Chapter 9

LIVESTOCK, CAPTURE FISHERIES, AND AQUACULTURE: STATUS AND RECENT TRENDS

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Livestock rearing and fishing have been central components of rural livelihoods in Myanmar for centuries and remain so today (Khin 1948). More capital-intensive forms of marine fishing, aquaculture, and poultry farming began to expand during the early 1990s and have grown briskly since then (Belton et al. 2020; Tezzo et al. 2018). Poultry and aquaculture commoditization accelerated between 2011 and 2019, stimulated by the demand-side pull of rapid income growth and by foreign and domestic investment in areas such as feed milling and food retail (for example, businesses such as Kentucky Fried Chicken, which opened in Myanmar in 2015). However, despite recent growth, both sectors lag behind those in more developed countries in the region in technological sophistication, scale, and regulation (World Bank 2019a).

This chapter summarizes the status of the supply side of livestock, capture fisheries, and aquaculture based on an analysis of nationally representative data extracted from the Myanmar Living Conditions Survey (MLCS) 2017 (CSO 2019) and a review of trends in these sectors using information drawn from other recent surveys and secondary sources. We analyze MLCS to sketch a picture of the contributions of livestock, capture fisheries, and aquaculture to household incomes in the four agroecological zones (AEZs—Delta, Dry Zone, Coastal Zone, and Hills and Mountains) into which MLCS results are categorized (CSO, UNDP, and World Bank 2019). The MLCS livestock and fishery modules asked questions about each household's ownership, production, sales, and consumption of livestock and livestock byproducts, as well as aquaculture and capture fisheries products in the previous 12 months. Respondents were asked to estimate the quantity or value of these variables, making it possible to calculate the value of livestock and fish income, expenditure, and consumption for each household.

We examine levels of livestock ownership, participation in capture fisheries and aquaculture, reasons for rearing livestock, ownership of fishing assets, and average household earnings from all three activities. We also discuss the

characteristics of more geographically clustered, capital-intensive forms of poultry and swine farming, fishing, and fish farming and the downturn in these sectors since the multiple crises beginning in 2020. We conclude by discussing possible future directions and priorities for sectoral upgrading.

Contributions of livestock and fisheries to rural household incomes

Table 9.1 presents data from MLCS on the average value and share of rural households' gross income originating from crops, livestock, and fish among households engaged in any of these activities. Gross income is calculated as the value of sales plus the imputed value of consumption originating from own production and any production given away. We divide households by residence in the four AEZs used in the MLCS sample and by household consumption expenditure terciles.

The following points stand out. Overall, the total gross income from these three sources is highest on average in the Delta ($2,008 per household) and lowest in the Hills and Mountains ($1,220 per household). These variations are likely driven in part by differences in average landholding sizes among zones.

As expected, crop farming makes the biggest contribution to gross income among the three activities, averaging 86 percent nationally. The share of livestock in gross producer income is highest in the Dry Zone and the Hills and Mountains, underlining the importance of animal husbandry for livelihoods in these zones (Belton et al. 2021a), and lowest in the Coastal Zone. Conversely, the share of fish in gross income is by far the highest in the Coastal Zone, underlining the importance of marine fishing to the coastal rural economy. In the Delta, where most of Myanmar's freshwater fishing and aquaculture are concentrated, fish and livestock account for similar shares of producer income. Fish contributes only 1 percent of gross producer income in the Dry Zone and the Hills and Mountains.

Fish and livestock make proportionately greater contributions to the incomes of poorer households than to those of the better-off. We divide households into expenditure terciles as a proxy for income, where tercile 1 is the third of households with the lowest per capita expenditures and tercile 3 is the third with the highest per capita expenditures. The wealthiest third of households obtains higher average gross incomes than the poorest third from crops, livestock, and fish. However, fish contributes twice the share of producer income for households in the poorest tercile compared with those in

TABLE 9.1 Household average gross income from crops, livestock, and fish for producing households, by agroecological zone and consumption expenditure tercile

Income/source	All	Delta	Coastal Zone	Dry Zone	Hills and Mountains	Tercile 1 (poorest)	Tercile 2	Tercile 3 (richest)
Average gross income ($)								
Crops	1,450	1,737	762	1,561	1,101	830	1,535	2,316
Livestock	139	143	74	172	110	108	148	174
Fish	92	129	425	20	9	80	91	113
Total	1,681	2,008	1,261	1,753	1,220	1,018	1,774	2,604
Share of gross income (%)								
Crop	86	86	60	89	90	82	87	89
Livestock	8	7	6	10	9	11	8	7
Fish	5	6	34	1	1	8	5	4

Source: Authors' calculations using MLCS data.

Note: Table based on subset of MLCS sample households that reported engaging in crop farming, fisheries (aquaculture or fishing), or selling own livestock. Gross income is the aggregated value of sales, own consumption, and gifts given away.

the wealthiest. Similarly, livestock contributes 11 percent of gross producer income for the poorest third of households and 7 percent for the wealthiest.

