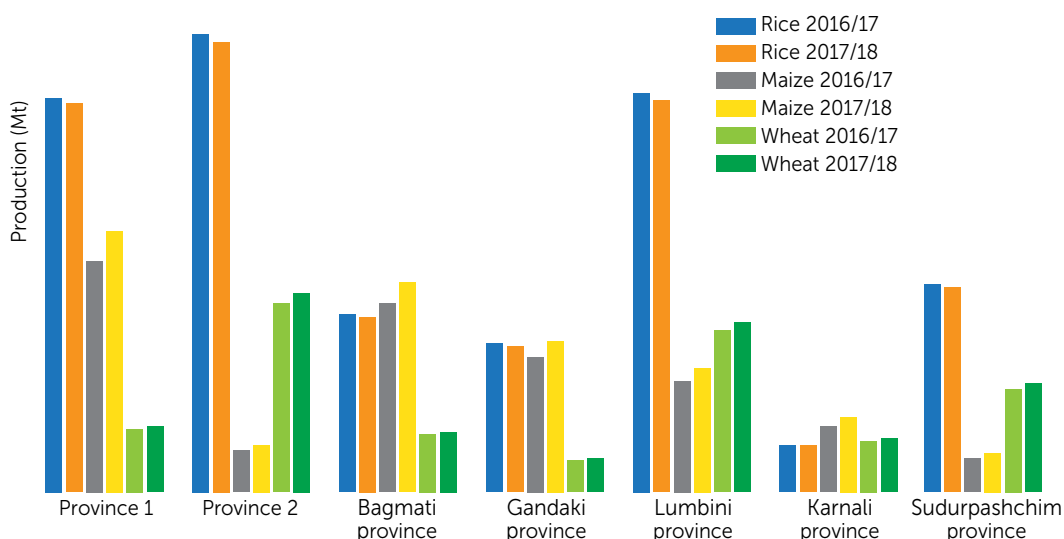


Figure 7. The province-wise distribution of rice, maize and wheat production for 2016/17 and 2017/18.

Within these systems, nearly all the tillage in the Terai has been mechanized by tractors, but only recently have farmers in the hills begun to catch up as new mini-tillers became available. In the Terai, a focus of farmers has been how to get around the two remaining labor bottlenecks: rice transplanting and the harvesting of rice, wheat, and maize.

### 3.2. Grain harvesting process

The various steps in grain production require different specialized machines, and in the harvest phase there are several steps that require different machine and a variety of technology choices. Due to this complexity, the mechanization of harvesting has lagged behind the mechanization of land preparation and crop planting.

**Rice and wheat** – The seven main activities in the traditional harvesting process for rice and wheat crops are:

1. Cutting the grains by hand with sickles and laying them in windrows for drying
2. Collecting and binding the grain after drying
3. Collecting the bundles and piling them ready for threshing
4. Manual threshing by hand or treading by animals
5. Winnowing to separate the grain from the chaff
6. Bagging
7. Collecting the straw for animal fodder.

In Nepal's Terai, these activities were traditionally carried out manually, and in the case of rice it took up to a month or more to complete these steps. Wheat threshers (see Photo 5) were introduced in the 1980s and by the 2000s nearly all wheat in the Terai was threshed using these machines. Rice threshers (see Photo 4) were introduced later, but by

2015 about 75% of all rice in the Terai was threshed with powered rice threshers. The full mechanization of rice and wheat harvesting using combine-harvesters began in Rupandehi and Kapilvastu districts in the central Terai in the late 1990s. By 2015 their use had spread to neighboring districts and beyond to Bara and Parsa Districts further east and approximately a total of 400 units had been sold across Nepal's Terai. Even less common is the straw reaper which follows the combine harvester to cut straw (100 units sold to 2018). The mechanization through the use of reapers began to spread in 2015 – and by 2018 nearly 3,000 units of 2WT and 100 units of 4WT had been sold mostly in far western districts in the Terai.

Of the remaining operations that are still mostly carried out manually, harvesting by hand with a sickle is by far the most labor intensive and costly operation. The manual harvesting and laying down of crops in windrows for drying can take 20–30 person-days per hectare. Figure 8 visualizes the various activities in the rice and wheat harvesting process and shows how combine harvesting can carry out all operations.

The degree of mechanization has been driven by a number of factors other than affordability and access to finance, such as topography and land size. For example, the full mechanization of harvesting by combine harvester is mostly preferred by farmers in flat areas. The high cost of these machines and their unsuitability for harvesting small, fragmented holdings or on sloping land has slowed the spread of their use. Even where combine harvesters have spread, many farmers who also raise livestock prefer to use reapers and thresher to enable the easier collection of the straw for animal feed. The straw is much more easily collected as the sheaves of grain and straw are brought to single "threshing floor" where the grain goes one way and the straw is blown into a large pile behind the thresher. Combine harvesters do not produce good quality nor easily collected straw.

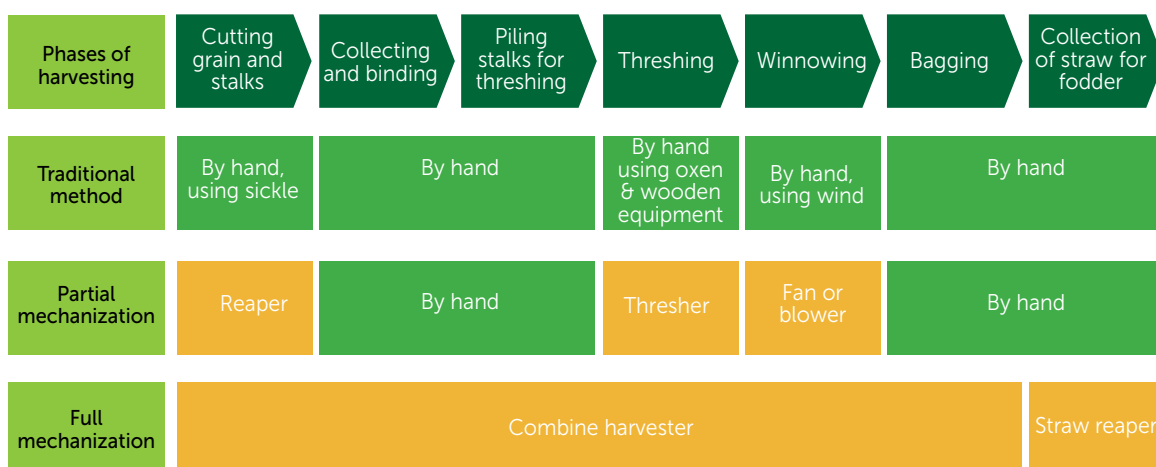


Figure 8. The traditional manual and partially and fully mechanized harvesting of rice and wheat in Nepal.

Farmers with steep, terraced, hilly, or sloping land have to use lighter machines like self-propelled reapers and smaller stand-alone threshers rather than fully-mechanizing harvesting using combines.

**Maize** – The six main steps the traditional harvesting of maize are:

1. Cutting the stalks with cobs and husks
2. Removing cobs from stalks
3. Collecting and binding stalks
4. Separating cobs from stalks and piling them up

5. Hanging cobs up by their husks to dry
6. Removing husks from the cobs
7. Shelling cobs to separate the maize grains from the cobs
8. Bagging the grain

Figure 9 visualizes the various activities in the harvesting of maize showing how the use of maize combine harvesters mechanizes all stages of harvesting.

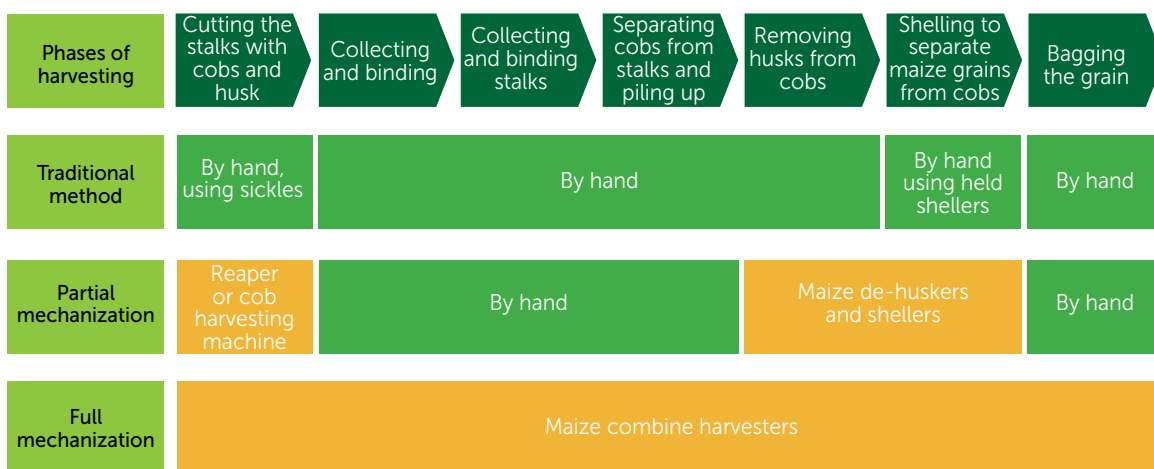


Figure 9. The traditional manual and partially and fully mechanized harvesting of maize in Nepal .

# 4 Machines used for harvesting grain

Reapers, threshers, combine harvesters and maize de-huskers and shellers are the main machines used for harvesting Nepal's main grain crops.

## 4.1. Reapers

### 4.1.1. Self-propelled reapers

Also known as walk-behind reapers or, more popularly, self-propelled reapers, reaper sets are permanently attached to two-wheeled mini-tiller engines and transmissions with the operator walking behind the machine. They are only used for cutting rice and wheat stalks and laying the harvested crops in windrows for drying and collecting. Self-propelled reapers are easy to operate and operators need no license. They are light in weight (under 200 kg), which allows them to be easily maneuvered and transported. They can also function in muddier conditions without sinking like larger reapers and combines do and can work even in fields with standing water, which makes self-propelled reapers a favorite of smallholders and farmers in hilly areas with sloping fields and also with farmers who have mature rice standing in wet fields.

Fueled by either diesel or petrol, engine size ranges from 5 to 9 horsepower (hp) with 90–120 cm wide reapers. One machine can reap at least 0.67 ha of rice (1 bigha) in about four hours. The time taken depends on the size of the reaping equipment, the capacity of the engine, and the users' stamina. Compared to riding type 2WT reapers or combine harvesters, these machines are more physically demanding to operate. This means that operators need more rest and so there are usually two operators per self-propelled reaper. Machines with lower horsepower engines take longer to cut a field.



Photo 1. A self-propelled reaper (Source G. Basnet).

The main downside to self-propelled reapers is that they are relatively expensive, costing about NPR 150,000 or 1,400 USD in 2019<sup>8</sup>. Moreover, since the reapers are permanently fitted, there is no other use for this machine.

Most of the popular and cheaper models of self-propelled reapers in Nepal are produced in China. The models made in India are more expensive.

### 4.1.2. Two-wheeled tractor mounted reapers

Two-wheeled tractor mounted reapers have reaper attachments mounted on the front of two-wheeled tractors (also known as power-tillers), with the operator sitting at the rear of the tractor. The 2WTs/ power-tillers are usually purchased separately from the reaper attachments. These 2WT mounted reapers cost about NPR 60,000 (USD 560) in 2019. This makes the cost for farmers and other buyers who already own 2WTs about 60–70% less than buying self-propelled reapers. The reaper attachments can be removed to allow 2WTs to be used for other purposes.

2WT engines range from 12 to 22 hp and can reap 0.67 ha. (1 bigha) of rice wheat, other small grain field crops like buckwheat, millet, etc. in 2.5 to 3 hours. The average reaper attachment has a cutting width of 120 cm, although some models have 130 cm or 150 cm wide reapers. All reapers and small combines have crop dividers (pointed pyramidal shaped structure for dividing standing crop) that can act as grain lifters, so that they can be driven perpendicularly to even partially lodged or fallen rice or wheat to lift and cut. Lodged or fallen rice is a big problem in manual harvesting as it takes considerable extra effort and labor to harvest such crops.



Photo 2. A self-propelled reaper.

<sup>8</sup> The exchange rate at the time of the research was USD 1 = NPR 107.

### 4.1.3. Four-wheeled tractor mounted reapers (4WT)

4WT mounted reaper implements are large machines mounted on the front of four-wheeled tractors with the operator sitting on the tractor. The tractors have 30 to 60 hp engines and with the reaping attachment can cover approximately 1-1.3 bigha/hr or 0.3-0.4 ha/hour. The attachment can be removed and remounted as needed, and comes in cutting widths of 2, 2.2 and 2.4 meters.



Photo 3. A 4WT mounted reaper.

There are also simpler and cheaper rear-mounted models which require the tractor to be driven in reverse, making operation and mobility more difficult and slower.

Table 3 lists some of the popular models of self-propelled reapers and 2WT and 4WT reapers. The area of crop they can harvest is similar, but the self-propelled reapers are more laborious to operate, and the rate of harvesting usually slows the longer they are operated by single operators. The 4WT reapers attachments brought to Nepal are made in India while the 2WT reaper are made in China.

## 4.2. Threshers

Threshing is the next step in the harvest process after reaping or cutting standing crops and letting them dry for a few days. Threshers separate grain from stalks through either friction, beating or both. The choice of technology depends upon the variety of crop, the moisture content and the degree of maturity of the grain. The three main types of mechanical threshers used in Nepal are 4WT/2WT tractor PTO-driven thresher, stand-alone closed



Photo 4. A 4WT PTO-driven paddy thresher.

drum threshers (powered by belts from a stationary diesel engine), and manual powered open drum pedal threshers.

Threshers were one of the earliest agricultural machines adopted in Nepal's Terai after the tractor-plough. The use of 4WT power take-off (PTO) driven threshers in both rice and wheat is a very common sight in the Terai and the inner areas of Provinces 1, 2, 5 and Sudurpashchim province. However, in hilly areas, smaller horsepower drum and pedal-operated open drum threshers are preferred due to their light weight and ease of transport.

The various types of threshers in use in Nepal are listed in Table 4. By far, the most common type in use in Nepal are 4WT PTO-driven threshers that need two or three workers to operate them.



Photo 5. A 4WT PTO-driven wheat thresher.

Source: [https://www.youtube.com/watch?v=NfpM1FJoCrc&ab\\_channel=RavinderSingh](https://www.youtube.com/watch?v=NfpM1FJoCrc&ab_channel=RavinderSingh)

Table 3. Types of reapers used in Nepal.

