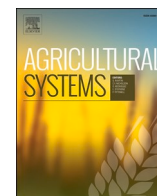




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Short Communication

Impacts of COVID-19 on agricultural production and food systems in late transforming Southeast Asia: The case of Myanmar



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ABSTRACT

The objective of this contribution is to report the initial impacts of measures taken to contain the COVID-19 pandemic on Myanmar's agri-food system. Myanmar is one of several late-transforming low-income countries in Southeast Asia where agriculture still plays a large role in rural livelihoods, and where food prices are a key factor affecting nutrition security for poor urban and rural households. Whereas the economic impacts of COVID-19 disruptions on tourism and manufacturing were obvious to policymakers, the impacts on the agri-food system were less evident and often more indirect. This resulted in the rural sector being allocated only a very small share of the government's initial fiscal response to mitigate the economic impacts of COVID-19.

To correct this information gap, a suite of phone surveys covering a wide spectrum of actors in the agri-food system were deployed, including farm input suppliers, mechanization service providers, farmers, commodity traders, millers, food retailers and consumers. The surveys were repeated at regular intervals prior to and during the main crop production season which began shortly after nationwide COVID-19 prevention measures were implemented in April. While the results indicate considerable resilience in the agri-food system in response to the initial disruptions, persistent financial stress for a high proportion of households and agri-food system businesses indicate that the road to a full recovery will take time. The experience provides important lessons for strengthening the resilience of the agri-food system, and the livelihoods of households that depend on it.

1. Introduction

Myanmar is a late transforming economy with a very diverse but low productivity agricultural sector. Together with ancillary services, the agri-food sector as a whole employs approximately half the population and contributes just over a third of GDP, 23% in farming and another 11% in input distribution, agro-processing, trade and retailing (Cunningham and Munoz, 2018); Diao et al., 2020). Prior to COVID-19, Myanmar's economy was growing rapidly, but nevertheless faced many challenges, including climate change, a legacy of repressive

economic policies, prolonged armed conflict and population displacement, and unpredictable trade policies of neighboring countries (especially China and India). In 2016, after more than five decades of military rule, Myanmar's hybrid military/democratic government developed an agricultural development strategy designed to diversify and improve crop production, promote competitive value chains, and ensure safe food systems (MOALI, 2017; 2018). In the urban economy, garment manufacturing took off on the back of cheap labor and investment incentives, leading to growth in the urban population, which – along with overseas migration – led to increased rural wages and rapid agricultural

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mechanization (Win et al., 2018). The decade prior to COVID-19 saw rapid declines in poverty and malnutrition, though these remain widespread, and clearly even many non-poor households had precarious livelihoods (CSO et al., 2019; MoHS, 2019).

COVID-19 caused major disruptions well before the first confirmed case in March 2020, starting with border trade closures with China in late January, the collapse of international tourist arrivals, and factory closures from February onwards due to shortages of imported raw materials and capital flight (Diao et al., 2020). Until August, Myanmar only registered a few hundred cases.¹ Nevertheless, the government's rapid and stringent response to the threat of COVID-19 inevitably accelerated economic consequences (Minoletti and Hein, 2020). In April the government imposed a three-week lockdown of the entire country and closed all international borders. Macro-economy simulation analysis predicted the measures would shrink economic output by 40% and lead to around 5 million people losing employment (Diao et al., 2020). Thereafter, internal movement restrictions were partially relaxed, but schools remained closed and public health measures such as restrictions on the size of gatherings, factory inspections, mandatory wearing of face masks, and restrictions on international entry remained in place. Moreover, as a second wave of infections took hold in September, the more stringent COVID-19 measures were re-imposed, sometimes with additional restrictions, especially on transport between different states/regions.

Recognizing the economic challenge posed by COVID-19, the government established an Economic Recovery task force to develop a Comprehensive Economic Recovery Plan. Due to the government's very limited fiscal resources, the plan was modest in financial terms, at approximately \$2 billion, with a focus on supporting shuttered industries such as garment manufacturing. The vulnerability of agriculture and rural livelihoods to COVID-19 was not initially well recognized by the Economic Recovery task force, which did not even include representation by the Ministry of Agriculture, Livestock and Irrigation (MOALI).

The objective of this paper is to document and understand the initial impacts of COVID-19 on Myanmar's agri-food system, covering crop production, inputs and mechanization services, marketing, retail and household income effects.² To do so we analyze data from 10 different phone surveys conducted at all stages of Myanmar's agri-food system. While every country is unique, the results from Myanmar are relevant to other late transforming economies (e.g., Cambodia, Laos, Vietnam), and the kinds of economic disruptions and potential mitigation measures are likely similar to those of other low-income countries.

The remainder of the paper proceeds as follows. The next section presents the data sources used. Section 3 presents the findings of phone surveys of farm households and traders and businesses upstream and downstream from the farm. Section 4 concludes.

