Chapter 8

CROP PRODUCTION: AN ENGINE IN NEED OF AN UPGRADE

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According to the Myanmar Living Conditions Survey (MLCS) undertaken in 2017, 54 percent of rural households and 8.4 percent of urban households earn some of their income from crop farming (CSO, UNDP, and World Bank 2020). As seen in Chapter 2, crop production has important value-added and employment linkages upstream and downstream from farms, including in fertilizer and chemical input supply, mechanization services, transport, processing, wholesale and retail distribution, and exports. Crop production also provides the majority of the nation's calorie intake as well as raw material for processed animal feed. However, as Chapter 3 shows, with maize as the one exception, the crop sector itself has not grown in recent years due to decades of underinvestment in agricultural research, limited transport infrastructure, and highly variable prices for export crops. This chapter provides a more detailed picture of the spatial distribution of crop production and production technologies, which is relevant to the discussion in Chapter 18 on regional variations in rural livelihoods.

The key decision-makers in Myanmar crop production are smallholder farmers who gain their livelihood from multiple economic activities on and off the farm. They allocate their limited time and resources in an environment characterized by high levels of uncertainty in weather and economic conditions, especially crop prices. Within the crop production subset of family economic activities, their choices depend on agroecological conditions, access to land and labor for farming, knowledge of and access to technology, access to financial resources, expectations of market prices, and perceptions of risk. Put simply, crop production is a very difficult juggling act.

Government support for crop production has often been ineffective. The rice subsector is a classic example. Here, large public investments in irrigation and seed production to ensure self-sufficiency have often been undermined by draconian marketing policies, such as forced quota sales at low prices (Boughton et al. 2020a). By 2013, most of these restrictions had been lifted, but they left many farmers indebted. Other crop sectors, such as pulses, maize, and horticultural crops, thrived (in a relative sense) because of government neglect. However, as pointed out in Chapter 3, limited public investment in agricultural research and extension and in transport and export logistics infrastructure has held them back.

This chapter has four objectives. First, we describe the composition of the crop sector and general trends over time—data limitations do not permit anything more precise. Second, we describe how a range of constraints to crop production—related to climate, technology, markets, and policies—interact to result in stagnation. Third, we consider how the military coup has affected farm households and crop production. In conclusion, we review the investments and policies necessary to make crop production a more viable enterprise in the small farm household portfolio over the long run. This chapter also provides links to other chapters in the book that explore in more detail specific drivers of (or influences on) crop production, such as mechanization.

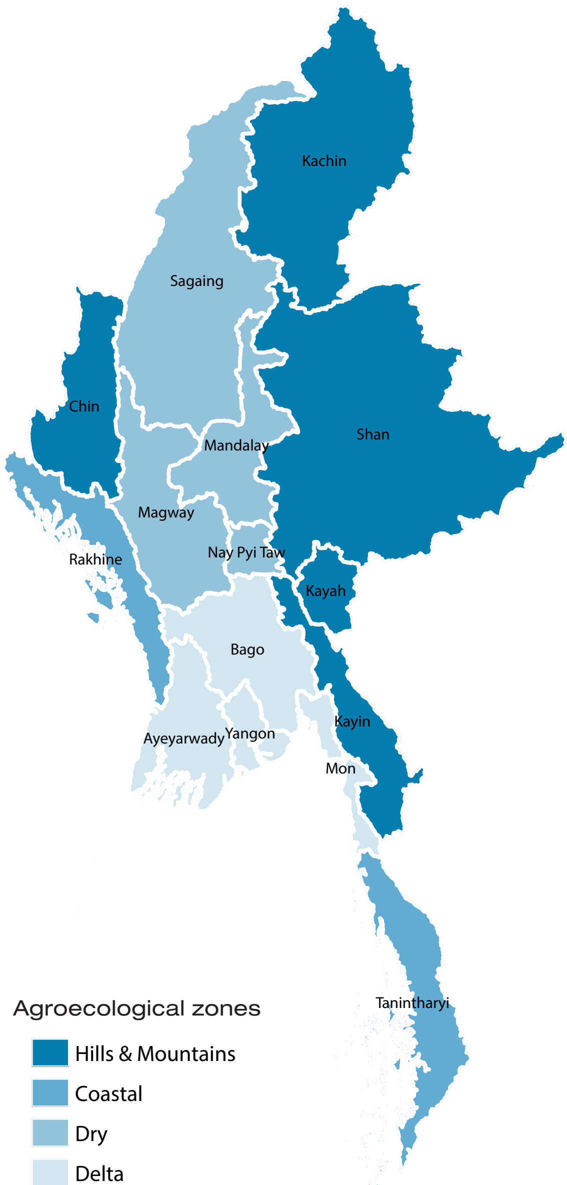
This chapter does not aim to be comprehensive. We include all crops that make a major contribution to consumption, smallholder incomes, and value-added processing: rice, pulses, oilseeds, maize, horticulture, coffee, and tea. We omit others that are potentially interesting but of limited significance to agrifood system development, including cotton, palm oil, and rubber. The next section provides a brief overview of Myanmar's agroecological zones (AEZs) and cropping patterns, noting the significance of climate change. We then unpack the technology–markets–policy nexus affecting specific crop subsectors before presenting conclusions.

