When It Rains, It Pours

Challenges And Opportunities in Sesame Farming in Myanmar

Proximity Designs with Studio D Radiodurans

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Challenges and Opportunities in Myanmar's Sesame Value Chain

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For Myanmar's smallholders

Preface

Some months ago, I was chatting with a group of our farm customers in a village home. They were giving me feedback on the agricultural practices they've adopted from us, and how these new cropping practices have boosted the yield and quality of their rice crops. Now, they wanted to know about similar practices for sesame.

Sesame is the second largest staple crop grown in Myanmar, both in terms of acreage and its estimated 500,000 farmers. Myanmar is also one of the world's largest producers of sesame. Despite this, the crop has been largely neglected at higher levels. Previous governments have obsessed over rice production and prices to the detriment of other crops, largely for reasons of food security and political stability. Agronomic researchers and policymakers have paid little attention to sesame and provided scant support to grow markets or promote value-added investments. Both sesame growers and traders have been "muddling through" for decades on their own.

Hearing of this large, unmet need from sesame farmers, traders, and exporters led us to delve for eight intensive weeks into the world of sesame in Myanmar, starting with some foundational questions: Why are sesame yields a fraction of those in other countries? Why do farmers grow it? What are their biggest risks and challenges? What choices do they make at key decision points? How are sesame growers innovating themselves? How can they "leap-frog" out of some centuries-old practices? How can we best help?

We set out to learn about sesame farmers, based on our human-centered design approach that involves customer research and rapid and iterative prototyping of solutions. We focus on farm families as customers, not recipients of handouts. This serves as a strong feedback loop, keeping us accountable to offering only products and services that farmers value. The rural landscape in Myanmar is changing rapidly, and our design-driven approach has kept us agile and responsive over the past 15 years.

Here's how I hope you will use this report:

- Get inspired to learn more about sesame farmers.
- Be farmer-centered, start small, and iterate quickly on possible solutions you want to pursue.
- Find practical tools and impactful strategies to address root causes.
- Share your challenges and learnings with us, and with others in government, the private sector, and development aid partners.

We look forward to hearing from you.

Jim Taylor
CEO, Proximity Designs

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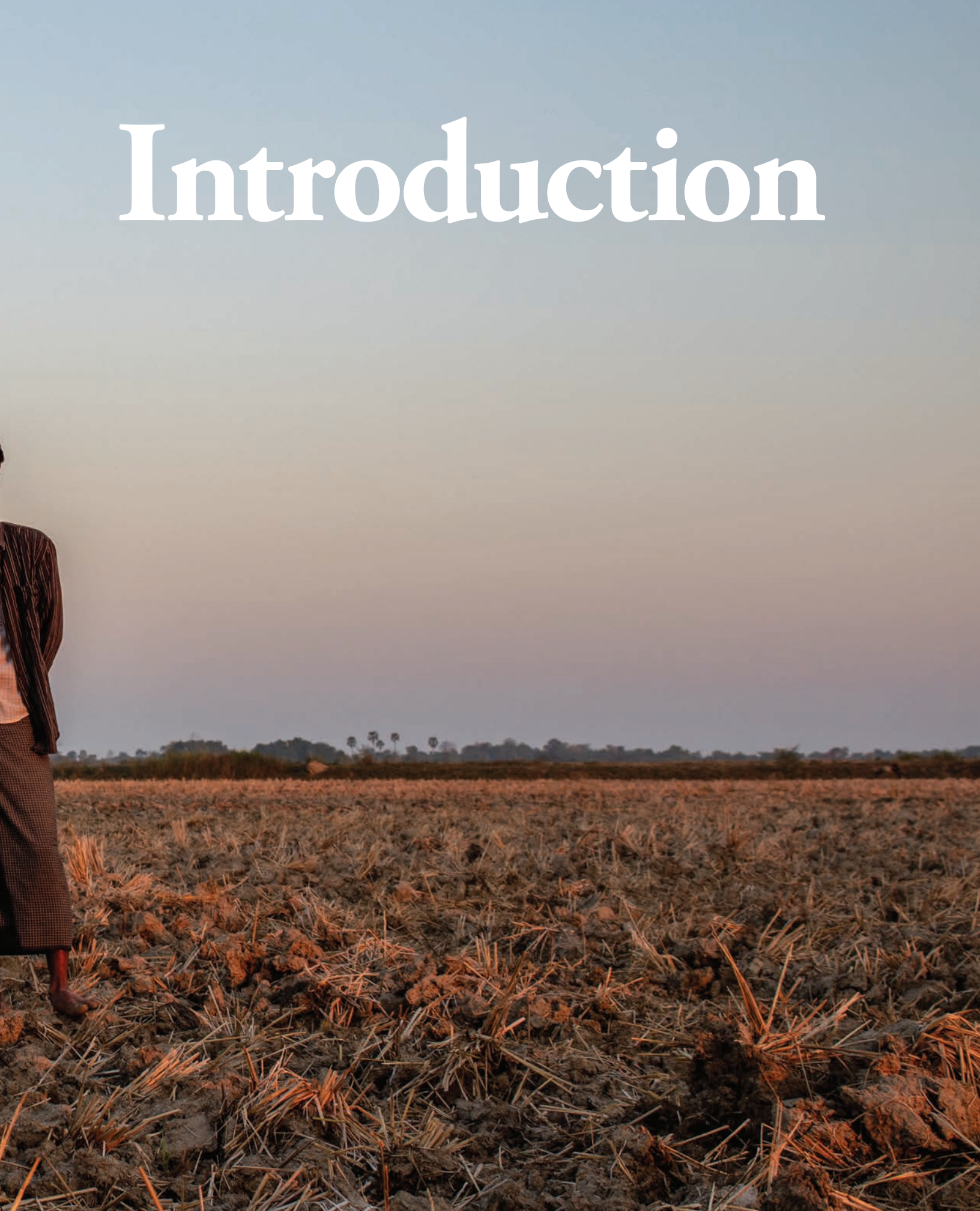


Introduction

In Myanmar, it is not uncommon for sesame to be referred to as "the gambling crop" (*Laung-ka-sar-thee-nan*). With a relatively low barrier to entry in terms of equipment and training, sesame has long been a popular crop for those with suitable land who are willing to assume greater risk for a more lucrative yield than from the country's dominant crop, rice paddy.

While production in the past was largely confined to the region around Magway, it has become widespread across much of Myanmar's Central Dry Zone in recent years, as smallholder farmers strive to increase their income. Over 500,000 farming households now cultivate the seed over the course of three annual harvests, giving it a crucial role in Myanmar's rural economy. While some product is directed for domestic consumption as oil and snacks, the country is now the sixth-largest exporter in the global market, with nearby China, South Korea, and Japan being the primary destination for 76 percent of overall product.

A number of factors, though, have contributed to the crop's recent shift from a "best bet" to a genuine gamble. Though the Central Dry Zone accounts for two-thirds of the country's agricultural land and the majority of its sesame production, as the name would suggest, it is characterised by water scarcity, getting less than 50 percent of the average annual rainfall Myanmar receives. To make matters worse, the country is ranked third amongst those most affected by climate change over the last 20 years, with the Central Dry Zone now being particularly vulnerable to failed harvests through higher temperatures, extreme weather events, and sparse or uneven rainfall.

It's not just a changing climate that threatens the livelihoods of Myanmar's sesame farmers, but a host of other factors—some old and familiar, others more recent, many of them interconnected. These include the chronic hazards of pests and diseases, along with shortages of labour, inappropriate agricultural practices, inadequate transportation infrastructure and access to electricity, population migration to urban centres and abroad, and a lack of access to appropriate financing. Most knowledge of sesame growing has been passed informally from farmer to farmer, and generation to generation; cultivating the willingness and capacity to change requires not only changing minds through education, but tackling myriad systemic factors.

Beyond the farm gate, there are further problems, including a reliance on brokers to secure the best prices on behalf of farmers, the poor quality of milling operations, and Myanmar's underde-

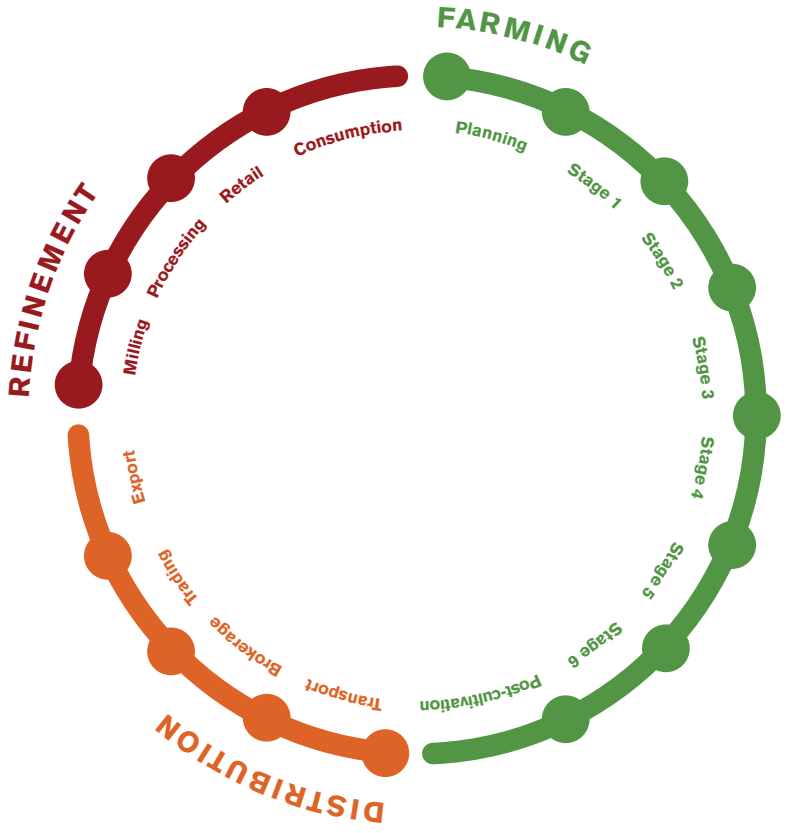
veloped refinement and distribution value chain for sesame, with most processing into higher value products occurring outside the country. Fortunately, there have been some worthwhile initiatives to improve the situation in recent years, notably the expansion of Myanmar's Good Agricultural Practices (GAP) programme to include sesame as well as other crops in 2017. Designed to enhance production and food safety standards, GAP enables participating farmers to secure better access to export markets, and therefore better prices. Implementation of GAP to ASEAN and international standards, however, is currently far from a reality for many smallholder farmers. For an overview of GAP, see *Call-out 09* on page 158.

When It Rains, It Pours is based on primary research using well-established, human-centred design and ethnographic research principles. Research in Myanmar began in January 2019 following six months of planning and coordination between Proximity Designs and Studio D. The on-the-ground interviews, data collection, and sensemaking took place over eight weeks with a team of ten. For a more detailed overview of our methodology, see *Appendix A* on page 223.

Ultimately, we identified several areas of opportunity to enhance the farming, distribution, and refinement of sesame, including the design of new products and services that can be tailored to the constraints of the context at hand. These are outlined on page 202.

We believe that the livelihoods of half a million farming households is not something we can continue neglecting. It is time we changed the odds stacked against sesame farmers.

Figure 01: The sesame value chain



Overview of the sesame value chain

Although *When It Rains, It Pours* is driven by a mission to support sesame smallholders in Myanmar, a foundational study on sesame focusing solely on farming would be incomplete. This report looks at the broader sesame value chain, shown in Figure 01, and is largely structured around three areas: the production value chain, or farming; the distribution value chain, for export; and the refinement value chain, for domestic consumption.

Even when looking at what happens to sesame past the farm gate, *When It Rains, It Pours* attempts to consider the smallholders' perspective and their relationship with other actors involved in the distribution and refinement of sesame.

Exchange rate

Numbers are calculated as 1,500 kyat (MMK) to 1 USD.
1 lakh = 100,000 MMK, equivalent to 67 USD.

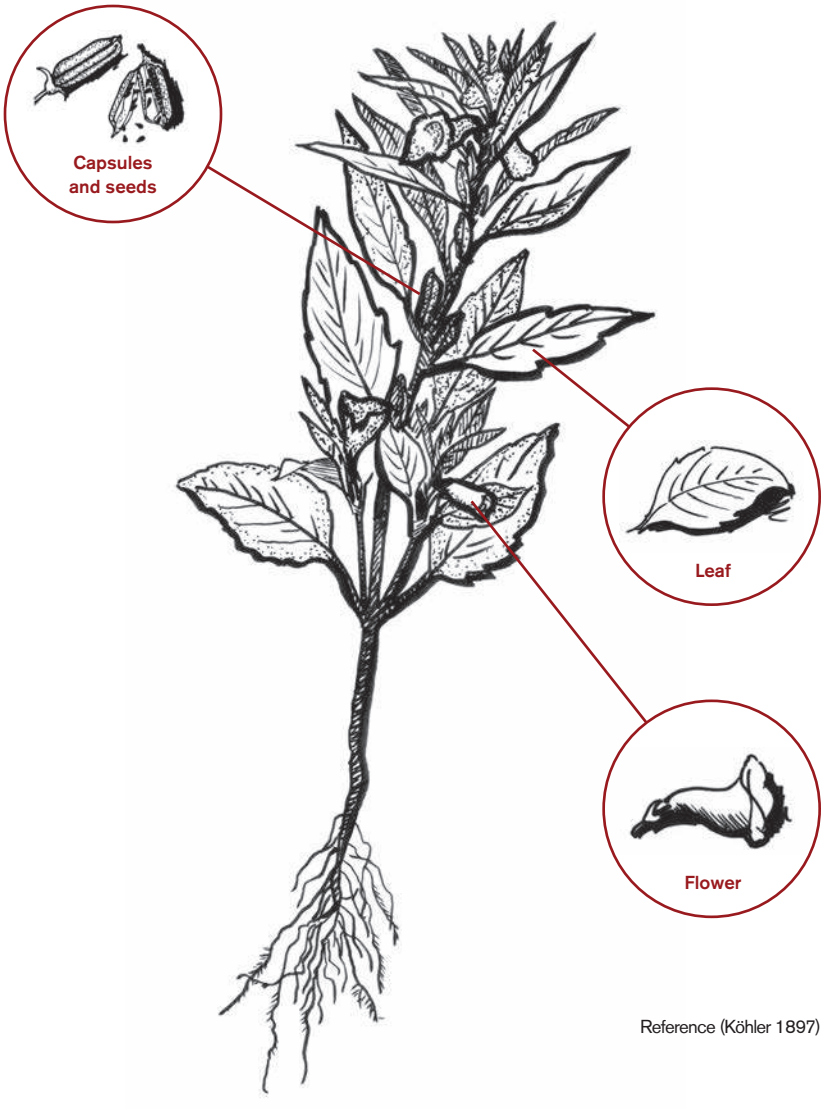
Sesame production

Sesame is an oilseed produced mainly in the Central Dry Zone of Myanmar, as shown in *Figure 02*. Myanmar was one of the top five exporters of sesame in the global market in 2017, along with Tanzania, Ethiopia, Sudan, and India.

What is Sesame?

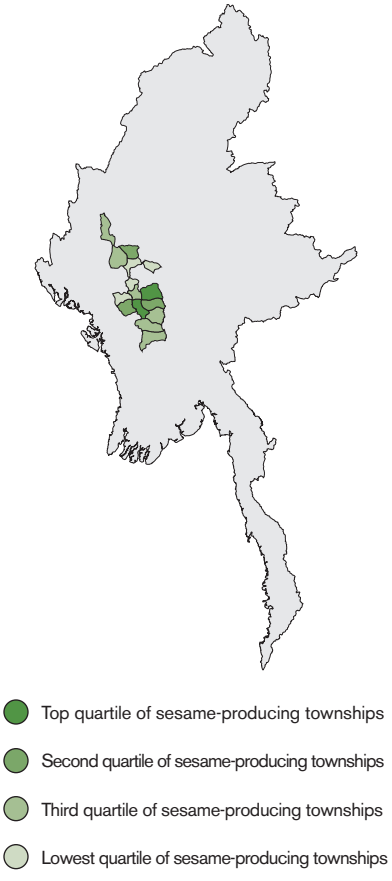
Depending on the variety, each sesame plant can produce 20 to 30 capsules, with each capsule containing 40 to 100 sesame seeds.

Figure 03: Anatomy of a sesame plant



Reference (Köhler 1897)

Figure 02: Where sesame is grown



Rural Context

In order to understand the sesame farming ecosystem, we first need to consider the wider context, including infrastructure, climate, geography, land distribution, village and family dynamics, religion, migration, and mechanisation.

Economic growth and infrastructure

Rural infrastructure development

As one of the last frontier markets in Asia, located between the dynamic economies of China and India, Myanmar has much to gain from trade and development. With recent political and economic reforms, there has been significant growth in gross domestic product (GDP) since 2011 (World Bank 2018a). The gains from this growth have taken longer to reach rural communities, where people continue to live off-grid with limited access to secondary healthcare, higher education, central water, and sewage systems.

Access to electricity, water, and mobile technology

Mostly off-grid

While mains electricity is making inroads, rural communities have turned to alternatives such as diesel pumps and solar panels to improve their living standards. While 45 percent of households in Magway division—where sesame is widely grown—are connected to mains, many homes rely on solar, car batteries, or a generator for their home power needs (General Administration Department 2013). Access to electricity extends day beyond sunset, decreasing theft by allowing for better-lit compounds. In the words of one farming couple, "When we have electricity, cooking is much easier. Our hands don't get dirty from charcoal, the evening lasts longer" (PB-IND-C01).

Whatever the source, power use centres around low-voltage uses such as mobile phone charging, fans, a few LED light bulbs, radios, home stereos, and a TV. The kinds of electrical devices found in rural households of different income levels can be typical to *Table 24: Net wealth signifiers* on page 229.

Variable access to water

Mains water access is not consistent in villages. In rural Myanmar, the percentage of households having access to improved drinking water varies considerably between dry and rainy seasons: 74 percent of the rural population report improved water sources in the dry season, compared with 84 percent during the rainy season. Drinking water sources are improved through piping into a dwelling, yard, or plot; access to public standpipes; boreholes or tube wells; protected dug wells; protected springs; packaged or bottled water; tanker- or truck-delivered water; and rainwater (Central Statistical Organisation 2018).

Village water-delivery service

When not connected to mains infrastructure, villagers with good groundwater access can install a pump or well, either individually at the household level or at the village level as a communal investment. Household-level infrastructure is more expensive but more flexible, given that there are often queues at communal water pumps or wells. As a farmer near Magway who recently invested in a home pump said, "Before, it took 45 minutes to draw water from the village pump, and we can't go when it's too hot for cows to pull the cart" (MG-ADH-F04).

As a way to organise water distribution, a village we visited in Magway with three community pumping stations auctions off the distribution rights every year for 1.5 million MMK per station. The auction winner earns the right to charge fellow villagers for water access, and is responsible for the upkeep of the pumping stations.

Mobile phone, Facebook, and mobile money penetration

The lack of reliable mains electricity has not slowed the adoption of mobile or smartphones, with even the poorest households

A labourer uses Facebook at the start of the day

maintaining multiple devices. Access to mobile phones rose from 7 percent in 2011 to 90 percent in 2016 (Aung Kyaw Nyunt 2016). A new entry-level smartphone such as a Huawei Y3 costs 100,000 MMK, and a used equivalent 60,000 MMK. The main barrier to adoption is the price of data, with one gigabyte (GB) of data costing ~1,000 MMK.

In Myanmar, Facebook is synonymous with the Internet, supplying entertainment, social connectivity, memes, and news—much like the rest of the world—along with farming-specific information. Aside from high data costs, given the corporation's well documented privacy violations, and dark patterns in manipulating user behaviour, the reliance on Facebook as a gatekeeper to content merits pause. The extent to which rural users understand the broader picture varies considerably. In the words of one farmer, "I used to have Facebook before but not anymore, because it costs too much money to use data and it makes me procrastinate from doing my work" (PB-IND-C01 Farmer Couple).

With the advent of mobile phone technology comes the emergence of mobile financial services. Increasingly, mobile money agents are playing a bigger role in villagers' financial lives, by channelling remittances sent from migrant workers or relatives living in other towns. In a village of around 600 households, there was one mobile money agent, facilitating about 2.5 million MMK in transactions weekly. Such agents also play a role in helping villagers navigate mobile technology, as one mobile money agent explained, "When my customers first come to me, I sit with them and do the Wave transaction the first and second time. After that, they gradually understand how it works" (AL-ADH-F04).

Figure 04: Myanmar's Central Dry Zone

Financial access and inclusion

Across all of Myanmar, 26 percent of adults have access to an account at a bank or another type of financial institution, including mobile money providers. That number remains consistent in rural areas, at 25 percent. The main reasons cited for not having an account by those who are unbanked are lack of sufficient funds (57 percent), lack of necessary documentation to open one (31 percent), and the fact that formal financial institutions are too far away (22 percent). Half of rural households borrowed within the past year, with 23 percent borrowing from family and friends (World Bank 2017). Myanmar Agricultural Development Bank (MADB) is the largest state-owned agricultural credit provider, followed by a number of private banks, cooperatives, and informal lenders (see also *Call-out 02: Available credit providers for sesame farmers* on page 92).

Climate change

Myanmar ranks third in the list of countries most affected by climate change in the last 20 years (Eckstein et al. 2018). The country's Central Dry Zone—the area which is home to the majority of its sesame production, stretching across the southern part of the Sagaing Division, the western and middle parts of the Mandalay Division, and almost all of the Magway District—is particularly vulnerable to changing climate (Aye Myint Khaing et al. 2016), including higher temperatures, droughts, floods, and storms.

Changing rainfall patterns and increasing temperature

Over the past four decades, trends indicate that it rains fewer days in the year, with monsoons arriving later and ending earlier. The duration of the monsoon season averaged 144 days in the

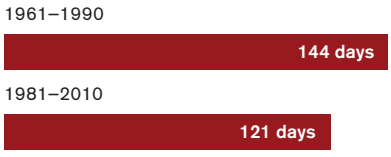
period between 1961 and 1990, and shrunk to 121 days in the period between 1981 and 2010 across all of Myanmar (Lai Lai Aung et al. 2017).

While it accounts for more than two-thirds of Myanmar's agricultural land (Aung Tun Oo 2018), the Dry Zone is characterised by water scarcity, with less than 50 percent of the annual rainfall the country receives on average (Aye Myint Khaing et al. 2016). The region's sparse rainfall is highly variable and unevenly distributed. A farmer in Magway noted, "Even if my plots are a few miles apart, spot rains means that it might rain on one and not the other" (MG-IND-F01 Detail Oriented Farmer).

In addition to changing rainfall patterns, Myanmar has experienced an average annual temperature increase of 0.5°C from 1990 to 2010 (Lai Lai Aung et al. 2017). Given the impact of even small temperature changes on growing patterns, climate change is already having a profound effect on farmers' lives.

As part of a large survey carried out in three main regions of the Dry Zone—Magway, Sagaing, and Mandalay—communities overwhelmingly reported that climatic conditions have changed, citing decreasing or more erratic rainfall and increasing temperatures, with trends suggesting that conditions may worsen over time (Aung Tun Oo 2018). As one farmer said, "The weather in the past three years has been the worst I have ever experienced in my thirty years of farming" (AL-IND-M03 Retired Farmer).

Figure 05: Shrinking monsoon season



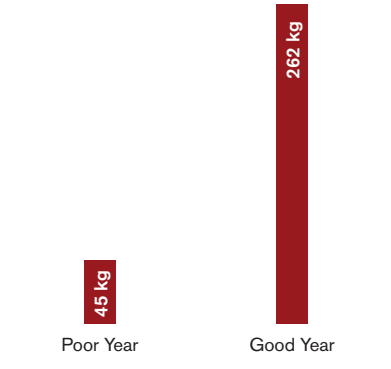
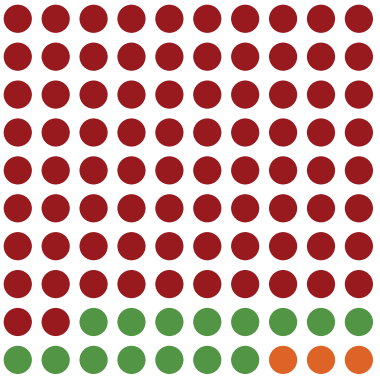


Figure 06: Good versus bad harvests yield difference

Severe repercussions on sesame farming

No other crop in the Dry Zone has a yield more impacted by weather. Average yields are just two baskets (45 kg) per acre in poor years, but 11 baskets (262 kg) per acre in good ones (Aung Tun Oo 2018). Changing rainfall patterns have significant repercussions on the sesame cultivation calendar, with farmers having to delay or adjust the timing of the cultivation stages to fit expected rainfall and resulting soil conditions. For example, inadequate rainfall leads to the hardening of the topsoil, which affects the timing for seeding. As one farmer said, "The weather has completely changed. Before, if it rained once, we could plant for five days, but now we can only take two days for seeding [because] the rain does not fall evenly across the field, so the soil dries up quickly" (MG-IND-M05 Modernised Farmer).

Figure 07: Distribution of farm land ownership



The top tercile of farmers own 82% of farm land

The middle tercile of farmers own 15% of farm land

The bottom tercile of farmers own only 3% of farm land

Agricultural land

Unequal agricultural land distribution

In Myanmar's Dry Zone, 60 percent of households own or operate agricultural land. An overwhelming proportion of farming households run small plots, with the lowest third of farming households (in income) operating just 3 percent of all agricultural land, the middle third operating 15 percent, and the top third the remaining 82 percent. Non-owned land operation arrangements are rare, with land sharing, leasing, and mortgaging accounting for a combined 3.4 percent of all agricultural land (Aung Hein et al. 2017).

Land ownership and titling

Eighty-eight percent of agricultural land is attached to some form of formal land documentation, including the most secure form of title, Form 7 (Aung Hein et al. 2017).

Traditionally, farmers take the first step on their path to financial independence by obtaining land through inheritance or a dowry. If successful, farmers are able to expand their acreage over time. One farmer, with the support of family members,

Figure 08: Upland versus lowland farming (Mather et al. 2018)

reinvested earnings from his first acre to purchase more land. "In 1999, I owned one acre… expanding to fifteen acres today" (PB-IND-C01 Farmer Couple). Because they gradually acquired the plots at different points in time, many farmers have plots that are scattered around their village. Each plot requires a separate land title, complicating the process of acquiring loans or credit.

Two categories of farmland: upland and lowland

There are two commonly used categories of agricultural land in Myanmar: lowland (or paddy land) and upland. Fifty-nine percent of owned and operated agricultural land in Myanmar is upland, whereas 36 percent is lowland (Mather et al. 2018). All farmers know which category of land they own or operate, as documented in Form 7.

Farmers use upland and lowland differently because of the composition of the soil and the elevation. The drier, sometimes sandy nature of upland soil makes it more suitable for low-irrigation crops such as sesame. In contrast, clay-prone lowland soil tends to hold water better, which is ideal for growing paddy. *Figure 08* shows the most common crops planted in all cultivated uplands and lowlands in the Dry Zone based on the three main crop cycles each year: summer, monsoon, and winter.

Figure 09: In one village

1 village contains

1	Village head
50	Village secretaries
580	Households
1,740	People
250	Farmland-owning households
380	Households without farming land (labourers, livestock, salaried work)
10	Crop farmers with 15+ acres
120	Crop farmers with 8–14 acres
120	Crop farmers with less than 6 acres
150	Livestock farmers (kept in home compound)
10	Labour heads
150	Labourers (peak season), 100 labourers (low season)**
1	Main dirt road
1	Monastery
10	Snack shops/small convenience stores
5	Informal money lenders
1	Water station
0	Transporters (they come from the town)
1	Small-scale miller
2	Machine renters
3	Mechanics
4	Input shops (seeds, fertilisers, pesticides)
1	School (up to grade 8)
1	Volunteer group ***
0	Police stations
1	Volunteer fire assistant
1	Clinic
¼	Nurse/midwife
0	Doctors
~20	Weddings per year
12	Festivals per year
~20	Babies born per year
~8	People die of old age per year

Based on the Shar Zaung Kan village in the Magway township.

** During low season, labourers migrate to other villages to find work.

*** Works on village improving projects, such as cleaning the roads.

Village, family, and social networks

A typical Myanmar village's population ranges from 600 to 1,500, with between five and ten people living in each household. In addition to immediate family members, a person can easily have about 30 relatives living in the village or nearby, making it easier to find help for farming activities (though it comes with reciprocal assumptions). Most villages have an elementary and middle school, monastery, convenience shop, and may or may not have a health clinic or a store that sells inputs (seeds for planting, fertilisers, and pesticides)—the relative values are shown in *Figure 09: In one village*.

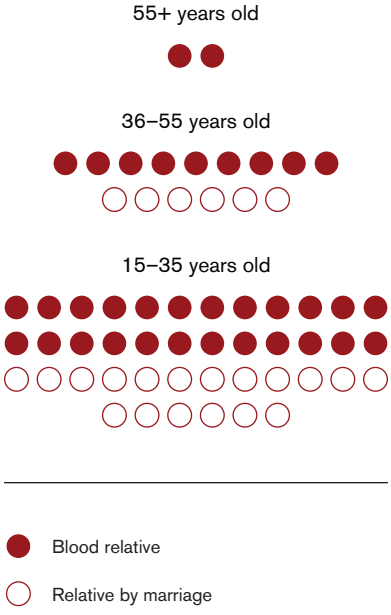
Village administration

Administrative duties at the village level are undertaken by a village head, treasurer, and a number of secretaries, each representing 100 households.

Prior to the Ward and Village Tract Administration Law in 2012, the village head was appointed by the township administrators from the General Administration Department (GAD). Since 2015, the role has been appointed by election at the village level; and this reform is often cited as a case for bottom-up democratisation (Kempel et al. 2016). The village head is often the first touchpoint for accessing government infrastructure such as electricity, canal water, bridges, and roads. With a disproportionate number of men currently in the role, the village head is often the literal gatekeeper to access government canals each season, and a gatekeeper to additional services from development agencies.

While smaller villages do not have a fire station or police station, they do have self-organised groups of young volunteers who take care of many of the village's needs, from fixing roads to helping out with food preparation at a wedding.

Figure 10: An extended family



Household unit and extended families

A typical rural household includes three generations under one roof: grandparents, parents, and children, sometimes with other relatives living in a separate building in the same compound. Educational and non-farming-related work achievements are a source of pride for the family and it is common to display photographs of children in graduation gowns or in reputable jobs, or to show off trophies earned for academic achievement.

Younger generations in rural households are able to introduce new ideas, technologies, and practices to their parents and elders. A farming family in Magway village with children who attend university commented, "My son and daughter bought the refrigerator after they graduated from university. They now work in the city. They like to have cold drinks during summer, but it's not for me. I am afraid that cold water will make my blood freeze!" (MG-IND-M06). In the case of one elderly couple in a village near Magway, their tech-savvy son purchased a computer with a printer for the family home, allowing them to make additional income providing printing and photocopying services to their fellow villagers.

Beyond those living under the same roof, extended families support one another with farm work, finances, and other household needs such as childcare. It is common to hire an extended family member for a job or simply trade time and skills. Another

female farmer from a village near Magway leaves her oxen with cousins who can better manage the manual labour.

A single farmer in his twenties is likely to have more than 30 direct relatives from the current and previous generations to turn to for advice and support. A subset of these may form a labour group available to work the extended family's land.

Gender dynamics

Gender roles tend to be fixed in rural Myanmar. Village heads are almost all men, while early education teachers and nurses are typically women. Women are seen as lesser, or less enlightened, in the Buddhist belief system. Women and nuns, for example, are expected to take a lower seat relative to monks at a monastery. In the context of everyday life, women are not allowed to wear men's longyi (an ankle-length wraparound of cloth that is considered the country's national attire) or step over a man, and their clothes are laundered separately, as mixing clothing may weaken the male power of enlightenment.

Farm-Related Activities	Male	Female
Decision whether to use GAP	●	
Land clearing	●	
Renting machines	●	
Land preparation	●	
Hiring labourers for fertilising		●
Seeding	●	●
Weeding	●	
Hiring labourers to apply pesticide		●
Hiring labourers for harvest		●
Harvesting (hand pulling)	●	
Post-harvesting (piling, bundling, stacking, shaking)	●	
Post-harvesting (sieving)		●
Sales		●

Table 01: Gender roles for common farming activities

Farming roles are traditionally gender split, except for at the busiest times of the year—seeding and harvesting. These roles change due to the prevalence of mechanisation, personal preferences, household needs, and local norms. Stereotypes also play a role—hard manual labour or technical jobs such as driving an ox-cart or tractor are only given to men, while more detail-oriented jobs are given to women.

Gender inequality is reflected in a distinct pay gap—women are paid only half of what men get paid for doing the same work. In a village near Pwintbyu, the male labour wage is 6,000 MMK per day, while the female labour wage is 3,000 MMK per day. While men are typically hired for the whole day of work at 6,000 MMK, women are often hired for half days at 1,500 MMK.

In a typical farming household, women are responsible for financial management, while men control the farming practices. There are women who are nonetheless adept at farming, as one noted, "I know how to till the land with a cow. I know every process of the farming stage, I can do it all myself. I can do everything a man can, from land prep to harvesting" (MG-IND-F02 Lifelong Farmer).

ARCHETYPE

The Entrepreneurial Shop Owner

Daw Thu Zar Lin, 50
Ywar Ma Htone Village, Aunglan Township

"I tried farming, but I just couldn't make a profit. Now I'm much better off with my small shop, where I also sell fertilisers and pesticides, and offer WAVE money transactions."

Backstory:

Daw Thu Zar Lin has managed a convenience store in the village of Ywar Ma Htone for the past seven years. She tried farming the land she inherited from her parents herself, but could not make a profit. She ended up selling a portion of the land and investing the money to start a shop, to make additional income and help pay for the education of her two daughters while her husband focuses on his farming.

There are ten mom-and-pop stores in her village, though hers is the largest. She sells basic groceries, dry goods, medicine, shoes, sesame snacks, and other snacks that are produced in the village. She also sells inputs to farmers, and lends money to other villagers who need it.

Four years ago, after she decided to start selling fertilisers and pesticides in addition to the products typically found at a convenience store, Thu Zar Lin realised that it added a good stream of regular income. There are about 600 households in this village, including almost 70 farmers who buy fertilisers and pesticides from her shop, as do farmers from nearby villages. These farmers are drawn to her variety, and appreciate that they do not have to go all the way to Aunglan to buy their inputs. She does not earn any commission from selling fertilisers, which she purchases in larger quantities from an input store in Aunglan, but she does receive a 20 percent commission from Awba when selling pesticide on a consignment basis.

After hearing from her husband about the struggles farmers face in securing working capital, she used the relatively steady cash flow of her shop to begin offering informal loans. This began as something she did only with close relatives, but grew into a larger business as other villagers came asking for loans. She dedicates 5 million MMK in capital to her lending business, charging a 4-percent monthly interest rate. Farmers mostly take out loans of around 100,000 to 300,000 MMK for land preparation in June, up to 150,000 MMK for weeding in July, and 100,000 MMK during harvesting in August. She faces many challenges with loan repayments as farmers struggle to yield enough harvest to generate profit. Given that she does not require any collateral from borrowers, the only leverage she has is on their reputation—she will stop giving out additional loans to those who have not paid back after six months. With only four informal lenders in the village, farmers try to pay back as soon as possible to keep their financing options open. Thu Zar Lin also extends loans of up to 700,000 MMK to migrant workers, to help pay for their travel and first few months of living expenses until they can start repaying the loan.

Thu Zar Lin started her latest entrepreneurial venture less than a year ago, when she signed up to become a mobile money agent for WAVE, investing 1 million MMK upfront for her start-up cash float. In her first month, she had a customer base of seven people per week. Now, she manages close to 50 customers and 2.5 million MMK in transactions per week. Cash-out transactions from villagers are more pronounced at the end of each month, as families withdraw mobile money sent from a family member working in a town or abroad. Only

two or three customers per month use mobile money to make purchases from major cities—these tend to be for a mix of products, from chickens to water purifiers.

Relationship with farmers:

- Sells inputs to farmers, but does not have the knowledge to advise them on which fertiliser or pesticide to use based on their needs.
- Provides informal loans to farmers before planting their crops, and hopes to get repaid after harvest.

Technology:

Owns a smartphone which she uses to facilitate WAVE money transactions.

Decisions:

- When should I deposit and withdraw cash at the bank to minimise the risk of theft?
- What input suppliers and brands should I sell to maximise potential commissions and meet customer needs?
- How do I know which potential borrowers are solvent and will be able to repay the loans on time?

Challenges:

- Bearing the risk of delayed loan repayment from farmers.
- Selling inputs to farmers on credit and being paid a few months later, after harvest.
- Managing the mobile money cash float, in order to have enough cash on hand for peak withdrawal times.
- Balancing the household finances with the finances of her different entrepreneurial ventures.

Busy Season:

- Lending is busiest between June and August.
- Fertiliser and pesticide selling is busiest in July.
- Other businesses are relatively steady.

Yearly transaction volumes:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		Lowest: 465,000 MMK									Highest: 1.9 million MMK

Business Relationships:

- Convenience shop: at least five customers a day.
- Input shop: ~100 per year.
- Informal lending: ~30 lenders per year.
- Mobile money agent: ~50 customers per month.

Margins:

- 10–15% margin from selling groceries and other household items.
- 20% commission from selling pesticides, from 10–20% margin from selling inputs.
- 4% interest rate for money lending.
- ~0.25% mobile money commission.

Transaction Volume:

- Peak months (when loan principal repayment is due): ~1.9 million MMK.
- Other months: ~465,000 MMK.

ARCHETYPE

The Village Gatekeeper

U Tun Aung, 52
Taw Bo Kone Village, Minbu Township

"I feel responsible for making sure that the villagers get what they need. I want to work hard for them."

Backstory:

Two years ago, U Tun Aung was elected as village head. He has always been interested in politics, and is very sociable. This, he said, "is why the villagers voted for me".

He is very interested in new farming techniques. As an eight-acre landowner, he has been a client of Proximity's Farmer Advisory Services for three years, and regularly attends meetings and training sessions.

As village head, one of Tun Aung's main responsibilities is to formally request canal irrigation access from the Department of Irrigation (DOI). He does so by submitting a letter written together with the village farmers. He heard from his predecessors that this was a long, tedious process. The previous village head made multiple requests that were rejected, before canal irrigation access was finally granted to the village five years ago. Tun Aung informs the farmers about the timing of access, how much water they will get, based on planned crops, and how much they will pay.

Farmers also turn to Tun Aung when they notice a pest or disease symptom they cannot recognise. If he is able to diagnose the cause of the problem, he advises the farmer on the remedy. If not, he calls a DOA representative to come and assess the symptoms. Representatives from pesticide and fertiliser sellers often contact him to promote their products.

Many brokers in the Minbu township also reach out to Tun Aung when they're interested in buying crops harvested by the village. The brokers quote the day's market price, and Tun Aung then connects them with farmers interested in selling.

When Progetto Continenti in Myanmar (PC Myanmar) selected Taw Bo Kone as one of 30 villages from which to recruit GAP farmers, they contacted Tun Aung to help them shortlist and make connections with 20 farmers.

Relationship with farmers:

A big part of Tun Aung's duties as village head consists of regularly communicating with farmers. He wants them to trust him, and works hard to seek their approval.

Technology:

Tun Aung owns a smartphone, on which he uses agricultural apps such as Awba and Yetagon. He uses his phone to call brokers and DOA or DOI officers.

Decisions:

- How do I determine the quantity and timing of canal irrigation water before making a request to the DOI?
- How do I decide which service providers should come to the village to promote their products to farmers?
- Which farmers should I select to become GAP farmers?

Challenges:

- Has only been a village head for two years. It still feels like a new job and is sometimes quite challenging.
- Has to juggle the needs of many stakeholders.
- Because of his village head duties, he has less time to spend on his own land.

A photo of the novitiation ceremony on a household wall

Faith and superstition

Buddhism in Myanmar

Although Myanmar is a multi-religious country with no official state religion, Buddhism is practiced by 88 percent of the population (Ministry of Labour, Immigration, and Population 2016). Nearly all Buddhists in Myanmar practice Theravada Buddhism, a branch of Buddhism that complies most strictly with the religion's texts, traditions, and monastic code. To attain enlightenment in future rebirths, Theravada Buddhists must build positive karma, or merit, in this world (Harvard Divinity School 2015).

Religious figures and buildings are prevalent in villages and towns; each village in the Dry Zone has at least one monastery. There is widespread belief among villagers that without a temple, stupa, pagoda, or monastery, villages will suffer scarcity, ill-health, and misfortune. Contributions to village religious and community building events are core to villagers' recurring expenses, and are viewed as a form of investment in their social safety net. Monasteries also serve a variety of social purposes such as taking in orphans and being a retirement home for the elderly with no living relatives. They also host significant rituals such as weddings and novitiation ceremonies, in which boys under twenty signal their intention to become a novice monk.

Faith in the face of agricultural uncertainty

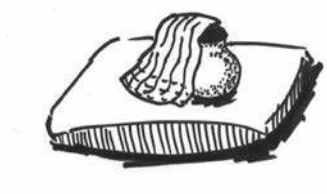
One aspect of building positive karma is taking care of animals, which impacts how farmers consider livestock. Many farmers do

Table 02: Farming rituals and religious practices

Lon swel pwel

Lon swel pwel (literally, "struggle") is a tug-of-war ceremony held in May to bring about rain. A 30-foot vine is pulled by a group of seven or nine women on one side and five or seven men on the other. No side is meant to win: It is believed that the ceremony will trigger the spirit named *moe kaung kyaw swar*.

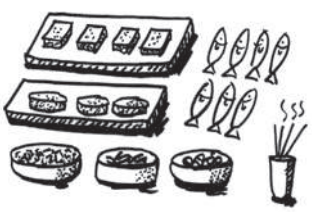
Before beginning the ceremony, the village needs to donate one coconut, one bunch of bananas, and a bamboo stem to the spirit. The ceremony then takes place from 3–6 pm every day for three to five days, or until it rains.



Pona ma kyi shin ma ma kywal wa

Pona ma kyi shin ma ma kywal wa (literally, "the spirit that hides in a quiet place to feel tranquil") is a spirit that villagers appeal to through a ritual that occurs in early March during the new moon (*tabaung la' san*)

At around 3 am ("before the crows wake up"), villagers place seven rice snacks inside a clay pot, and cover it with a white cotton cloth, leaving a small gap. They then put the partially covered pot on top of any bags of sesame and groundnut they have. If they don't have any, they put it on top of oil barrels. They pray to the spirit, inviting her to eat the snacks she likes, and urging her to take care of them and bring about a great yield.



A ba myin phyu shin

A ba myin phyu shin (literally, "the one who rides the white horse") is a spirit that villagers pray to in order to bring about prosperity, better yield, and good weather.