Company	Reaping width (cm)	Capacity <sup>9</sup>	Model	Operated by
Kisankraft	127	0.25 ha/hr	KK-SPR-1201P	Self-propelled 5.6 hp petrol engine
Jai Guru Dev	220	0.3–0.4 ha/hr	Jai Guru Dev	4WT
Shandong	120	0.2–0.25 ha/hr	4GL-120	2WT
Mingyue	120	0.2–0.26 ha/hr	4GL-120	2WT
Mingyue	120	0.2–0.3 ha/hr	4G-120 A	2WT
Xtra Power	90	0.2–0.3 ha/hr	XPW-750T Plus	Self-propelled 7 hp petrol engine

<sup>9</sup> Manufacturer provided



**Table 4. Types of threshers used in Nepal.**

Thresher type	Drum diameter (inches)	Capacity (kg/hr)	Model	Operated by:
Rice thresher	32	2,500-3,000	Hamidi	4WT
Wheat thresher	32	1,500-2,000	Hamidi	4WT
Rice thresher	36	3,000-3,500	Jai Guru Dev	4WT
Wheat thresher	36	2,500-3,000	Jai Guru Dev	4WT
Multi-crop thresher	36	2,000-2,500	Jai Guru Dev	4WT
Wheat thresher	32	1,500-2,000	Sonalika 2013	4WT
Rice thresher (bar type)	na	2,000-2,200	Sonalika 2013	4WT
Multi crop thresher	32	1,500-2,000	Sonalika 2013	4WT
Self-propelled multi-crop thresher	na	300-500	ST-70, 80	4 hp petrol engine
Paddy thresher	na	4,000	Super HD-51	4WT
Wheat thresher	na	3,000	Super HD-51W	4WT
Multi-crop thresher	na	800- 1,200	Super Nano-51	2WT/power-tiller
Multi-crop thresher	na	560-800	5TG 80	3 hp electric motor (2.2 kw) or 3-5 hp petrol or diesel engine

Although most rice, wheat, and multi-grain threshers used by Nepalese farmers are imported from India, a few models are manufactured in Nepal despite the large economic hurdles.

Most threshers in Nepal are single-crop rice or wheat threshers. However, multi-crop rice-wheat threshers are available and are becoming more popular, although their 25% higher cost limits uptake.

#### 4.2.1. 4WT PTO-driven thresher

Rice, wheat, and multi-crop 4WT PTO-driven threshers are high capacity machines whose output is usually measured in tonnes per hour. They can also be powered by electric motors, stationary engines through belts. These machines have rotating threshing-drums (with beaters or teeth), and devices to shake and blow out the straw to clean and then collect the grain.

By simply replacing a few accessories and changing the speed and other settings, these machines can thresh different kinds of grain, including rice, wheat, maize, lentils, sorghum, beans, sunflowers, and soybean. However, crop-specific threshers are mostly used in the Terai for threshing wheat and rice.

Most threshers manufactured in Nepal are powered by small 2 or 3 hp electric motors or 5 hp petrol or diesel engines. The larger machines that are imported from India are powered by engines or attached to a 35-55 hp tractor.

#### 4.2.2. Closed drum threshers for rice and wheat

Closed drum threshers are manufactured in India and Nepal and are usually smaller than 4WT PTO-driven threshers with a capacity to thresh just under less one Mt of crop per hour. They often do not have grain sifting or cleaner functions and can be powered by power tiller engines or electric motors. They cost much less than PTO-driven threshers.

With rice, often only the panicles or heads of rice plants are threshed, not the lower straw. This requires less fuel and mixes less straw residue



**Photo 6. An open drum rice pedal thresher.**

into the grain, making manual winnowing faster and easier. It also leaves rice straw undamaged, making it easier for farmers to store outside. Yet, farmers remarked that rice straw produced as a by-product of closed drum threshers are higher quality and require less processing to be useful for cattle consumption.

#### 4.2.3. Open drum rice pedal thresher

Rice pedal threshers are manually operated using pedals to drive the rotating open threshing drum. As with the usual drum threshers, a rice straw bundle's panicles are held against the open drum to separate the grains from straw. The output capacity ranges from 150-200 kg per hour and most of these machines are manufactured in Nepal. However, the low number of revolutions per minute (RPM) of their drums is too low to thresh wheat. Since 2005 some small workshops have specialized a small electric motor and pulleys so that they can be operated both by pedal at lower speeds for rice or powered motors at higher RPMs (650-700) to thresh wheat.

Also around the same time workshops in Kathmandu have produced slightly larger electric or petrol driven open drum threshers (Photo 7). Since 2010 Chinese versions have also entered in small numbers into the market (Photo 8).



Photo 7. Nepal made open drum powered thresher.



Photo 8. China made open drum petrol powered thresher with pushcart.

### 4.3. Combine harvesters

Combines are multi-function machines that can simultaneously reap standing crops, thresh, and separate the chaff from the grain. They are gaining popularity among farmers, especially in the Terai plains near the Indian border where the land is flat and fields are large. Combines can cover a large area in a short period—up to 0.25 ha/hr—producing large heaps of clean ready-to-sell grain. With minor adjustments, standard combines can harvest both rice and **wheat**. The application of an additional ‘maize header’ attachment enables combines to harvest row-planted maize.<sup>10</sup>

Most combines have 60-100 hp engines and only experienced and licensed drivers from India (mostly Punjabis) are brought in by combine owners to operate the machines. The shortage of Indian drivers and more Nepalese gaining experience means that many combines are now being driven by Nepali operators.



Photo 9. A combine harvester.

*While almost all combines can harvest and thresh the whole stalk, doing so requires more fuel and slows down the machine, reducing the amount harvested per hour.*

As such, combines are more often set to cut grains at the upper parts of stalks, leaving behind most of the stalks standing in fields. This causes many farmers to complain that they then need to carry out another operation to harvest the left-behind straw. Doing so by hand is expensive and wheat-straw combines that can harvest and cut the straw and collect the wheat chaff (*busa*) for fodder are not widely available in Nepal. Instead, the less valuable rice straw is burnt in fields causing air pollution across the Indo-Gangetic plain.

### 4.4. Maize de-huskers and shellers

De-huskers are used to separate the husks that cover maize cobs, while shellers separate the grain from the cob. Indian de-huskers and shellers are one machine which first de-husks the maize cob and then shells the grain from the cobs. Many of the Chinese-sourced machines separate the functions of de-husking or shelling and usually come in smaller sizes, with electric power ranging from 0.5-3 hp.

<sup>10</sup> The authors know of only one maize header in Nepal, which was introduced by Buddha Air’s corporate social responsibility Smallholder Agribusiness Support Project in Morang district. Another rice-wheat combine has been modified by its owner in Bardiya district to pluck cobs from standing stalks, but has had some problems including missing cobs.



**Table 5. Most commonly used maize shellers in Nepal**

Equipment type	Use	Capacity	Model	Operated by
Maize sheller (single phase, 1400-1600 RPM)	Shelling	1,000-2,000 kg/hr	Kisankraft	Motor or engine (3-4 hp)
Maize sheller (36-inch drum diameter, axial type)	De-husking and shelling	1,200-2,800 kg/hr	Jai Guru Dev	4WT
Corn sheller (squeeze roller type)	Shelling	0.2-0.25 ha/hr	STY-31-86	Electric 5 hp motor
Electric corn thresher	Shelling	300-500 kg/hr	KISHNA	650 W electric motor

Between 8 and 100 de-huskers and shellers are sold in Nepal each year by four importers. A few local manufacturers are also producing de-huskers and shellers. Some manufacturers have used designs from the National Agricultural Research Council (NARC), but these machines often need to be adjusted and customized based on their actual use.

**Photo 10. A maize de-husking and shelling machine**

#### 4.4.1. De-huskers

Small stand-alone electric powered de-husking machines were introduced from China into Nepal around 2014. Some are combined with a sheller, but many simply de-husk using two counter rotating rubber-toothed rollers that leave the grain on the cob for later shelling. They are small and are usually powered by 1–3 hp electric motors.

#### 4.4.2. Shellers

Mid-size, stand alone, shellers are generally in the 5-7 hp range and are powered by stationary or power tiller diesel engines. Mid-sized shellers began appearing in the Terai in the early 2000s. Both locally-manufactured and Indian-manufactured machines are now available that can de-husk and shell at the same time.

Larger horsepower, PTO-driven shellers are powered by 30-50 hp 4WTs. These machines appeared in Nepal around 2010 and their number is growing. They can shell 1-2 Mt per hour and can de-husk and shell at the same time.

Also, mini-maize shellers began to be used in about 2015 which are like the above mentioned de-huskers but with a low horsepower (1-2 hp). Thousands of these low cost (100 USD) easy to operate machines have sold mostly into the hilly region also in the Terai. They can shell 200–500 kg of maize per hour.

#### 4.4.3. Combines

As stated earlier, some models of Indian rice-wheat combines can also harvest row-planted maize. The header attachment alone costs \$5-10,000, which along with lack of awareness, has limited its sale.

That said, the interest of Terai farmers' in maize combine harvesters greatly increases once rice-wheat combines move into Terai commercial maize growing areas. Most commercial maize combines can only harvest maize that is sown in rows; but as maize planters are used more the potential for maize combines will also grow.

**Photo 11. A mini maize sheller.** Source: <http://www.sktnepal.com/site/product?id=6>

# 5 Value chain analysis of main harvesting machines

This chapter follows the main steps of value chain analysis of the main harvesting machines in Lumbini province and Sudurpashchim province:

- ♦ Identifying the final market.
- ♦ Identifying the key functions in the value chain.
- ♦ Identifying the main actors who perform these functions.
- ♦ Mapping the actors and other service providers according to the functions they perform and the relationships between them.

## 5.1. The market for grain harvest machines in Nepal

**Profile of respondents** – As explained in Chapter \*\* the study gathered questionnaire data from 22 farmer-users. The profile of the average farmer covered by the study was as follows:

- ♦ Almost all of them have farmed since their childhood.
- ♦ The size of their farms is 2.5-10 ha (4–15 bigha).
- ♦ The main crops they farm are rice, wheat, maize, mustard, potato, pigeon pea, vegetables, red gram and lentils, with a rice-wheat based cropping system.
- ♦ 30-50% of the rice and 10-20% of the wheat produced is kept for household consumption.

**Use of machines** – These farmers were found to be using machines for almost all phases of production, including cultivators, rotavators, harrow discs, seed drills, threshers and combine harvesters. Tractors have been used for tilling in the study areas since the 1980s. These machines are either owned by farmers, owned by service providers and rented out with operators, owned by cooperatives and farmers groups, or owned by custom hiring centers.

**The spread of machines** – In addition to the general openness of Nepali farmers to mechanization, the lack of labor due to migration, as well as falling costs and improving technology, have caused farmers to depend more on machines.

**Adoption of threshers** – Threshers began to be used by wheat farmers around 1990, and rice threshers around 2005. The affordability of threshing machines, their low operating costs, and the ability of smaller models to operate on sloping and irregularly shaped fields drove adoption. The use of stand-alone threshers powered by stationary diesel engines in flat areas will continue for as long as there are farmers who are involved in livestock production as they prefer the residual small cut straw (bhusa) for fodder.

**Adoption of reapers** – Reapers became popular around 2012 in the study area as the situation in farming communities changed. The combination of large-scale outmigration, better education, higher off-farm incomes, and access to information and communication is correlated with reaper adoption. Conversely, family size is inversely proportional to adoption (Paudel 2018).

**Types of reapers** – The walk-behind self-propelled reapers and 2WT mounted reapers are popular in areas near the Midhills foothills where the terrain is unsuitable for larger machines like combines, as well as on sloping land where larger machines cannot operate. The lightweight, walk behind self-propelled reapers and 2WT reapers can be moved from one part of farm to another with ease compared to the much larger combine harvesters. The study found that, in Provinces 5 and Sudurpashchim province, walk-behind self-propelled reapers and 2WT mounted reapers are very popular in the valleys and Terai that lie close to the main East-West highway.

**Satisfaction with reapers** – Most farmers rent their self-propelled or 2WT or 4WT reapers from neighbors and relatives or from cooperatives and farmer groups that they are members of. 90% of the farmer covered by the study were satisfied by the performance of the reapers and are willing to recommend the machine to others who do not yet use them.

**Straw for fodder** – Farmers who also raise livestock use reapers to ensure that their rice straw can be used as animal fodder. Despite the presence of more efficient harvest machines like combines, some farmers prefer stand-alone reapers because of the better quality rice straw fodder that is produced.

**Combine owners** – Farmers with large land holdings are the main buyers of combine harvesters. When they are not using them on their own farms, they rent out their machines (usually with operators) and become service providers to other farmers who are unable to buy machines themselves. Additionally, a few farmer groups and cooperatives also own combines, although they were mainly donated by NGOs or provided through a government subsidy program. Also, Indian contractors travel through the Terai during harvest season offering their services.

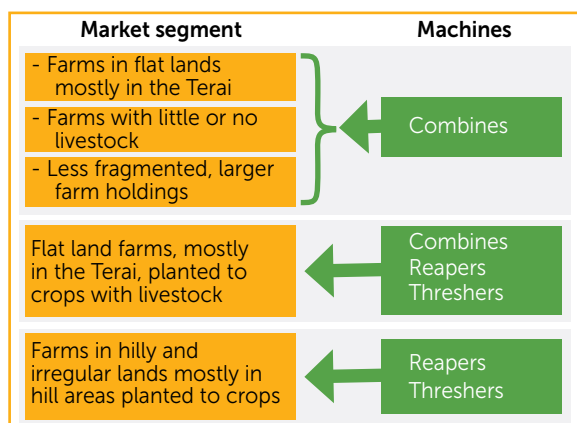
**Selective harvesting** – Many farmers complain that harvesting rice and wheat by combine harvesters make the straw unpalatable to animals and prefer using reapers and threshers. Almost all of the farmers with combines who were interviewed for this study reported that, especially with rice, the combines kick up stink bugs, and when they are threshed with rice it makes straw unpalatable to livestock.

**Harvesting high up on the stock-** Some farmers complained that even after asking the combine service provider to harvest all the stalk they will still set the header high so as to save fuel by not threshing the whole stock.

Farmers who raise livestock often prefer to use a combination of grain-harvesting machines. They determine the volume of straw they need from the crop to feed their livestock and then harvest that amount using a reaper and thresher to get the desired volume of quality straw for feed. Then they harvest the rest of the crop by combine.