2. Methods and data

To monitor the impacts of the COVID-19 crisis we designed a suite of panel phone surveys in the second quarter of 2020. The phone surveys cover almost the full spectrum of actors in the agri-food system: upstream agribusinesses (mechanization service providers and retailers, and farm input suppliers), rural farm and non-farm households, commodity traders, and urban consumers (Table 1). Each phone survey was designed as a panel (though sometimes unbalanced where replacements were needed). There are several limitations to the surveys worth noting

¹ A second wave from mid-August onwards saw the disease itself become a major problem. See Ministry of Health and Sports COVID 19 dashboard for updated numbers <https://mohs.gov.mm/Main/content/publication/2019-ncov>

² The impacts on aquaculture and livestock production are sufficiently distinct and complex to warrant separate discussion. See Fang and Belton, 2020 for the case of poultry and egg production.

Table 1
Phone survey details.

Survey	Targeted respondents	Sample size ¹	Geographic coverage (states and regions)	Thematic areas
Upstream agribusinesses				
Mechanization service providers	Tractor and combine service providers	333	Sagaing, Mandalay, Magway, Bago, and Ayeyarwady	Business disruptions, prevention measures, challenges, prospects, finances
Mechanization equipment retailers	Tractor retailers	93	Sagaing, Mandalay, Magway, Bago, and Ayeyarwady	Business disruptions, prevention measures, challenges, prospects, finances
Agricultural input retailers	Input retailers	221	Shan, Kachin, Bago, Ayeyarwady, Sagaing, and Mandalay	Business disruptions, prevention measures, challenges, prospects, finances
Agricultural production and rural economies				
Agricultural production	Agricultural households	600	Sagaing and Magway	Farm production, marketing, economic welfare, coping strategies, food security, diets, external assistance
Urban and rural community survey	Community representatives	561	All states/regions	Community disruption, prevention measures, shocks, subjective assessments of poverty, external assistance
Agricultural marketing & trade				
Agricultural commodity traders	Crop traders, brokers, and wholesalers	154	Shan, Sagaing, Magway, and Mandalay	Business disruptions, prevention measures, challenges, prospects, finances
Food retail				
Rural and urban food vendor	Food vendors	200	All states/regions	Business disruptions, prevention measures, challenges, prospects, finances, consumer behaviors
Household welfare				
Rural and urban food security	Households	2000	Yangon, Sagaing, Mandalay, and Magway	Household incomes, coping strategies, food security, diets, health/nutrition

(continued on next page)

Table 1 (continued)

Survey	Targeted respondents	Sample size ¹	Geographic coverage (states and regions)	Thematic areas
				service disruptions, external assistance

Notes: 1. Sample sizes can differ by survey round due to attrition, so sample sizes in the table reflect the average (approximate) sample size in some cases. See <https://www.ifpri.org/country/myanmar> for details.

here. First, the sampling strategies were necessarily opportunistic given time constraints, based on the availability of phone numbers from previous surveys. Hence they are typically not strictly representative of either the geographies or the agri-food system actors covered (though many surveys have samples that are relatively large in comparison to the target population). The samples primarily focus on the two main crop production areas of Myanmar, the delta and the central dry zone, which account for three quarters of national crop output value. Hence, with the exception of the community and food vendor surveys – which sample communities from all over Myanmar – the surveys generally do not cover the hilly areas of Myanmar, Rakhine in the west, nor the south-east.³ Second, although all surveys are panels, several of these panels were not completed at the time of writing, such that most of our results focus on earlier rounds of data pertaining to the disruptions that took place in the second and third quarters of 2020. Finally, there are the usual technical limitations of phone surveys to be noted, including attrition and non-response (which could lead to some bias, although these were not so common as to be of serious concern) and the need for quite short survey instruments and relatively simple question structures.

2.1. Upstream agribusinesses

Three rapid assessment phone surveys were developed to identify the impacts of COVID-19 on businesses operating upstream of the farm, all of which play key roles early in the monsoon season: agricultural input retailers, mechanization service providers, and equipment retailers. These surveys included questions to identify and monitor the effects of transportation restrictions on input supply chains (including fertilizer, pesticides, and seed) to learn about supply shortages, delays or lags in procurement, and their effects of prices and to understand the demand-side effects of the COVID-19 policies and transportation restrictions. In all three surveys, we asked about sales levels during the pandemic along with recall questions back to the same period in 2019 to understand the year-on-year changes in demand. These questions help us understand how income shocks to rural farm households affected their use of mechanizations services and input purchases – two important leading indicators for monsoon crop production.