The figures do not capture the full extent of the contributions of livestock and fish to Myanmar's rural economy because intensive livestock farming, commercial aquaculture, and larger-scale capture fisheries tend to be highly clustered spatially, often in peri-urban areas. Targeted oversampling or dedicated surveys in these locations would be required to ensure the representation of these enterprises. We discuss these specialized, highly commercial forms of livestock and fish production in more detail later in this chapter.

National survey results

Livestock

This section presents an analysis of data from MLCS, summarizing (1) the share of households involved in raising different types of livestock, (2) the number and value of livestock owned per household, and (3) the reported purpose of livestock ownership. Ownership of livestock is far more common in rural areas than in urban ones (although 12 percent of urban households own some form of livestock), so we limit our analysis to rural households.

Rural livestock-keeping is extremely common, even among households without agricultural land. More than half (59 percent) of rural households

and 41 percent of landless rural households raise animals (Table 9.2). Among landed households (defined here as those owning any farmland), this share rises to 75 percent.

Chickens are the most common animals raised by rural households, followed by cattle and pigs. Less common animals include ducks, buffalo, and goats (Table 9.2).[1] Cattle are the most common animals kept by landed rural households (reared by 45 percent), consistent with their use in agriculture and with these households' access to fodder from farm crop residues, followed by chickens (39 percent). Among landless households, chickens (29 percent) and pigs (20 percent) are the most common animals raised.

Cattle are most common in the Dry Zone, where they are widely used as draft animals, kept by 42 percent of all rural households, rising to 69 percent among the landed. Chickens and pigs are most common in the Delta, followed by the Hills and Mountains. Ducks are most common in the Delta, and buffalo in the Hills and Mountains (Table 9.2).

The livestock-rearing activities captured by MLCS are predominantly small in scale. Households raise an average of 4 head of cattle or buffalo, 2.5 pigs, 29 chickens, or 20 ducks. Buffalo and cattle are the most valuable of these, worth an estimated total of $1,602 and $1,345, respectively, to the households that raise them. The average total value of goats and pigs owned is estimated at $405 and $196, respectively. The total value of chickens and ducks owned per household averages $36 and $46, respectively, reflecting small flock sizes. These numbers do not vary much by zone, with the partial exception of goats, herds of which are three to four times larger in the Dry Zone than in the rest of the country.

The average gross income earned by rural households rearing livestock is $143 per year (Table 9.3). This underlines the small-scale nature of most livestock rearing reported in the survey. Average gross income from most types of livestock ranges from $100 to $150, although for chickens it is only $36 per year. Gross income from livestock rearing is highest in the Dry Zone and lowest in the Coastal Zone.

Livestock rearing is used strategically to meet a variety of important functions within the rural household economy. Cattle and buffalo are kept mainly for draught and secondarily for the sale of the animal or its products (Table 9.4). Informal cross-border exports of live cattle to China increased steeply before 2020, leading to moves to formalize the trade (Diao, Masias, and Lwin 2020). This has increased commercial demand for cattle. Although

1 "Goats" includes a small number of sheep.

TABLE 9.2 Rural households owning livestock, by agroecological zone

	Share of rural households, by zone (%)				
Livestock type	All	Delta	Coastal Zone	Dry Zone	Hills and Mountains
Buffalo	4	2	4	2	11
Cattle	26	17	19	42	18
Goats	2	1	1	2	2
Pigs	24	29	13	20	29
Chickens	33	44	36	22	27
Ducks	5	12	3	1	2
Any livestock	59	59	54	60	58

Source: Authors' calculations using MLCS data.

TABLE 9.3 Average gross income per rural household by type of livestock owned and agroecological zone

	Rural household gross income, by zone (US$)				
Livestock type	All	Delta	Coastal Zone	Dry Zone	Hills and Mountains
Buffalo	153	206	115	152	142
Cattle	137	173	96	131	113
Goats	146	77	49	257	6
Pigs	101	111	68	119	66
Chickens	36	28	81	31	40
Ducks	54	61	5	10	15
Any livestock	143	146	113	160	116

Source: Authors' calculations using MLCS data.

Note: Gross income is the aggregate value of sales, own consumption, and gifts given away of livestock and their byproducts.

keeping cattle is widespread, there is little dedicated dairy farming. Fresh milk consumption is low and concentrated mainly in urban areas—averaging in 2015 just 1.4 kg per capita per year nationally and 0.5 kg in rural areas (Scott et al. 2023).

Pigs and goats are raised mainly for sale and, secondarily, as a form of savings and to cope with expenses (a similar function to savings). Only 1 percent of households rearing cattle and 6 percent raising pigs reported doing so for their own consumption. In contrast, households raising chickens and ducks reported that producing them for own consumption and for sale were of approximately equal importance (mentioned by more than half of

TABLE 9.4 Rural households reporting purpose for owning livestock, by livestock type

	Share of rural households, by livestock type (%)					
Purpose	Buffalo	Cattle	Goats	Pigs	Chickens	Ducks
Livestock or products for sale	30	29	83	87	56	60
Food for family	1	1	4	6	58	51
To cope with expenses	4	6	13	13	14	14
Draught power	72	74	0	0	0	0
Manure	14	18	2	0	0	0
Transport	8	14	0	0	0	0
Savings	7	5	14	22	4	4
Breeding	2	1	0	0	0	0

Source: Authors' calculations using MLCS data.
Note: Respondents could report more than one purpose for owning the type of livestock.

households). Coping with expenses is the next most important reported reason for raising poultry (Table 9.4).