Agroecologies, climate change, and cropping patterns

Four AEZs are typically distinguished in Myanmar: Dry Zone, Hills and Mountains, Delta, and Coastal Zone (Figure 8.1). Rainfed agriculture is still the primary livelihood for most rural people (IMWI 2015). However, growing rainfed crops has risks: access to water for irrigation is critical to reducing these risks and expanding the production options available to farmers (Rosegrant, Xie, and Valmonte-Santos 2018).

The Dry Zone of central Myanmar covers roughly one-third of the country's cropping area and is the most water-stressed of the four zones. The rainfall pattern is bimodal due to a July dry spell during the May to October monsoon season (Herridge et al. 2019). The zone's climate has changed noticeably over the past two decades: the same amount of rain now falls on

FIGURE 8.1 Map of Myanmar's states, regions, and agroecological zones



Source: CSO, UNDP, and World Bank (2019).

one-third as many days as before. The irregularity and intensity of rainfall in the Dry Zone leads to both drought and flooding within a single season (Mather et al. 2018). In the monsoon season, rice is grown as a rain-fed crop, often with supplementary irrigation. The post-monsoon rice crop is dependent on irrigation. Other crops commonly grown in the Dry Zone include pulses, groundnut, sesame, and sunflower. Significant investments in gravity and pump irrigation expansion schemes were undertaken in the Dry Zone to increase paddy production, particularly in the 1990s (Boutry et al. 2017). However, the potential of irrigation to contribute to increased crop production has been undermined by drought, reducing reservoir stocks in the case of gravity irrigation. Moreover, pump irrigation in locations with sandy soils has often proven unprofitable.

The Hills and Mountains AEZ covers roughly one-fifth of Myanmar's agricultural land area. The zone surrounds the Dry Zone to the west, north, east, and southeast and borders India, China, Lao PDR, and Thailand. Adequate rainfall and moderate temperatures allow for diverse cropping patterns in the Hills and Mountains, including maize, tea, coffee, horticultural crops, and vegetables. However, the cultivation of annual crops on steep slopes incurs a high risk of erosion.

The Delta lies south of the Dry Zone and covers roughly one-third of Myanmar's land area. Until the late 1920s, the Delta provided farming opportunities for households that the colonial administration recruited to cultivate newly cleared agricultural lands (Boutry et al. 2017; Brown 2012; Vicol and Pritchard 2021). The AEZ has a humid tropical climate, with heavy rainfall during the May to October monsoon season. Rice is the main monsoon crop, with pulses grown on residual moisture in the post-monsoon season. Maize and vegetables can also be cultivated in low-lying areas and riverbeds as floodwaters recede. Yet, even within the Delta, there is a range of rice-growing environments. This is due to saline intrusion in the southern estuarine areas, deepwater flooding, and lowland flooding. The lower half of the Delta is especially vulnerable to cyclones, which can generate devastating tidal surges.

The Coastal AEZ contains the two coastal areas of Myanmar: Rakhine State to the west bordering Bangladesh and Tanintharyi Region to the southeast bordering Thailand. These areas contain coastal strips and mangrove areas, with lowland and upland ecologies further inland. Like the lower Delta, the western part of the zone is prone to cyclone and storm surge flooding, aggravated by the conversion of mangroves to rice cultivation or shrimp farming (San 2018; Soe, Thant, and Htun 2018). Tanintharyi, a thin strip of land and one of the least populated regions in the country, holds nearly one-third of the country's private agricultural concessions, particularly for oil palm and rubber (Byerlee et al. 2014; Woods 2015). Relatively low rainfall makes Tanintharyi only marginally suitable for oil palm production, however.