2.2. Agricultural production and rural economies

Evidence about the impact of COVID-19 on rural households is derived from an urban and rural community survey. The community survey asked respondents from 85 urban wards and 223 rural villages (spread across about half of Myanmar's 356 townships) about perceptions of what is happening in their communities, such that responses are at least partially subjective. The survey included questions on (1) the impact on different rural income sources (farming, non-farm enterprises, farm and non-farm wage employment, and remittances); (2) particular impacts of COVID-19 mitigation measures on agricultural production

³ See appendix for a brief description of Myanmar's agricultural production systems and map.

and sales; and (3) coping mechanisms. Thematically, this survey included COVID-19 prevention measures, poverty and food insecurity, access to social safety nets or other forms of assistance, migration, agricultural production and marketing, and exposure to different kinds of shocks.

The community survey results are contrasted with a second, more geographically targeted survey focused on household member level gender dimensions of COVID-19 on rural livelihoods (Ragasa et al. (forthcoming)). This phone survey included 1072 male and female respondents from 606 households who were interviewed several times in 2020 about their individual and household's experiences related to COVID-19. The surveyed communities lie in the catchment areas of two irrigation sites in Myanmar's Central Dry Zone, which were drawn from a baseline survey (BL) conducted in January 2020 (pre-COVID) for a research project related to gender and nutrition.

2.3. Agricultural marketing and trade

Crop traders comprise the midstream of Myanmar's food supply chain and play a central role in crop marketing throughout the country. We developed a phone survey with crop traders to understand how crop marketing – specifically for post-monsoon crops which were being harvested around the onset of COVID-19 in Myanmar – was affected by COVID-19 policy responses. The survey included questions on (i) disruptions to crop buying and selling from transportation restrictions, and (ii) more detailed information on business activities including crop trading and credit offered to farmers, with recall comparisons of business in 2020 compared to the same time in 2019. Our sample of traders was randomly selected from crop trader lists collected during two in-person value chain studies conducted in 2017/18. Like the other phone surveys, we followed a panel design and called the same sample of crop traders three times at one-month intervals to track changes in crop trading activities and understand the evolving disruptions caused by transportation restrictions.

2.4. Food retail

A survey of small-scale food vendors, mostly general store owners, was conducted in the same wards/villages as the rural and urban community survey described above. Food vendors were asked about disruptions to their business, changes in consumer behavior, changes in supply, prices for representative food items in a range of food groups, whether prices, supply and demand were lower than usual for the time of year, as well as prevention measures in local wet markets.

2.5. Household welfare

To examine impacts on household welfare, a Rural and Urban Food Security Survey (RUFSS) was conducted from June onwards, in which approximately two thousand mothers were interviewed in urban Yangon (Myanmar's largest city) and rural areas of the Dry Zone (with the sample evenly split between the two areas). The questionnaire was designed to assess the welfare impacts of COVID-19 through different kinds of household income, economic, social, and health impacts of COVID-19, household coping mechanisms in response to income shocks; and questions on food security and dietary diversity. Here we chiefly focus on the income effects and briefly report findings on food security, dietary diversity and coping mechanisms.

3. Results and discussion

3.1. Impact on upstream agribusiness

The interviewed mechanization service providers (MSPs) mostly provided land preparation service with tractors, typically earning 5000 USD of revenue from the business in a year. Equipment retailers were

power tillers, four-wheel tractors (4WT) sellers, either franchise (relatively larger, selling 70 4WT units in a year) or independent (smaller, selling about 10 4WT units in a year). Here, key shares (%) among panel MSPs and ERs which responded to all three rounds are provided.

COVID-19 transportation restrictions significantly limited geographical areas of operations, and the timeliness of operations by MSPs. In June, 90% of MSPs were restricted to operating within the village tract and township, respectively. Similarly, 40% or more of equipment retailers (including more than half of independent operators) were restricted within their respective state or region. While land preparation was also delayed due to weather, 10–20% of MSPs perceived COVID-related restrictions directly delayed land preparation activities, notably in the Delta region. Partly due to movement restrictions, one-quarter to one-third of MSPs, and one-third of more of equipment retailers, reported reduced availability of machines and spare parts or attachments in May and June.

Most MSPs and ERs also faced reduced demand for their service or goods compared to a year ago, due partly to the cash constraints of customers. About half of MSPs in the Delta Zone and two-thirds of MSPs in Dry Zone reported lower demand (compared to 2019) for primary tillage services, with similar shares for other land preparation services. Similarly, two-thirds or more of equipment retailers reported reduced sales of machines, attachments and spare parts than one year ago (half of them reporting more than 50% declines in sales), with particularly higher shares among independent equipment retailers. Two-thirds of more MSPs were facing more requests from farmers for late payments than in 2019, and this share increased between May and July. Among equipment retailers, recovering credit from buyers has been one of the primary financial challenges, reported by one-third of interviewed ERs.

The consequences of these disruptions are mixed. By mid-2020 most respondents reported reduced restrictions on travel and fewer disruptions related to availability of equipment, yet over time an increasing share of ERs reported an outlook of reduced revenue in 2020 compared to 2019. About two-thirds of MSPs and equipment retailers expected their revenues in 2020 would be less than 2019, with significant numbers (20–30%) expecting more than 10% revenue reductions. Thus far there are no indications that these disruptions have significantly affected production of key crops in the 2020 monsoon season, although reliable data on this are yet to be publicly disseminated.