**Cooperatives** – Savings and credit cooperatives operate as intermediary organizations for financial and banking services but also for helping their member-farmers to acquire inputs and aid in marketing their produce. Many of the present day CHCs (approximately 20) are in fact cooperatives for banking or other services that took advantage of the government’s special subsidy program to set up CHCs to expand mechanization services members and non-members. Qualifying cooperatives were provided subsidies to purchase machines and grants for post harvest milling and storage facilities. Some that have tractors for collecting grain offer tillage services. Under the more recent (2016) PMAMP’s CHC programs many were newly established farmer associations, that were specifically to provide agricultural machinery services. Given the appropriate institutional development program to improve their entrepreneurial capacity, cooperatives could become a potent force for mechanization and other developmental change in rural areas. However, similar to India experience (Lokesh et.al. 2018) many of the cooperatives and farmer associations that have become CHCs are considered inefficient and ineffective. In this context, and while much more research is needed to understand the current CHC situation, it is apparent that the grants and subsidies for establishing CHCs as a service of a cooperative should also include multiple technical and business development trainings to improve the capacity of cooperative leadership and management teams to more efficiently manage machinery and get the use rate of the machinery up.

The three main market segments for grain harvesting machines in Nepal is shown in Figure 10.



**Figure 10. The market segments of grain-harvesting machines in Lumbini province and Sudurpashchim provinces.**

## 5.2. The main steps in the grain harvest value chain

### 5.2.1. Importation

Although there are few official statistics about imports, most of the machines in Nepal, particularly powered agricultural machines, are imported from India. All the farmers respondent to this study owned combines and threshers (rice, wheat or maize) made in India. Chinese machines have gained a large portion of the market, particularly with smaller scale pumpsets, 2WTs, and smaller harvest and post-harvest machinery. The farmers in this study used reapers and maize shellers from China. A few machines have been also been imported from Japan and South Korea.

### 5.2.2. Manufacturing in Nepal

The proximity of Nepal’s main grain growing region to India and the easy availability of agricultural machinery from there has stunted the growth of agricultural machinery manufacturing in Nepal. Although official statistics are not available, the study team observed that Nepal has a small agricultural machinery production sector which is mostly characterized by low technology, limited skilled manpower, and the absence of improved and more modern manufacturing equipment. Nepal’s workshops mostly produce simple tools (hoes, sickles) or at the most threshers and tractor trailers. The high cost of technology and raw materials, which also must pass through India, makes industrial production an expensive venture in Nepal. Furthermore, the policies that allow whole agricultural machines to be imported duty free while the imports of raw material (angle iron, rod, sheet metal, etc.) for making machines are subject to a 25% tariff, is a large disincentive to investing in manufacturing agricultural machinery. Finally, agri-machinery manufacturers, unlike importers, are unorganized and under-represented at national level policy discussions.

### 5.2.3. Distribution

Distribution of harvest machines to farmers is done through the network of affiliated distribution units of the importers and as well as non-affiliated independent dealers who sell both imported and locally-manufactured machines and equipment. They are mostly located in rural towns, and they usually stock spare parts and provide repair services. This sub-sector is unorganized and under-represented at the national level.

Distributors and importers interviewed for this study say that sales peak prior to the harvest season. The harvest schedule is a major consideration for importers to schedule the delivery of imported machines. The harvesting times of the main three grain crops are shown in Table 6.

**Table 6. Harvest seasons of rice, wheat and maize in Nepal.**

Crops	Harvest season
Rice	October to November
Wheat	February to March
Maize	June to July

#### 5.2.4. Rental

By far the main rental service providers are informal: farmers with larger holdings who own agricultural machines and rent them out when they do not need them on their own farms. This service has been replicated formally by custom hiring centers, which have been established with government support since 2013 to cater to smallholder farmers who do not have access to suitable machines or cannot afford the rent charged by large farmers. However, renters are also the least organized, and least represented actors in the value chain. Much of the current agricultural and rural literature<sup>11</sup> and programming looks professionalize the informal sector in order to attract younger people into this work stream. India's CHC program has the same goal of replacing informal agri-machinery rental service providers.

### 5.3. Grain harvest machinery value chain actors

The main actors in Nepal's harvest machinery value chain are importers, manufacturers, dealers, distributors and rental service providers.

#### 5.3.1. Importers

**Importers** – Agricultural machinery importers play a vital role in the mechanization of Nepalese agriculture. Although there are no official statistics collected by the government or NAMEA, the research found that most machines are imported from India or from China via Indian seaports and then by road to Nepal. Although no official statistics are available, the research found that many of the larger importers are based in Kathmandu, with a smaller number based in towns near the Indian border. Importers are usually well-established. Ten of the interviewed importers have been operating for more than ten years, with the oldest having operated for more than 30 years. However, only one or two of the 40 existing importers are members of NAMEA.

Nepali importers purchase agricultural machinery from Indian manufacturers and exporters, from Indian distributors of Chinese-made machines, or directly from Chinese exporters. Many machines coming from India were actually manufactured in China but are rebranded as "Made in India". This

is known as "trans-shipping". It is illegal, and often leads to a higher selling price compared to importing the machines directly from their source. By volume and value, the largest imports are of 4WTs: 3-4000 units a year at an average cost of 10,000 USD, accounting for 30-40 million USD in total value. For 2WTs, about 2-3000 units are imported a year with an average cost of 1,400 USD, for a total import value of 2.8-4.2 million USD.

**Importation process** – The research found that most importers place their orders for machines monthly, although some do it less often. The main basis they use for ordering machines is usually the previous year's sales, pre-booked orders, estimates of demand under the government's subsidy program, and the potential demand for new models (with improved technology). Importation usually follows the procedures outlined in Box 3.

#### Box 3: Procedures for importing agricultural machines in to Nepal

The importer identifies the machine they want, agrees with the supplier on the price they will pay and places the order. Note that increasingly representatives of importers visit Indian or Chinese companies when visiting agricultural expositions in India and China to identify potential new models, and confirm their orders. Also, it seems that many new machines are brought into Nepal as a result of importers visiting and searching the Chinese and Indian markets for new potential machines to try out to assess the demand in Nepal.

Once an order is confirmed, the importer makes full/partial down-payment through their bank or sends a letter of credit to the supplier.

Shipping documents are prepared and arrangements made with the shipping logistics company to sending the purchases machine to Nepal.

If bought from an Indian supplier, the supplier transports the machine to Nepal's border. If bought from a Chinese company, the shipping of the machine to an Indian seaport is managed by the importer through a shipping company (the nearest is Kolkata). These machines are then transported by road to the Nepalese border.

At the Nepali border, agents facilitate the payment of import duties and tax and the release of the shipment from customs.

The machines are then transported to the buyer's preferred point of receipt, which is usually to their storeroom or directly to a distributor.

**Risks** – The main risks to importers are that machine paint work can be damaged during handling and shipping, especially when machines are not shipped in cartons or boxes but individually in trucks. The rusting of metal parts and deterioration of plastic and rubber parts and damage from floods and other natural disasters during storage. Other risks include transportation delays caused by strikes and incidents

<sup>11</sup> USAID/Bangladesh's Agricultural Value Chains Activity, project in Bangladesh seeking to upgrade skills of informal service sector <https://www.agrilinks.org/post/jobs-agriculture-young-bangladeshis-have-options> From UN-CSAM "Private companies who are engaged into custom-hiring business are more professional and organized service providers." [http://www.un-csam.org/Publication/csam\\_case\\_study\\_stakeholder\\_mapping\\_for\\_custom\\_hiring\\_0.pdf](http://www.un-csam.org/Publication/csam_case_study_stakeholder_mapping_for_custom_hiring_0.pdf)



such as the three month economic blockade and border closure in 2015/16 that can lead to Nepali importers having to pay large demurrage costs and other fees at Indian seaports.

**Source of machines** – Most 2WT-mounted reapers, self-propelled reapers and electric maize shellers are imported into Nepal from China. Although similar machines are produced in India, the Chinese models are more popular due to their lower cost. However, larger machines like 4WT mounted threshers and combine harvesters are mostly imported from India even though the equivalent Chinese machines are cheaper. This could be due to buyers (especially of combines) preferring to buy machines they are familiar with from seeing them operating across the border or by Indian service providers in Nepal. Other factors are that Chinese machines are considered lower in quality, spare parts are more available for Indian machines, and the larger machines are easier and cheaper to import from India.

**Warranties** – Manufacturer warranties are usually only available for the Indian-made machines to cover mechanics costs for six months to a year and not spare parts. Farmers have to pay for parts that break during operation. Chinese-made machines are not covered by manufacturer's warranties; instead importers usually provide service maintenance warranties in the cost of machines for 6 month or a year as a sales incentive. After the end of the warranty, after-sales service s provided by importers' agents employing trained mechanics.

**Finance** – The research found that importers finance their purchase by taking loans from financial institutions and by requiring advance payment (partial or full) from buyers. Even so, these sources are not always sufficient, and especially since bank loans require more collateral (usually land) than they have, many importers also rely on informal loans from family, friends or money lenders to finance the purchase of machinery. Participation in the government subsidy program, which requires a substantial investment in inventory, often necessitates informal borrowing.

**Subsidy schemes** – Most importers participate in government subsidy programs, which is one of their main sources of income. Especially when participating in government subsidy financing schemes, importers need to set aside large amounts to finance the purchase of machines and to meet other requirements of these schemes. Importers have to deal with local government agricultural officers who manage these schemes and sometimes ask for a "commission" in order to be accredited to the program.

**Training of operators** – It is mostly importers and distributors who train the buyers of smaller machines like 2WT-mounted reapers and threshers. There is no other legal requirement (i.e., license, registration, or insurance) for the operation of small machines. The purchasers of combine harvesters in Nepal do not receive any training. Instead, Indian exporters initially provide licensed and trained operators

from India to run the machines. Knowledge about operating combines is not often transferred to Nepal. Sometimes this is because Indian exporters and service providers want to maintain their oligopolistic market position, but often it is a decision on the Nepali side as well. The research found only one Nepali combine owner who knew how to operate his own machine. Even he prefers to rely on Indian driver-mechanic teams.

**Taxes** – Two main types of taxes are levied on agricultural machines imported into Nepal:

- ♦ A custom duties of 1% of the cost, insurance, and freight (CIF) value except for tractors which is at 5%; and
- ♦ Exempted value-added tax (VAT) for agri-machines except for tractor which is 13% on the CIF plus customs duty value.

However, the standard rate of VAT of 13% of CIF plus customs duty is levied on imported spare parts of agri-equipment. This means that 14.13% import tax is levied on few spare parts upon including the 1% custom duty on CIF but some engine parts are charged around 25% to 37% in total. Importers consider the higher tax for the engine parts exorbitant.

**Sales** – In 2018 four importers sold a total of 705 self-propelled and 2WT-mounted reapers (Table 7) either directly to farmers and service providers, local distributors, farmers' cooperatives or to farmers through the government's subsidy program. In 2018 five importers sold 780 threshers, most of which were imported from India (Table 8)

**Table 7. Number of self-propelled and two-wheel tractor-mounted reapers sold by selected importers in 2018.**

Importers	Sales
SKT, Bhaktapur	300
BTL, Patan, Lalitpur	190
Adhunik Kisan Kraft, Bharatpur, Chitwan	200
Dahal Traders, Kathmandu	15
Total	705

**Table 8. Volume of sales of threshers of selected importers in 2018.**

Importers	Total
SKT, Bhaktapur	200
BTL, Lalitpur	180
Dahal Traders, Kathmandu	180
Narayanj Machines Pvt. Ltd., Kathmandu	200
Adhunik Krishi Kisan Sansar, Chitwan	20
Total	780

**Combines** – Most farmer-rental service providers in Lumnini province and Sudurpashchim province buy combines directly from manufacturers in India. However the trend is changing as similar services are being delivered by the showrooms in Nepal. One Nepali importer said it had sold 22 Indian-made combine harvesters in fiscal year 2017/2018.



**Promotion** – Most importers, and especially those based in Kathmandu, market their machines in newspapers and on FM radio and television programs; at agricultural fairs and exhibitions; by distributing brochures and booklets; by meeting farmer groups along with demonstration and training sessions about their machines and maintain a showroom. These marketing activities are usually carried out in partnership with their branches and local distribution centers.

### 5.3.2. Manufacturers

Neither the government nor NAMEA collect much information about manufacturers of harvest machinery in Nepal. Although some agricultural machines like threshers, 9-tine cultivators, milling equipment, etc are manufactured and manage to compete with imported machines, these locally-produced machines are quite simple, without the refined finishing of Indian and Chinese machines.

The main challenge faced by Nepal's agricultural machinery manufacturers is their lack of modern technology to produce larger quantities and more complicated agricultural machines. Only a limited number of skilled technicians are available to work in small manufacturing companies and such technicians are easily tempted away to higher paying work elsewhere. For example one local manufacturer (Chandragiri Machinery Udhyog of Kathmandu, which manufactures peddle threshers for rice, wheat, and millet, seed treatment machines and seed graders), said that they depend on outsiders for new designs and ideas.

However, some domestic capacity exists and could be built upon. For example, NARC's Agricultural Engineering Division makes various machinery and prototypes with custom adjustments, design changes, and refinements based on information gathered from customers and their own experience in using and testing of the machines. Another group of manufacturing stakeholder said that the new small scale threshers, corn shellers and de-huskers, reapers and other smaller implements coming from China could be made in Nepal.

**Foundries-** Little is known about foundries who make green sand molds and cast various parts for different sectors. Bhairahawa had a small group of 3 or 4 foundries including Shretha Agro making rough gears for peddle threshers. A much larger foundry steel mill further north, Everest Rolling Mills, makes cast iron parts and assembles hand-cranked winnow fans. Both reported encountering problems with the municipality due to smokestack emissions, indicating that the business environment for foundries is not particularly enabling.

**Blacksmiths-** Very few of the traditional blacksmiths (or *kamis*) make and repair hand tools and other equipment. They are usually under-equipped traditional small workshops with the one stick welder, drill press, cutoff saw, and a few other power tools.

**Trailers and trolleys for 2WT and 4WT tractors manufacturers** – Hundreds of 2WT trailers and thousands of 4WT trailers are manufactured in Nepal each year mostly in small and medium workshops in the Terai, and in a few hill towns of Bhaktapur, Pokhara etc. While they are used mostly for transporting rocks and sand for construction, they are also used in the agricultural seasons for transporting fertilizer and seed to farms, manure to the fields, grain and straw from the fields to the farm homes and grain from farm to mills.