Capture fisheries and aquaculture

Fishing and aquaculture are far more common in rural areas than in urban ones, with only 1 percent of urban households engaging in either activity. All results presented in this subsection refer to rural households. Table 9.5 presents the share and estimated number of rural households engaged in fishing or aquaculture by AEZ in 2017.

Aquaculture is comparatively rare, practiced by just 0.4 percent of rural households—34,000 households nationally. In contrast, 11 percent of the rural population engages in some form of fishing—over 26 times more than practice aquaculture. In the Delta and Coastal AEZs, 18 percent of households practice fishing, as do 13 percent of those in the Hills and Mountains (Table 9.5). About half of all fishers and fish farmers are in the Delta, which is the center of Myanmar's commercial aquaculture sector, the site of its main inland capture fishery, and a significant marine fishery. Participation in fishing and fish farming is lowest in the semiarid Dry Zone.

Most fishing households are landless (62 percent nationally; 75 percent in the Coastal Zone). Surprisingly, 31 percent of households practicing aquaculture are reported as landless, compared with only 11 percent of households involved in crop farming. This might reflect a tendency for fish farmers to access land via rental markets. It is also possible that the result is an anomaly

TABLE 9.5 Rural households engaging in fishing and aquaculture, by agroecological zone

Activity	All	Delta	Coastal Zone	Dry Zone	Hills and Mountains
Share of rural households involved (%)					
Fishing	11	18	18	2	13
Aquaculture	0.4	0.5	1.5	0.1	0.4
Number of rural households involved (weighted)					
Fishing	907,117	530,939	132,884	58,325	184,970
Aquaculture	34,157	16,273	10,766	1,458	5,660

Source: Authors' calculations using MLCS data.

driven by the small number of households practicing aquaculture in the sample.

Among landed fishing households, the average area owned is 2.6 hectares (ha)—almost the same as the average area owned by farming households (2.7 ha). In contrast, landed aquaculture households own an average of 4.9 ha, nearly double the average agricultural landholding. This suggests that they tend to be better off than the average rural household and may reflect their concentration in the Delta, where average landholdings are larger than in the rest of the country (Belton et al. 2020).

Ownership of fishing assets by fishing households is rather limited, reflecting the small-scale nature of most fishing activities practiced by households in the sample. Only 38 percent of fishing households own a boat, and just 15 percent own a boat engine, indicative of low average levels of capital intensity and fishing capacity (Table 9.6). About two-thirds of fishers own fishing nets, except in the Hills and Mountains, where only one-third do. About one-quarter of fishers own other fishing gear, such as fish traps. As expected, boat ownership and levels of motorization are highest in the Coastal Zone and lowest in the Hills and Mountains. Approximately 20 percent of fishing households reported processing part of their catch, such as by drying or fermenting. The share of fishing households doing so is similar across zones.

Table 9.7 presents the imputed gross annual income earned by fishing and fish-farming households, calculated as the total value of fish originating from own production, whether sold, consumed by the household, or gifted to others. The small sample size for aquaculture households makes it difficult to interpret or clean anomalies in reported costs of production, so we do not attempt to calculate average net incomes.

TABLE 9.6 Share of fishing households with fishing assets, by agroecological zone

	Share of fishing households (%)				
Asset	Total	Delta	Coastal Zone	Dry Zone	Hills and Mountains
Boat used for fishing	38	44	61	30	5
Engine for fishing boat	15	13	47	4	1
Nets	57	61	69	68	34
Other fishing gear (including traps)	26	28	29	20	22
Other fishing equipment	25	18	29	33	41
Household processing fish products	19	21	17	19	17

Source: Authors' calculations using MLCS data.

TABLE 9.7 Average gross household income from aquaculture and fishing, and marketed surplus (share of value of fish sold), by agroecological zone

Characteristic	Total	Delta	Coastal Zone	Dry Zone	Hills and Mountains
Aquaculture					
Gross aquaculture income ($)	735	965	654	1,119	166
Marketed surplus (%)	89	94	84	95	68
Observations	54	13	16	4	21
Fishing					
Gross fishing income ($)	524	453	1,426	561	59
Marketed surplus (%)	86	86	88	87	37
Observations	1,155	431	236	54	434

Source: Authors' calculations using MLCS data.

Average gross incomes earned from fishing and aquaculture are roughly 2.5 and 5 times higher, respectively, than gross incomes from livestock-keeping. Fishing incomes are highest in the Coastal Zone, consistent with the higher levels of motorized boat ownership in this area, and lowest in the Hills and Mountains. Aquaculture incomes are highest in the Delta and the Dry Zone (though with very small sample sizes in each) and lowest in the Hills and Mountains. Interestingly, despite the small-scale nature of much fish production captured by the survey, most of the fish produced is sold (89 percent of aquaculture fish and 86 percent of capture fish). This pattern is consistent across all zones, apart from the Hills and Mountains, where the marketed surplus is somewhat lower.