Input retailers also experienced large disruptions to both demand and supply caused by transportation restrictions early in the pandemic (mid-May, Fig. 1) when 64% of the sample reported negative effects on demand and 44% reported negative effects on supply. The supply-side disruptions led to longer input procurement times in 2020 compared to 2019, particularly for pesticides and fertilizer which have longer supply chains and need to travel across states and regions. Prices of these key inputs also increased in 2020 compared to 2019 with 38% of retailers reporting higher prices of fertilizer and 18% reporting higher pesticide prices. On the demand side, fertilizer and pesticide sales were lower in mid-May 2020 compared to the same time in 2019 for 69% and 58% of retailers, respectively. As a result of lower sales, 73% of the sample expected lower revenues overall in 2020 compared to 2019.

The disruptions from transportation restrictions lessened over time, partly due to both less stringent enforcement of the restrictions in some areas and to farmers and supply chains adapting to the new environment. However, collecting payments on inputs given to farmers on credit was a more persistent challenge experienced by 38% of our sample even in late July. Low repayment rates and lower revenues may have ongoing implications as input retailers may be more hesitant to offer inputs on credit in the future and may have difficulties repaying their own debts.

3.2. Impact on farming and the rural non-farm economy

The community survey results suggest significant and widespread disruptions to agriculture, both from disrupted production (perhaps more related to poor weather) and disrupted agricultural marketing

(mainly from COVID-19). The community survey respondents largely suggested that crop productivity was lower than normal due to delayed rains, low overall rainfall, and insufficient irrigation water. Around one-third of communities also mention problems with pests. A much larger share of farmers had difficulties in selling their agricultural produce. Nationwide and local travel restrictions and the closure of main markets limited the movements of traders, causing difficulties for farmers to market and sell their pre-monsoon crops. The results are similar to Ragasa et al. (forthcoming) who found that 68% percent of farmers in their irrigated area Dry Zone sample expressed difficulties in selling their harvest due to COVID-19 (Table 2). Among those reporting difficulties, 32% had trouble finding traders to whom they could sell, 28% were constrained by market closures, 27% were hindered by movement restrictions, and 25% could not find adequate transportation to markets. Challenges in selling agricultural produce were accompanied by lower prices for commodities, as reported by 39% of the interviewed farmers. Thirty-four percent of farmers also expected further challenges in selling their harvest due to COVID-19. Rural respondents in the community survey confirmed that these issues were present nationwide: 52% mentioned more difficulties than usual for farmers to sell their produce, mainly due to low output prices, COVID-19 related mobility restrictions and not enough traders/brokers making purchases (Table 2).

These surveys also suggest that poor weather and disruptions to agricultural marketing from COVID-19 adversely affected demand for unskilled labor in rural areas. Sixty-nine percent of nonfarm businesses in the AgProGrS dry zone irrigation sites were affected by COVID-19. Half of these businesses reported having no work at all, while the other half reported facing less demand between February and May 2020. A small percentage of men and women in these communities, 18% and 7%, respectively, were usually engaged as wage workers in nonfarm wage employment, either in their villages or in the nearby town. The majority (74% of male and 78% of female workers) experienced a negative impact on nonfarm work and wages during the crisis. Moreover, 31% and 66% of men and women, respectively, who normally work in nonfarm wage employment did not engage in any nonfarm wage employment during this period Ragasa et al. (forthcoming). During the first months of the pandemic, fewer rural households received remittances and the value of these remittances was lower compared to months prior to the COVID-19 crisis. In January 2020, 32% of households in the AgProGrS dry zone sites received cash remittances from non-household members in the past year, with an average monthly value of about 256,000 MMK. Between February and May 2020, only 25% of households received remittances with a much lower average monthly equivalent of 185,000 MMK Ragasa et al. (forthcoming).⁴

3.3. Impact on agricultural commodity traders

The principle business of crop traders in Myanmar is spatial arbitrage of agricultural commodities, but many also have strong connections to farmers to whom they offer inputs on credit. The crop traders in our sample were hindered in both of these roles by the COVID-19 policy responses. Over half of the sample of crop traders cited transportation restrictions as one of their two largest challenges from the COVID-19 crisis. In late May, 56 and 47% of traders reported disruptions to selling and buying crops, respectively (Fig. 2). These transport frictions, along with decreased exports from land border closures, reduced market access and put downward pressure on crop prices – 56% of the sample cited lower crop prices as one of their two main challenges during the

⁴ Note that the baseline survey only included cash remittances from non-household members. The phone survey question included both cash and in-kind remittances, from both household and non-household members. Hence, the true difference in remittances received prior to and after the onset of the pandemic is likely much larger than what one would infer from the numbers reported here.