**Thresher and sheller manufacturers** – A director of the now-defunct Agricultural Tools Factory said that many companies had tried and failed to manufacture threshers in Nepal.<sup>12</sup> However, other manufacturers, despite the high price of inputs like steel, are making a reasonable living from producing threshers including KN Agro of Dhangadhi. KN Agro has been in the market for 20 years and has a regional reputation for his PTO-driven threshers and shellers. He said he makes approximately 40 rice and wheat threshers a year and approximately five PTO-powered maize shellers. He also makes a few trailers as well as metal shutters, security bars and gates.

**Promotion** – Locally-manufactured machines are promoted mainly through local distributors. Some companies do promotion through their own regional and national branded radio, cable TV, and print advertising campaigns. Large 4WT importers sometimes get advertising support from their suppliers-manufacturers. However, rarely do non-importers get marketing support (monetary, corporate generated and branded advertising for print or other media, etc.) from their international suppliers.

Machines are produced in Kathmandu and are then sent to distributors as they place their orders. One-year free service guarantees are provided by local distributor using their own technicians and mechanics to provide after-sales services. Awareness and competition for participation in various time bound government and project based agri-machinery subsidy programs is high. Where the manufacturers struggle, their direct competitors the importers, for reasons still not well understood, get their products included in these government programs.

Most manufacturing operations are finance by banks; however factory owners consider the interest rates to be too high. It is challenging to access bank loan particularly because of the need to provide collateral and the usually short term loans which do not allow manufacturers to plan for the long-term.

<sup>12</sup> Personal communication by AB Karki, former director of Agricultural Tools Factory, Birganj, and one time thresher manufacturer also in Birganj, to Scott Justice.

### 5.3.3. Dealers partially or fully-owned by importers

Importers set up their own branches, mostly in provincial town centers, as points of sale. They participate in local marketing activities such as regional exhibitions, field demonstrations, advertisements, and distribution of brochures and posters. They also organize machinery service camps, which are held at the district level. Owners of large machines like 2WT or 4WT or larger implements like reapers are invited to bring their machines to the camps for servicing. They receive free advice and even free servicing and maintenance from company mechanics. Participants may also get temporarily discounted oil or spare parts and tips on operating their machines from other attendees. They also provide after sales service and spare parts.

### 5.3.4. Independent distributors

Although official statistics are not available, the research found that local distributors source their machines from importers and supply all types of agricultural machines except for combine harvesters and other large machines. They order machines from importers and then deposit the agreed partial advance payment in the importer's bank account. The machines are subsequently made available on credit in line with the relationship between importers and distributors. Machines are usually delivered within five days of this payment with buyers usually responsible for transporting machines to their farms.

Most distributors use bank loans with their land as collateral to buy in machines and have to fulfill onerous documentation requirements. Banks charge 10–14% interest.

For smaller machines like reapers and threshers, distributors provide demonstrations, basic training for operating them, and troubleshooting for buyers and potential buyers. A warranty of one year's free service is provided for some machines. They sell their machines without warranty, but most come with some promise to free repair for six months or a year. Even with warranty, farmers report that no warranty repair is provided without an argument. Different types of warranties and warranty repair are available. With some warranties both service and spare parts are to be paid for by seller. Others are where farmer pays for service but not part and vice versa where farmers pay for part but not for service.

A common marketing strategy for dealers of reapers and 2WTs is (as part of the machine's cost) to send junior technical staff for 1–2 days to go to the buyer's farm, set up the machine and train the buyer how to operate the machine. The salary and travel cost of the technician is included in the cost of the machine, but the buyer is expected to house and feed them during their stay.

Most small distributors do not market their machines. Those connected to importers depend on the head office in Kathmandu to carry out provincial marketing activities.

Various installment payment arrangements are one of the incentives offered by distributors. Although the price for cash buyers is normally fixed, discounts are sometimes offered to favored customers. Credit is offered with 50% of the cost paid upfront by buyers and the remaining amount payable within three months, the next season or, in some cases, or more rarely up to one year later. Most distributors who provide 3 months of credit do not charge interest on the credited amount.

Based on interviews conducted in Lumbini province and Sudurpashchim province, it is apparent that competition among distributors is high in many areas, with several distributors operating in multiple Terai and hill districts. Each distributor tries to highlight its competitive advantage, such as the quality of its machines and the availability of spare parts and timely after-sales service.

Most distributors are very aware of the government subsidy programs because accreditation to the programs significantly increases their sales.

### 5.3.5. Independent dealers and agents

While many independent dealers and agents usually have an affiliation with one main importer, they also have links to other importers. One of the reasons for this is that importers occasionally have problems delivering machines on time during the main selling seasons. Losing sales due to a late shipment can be a great loss to both importers and their agents. As such, even dealers with strong affiliations with one importer will in such cases try and source reapers and other machinery from other importers. The more trusted dealers and agents can get machinery and necessary spare parts advanced to them by importers with informal promises to pay once they are sold.

### 5.3.6. Rental service providers

Rental service providers are either large farmers or organizations that purchase the equipment and rent it out to small-scale farmers who cannot afford to purchase their own machines.

#### a) 2WT reapers

Most farmers with tractor-mounted reapers rent their machines along with the operator to other farmers when they were not using them on their own farms. Among the 10 2WT reaper service providers interviewed for the study:

- ♦ Their farms ranged in size from as small as 2.7 to as large as 16.7 hectares. Some leased land from other farmers to grow crops.
- ♦ They grow rice, wheat, maize, potato, mustard, vegetables and sugar cane. Rice and wheat are the main crops and the farmers set aside 10–30% of their harvests for home consumption and sell the rests.

- ◆ They use power tillers, threshers, cultivators, transplanter, seed drills, rotavator, leveler, and pump sets for other farm operations.

These farmers said that they had ventured into renting their reapers after they found that the reapers enabled them to harvest their crops quickly, leaving them available to rent out to others during the harvest season.

Among the ten renters interviewed during the study, six had bought their reapers from local distributors; two were bought second-hand from relatives and two were supplied by CSISA initiatives. Only those who had received their machines from CSISA had been formally trained to operate their machines. The rest had been orientated by the distributor at the time of purchase, but learned mainly by observing other operators.

The repair and maintenance of new reapers is carried out by local distributors for machines that are still under warranty. When the warranty has expired, independent local mechanics are usually called in and spare parts are acquired from the seller or distributor. Spare parts that are not locally available are ordered by from Indian or Chinese importers, which can be very expensive considering the tariffs that are levied. As the number of reapers have grown, so too has the number of experienced local mechanics grown, many of whom live in farming areas. They can be called out to the fields for quick repairs, although 2WT reapers can easily be taken to mechanic's workshops.

The use of reapers to harvest crops saves at least one week of manual labor per bigha (0.67 ha). A reaper can harvest one bigha of standing crop in 2.5-3 hour. In one season, reaper service providers can serve between 60 and 100 farmers. Service providers in the study area charge either NPR 1,500 per hour or NPR 2,000-2,500 per bigha for the reaper service (reaper and operator).

Most clients of reaper rental service providers are neighbors and relatives and its availability spreads by word of mouth (and cell phone number).

All of the 2WT rental services providers interviewed during the study said they are satisfied with their reapers and some are considering buying new machines as replacements or more advanced machines.

## **b) Threshers**

Threshers and reapers are used in tandem during harvests. In general, the research found that the profile of thresher rental service providers is the same as the reaper rental service providers' (see above).

Most reaper service providers also rent out multi-crop threshers. Some farmers with smaller holdings will harvest manually but rent threshing machines. Farmers with lesser-powered closed drum or pedal threshers may thresh their harvests after a reaper has been hired in to cut the crop.

The use of powered threshers saves farmers additional time and money. The usual three days of manual threshing using 3-5 workers to thresh one bigha (0.67 ha) can be reduced to just one hour using a PTO-driven thresher or 2-3 hours with smaller horsepower rice and wheat threshers. A PTO-driven thresher service provider can cover from 50-300 bighas per season.

Larger threshers with higher threshing capacity are heavier but can still be transported easily to fields by tractor. Lighter drum and pedal threshers can be transported using a power tiller or manually by pulling or pushing as they come with wheels mounted on them.

There are more thresher than reaper operators, thus making competition among service providers more intense and increasing the area covered. According to a research conducted by CIMMYT almost 95% of Provinces 1 and 2 farmers use threshers and 99% of farmers in Lumnini province and Sudurpashchim province use power threshers to thresh their wheat.

Local mechanics are initially called in if threshers break and if they cannot be fixed either the distributors' senior mechanic is called in or the machines is taken to the distributor.

## **c) Combine harvesters**

A combine can harvest at least 15 bighas of farmland in a day. One service provider said he could harvest at least 1,800 bigha (1200 hectares) of rice or wheat in a single season. Given their high costs, the number of combines is relatively few, and combine harvester service providers often operate outside their home areas.

Word of mouth from farmers is the main way that combine services are marketed. And combines are often flagged down as they are driven from farm to farm to enquire about availability. Some service providers also demonstrate their combines and distribute leaflets with contact details. The combines are maintained by their drivers and mechanic-helpers who are usually from India. The driver and mechanic-helper can usually can perform all minor repairs in the field or the home of the owner. The standard wage for drivers is NPR 100,000 (952 USD) per season.

The study mapped combine distributors, owners and service providers in Lumnini province (Figure 11). It shows how little combines have spread from Rupandehi, Parasi, and Kapilvastu to other areas along the Terai. Although in the ownership of combines is increasing in Sudurpashchim province, Rupandehi remains the main hub for combine harvester use in Nepal.

## **d) Maize de-huskers and shellers**

Maize de-huskers and shellers were introduced in to western Nepal mainly by CSISA/CIMMYT around 2015 and have been promoted in the Dang Maize Super Zone of the Prime Minister's Agriculture Modernization Project (PMAMP). In \*\* YR they were included in the government's subsidy program.



**Figure 11. Primary location of rental service providers, farmers and combine users in the study area (Source: Adhikari 2015).**

These machines are being rented out to other farmers, especially in the maize producing areas of Dang and surrounding areas.

Service providers prefer 4WT-driven maize de-huskers and shellers which have a high capacity and do both de-husking and shelling and can easily be moved between farms as they are wheeled and can be pulled by tractors. After completing de-husking and shelling in their communities, they move on to service nearby areas. Some service providers own light electric machines and service only their nearby neighbors, relatives or and farmer groups.

## 5.4. Value chain supporters

Repair and maintenance providers, international development agencies, financial service providers, Government agencies and industry association are not directly involved in bringing agricultural machines to market but help add value to the value chain.

### 5.4.1. Repair and maintenance providers

Although no official statistics are available, all of the machine distributors interviewed for this study have workshops and mechanics that repair and maintain machines that are under warranty. When warranties expire, or machines are usually repaired onsite by mechanics who are located nearby and who usually charge less than distributors' mechanics.

There are three types of mechanics who provide repair services for agri-machinery. First are the rural or home-based mechanics who work from small workshops and travel to provide services for smaller

machines like pumpsets, 2WTs threshes, etc. The next are the larger independent workshops who are based in bazaar areas and district town centers but also provide repairs at the field level. Lastly, there are the mechanics based with the larger agents and dealers who provide repair services at their shops and occasionally on field visits. All will specialize in a combination service and repair on engines or implement.

Very few mechanics, including distributors' mechanics, have received formal training. Most learn their trade on the job, working with an agricultural machinery distributors as a mechanic's helper.

Reaper repair workshops specialize in the repair of the engines of 2 and 4 wheeled tractors, pumpsets, threshers, shellers and other machines. Such workshops report that they repair about 75 machines a year at their workshops, while also regularly providing field repair services. Their fees are based on the complexity of the work done as well as any travel involved. In most cases, these workshops provide spare parts, which gives them an additional income stream.

Workshop mechanics interviewed for this study said that reaper blades and blade holders are the parts that most often need repairing. They are the highest wearing parts due to the constant friction and resulting heat and from coming into contact with soil from rat mounds and bunds.

### 5.4.2. International development agencies

International development agencies have been at the forefront of agricultural mechanization in Nepal. They work with government agencies and partner with local stakeholders to implement their programs.



The International Wheat and Maize Improvement Center (CIMMYT) has been working on agricultural and rural mechanization issues in Nepal since the mid-1990s. Currently its flagship project the Cereal Systems Initiative for South Asia (CSISA) has supported agricultural development in Nepal since 2009 to present promoting scale-appropriate machinery and improved agronomy, including seeders, planters, mini tillers, 2WTs and their attachments. It is also involved in promoting the adoption of appropriate farm technologies.

Other international institutions involved in agricultural mechanization are:

- ♦ the International Food Policy Research Institute (IFPRI), which is supporting the implementation of the Agriculture Development Strategy (ADS) and specifically the Agricultural Mechanization Promotion Policy (2014-17); and
- ♦ the Food and Agriculture Organization (FAO) of the United Nations, which supports agricultural mechanization through past 1 and 2 year technical cooperation programs as part of its Priority Area 3 on market orientation and competitiveness and promotes private sector investments in infrastructure and technologies.

#### 5.4.3. Financial service providers

In 2018 the Nepal Rastra Bank mandated that banks to set aside 10% of their loan portfolio to the agriculture sector. However, despite this directive, banks are reluctant to channel their resources to the agriculture sector and consider smallholder farmers as high-risk clients.

Of the five banks interviewed for the study (the Agricultural Development Bank, Laxmi Bank, Prabhu Bank, Muktinath Bikas Bank and Rastriya Banijya Bank), three (Laxmi Bank, Prabhu Bank, and Rastriya Banijya Bank) said they had no specific loan products for farmers and farmers seeking loans received no special treatment.

Banks require land as collateral, and providing this is often the main challenge for small borrowers because the valuation of land is often problematic as farmers and banks often value the land much less than the farmer. In addition to collateral, borrowers are required to submit business plans.

Even if farmers can meet all of these requirements, the irregular and small income from agriculture makes it difficult for smallholders to pass banks' risk assessments. Farm plans and budgets often show a low repayment capacity which is another reason why banks often reject their loan requests. Even if they are approved, the loan size is limited to 70-80% of the required amount to purchase the machine.

With the stringent requirement and tedious documentation procedures, it tends to be the largest actors in the value chain farmers, principally farmers with large holdings and importers and distributors who manage to acquire loans from commercial

banks. These loans tend to be large (usually NPR 1 million or more) and priced at the base interest rate plus a 2-4% premium, which translates into 12-15% per year. Some banks also add service charges.