Crop sector characteristics and drivers

This section focuses on the production of major crops: rice, pulses, oilseeds, maize, horticulture (fruits and vegetables), and coffee and tea. As seen in Chapter 2, each of these crop subsectors contributes to economic well-being in different ways, such as through domestic food supply, diet quality (directly or indirectly through livestock feed), export earnings, and potential for downstream value addition. As indicated in Chapter 3, the military coup of February 2021, combined with a global surge in fuel, fertilizer, and vegetable oil prices, has resulted in multiple disruptions for the crop sector. The rapid depreciation of the Myanmar kyat, combined with import restrictions to preserve foreign exchange, has magnified the effects of international price changes on local price increases. To reduce the budgetary cost of imported supplies, Myanmar's Central Bank has required agricultural exporters to convert foreign exchange earnings at an artificially low rate, effectively taxing export crops such as rice and pulses. This section distinguishes these (hopefully) short-run economic shocks from longer-term structural factors.

Other shocks directly attributable to the coup are conflict and displacement. The Dry Zone, especially in Magway and Sagaing Regions, has seen widespread destruction of entire villages by the military. Conflict has also affected parts of the Hills and Mountains AEZ, especially Chin State in the west, Kachin State in the north, and Kayah State in the east. While the humanitarian costs of conflict—loss of life and livelihoods, health and social costs of displacement—are far greater than the costs of the loss of crop production (see Chapter 5), the effects of the latter are increasing over time. By the first quarter of 2023, 27 percent of farmers in a nationally representative survey considered their situation insecure or very insecure, 23 percent considered movement to be unsafe, and almost 9 percent had fields they could not use for cultivation (MAPSA 2023a).

Rice

There is no doubt about the central role of rice in Myanmar's rural culture as well as its economy. The United States Department of Agriculture (USDA) projected rice production of 12.35 million tons (milled) in 2021/22, consumption at 10.25 million tons, and exports at 2.2 million tons, implying a small reduction in ending stocks (USDA 2022a). Myint and colleagues (2016) estimated average domestic rice consumption to be 155 kg per capita, providing 51 percent and 62 percent of urban and rural calorie consumption, respectively. The World Bank estimated that rice accounted for just over half (52 percent) of agricultural GDP in 2016 (World Bank 2019). Rice has important multiplier effects in the economy, as approximately two-thirds of total paddy production is sold (Chapter 10), and rice milling accounts for 57 percent of manufacturing value added (MOPF and UNU-WIDER 2017).

Spatial distribution of rice production. According to the MLCS, 60 percent of farm households nationwide grew paddy in 2017. The 7.15 million hectares (ha) planted represents 36.5 percent of the country's total crop area (including permanent crops) and 43.6 percent of the annual cropped area. Estimates from the Ministry of Agriculture, Livestock, and Irrigation (MOALI) are similar. Almost 4 of every 5 acres (79 percent) of paddy were grown during the monsoon, and the remainder in the post-monsoon season (commonly referred to as summer paddy). The total area planted appears to have been relatively stable over the past decade, although the area planted in the post-monsoon season varies from year to year, depending on the availability of irrigation water. While MOALI invested heavily in dams during the 1990s, field-level water distribution and management systems have proven inefficient (World Bank 2017).

The spatial distribution of rice production is necessarily related to agroecological conditions, given the crop's high demand for water. Lowland areas account for 68 percent of monsoon cultivated area and submerged and deepwater rice for 13.5 percent, while upland, seawater intrusion, and drought-prone areas account for the remainder (Mon, Yamamoto, and Aung 2019). Just over half (52 percent) of the monsoon paddy area cultivated is in the Delta, where rainfall is highest, a further 23 percent in the Dry Zone (often grown where irrigation is available), 16 percent in the Hills and Mountains, and just 9 percent in the Coastal Zone. Summer paddy production reflects spatial patterns in (largely) public irrigation investment: the Delta accounts for 60 percent and the Dry Zone 30 percent of summer paddy.

Rice production technology and yields. USDA estimates that yields in Myanmar average 2.9 metric tons per ha (t/ha). While these yield estimates are much lower than those reported by MOALI, they are consistent with estimates of total use (domestic consumption, exports, and stocks).