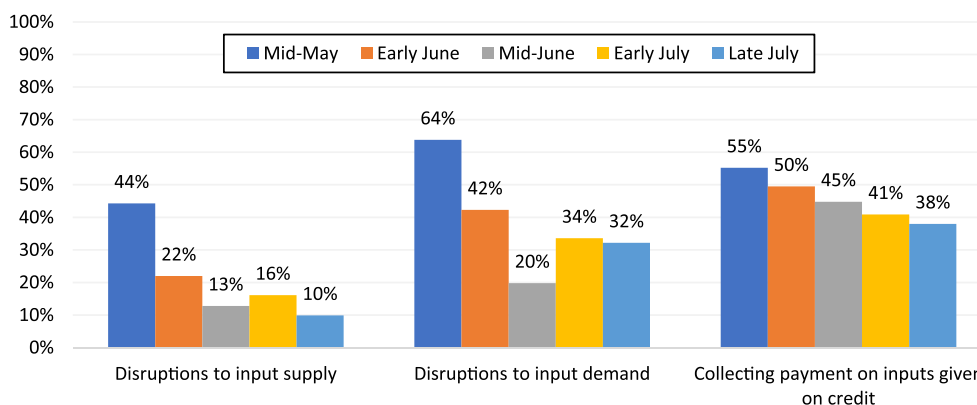


Fig. 1. COVID-19 disruptions to input supply, input demand, and collections of credit payments in the 2020 monsoon season (percentage of input retailers by survey round).

Table 2

Disruptions to sales of agricultural products in farming communities from irrigated dry zone areas and from the nationwide community survey.

	% of farmers, AgProGrS dry zone sample, Feb-May ¹	% of rural communities, nationwide, Jan-June ²
Any difficulties in selling your harvest?	68	52
If yes, which difficulties:		
Lower prices	63	66
Poor demand/no buyers	32	58
Markets closure	28	n/a
Movement restrictions	27	60
No means of transportation to markets	25	0

Sources: 1. AgProGrS Ragasa et al. (forthcoming) 2. COVID-19 Community Survey.

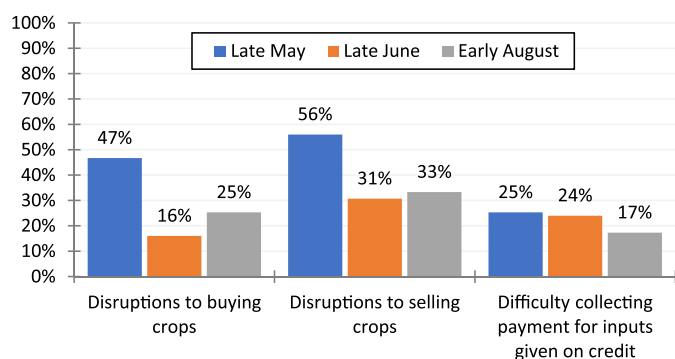


Fig. 2. COVID-19 disruptions to buying crops, selling crops, and collections of credit payments, percentage of crop traders by survey round.

crisis.

Similar to the upstream agribusinesses, the effects of transportation restrictions lessened in later survey rounds. However, there were still major disruptions as late as August when 33% and 25% of traders reported challenges to selling and buying crops, respectively. Furthermore, 17% were still facing challenges in collecting payment on credit previously lent out to farmers in early August, a relatively small improvement from 25% of traders faced these challenges in late May. The sum of these effects was a decline in crop trading and lower revenues: 64% of the sample expected lower business revenue in 2020 compared to 2019, and 42% expected a revenue decline of at least 25%.

3.4. Impact on food retailers and food prices

Disruptions to agricultural production systems can have important downstream effects on food availability, food consumption and nutrition outcomes. Over the first wave of COVID-19 disruptions from April to August, the food supply chain adjusted surprisingly quickly to meet consumer demand despite early disruptions from transportation restrictions and lockdowns. Interviewed food vendors in the major urban center of Yangon did not generally notice major disruptions to food supply, but a quarter reported higher prices. Most food vendors (86%) delivered more products to homes and customers who more frequently used phones to arrange their purchases. At the same time, consumers reduced the frequency of shopping. They purchased larger quantities and re-allocated purchases to more non-perishable foods (49% of the food vendors mention this), likely because such products can be stored longer and thus require fewer (and riskier) trips to the market and/or food vendors.

In general, there has not been much abnormal volatility in prices, with only a few exceptions. Poultry prices rose sharply in the wake of the first COVID-19 wave due to input supply disruptions – especially day-old chicks from China – but when these disruptions eased, prices again fell ((Fang et al., 2020). The food vendor survey conducted across a wide swathe of geographies also showed higher than normal prices for fish and poultry in some instances, but for most food groups respondents stated that prices were about normal. In September, at the start of the second wave of lockdowns and COVID-19 cases, there were major concerns about trade and marketing disruptions due to requirements that traders be tested when crossing state/region borders, and retail prices of fruits and vegetables in urban areas were starting to rise, but as these restrictions were relaxed supply began to stabilize. Even so, the events in September were a warning sign that significant disruptions to food trade can quickly have harmful consequences for consumers and farmers alike if they are not quickly resolved.