Characteristics of larger-scale production

Commercial poultry and pig farming

The data presented above indicate that most rural households raising chickens do so on a very small scale. In such "traditional" or "backyard" poultry systems, most birds are native breeds. Scavenging is the primary source of feed, supplemented by unformulated feeds, like rice and kitchen scraps. Most birds are unhoused (Birhanu et al. 2021).

Specialized larger-scale intensive poultry farms raise flocks of improved breeds of broiler (meat) or layer (egg-laying) chickens, usually numbering in the 1,000s, in enclosed feedlots using commercially manufactured formulated diets. Farms of this kind proliferated in the peri-urban zones around larger cities between 2011 and 2019 (Belton et al. 2020). Broiler production is concentrated in Yangon, Mandalay, and Eastern Bago, which together account for more than half of Myanmar's broiler population. Southern Shan, where cooler average temperatures favor egg production, has the highest concentration of layer farms, accounting for 28 percent of Myanmar's layer population (LBVD 2019).

Two-thirds of poultry farms in the peri-urban zone around Yangon are integrated with fishponds, whereby poultry houses are constructed above fishponds, making it possible to use poultry manure and uneaten feed as inputs for fish cultivation (Fang et al. 2021). Analysis of satellite images shows that the number of chicken feedlots built over fishponds within a 100 km radius of Yangon more than doubled from 2014 to 2018, growing from 1,898 to 3,868. The number of village tracts in this zone with integrated chicken–fish farms increased from 121 to 230 (Belton et al. 2020).

A national livestock census conducted in 2018 indicated that 10,747 holdings were raising broilers and 6,278 holdings layers, accounting for less than 1 percent of poultry producers. However, the combined population of broiler and layer farms was 29.2 million birds (16.2 million broilers and 13 million layers). In contrast, around 4 million holdings raised 45 million native chickens (LBVD 2019). These figures suggest that approximately 40 percent of Myanmar's standing chicken population in 2018 comprised improved breeds reared under intensive conditions. The contribution of intensively reared chickens to Myanmar's total poultry and egg production is likely higher still, given that broilers, with an average production cycle of 45 days, attain market size much more quickly than do native breeds (Fang et al. 2021). Similarly, layers produce eggs at a rate significantly higher than that of native birds.

It has been estimated that independent farms grow only 40 percent of broilers. The remaining 60 percent are produced by vertically integrated international firms and by contract farmers linked to them as outgrowers (Birhanu et al. 2021). The largest of these companies is CP Myanmar, a subsidiary of a Thai multinational. This was the first company to initiate broiler production in the 1990s. CP is estimated to command about 45 percent of Myanmar's broiler market. However, there was a significant increase in foreign direct investment in the poultry sector between 2011 and 2019. Companies from China (New Hope), South Korea (Sunjin), Viet Nam (Greenfeed), Indonesia (Japfa), and the Netherlands (De Heus) established over this period feed milling and distribution operations, as did many domestic companies (Belton et al. 2020).

Pig farming is undergoing a transformation similar to that in poultry. More than 2 million households raised 5.8 million pigs in 2018, predominantly as a traditional "backyard" activity, but swine production is becoming increasingly commoditized, particularly on the periphery of large cities (LBVD 2019). For instance, Hlegu, a peri-urban township on the northern outskirts of Yangon, has relatively large-scale pig farms of 70 or more pigs, including some with herd sizes numbering in the thousands (Ebata 2022).

A recent survey of mainly medium-scale pig farms in the Yangon peri-urban zone found that improved breeds were much more common than local breeds, with the latter accounting for only about 25 percent of pigs raised. Local breeds have a longer production cycle than improved breeds, and their meat is fattier and less valuable. However, they can be raised wholly or partly on a diet of low-cost ingredients, such as kitchen scraps. In contrast, improved-breed pigs must be raised using more expensive commercially manufactured formulated feeds for optimum performance. Until 2010, most surveyed farms used nonformulated feeds, but, by 2019, 89 percent reported using formulated feeds, reflecting the recent shift toward the intensification of pig production (Belton et al. 2020).

Marine and inland capture fisheries

Myanmar's fisheries statistics are unreliable, leading the Food and Agriculture Organization of the United Nations (FAO) to take the unusual step of revising Myanmar's national fish production statistics downward from about 5.6 million to 3.0 million metric tons in 2016 (Tezzo et al. 2018). The poor quality of official statistics means that it is impossible to estimate the share of catch landed by small- and large-scale fishers with any degree of confidence. However, as in the poultry sector, it is clear that small-scale fishers account for

a large majority of households involved in fishing as owner-operators, whereas large fishing businesses are far less numerous but account for a major share of total fish landings. A high degree of concentration is evident in marine fisheries, where wealthy boat owners or fishing companies often own multiple large offshore fishing vessels, and in inland fisheries, where powerful leaseholders control fishing rights to many of the most productive fishing grounds (Tezzo et al. 2018).