Paddy yield is lower for the monsoon season crop than for the post-monsoon season crop by approximately 1 t/ha, as a result of fewer sunlight hours and a high share of area planted to photoperiod-sensitive varieties adapted to deeper water during the monsoon. Many of these belong to a group known as Pawsan varieties, whose grain attributes and aroma Myanmar consumers prize highly. Summer paddy has a higher yield potential because of longer sunlight hours and the use of improved Emata varieties with determinate (fixed maturity period), short straw length, and fertilizer-responsive characteristics. No accurate information is available on the level of adoption of improved varieties. However, the absence of any noticeable trend in paddy yields over the past 15 years suggests that, despite the release of many approved varieties by the Department of Agricultural Research, low farmer access to improved varieties is a constraint to paddy productivity growth.

A high proportion of paddy fields are plowed using two- or four-wheel tractors, although oxen are still widely used for leveling prior to dry seeding or transplanting. Since 2015, there has been a rapid increase in the availability and use of combine harvesting services (see Chapter 7). Combine harvesting dramatically reduces labor requirements and enables farmers to remove their crop from the field quickly once grain maturity is reached. This reduces the risk of spoilage from late monsoon rains (or, in the case of summer paddy, early monsoon rains). Combine harvesting of monsoon paddy also allows for earlier planting of post-monsoon crops that depend on residual soil moisture, especially pulses, thereby raising their yield potential.

Mechanization is not the only source of labor savings in rice production. In response to increased labor costs, broadcast seeding has become increasingly popular in place of transplanting, even though more seed is required for weed suppression and the higher seed rate depresses yield potential due to reduced tillering.

Fertilizer is widely used for paddy production but at relatively low intensity. Compound fertilizers containing a mix of nitrogen, phosphorus, and potassium macronutrients are recommended at planting time for root development and plant growth. Nitrogen fertilizers, notably urea, are applied during the grain formation phase. National average fertilizer application rates were 55 kg per acre in the 2021 and 2022 monsoon seasons—a median rate of just one 50 kg bag per acre (MAPSA 2023a). Potential returns to fertilizer are much higher in the post-monsoon season under irrigation because of more sunlight hours and the ability to use more fertilizer-responsive varieties. Myanmar's irrigation infrastructure is very poor in terms of water control at plot level, leading to inefficiency in water use and making it impossible to use techniques such as alternate wetting and drying that reduce greenhouse gases.

Perhaps surprisingly, only half of all paddy farmers sell to the market, and just 20 percent of producers account for 80 percent of paddy sales (Chapter 10). This pattern reflects the unequal distribution of cropland among farm households, reinforced by transport infrastructure constraints to market access.

Effects of the coup on paddy production and marketing. The military coup has had significant effects on rice production, as exchange rate depreciation has multiplied the impact of global increases in fuel and fertilizer prices, as well as the value of paddy. Estimates of the effects vary spatially and by information source. A survey of input retailers found that urea and compound fertilizer prices were 91 percent and 75 percent higher, respectively, in the 2022 monsoon season compared with a year earlier, leading to reductions in fertilizer sales (MAPSA 2022b). Tractor plowing and combine harvester services also increased in price by 66 percent and 50 percent, respectively, in the 2022 monsoon season compared with a year earlier (MAPSA 2022c).

Rice production during the 2021 post-monsoon season was estimated to be 25 to 40 percent lower than average and 13 percent lower than average in the 2022 monsoon season. This decline was attributed to reductions in area planted and higher input costs, especially for fertilizer (ADPC 2022; MAPSA 2023a).

A nationally representative survey of farmers conducted in early 2023 found that postharvest paddy prices were 81 percent higher on average in the monsoon season of 2022 compared with a year earlier (MAPSA 2023a). The increase in paddy prices reflects the combined effect of a 22 percent increase in international rice prices and a 46 percent depreciation of the Myanmar kyat for agricultural exports. Prices for paddy would likely have increased even more if it had not been for Myanmar's Central Bank policies that require exporters to convert 65 percent of their foreign exchange earnings at the official exchange rate.[1] The policy has a similar effect on farm paddy prices as that of a rice export tax. The implicit export tax rate was 19 percent between January and June 2023, rising to 30 percent by December 2023 as the depreciation of the Myanmar kyat led to diverging parallel and official exchange rates over the course of the year.

1 Rice millers with foreign ownership have not been subject to the same restriction, resulting in tension between domestic and international milling companies.