Villagers pay homage to the spirit twice a year, in July and in October (war win war htwat). They can pray to him between 9 and 10 am, and bring an assortment of offerings: four red snacks (made of flour and red bean paste), three white snacks (made of fried flour paste), seven fried fish, a small plate of tea leaves, one betel chew, and one plate of cooked rice.

Nga yant min pa yate

Nga yant min pa yate (literally, "king of the snakehead fish chant") is a chant that can be done any time of the year in periods with no rain, especially in May and June.

Before the chanting begins, the villagers make a statue of the king of the snakehead fish out of clay near the lake. The length of the statue should be about the size of one forearm from elbow to fingertip. Once the statue has been constructed, the village invites all of its monks to chant from 6 am to 6 pm. Each monk takes a turn chanting for half an hour, before another monk takes over.

Bone ma shin nat ma aung phyu

Before this ritual, named for the spirit it calls upon ("*Bone ma shin*" is a form of honorific for someone with significant spiritual power) begins, a farmer hides a water bowl and stick of firewood in the house. Then, the farmer takes an ox feed basket, covers it with a longyi flipped downside up (with the waistband at the bottom), and sprays it with perfume. If no perfume is available, the farmer can use sandalwood paste, or *ka lar mat*.

The farmer then invites the *Bone ma shin nat* spirit and asks her to help predict rainfall. If it is going to rain, the spirit will find the hidden water bowl, and cover it with the ox feed basket. If it's not going to rain, the spirit will cover the hidden stick of firewood instead.

not raise or own any more animals than are necessary to complete farming tasks. In the words of one farming couple, "It is bad karma to breed them if they end up at the slaughterhouse" (PB-IND-C01).

In the face of unpredictable weather, Myanmar farmers call upon their faith, rituals, and religious practices to bring about rain and prosperity to their land and family. These rituals and practices, a few of which are shown in *Table 02*, remain widely practiced to this day, particularly in villages where the only available irrigation method is rainfall. While some of these rituals are affiliated with, or at least known to, the Buddhist monastic order, others fall more within the realm of superstition.

Labour and migration

Labourers are villagers who, for the most part, do not own land. Labourers without land, also referred to locally as "coolies", make up the dominant casual labour workforce for farmers.

Table 03: Skills required for farming tasks

Specialised tasks	Semi-skilled tasks	Low- to unskilled tasks
Driving tractor/ox-cart	Planting	Carrying loads
Broadcasting seeds	Fertiliser/pesticide application	Cutting plants for animal feed
Bundling and stacking upright	Ox herding	Night guarding
Sieving	Weeding	Fruit picking

Rural agricultural jobs can be categorised based on skill level. Within each labourer group, there are teams with different specialties such as weeding and threshing. Specialised tasks require labourers with knowledge and experience to complete them in the short time allotted. Some tasks require labourers to be only semi-skilled, with minimal prior knowledge. Pesticide application, for example, requires some knowledge of the optimal amount of pesticide to apply, but the application itself is otherwise straightforward. Similarly, weeding requires the labourer to know how to recognise weeds in the field, but the labour itself is uncomplicated.

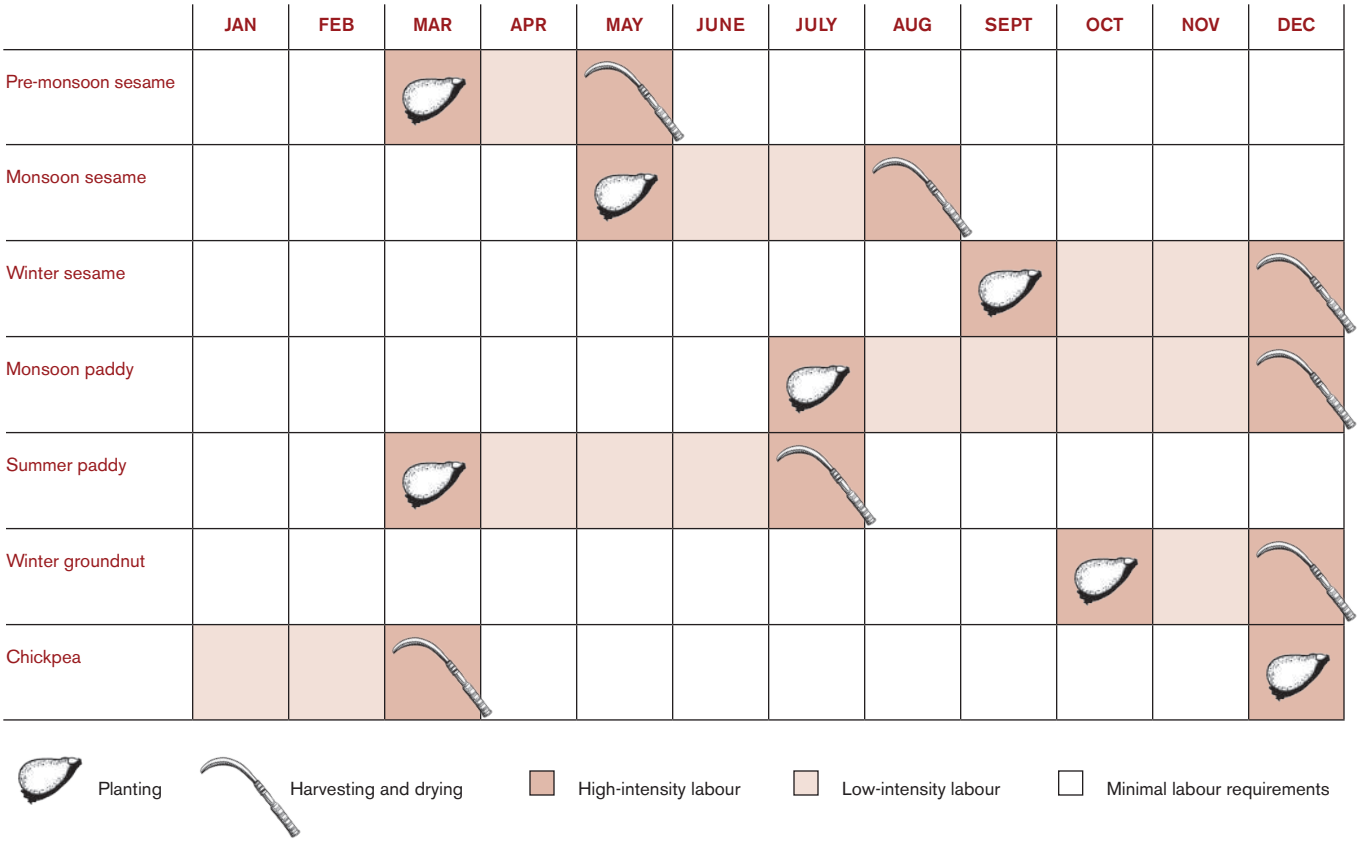
How farming labour is organised

Some farmers find labourers directly while others work with labour group heads who help coordinate and play a strong facilitation role within the community. Others may barter labour by working on each other's farms rather than hiring labourers. When there are dozens of extended family members living nearby, farmers may not need to hire outside their network.

When dealing with labour groups, farmers rely on personal relationships built up over many years. The channels through which farmers and labour organisers communicate varies from in-person meetings to calls and text messages.

In the Shar Zaung Kan village in Magway, there are about 700 labourers and ten labour groups. A single labourer can be part of multiple labour groups, as membership is not exclusive. During busy periods, labour heads need to gather as many as 60 labourers on short notice. It is relatively easy to organise labourers in peak season because the labourers expect the workload. During off-peak season, however, labourers often work in other villages, so the labour head may need to reach outside their labour group.

Table 04: Demand for labourers over a year in Pwintbyu



Labour heads negotiate with farmers when the advance will be paid, and borrow money if farmers do not have enough reserves to pay. "We have to pay 30,000 MMK in advance per labourer, a total of 18 lakhs [1.8 million MMK] for sixty. If farmers cannot pay the entire amount, I have to come up with the money by going to credit providers" (PB-IND-F03). Labour heads take a commission worth 10 percent of the labourer's wage. A labour group leader with 50 labourers earns about 15,000 MMK/day.

Seasonal demand for labourers

The level of demand for farm labour varies from region to region. In Pwintbyu township, as shown in *Table 04*, commonly grown crops include pre-monsoon, monsoon, and winter sesame, as well as paddy, groundnut, and chickpea. The planting and harvesting time for each of these crops is a high-demand period for labourers. Labour demand peaks from September to December with a consequent rise in labour costs. The seasonality in demand for labourers in other townships will vary based on their most commonly grown crops.

With the rise of labour migration, it can be difficult for farmers to find sufficient labourers during peak season. To help secure labour, they may be motivated to pay at least a portion of wages up front, if they can afford it. Labourers want the cash in advance partly in order to make timely donations to the monasteries.

Labour migration

Lack of work drives farmers and labourers to migrate to other areas to find it. Thirty percent of households in the Dry Zone include a migrant member. Eighty-five percent of these migrants remain within Myanmar, with the main migrant destinations being Yangon and Mandalay, as well as other secondary towns (Boughton et al. 2018). Such migration does not bring assured success—issues may arise at home, work may not pan out as planned, or they may struggle to pay off unexpectedly high costs of travel.

Rural-to-rural migration

During off-peak season, labourers migrate to other villages that require additional labour for different crops. One labour group head said, "Last year 200 people went to Lowkai for sugarcane harvesting, making up to three lakhs [300,000 MMK] per

month" (MG-IND-C01). A labourer who frequently makes these trips will typically organise a group of fellow labourers and travel together.

Aside from farm work, some labourers are drawn into other low-skilled work. A labour group leader shared: "During the four months when the work is slow, I may sell some garden vegetables to the Pwintbyu market" (PB-IND-F03).

Rural-to-urban or overseas migration

An increasing number of labourers migrate to urban areas looking for low-skilled industrial or service jobs. A farmer estimated that about half of the labourers from his village near Magway had moved to urban areas. Most of them migrated for the first time in their early twenties. The gender split is about even amongst these migrants (Boughton et al. 2018).

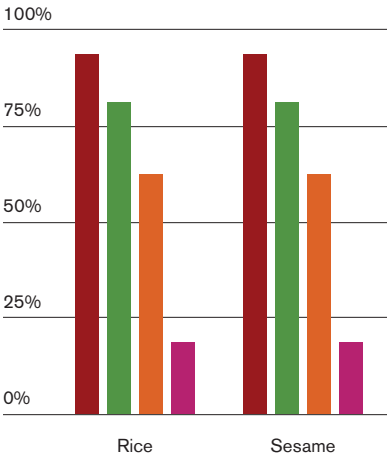
While the majority of migrants stay within Myanmar, overseas migration is increasing. A farmer in a village near Aunglan said that at least one person from each household had gone to work overseas (AL-IND-M01). Those who go tend to be young adults, some of whom may have a university degree. Those who take overseas jobs gain access to higher salaries, but are burdened with having to repay loans incurred for travel and living expenses. They may also face exploitation by agents who take their money and fail to deliver on employment promises, and they may risk working without a visa.

Impact of migration on wages

Labourers are not subject to the inherent risk of crop losses, and are able to rely on somewhat steady daily wages. Due to increased labour migration, rural wages jumped by more than one-third over the five-year period from 2011 to 2016. Recent growth in secondary schools also contributed to a reduction in workforce participation by children, further contributing to this wage increase (Boughton et al. 2018). Since 2012, rural real wages, after adjusting for inflation, have increased by more than one-third (Boughton et al. 2018).

While this is good news for labourers, it means increased costs for farmers. Some farm households with successful migrant workers receive additional income through remittances, but this is not the case for all households.

Figure 11: Comparison between machinery adoption for rice and sesame



Mechanisation

Rise in usage of agricultural machinery

Mechanisation of agriculture has risen rapidly in Myanmar in recent years. The adoption of large-scale machines (combine harvesters and four-wheel tractors) is a more recent phenomenon, accelerating particularly from 2013 onwards (Myat Thida Win et al. 2016). The sales of four-wheel tractors increased by 243 percent from 2013 to 2017 (Belton et al. 2018).

Adoption of machinery by sesame farmers

As shown in *Figure 11*, 60 percent of sesame farmers use machinery. A four-wheel tractor with a 16-tooth extension is the most sophisticated tool to use throughout the sesame cultivation cycle during land preparation, slowly replacing the ox-carts traditionally used for ploughing.

Harvesters are not commonly used for sesame farming. When asked if there is anything they wish for in their farming process, a small farmer in a village in the Wetlet township replied, "I'd like to get a harvester if possible, but I don't know if there's any in the market" (WL-IND-M01). Instead, sesame farmers rely on simple tools such as sickles, sieves, and homemade seeders for the other stages of cultivation. Due to their simplicity, these tools tend to produce imprecise results or take longer than their mechanical counterparts (Zaw Min Naing 2017). Additionally, reliance on non-mechanised tools means farmers need to hire labourers, especially when farming tasks must be completed quickly, as is the case for weeding and harvesting.

CALL-OUT

Call-out 01: Machine rental and repair

In villages with access to asphalt roads, entrepreneurial farmers with spare capital have the opportunity to invest in farming machinery and rent it to farmers in their village or in neighbouring villages. Nearly all machine renters are farmers (Belton et al. 2018), and as such they can partially justify the purchase for their own use. Most in demand are tractors, to which different extensions can be attached for land clearing and ploughing. Some machine renters also own combine harvesters, but they're not used for sesame planting (Zaw Min Naing 2017). In 2017, among farmers of all crops who have used agricultural machinery, 80 percent of general farmer households rented the machinery, while only 10 percent owned it, leaving 10 percent who neither rented nor owned (Zaw Min Naing 2017).

The business of renting farm machines and equipment

To rent a tractor, farmers pay 15–25,000 MMK per hour, depending on the extension. Rental is in 30-minute to 1-hour increments. The usage duration is logged directly in the tractor, thereby facilitating the documentation of how much time each farmer uses the machine.

The start up costs to acquire farming machinery are quite significant, usually financed through either loans or leasing agreements directly from machinery dealerships, or with financing from formal credit providers (Myat Thida Win et al. 2016). As one tractor renter recalled, "I bought my tractor with Co-op Bank for 280 lakhs [28 million MMK], payable over a period of six years, with installments every six months [at a nominal interest rate of 0.08 percent per annum]" (MG-ADH-M03). A survey conducted with 122 machine renters reveals that the average price of a harvester in 2017 was 48 million MMK, and a tractor was 32 million MMK (Belton et al. 2018).

Each farm machine comes with its own operator, as the machine renters typically enlist a relative, as one renter explained: "We hire our grandsons to drive the tractor. We pay them 1,000 MMK per hour during peak seasons, and give them a monthly salary of 1 lakh [100,000 MMK] during off-season. We also buy them phones or clothes sometimes". Aside from labour and installment repayments, they also need to purchase fuel. After covering all of their costs, if there is limited local competition, business can be quite profitable: "Every year I earn about 190 lakhs, and my gross margins are 50 percent, with the main costs being to labour and diesel" (MG-ADH-C03 Machine Renters).

Farmers in villages with existing machine renters may find that the market is already saturated. A machine renter in a village near Magway talked about the number of renters in the area: "In 2016, we had more customers and rented the tractor for 600 to 700 hours every season. Now there are other machine renters and we only rent 100 hours each season" (MG-ADH-C03).

Similarly to any agriculture activity, the machine rental business is highly seasonal. Peak usage occurs in April and May for the monsoon sesame season, and September and October for the winter sesame season. Off-season, the machines sit idle at each machine renter's house.

Machine repair and village mechanics

While mechanics are widespread at the village level, their main focus is on bicycle and motorcycle repairs. Given this, machine renters often have to hire mechanics outside of the village and then gauge their trust. As a machine renter said, "We found a repair workshop in the Minhla township through a neighbour. We visited it and saw that it had a letter of recognition by the government hung on the wall, so we trusted it" (MG-ADH-C03). Anecdotal evidence suggests that costs of maintenance can reach up to 6.5 percent of the purchase price of a new machine.


CHANGCHAI

Aspirations and risk taking

In addition to the day-to-day farming business, farmers think about the needs of their immediate and extended families, such as tuition for children, healthcare fees for aging and sick family members, and house maintenance. Their attitude towards risk informs the decisions they make when it comes to maximising their income, building savings as a financial cushion, and adopting new farming techniques.

Supporting children's education

Many farmers do not want their children to continue with the hardship of the farming lifestyle and are eager to invest in their education. Some are willing to sell their livestock or get a loan for their children's tuition: "I sell my crops and my cows to support my children and keep them in school" (PB-IND-M03 Indebted Farmer). There is a recognition that education leads to better non-farm work opportunities. In the words of one milling labourer, "I want my daughter to hold a pen at work when she grows up" (PB-ADH-F08).

Graduating from farming

After years of losing harvest due to bad weather conditions, or enduring the strains of physical labour, many farmers aspire to rent or sell their land and leave farming for a job in town, or seek greater stability by starting their own business. Given the size of extended families and the rate of urbanisation, most people can cite a relative that has made the move. Said one impressed farmer, "There are farmers who worked their way out of the job. For example, Ko Htay Aung's family only had about five to seven acres. They're in Sagu right now. They started out with

some money from paddy and sesame yields. His mother-in-law supported him with opening a small shop and renting cars. They slowly worked their way up" (PB-IND-M03 Indebted Farmer).

Attitudes towards risk

The extent to which farmers are willing to take a risk is dependent on two main factors. The first is how much of an unknown the risk represents. The second is the extent to which they can rely on their support system—including extended family, friends, and the local monastery—as a safety net in case things go wrong.

As a result, decisions that can influence their income—e.g., changing cultivated crops or adopting unfamiliar farming techniques—are not taken lightly. Farmers typically follow practices their parents and grandparents taught them. When they are trying anything significantly different from their current practice, they prefer to wait for others to try it first. According to a farmer turned transporter: "Before growing black sesame, we have never seen one before, so people were mostly skeptical and did not dare to follow. But after planting, it produced high yield. So now everyone wants to do it" (PB-ADH-F01).

ARCHETYPE

The Maverick Farmer

U Kyaw Min, 26
Yay Poke Gyi Village, Pwintbyu

"I learned most of my methods from an agronomist on Facebook who posts about farming methods and techniques, and links to resources and other agricultural news."

Family:

Married two years ago, no children… yet. Returned to village to look after parents and lives in the same compound. His younger brother lives in Mandalay and works as a fabric seller.

Education:

Highly educated, he attended boarding school in Pwintbyu. He then went to Meiktila University of Economics for his bachelor's degree.

Backstory:

U Kyaw Min was born and raised in Yay Poke Gyi. He lived there for most of his formative years, until he was sent to boarding school in Pwintbyu and later attended university, after which he worked at a bank. Two years ago, he came back to his village to look after his parents, who are too old to continue farming. Because he's the oldest child, he's responsible for taking over the business. He doesn't like farming, but now that he is responsible for the family's land, he wants to make the most of it. He often has disputes with his parents when deciding to change the way he goes about farming. Even though he is busy with farming activities, he likes to read a lot, is very interested in politics, and follows the news regularly.

Both he and his wife own smartphones. They both rely on their phones to call suppliers to stock their convenience store. Kyaw Min also consults Facebook frequently and follows agronomists to learn about new techniques. He approaches content he reads on the Internet with caution, as he knows that some information can be fake or exaggerated.

When it comes to farming, he approaches the decision of which crops to grow very carefully, to maximise the potential for profit while having enough low-margin yet low-risk crops as a safety net. Of the 7.5 acres he manages, four are planted with sesame during the winter and monsoon seasons. Of those, two acres are planted with black sesame for selling (except a few baskets for farming next season); one acre is planted with white sesame, also for selling (aside from a small amount his wife keeps for garnishing); and one acre is planted with red sesame (for local milling for home use). The rest of the acreage is planted with other crops, including monsoon paddy, chickpea, cotton, pigeon pea, white kidney beans, maize, and groundnut. Kyaw Min owns four oxen and a cart but rents a tractor for ploughing, when he can afford it. He continually experiments with new farming techniques. For instance, a year ago he switched from commercial pesticides to organic pesticides (onions, tobacco, etc.), which allowed him to cut his pesticide costs in half. He also took part in a GAP training and learned some of the methods, but remains skeptical and is still deciding whether he wants to fully implement them.

For his monsoon sesame, Kyaw Min relies mostly on rainfall for irrigation. If he does not get enough rain, he rents a few days of water access via a neighbour's hand pump, which he sprays over the plot through a hose. It costs him 1,300 MMK per hour to rent the pump. In addition to the rental fee, he also hires one labourer to hold the hose while he sprays the water.

His primary income comes from selling his various harvests. His other source of income is the small convenience store that his wife man-

ages. Even though farming income fluctuates highly, income from the shop is steady all year long. Income from both sources in one season is used to finance working capital for the next, and for living costs. Kyaw Min and his wife usually try to keep household expenses to a minimum, except for religious donations. Only in the event of cash-flow constraints will he seek out formal loans, as he also tries to keep his debt levels to a minimum. He mostly relies on formal loans from MADB and other credit providers, such as input sellers and the machine renter. He does not rely on informal lenders as he does not yet have significant social capital in the village. He has not made any investments, as he inherited the livestock from his parents, but he's saving to invest in a water pump or to dig a well in order to become more independent with his irrigation needs.

Land acreage and use:

- 7.5 acres in total
- 2 acres of lowland, 5.5 acres of upland
- 3 plots of land
- 4 acres of sesame
- 3.5 acres of other crops

Access to irrigation:

Rainfed only, though Kyaw Min's neighbour has access to groundwater through a hand pump and he can rent from him as needed.

Access to machinery:

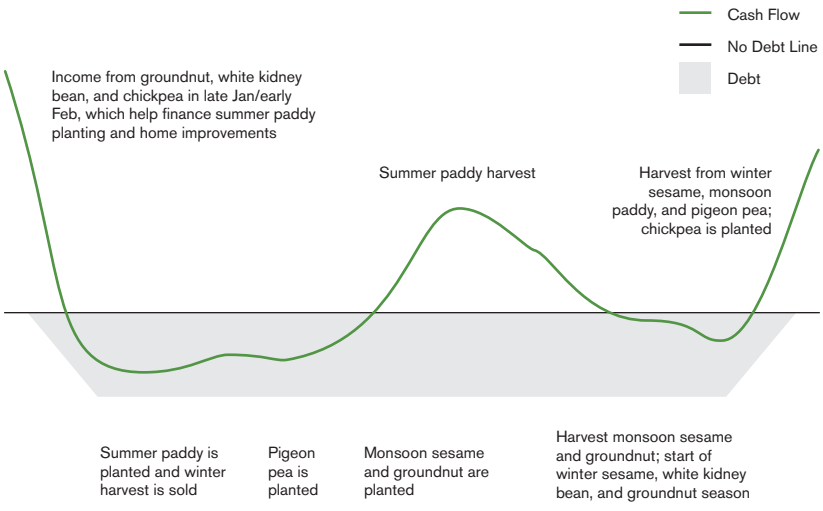
Only has an ox-cart. He rents a tractor with extension for ploughing as needed.

Appetite for risk aversion:

He is a maverick who wants to break with his father's old ways of farming, fix the health of the soil he took over, and try out new things. Some of his plots have very high yields, and others have low yield, with no in-between.

Income diversification:

Income type	Value	Predictability	Frequency
Farming	High 2.2 million MMK per season (Taking sesame as an example)	Low	Seasonal (every 4–6 months)
Convenience shop	Medium 150,000 MMK per month	High	Daily



Decisions:

- Which crops do I grow to maximise potential for profit?
- Should I rent machinery or use ox-carts, given the need for significant working capital to plan the cultivation seasons?
- In a drought, should I wait for more rain or spend money to get groundwater immediately?
- Which new farming methods or varieties should I experiment with that no one else in the village has tried before?
- What additional cost-saving measures should I take to be able to save enough money to invest in household-level irrigation?

Challenges:

- Having just arrived to the village two years ago, he has a small social circle and does not have many connections among farmers and others in the ecosystem, which means a smaller pool of options for credit providers.
- Having to source labour during peak season, given the lack of family members to help with farming.
- Lack of supply of improved seed varieties and sophisticated technology to experiment with.
- Supporting parents, with increasing healthcare expenses given their old age.

Farming—— Planning For The Year

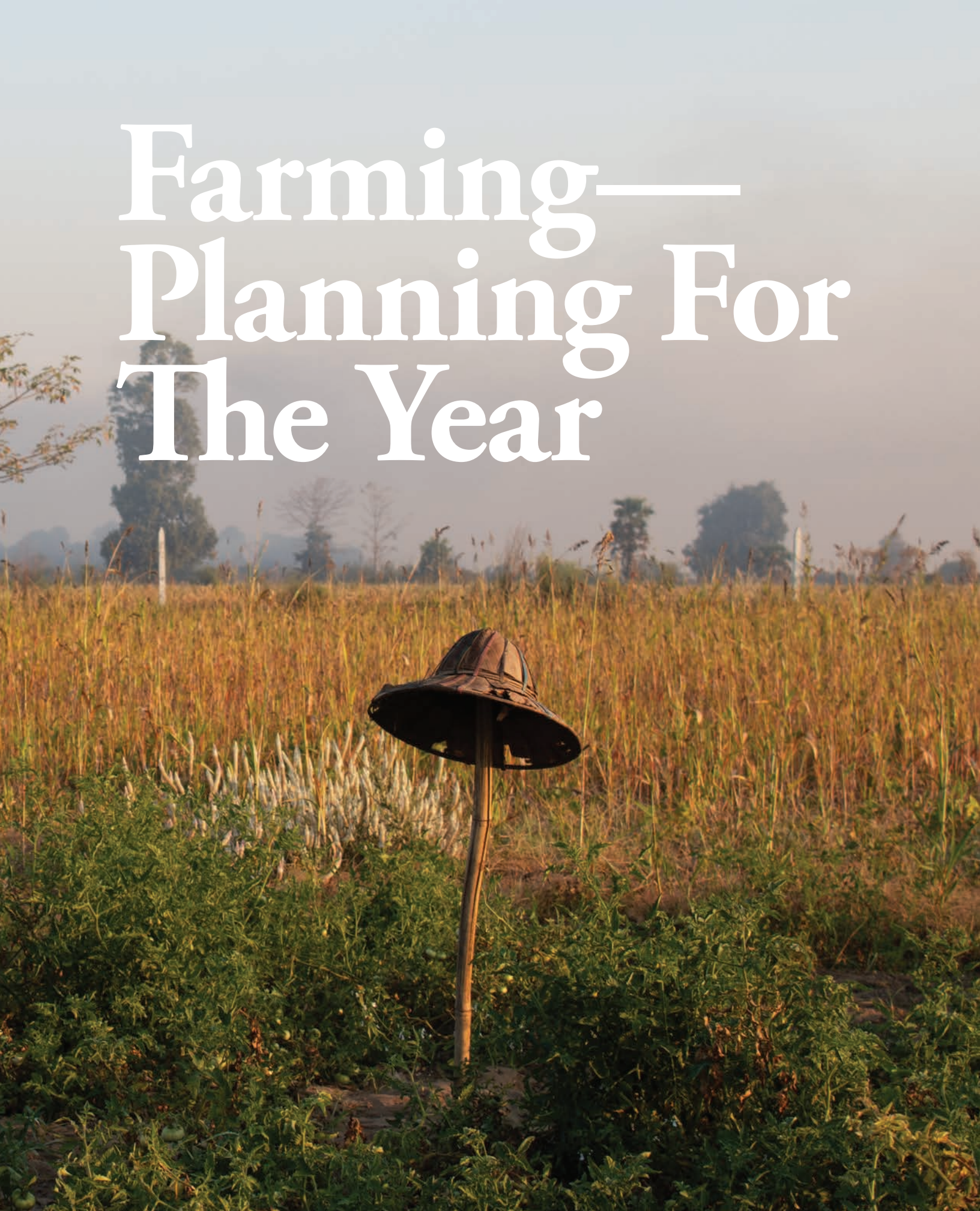


Table 05: Sesame season trade-offs

	Summer sesame	Monsoon sesame	Winter sesame
Potential for yield	**Low** 6–7 baskets per acre for summer irrigated sesame **Medium** 8–10 baskets per acre for pre-monsoon sesame	**High** 11–13 baskets per acre	**Medium** 8–10 baskets per acre
Risk of over-irrigation	**Low**	**Very high**	**Low**
Risk of under-irrigation	**High** Hence need for additional source of irrigation	**Low**	**Low** Due to residual moisture

Planning the year and cultivation season

The six stages of sesame cultivation

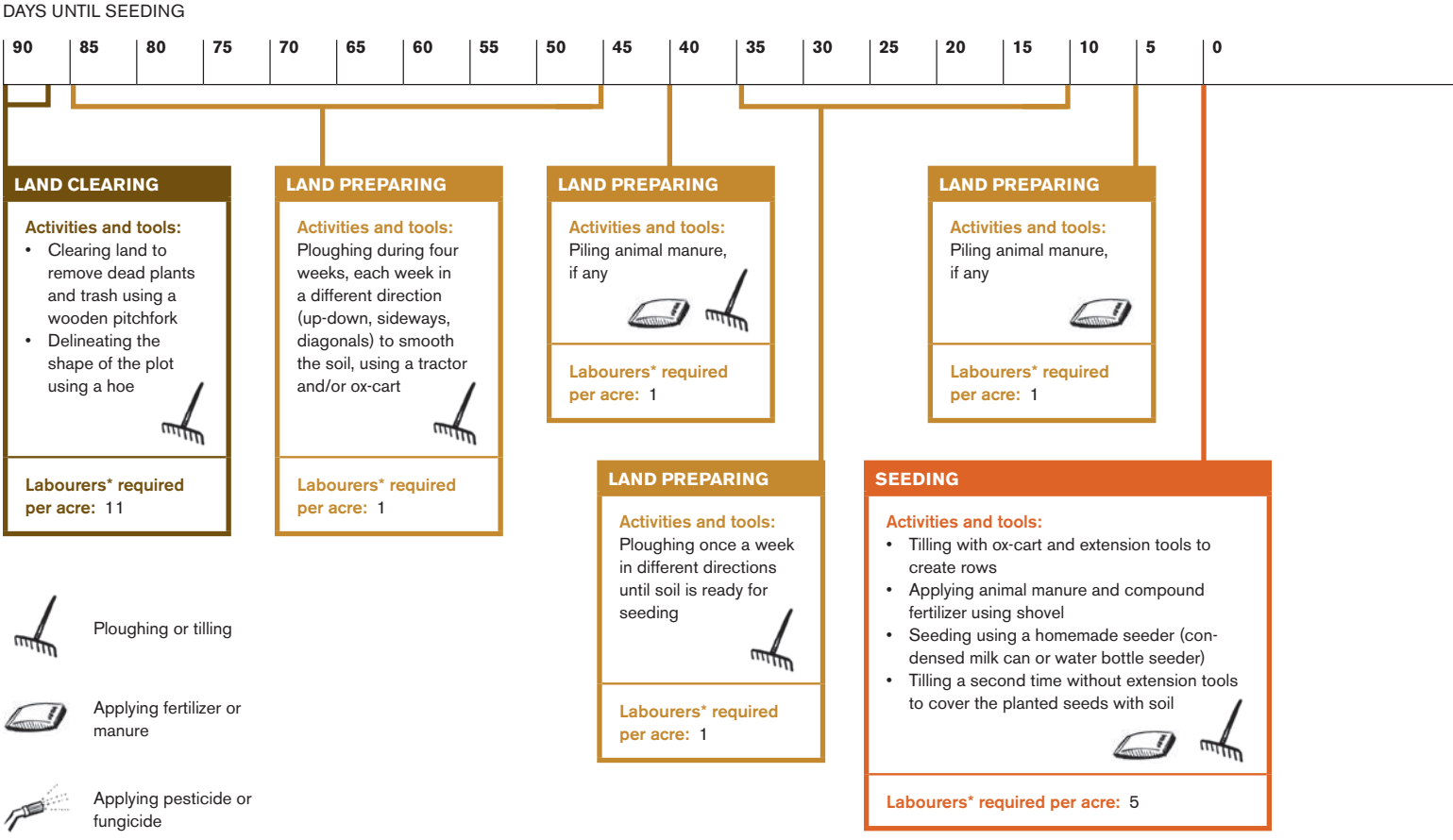
To appreciate the decisions and trade-offs that sesame farmers need to make when planning their farming year, the stages of sesame cultivation must first be understood. They help reveal how farmers prioritise their time, distribute their resources, and work around the needs and constraints inherent to each stage.

There are six stages: land clearing; land preparation; seeding; upkeep (including the seedling, flower bloom, and ripening stages of the plant); harvesting; and drying. The decisions that farmers need to make following cultivation are covered in the chapter *Farmer Decision Points*.

Figure 12 shows the activities at each stage, along with the tools and labour required. While some varieties take up to 100 days to grow, our example uses 75 days, based on the most common varieties taking 75 to 80 days. The days in the cycle are counted in relation to the seeding day, which is day zero.

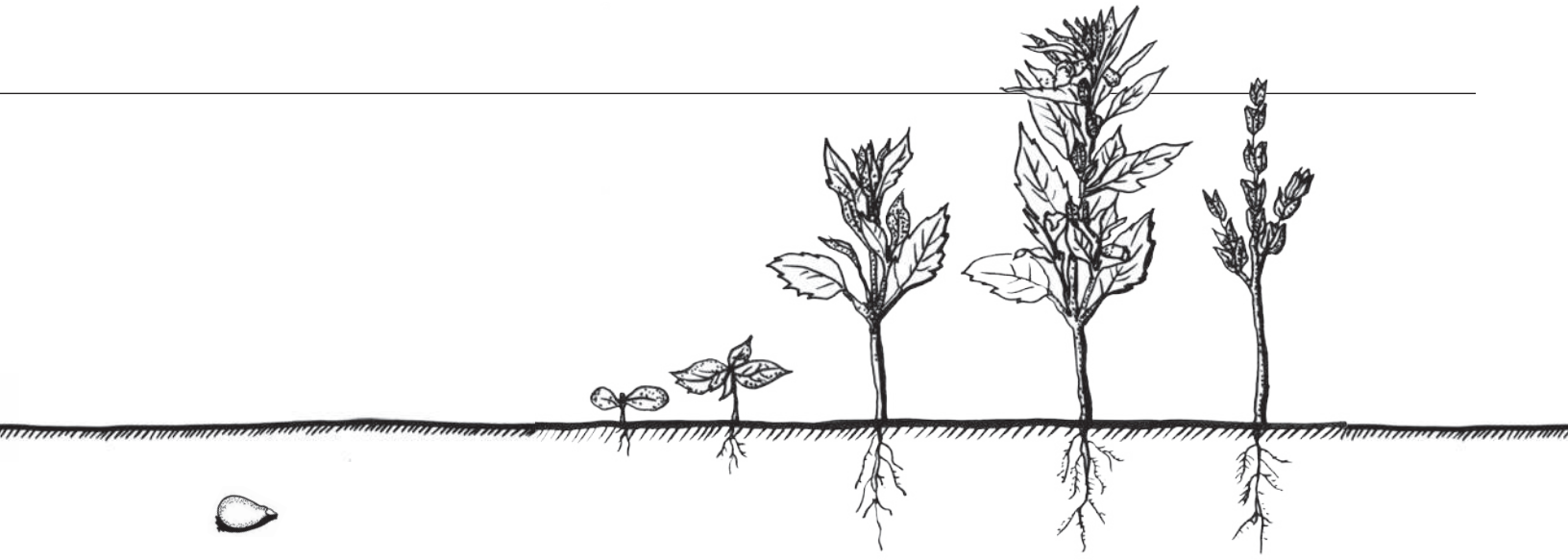
The duration of the land clearing and preparation stages is largely dependent on whether the farmer was cultivating crops in the same plot in the previous season. If not, the land preparation needs to be thorough enough to ensure that the soil is ready for planting. If other crops were planted in the same plot prior to the start of the season, the need for ploughing during land preparation is less pronounced.

Figure 12: The six stages of sesame cultivation



* The number of labourers takes into account half-day shifts every day for the entire duration of the corresponding activity

Reference (Zavareh et al. 2008)



DAYS AFTER SEEDING

5 | 10 | 15 | 20 | 25 | 30 | 25 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95

UPKEEP, SEEDLING

Activities and tools:
Third tilling with an ox-cart and extension tools to allow the germinating plant seeds to easily break through the soil

Labourers* required per acre: 1

UPKEEP, SEEDLING

Activities and tools:
Fourth tilling and plucking out overcrowded plants by hand to allow sufficient space for each plant to grow in each row

Labourers* required per acre: 10–15

UPKEEP, SEEDLING

Activities and tools:
Weeding (twice per plot) by hand

Labourers* required per acre: 15

UPKEEP, SEEDLING

Activities and tools:
Fifth tilling for weeding purposes, using an ox-cart with extension tools

Labourers* required per acre: 1

UPKEEP, SEEDLING

Activities and tools:
- Applying fertilizer.
- Apply preemptive fungicide and pesticide using sprayers.

Labourers required per acre: 1–2

UPKEEP, FLOWER BLOOM

Activities and tools:
- Applying foliar fertilizer using a sprayer
- Applying reactive pesticide (if needed) using a sprayer
- Weeding, only if has not been completed in the previous stage, due to lack of labor

Labourers* required per acre: 1–2

UPKEEP, RIPENING

Activities and tools:
Applying foliar fertilizer three times using sprayer, any time before day 55, when the bottom part of the plant is mature, so as to avoid any chemical residues in the seeds

Labourers* required per acre: 1

HARVESTING

Activities and tools:
Harvesting (either through reaping using a reap curl knife, or plucking out the plants by hand) and piling of the harvested plants (3 to 8 days)

Labourers* required per acre: 15–30

DRYING

Activities and tools:
Bundling the harvested plants and stacking the bundles (6 to 7 days)

Labourers* required per acre: 10

DRYING

Activities and tools:
Shaking plants and briefly sieving the falling seeds (1 to 2 days)

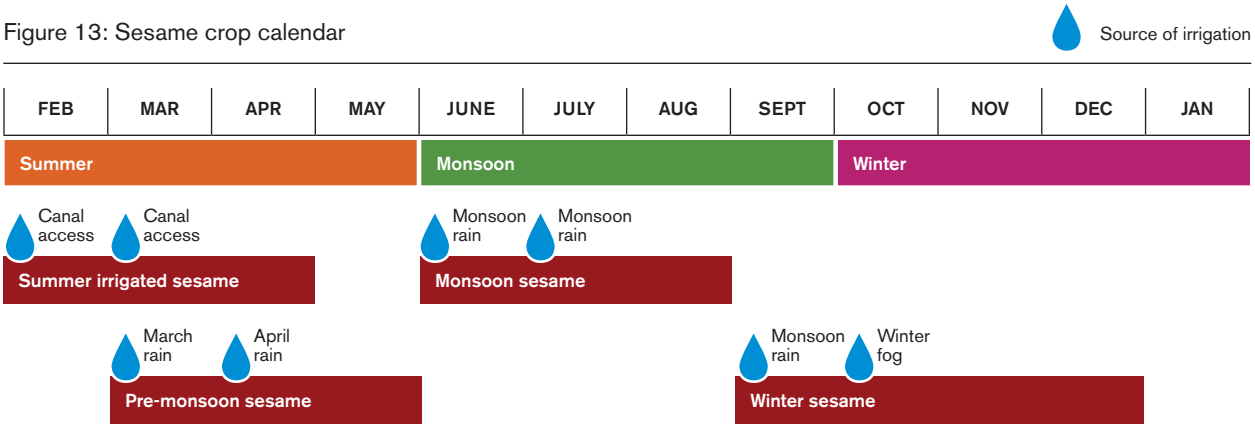
Labourers* required per acre: 10

DRYING

Activities and tools:
Finely sieving the seeds (1 to 2 days)

Labourers* required per acre: 5

Figure 13: Sesame crop calendar



Different sesame cultivation seasons

There are three different seasons for growing sesame: summer, monsoon, and winter. While the exact cycle varies from 70 to 90 days depending on the specific seed variety, *Figure 13* shows the months for growing sesame during each season, as well as the expected yields. This calendar is mostly dictated by the availability of irrigation at two crucial points of the sesame cultivation cycle: at the beginning prior to seeding, and later during the upkeep stage, the water from which is adjusted based on rainfall.

While there are no differences in cultivation practices between the different seasons, farmers must make a trade-off between potential for high yield and risk of under- or over-irrigation when deciding which sesame season to cultivate, as shown in *Table 05*.

Summer sesame: An option for farmers with additional irrigation sources

During summer, sesame can be planted starting in February, referred to as 'summer-irrigated sesame' or later in March, referred to as 'pre-monsoon sesame'.

Summer-irrigated sesame is only an option for farmers with access to adequate canal irrigation. The exact planting timeline will depend on access to irrigation, with a start date for seeding varying from early- to mid-February. During the upkeep stage of cultivation, farmers with canal irrigation do not need rainfall to cover their water needs.

Farmers without access to canal irrigation can still grow pre-monsoon sesame during the summer. To start planting, farmers rely on the timely arrival of rain in March to decide whether they should plant pre-monsoon sesame. For the upkeep stage, pre-monsoon sesame farmers rely on light April rainfall. If there is no rainfall, they lose yield.


Urea Fertilizer
၅၀ ကီလို

Monsoon sesame: The most common choice with highest yield potential

Sesame is mostly planted during monsoon season. Given the monsoon rainfalls throughout the season, including during upkeep, this is the most typical sesame calendar for rainfed-only farmers, including in Magway and Aunglan townships.

Monsoon sesame is ideally planted from the end of May to the first week of June, but if there's too much rain, planting can be delayed. Too much rainfall during seeding can cause plants to die; later, during flower bloom, too much rain can cause the flower to fall even though the plant may remain standing, also resulting in yield loss.

Winter sesame: A safer but less fruitful choice

The last sesame season occurs during winter. Planting of winter sesame starts in September, with farmers relying on the month's rainfall to achieve the optimal moisture necessary for seeding. If it doesn't rain in September, farmers may still rely on residual moisture from the previous monsoon months. Regardless, the moisture levels should be high enough to last the rest of the cycle, with no need for additional irrigation except for the expected winter fog.

The need for irrigation prior to seeding is less pronounced for winter sesame given residual moisture from the monsoon season and the low risk of over-irrigation with no rainfall after September. However, when compared with monsoon sesame, winter sesame produces a lesser yield. In the words of a grinning farmer, "With monsoon sesame, if you are successful—you get a good yield". Then he added, more seriously, "But winter sesame is a safer choice" (PB-IND-C02 Farmer Village Secretary).