3.5. Impacts on household incomes and food security

Fig. 3 reports median income trends by the primary source of household income from the RUFSS survey conducted with approximately 2000 households per month in urban Yangon and the rural Dry Zone over June-October. Across all households, incomes dropped by roughly one-third from January to June, recovered somewhat from June to August as COVID-19 cases fell and the economy recovered, but then fell sharply again in September and October as the second COVID-19 wave hit from late-August onwards. The COVID-19 crisis is also striking in how pervasively it has affected different types of livelihoods (Fig. 3).

Source: Authors' estimates from the C19 Rural-Urban Food Security

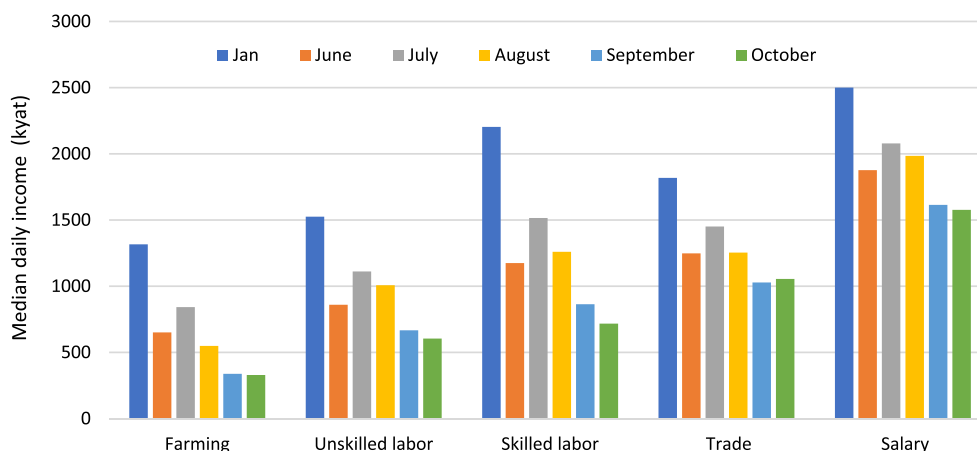


Fig. 3. Trends in median daily income per adult equivalent in a sample of households from urban Yangon and the rural dry zone.

Survey (C19-RUFSS). Respondents were asked to estimate total household income in the past month in each round, as well as household income in January 2020 as a pre-COVID baseline. Estimates were then converted into daily adult equivalent terms. The USD exchange rate for most of 2020 means that 1000 kyat corresponds to around \$0.75.

Relative to January, incomes of farming and both skilled and unskilled labor households fell by half between January and June 2020. July and August saw some recovery, but by the time the second wave had fully hit in September incomes in labor households were roughly one third of the levels reported in January, while farm-based incomes just one-quarter of January 2020 levels (although half of farm households cited normal lean season income problems as the main explanation of this). The incomes of trade-based households were also sensitive to COVID-19 disruptions, falling by just over 30% between January and June, recovering in July, but falling rapidly again from August onwards. Moreover, while salary-based households were the least affected, they were by no means unaffected, with incomes in September and October 40% lower than normal.

In the community survey – which covered villages/wards spread across Myanmar, respondents were asked to estimate what proportion of households in their village/ward were struggling to eat sufficient food and in urgent need of external assistance. In June/July this metric typically varied between 16 and 18% across the different states/regions and rural/urban aggregates reported in Fig. 4, it fell to 11–13% by August. However, the second wave of COVID-19 infections from late August onwards, followed by further lockdown measures, saw estimates of extreme poverty rise to 27–29% in most locations, falling only slightly 23–25% in October. Those results suggest that income losses have been

pervasive across Myanmar.

Coping mechanisms reported in RUFSS are also a cause of concern for longer term economic recovery. Almost half of poor households reported taking loans or making purchases on credit, raising the risk of longer-term indebtedness. In contrast, better off households used cash savings and reduced non-food expenditures (roughly 40% for both measures). Selling off assets was relatively rare in the RUFSS data (<10%), as was reducing food expenditure, although this became more common over time. Another striking finding from this survey was that urban mothers were at least twice as likely to report food insecurity experiences, irrespective of the specific measure, and also twice as likely to consume an inadequately diverse diet (Headey et al., 2020). This may suggest that urban livelihoods are even more dramatically affected by COVID-19 than farm households, although plenty of evidence suggests that rural non-farm (labor) households are also experiencing considerable economic suffering.