Pulses

After paddy, pulses and beans are the second most important crop group in terms of area, production, and value. More than 60 types of pulses and beans are grown across the country. Black gram, green gram (mung bean), chickpea, and pigeon pea are the "big four" among pulses, with butter bean, sultani, sultapya, lima bean, and kidney bean also important. According to traders, most of the production of the big four (except for chickpea) is exported, generating between $1 billion and $1.8 billion in foreign exchange earnings per year. India is the largest market, but unpredictable import quotas, asymmetric market information, and segmentation of domestic and international traders lead to high levels of price uncertainty (Boughton, Haggblade, and Dorosh 2018).[2]

Domestic consumption of pulses occurs in many forms. Flour made from a range of pulses is used for noodle production; chickpea flour is used widely in traditional dishes; lentils are boiled for soup; steamed cowpeas and garden peas are consumed with rice for breakfast; and fried beans are used in salads. Fried sprouted pulses are also used as a snack. Yet, despite the wide variety of forms in which pulses are prepared, the quantities consumed are small relative to their nutritional value as a source of protein, vitamins, and dietary fiber.

Spatial distribution of pulse production. According to the MLCS, 32 percent of farm households nationwide grew pulses in 2017. However, in contrast with the MLCS estimate of 5.32 million ha planted, the MOALI estimate for the same year was 4.66 million ha, decreasing to an average of 4 million ha for 2019/20 and 2020/21 (MOALI 2022).[3] USDA estimates of pulse cultivated area are close to MOALI estimates (USDA 2021). The decrease in area cultivated in recent years is due to a reduction in the cultivation of black gram and pigeon pea, for which the dominant market, India, is unstable because of its import quota policies. Approximately 70 percent of pulses are grown on residual moisture during the post-monsoon season, primarily in the Delta; most of the remainder is grown in the monsoon season in the Dry Zone. The Hills and Mountains account for less than 5 percent of the planted area. Black gram and green gram are the most common pulses in the Delta, while chickpea, green gram, and pigeon pea are most common in the

2 As an example of unpredictable policies, at the end of March 2022, after the peak marketing period for post-monsoon pulses in Myanmar, India's Directorate General of Foreign Trade lifted all quota restrictions on the import of black gram and pigeon pea for one year.

3 The geographic distribution of pulse production in the MLCS data suggests that the survey instrument may have conflated pulses with oilseeds, resulting in an overestimate of pulse area and an underestimate of oilseed area planted.

Dry Zone. Pigeon pea is also common in the Hills and Mountains as a rotation crop with maize.

Pulses production technology and yields. Production technology varies by AEZ, type of pulse, and whether it is managed as a sole crop or an intercrop. In the Delta, pulses are grown as sole crops in the post-monsoon season on residual moisture after the monsoon paddy crop. The introduction of tractor plowing and combine harvesting has greatly helped farmers, who can now plant early to maximize the use of residual soil moisture. In the Dry Zone, pulses are grown mainly in the monsoon season, often as intercrops.

Yellow mosaic virus is a serious disease of green gram and black gram. MOALI's Department of Agricultural Research has released resistant varieties to counter the threat. A concerted effort has also been made to promote improved varieties of chickpea. Pulses are also notoriously susceptible to pests, especially in the post-monsoon season. Hence, insecticide is the main purchased input cost besides tractor plowing services.

According to MOALI, average yields are 1.4 t/ha for black gram and chickpea, 1.3 t/ha for green gram, and 1.2 t/ha for sole crop pigeon pea (MOALI 2022). A community survey in the Dry Zone reported average yields of only half these levels: 0.62 t/ha for green gram and 0.55 for pigeon pea (Mather et al. 2018). Yields at the household level for chickpea in 2017, 0.64 t/ha, were also less than half the MOALI reported average.

Effects of the coup on pulse production and marketing. As noted, the concentrated nature of Myanmar's pulse exports makes them vulnerable to price uncertainty, aggravated by unpredictable import quotas imposed by India. The coup has amplified marketing uncertainty. Nevertheless, the large increases in fertilizer prices, combined with labor shortages, appear to have resulted in an increase in the pulse crop area at the expense of rice production (MAPSA 2023b). However, any expansion of pulse crop area could be offset by yield reductions due to higher costs resulting in lower use of fertilizer and insecticides: the prices of the latter increased by 38 percent between mid-2021 and mid-2022 (MAPSA 2022f).

In August 2022, a survey of agricultural traders with good coverage of pulse-growing areas found that chickpea prices were 32 percent higher and green gram prices 25 percent higher than a year earlier (MAPSA 2022a). A nationally representative survey of farmers in the first quarter of 2023 confirmed average price increases of 29 percent for green gram, 40 percent for black gram, and 39 percent for pigeon pea (MAPSA 2023a). Depreciation of the Myanmar kyat and the suspension of Indian import quotas were key drivers. Similar to the situation with rice exports, price increases for pulses would have been even higher in the absence of the Central Bank requirement for traders to deposit 65 percent of their earnings at the official exchange rate.