Small-scale fishing activities occur wherever there are waterbodies containing fish and, thus, are widely distributed along the coasts, the Ayeyarwady Delta, and the courses of major rivers. Larger-scale marine fishing activities are concentrated mainly in a relatively small number of ports, including Kaw Thaung and Myeik in Tanintharyi, Ye in Mon, the city of Yangon, and Pyapon township in Ayeyarwady. Large-scale inland fishing occurs in fishing lots in the delta and floodplains of the Ayeyarwady River.

Myanmar's highly productive inland fisheries have long been an important source of state revenue, being administered as leasable fishing lots since the British colonial period (Reeves, Pokrant, and McGuire 1999). In contrast, marine capture fisheries development was very limited until the socialist period (1962–1988). It accelerated rapidly under the State Law and Order Restoration Council (SLORC), with the military government establishing international joint ventures with predominantly Thai vessel owners to generate foreign exchange to shore up the collapsing economy (Barbesgaard 2019). Most fish captured under these joint ventures were transshipped directly to Thailand.

Inflows of capital and technological advances, such as the motorization of boats, the introduction of new fishing gear, and the establishment of cold chain facilities, have contributed to the intensification of domestic fishing since the 1990s, both to meet domestic consumption needs and for export to China and other countries in the region (Belton, Marschke, and Vandergeest 2019). Most fishing licenses granted to foreign-owned vessels were revoked in 2010 under the Union Solidarity and Development Party government and transferred to Myanmar vessels (Tezzo et al. 2018).

Analysis of logbook records collected from offshore fishing vessels operating out of Tanintharyi region from 2009 to 2018 shows declines in catch per unit effort (a measure of the abundance of fish stocks) of between 27 and 64 percent for five types of fishing gear (Hosch, Belton, and Johnstone 2021). This pattern is consistent with stock assessments that show a decline of 89 percent in marine fishery biomass between 1980 and 2013 (Krakstad et al. 2014) and with reports of rapidly declining catches by inshore fishers (Belton,

Marschke, and Vandergeest 2019; World Bank 2019b). Anecdotal reports also point to significant declines in inland fish catches in recent years (Radford and Lamb 2020).

Reports of fisheries conflicts are frequent, particularly in Tanintharyi and Rakhine, often sparked by large offshore vessels, which are legally required to fish at least 5 km from the coastline, encroaching on inshore fishing grounds that are allocated exclusively to smaller inshore vessels (Barbesgaard 2019; Hosch, Belton, and Johnstone 2021; World Bank 2019b). Since 2020, most vessels in Myanmar's offshore fishing fleet have been fitted with vessel monitoring systems (VMS), making it possible to track and record their position in real time to demonstrate an absence of illegal, unreported, and unregulated (IUU) fishing—a requirement for export to the European Union. By logging violations of spatial or temporal fishing restrictions, VMS could support a much more highly regulated fishery management regime. However, the extent to which this new information is used to enforce regulations, particularly since the beginning of the coup, is not well understood.

Conflicts between larger- and smaller-scale actors are also evident in the governance of inland fisheries. Reforms introduced by the regional National League for Democracy government in Ayeyarwady to support leasing some fishing concessions to groups of small-scale fishers met stiff political resistance from powerful absentee licensees. This ultimately led to the reversal of the policy and the clawing back of the redistributions of fishing rights that accompanied it (Nyein, Gregory, and Thein 2020; Zin 2019).

Recent research (Belton, Marschke, and Vandergeest 2019; Nyein and Mathew 2017) and media coverage from Myanmar (BBC 2018) highlight hazardous and exploitative working conditions in some marine fisheries. Offshore raft fisheries in Ayeyarwady and Mon State use domestic migrant workers who receive seasonal wages in advance, compelling them to spend about eight months at sea on bamboo rafts exposed to the elements without access to safety equipment or medical treatment. These workers are often subject to malnutrition and physical abuse, and large numbers (likely in the hundreds) are thought to die at sea each year.

Entrenched governance problems and declining fisheries' productivity result in large part from the tendency of successive governments to treat the fisheries as a source of rents to be maximized in the short term rather than a resource to be managed for long-run sustainability (Nyein, Gregory, and Thein 2020). Despite these issues, Myanmar's capture fisheries remain extremely important for domestic food and nutrition security, particularly for rural and lower-income consumers (Scott et al. 2023), providing an estimated

80 percent of the aquatic food consumed in 2015, with aquaculture supplying the remaining 20 percent (Aung et al. 2022).

Moreover, despite steep declines, Myanmar's fish stocks probably remain in better health than those in many other parts of the region, given the later onset of intensive exploitation of marine fisheries compared with the other countries of Southeast Asia (Butcher 2004) and the relatively intact nature of inland fisheries habitats—for example, there are far fewer hydropower dams in the Ayeyarwady Basin than in the Mekong. For these reasons, Myanmar's capture fisheries should be understood as a cornerstone of nutrition security and rural livelihoods that can be maintained over the long term, provided adequate governance and management approaches are in place.