Figure 14: Common sesame intercropping patterns

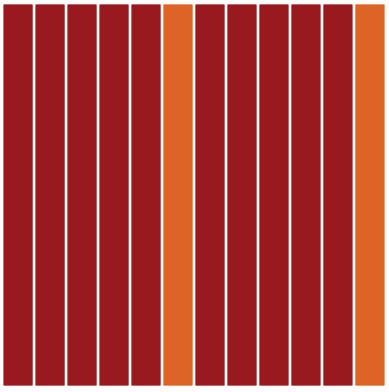
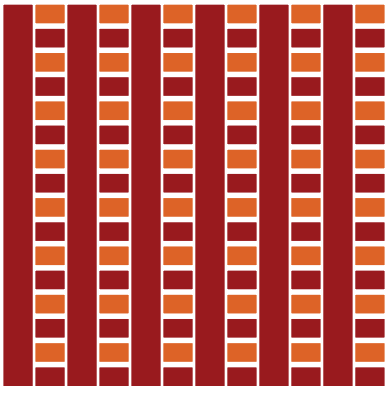


Figure 14a.v Five rows of sesame followed by one row of pigeon pea, with the pattern repeating.



F14b. One row of sesame only followed by one row of sesame mixed with pigeon pea, with the pattern repeating.

Deciding on crops and varieties

Deciding which crops to plant and when to plant them is not a simple business. First, there's the question of suitability: Which crops are best suited to one's land, at what time of year? Then there are the capital requirements: How much do they cost to plant and tend compared with the likely yield and probable market price? Finally, there's risk: How likely are the crops to fail, and how big of a chance is one prepared to take?

Reasons for choosing crops and cropping patterns

In planning the entire year, farmers must first decide which crops they wish to plant and in what order.

Table 06: Sesame seed varieties

	Seed variety	Cultivation seasons	Cultivation cycle (*days*)	Yield rate (*baskets/ acre*)	Oil production rate (%)	Intended use
Black sesame	Black Magway 1/13	All seasons	80–85	15–20	48	Mostly for sale
	Black Magway 2/14	All seasons	70–75	15–20	48	
	Black Theitpan	Monsoon & winter season	80–90	15–20	48–50	
	Black Samone	Monsoon season	90–105	10–15	48	
	Sin Yadanar - 3	All seasons	90–95	15–25	50	
	Sin - 3	All seasons	75–80	12–15	48–50	
White sesame	White Magway	Summer & monsoon season	65–70	15–20	45–48	Mostly for own food consumption
	Sin Yadanar - 4	Summer & monsoon season	80–85	15–25	45–46	
	Bapan	Monsoon season	85–95	10–15	45–46	
	Sin Yadanar - 5	Summer & pre-monsoon	80–85	15–30	5–48	
Red sesame	Red Magway - 104	Monsoon season	85–90	15–20	50–53	Mostly for own oil consumption
	Red Magway - 204	All seasons	85–90	15–20	50–53	

Orange text represents the best attributes of that variety

The type of land (lowland versus upland) dictates many of the available options. The farmer also needs to balance the resources required to cultivate other crops at the same time, and to manage the expected income which is in turn needed to pay off debts and invest in the next season's crops. Even if a crop has the most potential for profit, farmers may mitigate the risk of crop failure by allocating different plots to grow other crops each season. A lowland farmer in a village near Pwintbyu described how the sesame cycle is "built around the constraints of paddy, with the need to rush the sesame harvest and sell it to prepare for monsoon paddy" (PB-IND-M02).

A crop's resistance to adverse weather conditions will factor in risk-management strategy, for example combining chickpea (highly resilient, but low margins) with sesame (low resilience, but

high margins). The importance of diversifying crops is even more pronounced for farmers who rely on rainfall as their only source of irrigation. If they lose some of the harvest due to drought or flooding, they can fall back on income earned from other less-affected crops.

Farmers must also weigh the required capital to grow a crop against the potential for profit once all costs have been recouped. A farmer from a village near Pwinbyu, sitting atop sacks of grain, explained why he chose to grow tomatoes: "Tomatoes require little capital, but are labour intensive… but they generate a lot of revenue. When I compare this to green gram or corn, tomato is the clear choice to grow" (AL-IND-M01).

Crop patterns: Monocropping versus intercropping

The vast majority of cultivated land in the Dry Zone is monocropped, meaning that a single crop is cultivated in a plot at a time (Mather et al. 2018). Given the high susceptibility of sesame to weather-related losses, some farmers adopt intercropping, which is the practice of growing two or more crops on a plot at the same time, either in the same row or in adjoining rows. In the words of one risk-averse farmer, "Even if I lose the sesame, I still have the groundnut to rely on" (PB-IND-M01).

The prevalence of intercropping remains limited, with no more than 7 percent of irrigated lowlands and uplands being intercropped. It is more common in rainfed-only lands, with up to 26 percent of farmers using this cropping pattern, particularly in upland regions. Of all possible sesame intercrops, including groundnut and cotton, the most common one by far is pigeon pea, which represents 61 percent of all intercropped areas in rainfed uplands, and 32 percent of rainfed lowlands (Mather et al. 2018).

Reasons for choosing a particular sesame variety

While there are three distinct types of sesame (black, white, and red), there are many varieties within each type. A fourth type, brown sesame, is no longer grown in Myanmar because of the lack of export demand. Every seed variety has differentiated characteristics, such as cultivation days, yield rate, and oil production rate, as shown in *Table 06*.

In reality, both farmers and traders rarely know the exact varieties of seeds they are planting or trading. Some refer to the Sin and Sin Yadanar varieties as "dark blue" sesame, even though they fall under the black sesame umbrella. Farmers and traders can differentiate between the Bapan and Sin Yadanar white sesame varieties based on the colour; Bapan being pure

white, and Sin Yadanar having a brown outline. However, for most purposes, they are not treated differently. By far the most commonly known sesame variety is Black Samone, but all good-quality black sesame is equated to Black Samone regardless of the actual variety.

Farmers ultimately prioritise perceived market price (as communicated by brokers and other traders) and needs for personal consumption when selecting varieties to grow. It's not uncommon for farmers to grow more than one variety at a time. Even though farmers are increasingly adopting black sesame to seek the highest market prices driven by export demand, they will still dedicate some of their acreage to white sesame for food-related consumption (snacks, brittle, tea-leaf salads, etc.). A few farmers also leave some acreage to plant red sesame, given its high oil production rate, to mill oil for their own consumption.

Black sesame: The export sesame

Varieties of black sesame are mainly grown for export. They are the varieties with the highest market price and demand, driving more farmers to plant them as the majority of their sesame. As a tahini processor described, "The Samone variety has a good quality. The Japanese market likes it and it gets a good market price" (MG-GRP-02).

In addition to high export demand driving good market prices, farmers also choose to cultivate sesame due to its ability to better withstand inclement rainfalls. "Black sesame is weather resistant, but white isn't so good with weather", lamented a detail-oriented farmer (MG-IND-F01).

White sesame: The fallback sesame

White sesame used to be the most popular type of sesame in production volume before export demand for black sesame took off. While obtaining historical data for sesame prices in Myanmar is challenging, anecdotal reporting by farmers suggests that the switch to black sesame started in 2012, with prices significantly increasing about five years ago. As one farmer couple recalled: "When people started growing black sesame, they used to make 15,000 MMK per basket, but now can make up to 80,000 or 90,000. Our village started growing black sesame about seven years ago" (PB-IND-C01).

White sesame remains the second most planted type of sesame. Farmers still grow it because of good potential yields and steady domestic market demand throughout the year.

Red sesame: The oil sesame

Red sesame is mainly grown for milling into oil. Very few acres are still dedicated to red sesame, as most farmers who grow it do so for their own home oil consumption, rather than for export or domestic retail. As one farmer noted, "We used to plant red sesame for making cooking oil, but it's not popular in the market now" (PB-IND-M02).

Shorter cycle sesame varieties preferred but harder to obtain

When discussing which types of sesame they want to cultivate, farmers expressed interest in planting varieties with shorter cultivation cycles. Their motivation is that harvest time is less likely to coincide with heavy yield-damaging rains. As an organic farmer said, "I want to change the sesame variety as a water loss avoidance technique, and use the 70 to 80-day Samone versus the 90-day Samone to be able to harvest before rainfall" (PB-IND-M07).

However, some farmers reported difficulty accessing short cultivation cycle varieties in the market. Although the DOA carries these improved shorter cycle varieties, there is not enough quantity for all sesame farmers in Myanmar, and supplies run out quickly. Obtaining shorter cycle varieties from the DOA remains the most credible way for farmers to ensure that they are buying the exact variety they need. When seeds are bought from their peers, farmers cannot distinguish between the varieties. This was the case for a groundwater farmer who lamented, "I have to be careful when buying seeds from others because some people may sell 120-day seeds instead of 90-day seeds. If that's the case, I am at risk of monsoon rainfalls and my paddy planting time will also be late" (WL-IND-M02).

Rotating varieties of sesame crop

The choice of sesame varieties is not a permanent one. Some farmers reported changing the varieties they grow every few years in order to improve their soil. This was the case of one detail-oriented farmer who rotates between black and white sesame "every three years for soil health" (MG-IND-F01). The drawback is that it can impact seed purity. The same farmer noted, "I cannot do black and white sesame seed rotation every year because the seeds can get mixed up", hence the need to wait a few years before rotating.

The Striving Farmer

U Saw Win, 50
Hla Taw Village, Wetlet

"I am worried that when my children get married, I cannot give them land as a gift."

Family:

U Saw Win is married with five children, one of them a migrant worker. He has two children who help him out in the field, and the rest are in grade school in the village.

Education:

Grade four in the village.

Backstory:

Through contacts amongst his extended family in Wetlet town, U Saw Win moved from the hilly Chin state to the Dry Zone ten years ago looking for a better life. Upon arrival to the Hla Taw village, he became a casual labourer and did odd-jobs in the nearby town. Gradually, he managed to save enough to buy his own land and was proud to become a farmer just like his parents. His oldest son is a migrant worker living in Thailand.

Similar to many micro farmers, Saw Win faces cash-flow challenges during the non-farming season and relies on credit for working capital. He is able to stay afloat with careful budgeting and decision-making throughout the season, but bad weather can push him into a debt cycle. After harvest, he might still be below the debt line because his debts are due to be paid off at the same time.

Saw Win's major credit sources are MADB and a sesame broker. He receives a sizable loan of 400,000 MMK at the start of summer sesame, but is required to sell at least 80 percent of his harvest to the broker. He relies on remittance income from his son to smooth out the cash-flow needs of the household and to pay for his children's education.

In order to save on labour, Saw Win, along with his wife and son, are always busy working the two acres of sesame they own along with two more rented acres. During the harvesting season, they hire labour only when they absolutely must.

Being a canal-irrigated farmer, he has to negotiate with the village head along with other sesame farmers to ensure that they receive adequate water during sesame's land-preparation phase. Saw Win has heard news about GAP, but has yet to receive any training at his village. He is eager to learn more about it so he can obtain a better sale price.

With his 24-year-old son helping him out full-time, Saw Win is worried that he will not be able to provide him with sufficient land as a dowry when he eventually marries.

Land acreage and use:

- 4 acres: 2 owned, 2 rented.
- 2 acres of sesame.
- 2 acres of paddy (on the rented plot).

Access to irrigation:

The farm plots are irrigated by government canal during summer.

Access to machinery:

Rents an ox-cart and four-wheel tractor during the land-preparation stage.

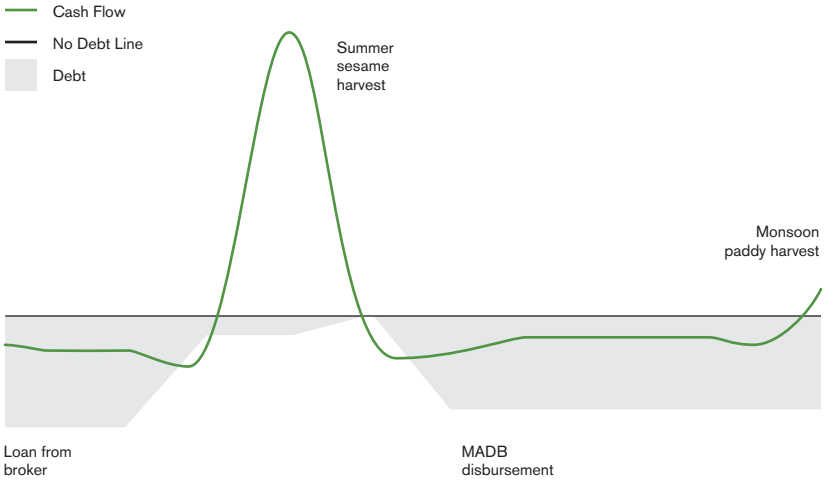
Appetite for risk aversion:

Low. With low income and children in school, they have limited savings, so trying untested things is a risk he cannot afford.

Income diversification:

Income type	Value	Predictability	Frequency
Crop income Summer sesame Monsoon paddy	High 5 to 12 lakhs	Low	Seasonal (every 4–6 months)
Remittance income	Medium 300,000 MMK	High	Once every 3 months
Casual wages	Low 5,000 MMK	Medium	Daily

Household cash flow and debt:



Decisions:

- Should I borrow money at the start of the season to pre-pay labour, or not borrow money and hire labour only when I need it?
- Should I broadcast seeds and save labour costs, or row plant and save seed costs?
- Should I sell all my harvest so I can pay off debts, or leave aside some for next season and roll over some of the debts?
- Should I save harvested seeds or buy seeds for planting next season, incurring additional cost, and potentially debt?
- Should I invest more in sesame farming or diversify in other income sources?
- Should I spend more time in my field or work as a casual labourer?

Challenges:

- Timing of the canal irrigation, and volume of water.
- Sesame crop failure due to heavy rainfall leaves him vulnerable to indebtedness.
- Limited contact with a handful of brokers diminishes his negotiating position.
- Limited cash flow to pre-pay labour, rent machinery at start of season.

Anticipating weather, water access

Water is the most important factor in the success or failure of sesame cultivation. As one sesame and groundnut farmer summarised, "Without rain, the soil can't do anything" (MG-IND-M02).

Given that weather is the most unpredictable factor farmers are confronted with every farming season, those who rely solely on rainfall for irrigation are particularly vulnerable to the whims of the weather. Farmers with access to government canals or groundwater have slightly better control over the success of their yield.

Current access to water

While access to irrigation remains a major constraint for farmers in the Dry Zone, irrigation infrastructure for sesame is slowly being rolled out, including new irrigation types such as tube wells and river pumping. Twenty-one percent of sesame farming households used irrigation during pre-monsoon season in 2007, compared with 32 percent in 2017 (Zaw Min Naing 2017). The great majority of sesame farmers still rely on increasingly unpredictable rain. Rainfall is such a crucial part of villagers' lives in Myanmar that farmers have a variety of expressions and idioms to refer to rain at different points in time during the year, and to describe its intensity and duration, as shown in *Table 07*.

Aside from monthly rains, there are nuanced rains applied to particular contexts. For example *thauk-yay-oh-moe* is "drinking pot water", *ah nyo tan moe* is "the heavy rain that holds a grudge towards farmers" because it occurs seven to ten days after seeding and washes the seeds away, and *let-say-moe* is "the rain that is just sufficient to wash hands".

Reliance on rain for rainfed-only farmers

Overall, at least 30 cm of rain is necessary throughout the cultivation period, though rainfall needs vary from one stage to another. Sesame requires around 1.2 cm of rainfall at seeding, 2.5 cm at the time of tilling, and 0.6 cm during flower bloom (Nyein Set Lin 2019). *Figure 15* showcases the rainfall needs of sesame at different stages of sesame cultivation, and the reality for rainfed-only farmers.

Farmers feel powerless when it comes to rain

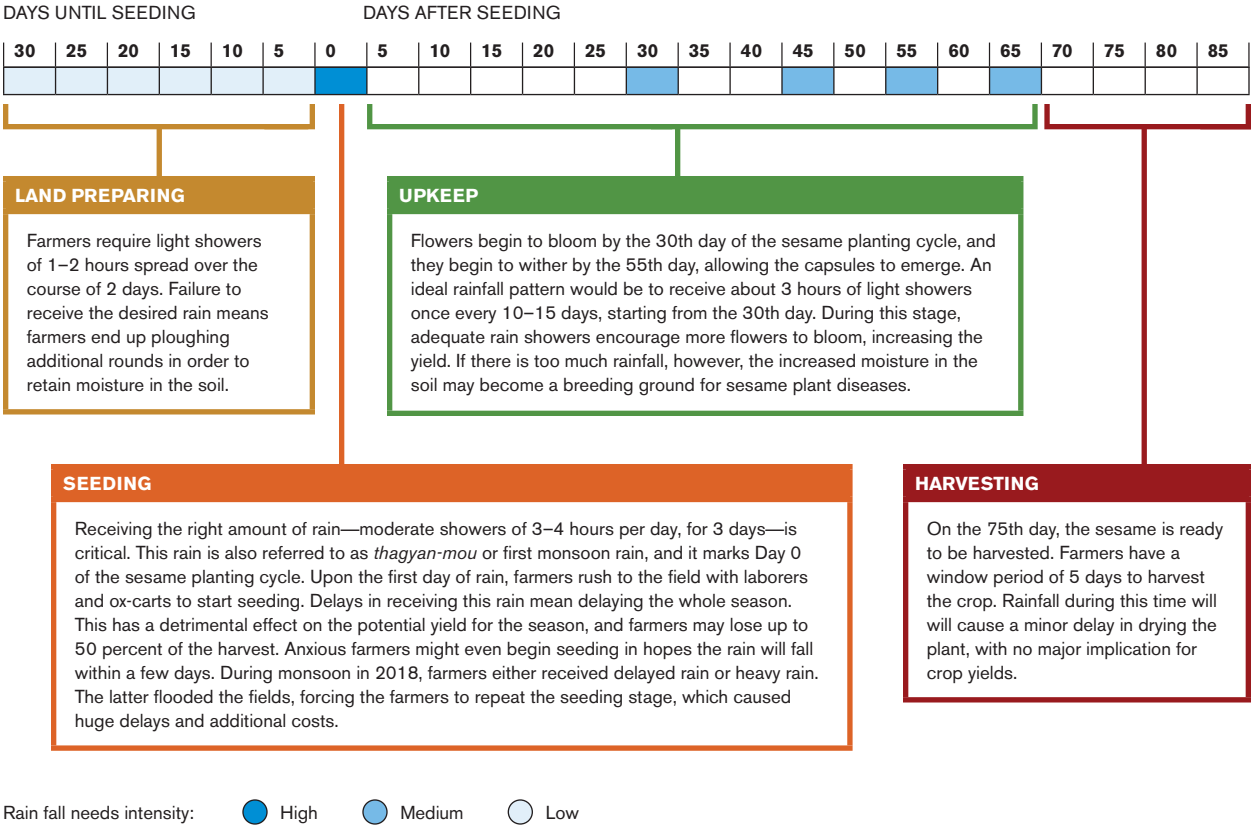
There is a sense of powerlessness felt by sesame farmers with regards to rainfall patterns. Rain is perceived to be a frightening force that can come in and wipe away everything. One village head-couple summed it up, saying: "Sesame farming is not difficult, but the weather is" (PB-IND-C03)

Table 07: Types of rain, by month

Season	Month	Transliteration & direct translation	Meaning
Summer sesame	February	*Kyan moe kywin* Leftover rain	The rain that's finishing up
	March	*Moe thar kyuu* Intrusive rain	The rain that isn't supposed to come yet
	April	*Tha gyan moe* Thingyan rain	The rain that welcomes change
	May	*Myay thin moe* Earth rain	The rain that makes earth fragrant
Monsoon sesame	June	*Myat thar moe* Grass rain	The rain that makes grass grow
	July	*Mi gyaung moe* Crocodile rain	The rain that makes crocodiles happy
	August	*Moe phwe phwe* Erratic rain	The rain that barely comes, but is hard to stop when it comes
Winter sesame	September	*Sar pho sin ye moe* Poor kitchen (housewife) rain	The rain that never stops, making housewives' work finding firewood difficult
	October	*Palin say moe* Throne-cleansing rain	The rain that showers to clean the Buddha shrine
	November	*See hnin ta lite moe ta phyite* Snow (hail) rain	The rain that alternates between rain and snow
	December	*Dar hlee moe* Knife rain	The rain that is very spotty
	January	*Hnan pyat moe* Sesame damaging rain	The rain that destroys the sesame field

Even if farmers invest significant time, energy, and resources into optimising the growth conditions for their sesame plants, all of their efforts could be negated due to the rain. In the words of an input vendor representative, "It is not because the plant is weak or because the soil has poor conditions. It's excessive rain… you lose as many acres as you grow" (PB-IND-M06).

Figure 15: Rainfall needs



This is particularly true for rainfed-only farmers, who feel like they're getting either too much rain or too little of it. As encapsulated by a farmer and village secretary: "When we need rain [during irrigation and blooming], we don't get any or we get too little. When we don't need it [during seeding and upkeep], we get a lot of rain" (PB-IND-C02).

Farmers are unable to control the rain, but are able to control their fate by diversifying their income sources.

Farmers with additional sources of irrigation

Farmers with access to other sources of irrigation such as government canal water or groundwater are able to better mitigate unpredictability than their rainfed-only counterparts. The benefits are most felt during droughts or times of too little rain.

Nonetheless, while having additional sources of irrigation means farmers are better equipped to irrigate when rain is not enough, it doesn't help with damage caused by excess rain. The

exception comes with farmers who have devised ways to drain excess water, as with a groundwater farmer who said, "If it floods, we create water paths that help the water run off from the plots" (MG-IND-M06). However, due to factors including awareness, time, and the cost of labour versus expected return, very few farmers reported using these techniques.

Canal water: Dependent on government infrastructure

Villages with access to canal water are connected to large government canals, with offshoots or dug rows connecting the main canals to the different plots. It takes varying amounts of time for the water from the main government canal to reach different plots; the plots closest to the canal get water first. If the farm plots are directly adjacent to the main-concrete canal plots, farmers may need to use a diesel pump to irrigate water into their farm plot.

Access to canal water is granted by the government for specific times of the year, either automatically according to predetermined days, or through negotiation via the village head. The duration

Digging a two-inch tube well

of canal water access varies from village to village. Some villages report having access to canal water for several months (from February to November), while others only had access for about 12 days a year. This is dependent on the distance between the village and the main government canal.

Farmers are then informed when the canal water will be available, either through "a bulletin board ad or a government agent" visiting the village (AL-IND-M02 Sorghum Farmer). In exchange for receiving this water, farmers pay a fee to the Department of Irrigation. The fee varies from 2,000 MMK to 5,000 MMK per acre, based on distance from the main government canal.

Ground water: More flexible but more expensive

For areas with underground aquifers, farmers may rely on groundwater as an additional irrigation source. Due to immutable geologic conditions, some areas like Magway township have very limited access to groundwater.

Farmers have three options to for accessing and surfacing groundwater:

- The cheapest option is digging a two-inch tube well, and connecting it to a simple treadle or hand pump; costing from 150,000 to 200,000 MMK to install, a tube well can reach 9–15 metres underground.
- The second method is building a concrete dug well about 1 metre in diameter. Depending on the depth of available groundwater, costs can start from 700,000 MMK and go up to 1.5 million MMK. At depths of 30 metres, a concrete dug well requires a diesel engine to retrieve water.
- The third method is installing an engine-powered pump that draws water from a large dug well, up to 150 metres below the surface into a large water tank. This village-level investment has been supported by bilateral organisations like the Japan International Cooperation Agency (JICA) in villages that suffer from persistent droughts. It costs up to 3 million MMK.

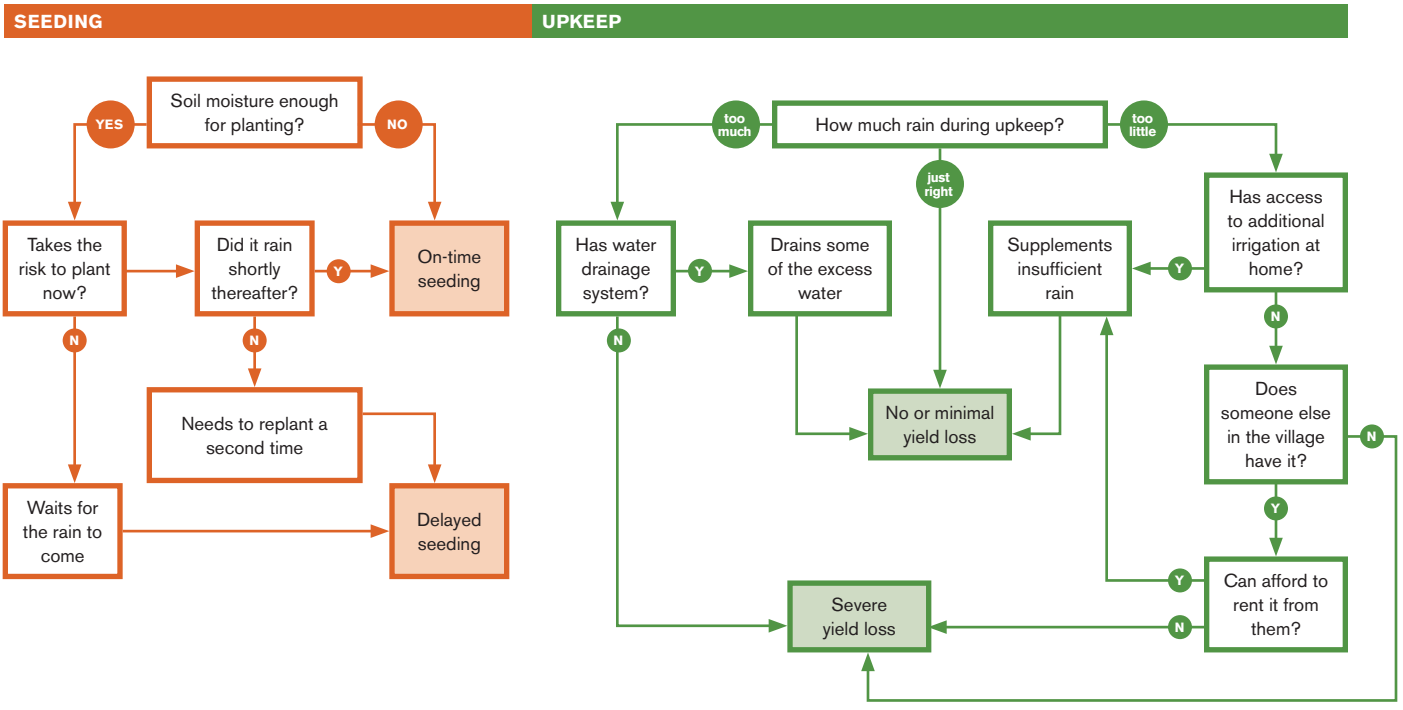
Building a hand pump or well can be an expensive upfront investment for farmers, but it is worthwhile because it provides more flexibility than relying on government canal irrigation. As one organic farmer noted: "I dug my tube well because I realised I needed water access all the time. If I can control my water by digging a tube well, then I can have better control of my crops and my yields. Before digging the tube well, I grew my crops with regular canal irrigation. It worked, but the yields were not as high" (PB-IND-M07).

Forecasting weather

Farmers rely on various traditional weather forecasting techniques to anticipate rainfall. Today, the average village household will have a smartphone or radio, which has helped deliver weather updates and alerts to farming communities. However, these weather forecasts do not capture more localised weather patterns.

It is one thing to accurately forecast weather, but quite another to be able to adjust farming practices based on experience. Farmers can adjust the timing of seeding based on rainfall needed to ensure the required moisture, but inadequate rainfall often happens later in the cultivation cycle and can only be marginally mitigated. As representatives from Winrock described, "Farmers learn about extreme weather changes four days ahead, but they just do not know how long it will last" or what to do in response (MG-GRP-03).

Figure 16: Rain-related decision-making



Traditional forecasting methods

In a village near Magway, some farmers still hold on to traditional weather forecasting techniques despite the adoption of new technologies. The most common method of ascertaining rain was described by a Magway farmer as, "Observing the wind direction… On the first day of Tabaung month [based on the Burmese lunar calendar, close to March period], if there is no wind, there will be a drought in the first period of the monsoon season. If there is wind on the second day of Tabaung, then it will rain normally in the middle of the monsoon season. If there is wind on the third day, then it will rain during the end of the monsoon season" (MG-IND-M05).

A less common method is to observe the 'dee-dote' plant (*Sterculia foetida*), as the initial growth of its branches indicates rainfall to come.

Adjusting cultivation practices based on rain and irrigation access

Depending on the types of irrigation sources they have access to, farmers must preemptively or reactively adjust the timing or activities of their cultivation cycle based on expected or observed rainfall. *Figure 16* summarises the different decision points that sesame farmers must face prior to planting and during upkeep.

ARCHETYPE

The Independent Farmer

Daw Mya Aye, 45
Shar Zaung Kan Village, Magway

"I started farming at age fourteen. I know every stage of the farming process, and can do heavy work like tilling the field. I love farming but it's becoming increasingly challenging—the future for my children is in the city."

Family:

Widowed, with three children (16, 18, and 20). Lives with sister, mother, and two children. Eldest child is attending college in Mandalay, the others at high school in town. Husband died of a heart attack four years ago.

Education:

Monastic school until grade five, then government school to grade eight.

Backstory:

Daw Mya Aye was born in Shar Zaung Kan, a village one hour from Pwintbyu, as the eldest of six. Although only educated to grade eight, she was farming from an early age and enjoys speaking with her college-educated brothers. She married at 20, and she and her husband received eight acres of prime sandy loam land as dowry from their families. They built a two-story timber and bamboo house in her family's compound so she could be close to her sick father.

When her husband died of a heart attack four years ago, she had to run the farm, grown to 20 acres, herself. To handle manual work, she hired a foreman and two full-time labourers. She inspects all the plots and makes input and management decisions. For the most recent season, she followed what she called, "common sense" GAP suggestions, and now appreciates the extra 3-percent margin for selling premium seed. She will continue GAP practices next year.

Normally she takes two loans from MADB and a microfinance institution, repaying them as soon as the harvest comes in, and selling the excess when the price is right. Last year was a good crop, and she has excess cash to invest either in equipment or a plot of land in town to build a house for the family.

Her reliance on rainfall means that every year is a gamble, particularly as the weather has become less predictable. She mitigates risk through planting groundnut (and one field of corn for animal feed), but this only goes part of the way towards salvaging a poor season. There are signs of problems this year already. There was too much rain five days after seeding and the water did not drain well. Her sesame stalks show the dreaded black stem disease, and today she needs to visit the fungicide seller for advice.

She has an old screw milling machine to make oil for domestic consumption. While the income it generates is small, she accepts cake to feed her four oxen in lieu of payment.

Because she already has a tractor, she can book labourers months ahead of time, but many have migrated to towns and she's not sure if they will return. To mitigate labour shortages, she can change the variety of seeds to stagger the harvest times, but for that she needs to obtain 75-day Black Samone yet there are seemingly none available.

The biggest decision in the years ahead will be whether to diversify out of farming, or quit rural life and move to the town. She sees a future for her family away from the fields, having invested in her children's education to give them a chance of obtaining an urban or government job.

Land acreage and use:

- 20 acres (mostly upland, some lowland)
- 6 plots
- 12 acres planted with sesame (on all plots)
- 5 acres for groundnut, 1 acre for corn for animal feed, 2 acres left fallow
- 2 acres of sesame (on her owned plot)
- 2 acres of paddy (on a rented plot)

Access to irrigation:

None. Only rainfed.

Access to machinery:

Her husband bought a second-hand 16-tooth tractor plough from a government auction five years ago for 8 lakhs. Supplemented by oxen. Thinking about investing in more machinery to rent out.

Appetite for risk aversion:

- Her investment in GAP methods are considered an educated risk.
- Chooses low-risk chickpea and groundnut to supplement her sesame income.

Decisions:

- Should I continue farming, or diversify income streams? Or should I quit farming and move to the city with my children?
- Which varieties of sesame should I plant next year?
- When should I sell the 94 baskets of sesame to optimise profit?

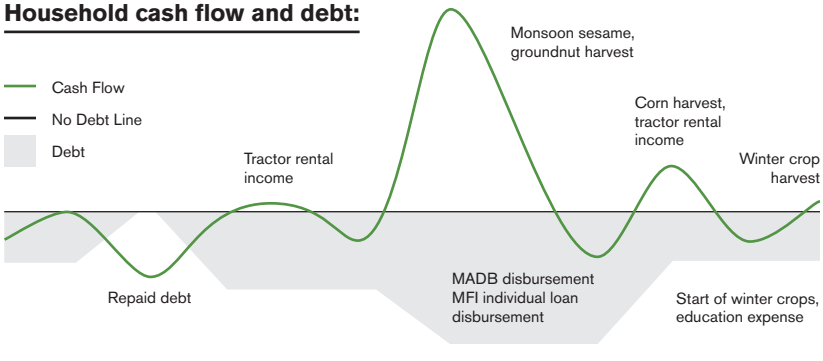
Challenges:

- The weather is becoming less predictable.
- When to plant the first seeds, purely based on rain forecast.
- Buy the optimal variety of seed, ideally to shorten the season and better cope with unpredictable weather.
- This makes it difficult to get labour for the exact days she needs.
- Paying off her children's tuition. Planning for which child will take over the farm, if she still has it.

Income diversification:

Income type	Value	Predictability	Frequency
Sesame	High 7.5–60 lakh	Low	Seasonal - every 4–6 months
Other crops Groundnut Chickpea	Medium 6 lakh, 3 lakh	Medium	Seasonal - every 4–6 months
Tractor rental	Medium 24 lakh	High	Frequent
Milling seed	Low 1 lakh	High	Infrequent

Household cash flow and debt:



Knowing about potential outbreaks

Common pests and diseases impacting sesame

Diseases are caused by microscopic organisms including fungi, bacteria, viruses, and nematodes. Both pests and diseases can damage one or multiple parts (roots, stems, leaves, flowers, fruits) of a plant, causing loss in the quantity or quality of the yield. Pests include insects that chew, bite, suck on, or drill holes in plants.

Table 08 showcases the most commonly faced pest and disease outbreaks by sesame farmers in Myanmar. Current remedies include the ways that farmers deal with the outbreaks upon noticing the symptoms, whereas the prescribed remedies are the best practices recommended in Myanmar's GAP.

While farmers are capable of spotting pests and disease symptoms, they do not always know the exact causes of those symptoms. Therefore, they do not know which pesticides or remedies to use without the advice of pesticide sellers, farming extension service providers, or other farmers who have experienced similar issues. The exception to this is Black Stem disease, which the majority of farmers know, partly because the name of the disease describes the main symptom. Black Stem is also widely considered the "scariest" disease impacting sesame, with the potential to cause the most yield loss. In the words of a detail-oriented farmer, "You cannot tackle Black Stem with pesticide, the disease is just part of growing sesame" (MG-IND-F01).

Black Stem disease is amplified by weather conditions

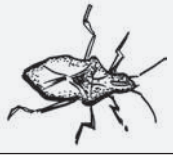
Sesame is widely considered an insect-resistant crop, and pest and disease problems are relatively manageable for sesame farmers (Langham et al. 2008). A combination of three factors impact disease outbreaks:

1. The host i.e., how healthy the plant is.
2. The pathogen i.e., how strong the disease is.
3. The environment i.e., how favourable the environmental conditions are for the disease to occur.

When the plant is weak, the pathogen strong, and the environment favourable, an outbreak is likely to occur. A disease outbreak will not occur with just one or two of these factors present, as all three need to converge simultaneously.

Black Stem disease is common during the heavy rains of monsoon season, due to water puddles in plots, usually in areas where sesame is grown in rainfed conditions. It is strongly correlated when plants are weak and pathogens are strong.

Table 08: Pests and diseases impacting sesame

Pest or disease	Type	Potential yield loss	Description and symptoms	Current remedies	GAP prescribed remedies
Sesamum Jassid *Orosius albicinctus* 	Pest	<60%	During the plant's growth stage (15 days after seeding), these leafhoppers attack the bottom of the stem where they suck the sap of the plant leaving no traces of bitemarks.	Preemptively, farmers use plant-protection pesticides 15–18 days after seeding. Reactively, farmers may also use pesticide. Farmers are rarely aware of the name or type of pesticide, and usually follow the advice of visiting pesticide company representatives.	Clear all weeds and rotate crops. Use seed treatment before planting the seeds. Spray plant protection pesticides.
Bollworm *Helicoverpa armigera* 	Pest	~20%	During the plant's growth (25–30 days after seeding), flowering, and ripening stages, these pests eat the flowers, leaves, and fruits. If the pest infects the plant's fruits, water soak spots will be visible and the fruit will fall before they ripen. Sooty mold will also be visible on the top of the leaves.	Farmers use pesticide as a reactive measure. Farmers are rarely aware of the name or type of pesticide, and usually follow the advice of visiting pesticide company representatives.	Perform deep tillage and spray different pesticides on the soil during land preparation. Rotate crops.
Sesame Seed Bug *Aphanus sordidus* 	Pest	<100%	Mostly after harvest during the sesame thrashing, stacking, and storage, these larvae suck the sap out of the plant.	After seeing the larvae, farmers take the infected branches and shake the larvae off over a bowl. They then bury the larvae in the ground and destroy the infected branches. Lastly, they clear any weeds in the surrounding areas.	Clear all weeds. Destroy visible eggs. Spray plant-protection pesticides. Apply pesticide around the sesame stacks so as not to affect the quality of the sesame seed. Do not use directly on the affected seeds.
Melon/Cotton Aphid *Aphis gossypii* 	Pest	<60%	During the plant's growth, flowering, and ripening stages, the flowers and leaves look abnormal, changing in colour, and/or wilting, with sooty mold forming. Growth significantly slows and the plants are dwarfed. The leaves begin to curl inwards.	Preemptively, farmers use plant protection pesticide 15 to 18 days after seeding.	Regularly cut down branches to provide plants with proper airflow. Spray plant-protection pesticides.
Black Stem *Rhizoctonia bataticola* 	Fungus	<80–100%	Brown or dark spots become visible at the bottom of the plant stem, which splits up and breaks out. Black bumps form and attach to the plant tissue and stem. The bottom of the stem turns a dark colour while the upper part of the plant turns more yellow before the plant begins to wilt. Ultimately, the whole plant dries up then dies. It occurs when rainfall happens 10–15 days continuously followed by sunshine.	Farmers do not believe this disease is treatable, even with pesticide or fungicide.	Add a mix of organic manure, sesame stems, roots, and other parts of the plant with Trichoderma (fungus) to sesame seeds before planting. Do not allow puddles of water to form in the field. Rotate crops frequently. Destroy infected plants. Use seed treatment before planting. Spray Validamycin, Benomyl, Azoxystrobin, Difenoconazole, Tebuconazole to get rid of fungus.
Sesamum Phyllody *Phytoplasma* 	Bacterial parasite	<100%*	The plant becomes dwarfed and leaves start to grow in small, twisted bunches along the stem. The branches appear abnormal and bend down.	The disease is most severe for the young plant. If it is affected in the adult stage, farmers cut the top part off and salvage the bottom for its seeds.	Avoid early planting. While the plant is young, protect it with pesticides. Uproot and destroy infected plants.
Nematode 	Parasite	22–26%	The roots turn to a darker, brown shade. The top of the roots turn white or yellow and both male and female nematodes become visible as bumps attach to the plant roots. Brown nematodes can be found in the soil. The disease starts to visibly affect surrounding plants as well. The plant is dwarfed and the leaves turn yellow or brown.	Some farmers use pesticide underground, then pluck out the plants from the roots before the disease spreads to other plants. Other farmers spray calcium carbonate, and plough again.	Grow crops other than sesame with crop rotation. Plough deeply during the land-preparation stage.

* If fungicide were used for the Sesamum Jassaid pest, yield loss would be less severe.

Gathering resources

After planning for the year and deciding which crops to grow and when, farmers must secure the resources necessary to carry out their plan. Having lived in the village for generations, most farmers have an extended kinship network to exchange resources with and to rely on as a safety net. As a farmer in Pwintbyu shared, "I borrowed one lakh [100,000 MMK] from one of my aunties for a period of one month without interest. I maintained this relationship by helping her with advice on farming techniques, pesticide usage, and recommendations" (PB-IND-M01).

Since 2010, there has been a rapid increase in rural non-farm businesses, such as machinery rental, transport, and retail (Boughton et al. 2018). For an average village of 600 households, there are about ten small shops that sell everyday household items, with some shops offering inputs. As shared by a village shop owner, "Farmers do not have to go all the way to town to buy inputs. They can just get the same items from my shop. I have a wide selection here" (AL-ADH-F04). Although this trend signals increased options for farmers seeking credit, inputs, and tools, farmers do not necessarily have the awareness or knowledge to make informed decisions when shopping around to find relevant, reliable, and timely products and services that meet their needs.

Budgeting for the year

Farmers face cycles of good and bad harvests, and due to the inherent cyclical nature of the farming profession, they have learned to diversify their income sources to reduce risk. Income generated through farming makes up between 35 and 68 percent of Dry Zone farmers' household income. The rest of the household's financial needs are supplemented through livestock raising, remittances, and casual wages (Boughton et al. 2018).

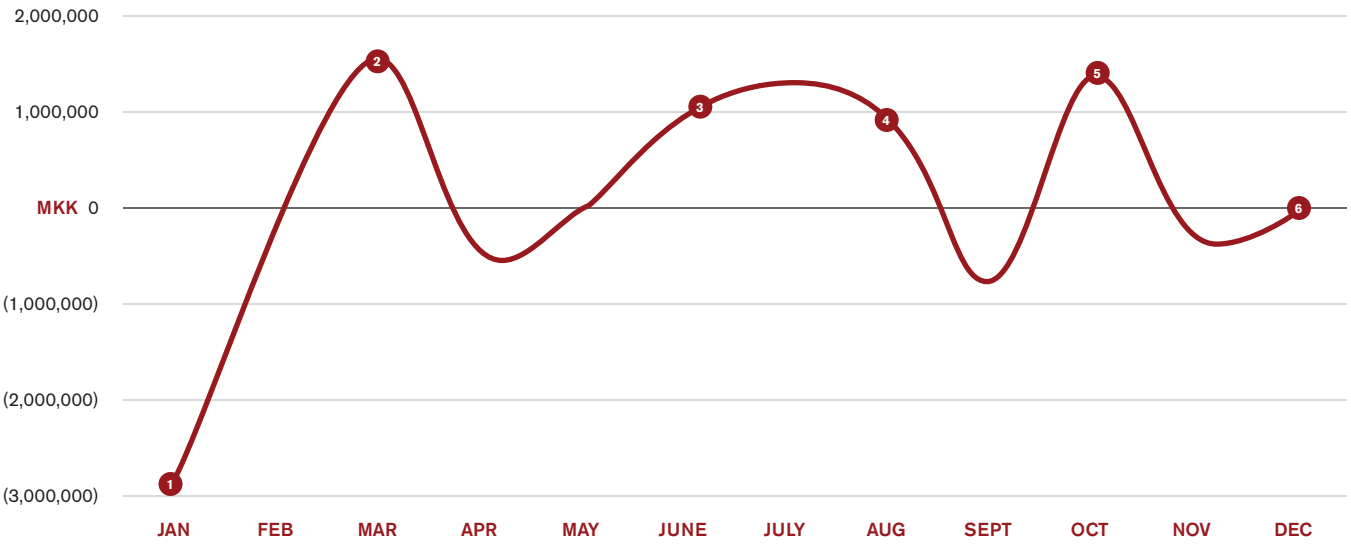
Farmers tend to compartmentalise their income, with each income source having its own intended use. Day-labour wages, usually earned in small amounts, on a day-to-day basis, are intended for food consumption. Crop harvests, earned in lump sums and infrequently, are budgeted to repay debts and for next season's working capital. With constant dependency on the previous season's harvest, there is little room for unexpected events such as health emergencies or crop failures. This is often the cause of farmers becoming over-indebted, taking out a combination of formal and informal loans from multiple sources. Those farmers who manage to highly diversify their activities and income sources are more capable of having one or two of those income sources go directly into savings and investments.