Oilseeds

Vegetable oils are a key component of diets, and households spent an average of 5.1 percent of their food budget on them in 2015. However, only 30 percent of the vegetable oil consumed nationally is produced locally; the remainder is imported, primarily in the form of palm oil (MAPSA 2022d). The main types of oilseed crops cultivated in Myanmar are groundnut and sesame, and a significant share of their production is exported. Sunflower, soybeans, and palm oil are cultivated on a smaller scale. Soybeans are used mainly for tofu production rather than for oil or animal feed processing.

The structure of Myanmar's oilseed sector changed dramatically following the liberalization of palm oil imports in 2011 (Belton and Win 2019). Imported palm oil is usually much cheaper than locally produced vegetable oil. Only wealthier consumers can afford groundnut or sesame oil, which fetch premium prices on the local market due to their preferred flavor and limited supply.

Spatial distribution of oilseed production. According to MOALI, the area planted to oilseed is approximately 1.1 million ha for groundnut, 1.5 million ha for sesame, and 0.25 million ha for sunflower (MOALI 2022). The 2017 MLCS estimate for sesame, the only oilseed for which information was collected in the survey, is similar to that for MOALI at 1.4 million ha, 88 percent of which was cultivated in the Dry Zone. According to the Myanmar Agricultural Performance Survey, 11 percent of farmers nationally cultivated groundnut, and 12 percent cultivated sesame (MAPSA 2022e). The share of farmers growing each crop rises to 25 percent in the Dry Zone, where agroecological conditions are relatively better suited (yet still far from ideal, owing to erratic rainfall patterns). This is lower than the MLCS estimate of 36 percent growing sesame in the Dry Zone in 2017, implying a significant reduction in the share of farmers growing the crop in 2022. As much of the expansion in sesame was driven by exports to China and South Korea, this may reflect border closures with China because of COVID-19.

Oilseed production technology and yields. In addition to tractor plowing services, fertilizer and pesticides are widely used for oilseed production. A

2017 household survey in 100 village tracts in four central Dry Zone townships found that 90 percent of groundnut producers used some kind of fertilizer, with 79 percent using inorganic fertilizer and 59 percent organic fertilizer (Mather et al. 2018). Application rates were quite low, however, averaging just 50 kg per ha. A similar frequency and rate of fertilizer use were found among sesame growers. Between half and two-thirds of groundnut farmers also used pesticide, depending on the season (monsoon or post-monsoon). Trichoderma bio-fungicide has been promoted on a small scale by a nongovernmental organization, Proximity Designs. Results have been promising, with 80 percent of users experiencing a reduction in yield loss, a median yield benefit of 17 percent, and a net income gain of $50 (Proximity Designs 2022).

According to MOALI, yields of groundnut (in shell) are 1.5 t/ha, sesame 0.5 t/ha, and sunflower 0.95 t/ha (MOALI 2022). A community survey in 2015 reported considerably lower yields for groundnut, however, at just over 1 t/ha (Mather et al. 2018). The same survey reported yields of 0.44 t/ha for sesame. Besides weather, low groundnut yields are also a result of the use of outdated varieties and poor seed quality (Boughton et al. 2020b). Mather et al. (2018) found that just 12 percent of groundnut farmers use improved varieties, compared with 23 percent of sesame growers.

Effects of the coup on oilseed production and marketing. Oilseed prices have increased even more than pulse prices because of domestic vegetable oil shortages resulting from a temporary Indonesian export ban on palm oil combined with import quotas imposed by the military regime to reduce foreign exchange expenditures. Average retail prices of vegetable oils rose 122 percent between March 2021 and March 2022 (MAPSA 2022d). An August 2022 survey of traders reported groundnut prices 77 percent higher and sesame prices 48 percent higher than a year before (MAPSA 2022a). As international and domestic vegetable oil prices stabilized, so did the prices of oilseed crops. A nationally representative survey fielded in the first quarter of 2023 found that postharvest prices for the 2022 monsoon season had increased by 41 percent for sesame and 47 percent for groundnut, compared with a year earlier (MAPSA 2023a).