Aquaculture

Similar to marine capture fisheries, the growth of aquaculture accelerated from the 1990s, driven by the SLORC government's policy of promoting export-oriented industrial-scale forms of agriculture and aquaculture to secure foreign exchange. Large tracts of "wasteland" (the official designation for land unregistered on cadastral maps) were allocated as concessions to individuals and companies linked to the military in the Ayeyarwady Delta west of Yangon. Land allocated to these concessions was a mix of uncultivated wetlands and agricultural land worked by farmers without formal land use rights. The appropriations of land also resulted in the loss of community access to former common pool fishing and grazing areas. Some land concessions in the Delta were initially intended for paddy cultivation and others for aquaculture. However, most were ultimately converted to fishponds because of their higher profits and less complex management requirements compared with paddy. The initial expansion of large-scale aquaculture was thus highly inequitable (Mark and Belton 2020).

Aquaculture has continued to grow since this time, driven by the continued expansion of very large farms and the emergence of numerous commercially oriented small and medium farms. Many of the smallest commercial farms are nurseries, raising fingerlings for sale to larger grow-out farms. Successive land use policies and legislation up to the present have sought to safeguard rice production by prohibiting the conversion of paddy land to nonagricultural uses. However, the implementation of these rules in areas of the Delta where clusters of large fish farms are already established has been partial. In these areas, local authorities have often turned a blind eye to the conversion of paddy land to ponds, perhaps facilitated by "unofficial" payments (Belton et al. 2015). Thus, although land use policies have slowed the speed and extent of

aquaculture expansion, in some parts of the Delta they have also been widely circumvented, contributing to continuing brisk growth in aquaculture despite few new concessions being granted to fish farms during the past decade (Belton et al. 2018).

This history has given rise to a top-heavy distribution in the size of aquaculture farms in the Delta. Operations of 200 ha or more account for 1 percent of farms but 32 percent of farm area, while those with areas of 4 ha or less account for 49 percent of farms but only 4 percent of farm area. In most other parts of Asia, very large aquaculture farms account for a much smaller share of operations and total farm area (Belton et al. 2018).

This highly concentrated farm structure has important implications for the distribution of economic spillovers from aquaculture. Based on a Local Economywide Impact Evaluation model, Filipski and Belton (2018) estimate that large fish farms (defined as >4 ha) and small fish farms in the Ayeyarwady Delta both generate substantially larger economic impacts per hectare than crop farms, directly (through farmer profits) and indirectly (through wages paid to workers and use of farm profits and wages to purchase locally traded consumption goods and production inputs). However, while large and small fish farms generate similar levels of direct income, per hectare small fish farms generate considerably bigger indirect income spillovers because they are more labor-intensive and purchase more locally traded goods and services. Moreover, the authors find that putting additional land into production as part of large fish farms would increase economic inequality within the local economy, whereas increasing the area under small fish farms would reduce inequality, primarily through income spillovers to landless workers.

Myanmar's aquaculture is also somewhat unusual in being dominated by a single species, rohu, a carp species native to Myanmar and South Asia. Rohu accounts for 60 percent of production. Two similar native carp species, mrigal and catla, combined account for 21 percent. Pangasius catfish and tilapia are also produced. The mix of species farmed is diversifying gradually, but it remains far less diverse than in most other countries in the region. Some rohu is exported to the Gulf states, where it is mainly eaten by migrant workers from South Asia. However, most of Myanmar's farmed fish is destined for domestic markets, particularly in the cities, and has rapidly been assimilated into urban diets (Tezzo et al. 2021).

Fish farming techniques are generally simple, and average yields are modest at 4.8 tons per ha. Rice bran and peanut oilcake—byproducts from agricultural processing—are the most widely used feeds (Belton, Filipski, and Hu 2017). However, the use of floating pelleted fish feeds, which can support

faster growth rates and more efficient feed use, has increased in recent years as several poultry feed manufacturers have begun to produce and distribute them. As noted, the rapid growth of poultry farming prior to 2020 also stimulated the co-expansion of aquaculture through the establishment of integrated chicken–fish farms on the Yangon periphery (Belton et al. 2020).

Myanmar once had a burgeoning export-oriented shrimp industry, concentrated primarily in extensively managed ponds in Rakhine State. The sector collapsed in the mid-2000s as a result of a confluence of factors, including sanctions, cyclone damage, shrimp disease, and a decline in the natural recruitment of shrimp larvae caused by mangrove destruction. It has shown no signs of recovery since then (Joffre and Aung 2012; World Bank 2019c).

Impacts of COVID-19 and the coup

The COVID-19 pandemic had severe impacts on Myanmar's economy. Movement restrictions during the earliest stages of the pandemic affected supplies of production inputs and the distribution of livestock and fish products to market. However, these logistical issues were overcome relatively quickly. Longer-lasting impacts were felt in the form of depressed consumer demand caused by the economic downturn associated with the pandemic, which was transmitted upstream along livestock and fish supply chains. Fang and colleagues (2021) found that only 69 percent of surveyed broiler farms around Yangon remained operational in June 2020, although many closures were temporary, and some farms subsequently reopened. In November 2020, 81 percent of surveyed broiler farms and 83 percent of layer farms were operational.