In general, the banking sector has been experiencing overall growth of 2-3% in loans per annum in recent years, but this does not necessarily reflect the same level of growth in volume of loans to the agriculture sector. Banks prefer to focus on larger loans meaning that farmers with small landholdings are not prioritized in the provision of financial services.

#### 5.4.4. Government agencies

One of the Government of Nepal's main pillars of its agricultural modernization policy is the promotion of farm mechanization. The bureaucracy for this has been recently enhanced with the setting up of the following offices that are directly related to agricultural mechanization:

- ♦ The Agricultural Machinery Testing and Research Center at Nawalpur aims to improve the quality of machines and develop a pool of skilled agricultural technicians. Established in 2017, the Centre for Agricultural Infrastructure Development and Mechanization Promotion (CAIDMP, formally the Directorate of Agricultural Engineering) is one of the Department of Agriculture's six centers.
- ♦ The Agricultural Engineering and Post-harvest Section (AEPHS) at the Department of Agriculture under CAIDMP. Re-established in 2018.
- ♦ The Agricultural Mechanization Promotion Center (AMPC) under CAIDMP in Janakpur, which is to be developed as an agri-machine training center. Established in 2017.
- ♦ Agricultural engineering and small irrigation sections in the seven provincial ministries of land management, agriculture and co-operatives (MoLMAC). Established in 2017.
- ♦ Agricultural mechanization and small irrigation branches under MOALD were established in 2018.

The Prime Minister's Agriculture Modernization Project (PMAMP) promotes new technologies in specific crop zones and super zones. PMAMP has embraced the need for agricultural mechanization to increase farm productivity and profits while decreasing the cost of production. This is being done by providing subsidies for new farmer cooperatives and service providers to buy farm machinery.

#### 5.4.5. Industry associations

The Nepal Agricultural Machinery Entrepreneurs Association (NAMEA) is the industry association for importers and distributors and carries out policy advocacy on behalf of its members. Founded in 2014 with support for Directorate of Agricultural Engineering and CIMMYT it facilitates annual exhibitions that showcase the latest agricultural machines to enable larger service providers to see



new technologies that could improve their services. The association also organizes training activities for technicians and mechanics on maintaining and repairing machines.

However, many NAMEA members who this study consulted and other stakeholders report that NAMEA needs to do more for all its members. And that it makes only minimal efforts to engage with the wider membership. Most discussions during annual meeting and Agri Expo revolve around technical aspects of machines with little discussion and sharing of business strategies and market insights to build all members' capacity. It was widely held that while many of the subsidies are having a positive and fair impact farmers, the executive committee members of NAMEA are using their office to gain undue and unfair advantage to direct government subsidized sales to their companies and leaving ordinary members with limited or no sales under the subsidy program.

Most of the past upgrading activities for NAMEA have been conducted with support from CAIDMP and international organizations like CSISA/CIMMYT and United Nation's Center for Sustainable Agricultural Mechanization.

## 5.5. Value chain influencers

This sections looks at the influence of the regulatory framework, government programs, the tax regime and the business environment o the agricultural machinery value chain.

### 5.5.1. The regulatory framework and government programs

The government is committed in its policies to promoting agricultural mechanization. However, it has limited resources to fast track the adoption of full mechanization in the agriculture sector. The following government programs may not be enough to fast track mechanization, but are good building blocks towards the more sustained growth of agricultural mechanization:

- ♦ The subsidy program which is currently implemented by local governments is responsible for increasing the number of farmers, service providers and cooperatives who own machines.
- ♦ The establishment by DOA and local governments of custom hiring centers and post-harvest centers in existing and newly created cooperatives

are meant to promote access to agricultural machines. However, there is growing evidence<sup>13</sup> that while they have been useful to demonstrate the benefits of old and new types of machinery to their members and surrounding communities these centers suffer from low usage rates.

- ♦ In the early 1990s the Government of Nepal declared the import of agricultural machines to be exempt from import tariffs and VAT tax. However, from 2017, 4-wheel tractors have become liable for VAT as an important source of government revenue. The private sector decried this an attack on farming. But the Government cited that a large percentage of 4WTs are being used for transport only in urban and peri-ugban areas<sup>14</sup>.

Many agricultural machinery are acquired through the government's subsidy programs. Although many 2WTs, 4WTs, plowing implements, and threshers are also bought outside this program. For example, 95% of the market for mini-tillers is in the midhills, and purchases there are heavily subsidized by government programs. Distributors interviews for this research said they would not be able to make sales if the subsidies were removed.

Through the Nepal Rastra Bank (the central bank), the government has tried to encourage banks to lend to farmers for production and mechanization by mandating that 10% of their loan portfolio be allocated to agriculture. However, banks continue to resist due to the perceived risk (and lack of collateral available from most small farmers), preferring to pay penalties rather than lend.

### 5.5.2. The tax regime

Although new imported agricultural machines are only required to pay 1% customs duty, spare parts are taxed at 13% on top of the 1% and some parts are taxed as high as 25%, which makes it expensive to maintain older machines. And the tariffs charged on imported materials for manufacturing machines makes locally manufactured machines more expensive than imported machines, which greatly discourages local manufacturers.

## 5.6. Value chain maps

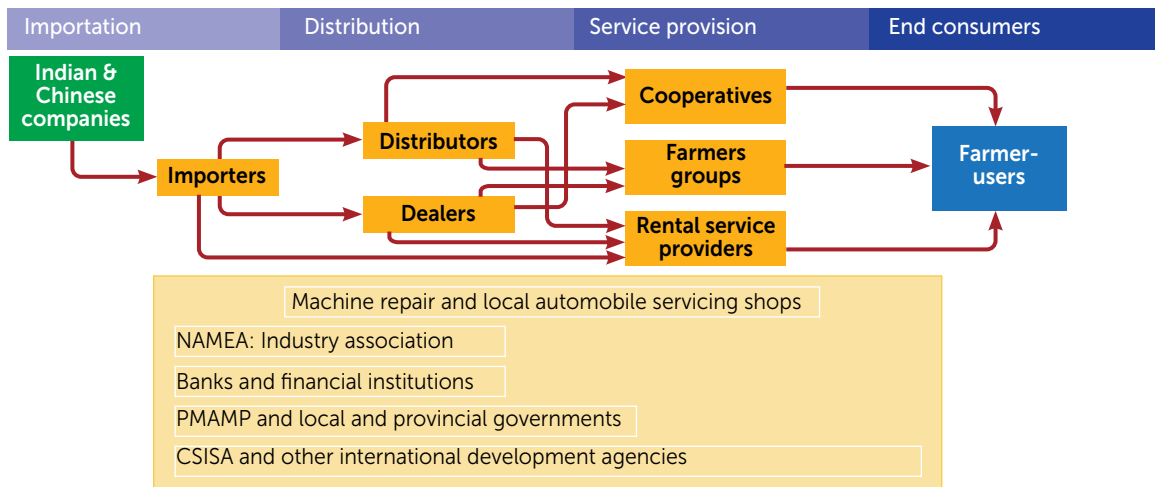
For each of the main categories of grain harvest machines, a map of the value chain of nodes and actors is provided along with costs and prices and a SWOT analysis.

<sup>13</sup> Dick Tinsley has written extensively on mechanization in developing countries noted in his book *Developing Smallholder Agriculture: A Global Perspective* that "They are simply too administrative cumbersome resulting in excessive overhead charges so relying on them will push the farmers deeper into poverty." In discussions with PMAMP and other stakeholders they also have complained that the cooperatives are not adequately trained nor of of the right entrepreneurial spirit and that relatively unused machinery lies broken and that staff claim they have no budgets to repair them.

<sup>14</sup> See Tractor imports come to a screeching halt <https://kathmandupost.com/money/2017/07/29/tractor-imports-come-to-a-screching-halt> <https://kathmandupost.com/money/2017/07/29/tractor-imports-come-to-a-screching-halt> last accessed 08/10/20.

### 5.6.1. Value chain maps of 2WT reaper attachments

**Figure 12. Value chain map of reapers in Lumnini province and Sudurpashchim province, Nepal.**



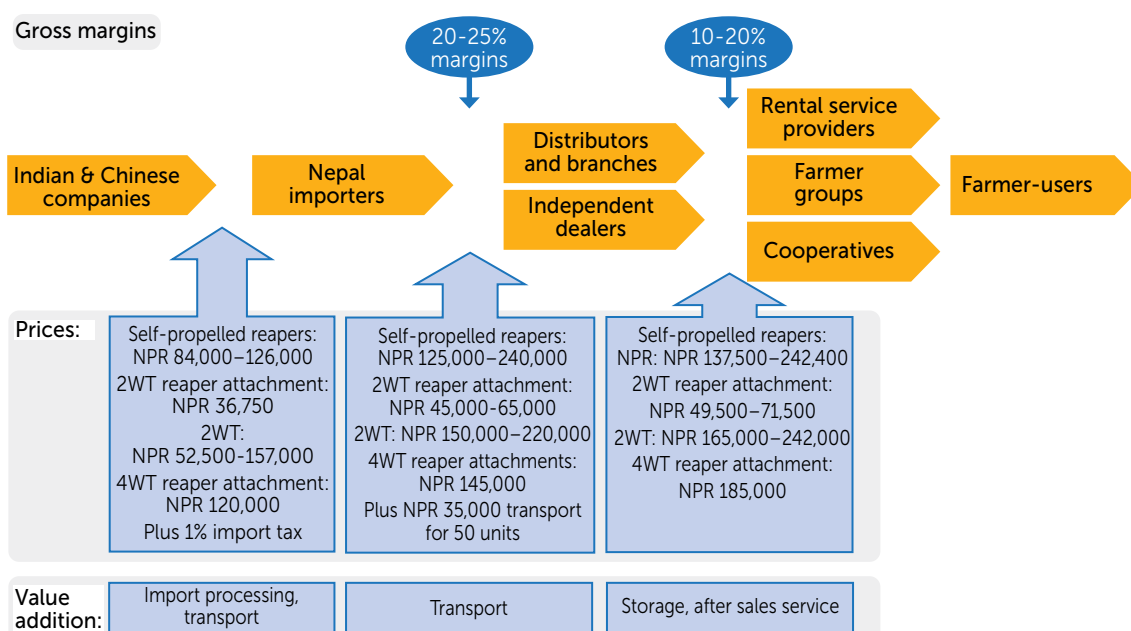
The source of 2WT reapers are either Indian or Chinese manufacturers and are brought into the country by importers. The marketing of the 2WT reapers are then made through the local distribution centers of the importers or through independent dealers. From the importer distribution centers and dealers, the 2WT machines are purchased by cooperatives, farmers groups and rental service providers who are mostly farmers with capital and bigger landholdings. Farmer-users avail of the services from the cooperatives, farmers groups and rental service providers.

One of the main bottlenecks in the value chain is distribution. The cost of the 2WT reapers are still not within the capacity of the small farmers. As such, Farmer-users have to deal with cooperatives and farmers groups, and rental service providers.

There are several support institutions in the value chain of 2WT reapers. These includes:

- ♦ Machine shops providing repair and maintenance service to the 2WT reapers.
- ♦ As the industry association, NAMEA provides policy recommendations on the most appropriate policies on importation, taxes and other regulatory issues.
- ♦ Private banks as the source of financing for the acquisition of the reapers.
- ♦ The national government through PMAMP and the local government units for providing subsidy programs to enable farmers to acquire reapers.
- ♦ CSISA and other international development agencies in providing technical support in the promotion on the use of reapers.

**Figure 13. Average prices along the value chain of 2WT reapers.**



Sources for prices: [www.Indiamart.com](http://www.Indiamart.com) and [www.alibaba.com](http://www.alibaba.com) in 2019

### 5.6.2. SWOT of the 2WT reaper value chain

#### Strengths

- ♦ Reapers speed up rice and wheat harvesting. They reduce the time to harvest one bigha from 12 laborers in 8 hours to 2-3 laborers in 2-3 hours.
- ♦ Reapers reduce the need for labor thus mitigating labor shortages during harvest seasons.
- ♦ Reapers allow farmers to more easily collect straw for fodder for their livestock.
- ♦ The main sales areas in Nepal are Kanchanpur, Kailali, Bardiya, Dang and Nawalpur and Parasi Districts.
- ♦ Reapers are affordable and within the buying power of many farmer-users.
- ♦ Reapers are lightweight and so can be easily transported and operated over land with irregular features and that is less accessible by road.
- ♦ Experienced drivers can operate reapers in smaller fragmented holdings-areas where combines and larger 4WT reapers cannot operate.
- ♦ The more rapid harvesting using reapers reduces farmers' turnaround time, allowing them to cultivate other crops in succession rather than missing a season, thereby increasing intensification and the overall productivity of the land.
- ♦ Reapers service providers mostly serve their surrounding family and neighbors meaning that hiring on credit is easier compared to hiring combines that come from outside the area.
- ♦ Walk-behind reapers, which have fat tires and are light in weight, making them appropriate for muddy conditions and sloping land.

#### Weaknesses

- ♦ Chinese 2WT reapers do not have warranties.
- ♦ Reapers require considerable maintenance. Reaping blades must be oiled, the machinery greased, and the overall unit served regularly. If not, bearings, belts, and reaping blade break easily.

- ♦ Reaper owners complain that spare parts are too expensive. Some parts and major assemblies, such as gear boxes and connecting arms, are not easily available and need to be specially ordered from Kathmandu or imported from India or China.
- ♦ Demand for reaper attachment blades is limited to areas where farmers already own 2WTs (i.e., most of the Terai, but not elsewhere).