Table 09: Financial snapshot of a diversified farmer

	MMK	USD
Farm income	9,540,000	6,155
Off-farm income	925,000	597
Farm working capital	(6,650,000)	(4,290)
General household expenses	(1,240,000)	(800)
Net profits	2,575,000	1,661
Debts	850,000	548
Investments	(2,700,000)	(1,741)
Cash balance	725,000	468

Based on AL-IND-CO1, a multi-crop grower (sesame, onion, tomato, paddy and corn) in a year with low to moderate sesame yield.

Figure 17: Monthly net cash flow of a diversified farmer



1 **January:** Accruing profits from the past seasons, the family decide to invest in buying two cows, costing 2.7 million MMK.

2 **March:** Income from onion and tomato harvests is used for start of summer paddy, and household improvements.

3 **June:** Income from summer paddy harvest and brokering of paddy are used to finance planting monsoon-season crops (sesame, green gram, and corn).

4 **August:** Income from monsoon crop harvest and casual work are used to finance post-monsoon crops (green gram, corn, and paddy).

5 **October:** Income from post-monsoon crop harvest is used to finance next season's crop.

6 **December:** An informal loan of 400,000 MMK is taken from a broker in town to finance upkeep of onion and tomato crops.

An average farming household sets aside ~20,000 MMK per month to spend for community-related expenses, ranging from monastic donations to birthday events for neighbours' children. For some festival months, such as April, when Myanmar celebrates the lunar new year, families can spend up to 100,000 MMK on donations. Farming families consider these expenses as a budgeted investment in their social capital and safety net.

Yearly cash flow

Table 09 outlines the financial snapshot of a diversified farmer in Aunglan. With 15 acres of land, he is able to grow up to eight crops, and works two seasonal casual jobs. This enables him to have ten discrete income sources, netting an estimated 2.6 million MMK in 2018.

Figure 17 highlights how the same farmer's household budgets for the year, using a mix of farm income, off-farm income sources, and debt to meet their financial needs and potentially invest for longer-term gains.

Figure 18: Production costs by cultivation stage

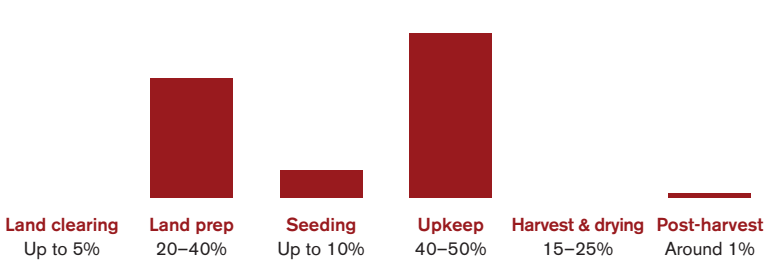
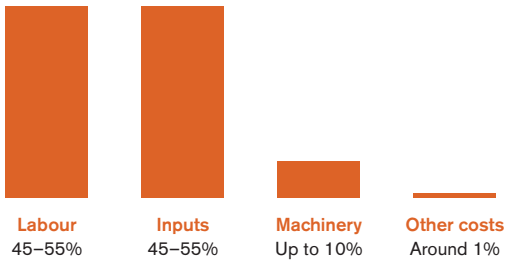


Figure 19: Production costs by expense category



Securing credit

Working capital required for each sesame season is typically financed by farm income from the previous season, as well as debt raised from formal and informal credit providers.

Sesame production costs

In Myanmar's Dry Zone, a sesame farmer spends an average of 100,995 MKK per acre to grow sesame (Mather et al. 2018). Based on qualitative data collected across our three research locations, most of the costs are spent during the upkeep phase, followed by the land-preparation and harvest phases, as shown in *Figure 18*.

In terms of expense categories, as shown in *Figure 19*, the bulk of costs is split between hired labour and inputs (including seeds, fertilisers, and pesticides). Machinery rentals are up to 10 percent of production costs, with around 1 percent remaining for other costs. Findings from a larger household survey in the Dry Zone corroborate these findings, with 44 percent spent on hired labour, 36 percent on seeds and inputs, and 9 percent for machinery (Mather et al. 2018).

The land-preparation stage is stretched over a two-month period that allows farmers to better manage the required cash flow. During that same period, however, farmers might need to pre-pay for labour and buy inputs in advance, requiring them to secure at least 70 percent of the total working capital.

Farmers need to obtain financing beyond just sesame

No farmers can exclusively rely on sesame for their income—most farmers grow at least two other crops, with groundnut, green gram, and pigeon pea being particularly complementary. This means that farmers not only have to secure credit for sesame-re-

ARCHETYPE

The Loyal Labour Head

U Maung Kyi, 50
Kwan One Village, Magway

"I want to continue the job successfully—almost sixty labourers depend on me for livelihood."

Backstory:

U Maung Kyi has been working as a labour head since 2008. After he married, he and his wife ran a small grocery store for three years. During that time, he accumulated significant debt from providing credit to farmers who failed to pay him back. Luckily his uncle, a successful farmer, suggested he organise labourers for him as well as working as one himself. This turned out to be a life-changing moment, as Maung Kyi was able to grow the number of farmers he works with and climb out of debt.

Ten years on, he works with 60 labourers and eight farmers in his village. About ten labourers are from his extended family, and he maintains a good relationship with the rest. It is challenging to make advance payments to labourers in April when his farmers do not have the money, and he usually has to borrow money from relatives or informal village lenders.

Due to a high migration rate, his labour group is shrinking, and it is becoming increasingly difficult to find enough people during the peak season, forcing him to reach out to other villages to meet demand. As a labourer, he needs to work double shifts during harvest time, an increasing challenge for his aging body.

Yearly transaction volumes:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	Lowest: 32,000 MMK										Highest: 1,050,000 MMK

Decisions:

- Should I travel to other villages or townships for farming-related jobs or stay in the village and take on side jobs during the slow season?
- Should I push labourers harder even when the day is extra hot, or let the labourers take a break and risk not meeting my promise to the farmers?

Challenges:

- Gathering labourers can be time-consuming and he needs to make in-person visits for those without a phone.
- Lending money to farmers so they can pay labourers they otherwise can't afford in advance.
- Managing ten farmers, he needs to organise and rotate his group to meet everyone's schedule.

Busy Season:

From May to July: Tasks include monsoon sesame and groundnut weeding and harvesting.

From October to December: Tasks include winter sesame and groundnut weeding and harvesting.

Margins:

- As a labour head, he makes 10 percent commission from organising labourers.
- As a labourer, he makes 6,000 MMK/day during peak season, and 3,000 MMK/day during off-peak season.
- Income from May to July is at 1.8 million MMK as a labour head, and 180,000 MMK as a labourer.

lated costs, but they also have to secure sufficient credit for other planted crops.

In Aunglan, May sees loan disbursements from MADB, the largest agricultural credit provider for farmers. This does not align with when farmers need to pay for machinery rental and labour costs related to the land-preparation period for monsoon sesame in March and April. Therefore, a key constraint for sesame farmers is to secure credit during the period when they do not have any farm income to rely on and before major loan disbursement from their current providers. A farmer in Magway shared, "It will be great if I can get all the loan that I need from just one group and get it when I need it [without the group-lending model]. If that is the case, I would choose to repay the loan in October, when I harvest sesame" (MG-ADH-F05).

Securing labour

Even an unusually large family unit living under one roof, with ten members playing an active role in farming, has to rely heavily on casual labour over the course of the season. Sesame farming requires 19 labour working days per acre (Mather et al. 2018). This means that an average sesame farmer, growing up to seven acres, needs to secure 10 to 15 labourers twice throughout the season—once during weeding and then during the harvesting stage.

Sesame farmers face intense competition to secure labour during these periods. This is mainly driven by labour shortages and farmers growing equally labour-intensive groundnut during the same months (addressed in the *Labour and migration* chapter on page 44). Failure to secure labour at required times comes at a cost, as described by one farmer: "Because everyone needs labour at the same time, I may need to wait up to a week. If I am too late to harvest, the sesame seeds will shatter and I might lose yield" (MG-IND-M03 Manure User).

A sure way for farmers to secure labour is to pre-pay one to two months ahead of time. Depending on the relationship between the farmer and the labourers, there are varying terms, including paying 50 to 100 percent upfront, or paying either below or above market price. One labour group leader said, "I pre-pay the labourers in my group at the start of the sesame season, below the market rate because the labourers needed cash upfront. For me, I do this mainly to secure labour, not to save cost" (PB-IND-F03). To be able to pre-pay labourers at a time when farmers do not have available savings or income, small farmers take out high interest loans from informal lenders or sell gold or other valuable personal items to pawn shops.

CALL-OUT

Call-out 02: Available credit providers for sesame farmers

Formal credit providers

Formal credit providers include state-owned banks, private banks, non-governmental organisations (NGOs), and cooperatives. These credit providers are formally regulated and supervised by a number of bodies, including the Central Bank of Myanmar, the Ministry of Revenue and Finance, the Microfinance Supervisory Enterprise, and the Central Cooperative Society, based on their type (Duflos et al. 2013). Additionally, farmers frequently receive lines of credit from their suppliers (including input sellers and machinery renters) and buyers (brokers and traders).

Since 2016, almost three-quarters of all agriculture loans by value originated from these formal institutions, mostly from the state-owned MADB (Belton et al. 2018).

Semi-formal and informal credit providers

Small-scale, semi-formal credit providers consist of community-based organisations (village revolving funds and village savings and credit groups) and pawn shops registered by the Myanmar Small Loan Enterprise (Duflos et al. 2013). Informal lenders, including relatives, village heads, and other individuals in the village, are also widespread.

The increased presence of formal credit providers at the village level has directly impacted the business of semi-formal and informal lending. The prevailing interest rate offered by informal credit providers in the Dry Zone has dropped by 5.2 percent to an average of 3.4 percent in 2017 (Belton et al. 2018). Informal lenders, however, must bear a higher risk of default and late repayments from farmers, while requiring little or no collateral. This means farmers end up paying a premium for those risks, represented in the form of higher interest rates than those offered by formal credit providers. The availability and terms of the loans dependent on the social capital of the farmer. Informal lenders minimise their risk by targeting customers with high perceived income, as encapsulated by this observation from one informal credit provider: "For a village of around 600 households, there are four major money lenders. Their main clients are migrant workers and big farmers who own more than 20 acres, not landless labourers or small farmers" (AL-ADH-F03).

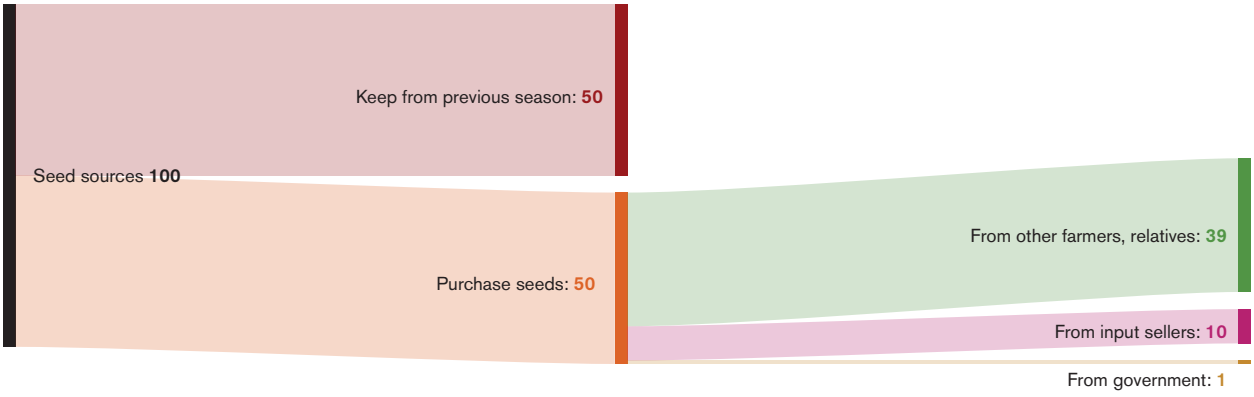
Table 10: Commonly cited formal institutions providing credit to sesame farmers

Credit providers	Loan type	Loan term	Credit amount	Monthly interest
MADB *(State-owned bank)*	Based on number of acres owned	8–9 months	Lowland: 150,000 MMK per acre Upland: 100,000 MMK per acre	~0.08%
Cooperative Bank *(Prive bank)*	Based on number of acres owned	6 months	100,000 MMK per acre	~1.5%
Proximity Finance	Crop, enterprise, livestock, and migration	6 months	200,000–600,000 MMK	2.5%
Pact Myanmar *(Micro-finance institution)*	Agricultural, business, leasing, and livestock loans	14 days	350,000 MMK	2.5%
Good Brother *(Input seller)*	Based on number of acres owned	4 months	150,000 MMK per acre*	2.5%
Awba *(Input seller)*	Individual loans	4 months	2 million MMK	2.5%

* Mandatory for farmers to buy one fertiliser bag per acre


MAB

Figure 20: Seed sources for planting



Opposite page: propagation seed for planting the following season

Sourcing seeds

Farmers do not have a sophisticated understanding of the different varieties and cultivation cycle lengths for their propagation seeds. Informed farmers who seek specific varieties, based on recommendations they find online or advice from a DOA representative, are inclined to purchase them directly from a government branch or seed farm. However, farmers reported that the DOA does not have enough seeds to distribute to all sesame farmers within Myanmar, so many are slow to adopt improved varieties. In addition, distance can be a barrier to purchasing improved seed varieties. For many villages, the nearest DOA branch can be several hours drive away.

Purchasing inputs

When planning for the different cultivation seasons, farmers purchase what they perceive to be the necessary quantities of fertilisers in advance. However, fertiliser costs can be prohibitive to some farmers, who resort to using a lesser amount than what is optimal or GAP prescribed. This was the case for a GAP farmer who said, "I can't follow the steps and quantities of fertiliser usage recommended in the [GAP] training. My yields decrease every year and fertiliser cost increases every year" (MG-IND-DY1).

Farmers have access to a wide variety of commercial fertilisers to choose from in the market, though sometimes they are required to purchase a specific brand of fertiliser tied to a loan provided by that fertiliser's seller.

Farmers who mix pesticides with their seeds during planting, or choose to use pesticides as a preemptive measure, buy small quantities of pesticides ahead of the cultivation seasons. But the

Figure 21: Sesame farming tools and equipment

	LAND PREPARING						
Tool or equipment	Ox-cart with 2 cattle	Ox-cart ploughing extension (Htal Thwar)	Ox-cart tilling extension (Htun Thwar)	Ox-cart tilling extension (Gyan Tone)	6-tooth extension with mechanical tractor (40 hp)	16-tooth extension with mechanical tractor (60–75 hp)	18-tooth extension with mechanical tractor (90 hp)
Purpose	Used for land cultivation as well as for transportation and hauling.	Attached to the ox-cart, it is used for ploughing to clear the land.	Attached to the ox-cart, used for tilling before seeding and weeding.	Attached to the ox-cart, used for tilling the land after seeding, so the soil lightly covers up the seeds.	Attached to a tractor, used for ploughing to clear land.	Attached to a tractor, used for ploughing to prepare land.	Attached to a tractor, it is used for ploughing to prepare land.
Adoption	High ownership	High ownership	High ownership	High ownership	Moderate rental adoption	Moderate rental adoption	Low rental adoption
Cost to buy (MMK)	~20 million for a pair of cattle	Marginal (homemade)	Marginal (homemade)	Marginal (homemade)	10 million	20 million	40 million
Cost to rent (MMK per hour)	3,500	-	-	-	20,000	20,000	20,000

majority of farmers purchase pesticides after noticing pest and disease symptoms in their plants, in which case they inquire among their peers or ask extension service providers or pesticide sellers which remedy is the most appropriate. Some farmers also buy and use pesticides as soon as they see their neighbours using them, for fear that the pests or diseases will travel from the neighbouring plots to theirs. In these cases, without having properly diagnosed the symptoms, farmers may end up spending money on pesticides they don't actually need.

Obtaining tools and equipment

Machinery owners purchase tractors and other machinery for ploughing and seeding on credit, and then rent them out to farmers. Farmers are required to book the machines at least a week in advance, rent them out on credit, and pay back the owners after

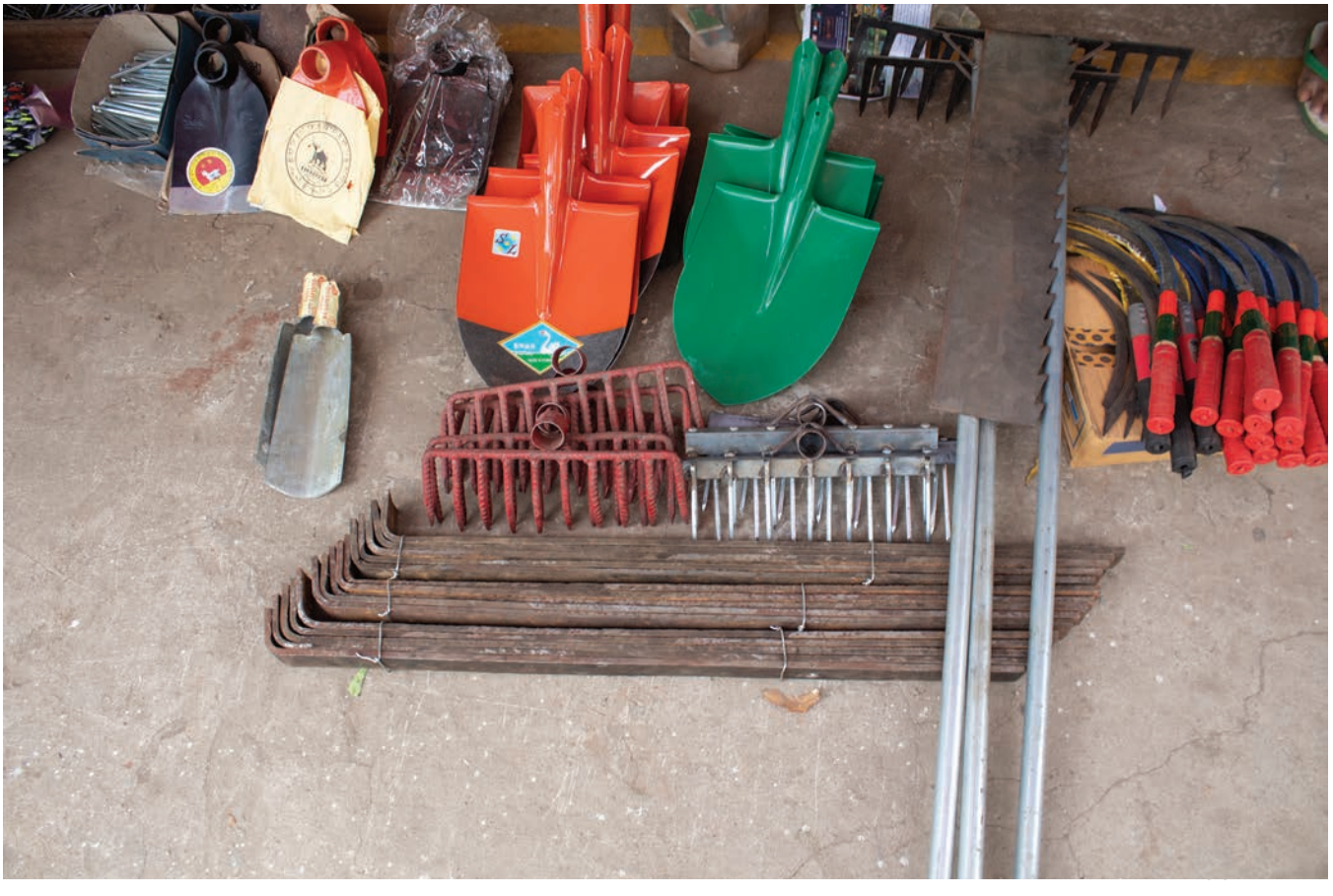
	SEEDING	UPKEEP				HARVEST		
	Homemade seeder (can or water bottle)	Water pump (7.5 hp)	Water hose (100-yard)	Nozzle	Ox-cart tilling extension (Gyan Tone)	6-tooth extension with mechanical tractor (40 hp)	16-tooth extension with mechanical tractor (60–75 hp)	18-tooth extension with mechanical tractor (90 hp)
	Used by farmers who prefer to sow their seeds in lines instead of hand broadcasting.	When canal or groundwater irrigation is accessible, water pumps are used to obtain water during land-preparation and growing stages.	Hoses are used to convey water provided from a canal, well, or pump. Typically, one person sprays and another holds the hose.	A nozzle for spraying the water in a way that mimics rainfall.	Attached to the ox-cart, used for tilling the land after seeding, so the soil lightly covers up the seeds.	Attached to a tractor, used for ploughing to clear land.	Attached to a tractor, used for ploughing to prepare land.	Attached to a tractor, it is used for ploughing to prepare land
	Moderate ownership	Low ownership	Low ownership	Low ownership	High ownership	Moderate rental adoption	Moderate rental adoption	Low rental adoption
	Marginal (homemade)	170,000	120,000	<400	Marginal (homemade)	10 million	20 million	40 million
	-	1,300	-	-	-	20,000	20,000	20,000

the harvest. The main challenge is that during distinct stages of the season, there is too much demand. Machine renters try to optimise the routes the machines travel between farmers to save time and fuel costs. In such cases, farmers may need to wait a few days before receiving the machines, delaying the timing of the corresponding farming activities.

Some farmers who can only partially afford machine rental will do so to cover part of their plot, and use animal carts for the remainder. Farmers who cannot afford rental and do not own their own animal carts and extension rent the latter from fellow farmers (see *Call-out 01: Machine rental and repair* on page 50 for more details).

Smaller tools used by sesame farmers, such as reapers, hoes, and shovels are purchased at the market and used by each farmer independently.


KIOTI



Farming— The Six Stages Of Cultivation

Stage 1: Clearing the land

Sesame farmers must complete two activities during the clearing stage. The first is burning trash and raking the plot to remove any visible weeds or dead plants that may have persisted from the previous farming season.

The second is delineating the plot with a hoe in order to clearly indicate its boundaries. Farmers need to track exactly where one plot ends and another begins, to then apply the proper resources to each.

This stage is relatively short in duration (one to two days, depending on plot size) and requires only light resources. Farmers may decide to complete this stage by themselves, or hire labourers.

Stage 2: Assessing soil conditions and preparing the land

Before spending valuable time and resources working the land, farmers need to check whether soil conditions are appropriate, particularly the moisture level, texture, and density. In the words of a farming couple near Pwintbyu: "Almost every day we go to the field to check the soil. If the soil is suffocating, we have to loosen it [by ploughing]" (PB-IND-C03 Village Head Couple). If they don't, the soil can become clogged and prevent water from flowing to the roots of the sesame plant.

Farmers resort to different methods of assessing soil moisture. One savvy farmer checks "if the [soil] moisture is good enough for sesame by looking at the soil and seeing if the surface is dry" (PB-IND-M02), while another farmer who uses GAP practices gauges soil moisture by digging a "ten-inch" hole (MG-IND-DY1). In an ideal world, the soil would "be a bit dry on the surface, and still have moisture underground"(PB-IND-M02 Savvy Farmer).

Other farmers begin by ploughing the land to evaluate moisture. In the words of one farmer: "I don't use any technology to measure the moisture, I can gauge it through ploughing. If you plough the land and the soil sticks to the plough, then the soil is too wet, and if a lot of dust comes out when you plough, then it means the soil is too dry. If the soil is too dry, the seed will not be able to grow. And if the soil is too wet, the soil will crack and the plants will die at the seedling stage" (PB-IND-M05 Miller and Farmer).

Aside from soil texture and moisture, there are other conditions that impact the growth of the sesame plant, including acidity and temperature. Few farmers have the technology to be able to check these with high precision, with most relying on tradi-

Table 11: Optimal conditions to grow sesame

Category	Optimal conditions	Conditions leading to lower yields
Temperature 	Overall: 25–37°C Sprouting: 20°C Crop growing: 25°C Flowering: 24–27°C	Overall: Below 11°C and above 40°C Spouting: Cannot go below 20°C
Rainfall 	300–800 mm Optimum yields when 500–650 mm rainfall per annum is well distributed over 3–4 growing months.	Below 300 and above 1,100 mm
Soil Texture 	Deep, well-drained sandy loams	Heavy clay, salty and waterlogged soils
Soil acidity 	5–8 pH	Below 5 and above 8 pH

Source (Terefe et al. 2012)

tional methods such as observation, touch, and smell to conduct their assessment.

With the exception of ploughing, there are virtually no costs associated with assessing soil conditions. Once the soil is considered adequate, land preparation can begin. Sesame farmers prepare their land by ploughing it every week for three months. Ploughing in different directions helps with weeding and softens the soil, while mixing in animal manure makes the soil nutrient-rich (see *Call-out 03: Ploughing and tilling needs* on page 112 for more details).

Stage 3: Seeding

After months of ploughing the soil and adding animal manure comes seeding day. Despite being short in duration, this stage is crucial to the sesame plant's cultivation, and requires significant investment in labour and seeds. Some farmers hire labour for seeding, while others do it themselves with the help of family members.

Labourers removing the topsoil for transportation to another field

Making a bottle seeder

Seeding methods: Broadcasting versus row planting

Sesame farmers rely on two different methods for seeding: broadcasting and row planting. Each is associated with different quantities of seeds and, varying levels of labour intensity, and may result in a different yield.

This choice will have repercussions on sesame plant growth. Row planting helps with pest and disease outbreaks and weed control, due to the spacing between the rows, and requires fewer propagated seeds. Broadcasting may lead to overcrowding of plants, resulting in a lower yield. It is also worth noting that when some farmers refer to broadcasting, they are describing a process wherein they first draw rows on their land, broadcast the seeds by hand, and then cover the seeds with soil using a tiller. This is how farmers of the Magway township have adjusted the row-planting method recommended by GAP to fit within their constraints. Even though this process does not follow the exact GAP instructions for row planting, the GAP author we spoke to still considered it valid, saying: "I urge them to continue" (MG-IND-M04).

Preparing the land with manure, before the heat of the day

Resource-constrained farmers choose broadcasting over row planting

The financial cost of tools used in seeding is marginal. Broadcasting is done by hand, and line seeding can be done using homemade seeders fabricated out of plastic water bottles or condensed-milk cans. This was demonstrated by one farmer, who said, "I can create my own seeder by taking a plastic bottle, making a hole at the bottom, and attaching the bottle to a bamboo stick with string" (PB-IND-C02 Farmer and Village Secretary).

Significant costs during the seeding stage are the price of seeds and labour. Broadcasting requires a higher quantity of propagation seeds, but line seeding requires more labourers. As one farmer who uses both methods compared, "I use five pyi [cups] of seeds per acre for broadcasting. For line seeding, it's only three pyi per acre" (MG-IND-F02 Lifelong Farmer). As another farmer noted, "For row planting, you need [9 to 12] labourers [for three acres]. For broadcasting, you only need one" (MG-IND-DY1 GAP Farmer). When it comes to making the decision between

the two seeding methods, resource-constrained farmers end up choosing broadcasting. The same GAP farmer summarised, "Farmers know it's better to do line planting, but because of time sensitivity and labour compared to broadcasting, they don't do it" (MG-IND-DY1).

Fertiliser and pesticide usage during seeding

Preference for animal manure over compound fertilisers

During the seeding stage, farmers do not use the amount of fertiliser recommended by GAP, as they do not see significant improvement in yield from doing so. Some farmers believe that overuse of fertilisers, particularly nitrogen, can harm the quality of the soil, as one organic farmer lamented: "During my father's time, he would put a lot of urea in the soil, which ruined it. Now that I'm in charge, I'm trying to fix the soil and help it recover" (PB-IND-M07).

In fact, farmers keep using animal manure in addition to compound fertilisers, despite GAP recommending only the use of the latter. This is due to the preferred effect that manure has on plant growth over compound fertilisers. In the words of a farmer, "With cow manure, the plant has a steady gradual growth. With fertiliser, the plant grows only when it rains and it has a sudden growth rate. If you add the wrong amount and there's no rain, the fertiliser can dry and doesn't become effective" (MG-IND-M03). Cost is also an inhibitor in the adoption of fertilisers, as prices increase each year.

It is easier for farmers to buy compound fertiliser than it is animal manure. Few farmers raise cattle, with many raising oxen for labour. Coupled with the rise in mechanisation, and demand from China driving livestock farmers to sell oxen beyond the border, animal manure is in limited supply. Indeed, a farmer remarked, "There is a preference for animal manure compared to chemical fertiliser, but it's low in supply" (PB-IND-C02 Farmer and Village Secretary).

Mixing pesticide with planted seeds

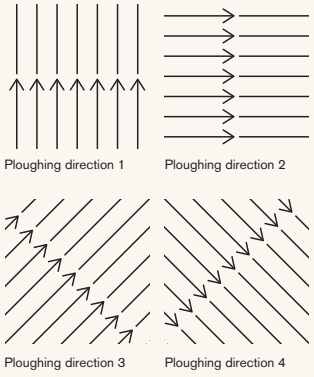
Some farmers reported mixing pesticide with the seeds they planted as a preemptive measure. A lifelong farmer from a village near Magway said, "I mix one bag of pesticide with my sesame seeds before planting. There are farmers who use more than that for their baskets" (MG-IND-F02). There are no repercussions if farmers use more pesticide than needed; there is no impact on the sale price of sesame as traders and brokers have no way

CALL-OUT

Call-out 03: Ploughing and tilling needs

To ensure ideal conditions for sesame to grow, farmers are required to devote considerable resources to the land. Factors to consider include soil moisture, potential disease problems, weed encroachment, and draining excess rain. A farmer may need to plough their plot up to 12 times and till it up to five times to achieve these benefits. These ploughing and tilling techniques span different cultivation stages, though ploughing occurs primarily prior to seeding, and tilling thereafter.

It's worth noting that not all farmers have the luxury of being able to go through 12 rounds of ploughing and five rounds of tilling. This is mostly possible for farmers who live in areas where they do not have access to irrigation sources to grow crops in the summer. In this case, plots remain idle from December to April, after the harvest of winter crops, allowing monsoon sesame farmers to have weeks to clear and prepare their land, and to deal with the dry and hot conditions that make the land harder and less prone to planting. Farmers who move from planting summer crops to monsoon sesame have an easier time preparing their land, as it has been worked and has had access to irrigation beforehand.

Cultivation stages	Farming techniques	Benefits
Land preparation	Farmers plough once a week for 12 weeks in four different directions.  	Ploughing frequently and in different directions helps ensure that the soil is smooth. If it is not smooth, the planted seeds will not grow sufficiently deep, and their roots will not take hold. Ploughing deeply also helps prevent weeds from forming, and reduces the reproduction rate of disease-inducing nematodes that thrive underground. As a GAP author said, "Plough deep into the soil and leave the soil as is so the nematode population will drop" (MG-IND-M04). Additionally, ploughing enables farmers to check the moisture level of the soil prior to seeding. Lastly, lowland farmers may also perform additional ploughing to help channel excess rain water. According to Winrock representatives, "For lowland, farmers will do an extra ploughing to enable the rain to drain when there's too much rain" (MG-GRP-03). Some farmers add animal manure during land preparation to ensure the nutrients are locked in through multiple rounds of ploughing.
Seeding	Immediately before seeding, farmers plough with a tractor and/or ox-cart to create rows in the land.	Unless they form rows, it is difficult for farmers to maintain the field over time, particularly weeding and removing plants that are too close together.
	After applying animal manure and seeding, farmers till the land a second time to cover the seeds with soil.	Tilling at this stage ensures that the seeds and animal manure are mixed and locked in together below the topsoil so that the seeds can germinate.
Upkeep	Farmers till the land a third time with ox-carts before germination.	Tilling at this stage enables the germinating plant to reach the surface. If it is not tilled properly, the plant may become trapped below the surface.
	Farmers till the land a fourth time to remove overcrowded plants.	If overcrowded plants are not removed when they start to branch out, they will overlap, resulting in a suboptimal yield due to a reduced number of blooming flowers and fewer nutrients absorbed by each plant from fertilisers.
	Once overcrowded plants are removed, farmers till the land a fifth time before weeding.	Tilling at this stage makes the process of plucking weeds by hand easier as they will not be entrenched in the ground.

to check the seeds for overuse. The same farmer acknowledged: "Although farmers mix pesticides with seeds before planting, they get high-quality prices for the sesame since there's no technology to test for chemical residue" (MG-IND-F02). Rather than mixing pesticides with planted seeds, GAP recommends mixing in Trichoderma, a fungus powder that reduces the likelihood of getting Black Stem disease, which is unlikely to leave any chemical residue once the plant has matured.

Stage 4: Upkeep

Once sesame farmers have planted seeds, they need to ensure that the plants are growing appropriately, from germination to flower bloom, and ripening until they are ready for harvest.

Tilling and weeding

Two major activities that need to be completed during the upkeep stage are weeding and tilling. Tilling is done for a variety of

reasons, including to help the germinating plant reach the surface, and to reduce the likelihood of stunted plant growth due to overcrowding (see *Call-out 03: Ploughing and tilling needs* on page 112 for more details).

Upkeep is the most costly of the six stages of cultivation, given the labour required for weeding. One GAP farmer said he deals with the "high bargaining power of labourers during weeding" (MG-IND-DY1). The demand for labour is so high that a couple organising a labour group explained, "During weeding time, labourers work two shifts during peak season… Each labourer works three people's workloads and gets paid three times more" (MG-IND-C01 Labour Head Couple), with wages in the range of 15,000 to 20,000 MMK per day.

Fertiliser, pesticide, and fungicide application during upkeep

In addition to tilling and weeding, upkeep is also the stage at which sesame farmers have to consider applying fertiliser or animal manure to supplement the soil, as well as any pesticides or

Table 12: Fertiliser usage during cultivation

Cultivation stage	Types of fertiliser available in the market	Common types of fertiliser applied by farmers	GAP recommendation for fertiliser usage
Land preparation	• Animal manure (if the farmer does not have enough, it can be purchased from other farmers or from an animal farm) • Compound fertilisers (varieties mixing multiple single-nutrients in different ratios and combinations)	• Animal manure	• Animal manure
Seeding	• Animal manure • Compound fertilisers	• Animal manure • Compound fertilisers	• Compound fertilisers
Upkeep	• Urea (nitrogen treatment) • Compound fertilisers • Gypsum (meant for keeping moisture in soil and strengthening plant) • Foliar* (liquid fertiliser)	• Urea • Compound fertilisers • Foliar	• Urea • Compound fertilisers • Gypsum • Foliar

Green text represents farming practices that are in agreement with GAP recommendations
Orange text represents areas of discrepancy

* Even though foliar is a fertiliser, farmers think of it as a "supplement" instead. This may be due to its distinct application method, using a sprayer rather than applying by hand.

fungicides, either as a preemptive or reactive measure. While these can be added during land preparation or seeding, the majority is added during upkeep.

Marginal use of gypsum fertiliser helps with moisture control

One major difference between farming practices and GAP recommendations during the upkeep stage is the lack of use of gypsum fertiliser. Farmers are not aware of the benefits of gypsum, including how it helps the soil maintain its moisture and promotes stronger plant growth. This is due to the fact that input vendors and representatives at the village level push for the sale of compound fertilisers, urea, and foliar treatments more aggressively. The few farmers that reported using gypsum have either done so after recommendation from a DOA representative, or are savvy farmers who seek agronomic information from Facebook or other sources. Inversely, most farmers purchase foliar for farming, even though its effectiveness is not well-documented. One GAP expert recommends an ingredient called "Balone Lat-cha" available at traditional medicine shops (MG-IND-M04). However, its usage is not very straightforward, given that it requires drying under the sun for a couple of days, then transforming into powder, and

Table 13: Pesticide usage during cultivation

Cultivation stage	Types of pesticide available in the market	Common types of pesticide applied by farmers	GAP recommendation for pesticide usage
Seeding Proactive	Pesticide powder, to be mixed with seeds	• Pesticide powder	• No recommendation on pesticide power, but recommendation to use Trichoderma (fungus) during seeding instead
Upkeep Proactive and reactive	Different types of proactive and reactive pesticides	• Rare usage of proactive pesticides • Different types of reactive pesticides (depending on outbreak)	• Prescribed proactive pesticide application, including specific timing • Different types of reactive pesticides (depending on outbreak)

Green text represents farming practices that are in agreement with GAP recommendations
Orange text represents areas of discrepancy

mixing it in specific tablespoon measures with urea. No farmer reported using this method.

Lastly, given the choice between multiple brands of commercial fertilisers, farmers look for Burmese instructions on the packaging to feel confident about the quantities they should apply. The main drivers of fertiliser choice are familiarity and the advice from input seller representatives.

Preemptively underusing pesticides, reactively overusing them

When using pesticides preemptively, sesame farmers tend to apply a lesser quantity than prescribed. However, once they observe the symptoms of a pest or disease, anxiety tends to drive them to use more than needed. This symptom-based diagnosis was encapsulated by a farmer who said, "A pest is like AIDS. You can't see it clearly at the start, the plant might seem strong, but it will show when it reaches the flower bloom stage" (MG-IND-M02). If an outbreak impacts the yield significantly, farmers will be more inclined to overuse pesticide as a preemptive measure in future cycles.

When using pesticides preemptively, farmers follow the advice of sales representatives to spray earlier in the cultivation cycle. Nevertheless, they do not appear certain about the effectiveness of these proactive measures, even if no pests or diseases occur later in the cycle. They questioned whether it was due to the absence of outbreaks or the performance of the pesticides themselves. As one farmer couple said, "There's not a lot of pest and disease problems here, so we don't know if the supplement is working or if there is just no pest and disease to begin with" (PB-IND-C01).

Additionally, though there is generally good market access to pesticides, advertisements mislead some farmers into inappropriate application. Most advertisements show the person spraying pesticides superficially over the plants, from a distance while standing. The correct way prescribed by GAP is to "patiently drench the entire plant in the pesticide", as described by a GAP author (MG-IND-M04).

Organic pesticide application is not a common practice for sesame farmers, being more commonly found among horticulture farmers such as growers of onion, chilli, and tobacco. This is perhaps driven by limited options for organic pesticides in the market, and a lack of buyers willing to pay a premium.

The GAP author and ex-DOA representative said in an interview, "Organic pesticides are better off used as a preemptive measure, but they can also effectively protect crops" (MG-IND-M04). Organic pesticides are also a way for the farmers who use them to save money when purchasing inputs. One such farmer noted that "switching to organic pesticides

meant reducing the cost [of pesticides] by half from 20,000 to 10,000 MMK per acre" (PB-IND-M07 Organic Farmer). However, not all farmers reported feeling confident that organic pesticides would be strong enough to remedy pest and disease problems.

Misconceptions around the extent of chemical residue linked to pesticides

While there is widespread awareness among farmers that pesticides can be dangerous, misconceptions remain around how much chemical residue remains in the sesame. Farmers do know not to leave pesticides in the house around children, or apply too much of it for sesame that will be turned into oil consumed at home. One fertiliser seller said, "I don't sell pesticides because I have three kids at home. Instead, I sell other things like fertilisers, food, petrol, and snacks" (PB-ADH-F06). One farmer also said, "We don't use pesticide because we consume the oil at home" (PB-ADH-F07 Vehicle Owner Farmer).

Despite appreciating the dangers, farmers and other actors along the sesame value chain do not know exactly how much residue gets left in the sesame or for how long. One young broker mistakenly believed that "pesticide residue will go away after a few days, so it's safe to consume just like carrots" (PB-IND-M08). GAP recommends that farmers stop applying pesticides at least one month before the planned harvest day to avoid chemical residue in the sesame seeds. A GAP recommendation that farmers wear certain clothing when spraying pesticides, including masks and long sleeves to protect their arms, is not widely followed.

Waiting for flower bloom

At 30 to 40 days into the upkeep stage, the sesame plants begin to bloom. Farmers stop all activities, including irrigation, during this ten-day period of critical growth. One farmer described flower bloom as "the most critical [phase] for yield success," when the sesame plant is most "sensitive to rain and pests" (PB-IND-M03 Indebted Farmer).

Unwarranted fear of entering the plot during flower bloom

In addition to over-irrigation, farmers are scared to enter their fields for fear of losing yield by breaking plant branches or knocking off flowers that are just forming.

This fear is not only exaggerated, it can also get in the way of farmers applying treatments that can help the sesame plants

flower and ripen. The GAP author and former DOA representative remarked, "If farmers enter their fields, there isn't really a high risk of losing their seeds. But because farmers are afraid of entering the field, they cannot use foliar to get a better yield" (MG-IND-M04).

Inability to control mixed pollination compromises seed purity

Another challenge that farmers face during flower bloom relates to pollination, which can lead to less-than-ideal sesame seed purity. Currently, there is no way to avoid mixed pollination. One farmer summarised, "I have no way to protect my sesame from mixing. I'm trying to make sure that my sesame has a uniform colour, but I only notice discolouration when it is too late."

Stage 5: Harvesting

Once the sesame plants have ripened, the harvesting stage can begin. At this stage, the sesame plant "attains a golden hue", with the capsules gradually turning yellow (Nyein Set Lin 2019). This happens 70 to 100 days after seeding, depending on the variety. In the words of a farmer from Pwintbyu, "Farmers remember the date they planted sesame seeds and count the days, then check the seeds every day to understand the maturity process for when it's time to harvest" (PB-IND-C03). So as to not rely solely on their memory, GAP farmers are given log books to keep track of the exact number of days since seeding.

Labour availability and timing of harvest activities

Regardless of the sesame ripening day, the timing of harvest activities remains dependent on labour availability. It is a period when heavy demand for labour means some farmers may not be able to begin harvesting immediately after the plants have ripened (for more detail, see the "Securing Labour" section on page 91).