Broiler prices peaked during the first lockdown in May 2020 at 50 percent above average 2019 levels before slumping in September to around half of the 2019 average. They then gradually regained equilibrium by November. In contrast, between May and August 2020, the price of eggs increased by 30 percent, reflecting the slow response time of layer farms to market demand as a consequence of their long production cycle (Fang et al. 2021). Fang and colleagues found that more than 40 percent of chicken farm workers around Yangon had lost permanent employment by November 2020. They estimated a loss of approximately 10,000 full-time chicken farm jobs and a monthly wage loss of $1,200,000 for Myanmar's chicken sector nationally.

In the case of farmed fish, farmgate, wholesale, and retail prices were 10 to 20 percent lower in most months between March and September 2020 than before the pandemic began in February 2020. Conversely, fish feed prices increased by about 40 percent over the same period. These trends suggest that

the profitability of farming operations became increasingly squeezed (Belton et al. 2021b). Two-thirds of surveyed actors in the fish value chain reported that the incomes they earned from these businesses were lower in 2020 than in 2019. Forty-one percent of all fish value chain businesses reported incomes that were between 10 and 30 percent lower in 2020 than in 2019, while 18 percent reported incomes 30 to 50 percent lower (Haas et al. 2021). The impacts of COVID-19 on fish value chains in 2021, compounded by the effects of the coup, were even more severe, causing sales of farmed fish to drop further relative to 2020 (Hoong et al. 2021).

Data from a national phone survey implemented by the International Food Policy Research Institute (IFPRI) in late 2021, almost a year after the coup, indicate that 69 percent of households reporting fish and 78 percent reporting livestock as their major source of income experienced difficulties related to production in 2021 (Table 9.8). Well over half reported challenges related to marketing in the three months prior to the survey. High input prices and difficulties hiring workers were the most common production challenges, especially for households dependent on livestock. The inability to acquire inputs was also a common problem for both livestock and fish-producing households, whereas the inability to reach fishing grounds or ponds affected 20 percent of fish-producing households. Low prices received for products was the most common marketing challenge reported, especially by livestock producers. Difficulties in accessing buyers was a common problem for both types of households.

Hoong and colleagues (2021) report that the most common coping strategies used by actors in fish value chains during these crises included borrowing cash to cover operating costs (reported by 40 percent of businesses), making transactions electronically (39 percent), drawing down savings (30 percent), buying inputs on credit (28 percent), and changing business working hours (25 percent). Notably, considerable numbers of businesses also reported donating (38 percent) or lending (25 percent) food to others, suggesting the existence of strong informal support mechanisms.

Reduced incomes are likely to have had negative impacts on the welfare of many fish and livestock producers. Belton and colleagues (2021b) found that the share of respondents in the fish value chain reporting that their household had purchased less food than usual rose steadily from 29 percent in May to 52 percent in September 2020. More broadly, the health status of low- and middle-income consumers, for whom fish and eggs are key sources of scarce micronutrients, is likely to have suffered substantially owing to reduced intake of these foods (Fang et al. 2020; Scott et al. 2023).

TABLE 9.8 Challenges facing livestock- and fish-producing households during the previous three months

	Share of households reporting (%)	
Challenge	Fish	Livestock
For production activities		
No difficulties	31	22
High prices of inputs	15	27
Difficulties hiring workers	4	36
Unable to acquire enough inputs	15	12
Cannot reach farm/fishing location	20	1
High price of fuel	7	0
Water/irrigation supply problems	4	1
Disruption to banking services, access to cash or loans	3	2
Electricity/energy supply problems	1	1
Difficulties in paying tax	1	0
For marketing activities		
No difficulties	46	39
Low prices for fish or fish products	29	38
Difficulty accessing buyers	18	19
High price of fuel/high transportation cost	2	3
Markets are closed	3	1
Payment problems	2	1
Observations (fish/livestock business households)	148	298

Source: Myanmar National Phone Survey (2021) data.

Future directions and priorities

The review above underlines the importance of the livestock and fisheries sectors for livelihoods, employment, the rural economy, and food and nutrition security, and their diversity in terms of production technologies, scale of operations, and organization of production. Here, we summarize key observations on the likely future direction for the sectors and areas for prioritization.

Prior to the COVID-19 pandemic and the coup, Myanmar's poultry, pig, and aquaculture sectors were growing rapidly and transforming, particularly in the peri-urban zones around major cities. Small backyard production units existed in large numbers alongside a growing segment of intermediate-sized specialized farms and a handful of large vertically integrated firms. The dynamism evident in these sectors corresponded with a period of rapid economic development that spurred rising real incomes and domestic urban demand

for animal-source foods. Production growth was also supported by large foreign and domestic investments in sectors like feed milling, as well as by investments from small and medium enterprises such as traders, which also grew rapidly during this period (Belton et al. 2018).