#### Opportunities

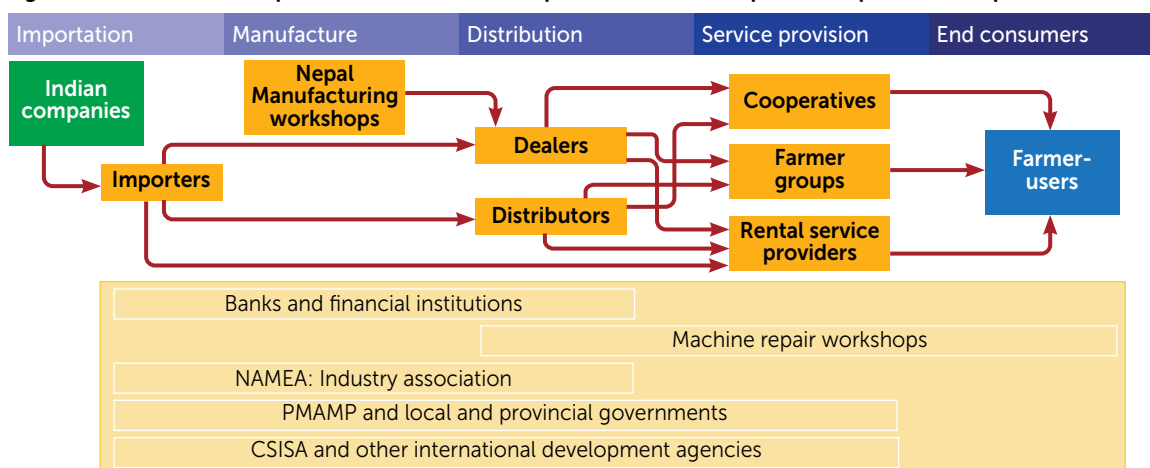
- ♦ The demand for 2WT reapers will increase in Terai districts where they are not yet popular (i.e., the eastern Terai) and perhaps larger river valleys in the hills as farmers increasingly appreciate the advantages of mechanization.
- ♦ Farms with small and fragmented holdings can save much time and money by mechanizing their wheat and rice harvesting with reapers and threshers.
- ♦ The government subsidy program incentivizes farmer-users to buy machines for their own use and to earn additional income as service providers.
- ♦ Inexpensive reapers from China are easily imported into Nepal and sold at affordable prices to Nepali farmers.
- ♦ As shown in Rupandehi and Nawalpur and Parasi Districts where combine harvesters are widely used, combines cannot serve all farmers so reapers will continue to serve smaller farmers.

#### Threats

- ♦ In some areas in the Terai, farmlands are being converted into real estate development and other commercial purposes, limiting the area devoted to farming.
- ♦ Compared to the reaper-thresher combination, the increasing popularity of more advanced machines like combine harvesters will erode the market for reapers.
- ♦ Rental prices of reapers are tied to fuel costs; an increase in the price of fuel would increase the cost of rental or decrease the profit that can be made from renting them.

### 5.6.3. Value chain maps of threshers

Figure 14. Value chain map of threshers in Lumnini province and Sudurpashchim province, Nepal .



There are two sources of threshers: manufacturers from India and Nepal domestic manufacturers.

Importers bring in threshers from India and distribute them through its own distribution centers and independent dealers. They also sell directly to rental service providers. From the distribution centers and independent dealers, the threshers are then sold directly to the farmer-users or through the cooperatives, farmers groups and rental service providers.

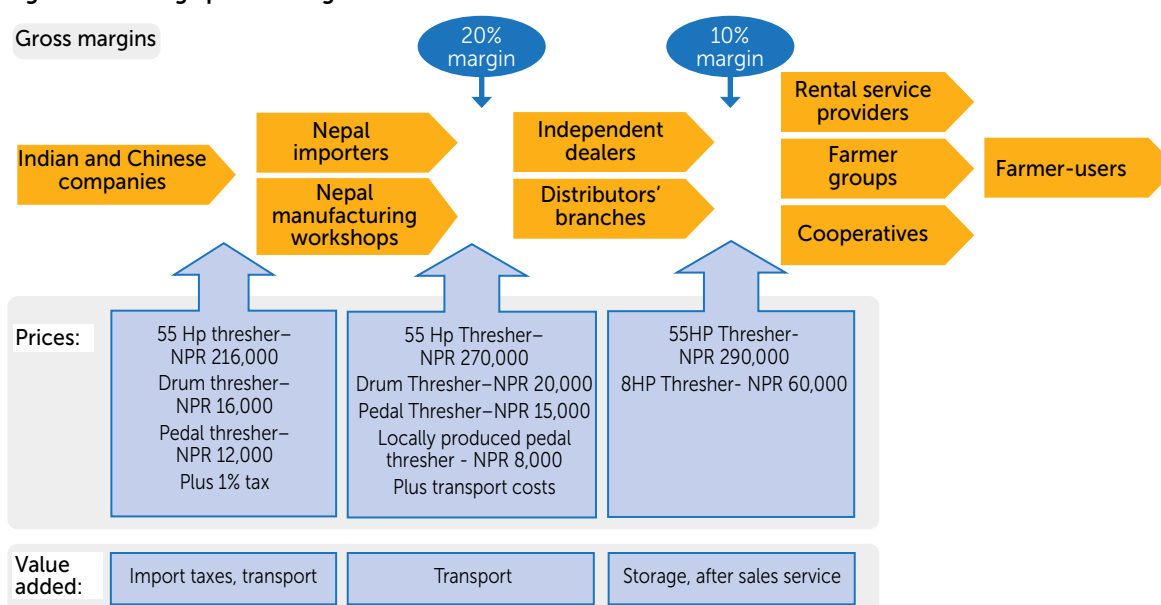
Local manufacturers usually sell their threshers to dealers who sell the same to cooperatives, farmers groups and rental service providers.

From these cooperatives, farmer groups and rental service providers, the farmer users are renting the use of threshers.

Support institutions in the thresher value chain includes:

- ♦ Banks and financial institutions that finance the importation and distribution of the threshers.
- ♦ Machine shops providing repair and maintenance services to distribution centers and dealers, cooperatives, farmers groups and rental service facilities and the farmer-users.
- ♦ The NAMEA providing support to policy recommendations to streamline import regulations.
- ♦ The national government through PMAMP and the local government units for the subsidy program and other support to ensure farmers can acquire threshers.
- ♦ CSISA and other international organizations providing technical support to the government and NAMEA.

**Figure 15. Average prices along the value chain of threshers**



#### 5.6.4. SWOT of thresher value chain

##### Strengths

- ♦ Butwal, Banke, Bardiya and Kailali, are areas in Lumnini province and Sudurpashchim province where threshers are popular with most of them acquired through the government's subsidy program.
- ♦ Farms with small and fragmented holdings that cannot accommodate combine harvesters can save much time and money by mechanizing wheat and rice harvesting using reapers and threshers.
- ♦ Threshers thresh straw into edible fodder. Farmers who are also involved in livestock production seek threshers to collect the valuable straw after harvest.
- ♦ Since around 2015, smaller horsepower lighter threshers have become more popular as they can be easily transported in areas without roads, and can be used on sloping and irregular land.

- ♦ Local manufacturers can produce threshers that compete with Indian imports in the market.
- ♦ Threshers are affordable to service providers and farmer renters.
- ♦ The time saved by mechanizing threshers give farmers more time to work on other farm operations.

##### Weaknesses

- ♦ Chinese threshers do not have warranties.
- ♦ Threshers emit large amounts of dust that can affect the health of operators and laborers.
- ♦ Open belts and other non-covered moving parts cause many injuries.
- ♦ Spare parts, particularly those imported from India, are expensive.
- ♦ Threshers are sometimes inappropriately set, which can damage the grain/seed and affect germination of seed grain.

- ◆ Some farmers-users believe that threshers cause too much wastage (un-threshed grain), although this is usually due to poor operation by improper speed settings or feeding too much un-threshed rice or wheat at a time.

### Opportunities

- ◆ There is a great need to training service providers on properly adjusting threshers.
- ◆ The government subsidy program enables many farmers to buy threshers of their choice, especially in hill areas.

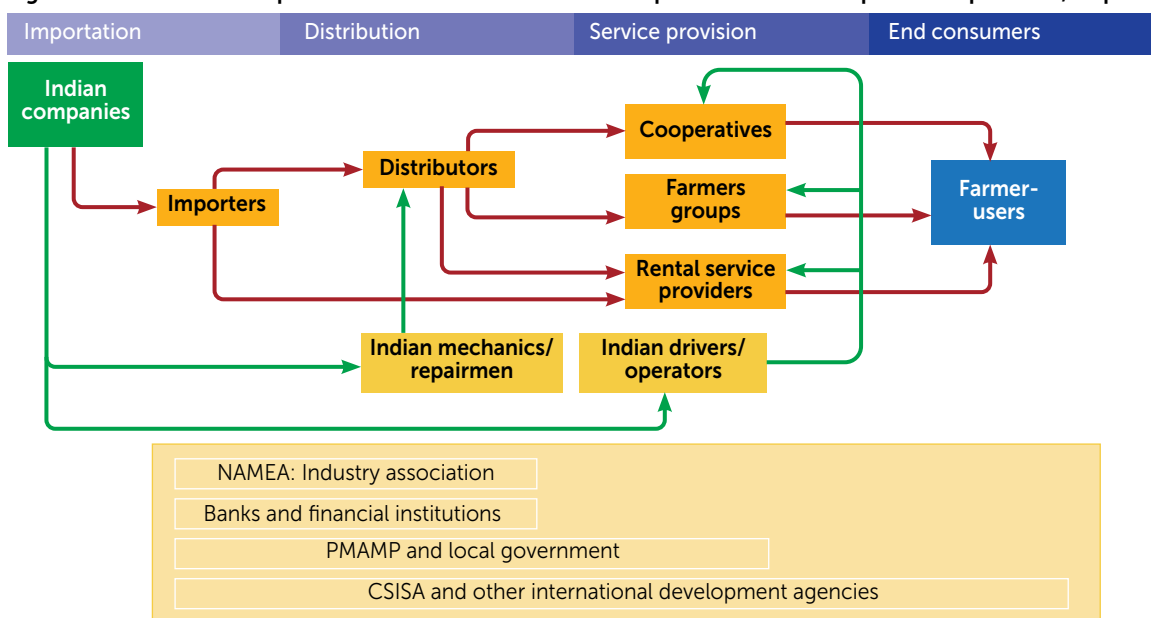
- ◆ Continued labor shortages in agricultural communities are pushing farmers to further mechanize increasing opportunities, particularly in the hills, for powered threshers and shellers.
- ◆ Improved understanding of successes in local manufacturing and modifications to the national policies would enable the relatively simple technology threshers to be manufactured by workshops and factories in Nepal.

### Threats

- The growing use of combine harvesters will decrease the demand for threshers.
- ◆ More farmers buying their own threshers will decrease the demand for service providers.

## 5.6.5. Value chain maps of combine harvesters

**Figure 16. Value chain map of combine harvesters in Lumnini province and Sudurpashchim province, Nepal.**



Combine harvesters are manufactured in India and brought into the country through the importers. No local manufacturer has the capital, the technology and the capacity to produce combine harvester machines. There are also cases where farmers with big landholdings are able to purchase directly from Indian manufacturers, particularly those who are close to the border with India. Due to the complexity of operating the machine, the arrangement upon purchase is that Indian operators will be hired as part of the whole package of product and services.

Importers distribute the combine harvesters through their local distribution centers. From these centers, cooperatives, farmers groups and rental service providers purchase combine harvesters.

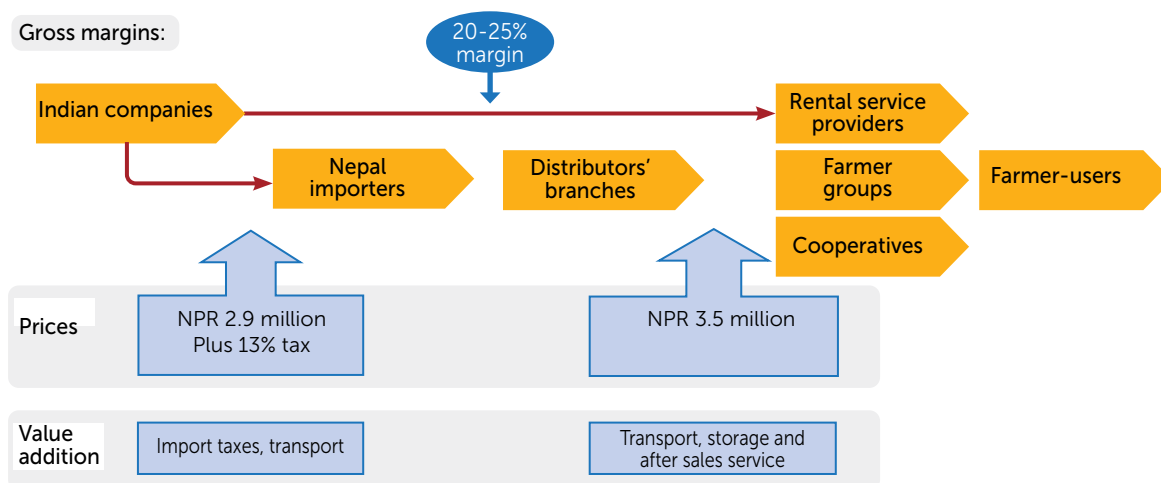
Farmer-users deal with the cooperatives, farmers groups and rental service providers when they need to use the combine harvesters during harvest season.

Support services for the combine harvesters includes:

- ◆ Indian technical people: Indian technicians are assigned in the distribution centers to address technical issues that may occur. They also provide trouble-shooting and repair activities. Other than the technicians based at the distribution centers, Indian operators are assigned to each of the combine harvesters.
- ◆ Individual buyers and even those purchasing through the government subsidy programs can deal with banks and financial institutions.
- ◆ Combine harvesters are among the machineries highly promoted by the government and as such part of the PAMP and local government subsidy programs.
- ◆ CSISA provides technical and promotional support on the use of combine harvesters.



**Figure 17. Prices along the value chain of combine harvesters.**



### 5.6.6. SWOT of combine harvester value chain

#### Strengths

- ◆ Combine harvesters are the fastest and the most efficient machines for harvesting grain crops, saving all types of farmers time and money.
- ◆ The taking of less time to harvest crops reduces turnaround times and often results in more timely cultivation which increases yields.
- ◆ Combine harvesters work most effectively in plain areas as found in the Terai of Lumnini province and Sudurpashchim province.

#### Weaknesses

- ◆ Belts and chains are the parts most prone to breaking on combines. However, spare parts must be ordered from India and the Nepali importers are located far from most farm areas.
- ◆ The high price of spare parts with 13% extra VAT charged on them.
- ◆ The fragmentation of agricultural holdings is reducing the areas where combines can operate.
- ◆ It does not pay combine service providers to harvest small farms given the time to transport and the slow rate of harvesting small fields.
- ◆ The malfunctioning and when of parts and improper adjustment causes wastage as grains are blown out of the machine, in some cases along with un-threshed grains.
- ◆ Drivers and operators try to earn more by driving faster than they should while harvesting, causing grain losses.
- ◆ Because of the heavy weight, combine wheels leave deep furrows in in wet soft fields. This entails extra leveling and land preparation costs especially for follow-on no-till wheat and other crops.
- ◆ There are few trained Nepali operators, and Nepali farmers prefer Indian operators because they are supported by mechanics who carry spare parts with them.

