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AGRICULTURAL MECHANIZATION AND STRUCTURAL TRANSFORMATION IN MYANMAR'S AYEYARWADY DELTA

Myat Thida Win and Aye Mya Thinzar

BACKGROUND

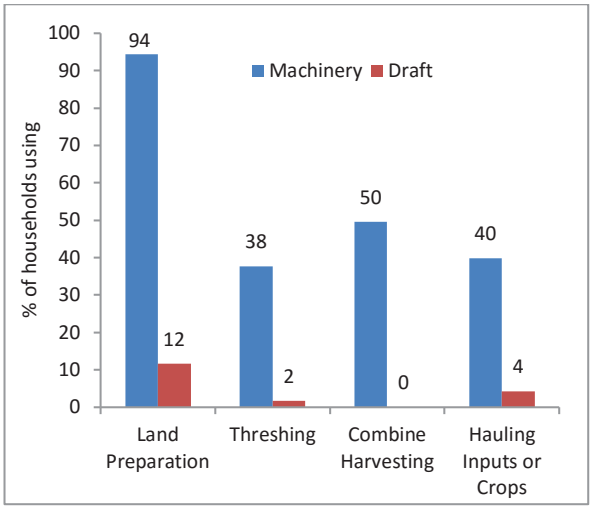
Myanmar has experienced rapid economic growth since the civilian government came into power in 2011. Structural transformation of the economy, similar to that already experienced by other countries in the region, appears to be underway, with labor moving from agriculture to more productive urban-based industrial and service sectors. As this trend continues, it is likely that the share of agriculture in GDP will shrink in relative terms, even while continuing to grow in absolute value. The immediate consequences of this shift are labor shortages and rising agricultural wages, causing farmers to seek to substitute machines for manual labor to keep agriculture productive and profitable. Given the likelihood that structural transformation is already underway, we set out to understand current levels and rates of mechanization, and its characteristics and drivers. In order to do so, a representative farm survey was conducted in May 2016 in four townships close to Yangon city where paddy and pulses are widely cultivated; two in Yangon region (Kayan, Twantay) and two in Ayeyarwady region (Maubin, Nyuangdon).

SUMMARY OF FINDINGS

The Current Extent of Mechanization

Machinery has almost completely replaced the use of draft animals in agriculture in the area surveyed. The average share of farm households using agricultural machinery and draft animals to perform activities related to paddy cultivation during 2015 monsoon and 2016 dry seasons is presented in Figure 1. Use of machinery was most common in land preparation, for which almost all paddy-farming households (94%) used machines, with only 12% still using draft animals. The share of households using draft animals for other activities was even smaller. Widespread mechanization of harvesting, another labor-intensive activity, has also taken place. Half of all sampled paddy farming households used large-scale machinery (combine harvesters) for this purpose, whereas 38% used small-scale machines (threshers). These figures demonstrate that a high level of mechanization has already taken place in locations close to Yangon city.

Figure 1. Machinery and Draft Animal Use in Paddy Cultivation, 2015–2016



Source for all figures: Authors (MAAS, 2016)

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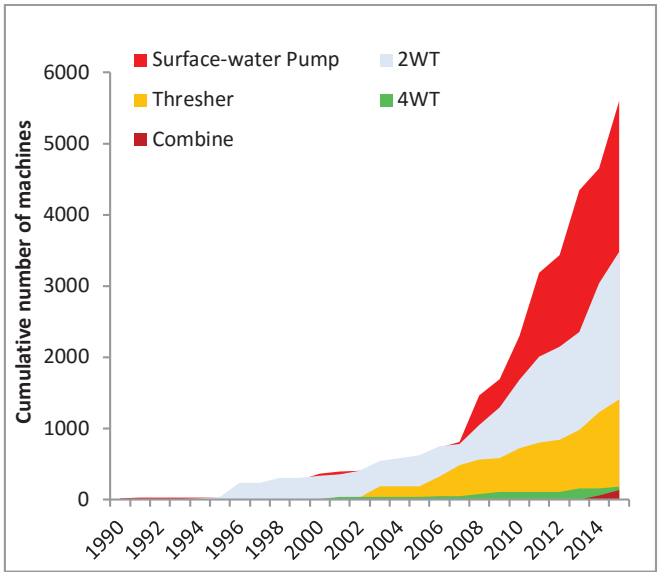
Mechanization Characteristics

Widespread mechanization is a very recent phenomenon. Cumulative growth in the ownership of various types of machinery is illustrated in Figure 2, which summarizes purchases made in surveyed village tracts from 1990 to 2015.