Maize

Maize is a powerful example of how favorable agroecological conditions, access to improved technology, and growing domestic and international market demand can lead to rapid growth in production, with important nutritional spillovers, as noted in Chapter 2. Maize provides important lessons on how to unleash potential growth in other crop subsectors. Chapter 12 provides a detailed account of how this process has unfolded over two decades.

Spatial distribution of maize production. The MLCS estimated the maize area to be 0.93 million ha in 2017, which is considerably higher than MOALI estimates for the same year of 0.5 million ha (CSO, UNDP, and World Bank 2020). USDA's estimate for 2021 is 0.67 million ha (2022b). One possible reason for the discrepancy is that MOALI data may overlook maize produced for fresh consumption. According to the MLCS, 83 percent of the total maize area was in the Hills and Mountains, especially in Shan State; 11 percent in the Dry Zone; and 5 percent in the Delta.

Maize production technology and yields. USDA estimated national maize production to be 2.9 million tons in 2021 (2022b). The engine of the maize subsector's growth has been the introduction of and widespread access to hybrid varieties over the past 30 years (Chapter 12). Hybrid varieties are well suited to the temperate climate of the hilly areas, and a strong distribution network of input retailers has emerged to supply hybrid seed. There is also increasing competition among hybrid seed companies. The increase in maize production has also been made possible by an expansion of cultivated area. However, a new pest, fall armyworm, has manifested itself widely in maize-producing areas since 2019, but accurate loss assessments are not available.

Effects of the coup on maize production and marketing. Hybrid maize is a fertilizer-intensive crop. However, it is likely that farmers have reduced their application levels in response to recent dramatic fertilizer price increases (USDA 2023). Demand for maize in the domestic feed industry has weakened because consumers can no longer afford to consume poultry and eggs in the same quantities as before the military coup. Feed demand from the aquaculture sector has declined similarly (see Chapter 9). Although regional market demand for maize (China, Thailand, Viet Nam) is still strong, the Myanmar government's requirements that export earnings from overland trade be transferred in advance of receipt have led to a sharp reduction in exports (USDA 2023).

Horticultural crops

As seen in Chapter 2, the horticultural sector, especially fruits, has the highest potential of any crop subsector to contribute to agricultural employment, GDP growth, poverty reduction, and dietary improvement. Fruits and vegetables are underconsumed because of income constraints (Chapter 4).

Spatial distribution and trends in fruit production. The total horticultural crop-growing area in Myanmar is approximately 590,000 ha, occupying 6.6 percent of the total sown area of the country (Yadanar 2019). Watermelon, mango, and banana were the top 10 export fruits between 2018 and 2020 (Chapter 14). Myanmar has exported mango, watermelon, and muskmelon since 1999 and has recently exported small amounts of avocado and dragon fruit. Exports of banana began in 2015 and surged dramatically to reach 800,000 tons by 2020 due to controversial investments by Chinese-operated plantations in Kachin State (MOALI 2022).

Watermelon is the country's most lucrative cash crop and top export fruit. The major production areas in Myanmar are the central Dry Zone (Mandalay and Sagaing) and the Delta (Bago and Yangon). Around 150,000 farmers grow watermelons, of whom 80 percent are smallholders (Winrock International 2019). Between 65 and 80 percent of watermelons cultivated annually are sold to China across the border, especially during Chinese New Year celebrations. Heavy dependence on this market can lead to large price fluctuations when cross- border trade is disrupted.

Although mango is grown throughout the country, the major growing areas are Ayeyarwady, Bago, Mandalay, Sagaing, and Yangon Regions and Kayin and southern Shan States. Among the 300 mango varieties grown, Sein Ta Lone mango is the most famous among local and foreign consumers. Since 2000, it has been exported to China, Singapore, Japan, Dubai, Malaysia, and some European countries (Maung et al. 2020).

Commonly misclassified as a vegetable, chili pepper is a fruit widely used as a culinary spice. The annual area planted is about 110,000 ha. Chili pepper is grown primarily in the Dry Zone and in Ayeyarwady Region in the Delta (MOALI 2022).

Spatial distribution and trends in vegetable production. Vegetable crops can be divided into perishable and semi-perishable categories. Perishable vegetables, including tomato, cabbage, cauliflower, and carrot, are grown as monsoon season crops in highland areas and as post-monsoon season crops in the Dry Zone and the Delta when temperatures are lower. Ladyfinger (okra), eggplant, cucumber, green chili, baby corn, and gourds are also grown in the Dry Zone and the Delta.