- ◆ Some farmers who directly buy combines from Indian distributors have problems with the authenticity of the machines and low performance.
- ◆ Because combines harvest in bulk, many farmers do not have space for post-harvest processing. This forces them to sell their produce soon after harvesting even if it is not properly dry, which lowers the selling price.
- ◆ Farmers harvesting with combines usually set them to leave the stalks standing in the fields. Much combine harvested rice and wheat straw is burned in fields, causing air pollution.

#### Opportunities

- ◆ Continuing labor shortages create demand for combine harvesting.
- ◆ The good results from combine harvesting is more and more recognized by farmers.
- ◆ A lot of areas are still not covered by services of combine harvesters, suggesting that demand will remain high for many years.
- ◆ As additional areas gain irrigation facilities, there will be increase in the potential areas that can be served by combines.
- ◆ Promoting machinery (wheat-straw combines, straw spreaders, etc.) to collect and process straw left in the field by combines, as well as developing markets for straw as fodder and fuel, would make combines even more attractive to farmers.
- ◆ Programs that promote "management or operational consolidation(Mandal 2017) <sup>15</sup> help aggregate demand in areas with small and fragmented holdings would encourage reaper service providers and combine harvester operators to provide services to smaller and fragmented farms.
- ◆ Programs supporting owners to join their contiguous plots by use of laser land leveling would also encourage combine harvester operators to provide services.

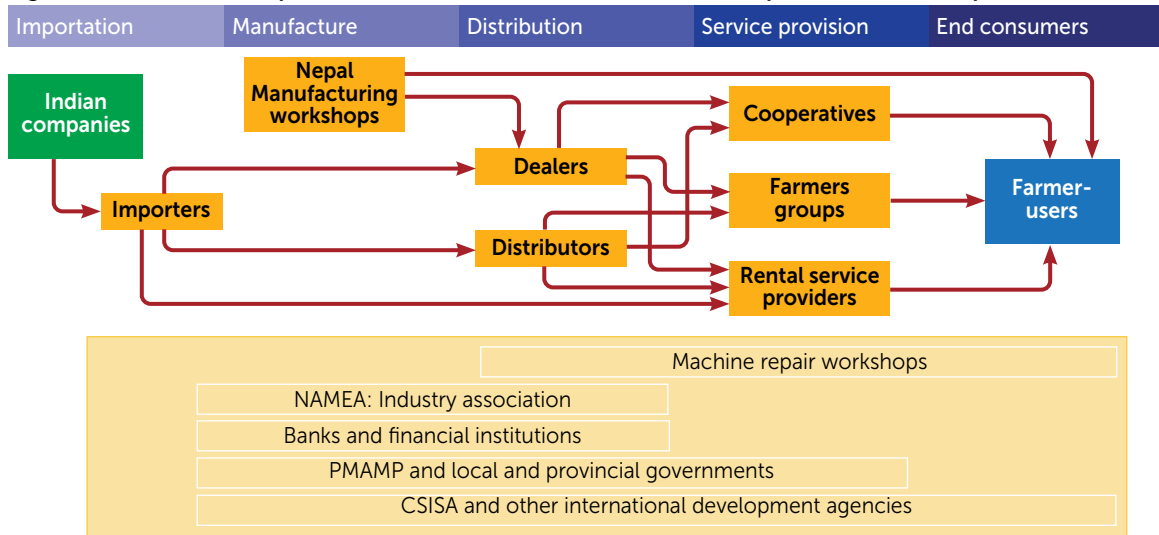
<sup>15</sup> See M. A. Sattar Mandal's (2017) Growth of Mechanisation in Bangladesh Agriculture: Role of Policies and Missing Links.

### Threats

- ♦ The increase in the number of combines may drive down service fees and reduce interest in purchasing combines.
- ♦ Political conflict with India could disrupt the supply of combines, spare parts and teams of drivers and mechanics.
- ♦ The continued fragmentation and division of farm holdings will make it less attractive to harvest fields using combines.
- ♦ As the area harvested by combines increases so does the amount of straw burning and the amount of air pollution.

### 5.6.7. Value chain map of de-huskers and shellers

**Figure 18. Value chain map of maize de-huskers and shellers in Lumnini province and Sudurpashchim**



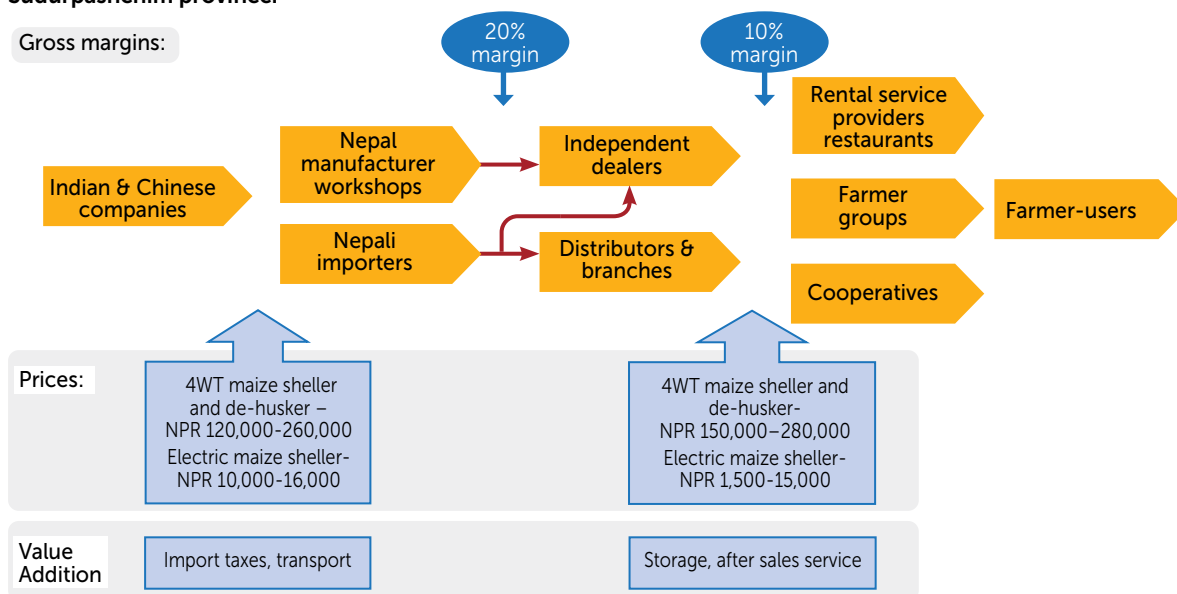
Dehuskers and shellers are made by Indian manufacturing companies and brought into the country by importers. There are also local manufacturers that produce dehuskers and shellers.

The importers are distributing the dehuskers and shellers in three ways: one is through their own distribution centers, second is through independent dealers and third, directly through rental service providers. Local manufacturers usually sell products directly to the farmer-users and also through independent dealers. Dehuskers and shellers are small machines and its cost is within the capacity of ordinary farmers which explains the direct purchases of farmer-users from local manufacturing companies.

The same support systems are available to the dehuskers and shellers:

- ♦ Machine shops providing repair and maintenance services.
- ♦ Banks and financial institutions providing financing to local manufacturers and importers for working capital.
- ♦ National government offices through PMAMP and local government units providing subsidy programs.
- ♦ CSISA and other international organizations providing support on promotions and advocacy.

**Figure 19. Prices along the value chain of maize de-huskers and shellers in Lumnini province and Sudurpashchim province.**



Sources of prices: [www.indiamart.com](http://www.indiamart.com); [www.alibaba.com](http://www.alibaba.com) 2019

### 5.6.8 SWOT of maize de-huskers and shellers

#### Strengths

- ♦ Maize de-huskers and shellers have mostly been adopted in Nepal's hilly region where large threshers cannot operate.
- ♦ Maize grows well in Nepal and there is a large demand from animal feed manufacturers.
- ♦ The technology is simple and can be produced locally and sold competitively.
- ♦ These machines are mostly operated using electricity, take up a small space (especially electric ones) and are cheap and affordable.
- ♦ Most are portable and can be easily transported.

#### Weaknesses

- ♦ Most spare parts come from India or China, which increases running costs.

- ♦ The larger multi-function machines cannot be used on areas with irregular contour which favor small portable machines.

#### Opportunities

- ♦ There is great potential for more use of maize de-huskers and shellers as maize is one of Nepal's main cereal crops.
- ♦ The government's subsidy program is an incentive for maize farmers to acquire de-huskers and shellers.
- ♦ The awareness created by farm mechanization programs promotes the use of these machines.

#### Threats

- ♦ The introduction of more sophisticated machines for maize harvesting will affect the use of current small and portable de-huskers and shellers.

## 6 Other concerns

### 6.1. Quality issues

#### 6.1.1. Grain quality issues

Most study participants reported no significant differences in the quality of grains or volume harvested by reapers and threshers compared to manual harvesting. However, FAO has noted that there are up to 6% losses when rice is cut and laid to dry in the field and that can be attributable to harvesting with reapers as opposed to combine harvesters.

Interview respondents also said that wastage occurs due to the weak capacity of tractors or engines to provide the required revolutions per minute to work threshers efficiently. This particularly occurs when the straw and grain has high moisture content and operators feed too much green-wet grain and straw into the machines. They also observed malfunctioning or not properly adjusted (drum speed/RPM, blower fans for cleaning, etc.) threshers spewing out grains and de-husking or breaking the grains during threshing.

Farmers who produce grain for seed interviewed for this study reported that harvesting these crops using threshing machines negatively affected germination. Some seed growers thus manually thresh their seed grain.

#### 6.1.2. Soil quality issues

Lighter machines such as tractor-mounted reapers and harvesters minimally affect soil quality as they do not leave marks that require additional work for farmers.

Combine harvesters more commonly affect soils because they are large and their weight increases by up to 2 tonnes when their grain bins are full, leaving deep ruts in the soil. The wheels make furrows in wet soils, which farmers need to get rid of before the next planting. Rotavators and other tilling machines are used to level the soil, erasing the furrow created by combines.

In discussions with CSISA researchers they have noted that heavy machinery like combine harvesters and even the common rotavators compacts soil, even very dry soil, and as a result reduces yields because roots have difficulty penetrating compacted soils. However, all of the interviewed farmers who harvested their crops with combines were not aware of such impacts and did not attribute any decrease in yield to the use of heavy machinery.

### 6.2. Gender issues

This study used the Women's Empowerment Agriculture Index (WEAI) as a framework to investigate gender issues in the use of agricultural machinery (Hazel, 2013). The framework covers the domains of decisions about agricultural production, access to and decision-making power over productive resources, control over use of incomes, leadership in the community, and the use of time.

**Decision making** – Decision-making in agricultural production, such as which crop will be planted, is usually the domain of male household heads. Most women work on farms to support their menfolk by cutting standing crops, collecting and bundling cut stalks for threshing, transporting and carrying crops to the thresher, and winnowing threshed grain. The area where most Nepalese women have most decision-making authority is in managing backyard vegetable gardens and livestock and poultry production.

All grain-harvesting machines are considered time-savers and labor maximizers. Operating farm machinery requires strength and technical skill. Though there is a smaller class of agricultural machinery like mini-tillers small shellers and threshers that can be easily operated by women, the larger horsepower machines are nearly always operated by men. Although there are growing instances where women operate smaller horsepower walk-behind reapers, women in general still have difficulty operating them. The self-propelled reaper, for example, is light and can be operated by a woman when reaping is done in a straight line, but it requires strength to turn the machine as well as start the diesel engine. Also, it requires strength to maneuver reapers up or down irregular and terraced fields or across bunds.

**Decision-making power over productive resources** – Within the household, men usually control productive resources and decide on matters related to farm expenditure including purchasing inputs, paying farm labor, and buying agricultural machinery.

**Control over use of income** – Farming income is family income, and no part can be identified as belonging to the husband or the wife. Families cover household expenses, expenses for farm activities, and expenses for livelihood activities from these funds. Women traditionally manage these expenses, even if they do not make the decision about what to spend money on. This situation applies equally to extended or joint families as individual nuclear families.

**Community leadership** – Women often have limited participation in communal activities and organizations. For example, the membership of farmer cooperatives is often dominated by men except in women's cooperatives. However, the increasing migration of men to work outside their home areas is creating more opportunities and responsibilities for women. However, although community-based organizations are reaching out to women to join as members, leadership positions are still usually filled by men.

**Time usage** – The increasing usage of harvesting machines means that work that used to take one week per bigha can now only take one day. And much of the work previously carried out manually by women is now carried out by machine. Women are subsequently expected to spend this saved time on household chores and other income-generating activities like livestock raising, backyard vegetable farming, and sun-drying grain, especially for home consumption. At the same time, as their participation in communal activities or organization is increasing, the increased use of harvest machinery is leading to women redirecting their efforts rather than reducing the time they work.



# 7 Conclusions and Recommendations

## 7.1. Conclusions

### 7.1.1. The Market for grain-harvesting machines in Nepal

- Generally speaking, the market for grain-harvesting machines across Nepal is mainly composed of farmers with small landholdings averaging 0.67 hectares, with a much smaller number of farmers with large landholdings averaging 15 hectares.
- The three types of users of grain-harvesting machines are farmers with flat land without livestock, farmers with flat land and livestock, and farmers with hilly land. In the plains of the Terai, the farms produce cereal crops such as rice, wheat and maize, where as hilly areas with irregular or sloping lands produce maize, millet, buckwheat, and small quantities of rice.
- The market for grain harvest machines can be divided into two broad segments: demand for small reapers and threshers and demand larger machines like combine harvesters.
- Labor shortages, fast and more efficient results, and affordable rental services are the factors that contribute to farmer's buying harvest machinery.
- The market for grain-harvesting machines in Nepal is supply-driven, and the farmer-buyers have limited influence over the products. The various actors in the value chain, from importers to distributors and dealers, are the ones in control of the type, quality, price, and other characteristics of grain-harvesting machines sold in Nepal. Thus, the actors high up in the value chain determine the price, payment arrangements, and other transaction details to make the machines available to farmers.
- However, these higher-level value chain actors have no control over the types and the technological features of the machines sold in Nepal, which are determined by the manufacturing companies in India and China. Their machines are designed to fit the specific conditions in their own

countries. Nepali importers, many times acting as knowledgeable "technology gatekeepers" and take the risk of bringing in new types of machinery (e.g. mini-shellors, mini-mills, and even mini-tillers into the market. They bring in machines they believe can be adapted sold and utilized well by farmers and service providers under Nepal's unique conditions. Importers attend exhibitions in China and India that showcase new machines and recent innovations, and manufacturers' factories to inform which machines they will import into Nepal. Anything public sector programs that could assist and support such activities could be looked at as a variation of Haverkort et. al. (1991) "joining importers market experiments.