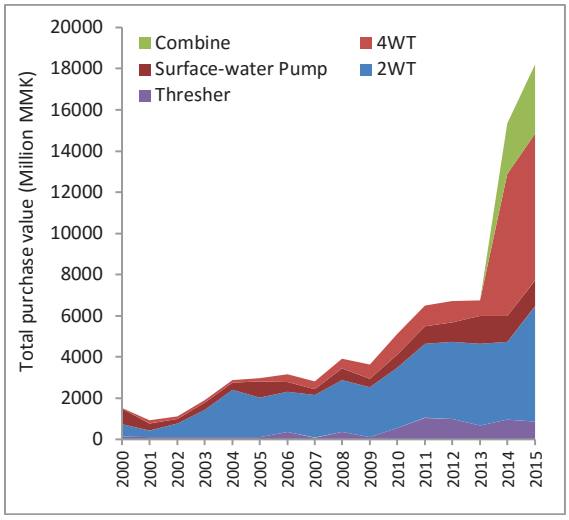
Figure 2. Cumulative Purchases of Selected Machinery (1990–2015)



Ownership of agricultural machinery increased slowly until 2008, but grew exponentially thereafter, accelerating particularly quickly after 2010. A sequential pattern of mechanization, in which stationary 'power intensive' operations such as pumping water and threshing are mechanized first, followed by mobile 'control intensive' operations such as harvesting is observed in many countries (Pingali 2007). The trend in Figure 2 is consistent with this sequence. Limited adoption of surface-water pumps and two wheel tractors began in the early 1990s, followed by mechanical threshers and four-wheel tractors almost a decade later, after 2000. Adoption of combine harvesters is a very recent phenomenon, occurring only from 2013 onwards.

Figure 3 depicts the characteristics of mechanization in terms of the total value (adjusted to 2015 prices) of different types of machinery purchased from 2000 to 2015. The figure reflects the pattern illustrated above, with expenditure on machinery increasing quickly after 2009, and accelerating extremely rapidly from 2013 onwards, with the total value of machinery sales more than tripling in just two years from 2013 to 2015.

Figure 3. Total Real Purchase Value of Selected Machinery (2000–2015)



Four-wheel tractors and combine harvesters alone contributed about half of the total value of machinery sales in 2015. The contribution of four-wheel tractors to the total value of purchased machinery was low prior to 2013, even though the total number of four-wheel tractor units purchased changed little before and after 2013 (see Figure 2). This implies that more expensive high performance four-wheel tractors were increasingly adopted after 2013.

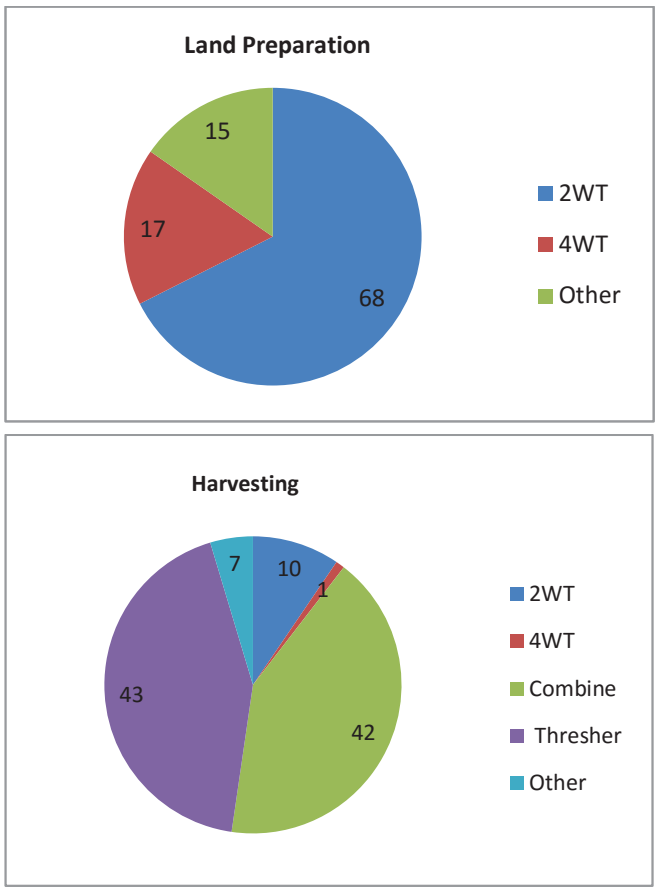
Large- and Small-scale Mechanization

Agricultural machinery can be categorized as small-scale (e.g. two wheel tractors, threshers), or large scale (e.g. four-wheel tractors, combine harvesters). Figure 4 summarizes the use of small and large-scale machinery for land preparation and harvesting by all agricultural households in 2015–2016.