A short window to harvest before potentially losing yield

If labour shortages prevent farmers from harvesting on time, they can face challenges when it comes time to shatter the sesame capsules that contain the seeds. They may also lose yield due to rain washing out the capsules. The ideal window to harvest is two days after ripening. Any delays "can lead to a loss of one basket per acre" (MG-IND-F01 Detail Oriented Farmer).

If the delays last over one week, the capsules begin to shatter due to over-ripening, and the seeds fall in the field and cannot be recovered. One farmer reported preventing this "by harvesting ten days before the harvest time" (AL-IND-M02 Sorghum Farmer). However, farmers who harvest earlier will end up with sesame plants where the bottom parts are ripe but the top parts are not mature, which means a lower yield. It's a trade-off they make when they foresee they may not be able to get labour in time for harvest; they prefer to take the upfront risk, rather than take on the risks of harvesting late.

The potential for rain to wash out the capsules and their seeds can have a significant impact on the final yield, as this farmer couple noted: "If it doesn't rain hard, we get 15 baskets per acre. But if it rains a lot after harvest, we would get ten baskets or less" (PB-IND-C01). This concern is reflected in the number of labourers that farmers will need to hire. If the weather is sunny, a farmer will need to hire 15 labourers, but if it is cloudy, signalling impending rain, the same farmer will be inclined to hire 30 labourers in order to finish everything in one day. Similarly, farmers who can afford it also pay higher wages to harvest faster when expecting inclement weather conditions. A labour group leader compared, "If there are bad weather conditions during the harvest… the female labourers can earn up to 4,000 MMK per day, compared to a regular rate of 3,000 MMK" (PB-IND-F03).

Harvesting methods: Plucking or reaping

Once farmers secure their labour, harvesting can begin. There are two methods to harvest sesame plants: plucking and reaping. The choice depends largely on the soil. Plucking is more appropriate with sandy soil, making it easier to take out the whole plant, roots included. If the soil has more of a clay consistency, the roots are stuck in the soil and farmers will have to cut the plants with a reap. One benefit of plucking is that there are no plant roots left in the soil, making it easier to clear and prepare the land for the next season.

Stage 6: Drying

After harvesting, GAP recommends moving immediately to the final stage: drying. Here, the harvested plants are dried through bundling and stacking so that the sesame seeds contained in the capsule can be extracted and cleaned. If not completely dry, the capsule will not open up to reveal the seeds inside.

Figure 22: Sesame drying techniques, GAP recommendations

Piling

Current farming practices
2–8 days, depending on sunlight

GAP recommendations
No piling, or less than 2 days
Due to the buildup of acidity

Bundling

Current farming practices
0–1 days

GAP recommendations
0–1 days

Stacking

Current farming practices
0–5 days, depending on sunlight

GAP recommendations
0–5 days, depending on sunlight

Bundling and stacking for drying

Plants are bundled by a labourer so that they can be carried by hand; the bundles are then tied with a sesame plant stem. Stacking then involves leaving three bundles upright in the shape of a tripod, meant to maximise sun exposure. The height of the stacks should should be 4–5 feet (Nyein Set Lin 2019).

Some farmers apply pesticide after bundling in the belief that it will keep away bugs that might spoil the harvest. As one farmer said: "Pesticide is sprayed on the bundles… Farmers don't want to risk small bugs eating their crops" (PB-ADH-F07 Vehicle Owner Farmer). GAP recommends avoiding direct contact between the bundles and the pesticide, preferring they apply pesticide around the perimeter of the bundles, not touching them directly.

To pile or not to pile: That is the GAP question

GAP states that farmers should bundle then stack the plants without piling them beforehand, as piling increases the acidity levels in the seeds. In reality, farmers pile the harvested plants for 2 to 8 nights. A farmer shared that he assembles "the harvested plants in a pile for eight nights" and puts "branches on top to keep them in place while waiting for the capsules to turn brown" (PB-IND-C03).

Farmers who pile believe that bundling immediately after harvest can cause breakage, as the stem is prone to breaking more easily in high temperatures, which makes it harder to thresh the seeds later on. This misconception is due to a lack of awareness

of the effects piling has on acidity. Some farmers, including GAP farmers who know the recommendations, still prefer to pile in order to ensure the plant stem does not break. They do attempt to limit the piling to no more than two nights. As one GAP farmer said, "Although in the demonstration from an agricultural service provider, the harvest that was immediately bundled and piled dried faster, the stems became easier to break. So we found two nights to be the optimal time to pile the sesame together" (MG-IND-DY1). Representatives from agricultural development non-profit Winrock said, "There is a misconception from farmers that to pile the plants will make them easy to thresh. But the acidity and aflatoxin levels will be higher… Every additional night you leave the harvest in a pile, there will be a 1-percent increase in acidity due to heat and moisture" (MG-GRP-03).

Sesame is exposed to theft while drying in stacks

Theft happens mostly during the bundling and stacking phase, because the seeds are already available and exposed. In the words of one farmer: "Theft only occurs in the week of stacking in the field when it is valuable. Before, the plant is not valuable as it's not mature. After, the plants are at home, safe, with people in the village watching" (MG-IND-F01 Detail Oriented Farmer).

Theft is non-existent or greatly reduced when the plots are close to the farmer's home or the village, with people watching for thieves. As one farmer said, "I don't have any theft issues. My plots are very close to the village" (MG-IND-M03 Manure User). In addition, having electricity can help increase visibility at night.

In cases where farmers live near their plot or there is enough visibility and foot traffic, risk of theft is minimal. In other cases, farmers may need guards to watch the sesame stacks until drying is complete. A single guard for a night shift costs 2,000 MMK per night. For plots that are further from the farmer's village, guards are hired for 4,000 MMK per full day. Guards can also stop the occasional roaming cattle that might inadvertently destroy the harvest. If a farmer cannot afford night guards, he will camp in the field for about a week himself until all the seeds are transported back to their home.

Threshing & sieving

After bundling and stacking, the dried plants are threshed to remove the seeds from the capsules. Following that, the final activity is sieving the fallen seeds to remove dust and impurities.

Threshing should be carried out on sunny days, ideally "between noon and 1 pm when the sun is strongest"

(PB-IND-M02 Savvy Farmer). At the very least, threshing must avoid rainy days; if it is raining, labourers "cannot thresh until the rain stops, so the sesame just stays in a bundle, stacked up" (PB-IND-F03 Labour Group Leader).

After the seeds have been threshed, it is time to sieve. As one farmer puts it, "My favourite part of sesame farming is when sieving. I get to see the yield" (PB-IND-M01 Risk Averse Farmer). Farmers typically apply a hurried first sieve of their seeds in the field as they seek to harvest all their crops before the rains. The roughly sieved seeds are carried back home in sacks and are then sieved a second time to obtain a high enough quality to sell to brokers or traders, who will then carry out further cleaning. *Figure 23: Sieving Impurities* shows the three different sieves used at each stage.

Storing

Once the seeds are cleaned, farmers pack them in sacks. If they need to store seeds before selling or using them, depending on the

Figure 23: Sieving impurities

Step 1
'Thee-Tote-Cha'

Largest rattan sieve with the widest holes
Separates rocks from sesame seeds

Diameter: 60 cm
Width: 1 cm

Step 2
'Lay-Byin-Htoe'

Medium rattan sieve with medium-wide holes
Separates sticks from sesame seeds

Diameter: 50 cm
Width: 0.5 cm

Step 3
'Thal-Cha'

Small rattan sieve with the smallest holes
Separates sand from sesame seeds. The seeds are carefully thrown and caught so the breeze can assist in removing dust

Diameter: 45 cm
Width: 2 mm

space they have available at home. they will leave the sacks on the floor, on top of wooden pallets, or inside a very large, raisedrat-tan basket. To further protect the sesame from the elements, the rattan is sometimes sealed with an extra layer of damp earth that is left to dry. Farmers avoid placing sacks on cold concrete floors as doing so can make the seeds damp.

Some farmers face issues with rodents during storage. This can be somewhat mitigated by acquiring a house cat—although this method is neither common nor sufficient.

In the case of white sesame, leaving the seeds in storage can make them turn a dark-tan colour. However, "If you put the seeds in the sun, they will turn white. I will always dry my seeds before selling them" (MG-IND-M03 Manure User).

Post-cultivation decision making

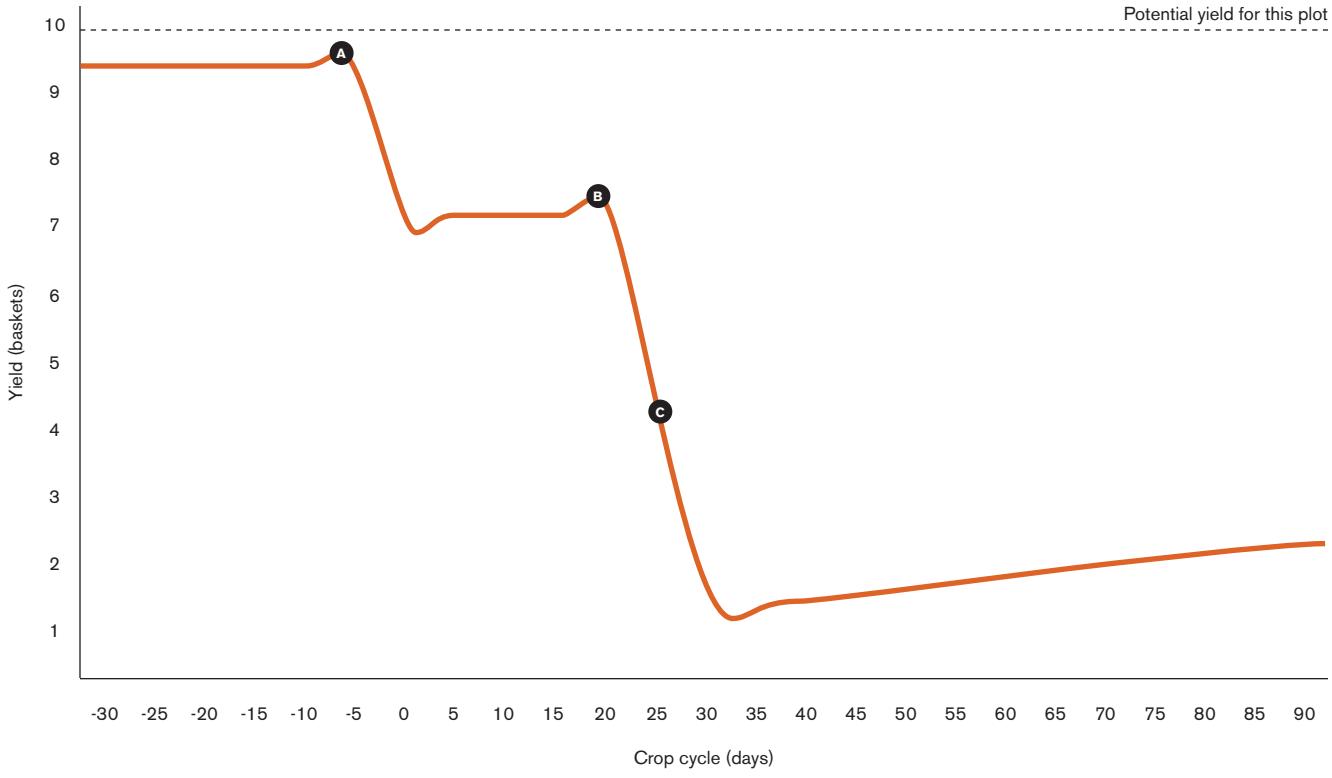
Once the six stages of cultivation have been completed, sesame farmers are faced with a number of important decisions. How much of the harvest should they keep or sell? Should they be holding back propagation seed for planting in the future?

Deciding what to keep or sell

The decision as to how much of their harvest they should keep or sell is as follows: assessing the final yield; selling enough of the

CALL-OUT

Call-out 04: Yield loss over a single season



A Event A: No rainfall after broadcasting

The end of May was already fast approaching. There was no rain in sight for U Kyaw Min to begin broadcasting, and he was growing increasingly nervous. "We were hoping for the rain to pour but it never did". Eventually, he decided to proceed in the hopes that rainfall would shortly follow, as he could no longer afford to delay the whole season. Although the two plots are not too far from one another, there was spot rainfall for two hours, and only one of his plots received sufficient rain for seedlings to emerge. By then, he already expected to lose about 25 percent of the harvest from the plot that did not receive any rain.

B Event B: Six days of heavy rain

On the 20th day after broadcasting, there was heavy rainfall, which lasted up to eight hours a day for six days, which is sufficient to be considered a 'storm', i.e., a problem. The downpour damaged the elevated rows created from hours of ploughing the land, causing the nutrient-rich topsoil to wash away. After six days, the weather returned to its usual sunny, 40°C outlook. However, the sudden shift in weather conditions caused soil compaction, restricting water and air flow to the roots of the plants. Kyaw Min recalled that by the end of the storm, more than half of his plot was visibly damaged.

C Event C: Disease outbreak

The excess rain led to a disease outbreak due to increased moisture in the soil and humidity in the air. Within three days, there was an outbreak of fungi that caused further yield loss for Kyaw Min.

harvest to cover all costs incurred during the cultivation cycle and potentially upcoming costs for the new season; and keeping the leftover amount (if any) to replant or sell at a later date.

Coming to terms with potential losses and an unpredictable yield

The first thing farmers do after cultivation is assess the season's final yield, discounting any losses incurred throughout the process. In the words of a risk averse farmer, "Losing yield after the plants mature is like preparing food and just before you put the rice in your mouth, you dropped it to the ground" (PB-IND-M01). As we have seen, over the course of a single sesame season, farmers are confronted with events that determine their yield outcome, including rainfall, outbreaks of pests and disease, and theft at harvest time.

Such events mean that farmers may end up with highly variable yields each season. For one farmer, even among her own plots, "The good plots had a yield of ten baskets per acre, the ones that were average had a yield of five baskets per acre, and the worst plot had only one basket per acre" (MG-IND-F01 Detail Oriented Farmer). In the Dry Zone, sesame yield in a good climatic year can be 55 percent higher than that of an average year, and the yield of a bad year almost 60 percent lower (Mather et al. 2018).

Figuring out how much to sell and at what price

Once farmers know how much yield they have made, the first decision they need to make is how much of the harvest they need to sell in order to cover their outstanding expenses, including labour charges, machinery rental, and debt repayments. Farmers can sell seeds to traders and brokers, and/or propagation seeds to other farmers.

When selling propagation seeds to their peers, farmers can charge a premium of around 5,000 to 15,000 MMK per basket on top of the price they would get from brokers. However, this assumes they can provide good quality seeds. Good quality seed usually comes from the bottom capsules of the plants, as they "receive the most water and nutrition from the soil" (WL-IND-M01 Small Farmer), and from plants that are at the centre of a plot. As one farmer noted, "I mentally mark the inner areas of the plot to sell to other farmers because the outer areas of the plot that neighbour with other farmers may be mixed with other varieties. For those areas that are reserved to resell as seeds to other farmers, I would ask the labourers to pluck away the upper part of the crop, as those are the areas with discoloured seeds" (MG-IND-F01 Detail Oriented Farmer). Farmers who get propa-

Figure 24: Decision whether to keep or sell harvested sesame

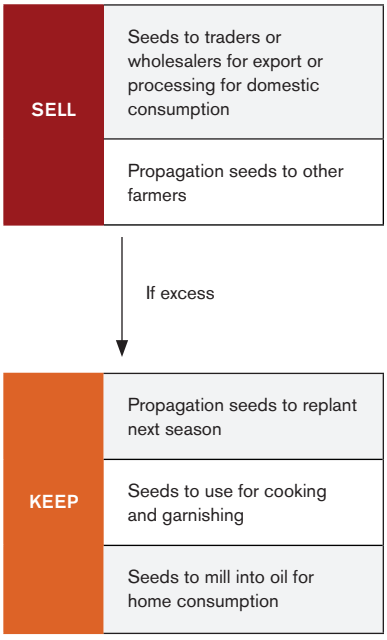
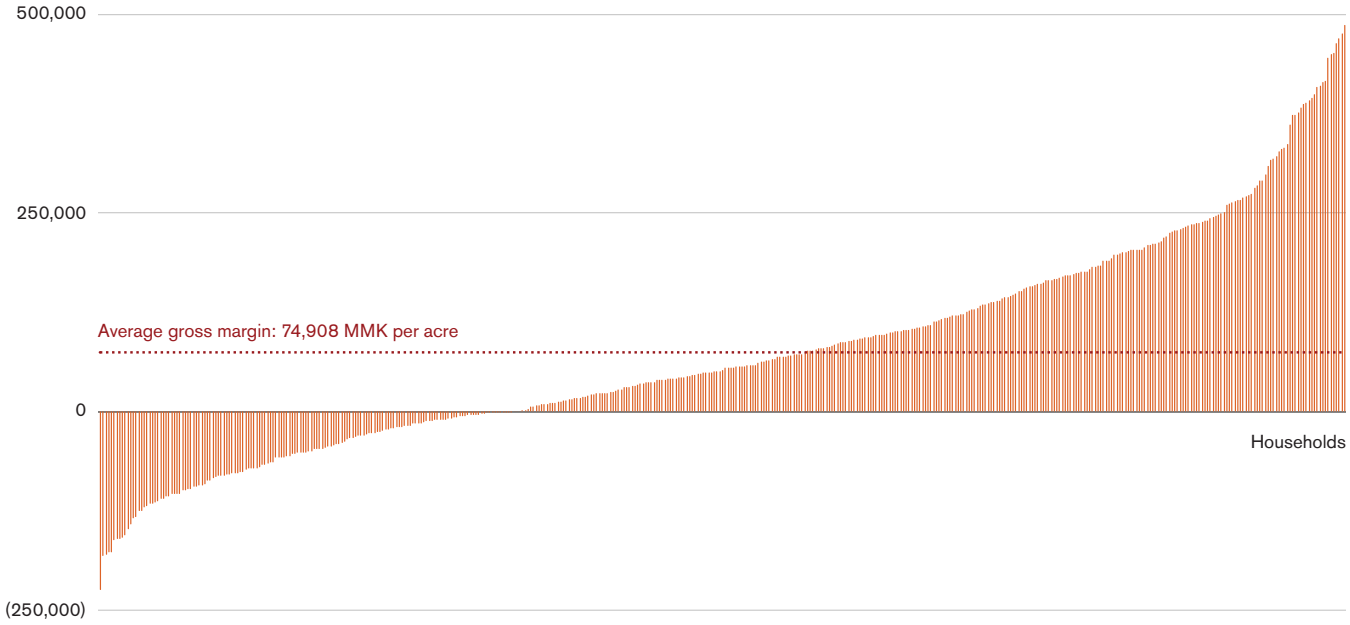


Figure 25: Potential gross margins (MMK per acre)



Source: Unpublished anonymised data shared by Dr. Nilar Aung, professor and consultant with the Centre for Social and Economic Development (YG-EXP-M02 CESD), collected as part of a household survey in Myanmar's Dry Zone (Mather et al. 2018)

gation seeds from other farmers rely on familiarity and reputation in order to trust that the seeds they are buying are of good quality.

Farmers tend to sell to traders or brokers immediately after harvest to cover their outstanding debts and expenses, even though they could get a higher price a few months later. For monsoon sesame, this means the majority of farmers sell around August or September when prices for black sesame are around 50,000 to 60,000 MMK per basket, whereas it can get up to 70,000 or 80,000 MMK in December or January. Some farmers lament that storing sesame for price gains is not always a done deal, given how volatile market prices can be. More well-off farmers store their seeds and check market prices regularly to sell when prices are at their highest.

Highly variable gross margins given variations in yield and market prices

The combination of variable yields and variable market prices makes for even more variable potential gross margins. *Figure*

25 shows gross margins reported by 455 farming households in Myanmar's Dry Zone, with each line representing one household. While the average gross margin was around 75,000 MMK per acre across the sample, gross margins ranged from households losing close to 225,000 MMK per acre to those gaining almost 490,000 MMK per acre. Over one-third of households (150) failed to recoup their costs and ended up with negative margins.

This variation in gross potential margins merits pause. Even with relatively predictable production costs, it makes growing sesame a high-risk business and hinders the farmers' ability to financially plan ahead for future farming seasons and other non-farming expenses. As one hustling farmer put it, "I consider the gross margins of the crop before deciding which crops to grow from season to season" (AL-IND-M01). It is no wonder sesame is referred to as the "gambling crop" (Laung-ka-sar-thee-nan).

After debt and expenses are covered, not much is left to keep

Only after all debt and immediate expenses have been covered

Table 14: How farmers decide when to switch crops

Decision	Factors
Stay with the same crop	• Market price is stable • Crop provides the highest revenue potential compared with other varieties • High yield expectations • Sufficient seed stock from last season • Equipment, inputs, processes are known • Lack of capital requirements to switch to another crop • Inertia
Same crop, different variety *Black Samone 90 day to Black Samone 75 day*	• Provides notable benefits over current crop (e.g., a shorter crop cycle that minimises the risk of weather loss) • Availability of shorter crop-cycle varieties; preferred varieties are not always in stock • Better anticipated market price switching from white or red to black sesame • Higher tolerance and resistance to weather, pests, and disease
Same crop, different season *Monsoon to winter*	Risk management (i.e., winter sesame yields are lower but less prone to loss from flooding)
Switch to another crop *Sesame to groundnuts*	• Through continuous trial and error, based on crop yield • Switch is part of a crop-rotation policy • Alternative crop also has relatively high market prices
Scale farm acreage up or down *20 to 10 acres*	Scale up: • Having sufficient savings to buy more land • Renting fields for seasons • Inheriting land Scale down: • Labour shortage (e.g., planting season makes land maintenance impossible) • Prioritising non-farm expenditures (e.g., child's education) • High debt or loss of farming income can be offset by renting out the land, if there is demand
Stop growing anything	• Running out of time to plant crops during the optimal seven-day planting window • Moving into other parts of the ecosystem (e.g., transportation), but maintaining links to their land
Abandon farming	• Sufficient savings to explore non-farming work opportunities • Sell land and move to town • Financial and social support from extended family in urban areas enables easy integration into urban work life • Availability of other steady-income, non-farming activities, or activities that have the potential for higher income

are farmers able to keep what's left. As one farmer put it, "I sell the sesame to cover my debt for inputs, labour, machine, and additional costs for [my children's] education and preparation for monsoon paddy" (PB-IND-M02 Savvy Farmer). For sesame meant to be sold to traders or brokers, very few farmers report being able to keep sesame more than a few months, given years of poor yield due to bad weather conditions. Similarly, almost no farmers report keeping excess propagation seeds for their own use to replant during the next season, as they need to sell almost all of it to other farmers.

Deciding what to do next season

For each of the three sesame seasons, farmers face the decision of what crops to plant, in which fields, and when. All decisions are dependent on anticipated market price at the time of harvest and throughout the following year. Planting the same crops as your peers can reduce risk through shared information and resources, such as pesticides. *Table 14* details the factors that impact their optimal choice.

As part of their risk-management strategy, farmers monocrop other crops such as groundnuts on separate plots of land, or less commonly, intercrop sesame with low-reward, low-risk crops such as pigeon pea, chickpea, or cotton. Some farmers also switch the variety of sesame they plant, preferring seeds with shorter cycles to better manage excess rains during harvest time. One such farmer said: "We have been suffering from bad weather for three years. That's why I changed my seed variety to seeds I can harvest in 70 days instead of 90 days" (PB-IND-M07 Organic Farmer). Other farmers choose to limit the risk inherent to sesame planting by reducing the acreage dedicated to that crop. A farmer and village secretary said: "If possible, we would like to grow sesame in all 30 acres, but due to weather and labour constraints, we only grow six acres of sesame during monsoon and eight acres in the summer" (PB-IND-C02).

Some farmers have been driven completely out of farming due to the gravity of sesame yield losses in recent years, selling their land and switching to other jobs such as carpentry or raising livestock. One broker noted: "A lot of farmers here started to abandon farming and migrated to Thailand for work. The market prices for crops are so unstable that some people don't want to deal with it anymore" (AL-ADH-C01 Credit Providing Broker).

CALL-OUT

Call-out 05: Agricultural development organisations

Non-profit organisation PC Myanmar focuses solely on sesame farmers, while other non-profits such as Winrock and the Sesame Farmer Development Association (SFDA) have a remit that includes support for sesame farmers. These organisations are proactive in Magway township. As a social enterprise, Proximity Designs' motivation for running this foundational research is to identify opportunities to better support sesame farmers.

Organisations work with sesame farmers through the cultivation and post-harvest stages to provide technical support and technology, connect them with suppliers and buyers, and offer cash advances to alleviate their cash-flow constraints. Each organisation has a focus area and things that are considered out of scope. As noted by a modernised farmer, "PC Myanmar does not work with farmers who own more than ten acres" (MG-IND-M05).

Providing farming technical support

Agricultural development associations partner with the DOA to offer technical training to its network of field extension officers on a variety of farming-related topics, including crop management, pest management, and post-harvest drying techniques. In turn, extension officers offer training to farmers. In doing so, non-profits are indirectly promoting GAP to farmers, and securing better farm-gate prices for farmers. As a GAP farmer recalled, "Winrock guides our sesame farming by providing training and courses on using our GAP logs, and helping us get the right market price for our sesame" (MG-IND-DY1). In addition, these associations offer sesame farmers access to technology that can support their cultivation activities and post-harvest sesame drying and cleaning, including harvesting, soil health, and moisture measurement tools. The criteria for distributing such tools to farmers are unclear.

Tahini processing plant

Connecting farmers to actors along the value chain

Some agricultural development associations connect farmers with suppliers. As an example, the same GAP farmer recalls, "SFDA… connects farmers to input sellers, machine renters, and organisations that provide loans. They organise meetings for farmers as needed" (MG-IND-DY1). On the other hand, some of these associations have existing contracts in place with exporters, facilitating the sale of sesame seeds directly from the farmers to the exporter who sells to international markets, thus cutting the brokers' and traders' fees along the way. However, this assumes that farmers must follow GAP farming methods to produce sesame of high enough quality for export. A modernised farmer said, "When PC Myanmar buys our seeds, they check the cleanliness level, the dryness level, and the chemical residue levels by using machines" (MG-IND-M05).

Providing advances to cash-strapped farmers

Some agricultural development associations offer cash advances to farmers who need to purchase seeds and inputs, deducting the advance from the sale of the harvested seeds.

CALL-OUT

Call-out 06:
Farmer decision points

Sesame farming is one long series of decision points and trade-offs. The consequences of making the wrong choices range from lower yields and income to taking on significant debt—and the need to migrate to earn enough for the household.

At a high level, these decisions are about:

- Contextual constraints, such as available infrastructure and resources.
- Performance versus cost, driven by price sensitivity.
- Potential for profit versus minimising losses, driven by appetite for risk.
- Trust and confidence in other value-chain actors.

Figure 26: Farmer decision points along the sesame value chain

F1: Planning cultivation
- How should I allocate my acres between my different crops and sesame varieties?
- Should I take out formal or informal loans to finance my working capital?
- Do I have sufficient seeds to plant, or should I buy more from the DOA or other farmers?

F2: Stage 1: Land clearing
- Should I devote time to my own plots or work as a labourer for additional cash?
- Should I spend resources ploughing my land now to help reduce weed growth, or wait and spend more money on labour for weeding during upkeep?

F3: Stage 2: Land preparation
- Should I rent farm machinery or rely on my ox-cart?
- Should I pre-pay to book labour now or pay later and risk not having enough labour, on time?

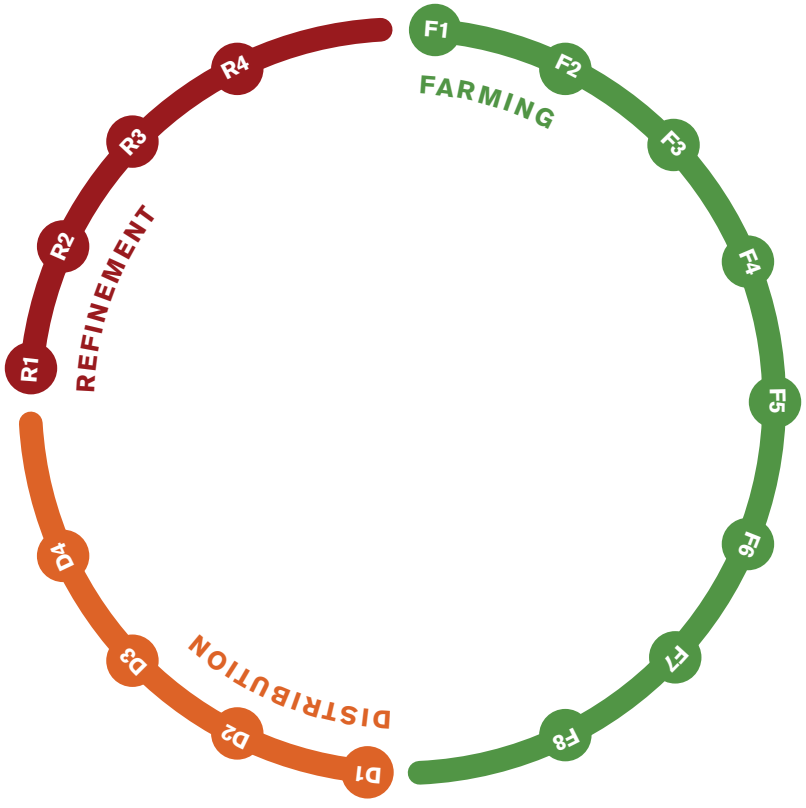
F4: Stage 3: Seeding
- Do I have enough moisture to begin planting, or do I wait for more rain and risk delays?
- Should I use broadcasting or row planting?
- Should I spend money to preemptively use pesticides mixed with the seeds, or wait and hope that I don't get any pest or disease problems?

F5: Stage 4: Upkeep
- Should I spend money to follow recommended fertiliser steps and quantities, or save some of the expense and hope that the soil is healthy enough?
- Should I enter my field during flower bloom to apply foliar?
- If it starts to rain heavily, should I cut my losses for this cycle, or still dedicate some labour and resources to get a minimal yield?

F6: Stage 5: Harvest
- Should I harvest early and risk only the bottom parts of the plant becoming ripe; harvest on time and compete with all farmers for labourers; or harvest late, and risk capsules shattering?
- How long do I have before the rains come and destroy the yield?

F7: Stage 6: Drying
- Should I pile the harvested plants or bundle immediately?
- Are my crops safe drying in the field, or do I need to hire a guard or watch the field myself?
- How long do I wait before threshing if it's not sunny enough for the plants to dry after harvest?

F8: Post-cultivation decisions
- Can I afford to store my harvest until the market price goes up?
- How much seed should I hold onto to replant next year?
- Should I mill my sesame harvest or buy oil from the market for home consumption?



D1: Transport
- Do I travel to or call the broker to negotiate the price for my sesame, or trust the transporter to do it on my behalf?
- How do I ensure all the volume I sent with the transporter gets to the broker?

D2: Brokerage
- Which broker offers the best and fairest price?
- Should I sell all my harvest to the broker I borrowed money from?
- Should I trust the broker not to mix my seeds with lower quality ones, or with pesticides?

D3: Trading
- How do I ensure that my seeds are not rejected for not passing food safety standards so I do not earn a bad reputation in the future?

D4: Export
- What quality seeds should I produce so they can be exportable?

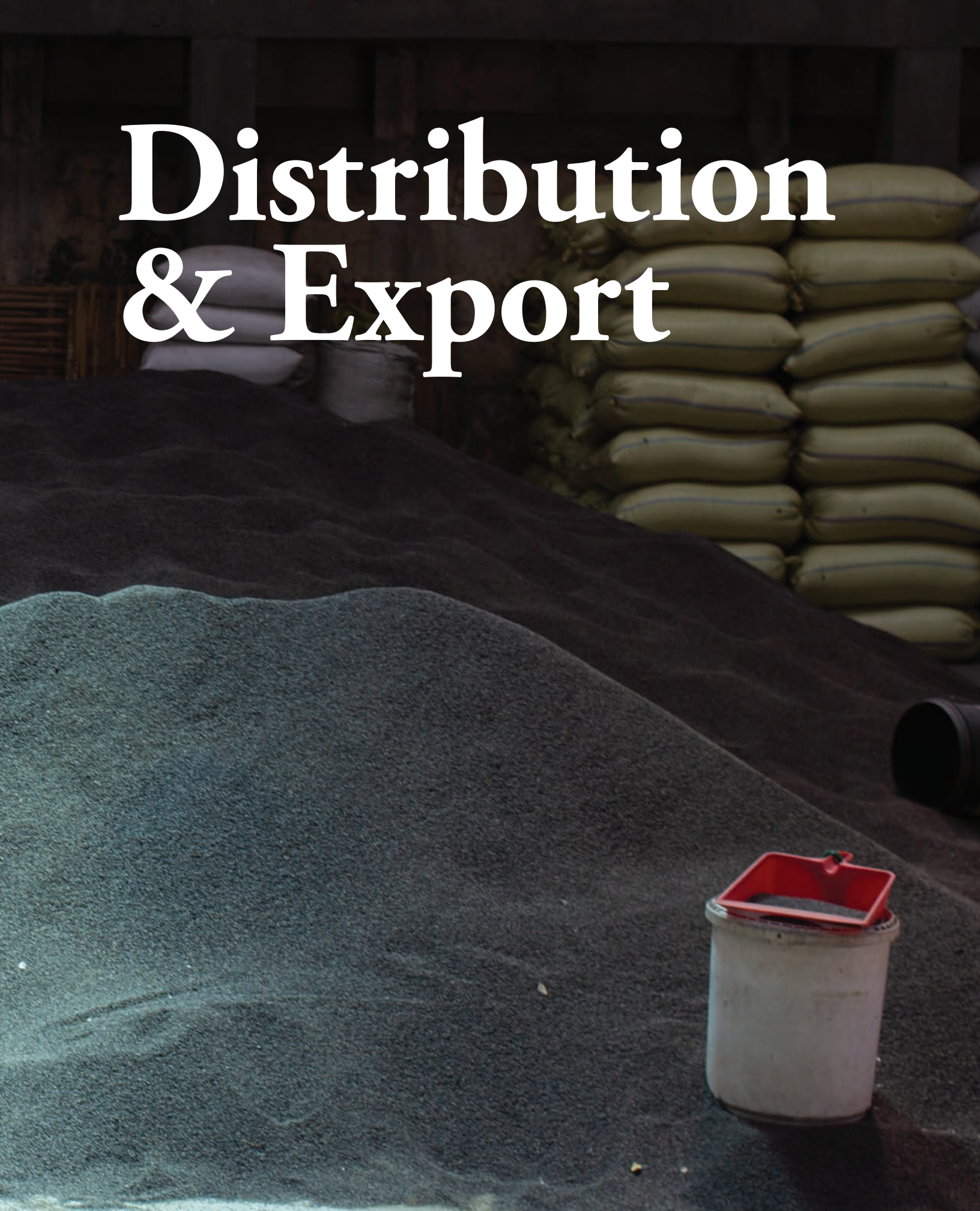
R1: Milling
- How much red sesame should I keep for milling into oil?
- Will the miller grind my sesame into oil in exchange for sesame cake or do I have to pay in cash?

R2: Processing
- What quality seeds should I produce so they can be processed into brittle?

R3: Retail

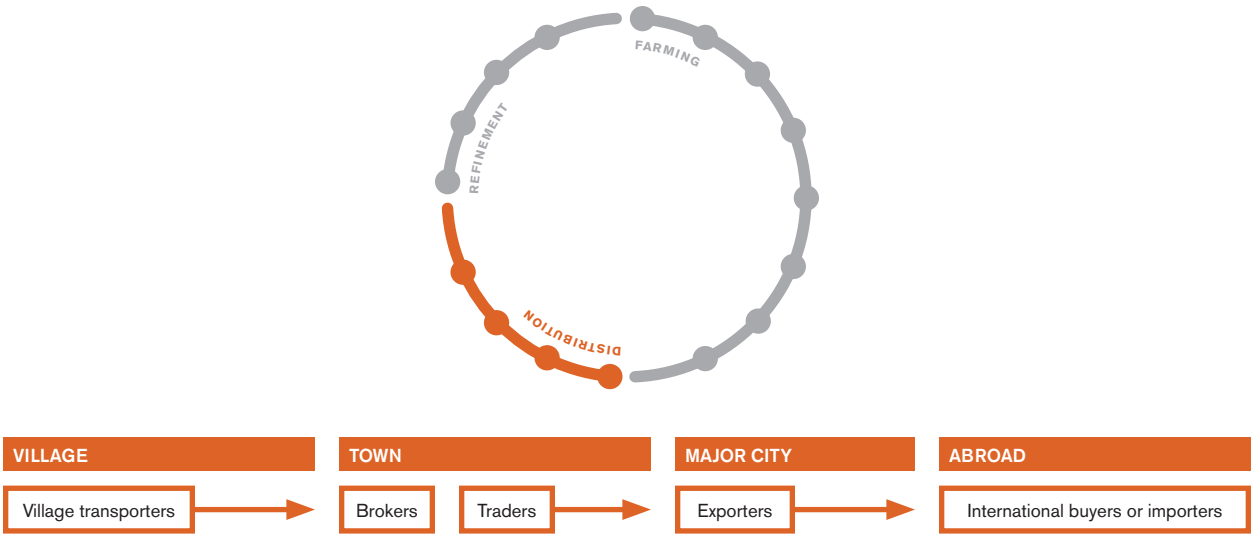
R4: Consumption
- How much white sesame should I keep for home consumption?

Distribution & Export




SPECIAL
TAPIOCA STARCH

Figure 27: Actors along the distribution value chain



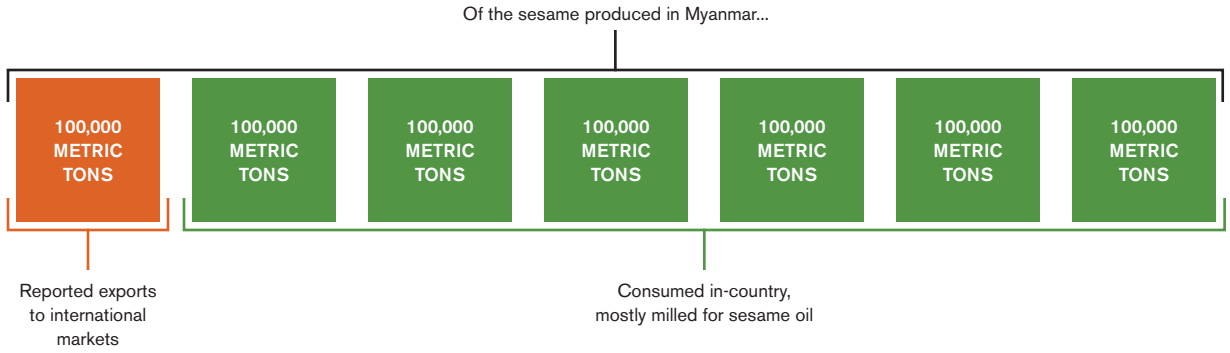
Distribution value chain

After harvesting, farmers transfer sesame seeds into sacks that can be taken to the marketplace. This section covers what happens to sesame after it leaves the village and enters the distribution ecosystem, as shown in *Figure 27*.

Farmers usually sell to a handful of brokers, with some brokers offering credit to strengthen relationships and lock in future harvests. During the busy months when farmers juggle multiple harvests, they may rely on village transporters to sell to brokers from their shortlist. Brokers aggregate the seeds based on colour and forward them to the right buyer, of which there are three main types: millers for domestic oil production, food processors for domestic retail, and traders, who then sell to either marine exporters in Yangon or overland exporters in Mandalay.

Cross-referencing multiple reputable sources to understand the pathways of sesame distribution reveals significant discrepancies (United Nations 2019, Food and Agriculture Organisation of the United Nations 2018, General Administration Department 2017). *Figure 28* highlights that among the estimated 700,000 metric tons of sesame produced in 2017, over 100,000 metric tons were reported as exports to the international market. This implies that the remaining 600,000 metric tons were consumed in-country. Due to a number of factors—addressed in detail in *Call-out 08: The mystery of the production numbers* on page 152—this number

Figure 28: Sesame production in a nutshell, 2017



seems highly unlikely to be reliable. Perhaps a more realistic and conservative estimate of sesame production is about 60 percent of the current reported figure, with majority share accounted for by undocumented exports at the Northern border.

By triangulating various data sources and interviews with experts, we estimate the breakdown in shares of sesame among the various actors in the value chain, as per *Figure 29*. On average, farmers set aside around 5 percent of the total harvest as propagation seeds for the next season, leaving the remainder to enter the distribution ecosystem (Thuzar Linn 2013). Through traders and exporters, up to 76 percent of total sesame production enters export markets such as China, Japan, and South Korea. The remaining 19 percent is processed to make oil and confectionery snacks for domestic distribution.

Village transporters

A recent study on rural infrastructure development in Myanmar revealed that over the past five years, travel times from villages to nearby towns had fallen by around one-third. This was driven by road improvements, increased ownership of motorbikes, and establishment and improvement of rural transportation services (Boughton et al. 2018). This trend is a nudge in the right direction to increase sesame farmers' access to markets.

Role of village transporters in selling sesame

Using their own trucks and/or three-wheelers, village transporters bring the sesame harvest from farmers' homes to brokers' warehouses. While there are some who rely solely on their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SKYNET
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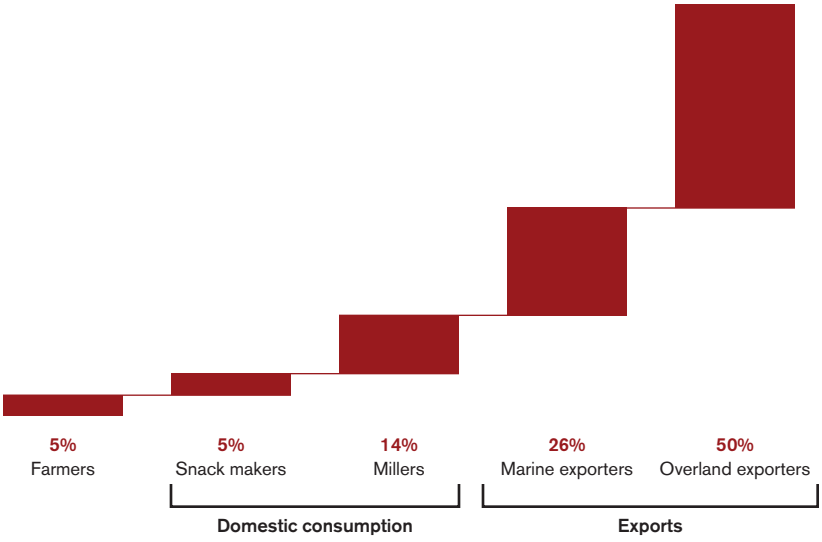
Figure 29: Percentage share of sesame through the ecosystem



transporting income, most village transporters are also farmers with enough capital to invest in a decent vehicle and maintain a sufficiently trusted relationship with brokers. One such sesame farmer and village transporter shared, "I have been transporting sesame for three years. I used to farm, and I find it stressful and risky. The transportation business is more profitable for me" (PB-ADH-F02). Village transporters charge up to 300 MMK to deliver one basket of sesame.