4. Conclusions

Results from an array of phone surveys across Myanmar’s agri-food system find that the economic effects of COVID-19 disruptions on farm and agricultural labor dependent households, agribusiness enterprises, and rural and urban consumers have been severe. The agri-food system has been hit by multiple shocks including domestic and foreign demand shocks, supply disruptions due to movement restrictions, and liquidity constraints. Farm households, in response to income losses and lower crop prices, cut back on investment in monsoon season crop production, with systemic effects on firms providing agricultural inputs and

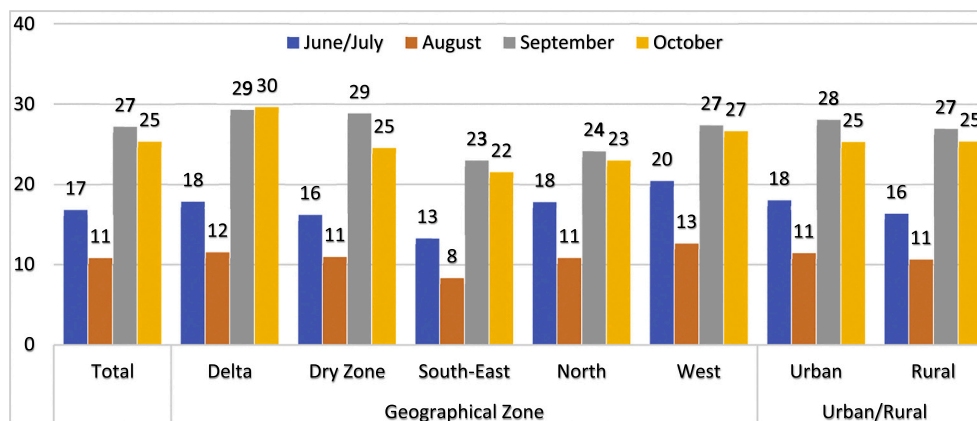


Fig. 4. Trends in community respondents' subjective estimates of extreme poverty in villages/wards across different regions of Myanmar.

mechanization services. While the agri-food system appears to have been resilient in its ability to adapt to disruption in the short run, persistent income losses among all types of actors may result in a prolonged recovery period.

Three key lessons emerge to enhance the resilience of Myanmar's agri-food system in the face of any similar future event. First, agricultural inputs, services and products must be allowed to move freely while ensuring safety measures appropriate to COVID-19 prevention. Second, additional financial liquidity should be made available to farmers and businesses, along with flexible terms, to prevent disruption of farm activities and service provision. Third, additional social protection will likely be required to avoid severe food insecurity and malnutrition among vulnerable households. This implies a larger fiscal allocation to social protection in the government budget. Expansion of mobile payment coverage could further ensure that such expanded social protection is timely. Finally, establishment of the capacity to monitor the agri-food system in a crisis situation would enable decision makers to have access to data and analysis to target fiscal resources in a timely way to minimize economic and welfare consequences.

Appendix A

Myanmar has four main agro-ecological zones, giving rise to distinct agricultural production systems and associated rural livelihoods for 35.4 million people (Ministry of Labor and Immigration, 2015): the Delta, the Dry Zone, Hilly Areas and Coastal Areas. The Delta receives heavy monsoon rains (in excess of 2000 mm per year) and is dominated by photoperiod sensitive rice adapted to flooding. The northern part of the Delta, where saline intrusion is absent, also allows the cultivation of pulses using residual moisture in the post-monsoon season or, with access to irrigation, a second rice crop. Aquaculture or mixed poultry/aquaculture systems are clustered close to the country's largest city, Yangon (Belton et al., 2015). The densely populated Delta accounts for 32% of Myanmar's total rural population (Ministry of Labor and Immigration, 2015).

The Dry Zone experiences rainfall generally associated with the semi-humid tropics (700–1100 mm per year), but the rainfall now occurs on only a third of the days it used to 30 years ago (Cunningham and Munoz, 2018; Cornish et al., 2018). The predominant cropping patterns are oilseeds and pulses on upland fields, and rice on lowland fields with access to irrigation. The Dry Zone is also densely populated and home to 35% of Myanmar's rural population. In both the Delta and the Dry Zone, high rates of landlessness and low wages encouraged rapid outmigration over the past decade. This led to increasing real wages and rapid mechanization (especially for land preparation and paddy harvesting and threshing). Although mechanization has led to an increase in labor productivity, limited varietal improvement and crop management innovation, combined with low and/or volatile market prices have resulted in agriculture being a relatively high risk, low reward activity (Mather et al., 2018).