Large-scale mechanization is most advanced in the case of harvesting, with more than 40% of all agricul-tural households using combine harvesters for harvesting, whereas about 17% used four-wheel tractors for land preparation. A large majority of households (68%) used smaller two-wheel tractors for land prep-aration. The comparatively low rate of adop-

tion of four-wheel tractors reflects the fact that these heavy machines are not well suited to preparing soft or waterlogged soils for paddy cultivation.

Figure 4. Use of Machinery in Land Preparation and Harvesting, by Type of Machine (All Agricultural Households, 2015/16)

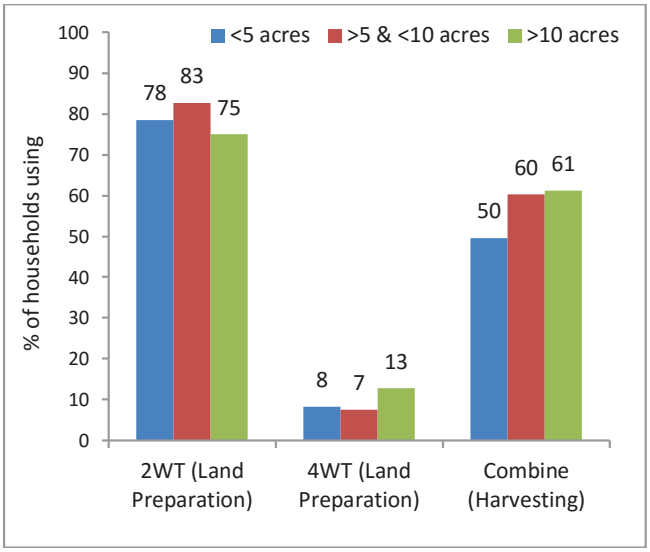


Mechanization and Farm Size

Agricultural mechanization is commonly perceived not to be scale neutral, implying that larger farms are better able to mechanize than small farms. Evidence from the survey runs counter to this, suggesting that in the village tracts sampled, farm size and adoption of mechanization are, at best weakly correlated.

Figure 5 presents data on the share of farm households using machinery for land preparation and harvesting in paddy cultivation, by farm size, with farms divided into three categories (<5 acres, 5-10 acres, and >10 acres). There is very little difference among farm size categories in the share of households using two-wheel tractors and four-wheel tractors for land preparation. Use of combine harvesters varies more with farm size, ranging from 50% on farms sized <5 acres to 61% on farms of >10 acres, but this difference is still small.

Figure 5. Share of Households Using Machinery for Land Preparation and Harvesting in Paddy Cultivation, by Farm Size Group (2015/16)



The Pace of Mechanization

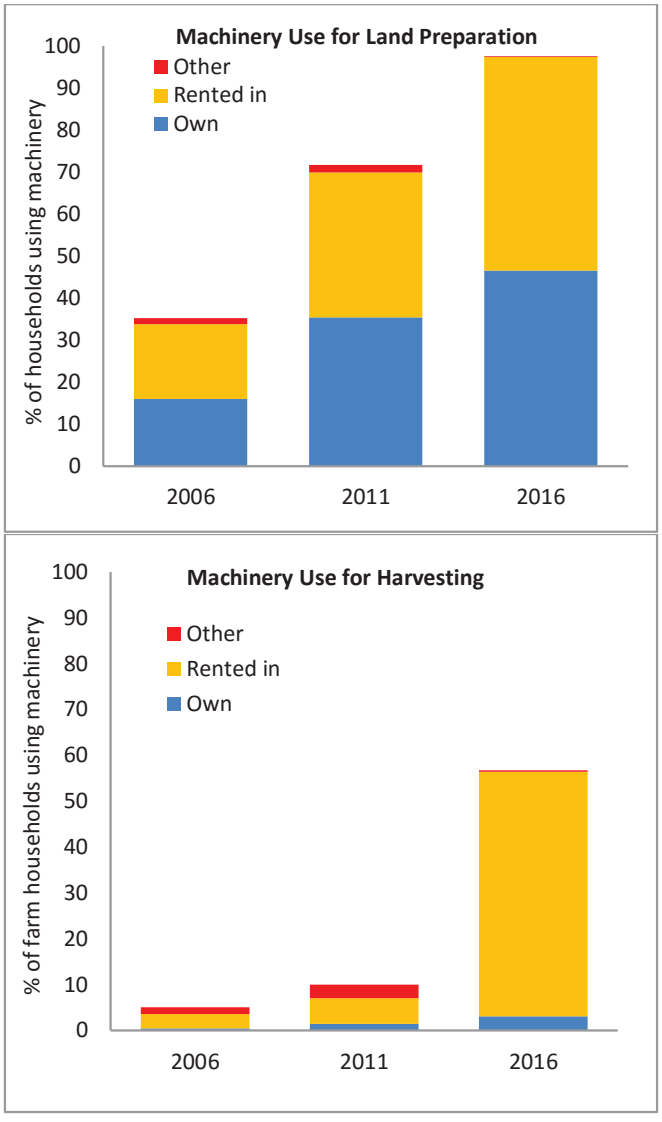
Mechanization occurred at a dramatic pace over the preceding 10 years in surveyed village tracts. Figure 6 illustrates changes in share of agricultural households using machinery for land preparation and harvesting over the period 2006-2016. The percentage of households using some type of machinery for land preparation rose steadily, from 36% in 2006 to 72% in 2011, to reach 97% in 2016. The share of households using some type of machinery for harvesting increased little from 2006 to 2011 (from approximately 5% to 10%) and then jumped very sharply to 57% in 2016.