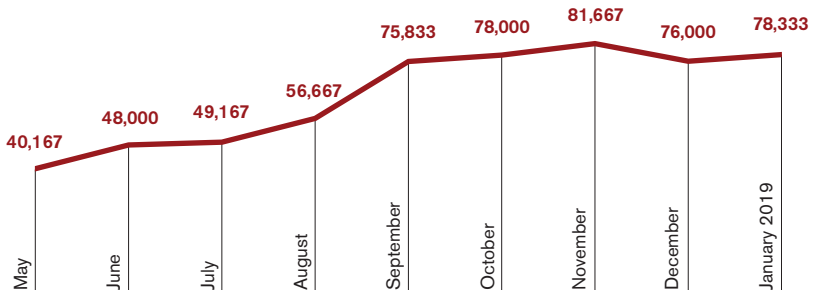
Potential mistrust between village transporters and farmers

"There is a lot of trust placed on the village transporter by the farmers. The transporter takes the seeds, sells them, and tells the farmer the price he got it for [accompanied by a receipt]", a Pwintbyu farmer commented (PB-IND-C02). Wary farmers "sometimes [go] along with the transporter to negotiate the price if they're not confident about the quality of the harvest" (PB-IND-M07 Organic Farmer). Even when not visiting in person, some farmers also call the broker to make sure that they have received the right quantity of sesame from the transporter, and then finalise the sale price directly.

Brokers

Brokers are middlemen between a large network of farmers and a handful of traders. The working and living space of a broker's

Figure 30: Sesame farm gate prices (in MMK)



Reference: (Mandalay Pulses and Sesame Association 2019)

family is shared, often with young family members playing in the vicinity. Most of the brokers are farmers themselves or come from a farming background. One such broker we met in Pwintbyu acknowledged, "I also own thirty acres of sesame. Being hands-on with farming helps me to better understand the challenges farmers have to face" (PB-IND-M08).

Tapping into their network of farmers who grow multiple crops throughout the year, brokers are willing to buy any produce that can be stored at their warehouse, including sesame, paddy, and pulses. Once a sale has been made to the buyer, the broker earns a commission of 0.5–1 percent of the transaction value. A broker from a small town like Pwintbyu may aggregate from close to 2,000 farmers throughout the year, and sell to only three traders from Magway and Mandalay.

Informal credit guarantees access to harvest

Brokers offer credit to farmers throughout the sesame season. The loan terms are relationship-based, with interest rates around 3–5 percent per month, and an option for farmers to repay with harvest.

By providing credit, a broker guarantees access to that harvest, which is useful during bad seasons. Farmers are aware that they could get a better price by selling directly to traders, but they are unable to make the switch due to their reliance on brokers. As a young village head lamented: "Traders have asked us to sell to them directly, so they can avoid broker fees. Although we would like to… we still need to maintain the relationship with brokers in order to secure credit" (AL-ADH-M02).

Brokers' sieving machine, which removes dust from sesame seeds

Determining the purchase price

Over the nine-month period from May 2018 to January 2019, farm gate prices for sesame increased twofold, per *Figure 30.* The price movements mirror the monsoon sesame farming season, wherein the harvest period begins in July, injecting huge quantities of produce into the marketplace. In December and January, there is a light injection of produce from winter harvest, but it is not substantial enough to create a surplus in the market.

Brokers follow prices set by a handful of traders, leaving a margin of 3,000 to 5,000 MMK per basket when buying from farmers. The year 2018 was particularly difficult for sesame farmers due to irregular rainfall, resulting in a stark decline of purchase volumes for brokers. One broker from Pwintbyu transacted 490 metric tons of sesame that year, allowing him to net a conservative amount of about 12 million MMK for the year. In an average year not affected by low production, he could trade up to 780 metric tons of sesame.

Broker's' weighing scale

Volume-based delivery versus weight-based prices

Due to a discrepancy between the volume-based understanding of harvest from farmers (i.e., baskets), and the weight-based price determination used by brokers (i.e., viss), farmers don't know exactly what price they will receive for their harvest. The difference is caused by some sesame having higher density than others. A full basket of good sesame will weigh 15 viss (24.5 kg).

While testing kits are used by some traders, none of the brokers we interviewed use such kits to scientifically ascertain the quality of sesame seeds. As a result, they rarely refuse to purchase any sesame based on quality. Brokers in Magway shared: "We never reject any farmers who walk into the door to sell their produce. If the sesame quality is very bad, it can still be used for animal feed, and we pay them a lower price" (MG-ADH-DY1). They only decide whether a batch of seeds is subpar when there is a visible discolouration or mixing of the sesame.

Some brokers are willing to pay a premium of 3–5 percent above market price to farmers who follow GAP, as GAP pre-

scribes post-harvest drying techniques that aim to reduce acidity and improve the quality of the seeds. “Farmers have to bring their GAP log book in order to get the higher price”, an Aunglan broker explained (AL-ADH-C01).

Potential for adulterating seed mix

At their warehouses, brokers mix the seeds sourced from various farmers in an open space. Industrial fans can be used to blow away dust and debris before repackaging sesame into standard sacks that weigh 24 viss (39.2 kg) each. Through this sorting and repackaging practice, brokers can mix seeds of varying quality—which is something that may later be assumed to be the farmer’s fault. An exasperated farmer and village head from Aunglan complained: “Our seeds are high quality, but the brokers mix them with low-quality seeds from other regions. So when our seeds are exported, they might get rejected due to high acidity. This will affect our reputation” (AL-ADH-M02).

ARCHETYPE

The Invested Broker

U Nay Lin, 30
Aunglan town

"We check quality by touch and sight. We have been running this business for a long time, so we know what's good quality."

Backstory:

U Nay Lin operates a trading business with his older brother. He is responsible for the procurement of commodities, sesame, and pulses, while his brother is responsible for selling. Their parents were farmers who eventually shifted to brokering, meaning the brothers grew up with a foot in both worlds.

Nay Lin buys almost all sesame and pulses from villages around Aunglan, and needs to store the supply in a warehouse prior to sale. Sesame crops are his largest revenue source in both trade volume and by margin, followed by pigeon pea and green gram. He maintains close relationships with many farmers, providing informal credit at the start of each season of 300,000 MMK, on average, at 3 percent interest.

Due to a storm during sesame season last year, most of the farmers lost significant yield, directly impacting Nay Lin's purchasing volume. He is aware that overland exporters are willing to pay a higher price for quality seeds, but has no tools to ascertain this quality. A good harvest year makes for high volumes and good profit.

Nay Lin's long-term goal is to tap into the export market and obtain better prices for sesame.

Decisions:

- Should I sell or keep sesame, depending on the market price?
- What price should I give to the farmer based on how much I can get selling it at the exchange centres?
- How do I figure out the optimal process for protecting the quality of my seeds and pulses in storage?

Challenges:

- Assessing credit worthiness of farmers.
- Grading quality of sesame to sell to the right buyers.
- Competition with ~150 other brokers.
- Cleaning the sesame seeds from farmers in bulk to obtain a better price.

Margins:

- Earns margin of ~1,000 MMK per basket from farmers.
- Earns 0.5–1 percent commission from traders.
- Annual profit from sesame brokering is 15 million MMK (~10,000 USD), making up about 40 percent of his total income for the year.

Business relationships:

- Buys from ~500 sesame farmers.
- Has representatives in Mandalay and Magway who have direct contact with buyers. He needs to communicate with these representatives almost daily.

Yearly transaction volumes:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
							Highest: 900,000 MMK		Lowest: 96,000 MMK		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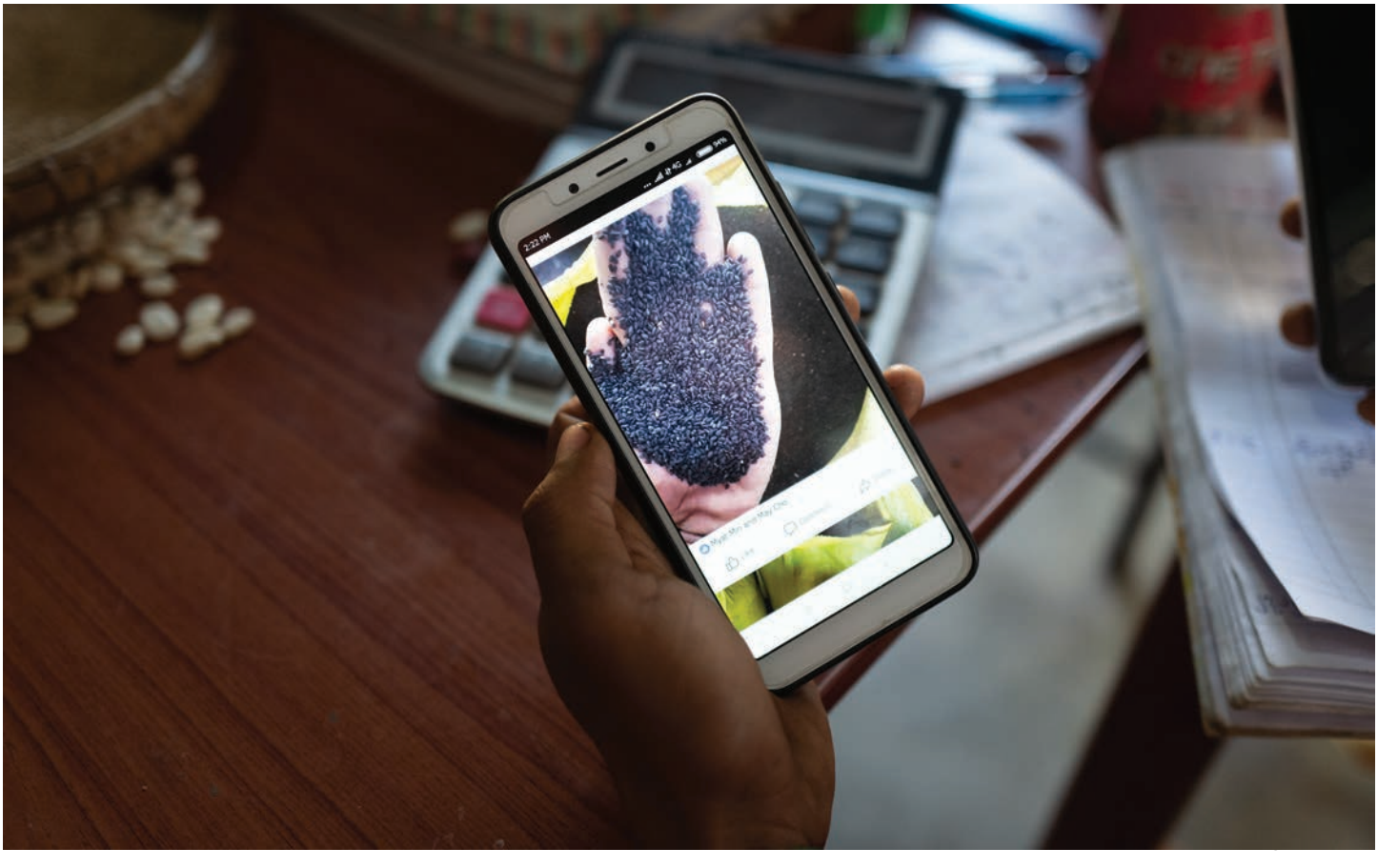
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CALL-OUT

Call-out 07:
Crop Exchange Centres (CEXCs)

Established in 1935, crop exchange centres (CEXCs) are membership-based marketplaces for major agricultural commodities such as pulses, oil seeds, corn, and rice (Favre et al. 2009). Members need to be Myanmar nationals above the age of 18 to conduct business at a centre. Currently, Mandalay and Yangon CEXCs are actively used, trading up to 90 varieties of pulses and oil seeds throughout the year.

The Mandalay CEXC is packed with hundreds of brokers chatting loudly and crowding around tables filled with samples, and the odd lucky pigeon nibbling at seeds. Samples are wrapped in craft- or newspaper, and are usually stamped with the broker's contact information. Prices are negotiated in person or on a quick call. One of the Mandalay brokers shared, "Once we have an interested buyer, we negotiate on a price and upon agreement, we ring up the trader. If the trader accepts the offer, he or she will arrange the logistics" (MDY-ADH-F01).

Through sheer trade volume, traders have the strongest influence in setting the price of sesame at the CEXC. Members are required to report their trade volumes and prices, which are then used to set the daily official market prices. The prices are displayed on physical bulletin boards at the venue and shared on the CEXC Facebook page.

In contrast to the Mandalay CEXC, the Magway CEXC was filled with barren tables on the weekday we visited, with all the brokers sitting at the tea shop nearby. They explained, "We do not really use the Magway CEXC anymore, ultimately everything from Magway ends up in either Yangon or Mandalay CEXC" (MG-GRP-04).

Generally, brokers, traders, and millers use the Yangon and Mandalay CEXC prices as a guide for their daily purchasing decisions (Favre et al. 2009). They are aware of the transport costs between procurement locations and the main markets, and therefore rely on regional associations and smaller CEXCs to get market price information.

CALL-OUT

Call-out 08: The mystery of the production numbers

Between 2000 and 2008, production of sesame in Myanmar more than doubled in output, somewhat mysteriously. It then levelled off for the next decade. During this period, recorded sesame exports remained low. Given that sesame oil—the main use for sesame domestically—is not favoured in Myanmar compared with other cooking oils, this begs the question: Was the growth in sesame output real, or reported to satisfy a high-level government demand that cooking oils be locally produced, perhaps due to the soaring imports of cheap palm oil in the late 1990s?

To investigate this mystery, one must look at three elements of the sesame production equation: the share that is consumed domestically, that which is exported (both reported and not), and the reliability of the overall reported quantities produced.

Low domestic sesame consumption

Since very little sesame is used domestically as seeds, or manufactured into brittle or other products, most of the non-exported sesame produced would have to be used in the form of sesame oil. This seems highly unlikely given the current state of the sesame oil milling industry in Myanmar. Interviews with sesame oil producers suggest a fragmented and small milling industry with low-quality output, consumed mostly unbranded, and not suitable for export.

Additionally, Myanmar consumers favour other cooking oils over sesame oil, mostly due to their cost and deep-frying capabilities. A 2015 news article stated that the total edible oil consumption in Myanmar was 900,000 metric tons, of which 400,000 metric tons were imported palm oil, with the remainder being mostly groundnut oil (Mizzima News 2015). This is corroborated by groundnut production in Myanmar, which sits at 1.5 million metric tons a year, with groundnut oil production accounting for most of its domestic output. Considering that groundnuts (and sesame) have 45–50 percent oil content, groundnut oil production would be nearly 500,000 metric tons a year. With 400,000 metric tons of palm oil, and 500,000 metric tons of groundnut oil, the tonnage of sesame oil produced per year can only be in the five figures. This is consistent with a Food and Agriculture Organisation study that estimated sesame oil production at 91,000 metric tons (Favre et al. 2009). To make this quantity of sesame oil, one would only need around 180,000 metric tons of sesame, keeping in mind that it would have to be 100 percent

pure and not mixed, as is common practice. Still, this number is far from the 700,000+ metric tons reported as being produced in 2017.

Underreported, but not massively so, exports

If most of the quantity of sesame produced is not consumed locally, this leads us to think that it must be exported. Official numbers report that 113,000 metric tons of sesame were exported in 2017, still half a million metric tons short of the quantity produced minus that milled for sesame oil.

However, official export numbers do not take into account exports through the northern border to China that may not be properly recorded. Even then, these underreported exports would not make up for the wide gap compared with reported production quantities. An unreported half a million metric tons of sesame would equate to 100,000 five-ton trucks each year, or at least 274 per day, traveling to the Chinese border over some difficult roads. This seems highly improbable.

Likely inflated sesame production values

Rounding up the sesame needed for domestic consumption to 100,000 metric tons, and exports to 150,000 metric tons, this still leaves about 450,000 metric tons of sesame unaccounted for, barring any seed and post-harvest losses. This brings us to the third element of the equation: the reported numbers themselves.

To understand this, a preface on official data quality in Myanmar is necessary. A warning on official data came from a study by Michigan State University and the Myanmar Development Resource Institute's Center for Economic and Social Development (CESD), alerting that "the quality of Myanmar's agricultural data is generally weak". The study added: "In the case of agricultural production, the Ministry of Agriculture and Irrigation's Department of Settlement and Land Records has historically served as the agency monitoring land use, assessing land values for tax purposes, recording cropping patterns, setting production targets and estimating output. Given the understandable motivation to achieve official targets... recorders of these data faced incentives to err on the side of achieving stated goals". Year after year, upward biases compounded, ultimately resulting in "wide disparities between reality and statistical reports" (Haggblade et al. 2013). This concern was echoed in Myanmar's national export strategy for beans, pulses, and oilseeds, published by the Ministry of Commerce, reiterating "that most stakeholders agreed that data relating to agricultural production in Myanmar is generally of poor quality", and further indicating that "these discrepancies arise not only from limited data-collection capacities but also from manipulation intended to align data with ministerial targets" (Republic of the Union of Myanmar 2015).

Taking these warnings at face value, it is not far-fetched to think that the sesame production numbers are overstated, which may have started in response to high-level instructions from senior officials in the 2000 to 2005 period to raise yields and achieve self-sufficiency in edible oils.

–David Dapice, Harvard University Ash Center, Cambridge, 2019

Traders

Traders purchase seeds from numerous brokers, and play a significant role in determining the market price. Due to seasonality, traders need sizable warehousing facilities to store large volumes of sesame, allowing them to trade for ten out of 12 months of the year. As a Mandalay trader explained, "The demand for sesame is consistent even with increases in supply during the peak season. This is because traders tend to stock up in anticipation for price gain" (MDY-ADH-F01).

Maintaining business relationship with brokers and exporters

Aunglan town, well known for its sesame trade, has fewer than ten traders buying from 150 brokers. One successful trader in Aunglan sourced from ~50 brokers across sesame-growing towns, but only sold to three key marine exporters. Upon sale from broker to trader, a commission fee of 0.5–1 percent is paid to the broker in cash or via bank transfer.

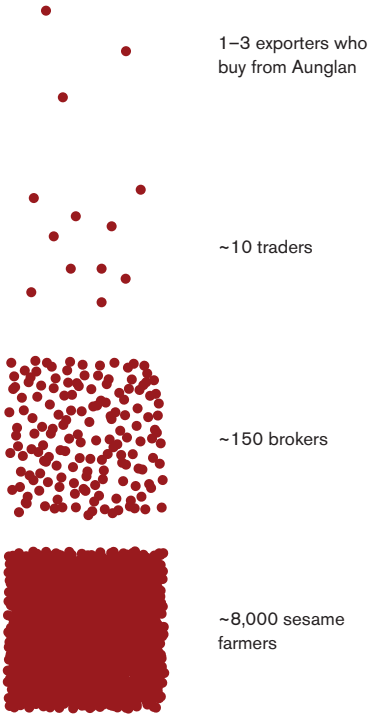
Traders are required to maintain strong relationships with exporters. Another trader we met with mentioned that whenever he visits Yangon for work, the Japanese buyers never fail to take him out for a nice meal and karaoke entertainment. This may be a customary Japanese business practice seen as an investment in the business relationship, arguably due to the volume of trade. "Now, I can host them properly in my humble Aunglan home", the trader beamed (AL-IND-M04). Relationships become more transactional when there are more of them to manage. When dealing with his brokers, the trader offers them short-term storage facilities upon arrival of goods until they reach an agreement on the sale price.

During our 90-minute interview, the trader received multiple phone calls from a broker in the Bago region wanting to set the price for a batch of sesame that was delivered the day before. He set the price of 180,000 MMK for 74 kg worth of sesame, well below the market price of ~270,000 MMK. As he explained, "I have already tested for the acidity level of [the broker on the phone's] sesame, and it tested quite high. In addition, the sesame contained dust and was discoloured" (AL-IND-M04).

Acute understanding of food safety standards

Traders who deal directly with exporters for the Japanese and South Korean markets understand the importance of meeting those countries' food safety standards. One of the traders recalled an instance in 2013, when Japanese buyers sent back containers of sesame that had failed lab tests for acidity and toxins. "Now,

Figure 31: Relative numbers of farmers to brokers, traders, and exporters in Aunglan



Acidity testing of sesame

I use the strip test whenever I buy from brokers to sell to the exporters for the Japanese market. I do a sampled approach for all sesame from all villages" (AL-IND-M04).

The tests results reveal the acid value (AV), which is an important indicator for cooking-oil quality. The majority of international food safety standards consider AV readings of more than 2.5 percent to be unsafe for human consumption (All QA [s.d.]).

International demand for sesame

As previously shown in *Figure 29* on page 143, we estimate that 76 percent of sesame production is bound for export.

In 2017, Myanmar ranked sixth in global market share of sesame exports, with ~132,000 metric tons worth 160 million USD (United Nations 2019, Food and Agriculture Organisation of the United Nations 2018, General Administration Department 2017). China is the biggest buyer of sesame from Myanmar, followed by Japan, South Korea, Singapore, and Thailand, as shown


酸 価 (AV)
0
0.5
1.0
2.0
3.0
4.0
4．油をたらして３０秒後に試験紙の色を色調表と比較して
酸価を判定します。

CALL-OUT

Call-out 09: Good Agricultural Practices (GAP)

The Good Agricultural Practices (GAP) programme was first launched in Myanmar for paddy in 2011. The focus of GAP is to help Myanmar's agricultural industry improve access to export markets by enabling commodities to meet the food safety standards of international buyers. In 2017, GAP was extended to 15 new crops, with sesame as a priority. The launch was assisted by the International Finance Corporation (IFC), a member of the World Bank Group, supported the Department of Agriculture of Myanmar's Ministry of Agriculture, Livestock and Irrigation (MoALI).

With close to 500,000 sesame farmers in Myanmar, and high export demand, GAP has the potential for high impact, if done right (General Administration Department 2017). In the initial phase, stringent GAP guidelines are not realistic to implement and may leave out participation from farmers at scale. As the Winrock team shared, "Current GAP is the easiest step to implement. Then we can proceed to promote ASEAN and international GAP standards" (MG-GRP-03).

GAP in practice

"Not all farmers have been following all the recommendations, but they can follow at least half of it," shared the author of the GAP manual, U Thein Htay U, a retired deputy director of the DOA (MG-IND-M04). GAP guidelines recommend that farmers conduct a soil test before planting. The Magway DOA, however, does not have the resources to provide timely tests to all farmers. As one farmer noted, "I am not sure when the results will actually arrive. Often we only get our test results after planting" (MG-IND-DY1).

Regardless, farmers who have received GAP training are most likely to adopt the most critical technique to meet food safety standards: reducing the piling of harvested sesame plants from seven days to one day, thus decreasing the acidity level in the seeds. Failure to adopt this technique is often due to the limited availability of skilled labour during the harvesting and drying periods.

An Aunglan farmer explained: "GAP does not mean we cannot use pesticides at all. It recommends that we use pesticides only during a limited period so there will be no chemicals left in the seeds when harvested" (MG-IND-DY1). Such simple tweaks to traditional farming techniques can have a significant effect on crop acidity and toxin levels.

Misconceptions regarding the value of GAP linger among farmers. While traders, exporters, and peripheral actors of the ecosystem appear to favour GAP, "some farmers may mistake GAP as a driver to increase yield, but the main intent is for food safety", shared an advisor of Myanmar Agribusiness Public Corporation Association (YG-EXP-DY1).

Obtaining a premium price for GAP sesame

Farmers are required to keep a physical log-book in which they record their activities throughout the cultivation stages, with emphasis on pesticide application and post-harvest drying activities. The logbooks are distributed by agricultural development organisations that conduct GAP training in partnership with the DOA. This is an imperfect process to authenticate GAP adoption, as it relies on self-reporting, but a handful of brokers and traders recognise the value of the log-book and are willing to pay a premium price when farmers show it. GAP farmers who receive the training and follow the prescribed steps are able to obtain a 3-percent premium on the market price. This gain translates to about 5,000 MMK per basket, a critical proof of concept for other farmers to adopt the following season.

The current authentication process for GAP is resource-heavy and requires streamlining. The process, managed by the DOA at Naypidaw, entails producing soil-test results as well as physical inspection of log-books and site audits. Winrock representatives suggested, "There is a huge opportunity to build up a digital traceability system, requiring farmers to key in the data that the government can administer" (MG-GRP-03).

Figure 32: Top international buyers of Myanmar sesame in 2017

	Trade value (USD)	Net weight (metric tons)
China	$120M	101,000
South Korea	$15M	11,000
Japan	$15M	9,000
Singapore	$5M	4,000
Thailand	$3M	2,000
Rest of the world	$7M	5,000
Total	**$160M**	**132,000**

Reference (United Nations 2019)

in *Figure 32*. Roasted sesame oil is an essential ingredient in many Chinese, Japanese, and South Korean dishes, and sesame seeds are also used in confectionery items in these countries. Sixty-five percent of the global production of sesame is used for oil milling, and the remainder is used for food products (Morris 2002).

Since 2013, due to transient trade agreements and an inability to maintain export-quality seeds, Myanmar has failed to maintain its share of sales to the Japanese market. Since 2017, JICA has partnered with Myanmar's Department of Trade Promotion & Consumer Affairs (DTC) and the DOA to promote GAP, with the aim of meeting food safety standards for exports. A professional in market linkages for sesame noted, "Sesame is one commodity where there are more buyers than producers globally. In 2018, the end buyers from Japan did not meet their purchasing targets from Myanmar" (MG-GRP-03 Winrock).

Trade routes and exporters

There are two distinct trade routes for Myanmar's sesame to enter the international market: marine and overland, as shown in *Figure 33*. Marine trade departs from Yangon port, sailing to the key markets of Japan, South Korea, and Singapore. Overland trade goes mostly through Muse on the border with China, and Myawaddy on the border with Thailand.

Figure 33: International trade flows

Sourcing seeds from traders

Exporters maintain a network of traders from major towns with high sesame production, counting on them to supply consistent volumes and quality of sesame. Usually, exporters do not interact directly with brokers and farmers except for specific projects such as non-profit Winrock International, which connects farmers directly with a Japanese buyer, and small-scale contract farming.

Marine trade exporters in Yangon

Marine trade exporters operate in Yangon, Myanmar's business capital, far from the sesame farmers and brokers in the Dry Zone. To operate legitimately as exporters, they are required to set up a legal entity with a license, a contract with an international buyer, and a letter of credit. Applying for an export license used to be a lengthy process, but since market liberalisation in 2010, it now takes just one working day.

There are seven major marine sesame exporters in Yangon, with key connections to markets in Japan and South Korea. The main barrier to entry for new players is the volume required

to be an international buyer: upwards of 10,000 metric tons a year. This is unlike the border trade, where Chinese buyers are willing to purchase in smaller volumes. An established trader from Aunglan commented, "You can count by hand the number of sesame exporters from Yangon, but in Mandalay, there may be up to 1,000 traders who conduct border trades with China" (AL-IND-M08).

Border trade exporters in Mandalay

Most sesame border exporters have legal permits from the Department of Trade to carry out their operations. On a yearly basis, the incorporated export companies apply for a permit to export a set quantity of commodities, including sesame, corn, paddy, pulses, sugar, and watermelons. Depending on the company's ability to fulfil the set quantities, it might sell its permits to other individual border traders that are not incorporated.

The duty fee to export sesame is a reasonable ~10,000 MMK per metric ton, less than 0.5 percent of the good's value. The application process for a border trade license takes only one working day to obtain at the customs duty office. Given the easy application process and low duty fees, there is little economic incentive for border exporters to export illegally.

Despite the legal nature of the export business on the Myanmar side of the border, buyers on the Chinese side have a preference for trade through border towns where they can avoid import duties, essentially turning border trade into a grey market (See *Call-out 10: Border trade routes* on page 158).

Most transporters own only a handful of trucks, and during peak season they may engage other operators to help fulfil deliveries. One of the transporters we met rented a 12-wheel truck with driver from another operator in 2018, but the driver went missing with 300 sacks of sesame (worth ~12 million MMK) along with the truck. "There is really no guarantee for this kind of situation, I just have to be prepared to absorb potential losses. Since that incident, I am very cautious about renting trucks from operators that I have not worked with before," shared a frustrated Mandalay exporter (MDY-IND-F01). Although she filed a police complaint, the driver was not found. She resolved the issue by threatening to sue the transport operator to cover half of the loss.

Another risk that transporters bear is currency exchange. There are no regulated currency markets for exchanging Chinese Yuan and Myanmar Kyat, and actors often use hundi, an informal way to remit money (Chipchase et al. 2014). There are no financial instruments in either formal or informal financial markets

Farmer showing the differences between low-quality seed (left) and high-quality seed (right)

to hedge against Yuan currency movement, leaving the border exporters to bear all the risk. Any slight currency changes directly impact the sesame market price.

Over-reliance on a single market and a single sesame variety

Demand from China drives much of the sesame production in Myanmar. The highest-quality black sesame seeds are used in Chinese curries and confectionery, while moderate-quality black sesame seeds are powdered for snacks and made into a paste for cooking. The lowest quality seeds are sent straight to the mill.

Chinese consumers' preference for Black Samone contributes to over-reliance on a single market and a single variety. One border trade transporter commented, "Last year, the Black Samone price reached its highest price ever in my ten years of business" (MDY-IND-F02). This was partly fueled by low production due to bad weather. Given the current high market price, there is an unwarranted confidence in Black Samone among farmers. An expert in sesame trade shared, "Farmers are now all

growing black sesame, but there is no guarantee that its price will always be higher than white sesame" (YG-EXP-DY1).

What does "export-quality sesame" mean?

Most of the distribution value chain actors we met with shared a baseline perception of sesame quality based on physical appearance, and an understanding that "export quality" means sesame with low acidity and chemical residue levels. However, there remain different benchmarks of quality at each stage of the value chain, along with varying levels of awareness on what is required to meet these quality standards.

On the one hand, with limited access to testing technology, farmers and brokers typically rely on familiarity to ascertain quality. They look for consistency in colour and the plumpness of the individual seeds, and rely on their sense of touch to gauge moisture level. A Magway farmer who was part of GAP training said, "When you touch the sesame, you can tell the moisture level. There is too much moisture if the sesame is soft when you grasp it. If there's a good level of moisture, when you grasp the seeds they will fall down from between your fingers. I know there is technology to measure moisture but farmers cannot access it" (MG-IND-DY01).

Traders and exporters test for acidity, moisture, colour, and chemical residue before determining whether seeds are export quality, as detailed in *Table 15*. Next-tier seeds are those that fail one or more of the four tests, but have consistency in colour. Those batches are most likely to be selected for border trade. The lowest-quality seeds, which are sent to mills in-country, are those with obvious discolouration, regardless of whether they pass the acidity and moisture tests.

Traders, exporters, and some food processors rely on a simple AV test kit to determine the acidity level of the fatty acid in the sesame seeds. Detailed laboratory tests are conducted overseas. As shared by a large-scale sesame snack producer, "One of the biggest challenges is the testing process. We get all our products pre-tested in Thailand, where there is a reliable and detailed report" (YG-IND-F01).

Table 15: Specifications for export quality

Specifications for export quality	Assessed by
<2% acidity	AV test kit
<8% moisture	Moisture test kit
<3% colour spots	Sight, colour sorting machine
Zero to low levels of chemical residue	Laboratory test

Adding value for export

Roasted sesame powder for South Korean market

There is a sizable but lesser-known market in South Korea for roasted sesame powder. With large-scale modern facilities in Mandalay and Yangon, there are a small number of exporters

that address this. “It is a win-win situation for both international buyers and exporters to powder sesame seeds and export as semi-processed goods. This way, the export is not subjected to heavily regulated Food and Drug Administration rules, and the importer enjoys favourable tax breaks compared to the importing of raw goods” (YG-EXP-DY1 MAPCO Experts).

Sesame oil

With dated facilities, and competition from cheap imported palm oil, the milling industry in Myanmar is not sufficiently competitive to export sesame oil. Almost all sesame oil that is milled in the country is used for domestic consumption. As an agribusiness expert said, “It is more likely that groundnut and sunflower oil from Myanmar will compete in the international market” (YG-EXP-DY1).

CALL-OUT

Call-out 10: Border trade routes

In Mandalay, there are many operators who own 12-wheel and 22-wheel trucks to facilitate sesame border trade. As shared by one of those transporters, border exporters first acquire a "*mhayaw-sar*" or transportation slip, with information regarding the vehicle number, goods carried, exporter, and the transporter. The transporters are only required to deliver commodities (sesame included) to the border town, where the Chinese buyers or other intermediaries then collect and transport them across the border.

Each day, hundreds of 12-wheel and 22-wheel trucks packed with commodities flow through the northern border, mainly via the two key towns of Muse and Chin Shwe Haw. The Muse trade route has been established for decades and has improved road infrastructure that can handle heavy-duty 22-wheel trucks, while the Chin Shwe Haw route has poorer infrastructure, allowing only 12-wheel trucks to commute.

With only 436 kilometers between Mandalay and Chin Shwe Haw, the cost to transport by land is comparable to marine-trade freight charges from Yangon to the nearest Chinese port. As shown in *Table 16*, it costs an estimated 1 million MMK, which includes brokerage fees, labour, and fuel, to transport 16 metric tons of sesame on a 12-wheel truck. This comes down to a cost of ~68,000 MMK per metric ton for border export, significantly more costly than ~40,000 MMK per metric ton for marine-export.

It takes a maximum of three days, and a number of checkpoints, as shown in *Figure 34*, for a driver to reach the border town from Mandalay. Regardless of which border town the cargo is headed towards, all trucks have to pass by #16 mile checkpoint and the Yay Pu checkpoint, before they branch out in two different directions, depending on the final destination. At #16 mile checkpoint, drivers face an inspection of up to two hours by customs police and Department of Trade officers. Later checks tend to be less rigorous if drivers can produce documentation from this check. Large 22-wheel trucks on the road to Chin Shwe Haw may be asked to go through an X-ray at #105 mile checkpoint if they arouse suspicion, costing an extra 20,000 MMK per truck.

Once the sesame arrives at the border, buyers are subjected to the Chinese government's import duty fees. There is a preference from Chinese importers to buy from Chin Shwe Haw, compared with Muse, in order to avoid the import duty fees. "Chinese traders are able to avoid the duty fees in Chin Shwe Haw, and save about 500 yuan (75 USD) per metric ton", said one of the border exporters in Mandalay (MDY-IND-Fo1).

As a consequence, most exporters from Mandalay bear huge counterparty risks, as they knowingly sell to buyers who avoid import duties from the host country by going through grey-market channels. This concern is reflected in the comments of the same border trader: "When the Chinese government arrests the Chinese buyers, it also means no payment for the goods sent. We [Myanmar exporters] are only paid when the goods arrive to the Chinese warehouse" (MDY-IND-F01).

Figure 34: Land transport route from Mandalay to the Chinese Border

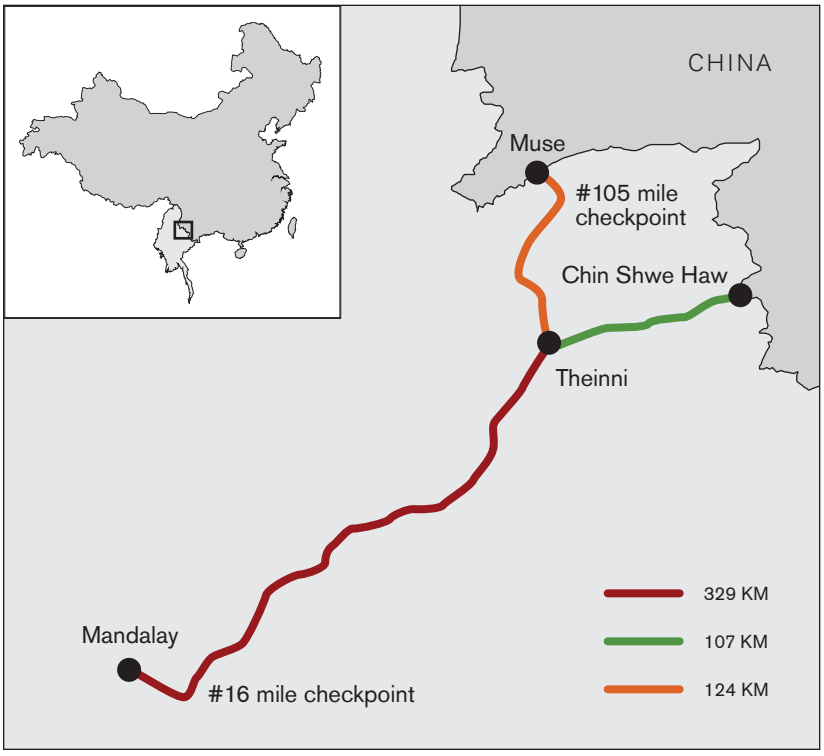
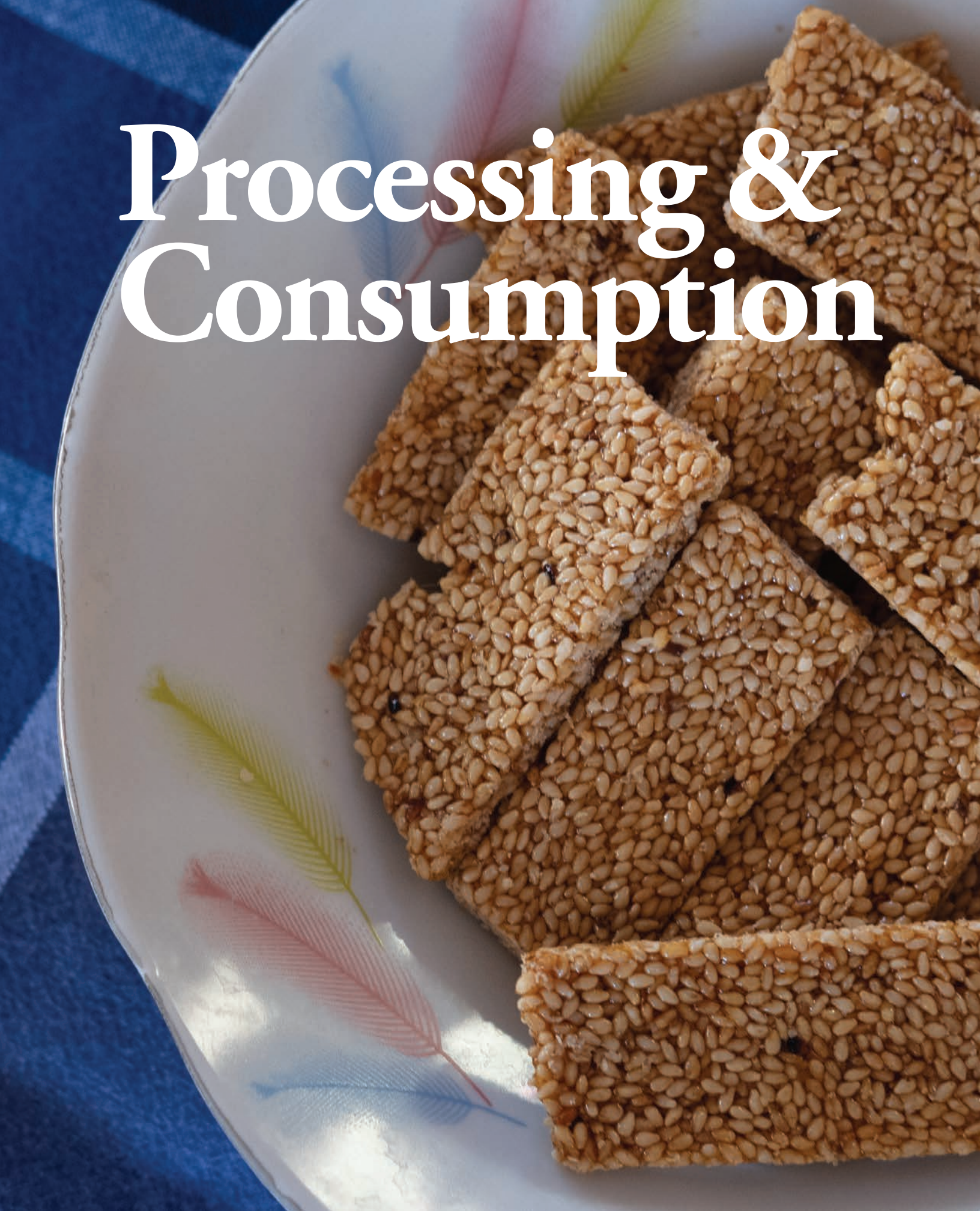


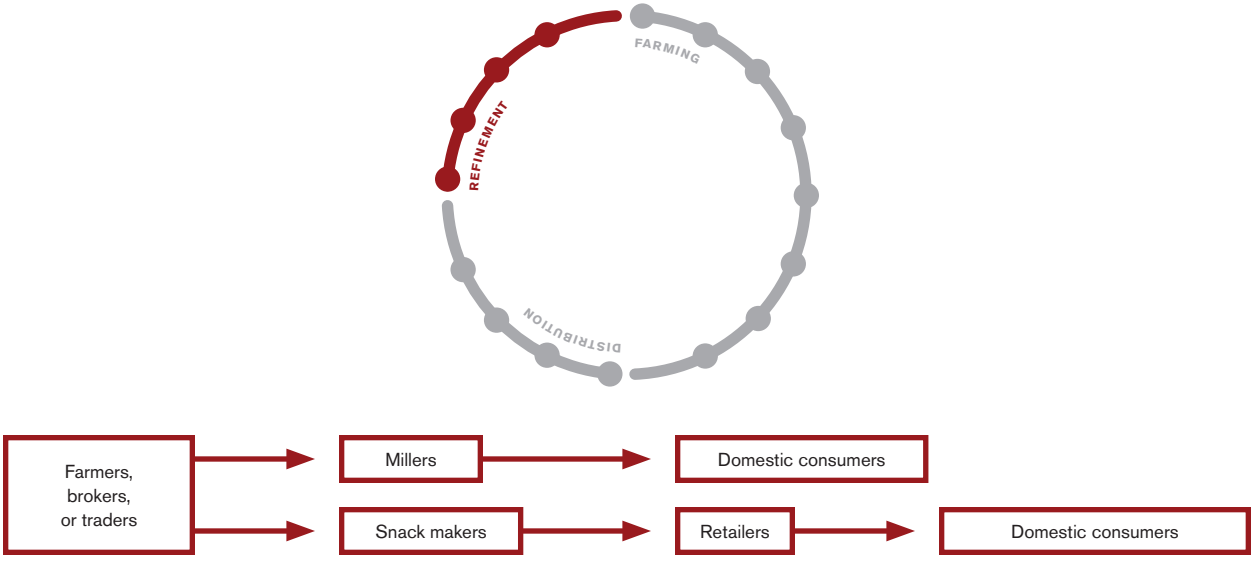
Table 16: Cost to transport 16 metric tons of sesame from Mandalay to Chin Shwe Haw

Hiring of 12-wheel truck driver	100,000 MMK
Hiring of driver's assistant	70,000 MMK
Checkpoint fees	40,000 MMK
Operator cost (including fuel)	880,000 MMK
Total estimated cost	**1,090,000 MMK**



Processing & Consumption

Figure 35: Actors along the refinement value chain



Refinement value chain

This section covers what happens to sesame destined for refinement, including milling into oil, and being made into snacks for retail and consumption, as shown in *Figure 35*. A study of the Magway sesame value chain over a single season noted that, of the sesame that remained in Magway, 75 percent was processed locally into oil and 25 percent into brittle (Thuzar Linn 2013).