The hilly areas in the northern parts of the country have a wide range of seasonal rainfall and cooler temperatures, making them suitable for diverse cropping systems including vegetables, fruits (e.g., mangos and avocado), tea and coffee. The introduction of hybrid maize varieties combined with demand for animal feed has led to a rapid increase in maize production over the past 15 years (Fang and Belton, 2020). The more remote areas are associated with opium production, but this has declined recently with the increased availability of chemical substitutes. With lower population density and landlessness, outmigration and mechanization have proceeded more gradually in northern hilly areas as compared to the Delta and Dry Zone. Hilly areas in the south and southeast lie behind the coastal areas and are home to low productivity rubber and oil palm plantations (Byerlee et al., 2014; Van Asselt et al., 2016). Together the hilly areas are home to 20% of the rural population. Coastal areas provide livelihoods for 12% of the rural population and typically depend heavily on marine fisheries, along with rice production and fruits (Hein et al., 2016).

The share of rural households with migrants, who typically send remittances to their homes once established in employment, has increased rapidly over the past decade. Among farm households, the share of households receiving remittances varies from lows of 12% and 15% in the hilly and Delta areas respectively, to 30% and 40% respectively in the Dry Zone and the coastal area of Mon State. The share of total household income contributed by migrants is relatively high, ranging from 38% to 54% depending on the zone (Boughton et al., 2020).

Both women and men are working in the agricultural sector, and women workers constitute a large share of the casual agricultural workers. In most communities there is no tradition of a gender divide in men and women separately managing plots or growing different crops. Agricultural land, a key asset for farm households, is considered jointly owned by husband and wife. Men are generally considered to be more knowledgeable about agricultural production, yet decisions on agricultural production and income are often made jointly (Carnegie et al., 2020; Lambrecht and Mahrt, 2019; Ragasa et al., 2020). Nonetheless, participants in most agricultural programs are mainly the household head, who is often the man, limiting women's direct access to agricultural services (Carnegie et al., 2020).

Agricultural production systems are well connected to local markets and major urban centers through local buyers and wholesalers linked to commodity exchanges in the major urban trading hubs of Mandalay and Yangon, as well as other secondary towns. Nevertheless, strong seasonality in farm sales and high post-harvest moisture levels for monsoon crops often lead to high price volatility. These domestic sources of volatility are aggravated by unpredictable trade restrictions imposed by neighboring countries (Boughton et al., 2018; Dorosh et al., 2019; Fang and Belton, 2020).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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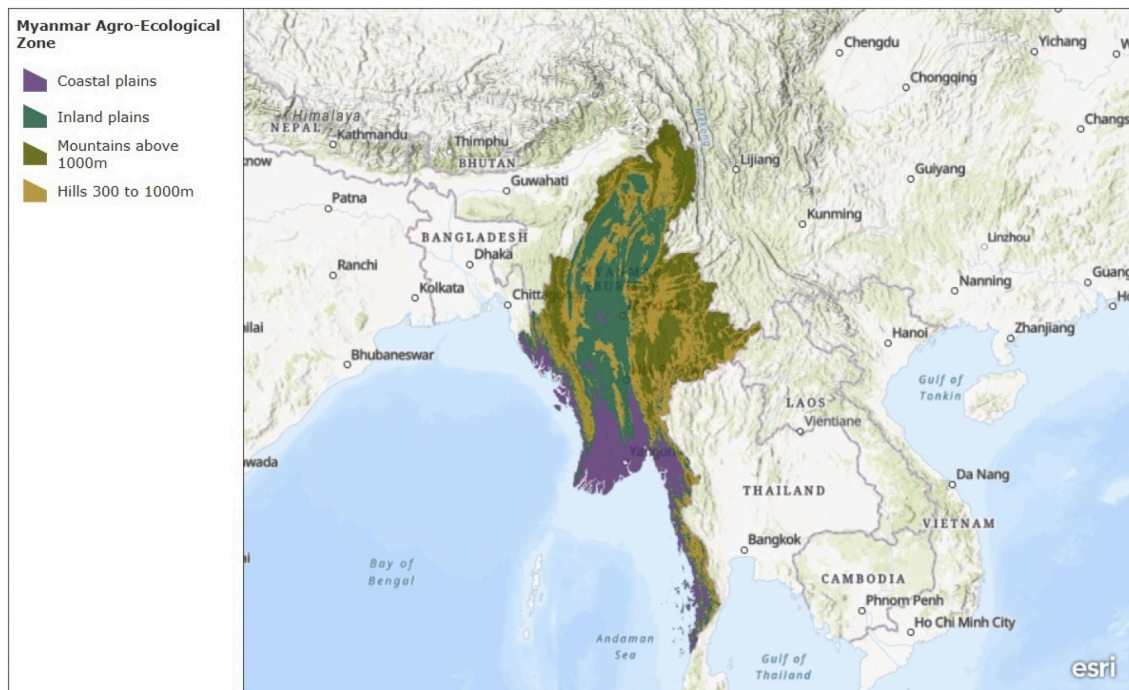


Fig. A1. Myanmar Agro-ecological Zones.

Source: <https://www.arcgis.com/home/item.html?id=1b1e3a6e98fc4780a0ea423ca568f5e8>

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