- Identified demand for grain-harvesting machines as juxtaposed with the current types of farmers. Table 9 provides the picture of the demand and the machines or services needed.

### 7.1.2. Value chain actors

- Despite its lofty goal to be a professional association formed to support its industry, NAMEA members operate in a highly competitive environment, where almost all value chain actors, rather than sharing new ideas and information, protect information about their practices, business contacts, and other insights.
- NAMEA has only limited interaction between the industry association and government planners. Industry-level cooperation by NAMEA with other actors is limited to discussions about advocacy for broad government policies and programs.
- There is no true professional publication that could help open the black box and discuss and share the problems faced at the various levels of the agri-machinery value chain.
- Though there have been recommendations and discussions to create a government – industry forum at the ministry level that would be a platform for discussions no such group yet exists.

**Table 9. Disaggregation of demand for various grain-harvesting machines and services in Nepal.**

Types Segment	Farmers with larger landholdings	Farmers with small landholdings	Cooperatives and farmer groups
Farms with flat land and no livestock	The purchase of combines, for own use and for renting out	The hiring in of combines and reapers from service providers and custom hiring centers	The purchase of combines and reapers or use by members
Farms with flat land and livestock	The purchase of combines, reapers and threshers for own use and for renting out	The hiring in of combines, reapers and threshers from service providers and custom hiring centers	The purchase of or hiring in of reapers, threshers full or use by members
Irregular, sloping and terraced farms	The purchase of stand-alone threshers 2WT reapers or self-propelled reapers	The hiring in of stand-alone threshers 2WT reapers or self-propelled reapers through rental service providers and custom hiring centers	The purchase of 2WT and/or self-propelled reapers and threshers for use by members

- e. Importers are the dominant actors in the value chain as they determine the type, volume, and quality of machines brought into Nepal. They have access to the significant financial resources they need to finance imports. Their accreditation as suppliers for the government subsidy program allows them to retain a dominant position.
- f. Most dealers and independent sales agents are not tied to specific importers, enabling them to offer a range of agricultural machines. On the one hand, selling different brands is advantageous to dealers and agents, but can it cause tension with importers who seek loyalty from dealers and agents.
- g. There is no formal or even informal local level professional associations that could assist dealers and independent sales agents in increasing their sales and services. Many note that NAMEA only represents the importers goals and actions that on occasion are diametrically opposed to the interests of these local businesses.
- h. Most rental service providers of grain-harvesting machines are farmers who see it as an extra source of income. They rarely have systematic business plans and mostly rent to neighbors and relatives first. As this sector is by far the largest provider of agricultural machinery services to Nepalese farmers, much more needs to be done to improve the technical and business skills of service providers while also improving the skills of mechanics and increasing the availability of spare parts.
- i. Large combine harvester operators are much more business-like. They position their harvesters in strategic locations and target specific areas as the harvest season approaches. Competition is high and drives prices down.
- j. Throughout the value chains for harvest machinery, the main competitive advantage among actors is based on price. With the government as one of the main buyers through its subsidy program, the tendency is to supply inexpensive, lower quality machines. This condition is favorable for Indian and Chinese manufacturers who produce cheaper machines.
- k. The economic condition of most Nepali farmers makes them overly sensitive to price and lower cost inexpensive machinery is likely to remain in the market for a long time.
- l. There is a limited opportunity for local manufacturers to produce competitive harvesting machines in the present market conditions. Local manufacturers would to either produce from a mix of local inputs (scrap iron, local produced steel-rod, angle iron, etc.) and imported (bearings etc) or import all parts and manufacture or assemble. And all with "old school" workshop tools and equipment like stick welders, drill press, and grinders. This rarely results in products that are cheap enough to compete with imported machines from India and

China. In addition they are also starting to compete directly with world class machinery from Europe, principally German-made in India- Claas combines, Italian BCS reapers, and Japanese Mitsubishi and Kubota 2 and 4-wheeled tractors, are slowly finding niche markets in Nepal with large and some mid-size farmers.

### 7.1.3. Support services

- a. National-level government agencies, particularly the Ministry of Agriculture and Livestock Development, have developed related national policies. The agencies that require more harmonization with MOALD's agriculture policies are those related to finance, especially the Inland Revenue Department and the Department of Customs, because the duties and taxes on spare parts and other items adversely affect the development of the sector and have no developmental or revenue-generation rationale.
- b. Local governments are in the forefront of implementing the agricultural machinery subsidy program . Each local government has its own needs and policies. While that ensures the subsidy program is geared to local needs, it creates a patchwork in which knowledge is not shared and economies of scale are reduced. A collaborative approach, for example in selecting which machines are to be subsidized and which suppliers are accredited, would increase market efficiency without sacrificing local responsiveness.
- c. Any approach to dealing with local governments must address the fact that some government personnel request 'commissions' for accrediting suppliers.
- d. NAMEA is the recognized apex organization of the agri-machinery industry and has made its voice heard policy advocacy. However, it has not shared information, fostered cooperation, or built the capacity of its members for the growth of the industry. It is also Kathmandu-centered and has not done enough to expand membership to other areas, especially the import corridors in the Terai.
- e. Banks are cautious about lending to small farmers unless they pledge their land as collateral. The Nepal Rastra Bank and NAMEA should consider ways to mitigate the risk of machinery loans.
- f. International organizations have supported government agricultural mechanization efforts by providing opportunities to experiment and consider the possibilities of machines in the country. Even as the machines are becoming more popular and their impact on the productivity of the farmers are felt, international organizations are still needed to share experiences from other countries.

### 7.1.4. Policy environment

- a. The legal framework is well established for agricultural mechanization in Nepal. However, the following areas require policy and regulatory interventions:
  - The enabling environment for local manufacturers of agricultural machines.
  - Reviewing the duties and tax policies on raw material imports for the manufacture of agricultural machines.
  - Establishing standards to ensure the quality and safety of imported machines.
- b. The subsidy programs have contributed to the adoption of agricultural machines in Nepal. However, there is a need to improve the transparency and fairness of these schemes.
- c. The planned establishment of more professional custom hiring centers will increase access to farm machinery. Lessons learned in Nepal and neighboring countries should be reviewed before the next round of expansion for better targeting and support. Some evidence on the performance of custom hiring centers in Karnataka, India (Lokesh et.al. 2018) indicates that the Nepal government should put supplement custom hire centers set up by private sector individuals with cooperative-based custom hiring centers and look to include more private sector and NGO-based custom hiring centers which are not allowed under present rules. Cooperatives and NGO-based custom hire centers will require management training and business development services (BDS) in areas such as governance, operations management, accounting and record-keeping, marketing and customer service.
- d. The government's infrastructure development program, particularly the expansion of irrigated areas and the construction of rural farm roads, will increase the number of farmers who have access to and a reason to purchase or rent harvest machinery.
- e. Nepal's banks remain cautious to channel 10% of their loan portfolio to the agriculture sector as mandated by the Nepal Rastra Bank. Some prefer to instead pay a fine. Additional risk mitigation measures could help, but the experience of other countries is that the carrot and stick approach is not effective. Cooperatives and microfinance banks are more comfortable lending to farmers.

### 7.1.5. The main bottlenecks to scaling up agricultural mechanization

- a. The market for agricultural machinery is limited first and foremost by poverty. The low incomes and small plots of most farmers limits their ability and incentive to mechanize. The subsidies and custom hiring centers offset this bottleneck to some degree, but farmers in remote areas still lack access to farm machinery.

- b. Local manufacturing is limited by a lack of technology, skilled labor, and financing. The only way to manufacture competitive machines would be for an international company to make a greenfield investment or, ideally a build-operate-transfer model. Even if import duties and other taxes were reduced, it is unlikely that the Nepal market is large enough to warrant such an investment without a substantial subsidy.
- c. Nepal's dependence on India as the main route for importing machines and fuel is a major bottleneck for the development of the harvest machinery market in Nepal. A repeat of the 2015 blockade, or a strike by Indian combine harvest operators, would have widespread repercussions for many value chain actors.

## 7.2. Recommendations

Based on the study findings the following recommendations are made to strengthen the agricultural machinery market, enabling environment, support services and value chain actors.

### 7.2.1. Continue to develop the market for agricultural machinery

- a. A market is made up of persons who have the capacity and willingness to pay for a product or service. The market for grain harvesting machines in Nepal is 'weak' because of the prevalence of small farmers. The subsidies for buying machines should be continued.
- b. Other public policies that promote the market, such as the establishment of custom hiring centers and road and irrigation development, should also be continued
- c. Carry out a study to review the progress of existing custom hiring centers to identify good practices and issues and address identified issues before expanding the number of custom hiring centers.
- d. Encourage and support cooperatives and farmer groups to purchase and rent out machines to their members. Building their capacity to manage machinery rental may be less expensive and have a more rapid impact than establishing new custom hire centers.
- e. Organize large farmers who rent out their machines (service provision) into associations so they have a forum to share information and receive skills training.
- f. Carry out more detailed studies on 2WTs 4WTs, mini-tillers and other market segments to inform extension-related training and marketing campaigns.
- g. Conduct a study to determine whether and how local manufacturers of threshers can produce machines that compete with Indian imports in the market.

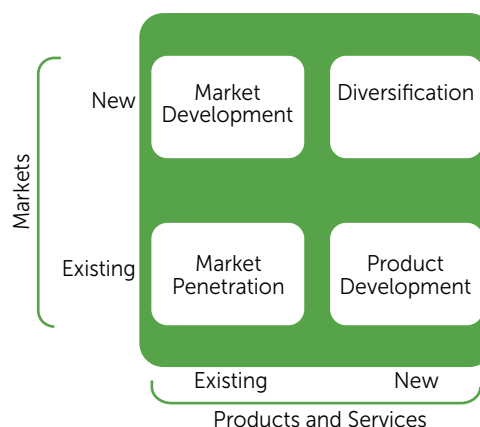
### 7.2.2. Improve product promotion

- Identify the demand for grain-harvesting machines by juxtaposing the identified market segments with the current types of farmers. Table 9 provides the picture of the demand and the machines or services needed.
- Distributors should tailor their marketing and support services to the different market segments and their differing needs: i) custom hire centers and cooperatives, ii) less formal farmer groups and associations who share machinery among members and iii) small, medium and large farmers who purchase machines as a side business activities.
- Segmenting the market like above can help better understand and gauge demand for various machinery. Currently, importers and distributors carry a wide variety of machines in order to meet all possible needs. A more targeted approach could help reduce inventory costs.

### 7.2.3. Improve the capacity of value chain actors to run their businesses

- Importers and distributors need to replace their outmoded and inefficient business management systems by adopting modern business tools and practices.
- Carry out a study to review the effectiveness of companies maintaining company-owned branches versus affiliated distributors versus independent sales agents to study the costs and benefits of each.
- Support value chain actors to improve the promotion of their businesses and sales under the '4 Ps' framework:
  - Products** – Carry out customer satisfaction survey to determine if products meet users' expectations.
  - Price** – Carry out sensitivity studies to check price competitiveness (similar to Poudel et. al., 2019) and the factors that affect various machinery's wholesale and retail price determination
  - Promotion** – Make profiles of potential customers to determine appropriate marketing strategies including encouraging customers to purchase higher specification machines and inviting customers to buy related or complementary items.
  - Place** – Each business- stakeholder needs to review of their current distribution arrangements.
- Encourage and support the carrying out of internal performance reviews of value chain actors to understand what is working and what is not in their businesses to inform strategic marketing plans. One of the most common techniques for this is the Ansoff matrix that allows actors to define their products and the reach of its marketing efforts (Figure 20). The defined products and reach will give the idea of the strategy that can be employed.

**Figure 20. Ansoff matrix for market growth** (Source: Mindtools 2019) .



### 7.2.4. Improve the capacity of institutions that deliver support services

- Develop NAMEA to enhance it as a strong professional organization that promotes value chain development, shares knowledge, and offer technical and business development support to its members. NAMEA also needs to extend its membership outside Kathmandu.
- Train youth on farm machinery operation and related services to attract them to the farm sector as an alternative to having to migrate for work.
- Importers should provide more technical training about the operation and maintenance of their machines and involve more youth participants in order to develop a pool of technically-skilled youth.
- Banks, with support from Nepal Rastra Bank, should investigate ways to mitigating the risks of lending for agriculture. For example, a guarantee mechanism for securing farmer bank loans to purchase farm machines has been effectively implemented in Myanmar by the Livelihood and Food Security Trust Fund (LIFT) with private banks. Also, the Agricultural Guarantee Fund Pool (AGFP) in the Philippines secures high-risk loans made by banks to farmers.

### 7.2.5. Enhance the enabling environment for agricultural mechanization

- Carry out reviews to identify the gaps in the policy framework including of the following:
  - Government efforts to establish national standards and set up the National Agri-Machinery Testing and Research Center (NAMTRC) in Nawalpur, Sarlahi to ensure better quality and for the safer operation of imported machines.
  - Intellectual property rights to enhance the branding of agricultural machinery products and to protect local designs and innovations.

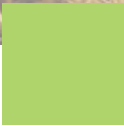
- Agriculture risk mitigation programs such as crop insurance to identify ways to encourage banks to lend more to the agriculture sector, particularly to actors in the agricultural machine value chains.
  - Policies on chattel mortgages to allow machines to serve as collateral for bank loans.
  - Taxes and custom duties on agricultural machinery and spare parts and raw materials, especially for developing local machinery manufacturing under the Ministry of Agriculture and Livestock Development's Agricultural Mechanization Operation Strategy.
  - The subsidy program to focus support to geographic areas with limited use of agricultural machines, to reduce support for buying large machines that are not affordable to most farmers, and to increase transparency in the management of the program.
  - Technical and vocational education and training related to agricultural machinery and its operation, repair, and maintenance.
  - The relevance of educational systems like family farm school (FFS) for the use of machinery in agriculture
- b. Formulate policy guidelines to build larger and stronger cooperatives and enable them to assume more complex functions, especially the capacity to manage enterprises such as custom hire centers for harvest machinery.

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