A family-owned mill

Milling

While there are an estimated 3,156 registered millers in Myanmar, only 10 percent are considered operational, while the rest have been shut down due to decrepit machinery or financial losses (Swe Lei Mon 2019). Although exact figures are not available, the majority of mills are individual or small-scale, with a single machine powered by either an ox or a generator, with the rest being larger and more modern with a range of machines and services.

Some millers prefer to keep their business small to avoid government registration and the possibility of being taxed. We estimate that there are thousands more unregistered mills operating at the village level that don't overtly advertise their services, but mill for their own use and for peers in the village.

The main byproduct from grinding seed for oil is sesame cake, a dense, bitter pulp that is sold for animal feed. While it varies based on the seed variety, a typical basket of sesame will yield 7.5 viss of oil and 7.5 viss of cake (Nyein Set Lin 2019). The decline in mill-

Table 17: Types of millers

	Individual miller	Small-scale miller	Large-scale miller
Machinery	Traditional wooden grinder, powered by ox	Screw-type machine, powered by generator or mains electricity	Numerous machines, powered by mains electricity
Seeds and nuts covered	Peanut and sesame milled on a single machine	Peanuts, sesame, and sunflower, depending on local availability, milled on a single machine	Dedicated machines for peanuts, sesame, and sunflower
Primary seed suppliers	Self, neighbours	Self, local, and surrounding villages	Farmers across the division/region
Primary sesame oil buyers	Rural consumers from the same village	Rural consumers from surrounding villages and some peri-urban consumers	Branded sesame oil producers
Volume/year	10s kg	10s–100s kg	1,000+ kg
Income	Paid in cake, oil, or cash	Paid in cake, oil, or cash	Paid in cash or cake

ers and milling has impacted the market for feed. In the words of Yangon-based ecosystem experts, "There is not enough sesame cake [and] it has impacted the livestock industry. Myanmar imports 30 million USD worth of animal feed a year" (YG-EXP-DY1). Furthermore, "Domestic production of oil cakes such as sesame, soybean, and peanut cakes are not sufficient to supply the feed industry, due to strong exports of whole peanuts and sesame rather than sales of these goods to the domestic crushing industry". Instead, Myanmar is importing soybean meal, animal feed (also referred to as "distiller's dried grains with solubles"), corn gluten, feed wheat, bone meal, and other protein source ingredients from the United States, India, Paraguay, Brazil, Pakistan, Canada, Ukraine, Moldova, and Argentina. Trade sources report that the import of these types of feed ingredients increased in 2018 due to higher domestic prices for yellow corn and other oil cakes (Swe Mon Aung 2018). Millers may charge money for milling and/or accept the cake byproduct as payment.

Seasonality in the milling business

One of the challenges for the miller is the uneven demand for services over the course of the year. Demand for milling is concen-

Sesame cake to be sold as animal feed, drying in the sun

trated in February through March to mill sunflower (harvested in December), winter sesame (December), and groundnut (January). A smaller miller will process 40–50 baskets per month during this peak season, with only 4–8 baskets per month during low season (April–June). For a small-scale miller, income from the mill can be up to 25,000 MMK per day during peak season, and 3,000 MMK in low season.

Milling process overview

Farmers are expected to supply millers with sufficiently clean seeds for milling. Small-scale millers only consider moisture through touch and sight. According to a Pwintbyu miller, "We do not sieve and filter through the seeds. Farmers are expected to bring sieved seeds. There have been instances where we had to reject some people's seeds. I decide whether to accept or reject seeds based on seed moisture. There is no technology to measure moisture, I know from experience. For sesame you can measure moisture from feeling it. If they feel wet or damp in the hand, the seeds are too wet. If they are

rough in the hand then they are dry enough" (PB-IND-M05).

As such, millers assess how free the seeds are from stones, dirt, and debris before milling. If it is visibly obvious that sieving has not been done and impurities remain, the miller will ask the farmer to sieve the seeds again before purchasing. However, small-scale millers are less strict than large-scale millers about quality before milling. If the miller cannot explain why processing seeds mixed with trash is a bad idea, he will still relent and mill them. In the words of the same miller, "I've never had issues with stones in the baskets, but sometimes there is leaf residue or dirt. If they are there, oil that comes out is not high quality, the smell is bad, the taste is bad. I try to explain it to the farmer. If I can't get the farmer to understand and he still is adamant that we process the seeds, we process it as is. I have a big headache when I can't get through to the farmer because it also damages the machines" (PB-IND-M05).

The seeds are placed into the milling machine's drum and are ground with pressure from a wooden or metal pole. Wood grinding is preferred for taste, although metal is more common and requires less maintenance. While most of the oil is released in the first pass, the resulting cake is fed into the grinder up to three more times to extract all of the available oil.

Most sesame in Myanmar has an oil content of 45–53 percent, as shown in *Table 06: Sesame seed varieties* on page 65. For quality seeds, a single basket of sesame (24.5 kg) will produce around 12 kg of oil and 12 kg of cake. Inferior-quality seed will produce less oil, of poor taste and smell, and more cake.

The oil is poured into jerry cans or bottles, and the waste cake is stored separately for sale as animal feed. Cake can be obtained by the miller for around 400 MMK per viss (1.63 kg), and sold for 1,300 MMK.

Individual millers

Most villages used to have at least one traditional wooden milling machine for making oil, although increasingly these are either solely for personal use or are in a state of disrepair.

To process two baskets of seeds into oil takes about 90 minutes, including 30 minutes to dry the seeds and 50 minutes to grind them. As the seeds become compressed, a wooden hand chisel is used to ensure every drop of seed is extracted. The final step is to release the stopper at the base of the mill and pour out the fresh, fragrant sesame oil.

The miller will grind his neighbours' seeds for free in return for the leftover cake, which is dried and used as animal feed.

An individual village miller makes sesame and groundnut oil for himself and other villagers using a traditional milling machine. The shed containing the machine sits in the home compound and used to be ox-powered, but was converted to electric motor.

Small-scale millers

Small-scale mills are family-owned businesses with one or two screw-press machines for making oil. They are often situated on the edge of, or between, villages, and serve a catchment area covering multiple villages.

Housed in a milling shed, the machines are caked with dust and grease, and sit on a dirt surface or an unclean concrete floor. The miller often runs their own farm and is able to grind both their own seeds and those of customers into oil. Many of the mills are passed down through generations of family members, and some still maintain machines that were first pressed into service half a century ago.

While start-up costs for a small mill are only about 350,000 MMK, stable electricity and a dedicated space that can afford to become dirty are also necessities. Annual maintenance can come to 50,000 MMK ($33).

In these mills, there is no scientific testing of seed quality, with millers preferring to rely on sight, touch, taste, and smell to

ascertain the quality. If small pebbles are present in the sack of seeds, they may cause the machine to seize, making millers wary of unknown suppliers. With no risk of health inspectors coming to visit, the mills are allowed to stay in a decrepit state.

Because of the uneven nature of the yearly business, the small-scale miller is likely to have diversified income sources, such as crops from farm land, sesame-oil sales, and extended informal credit.

Large-scale millers

Large-scale mills are industrial businesses in purpose-built facilities capable of processing seeds for sale to both domestic and international markets. Large-scale millers add value to the seed though cleaning, testing, quality assurance, and processing. Most large-scale oil processing is carried out by domestic manufacturers such as Ah May Htwar and Bayin.

While most oil is destined for the domestic market, a new Italian-funded processing facility went live in 2018 with a view to exporting quality, GAP-farmed seed (Global New Light Of Myanmar 2018). The facility's cost was estimated at 180 million MMK, including infrastructure costs for electricity and water, a drainage system, storage, a testing laboratory, and machines for sesame-seed cleaning, weighing, packaging, and oil production.


AMH
အမေထွား နှင့် သားများ


AMH
WE CARE ABOUT YOUR HEALTH
အမေထွား
2018
Calendar
AH MAY HTWAR PEANUT OIL

The Resigned Miller

Daw Aye Tin, 33
Pwintbyu town

"My parents didn't allow me to work elsewhere, they wanted me to take over the family milling business."

Backstory:

Daw Aye Tin is a miller who lives in the town of Pwintbyu, just 15 minutes away from the villages her mill services. She completed her first year studying mathematics at Magway University, but had to return home after her father had a stroke. Her younger sister is still working with a non-governmental organisation in Magway, so Aye Tin inherited the business from her family. Her father passed away two years after she returned. She is currently single and lives with her mother and her cousin. She is responsible for taking care of the entire household and the mill, although her younger sister sends remittances to their mother.

Her main source of income is farming, from which she earns about 7.6 million MMK in revenue. She owns around ten acres and plants black (five acres), white (three acres), and red (two acres) sesame. She rents machines for farming and does not own an ox-cart. She also receives income through milling oil for her customers, which she supplements by selling a small amount of unbranded oil using her own sesame to long-time customers in larger cities around Myanmar. Aye Tin is hesitant to overtly advertise about selling oil as she is afraid that she is operating without the proper license to be a seller in addition to a miller. She makes about 3.6 million MMK in annual revenue from milling, and over 900,000 MMK from selling oil.

The busiest season for Aye Tin's mill is after the sesame harvest around August (for monsoon sesame) and May (for summer sesame), when farmers bring sesame to mill to make oil for their own home consumption. Sometimes, farmers are unable to pay the full milling fee, and barter for oil instead.

Relationship with farmers:

Her family has been in the milling business for generations, and Aye Tin maintains close relationships with the many farmers who come to mill their oil. She also extends credit to them when times are tough.

Technology:

Aye Tin, her mother, and her cousin all own smartphones. They always keep their phones turned on and regularly purchase data and use Facebook, Viber, and farming apps. She uses her phone to call labourers

for her farm, receive orders for oil from customers around Myanmar, and call transporters to make deliveries. The household also owns a TV.

The mill also has two machines that produce oil, and one rice mill.

Decisions:

- Given the steady decline in business over previous years, should I abandon milling?
- Which crops should I grow to generate enough profit to support the household?
- Should I hire a full staff of employees and labourers, or reduce the labour load?

Challenges:

- Enjoys close relationships with farmers, and knows they still rely on her family for their oil milling, which is why she does not want to give up the milling business.
- Having to operate both a farming and milling businesses to generate sufficient profit to support the entire family.
- High expenses to regularly repair old machines in the mill, and paying mill employees and labourers working on the farm.

Busy Season:

August and May.

Business Relationships:

Around 210 customers per month.

Margins:

- Margin of up to 2,000 MMK per viss for oil sold to customers.
- Milling fee of 3,000 MMK per basket.
- Gross margins of around 500,000 MMK per acre for sesame farming.

Transaction Volume:

Peak Season: 30–40 baskets per day
Average: 10–15 baskets per day

Yearly transaction volumes:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
				Highest: 900,000 MMK						Lowest: 96,000 MMK	

Snack making

Although only a small percentage of domestic sesame production is made into sesame brittle, through both small- and large-scale processors, it is widely available in village shops as a cheap, tasty snack.

Small-scale processors

A small-scale processor can make brittle with little more than a stove, oil, sugar, and sesame, with the resulting brittle packaged up in bags and sold at convenience stores in local and neighbouring villages. A single processor can make 50 packets of brittle per day by hand, with one package selling for 650 MMK (MG-ADH-F02). Margins for brittle are estimated to be around 69 percent (Thuzar Linn 2013). A small-scale processor's proximity to market facilitates making smaller batches and maintaining freshness.

Large-scale processors

Large-scale brittle processors invest in machinery to automate much of the manufacturing process. As part of our research, we visited the family-run Kaung Mon factory in Magway. Their products are distributed and sold across Myanmar under the Kaung Mon brand.

All of the processing machines are from China, and when they break down, spare parts need to be ordered from China as well. While waiting for repair, the factory switches back to processing by hand.

The sign of a well-made sesame brittle snack, according to a Kaung Mon representative, is that "you should hear a crack" when you bite into it (MG-GRP-01). Thinner, handmade brittle is valued over the thicker, machine-made variety.

Large-scale processing takes place at the family-run Kaung Mon factory in Magway.


SHWE KYEE BAKERY (SKB)


Did you wash them?
Wearing Gloves
for Food Safety
Hisense
roots
roots


多功能枕式
MULTI-FUNCTION PILLOW-TYPE
130

Table 18: Sesame processing steps

Step	Activity	Small-scale processor	Large-scale processor
1	Sourcing sesame seeds	• During sesame season, seeds are sourced from other farmers in the village as uncracked seeds. • During off-season, seeds are sourced from Magway in the form of cracked seeds.	Seeds are sourced from a crop exchange centre (CEXC), and chosen for being of good quality and free of dust and rocks.
2	Cracking sesame shells	Soaks the seeds in water overnight, removes them in the morning, lays them on a large sack, and pounds them by hand.	Uses a wooden machine that cracks the shells of the sesame by pounding it on a table. What comes out of the machine is a mix of seeds and broken shells.
3	Grinding sesame shells and sieving	Takes the cracked seeds and uses a plastic handheld food grinder with small metal blades to grind the sesame.	Uses a six-foot-tall stainless-steel powder grinding machine to grind the sesame, resulting in pulverised sesame seeds and broken shells.
4	Sieving and cleaning	-	Uses a sieving machine to refine the ground sesame and separate the cracked shells from the sesame. Employees then process the seeds for a second time using a rattan sieve.
5	Melting sugar	Melts sugar in an electric pot while stirring it with a wooden spatula.	Uses a three-foot-tall sugar-boiler machine, with an employee stirring the mixture at the same time with a wooden paddle.
6	Mixing sesame and sugar	Mixes the ground sesame with the liquid sugar by hand in the pot used for the sugar, creating a sticky paste.	Uses a three-foot-tall steel machine with a rotating tub in the middle to mix the sugar and sesame together into a sticky paste.
7	Rolling into a thin layer	Puts oil on a rolling pin and a wooden table, then rolls the sticky paste into a thin layer covering the entire table.	Uses a machine that presses the sticky paste, cuts it into even rectangles, and packages the rectangles all at once. The resulting brittle rectangles are wider than those created by hand.
8	Cutting brittle	Cuts the thin layer into rectangles of brittle by hand using a knife.	-
9	Cooling down	Puts all the brittle rectangles into a large metal pot and lets them cool down and harden.	-
10	Packaging	Puts ~12 brittle rectangles into a transparent food-grade plastic bag, seals the bag using the heat from a candle, places the bag inside a disposable plastic food container with a printed label stapled on one side, and then finally staples the container shut.	-

Table 19: Domestic sesame consumption

White sesame	Red sesame	Black sesame
Widely used domestically, white sesame is refined as brittle, and served roasted in traditional dishes and salads. It can also be milled for oil.	If not exported, red sesame is largely processed for edible oil. It is rare to find red sesame seeds in markets.	Mostly for export and thus rarely found in markets. Some domestic demand for medicinal purposes such as Sayar Kho balm.

Retail

Processed sesame oil and brittle are distributed through retail outlets across Myanmar. Other refined sesame products include tahini and medicinal balm, though their production and consumption volumes remain marginal.

Sesame consumer preferences in Myanmar

Consumer preferences in cooking oil

Based on a Proximity Designs survey of 148 consumers across 48 townships, 57 percent of consumers in Myanmar have a bottle of sesame oil in their kitchen. However, only half of them had used it in the previous month (Proximity Designs 2019).

Among consumers who do not use sesame oil at home, 52 percent use groundnut oil, and the rest use other oils such as olive, sunflower, and vegetable oil. The use of groundnut oil was reported as the most common among all townships, with consumers in both urban and rural areas preferring it over sesame oil.

This preference for groundnut oil is due to taste, as well as the fact that it is cheaper than sesame oil (for more details on oil prices, see *Table 20: Sesame oil prices* on page 194). Additionally, as one oil market retailer explained: "If you fry sesame oil, it will foam" (PB-IND-F01), preferring mixed palm oil instead for deep frying foods. The majority of Myanmar consumers use sesame oil for dressing salads or drizzling on top of fried vegetables.

Sesame seeds as ingredients

Myanmar households use roasted white sesame seeds as garnish on the popular fermented tea leaf salad. It is also used in making traditional snacks such as Bein Mote (poppy seed pancake) and Si Htamin (yellow sticky rice), both of which are popular throughout the country. Ground sesame is also used in Shan noodles, to eat with Kaw Pote (traditional Shan dish).


Meizan
Vegetable Oil
Goody

Unbranded blended sesame oil available from market-stall owners

Confectionery

Sesame brittle is not the most popular of the seed- and nut-based confectionery snacks in Myanmar. Consumers favour peanut-based brittle, which is the most sold snack by large-scale brittle processor Kaung Mon. Even then, these snacks are not consumed on a daily basis, and consumers report purchasing them as a gift to take when traveling out of town. As one small-scale snack processor noted, "Migrant workers hear about my snacks and buy them from my shop so they can bring some to other migrant workers when they leave" (MG-ADH-F02).

Sesame oil retail market

Consumers mostly purchase unbranded sesame oil

Sesame oil is mostly sourced unbranded by consumers from their local mill or wet market, both in urban and rural areas. Of consumers who reported using sesame oil, 18 percent press their own oil, 44 percent buy it from the local wet market, and 36 percent buy it from their local mill (Proximity Designs 2019).

Table 20: Sesame oil prices

Type	Processor	Unit	Price
Pure sesame	Large-scale miller	1 viss	7,200 MMK + a 200-MMK discount for customers who bring their own container
Pure sesame	Local miller	1 viss	7,200 MMK
Sesame oil blended with palm oil	Local miller	1 viss	3,000 MMK

Furthermore, only 12 percent of consumers purchase sesame oil from a chain retail store, which are mostly located in peri-urban and urban areas. Large-scale processors such as Ah May Htwar manage their own distribution channels to make the oil available in mini-marts and supermarkets across the country.

Sesame oil prices in a competitive edible-oil market

The prices of sesame oil, as shown in *Table 20*, are likely to increase in the future. This is due to a decreasing number of local mills, an increasing amount of sesame being grown for export, and an increase in production costs of pure sesame oil due to the rising cost of raw materials (Phyo Wai Kyan 2019).

Additionally, sesame oil faces significant marketplace competition from other oils, including groundnut, sunflower, and vegetable oil, as shown in *Table 21*. The general secretary of the Mandalay Region Edible Oil Dealers' Association reported that imported palm oil and blended oils constitute 90 percent of the local market, and referred to them as a "brick wall challenge", making it impossible for processors of other oils, including sesame oil, to expand (Phyo Wai Kyan 2019).

Palm oil was imported and introduced to the Myanmar market in the early 1990s, causing a huge disruption in the edible oil market. Sesame, groundnut, and sunflower farmers and oil processors lost the majority of their business as they were unable to compete with the low cost and high demand of palm oil (Frontier Myanmar 2018).

The oils that dominate the market in Myanmar are currently a blended palm oil, also called "vegetable oil" by brands like Good Choice and Meizan, groundnut oil, and Goody's sunflower oil. Vegetable oil is a euphemism for palm oil blended with other edible oils such as groundnut, soybean, and coconut, with the exact percentages of each not known by retailers or consumers.

Table 21: Other cooking oil prices

Type	Processor	Unit	Price
Peanut oil	Local miller	1 viss	5,500 MMK
Sunflower oil	Goody brand	1 viss	4,700 MMK
Vegetable oil	Good Choice or Meizan brands	1 viss	3,500 MMK
Mixed palm oil	Local miller	1 viss	1,900 MMK

It is supplied by local millers and sold in local markets through small retailers. Its relatively low cost makes it a preferred choice amongst price-conscious consumers. As one farmer from Pwintbyu said, "These days, people cannot afford to buy sesame or sunflower oil so they buy mixed palm oil" (PB-IND-M05).

Potential issues with ascertaining oil quality

The chair of the Myanmar Oil Millers Association warned about illegal imports of groundnut and sunflower oils that contain other unidentified oils and artificial fragrances. Even with labels claiming that the contents are 100 percent pure, the association urged the public "to refrain from purchasing imported brands of cooking oils if the source is unknown" (Chan Mya Htwe 2017).

Domestically, even though brands such as Ah May Htwar are perceived by consumers to be trustworthy because they have to go through inspection and quality-control processes, their oils are more expensive than those obtained from local millers. Some local millers produce adulterated oil, for example mixing groundnut oil with other low-quality oils to dilute it (Swe Lei Mon 2019).

Similar experiences are reported with sesame oil. Due to its high price, it is sometimes blended with cheaper palm, groundnut, or sunflower oil, or with chemicals. Unscrupulous sellers enhance the value of their oil by lying about the percentage of sesame oil in the blend, or claiming that it is pure. Consumers used to test the quality of sesame oil by seeing whether it coagulated, but then sellers started adding chemicals to achieve the same non-coagulating properties. Other sellers add chemicals to affect the viscosity, or add fragrance. Blended sesame oils are commonly sold at one-fifth the price of pure sesame oil. Because consumers are close to their local millers, the only way they can ascertain trust is through familiarity and long-standing relationships.

Kaung Mon Brand sesame products

Brittle and raw seed points of purchase

Sesame brittle

Small- and large-scale brittle processors alike manage their own distribution channels. When not selling directly to consumers, a small-scale processor at the village level will partner with shops in the same village and in neighbouring villages to sell the brittle, adding a retail margin of 100 MMK per package in the process. Large-scale processors such as Kaung Mon work with distributors to whom they suggest sale price. However, distributors have the final say on setting the sale price at retail locations, including large and medium-sized retail chain locations, roadside stores, and market stalls.

By way of comparison, a small-scale processor will sell sesame brittle for 650 MMK for a plastic box containing 12 bars, whereas the cheapest Kaung Mon brittle box costs 800–1,000 MMK for the same number of units.

Packets of raw sesame seeds

For use in cooking and garnishing, small packets of white sesame are widespread and can be purchased in any market for as little as 500 MMK.

Other uses of sesame

Although the majority of Myanmar consumers use sesame oil for food preparation, 8 percent of respondents to our consumption survey reported using sesame products for their medicinal value. The most common product in this category is a balm named Sayar Kho, which is used for treating wounds, cuts, bruises, etc. Such balms are commonly available in convenience shops and other retail, and can be purchased for around 500 MMK.

In addition to the medicinal value of sesame oil, which is believed to reduce aches and increase stamina, it can also be used for cosmetic purposes, with sesame-based products available for face, hair, and body (Nyein Set Lin 2019).

Our team also met with Roots, a processor that manufactures tahini, a toasted-sesame condiment used extensively in the cuisine of eastern Europe, the Middle East, and northern Africa. The product is not yet well known to consumers in Myanmar, and remains mostly consumed in Yangon by expatriates and repatriates.

Looking Ahead

Looking Ahead

နှမ်းတစ်စေ့နဲ့ ဆီမဖြစ်နိုင်
"You cannot make oil with just one sesame seed."
— Myanmar proverb

Despite the importance of high-quality Myanmar sesame to the global market, it is a "neglected" crop among the agricultural community for a number of reasons. Domestic consumption of sesame, for instance, is negligible compared with other crops like paddy. Similarly, the value that Myanmar captures from exporting sesame remains quite small.

Thankfully, the outlook is not entirely bleak. Sesame as a crop is compatible with the climate of the Dry Zone, and it remains a crucial ingredient to products preferred among global consumers. Also, the Ministry of Agriculture, Livestock, and Irrigation's introduction of GAP to sesame farmers has been well received.

At Proximity Designs, our farm advisory business began with a small pilot project in 2015, providing best-fit agronomy advice to paddy farmers in the two lower Delta townships. Back then, our goal to scale our impact and reach paddy farmers beyond those two townships. To guide our ambitions, we conducted a similar foundational study on paddy. The research findings were published into a book, *Paddy to Plate*, in 2016. Based on the learnings from that study, we expanded our farm advisory service offerings from two to 30 townships, increasing our reach from 50,000 to 200,000 farmers. We introduced new knowledge services, such as weather-alert provisions, soil testing, and precise nutrient recommendations, as well as on-farm problem diagnoses and treatment recommendations. We connected with farmers through new digital channels, such as SMS and social media.

When It Rains, It Pours will enable us to replicate this process again. We will further explore some of the opportunity areas outlined in this report; and will test, pilot, and launch new offerings specifically tailored to sesame farmers. In doing so, we aim to reach 100,000 sesame-farming households in the next three years.

We hope that other stakeholders in the sesame ecosystem join us in furthering the many other opportunity areas we have identified. In Myanmar, we have a saying that goes, "You cannot make oil with just one sesame seed." The more organisations work hand in hand with us to meaningfully meet the needs of sesame farmers, the more impact we can all create together.

— Phyu Hninn Nyein, Proximity Designs, Yangon, 2019

Opportunity Areas

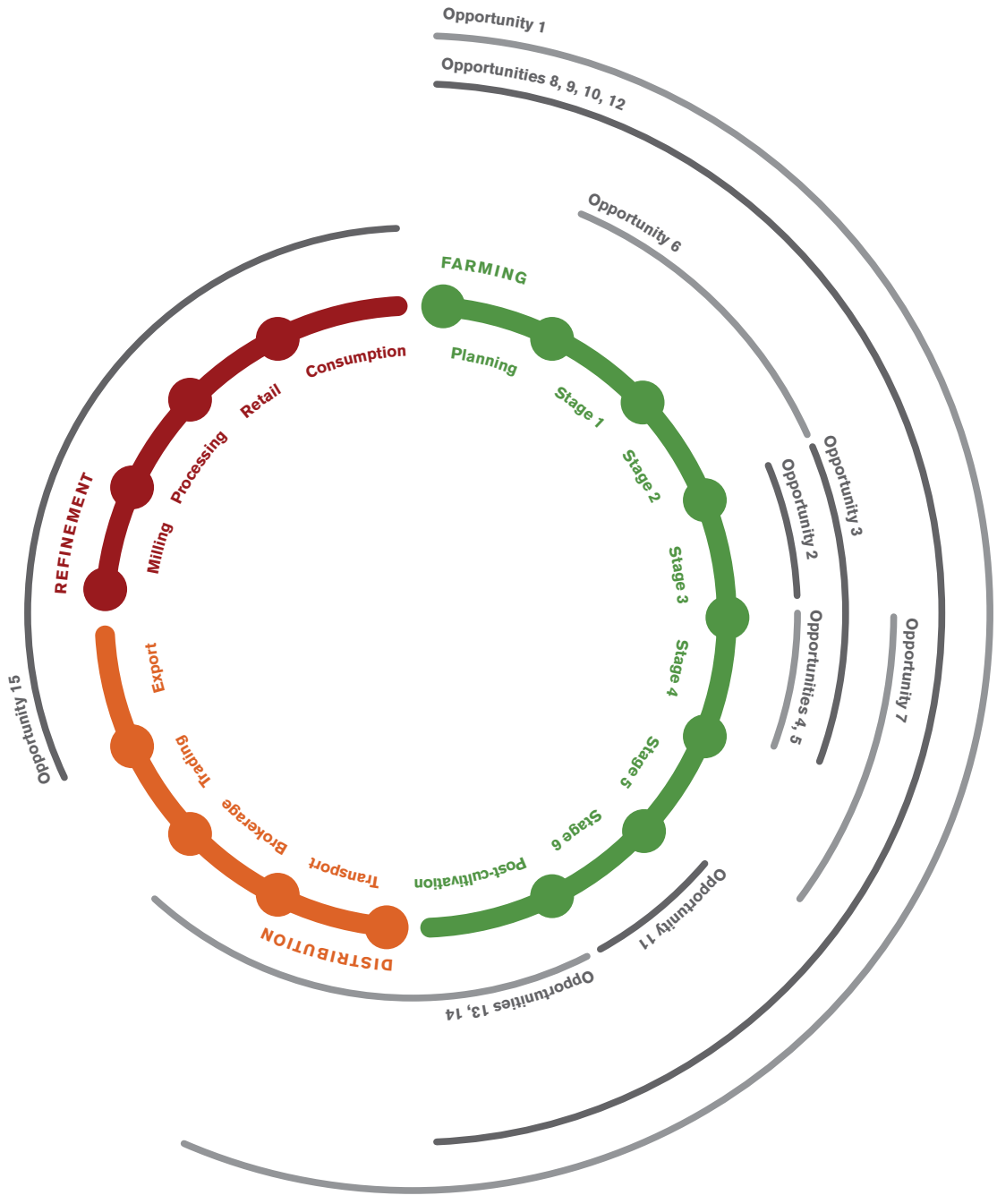
We identified 15 opportunities areas that specifically address the needs of sesame farmers. These are based on systematic research of the sesame value chain and an understanding of the pain points and key decisions faced by farmers and other stakeholders, within the wider context of local cultural norms and technological capabilities. While not exhaustive, we believe the opportunity areas are broadly representative.

Every opportunity area improves the livelihood of sesame smallholders in Myanmar in at least one of two ways:

- **Improve production:** Support farmers in capturing a greater share of the sesame production value chain (e.g., by achieving greater yields, growing more weather-impervious varieties, or reducing the pressure to sell their harvest when prices are low).
- **Expand markets:** Grow domestic consumption (e.g., by reinforcing or expanding the refinement of sesame products), and/or increase global export share for sesame (e.g., by growing varieties that are in demand on the global market, ensuring quality across the supply chain, or promoting higher-value refinement pre-export).

For more-generalised agricultural opportunity areas, see our previous report on the rice ecosystem, *Paddy To Plate* (Phyu Hninn et al. 2016).

Figure 36: Opportunity areas along the sesame value chain



Opportunity 1: Partner with village entrepreneurs to reach farmers

Opportunity 2: Expand reliable access to improved propagation seeds

Opportunity 3: Manage weather unpredictability and optimize irrigation access

Opportunity 4: Improve soil health awareness and management practices

Opportunity 5: Promote adequate and safe application of pesticides

Opportunity 6: Provide access to sesame-appropriate machinery and tools

Opportunity 7: Lessen labour shortages and organise labour payments

Opportunity 8: Smooth farmer cash flow to maximise income potential

Opportunity 9: Design sesame-friendly credit products

Opportunity 10: Reduce farmer over-indebtedness

Opportunity 11: Improve post-harvest drying techniques to enhance seed quality

Opportunity 12: Support farmers' informed decision-making to minimise their risk

Opportunity 13: Consolidate sesame farmers' bargaining power

Opportunity 14: Strengthen relationships between farmers, transporters, and brokers

Opportunity 15: Encourage more value-added production in Myanmar

Opportunity Area 1:

Partner with village entrepreneurs to reach farmers

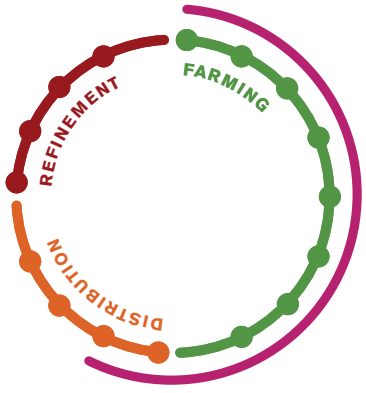
With improved road access to villages, higher mobile-phone adoption, and increased income, there has been an uptake in rural entrepreneurship. Most villages have shophouses, machinery rental services, informal credit providers, and a mobile money agent. In some instances, these roles are combined; for example, machine rental services that provide a credit line to farmers or shop owners that also act as mobile money agents.

The tight-knit nature of villages helps entrepreneurs maintain a good spatial and social awareness of villagers and their economic health through community events and transactional activities. For instance, village shops often act as a social hub where knowledge and gossip is exchanged over tea, cheroots, or other small purchases. Furthermore, mobile money services are slowly expanding into rural Myanmar—primarily through Wave Money, a joint venture between Yoma Bank and Telenor—and most mobile money agents are existing village entrepreneurs.

Any organisation that serves farmers over a large geographic area can only afford to maintain a limited footprint in that area. They therefore tend to focus on visits from loan officers and DOA or field extension officers for training and farmer recruitment.

As such, there is an opportunity to partner with village entrepreneurs in order to help them identify and recruit new customers; promote and cross-sell services; and manage lending due diligence, disbursement, and repayment.

Opportunity 1 along the sesame value chain



How might we...

- Leverage existing formal and informal networks in the village to provide services for farmers?
- Provide a faster way to disburse, track, and repay loans?

Opportunity Area 2:

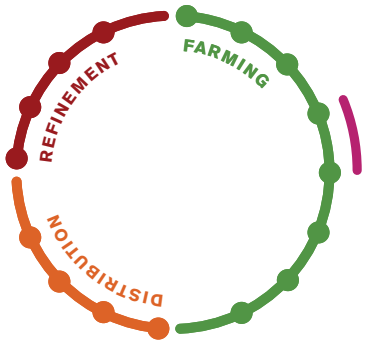
Expand reliable access to improved propagation seeds

Sesame farmers generally lack awareness of the different seed varieties available in Myanmar, beyond recognising the type of sesame (black, red, white) or other look-and-feel differentiations (e.g., if the seeds are plump or evenly coloured). When choosing propagation seeds to plant, this can pose a challenge to farmers as they are increasingly seeking specific, improved varieties with shorter cultivation cycles to mitigate the risk of yield loss due to excessive rains during harvesting time.

Despite existing demand from farmers for these improved seed varieties, stock from the DOA—farmers' most reliable supplier–is low. This drives farmers to purchase these varieties from other farmers, despite having no way of ascertaining the authenticity and purity of the purchased seeds. To make matters worse, they are only able to determine the length of the cultivation cycle in real time, once the propagation seeds have begun to grow.

This presents an opportunity to build awareness among farmers around sesame seed varieties, as well as to help them navigate their search for improved varieties with shorter cultivation cycles.

Opportunity 2 along the sesame value chain



How might we...

- Increase sesame farmers' awareness of the different seed varieties and their relative benefits and drawbacks?
- Help sesame farmers minimise their reliance on the short supply of improved seed varieties from the DOA?
- Increase the capacity and confidence of sesame farmers to trust the propagation seed varieties they're purchasing?

Opportunity Area 3:

Manage weather unpredictability and optimise irrigation access

The unpredictability of weather and lack of irrigation access is the biggest challenge facing farmers today. This creates three interrelated challenges.

First, weather forecasting can only be so helpful to sesame farmers, particularly prior to planting. Once the seeds have been planted, they have no way of reacting to incoming bad weather, and tend to just wait it out. There is opportunity to help farmers better coincide the timing of land preparation and seeding activities with optimal weather conditions.

Second, sesame farmers rely on irrigation one month after seeding and during the flowering stage of cultivation for the plant to optimally grow, but they often end up with too little or too much water. This is particularly true for farmers who are rain-fed-only, as they are unable to supplement insufficient rain with canal irrigation or groundwater. Excess water affects all farmers equally, regardless of their irrigation sources. This presents an opportunity to help sesame farmers supplement insufficient rain with additional irrigation infrastructure, or mitigate excess water damage by planting stronger seeds with fortifying inputs or building water-drainage mechanisms.

Third, when farmers require additional irrigation for their land, they mostly spray water with a hose onto their plants. Sesame farmers lack awareness of more-efficient irrigation techniques, such as drip irrigation, which allows the water to seep into the ground more effectively.

Ultimately, there is an opportunity to support sesame farmers in managing weather unpredictability and irrigation-access challenges through a combination of awareness building, technical support, and financing solutions.

Opportunity 3 along the sesame value chain

How might we...

- Provide useful weather information to sesame farmers so that they can better adapt their land preparation and seeding timing based on predicted weather?
- Help sesame farmers in areas with underground aquifers to invest in household- or village-level groundwater irrigation infrastructure to supplement insufficient rain?
- Encourage sesame farmers with no groundwater or canal irrigation access to use the proper seed varieties and/or inputs that enable their plants to better withstand insufficient rain?
- Advise and support sesame farmers in building water-drainage mechanisms in their plots to help alleviate excess water?
- Support farmers in optimising water usage in their land?

Opportunity Area 4:

Improve soil health awareness and management practices

Sesame farmers lack awareness of the different fertilisers available on the market, their specific ingredients, and the effects of each on the plants' growth and soil health. As a result, they overapply animal manure, using it past the land preparation stage, due to a common misconception among farmers that organic fertilisers such as manure cannot hurt the plants. However, applying animal manure after the plant has begun to sprout can cause burning.

In addition, high-quality yields are largely dependent on nutrients in the soil. Currently, farmers are largely unaware of the effects the different ingredients in the fertilisers and nutrients they purchase have on soil health. For instance, farmers overuse urea (nitrogen treatment) because they believe it makes the plant stronger, when in reality it increases the acidity of the soil.

There are also very few opportunities for sesame farmers to measure their soil health in order to understand the effects of their input choices on the soil, in a way that is both accurate and timely. Per GAP guidelines, sesame farmers are required to do a soil test at the start of each season. However, farmers have reported that the current tests provided by agricultural development organisations only deliver results after the planting period is over, leaving them no choice but to go ahead and plant their crops based on their own judgement call.

There is an opportunity to build the capacity of sesame farmers on which type(s) of fertilisers and ingredients to use, the ideal timing of their usage, and the subsequent impact on soil health and plant growth, as well as provide more timely soil-health testing prior to planting.

Opportunity 4 along the sesame value chain

How might we...

- Help farmers understand which fertilisers and nutrients to use, in which amounts, and when?
- Support farmers in conducting soil-health testing prior to seeding—before it's too late to inform their cultivation decisions?

Opportunity Area 5:

Promote adequate and safe application of pesticides

Farmers live in constant fear of pests and diseases, because of the impact they have on their yields. However, they are often unaware of the conditions that cause them to flourish, lack appropriate methods of diagnosis as to which pesticides or herbicides will be most effective in treating them, and in what volumes. The challenge is partly that they only become aware of pests and diseases when they are visible on their plants or those of their neighbours.

Because the impact of pests and diseases is so significant, farmers tend to over-purchase and over-apply pesticides, herbicides, and fungicides at the first sighting of symptoms in their community. Overuse puts farmers' health in danger and adds an unnecessary expense to the farming budget. In addition, the over-application of herbicides and fungicides causes seeds to fail the quality-control standards set by importers, thereby lowering their value.

There is an opportunity to help sesame farmers identify pests and diseases; promote awareness of the appropriate pesticides, herbicides, and fungicides to use—and in what quantities; and minimise health issues related to their application.

Opportunity 5 along the sesame value chain

How might we...

- Increase the confidence of sesame farmers to diagnose pest and disease problems by themselves and make informed decisions as to the appropriate pesticides, herbicides, and fungicides to use, and in what quantities?
- Help sesame farmers preemptively avoid diseases, such as Black Stem?
- Provide safety training on pesticide storage and application?

Opportunity Area 6:

Provide access to sesame-appropriate machinery and tools

During the land clearing and preparation stages of cultivation, the machinery used for ploughing and tilling is too expensive for most sesame farmers to own. While most can access machinery from machine renters, farmers who cannot afford the rental cost rely on slower and less-precise ox-cart equipment.
During the seeding stage, sesame farmers who want to use row-planting techniques rely mostly on homemade seeders that are labour-intensive and time-consuming.

Very few farmers use harvesters, as today's machines are not appropriate for sesame planting because they produce bundles that are too big and use nylon string that too easily becomes loose to secure them, ultimately requiring the farmers to re-tie the bundles by hand, thereby duplicating work.

To address these challenges, there is an opportunity to provide sesame farmers with access to equipment and machinery that will optimise their cultivation in an affordable manner without compromising performance. This can be achieved either through better financing options for sesame-compatible equipment that already exists in the market and/or more appropriate product design for new sesame-specific equipment.

Opportunity 6 along the sesame value chain

How might we...

- Ensure access to better-performing, cost effective ploughing and tilling equipment for sesame farmers?
- Provide more effective and less time-consuming tools for sesame farmers who wish to seed using row-planting techniques?
- Help sesame farmers access affordable harvester technology that is more adapted to the bundling and tying of sesame plants?

Opportunity Area 7:

Lessen labour shortages and organise labour payments

Sesame farmers face many challenges in securing labour. They require a lot of manpower during the peak cultivation stages of weeding and harvesting. Unavailability of labour can lead to decreased yields from weed-infested fields and shattered capsules spilling in the field due to late harvesting. High demand is met with labour shortages, heightened by urbanisation and labour migration away from sesame farming communities.

For this reason, sesame farmers must pre-pay labourers in advance of the season to secure their work when they need it. However, because farmers have only limited cash flow to pre-pay labour. They must either borrow money or hire labourers later and risk delaying or being short-staffed for weeding or harvesting.

There is an opportunity to increase the supply of labourers, minimise the need at peak times through mechanisation and early weeding practices, and help cash-strapped farmers reserve labourers' time without pushing them into unbearable debt.

Opportunity 7 along the sesame value chain

How might we...

- Reduce the need for labourers during peak times, particularly for weeding?
- Increase the supply of labourers during peak times, particularly for harvesting?
- Provide farmers with options to reserve labourers through non-monetary means?

Opportunity Area 8:

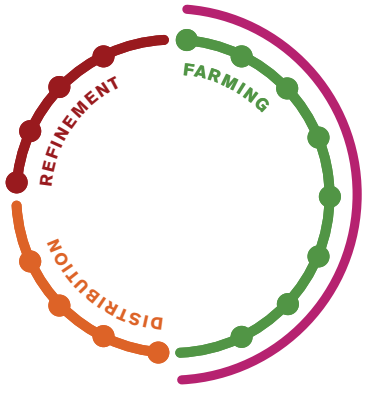
Smooth farmer cash flow to maximise income potential

The vast majority of sesame farmers grow multiple crops chosen to have compatible cultivation cycles, such as groundnut, green gram, and pigeon pea. They borrow at the start of the season in anticipation of receiving a lump sum when selling the harvest from their multiple crops. Until then, they have significant cash-flow crunches through the course of the year.

Because most farmers are obligated to repay their debts at the end of each season, they sell the majority of their harvest and set aside less than 5 percent of the seeds for the following year's propagation. Propagation seeds are the highest-quality seeds from any given harvest, attracting a 25-percent premium over regular seeds. Additionally, market prices are at their lowest during harvest season, but farmers are not able to store their harvest long enough to capitalise on price gains over the ensuing months.