Potato, garlic, and ginger are the main semi-perishable vegetables. They are cultivated primarily in Shan State. Potato was cultivated on 30,000 ha in 2021, showing a reduction of 20 percent over the previous five years. The area planted to garlic has been stable at just under 30,000 ha over the past decade.

Effects of the coup on fruit and vegetable production and marketing. Fruit and vegetable production is typically chemical input-intensive, and vegetable seed prices are typically high as a result of specialist production requirements. Because most chemical and seed inputs are imported, costs have risen dramatically, as for other input-intensive crops. Fruits and perishable vegetables are at high risk of price volatility as a result of the potential for conflict to interrupt domestic and cross-border marketing channels.

Coffee and tea

Coffee and tea are grown for domestic consumption and export. Myanmar is a tea-drinking culture. Moreover, fermented tea leaf is widely used in Myanmar dishes. Despite the country being the eighth-largest tea producer in the world, about 75 percent of tea production is consumed locally. Per capita annual consumption of tea products is 12.3 kg, comprising 5.7 kg of green tea, 5.2 kg of black tea, and 1.4 kg of pickled tea (ACDI/VOCA 2020). Coffee production was introduced in the colonial era, but local consumption on a large scale is a recent phenomenon, mainly in the form of imported instant coffee powder (Aye 2011). Although quantities are small compared with those of annual crops, Myanmar exports coffee and tea to 20 countries.

Spatial distribution of coffee and tea production. Coffee and tea thrive at high altitudes and in good soil conditions. Eighty-one percent of Myanmar's 20,000 ha of coffee and 81 percent of its 97,000 ha of tea are cultivated in Shan State (MOALI 2022). Approximately 85 percent of coffee is Arabica. The smaller area of Robusta coffee is concentrated in southeast Myanmar in Kayin, Kayah, and Mon States and the Tanintharyi Region. Most coffee and tea production is undertaken by smallholder farmers (ACDI/VOCA 2020).

Coffee and tea production technology and yields. Myanmar's soil and climate conditions allow for organic tea production (ILO 2019). Tea leaves can be harvested for nine months in the year, beginning around mid-March, before the rainy season, through to December. The first six months of the harvesting season produce peak yield, while the remaining three months yield less. Tea picked before the rainy season begins in May is famed for its stronger taste, higher quality, and better price. The average annual yield of tea increased from 1.2 t/ha in 2010 to about 1.4 t/ha in 2020.

Coffee plantations need intensive care for a minimum of five years before harvesting. About 90 percent of coffee is grown under shade trees, including fruit trees such as avocado, jackfruit, and macadamia. Coffee is harvested once a year between November and February and yields an average of 700 kg/ha. The processing methods used are important to obtain high-quality coffee and tea.

Effects of the coup on coffee and tea production and marketing. Production of both coffee and tea is labor intensive, both in the field and in processing. Most of the laborers for tea production in Shan State come from the central Dry Zone, where there has been a high level of conflict-induced insecurity, resulting in labor shortages. Reductions in consumer purchasing power since the coup have also resulted in lower demand and lower revenue for smallholders. One unanticipated effect of foreign exchange shortages and reduced imports of instant coffee has been a surge in small cottage industries producing domestic coffee powder.

Looking ahead

Even prior to the recent disruptions, Myanmar's crop subsector was underperforming in productivity and quality. Aside from pockets of innovation, such as the introduction of hybrid maize, the most important change has been the introduction of mechanization to help in the land preparation and combine harvesting of rice.

As discussed in Chapter 3, realizing Myanmar's agricultural potential will require significant public investments in agricultural research and irrigation management to adapt to climate change and raise yields and investment in transport infrastructure to reduce marketing costs. As discussed in Chapter 6, improved land laws and land administration are essential to protect smallholder land rights, including their freedom of choice of agricultural activities to allow for more profitable enterprise portfolios. Such improvements would also facilitate voluntary consolidation of or access to underused land. Land laws will also need to recognize the rights of farmers and local communities to invest in land conservation or management practices that generate revenue through carbon sequestration.

Innovations are also needed to improve the policy environment for farmers and other value chain actors that mediate market incentives. For example, bilateral trade negotiations must address the unpredictable and opportunistic trade policies of Myanmar's larger neighbors, China and India.

Once an end to the current conflict is achieved, investments in crop productivity, land tenure security, and a more predictable market environment will help crop producers recover and overcome many of the constraints now limiting the profitability of their crop production.

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