The economy contracted by 18 percent in 2021, following very weak growth in 2020, to around 30 percent smaller than it would have been in the absence of COVID-19 and the coup (World Bank 2021). Human welfare declined dramatically: it is estimated that more than half of the population had fallen below the poverty line by the end of 2021 (Diao and Mahrt 2020; MAPSA 2022). Animal-source foods are relatively expensive and are highly income-elastic. The economic shock depressed domestic consumer demand for such foods, stalling, and perhaps partially reversing, the expansion of specialized intensive peri-urban animal husbandry. Moreover, international prices for maize, a key ingredient used in feed manufacturing, reached a 10-year high in 2022. Coupled with a weak Myanmar kyat, which will raise the price of imported feed ingredients such as vitamin premixes and high-grade fishmeal, these market conditions seem set to squeeze the profitability of specialized livestock and fish farming operations, many of which operated on quite thin margins even prior to the crisis.

Pressure on producer profitability is likely to result in concentration within the livestock and fish sectors—more efficiently operated farms or those benefiting from economies of scale (or political connections) will endure, while less well-managed and smaller farms will fail. It may also result in extensification as producers seek to reduce costs by lowering stocking and feeding rates or substituting low-cost feeds, such as rice bran or brewery waste, for costlier, but more nutritionally complete, formulated feeds. Concentration is likely to be most pronounced in the feedlot poultry sector, where the bio-economics of production offer farmers little flexibility in modifying production practices (Fang et al. 2021). Extensification is likely to be most common in aquaculture, as fish can be raised using naturally occurring feed (plankton), and in small- to medium-scale pig farming, as local pig breeds can be grown using low-cost feeds, such as kitchen waste and broken rice.

Urban and rural food insecurity has increased sharply since 2020 (Headey et al. 2022). Consumption of animal-source foods—a particularly rich source of multiple micronutrients essential for human health—has almost certainly declined during this period. Such a trend is likely to have reversed modest improvements in nutrition indicators achieved over the preceding decade, exacerbating levels of malnutrition that were persistently high even prior to 2020 (Scott et al. 2023). However, the high income elasticity of animal-source

foods means that demand could rebound quite quickly if economic conditions improve in the future, prompting remaining producers to scale up production or stimulating investment by new entrants.

Over the longer term, climate change is likely to present increasing challenges to both sectors by affecting the production of feed crops such as maize, causing feed prices and production costs to fluctuate unpredictably or increase. Climate change is also likely to lead to shifts in the geographic distribution of wild fish stocks in ways that are difficult to predict. A changing climate is also set to increase the risk of flooding, with potentially negative implications for aquaculture profitability, as occurred in 2016 when many fish farms in the Delta lost a substantial share of their crop (Belton, Filipski, and Hu 2017). Saline intrusion in coastal and deltaic areas is also likely to increase, possibly altering the mix of aquatic animals farmed in favor of saline-tolerant species such as shrimp.

Rapid and widespread agricultural mechanization over the decade prior to 2020 is likely to have reduced cattle and buffalo populations, as many farms, particularly in the Delta and the Hills and Mountains, have substituted power tillers and rented four-wheel tractors for animal traction. However, rising demand for beef from neighboring China in recent years has stimulated the growth of cross-border exports of live cattle, which were in the process of being formalized prior to the crisis (Diao, Masias, and Lwin 2020). In the future, resurgent demand from China may encourage more rural households to raise cattle primarily for sale rather than as draft animals.

However, weakly regulated cross-border movements of live animals are highly risky, given the potential of such animals to act as vectors for potentially catastrophic animal diseases, some of which are also potential zoonoses. Pig grandparent stock and piglets are often imported to Myanmar, particularly from Thailand. Day-old chicks are also imported on occasion. Live cattle are also thought to enter Myanmar from Bangladesh and India. Much of this trade is informal or semiformal, and there is very limited animal quarantine capacity (Belton et al. 2020).

Access to veterinary services and information is patchy and mainly obtained through private providers. Few livestock or fish farmers have ever received formal training on farm management, and farmers' knowledge of important livestock diseases, such as African swine fever, is limited (Belton et al. 2020). Indiscriminate use of antibiotics, particularly in intensive poultry farming, also gives rise to health concerns, given the high potential for antimicrobial resistance to emerge. Food safety and standards are likely to become an increasing public health concern in the longer run (Ebata 2022), particularly if

the growth of modern retail resumes, and could contribute to farm consolidation if significant investments are needed to ensure compliance.

Marine and inland capture fisheries face serious governance challenges and unsustainable levels of resource exploitation. These challenges must be addressed if their important contributions to livelihoods and nutrition security are to be maintained over the long run. However, doing so would require a high level of political commitment to enacting the necessary changes, including shifting from governance strategies that favor resource extraction in the short term to those promoting long-term stewardship.

Our analysis reveals that the population engaged in fishing activities exceeds that involved in aquaculture by a factor of 26. Approximately half of all fishing and fish farming households live in the Delta. Future donor-sponsored programs aiming to alleviate poverty or improve nutrition by promoting aquatic food production should be attentive to the relative size of the two sectors and their geographic concentration when prioritizing resource allocation and site selection.

Finally, data on the livestock and fish sectors are very patchy. Little is known about the important dynamic segment of specialized livestock enterprises that have emerged over the past decade or the larger-scale commercial fishing fleets. Given the unique characteristics of businesses in these sectors and the high level of spatial clustering of larger enterprises, specially designed targeted surveys may be required in the future as an alternative to the random household sampling approach of MLCS.

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