There is an opportunity to design financial products that smooth farmers' cash flow throughout the year, in order to provide the financial cushion required for them to wait and sell during optimal market conditions. This would also enable them to retain their high-quality propagation seeds to sell at a premium the following year.

Opportunity 8 along the sesame value chain



How might we...

- Solve farmers' urgent need for cash at the start of the season without pushing them into high-interest informal debt?
- Enable farmers to sell at higher market prices?

Opportunity Area 9:

Design sesame-friendly credit products

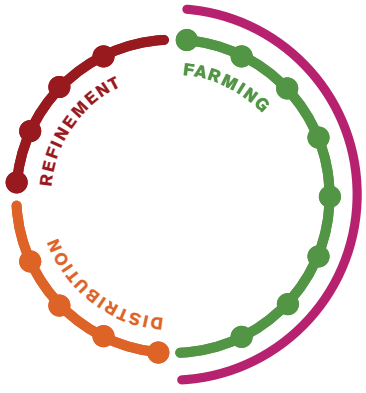
There are two particularly capital-intensive stages during sesame cultivation. The first is land clearing and preparation, when farmers rent tractors and machinery to plough and till their land. The other is weeding and harvesting, when they must pre-pay a portion of workers' wages in order to secure sufficient labour, paying the rest after harvest is sold.

Aside from cultivation-specific financing needs, sesame farmers also lack options for financing long-term investments. For instance, farmers in areas with groundwater access lack financing options to invest in household-level irrigation infrastructure such as dug wells or hand pumps.

The formal credit options currently available to sesame farmers can be restrictive. For instance, MADB loans—which are only for farmers who own up to ten acres of land—are granted based on a group lending model, wherein all farmers get their loans at the same time, and all must repay them in order to qualify for future lines of credit. This disincentivises farmers who are capable of repaying their loans to do so on time when they know other farmers are late in their repayment.

As a result, there is an opportunity to structure financing products with terms that are more friendly to sesame farmers, whether in amounts, conditions, or timing of disbursement.

Opportunity 9 along the sesame value chain



How might we...

- Provide more-personalised loans for the varying needs of sesame farmers, enabling farmers to break away from a restrictive group lending model that pushes them to seek out multiple loans to cover their immediate financing needs?
- Support farmers in financing long-term infrastructure needs?

Opportunity Area 10:

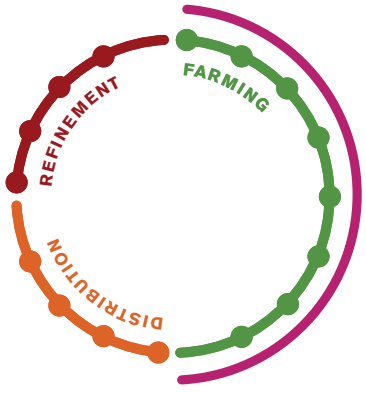
Reduce farmer over-indebtedness

Like many enterprises, farming relies on debt to operate. Farmers face inherent cash-flow shortages, and without a safety net, they risk falling into vicious debt cycles they may take years to recover from. It is common for farmers to compartmentalise household finances, with each income and loan source intended for its own discrete purpose. This leaves no room for errors, and any unexpected events such as health emergencies or bad yields cause farmers to borrow to underwrite the gap.

Investing in children's education is one of the most common aspirations for farmers, and is inevitably one of the common drivers for families to get into huge debt when the expense cannot be met through farming income.

This provides an opportunity to prevent or minimise over-indebtedness among farmers, and enable those who are already over-indebted to get out of the debt cycle.

Opportunity 10 along the sesame value chain



How might we...

- Relieve currently over-indebted farmers?
- Assess creditworthiness of farmers, to prevent them from taking out loans that they are incapable of repaying?
- Enable farmers to restart or build up a positive credit record?

Opportunity Area 11:

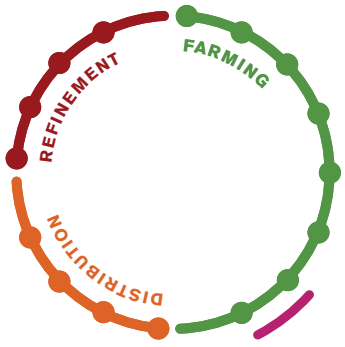
Improve post-harvest drying techniques to enhance seed quality

In order to remove seeds from the sesame plant's capsules, harvested plants need to be dried. The optimal drying process is to bundle the plant for two days before shaking out the seeds over a tarpaulin.

GAP recommendations prescribe bundling and stacking sesame plants immediately after harvesting. Most farmers, however, do not have the capacity to do so because of labour and time shortages. Additionally, farmers believe that going through the process of piling first before bundling and stacking can help them get seeds from the whole plant, maximising the quantity of seeds they can sell. As such, most sesame farmers first pile the harvested plants for six to eight days, unaware that this will increase seed acidity, lowering sale value. Traders conduct acidity tests at the point of purchase, knowing that exporters may reject the seeds.

There is an opportunity to promote better post-harvest drying techniques and provide technology that can demonstrate the value of these techniques to farmers and improve the quality of their yields for higher market prices.

Opportunity 11 along the sesame value chain



How might we...

- Help sesame farmers understand the financial impact of high-acidity seeds, in particular the potential for being rejected for export?
- Encourage sesame farmers to adopt GAP post-harvest drying practices?
- Provide sesame farmers with the means to test the acidity of their own seeds?

Opportunity Area 12:

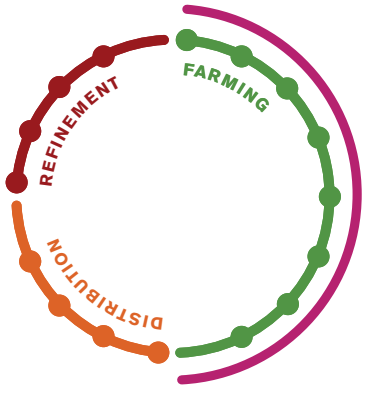
Support farmers' informed decision-making to minimise their risk

Sesame farmers need to make informed decisions when faced with potential yield-loss events and other hard-to-predict and hard-to-control fluctuations, such as storms, pest or disease outbreaks, or declining market prices. Without proper information on the likelihood and impact of these events, farmers are unable to adapt their practices to minimise or avoid these losses.

All farmers grow sesame alongside other crops, with the aim of finding the right balance between potential profit and risk. However, many farmers are driven by inertia and familiarity, using the same farming techniques and practices they are accustomed to and have been using for years. Unless they are particularly open to experimentation, this hinders their ability to adopt new, potentially advantageous farming techniques, which they currently perceive as risky.

As such, there is an opportunity to provide advisory services that enable sesame farmers to make calculated decisions that help them hedge their bets.

Opportunity 12 along the sesame value chain



How might we...

- Help farmers optimise their other crops to plant in conjunction with sesame to maximise their profits while balancing the risks inherent to sesame?
- Minimise the perceived risks and increase the awareness of farmers when it comes to trying unknown but potentially successful farming techniques?
- Support farmers in better absorbing hard-to-control and hard-to-predict weather-related losses?
- Ensure sesame farmers spread the risks of market price fluctuations?

Opportunity Area 13:

Consolidate sesame farmers' bargaining power

Aside from some low-membership groups such as the Myanmar Sesame Farmers Association, sesame farmers are not organised in farmer groups or any other form of collective organisation at scale. As such, they miss out on economies of scale for buying inputs, as well as collective bargaining when selling their harvest, on matters such as shared transportation costs and negotiating bulk sales to brokers.

There is an opportunity to support sesame farmers in organising, enabling them to potentially reduce production costs, negotiate sales prices, and advocate for their own interests.

Opportunity 13 along the sesame value chain

How might we...

- Help farmers organise themselves for bulk purchasing of inputs and required resources?
- Support farmers in strengthening collective bargaining power when selling their yields?

Opportunity Area 14:

Strengthen relationships between farmers, transporters, and brokers

Unless farmers travel with the transporter, they have no way of knowing what happens to their sesame after it leaves the farm gate. Some farmers distrust transporters and brokers, reporting that brokers may receive lower sesame volume than what was sent, or mix other low-quality sesame seeds into their yields. We have also collected unconfirmed reports from farmers of brokers adding pesticides to sesame bags after buying them in order to improve the longevity of the sesame seeds in storage. Brokers provide transporters with a receipt confirming the quantity and price of sesame purchase, but farmers do not currently provide any documentation to brokers through the transporter outlining the quantity and type of sesame they sent.

Traders and exporters often complain about the quality of the seeds they receive in order to obtain a lower price. This puts the farmers in a difficult situation as they have no control over what happens to their seeds once they are out of sight. There is also the potential for mix-ups, with the farmers measuring their yield by the volume contained in a basket, and brokers measuring the weight of the seeds (in viss).

There is an opportunity to build more-trusting relationships between farmers, transporters, and brokers to benefit all actors, ensuring that farmers get the right price for their harvests, and that buyers get the quantity and quality they need.

Opportunity 14 along the sesame value chain

How might we...

- Build trusted relationships between farmers, transporters, and brokers?
- Secure the chain of custody of sesame being transported to ensure it is not mixed with poor-quality sesame or pesticides?

Opportunity Area 15:

Encourage more value added production in Myanmar

The majority of sesame grown in Myanmar is low value and low margin. There is little-to-no refinement prior to export, which means that most of the value added in processing sesame into oil, snacks, and other formats occurs outside of Myanmar.
There are two ways to refine sesame at scale in order to add value to exports: grinding sesame into powder for milling at a later date, and direct milling to make oil. Capturing the value of these processes within Myanmar would require capital investment in local processing facilities.

This is particularly true of the milling industry, where most small, family-owned mills are unregulated, outdated, and unsanitary. Currently, oil processing is confined to small-scale, unbranded sesame milling, and has yet to achieve economies of scale that result in higher price points for both domestic consumers and export markets. There is potential for sesame oil to be produced at larger scale, but actors in Myanmar have yet to rise to the challenge.

Additionally, while sesame farmers are driven by export demand, as evidenced by the fact that a majority of them now focus on growing black sesame, the quality of the sesame grown does not always meet the quality and food safety standards upheld by importers, and exporters in turn. While the introduction of GAP for sesame attempts to address this disconnect, it has yet to be adopted by most sesame farmers in Myanmar.

There is an opportunity to support farmers in meeting export quality and food safety standards, as well as to increase the capacity of actors that refine and process sesame in Myanmar, in order to capture more value domestically.

Opportunity 15 along the sesame value chain

How might we...

- Increase the production of high-value sesame products in Myanmar?
- Motivate farmers to grow more red sesame, which produces higher yields, is more weather-tolerant, and increase the capacity of millers to produce high-quality, potentially exportable, sesame oil?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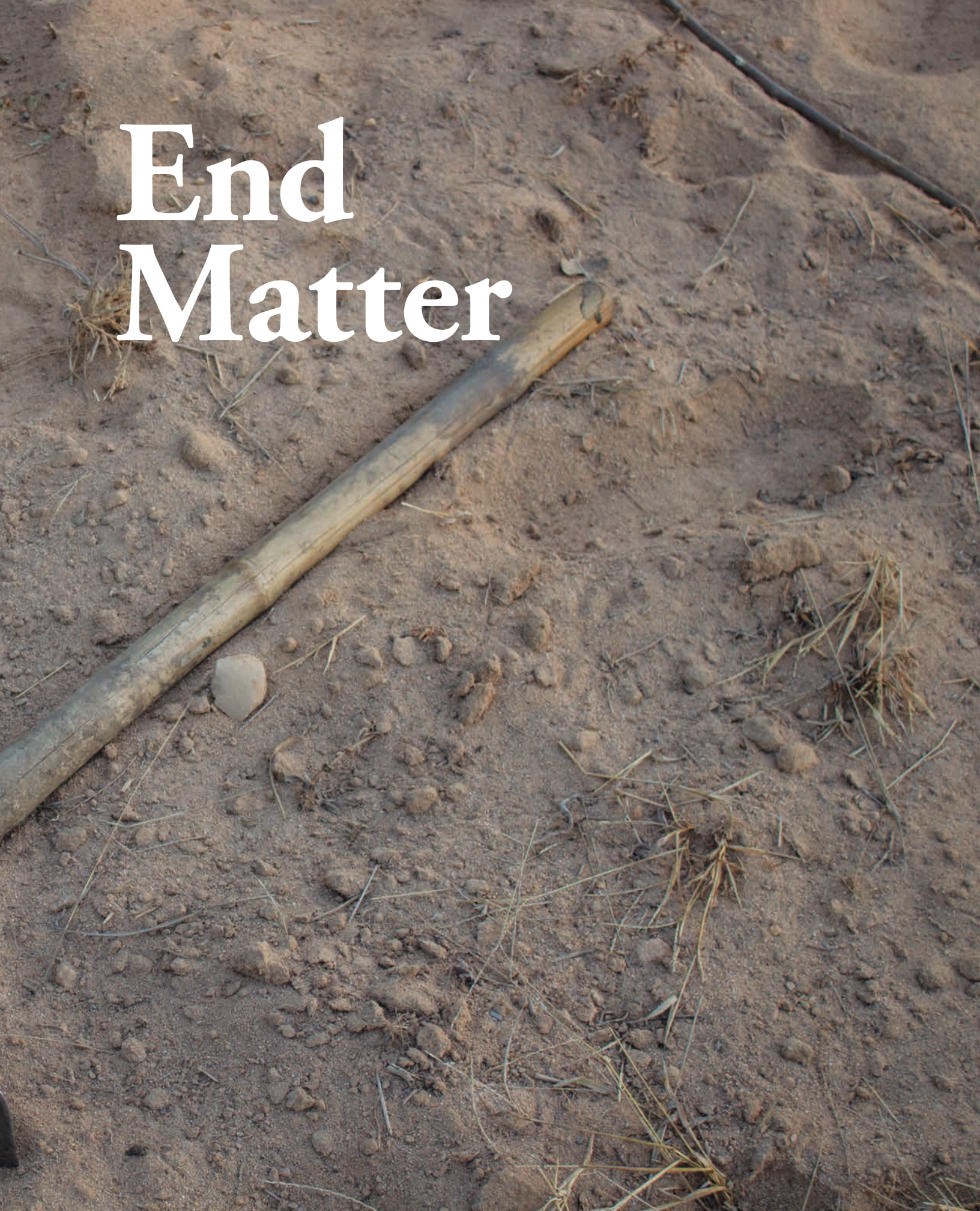


End Matter

Appendices

Appendix A: Methodology

Primary research in Myanmar began in January 2019 following six months of planning and coordination between Proximity Designs and Studio D. On-the-ground interviews, data collection, and sensemaking took place over eight weeks with a team of ten.

Research Protocol

Leveraging the extensive field presence of Proximity Designs, the team identified research participants across the entire sesame ecosystem. These included a range of farmers, day labourers, service providers, millers, brokers, traders, and exporters. Recruitment was carried out by research coordinators following recruiting criteria, including net wealth signifiers described in Appendix B, determined during the planning stage, and adapted throughout the data collection phase. A few participants were already Proximity Designs clients.

The research was completed through a combination of ethnographic interviews, a small-scale consumption survey, and desk research.

Ethnographic interviews

The team used the following qualitative and empathic research techniques:

- **In-Depth Contextual Interviews** held inside the home, field, or workplace, and sometimes including additional contextual visits (e.g., to the mill or market). These sessions focused on a single family member, such as the farming head of the household, but often included other people in proximity. Interviews ranged in duration from 60 to 120 minutes.
- **Ad-hoc Interviews** conducted in villages and local markets, with sesame input vendors, transporters, retailers, and other parts of the ecosystem. These sessions lasted from 5 to 50 minutes.
- **Dyads**, or pair interviews, to leverage the relationship between 2 participants (often married couples). This format prompted discussion about different roles and daily responsibilities in making large household and business purchase decisions.
- **Group Interviews** conducted with 3 to 8 people. Sessions lasted up to 1 hour.
- **Observations** to better understand behaviours in a diverse range of environments. Sessions ranged from a few minutes to an hour, and often led to ad-hoc and in-depth interviews.
- **Subject Matter Expert Interviews** conducted with government advisors, exporters, researchers, and members of the Myanmar Agribusiness Public Corporation (MAPCO), DOA, and CESD.

In total, the team conducted 81 ethnographic interviews with 108 participants, the majority of whom were recruited through purposive sampling, with the exception of ad-hoc interviews which used a combination of purposive and snowball sampling methods.

Survey

To better understand the sesame ecosystem from a consumer's point of view, and in the absence of comprehensive market research data around sesame consumption by Myanmar households, the team designed and administered a survey that was completed by 148 respondents, selected through a convenience sampling approach. The survey results were corroborated using 2018 sales data from a major retailer across Myanmar. References to the survey findings in this report are cited as "(Proximity Designs 2019)".

Table 22: Ethnographic research by the numbers

34	Farmers
20	Distribution value chain actors (including brokers, traders, exporters)
11	Refinement value chain actors (including millers, and brittle and tahini processors)
9	Labour and machinery actors
5	Input vendors (including seed, fertiliser, and pesticide vendors)
3	Financing actors
26	Other (including agricultural NGOs, government representatives)

Distribution

4	Yangon
29	Pwintbyi township
27	Magway township
14	Aunglan township
5	Mandalay
2	Wetlet township

Literature review

Findings from ethnographic interviews and the consumption survey were complemented by a literature review and internal reports from Proximity Designs. Additionally, the team referenced unpublished data from a large-scale household survey in Myanmar's Central Dry Zone graciously shared by CESD researchers.

Locations

The team travelled to Aunglan, Magway, and Pwintbyu, three major sesame-growing areas located in the Dry Zone.

- Our first destination was **Pwintbyu**, a township with a long history of sesame farming during both monsoon and winter harvests that suffered from several consecutive years of bad weather, leading its farmers to face significant yield loss and quality control issues.
- **Magway**, our second destination, is the township that produces most of the sesame volume in Myanmar during the monsoon season. It is a popular hotspot for extension service providers and other peripheral agricultural actors, making it a township with high farming knowledge and good access to markets.
- The third and final destination was **Aunglan**, a township known for producing the highest quality export sesame in Myanmar. Its farmers grow sesame almost exclusively during the monsoon harvest.

Additional interviews were conducted in Yangon with experts, in Mandalay with actors involved in border trade, and in the Wetlet township with farmers with unique irrigation access.

Team

The team comprised members from **Proximity Designs and Studio D**. Proximity Designs' researchers and coordinators have deep knowledge and experience of partnering with Myanmar's smallholder-farmers, allowing them to bring global ideas to local context. Studio D members are designers with expertise in high-paced field-research projects, sensemaking, cross-cultural team facilitation, ideation, design and strategy. Fieldwork was conducted using Studio D's pop-up studio methodology, a live/work space optimised for cross-cultural teams working towards a shared goal, and suited to international research, design, and innovation projects that require rapid immersion into new consumer segments, and considerable iteration on ideas and designs.

Figure 37: Research map

Myanmar (Magway division and three townships highlighted)

Table 23: Participant codes

Methodology	Location	Gender
In-depth interview, IND	Aunglan, AL	Couple, C (e.g., C01)
Ad-hoc interview, ADH	Pwintbyu, PB	Female, F (e.g., F04)
Expert interview, EXP	Magway, MG	Male, M (e.g., M12)
Dyad (pair) interview, DY	Mandalay, MDY	
Group interview, GRP	Yangon, YG	

Limitations

While the team believes the data presented in this report is broadly representative of the sesame ecosystem, a few limitations are worth noting:

- Although the team is well versed in conducting research on sensitive topics, it can be difficult to ascertain accurate financial figures due to reluctance and nervousness in disclosing revenue amounts presenting discrepancies with those reported for tax purposes, income generated from activities requiring specific permits and licenses, or the significant black and grey markets in sesame exports via the Chinese border.
- The project timeline spanned two months, including one week of desk research and three weeks of field research. The research overlapped with a particular part of the sesame growing calendar—namely the land clearing and preparation stage—but the team recognises that it has not experienced the entire cultivation process in its entirety. This impacts which contexts and activities can be observed, the participants available (given increasing seasonal migration in some parts of Myanmar), the topics on participants' minds, the direction of interviews, and the likelihood that responses are accurately recollected. A photographer was hired specifically to gather documentation from other stages of the cultivation cycle.

Photography

The team generated 10,227 photos during the project, a fairly typical amount for a study of this nature. These were catalogued and filtered down to 915 photos, for use as a working archive. A photo archive from this project is available under a Creative Commons license.

Quotes

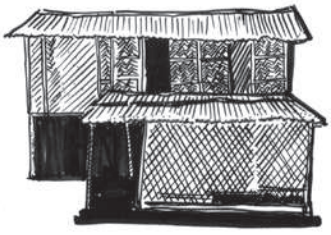
Throughout this document, we use direct quotes. Each quote is attributed to the subject using a participant code. Each participant code was generated and maintained throughout data collection, enabling the team to scrub sensitive and identifying information (e.g., name, village) while being able to accurately reference participant data. Every photo collected in the study uses the same encoding, enabling us to trace quotes to people.

Each code references the location of the interview, the type of interview, the participant's gender, and an optional short descriptor of said participant. For example, a quote attributed to the fourteenth female in-depth participant from the Pwintbyu township is coded as (PB-IND-F14 Modern Farmer). The full categories are shown in *Table 23*, on facing page.

Appendix B: Net Wealth Signifiers

In rural Myanmar, diverse income sources, inaccurate self-reporting, the use of barter, and extended families can make it challenging to estimate household income and equate it with wealth and a given standard of living. For this reason, we developed a more nuanced net wealth signifiers (NWS) approach, shown in *Table 24*, that considers the myriad of other factors. This approach guided our recruiting criteria for farmers.

Table 24: Net wealth signifiers



Properties	Low net wealth household	Medium net wealth household	High net wealth household
Home	Mostly bamboo structure	Well-built wooden structure	Brick wall
Roof	Thatch	Tin	Tin
Wall	Bamboo or open	Bamboo	Brick and plaster
Ground	Dirt	Dirt	Concrete
House extension	Open resting area on ground under home or tree shade	Kitchen attached to home	Separate building(s) to house relatives
Storage space	None—bags stored in living area	Multiple cabinets and metal trunk	Multiple cabinets and metal trunk, safe, and roof storage
Resting area	Blanket on ground	Shaded, raised platform	Dedicated seating areas, balcony
Kitchen	Wood-burning stove on ground	Wood-burning stove on counter	Wood-burning stove and electric stove on counter
Toilet	Basic wooden-shack outhouse, squat toilet	Solid wooden-shack outhouse, squat toilet	Concrete outhouse, with squat or seated toilet
Entertainment	Cell phone, radio	Small TV, satellite, basic sound system, old-model smartphone	Big screen TV, large soundsystem, new-model smartphone
Electrical appliances	<2 standalone lights, run from battery	Multiple standalone light bulbs, run from battery and solar charger	Access to mains electricity or generator, built-in lights with switches, fuse box, battery, fan
Rice purchase	Daily	Weekly to monthly	Monthly or a few times a year
Oil for cooking	Mixed vegetable oil	Mostly mixed vegetable oil and some sesame or sunflower oil	Sesame or sunflower oil
Farm equipment, if owned			
Farm machines	Ox-cart	Ox-cart + small tractor	Minimum of 1–2 small tractors
Acres owned	3–5	5–15	15–30
Selling-decision	Immediately sells crops after harvest for quick cash and to pay labourers	Immediately sells half of crops after harvest, stores some	Stores most of crops until there is optimal market price for selling

Appendix C: Units Of Measurement

The following are widely used in the sesame ecosystem and draw on traditional, imperial, and metric units of measurement. Some measurements are precise, others with margins of error. The units most commonly used by farmers are plot (land for farming), nozibu (for volume of planting seeds), basket (for volume of harvest), and viss (for measuring oil volume).

Measurements of Time

Farmers use different units of time for a plant's growth stages, e.g., *sat kyar hle chain* for a seed to grow three leaves, or *kyat chay su chain* for when the plant starts to flower.

Furthermore, farmers rarely use clocks to understand key moments in time, preferring to rely on *lay chat tee*—the 4 am call of the monastery gong—to start their day.

Animal sounds are also commonly associated with time, such as *kyee ma noe khin* (4 am), the time before the crow wakes up; *lin kyat ton chain* (6 am), the time before the cock crows; or *nwar yein thwin chain* (6 pm), the time for cattle herding.

Lengths / Distance

Unit	Metric or imperial	Example of use for measuring
1 sesame	0.79 mm	Height measurement of plants. The smallest unit of measurement is a single sesame
1 lat thit	Half a thumb length (1.9 cm)	
1 lat ma	Thumb length (5 cm)	
1 mite	The span of a hand with closed fist and extended thumb (10.16 cm)	
1 htwar	The span of a fully extended hand, from thumb to pinky (20.32 cm)	Distance between crops in an intercropped field
1 taung	One forearm (45.72 cm)	Height of piled sesame
1 pyan	One arm (76.2 cm)	Width of piled sesame
1 kite	91.44 cm (3 ft)	-
1 than kyoe	22 kite (20.11 m, 66 ft)	Distances (e.g., how far a house is from a road or field)
1 furlong	10 than kyoe (0.2 km)	Used as distance markers on the highway between Yangon and Naypyidaw (in addition to km)

Weight Measurements for Gold

Unit	Metric	Imperial/US
yway lay	136.078 mg	2.1 grains
yway kyi	272.155 mg	4.2 grains
petha	1.02058 g	15.75 grains
mutha	2.04117 g	31.5 grains

For savings, usually bought in the form of jewelry. Customer will pay a premium for a beautiful design

Weight Measurements for Non-Gold Items

mattha	4 g*	0.144 oz
nga mutha	8 g	0.288 oz
kyat tha	16 g	0.576 oz
peit tha (1 viss)	1.63 kg	0.576 oz
a chein taya (100 viss)	163.29 kg	360 lb

Used in multiple contexts, ranging from poultry at wet markets to spices.

* Decimal places are relevant for gold, but not oil.

Field Size

1 plot	1–3 acres	Standard unit of measurement used by farmers for field size
Baskets per plot	Typically 1–2 baskets per plot	Baskets of sesame seed required to plant a single plot
1 tin kya	1 basket	Baskets of sesame seed required to plant a single plot
1 acre (ac.)	4,047 m^2	Not used by farmers day to day, except in interactions with government officials
1 hectare (ha.)	10,000 m^2	Not used by farmers day to day, except in interactions with government officials

Seed Weight

1 seit	4 pyi	Widely used by farmers to measure the volume of seed required to plant a plot, or the yield of that plot after harvest
1 khwe	8 pyi	
1 tin (basket)	16 pyi / 15 viss / 54 lb / 24.5 kg	
1 pine	24 pyi	Used by brokers
1 sack	48 pyi / 3 baskets / 45 viss	Used by brokers. One sack is 25 viss
1 viss	1.63 kg / 3.6 lb	Used by farmers, brokers and consumers. For example the most popular volume of sesame oil bottle sold to consumers is 1 viss
2 stone	1 quart (6.35 kg)	For measuring body weight
4 quarts	1 hundredweight (25.4 kg)	For measuring liquid volume
20 hundredweight	~1 metric ton (1,000 kg)	For export weight measurement

Seed Volume Measurement

1 nozibu*	395 g
1 lat myote	¼ nozibu
1 lat myat	½ nozibu
1 sale	2 nozibu
1 khwat	4 nozibu
1 pyi**	8 nozibu
1 sate**	4 pyi

* A nozibu is a standard condensed milk can, widely available in villages. Used by farmers for measuring how much seed to plant in a field

** Seeds in a sack, typically used by seller

Appendix D: Administrative Units

References (General Administration Department 2013, Department of Population 2015)

Name	Nationwide	Magway Division*
National	1	-
States	7	-
Divisions	7	-
Districts	75	5
Townships	330	25
Towns	458	32
Wards	3,400	197
Village tracts	13,599	1,539
Villages	63,282	4,790
Households	10,889,348	919,777
Households with mains electricity	·	411,310

* Where most sesame is grown in Myanmar.

Appendix E: Glossary

12-wheel truck
Medium-sized truck used for the domestic transport of sesame.

16-tooth extension
Equipment that can be attached to a 4-wheel tractor, used for ploughing the land.

22-wheel truck
Largest truck used for transporting sesame out of Myanmar.

3-wheeler
Motorised vehicle with three wheels typically used by village transporters to take sesame from a farmer to a broker. Also known as a 'tuk-tuk'.

4-wheel tractor
Most commonly used large-scale machine in sesame farming. Often used with extensions to work the land. — *see also '6-tooth extension' and '16-tooth extension'*

6-tooth extension
Equipment that can be attached to a 4-wheel tractor, used for clearing the land of trash, weeds, and dead plants.

aflatoxins
Toxins produced by fungi that can cause an array of human health effects. Piling of plants post-harvest increases aflatoxins in the sesame seeds.

agrochemicals
Fertilisers, pesticides, herbicides, and fungicides.

aquifers
Underground bodies of water. — *see also 'groundwater'*

AV (acid value)
Indicator of acidity in the fatty acids of sesame seeds or cooking oil. AV values over 2.5 percent are considered unsafe for consumption. — *see also 'pH'*

basket
Farmers' unit of measurement when selling sesame to brokers. Based on volume, not weight.

Black Samone
Also known as Samone-Nat. Most popular black sesame variety, grown mainly for export.

Black Stem
Disease that causes the sesame plant to dry up and die. Most yield-loss-incurring disease for sesame planting.

bollworm
Insect that eats the flowers, leaves, and fruits of the sesame plant. Can infect the fruits, causing them to fall before ripening.

border trade
Flow of goods and services across international borders (e.g., from Myanmar to China). — *see also 'marine trade'*

brittle
Confection made of hard sugar candy embedded with nuts or seeds, the most popular of which are peanuts and sesame.

broadcasting
Method of seeding involving scattering seeds by hand. — *see also 'row planting'*

broker
Actor in the distribution value chain who purchases sesame directly from farmers and stores them for resale to a trader. — *see also 'distribution value chain'*

bundling
Process of tying a bunch of sesame plants together with a sesame plant stem. — *see also 'stacking'*

cake
Dense pulp obtained as a byproduct from milling sesame into oil and used as animal feed. With small millers, farmers often have their sesame oil milled for free, in exchange for the leftover cake.

canal irrigation
Irrigation provided through government canal infrastructure and connected to farmers' land via offshoots. — *see also 'offshoot'*

CESD (Centre for Economic and Social Development
Independent and non-political think tank focused on public policy research in Myanmar to support development.

CEXC (Crop Exchange Centre)
Physical location where business transactions and price negotiations between brokers and traders take place.

clay soil
Soil composed of clay minerals with high water-holding capacity. — *see also 'sandy loam soil'*

compound fertiliser
Fertiliser with varying permutations and proportions of potassium, phosphorous, and nitrogen mixed.

cotton aphid
Pest that causes sesame plant leaves to wilt, curl inwards, and ultimately dwarf. Also referred to as melon aphid.

crop rotation
Common farming practice that promotes soil health by switching the crops grown on a plot of land every season or every few seasons.

Daw
Honorific title, referring to a woman, generally aged 35+ ('Ma' is used for younger women). — *see also 'U'*

dee-dote tree
Rare tree found in certain villages used by farmers to forecast weather by observing the way it branches.

distribution value chain
Chain of activities starting with the sesame harvest leaving the farm gate to be sold to brokers and traders, and ending with export.

DOA (Department of Agriculture)
Department under the Ministry of Agriculture, Livestock, and Irrigation responsible for monitoring agricultural activities in Myanmar.

dug well
Water well consisting of a relatively wide excavation reaching groundwater. — *see also 'tube well'*

engine-powered pump
Water pump powered by an electric or fuel engine, also known as a 'motor pump'. — *see also 'hand pump' and 'treadle pump'*

farm gate price
Price that a farmer gets when selling a harvest.

flower bloom
Phase of plant growth when the sesame plant produces flowers that will set fruit. — *see also 'ripening'*

foliar
Liquid fertiliser applied to the leaves, used to promote flower and fruit strength.

formal credit providers
State-owned banks, private banks, non-governmental organisations, and cooperatives whose lending activities are formally regulated and supervised. — *see also 'informal credit providers' and 'semi-formal credit providers'*

Form 7
Legal document provided to landowners by the Department of Rural Development upon acquiring land through inheritance or purchase.

fungicides
Chemical substance used to kill fungus. — *see also 'agrochemicals'*

GAD (General Administration Department)
Civil service body that staffs all regional- and state-level governments in Myanmar and administers the country's districts and townships.

GAP (Good Agricultural Practices)
Set of guidelines to help Myanmar's agricultural industry improve access to export markets by meeting international food safety standards.

germination
Sprouting of a seedling from a sesame seed. — *see also 'seedling'*

grey market
Unofficial market of goods that are transacted legally but outside the commonly-used channels and at lower prices. Significant volumes of Myanmar sesame exports flow through the grey market.

groundwater
Water held underground in aquifers. — *see also 'aquifers'*

gypsum
Fertiliser used to promote plant strength and help retain moisture in soil.

hand pump
Human-powered pump used for irrigation, operated manually. — *see also 'engine-powered pump' and 'treadle pump'*

harvester
Large-scale machine used to harvest crops. Not commonly used for sesame farming.

herbicides
Chemical substances used to control unwanted plants, also known as "weed killers". — *see also 'agrochemicals'*

host
Plant, when infected with a disease. A plant's relative health or weakness is one of the three factors that determine the likelihood of a disease outbreak, in addition to a strong pathogen and favourable environment conditions. — *see also 'pathogen'*

hundi
Informal form of remittance instrument.

informal credit providers
Individual and institutional lenders whose credit provision activities are neither formally regulated nor supervised. — *see also 'formal credit providers' and 'semi-formal credit providers'*

intercropping
Cultivating two or more crops on a plot at the same time, either in the same row or in adjoining rows. — *see also 'monocropping'*

key plot
A pre-selected exemplary plot receiving the most investment from both farmer and extension service providers.

litmus test
Test of pH level to determine how acidic or alkaline a substance is. — *see also 'pH'*

lowland
Land with clay soil, best suited for crops with high water needs such as paddy. — *see also 'upland'*

MADB (Myanmar Agricultural Development Bank)
State-owned bank and largest agricultural financial institution in Myanmar.

marine trade
Shipment of goods by sea or other waterways. The main marine trade routes for Myanmar sesame go to Japan, South Korea, and Singapore. — *see also 'border trade'*

melon aphid
— *see 'cotton aphid'*

miller
Actor in the refinement value chain who processes sesame seeds into oil. There are 3,156 registered millers in Myanmar. — *see also 'refinement value chain'*

moisture test
Test to assess moisture levels in a sesame harvest.

monocropping
Cultivating a single crop in a plot of land at a given time. — *see also 'intercropping'*

monsoon season
Season spanning the months of June through September. — *see also 'summer season' and 'winter season'*

nematodes
Parasitic animals that can dwarf the sesame plant and cause the leaves to turn yellow and brown.

offshoot
Lateral shoot from a main canal, connecting it to farmer plots. — *see also 'canal irrigation'*

oilseeds
Crops grown primarily for the oil contained in their seeds.

pathogen
Disease-causing agent. When strong, is one of three elements needed for a disease outbreak to occur, in addition to a weak host and favourable environment conditions. — *see also 'host'*

peri-urban
Transition zone between urban and rural areas.

pesticides
Chemical substances used to control or kill pests and diseases. — *see also 'agrochemicals'*

pH
Indicator of acidity in soil. The optimal pH level for growing sesame is 5–8. — *see also 'AV' and 'litmus test'*

piling
Placing harvested sesame plants horizontally on top of one another. Causes increased acidity and aflatoxins in sesame seeds.

plot
Contiguous unit of land owned by the same person.

ploughing
Process of digging deep into the soil and turning it over. — *see also 'tilling'*

plucking
Removing sesame plants grown in sandy loam soil by hand in their entirety, roots included. — *see also 'reaping'*

processor
Person or organisation that processes sesame seeds into brittle or other refined product. — *see also 'refinement value chain'*

production value chain
Chain of activities starting with planning the cultivation cycle, and ending with the cultivated and harvested crops leaving the farm gate. Also referred to as 'farming'.

propagation seeds
Harvested sesame seeds meant for replanting, and selected on the basis of their high quality and purity.

pulses
Dried edible seeds, including dry peas, chickpeas, and pigeon peas.

rainfed-only irrigation
Sole reliance on rain to irrigate crops.

reaping
Cutting ripe sesame plants grown in clay soil with a reap curl knife during harvest, leaving roots in the ground.— *see also 'plucking'*

refinement value chain
Chain of activities starting with the sesame harvest leaving the farm gate, and ending with it being milled into oil or processed into food products distributed in retail for consumption.

ripening
Phase of plant growth when the fruits set by the sesame plant flowers are maturing. — *see also 'flower bloom'*

row planting
Method of seeding that involves planting seeds in straight lines. — *see also 'broadcasting'*

sack
Unit of measurement used by traders and exporters when packaging and transporting sesame.

Samone
— *see 'Black Samone'*

sandy loam soil
Soil composed of a mix of sand, silt, and clay, with the ability to drain water well. Ideal for planting sesame. — *see also 'clay soil'*

seeding
Planting seeds in the land.

seedling
Young sesame plant developing from a seed. — *see also 'germination'*

semi-formal credit providers
Community-based organisations (village revolving funds, village savings, credit groups) and registered pawnshops providing loans. — *see also 'formal credit providers' and 'informal credit providers'*

semi-processed sesame
Roasted sesame powder meant to be fully processed post-export.

sesame seed bug
Larva that sucks the sap out of the sesame plant.

sesamum jassid
Leafhopper that sucks the sap from the bottom of the sesame plant.

sesamum phyllody
Disease that can dwarf the sesame plant, causing leaves to grow in small, twisted bunches along the stem.

shattering
Breaking of sesame capsules due to over-dryness, resulting in the loss of the seeds they contain.

sieving
Separating sesame seeds from unwanted material such as leaves, branches, sand, and debris. Typically done in two phases: a rough sieving in the field post-harvesting, and a finer sieving after the seeds are transported to the farmer's home.

stacking
Process of positioning sesame plant bundles upright in the shape of a tripod for sun exposure while drying. — *see also 'bundling'*

summer season
Season spanning the months of February through May. — *see also 'monsoon season' and 'winter season'*

Tabaung
Twelfth month of the Burmese calendar. Forecasting for the months ahead takes place by observing wind during its first three days.

threshing
Process of removing seeds from dried sesame plants. Typically done in the field post-harvesting, on a tarpaulin.

tilling
Digging the topsoil to sift through it. — *see also 'ploughing'*

trader
Actor in the distribution value chain who purchases sesame from brokers and sells it to exporters. — *see also 'distribution value chain'*

treadle pump
Human-powered suction pump used for irrigation, operated by stepping up and down on levers. — *see also 'hand pump' and 'engine-powered pump'*

Trichoderma
Effective fungus added to the soil to prevent Black Stem disease. For the purpose of sesame cultivation, we are referring to *Trichoderma harzianum*.

tube well
Water well consisting of a narrow stainless steel tube bored into groundwater. — *see also 'dug well'*

U
Honorific title, referring to a man, generally aged 35+ ('Ko' is used for younger men). — *see also 'Daw'*

upland
Drier sandy loam soil, best suited for crops with low water needs such as sesame.

urea
Nitrogen fertiliser, used to support plant growth.

village head
Elected village-level administrator responsible for village development.

winter season
Season spanning October through January. — *see also 'monsoon season' and 'summer season'*

Appendix F: Abbreviations

AV
Acid value

CESD
Centre for Economic and Social Development

CEXC
Crop Exchange Centre

DOA
Department of Agriculture

DOI
Department of Irrigation

DTC
Department of Trade Promotion and Consumer Affairs

GAD
General Administration Department

GAP
Good Agricultural Practices

GB
Gigabyte

GDP
Gross Domestic Product

IFC
International Finance Corporation

JICA
Japanese International Cooperation Agency

LED
Light-emitting diode

MADB
Myanmar Agricultural Development Bank

MAPCO
Myanmar Agribusiness Public Corporation

MMK
Kyat (Myanmar currency)

MOALI
Ministry of Agriculture, Livestock, and Irrigation

NGO
Non-governmental Organisation

NWS
Net wealth signifiers

PC Myanmar
Progetto Continenti in Myanmar

SFDA
Sesame Farmers Development Association

USD
United States Dollars

Appendix G: References

Note: Given that Myanmar does not recognise surnames, author names are either referenced in full form for Burmese names or include last name with first name initial for non-Burmese names.

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Finally, to better understand domestic consumer preferences for sesame products, Proximity Designs conducted a consumption survey with 148 respondents in 48 townships across Myanmar. References to the survey's findings appear as "(Proximity Designs 2019)".


MODERN

About Proximity Designs

Proximity designs and delivers affordable, income-boosting products that complement the entrepreneurial spirit of rural families in Myanmar. We are a socially driven organisation, operating here since 2003.

Fast forward to 2019, we now run Myanmar's largest agricultural services platform, spanning farm technology, farming advice, and finance. An economic research team complements by understanding the macro picture, and our design labs team pilots new products and services. From modest beginnings, we have now grown to an 800-person-strong team.

Our focus is on sustainable impact, at scale. By 2018, we had served 550,000 farmers through our platform, and we now engage 100,000 new customers a year. Each sees an average of 250 USD annual income increase as a result—a life-changing amount for those living on less than 3 USD a day.

Our name, Proximity Designs, reflects the belief of the founders, Jim and Debbie Taylor, that the best way to serve people is to first understand their motivations, needs, and aspirations. To that end, we apply human-centred design, at the heart of which is empathy: the commitment to relate to people on their own terms, rather than ours. This is the foundation of thoughtful, impactful, and scalable products and services that we bring to market.

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About Studio D

Studio D is a research, design, and strategy studio based out of San Francisco and Tokyo. We specialise in running international ethnographic research studies to inform and inspire product, service design, strategy, and communications. While most of our work is for corporate and government clients, we believe that all projects should deliver positive social impact.

Furthermore, we recognise that the poor can least afford poor design, and that the onus is on the designer, in the broadest definition of the term, to ensure that the well-being of the users and customers is put first.

This is our fifth project with Proximity Designs. Each has been approached as a partnership, where deliverables extend beyond reports, recommendations, and prototypes—the things one normally finds in a contract—to include knowledge, process, and skill transfer. How we work together impacts what we are able to deliver, and every project should challenge minds and flutter hearts.

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Colophon

This report is commissioned by Phyu Hninn Nyein, on behalf of Proximity Designs. It takes a team.

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Made possible by the chime of the morning gong, dumplings from that stall, printed fans, impromptu karaoke, copious amounts of Milo, uncles and aunties, Black Samone 90, waking up to breakfast cooked by friends, Genius coffee, a cathartic firepit ceremony, and the intense satisfaction of everything turning blue as the sun dips below the horizon.

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