Rental Markets

The growth of rental services has contributed to the adoption of agricultural machinery over the last decade. Figure 6 also contains data on the percentage of households owning and renting machinery for land preparation and harvesting in 2006, 2011, and 2016. Among households using machines for land preparation, approximately half owned the machine

used, with around half renting in, in all three years. Rentals accounted for the vast majority of machine use in harvesting, and were most prevalent in 2016, likely due to dramatic the growth of combine harvester rental services occurring after 2013. The rental market clearly plays a key a role in facilitating farmer access to expensive large-scale machines, especially in case of combines. The highest rates of combine harvester rentals are found among households with small farms.

Figure 6. Use of Machinery for Land Preparation and Harvesting in Paddy Cultivation, 2006–2016

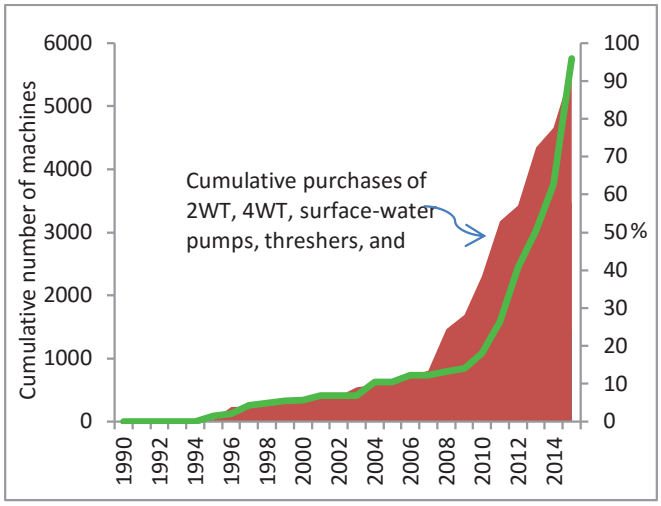


More than 95% of farms under five acres that made use of combine harvesters rented in these services in 2015-16, compared with 74% of those operating >10 acres of land. This suggests that the rental market for combine harvesters is dominated by large farmers who buy machines to rent out to smaller farmers as a business, in addition to use on their own farms.

Drivers of Mechanization

Figure 7 superimposes figures for the cumulative share of permanent migrants originating from surveyed village tracts onto the cumulative number of purchases of agricultural machines in the same locations, from 1990 to 2015.

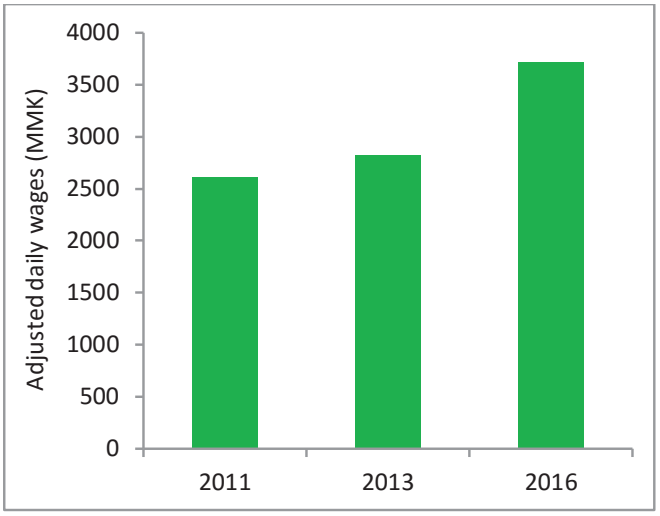
Figure 7. Cumulative Purchases of Agricultural Machines and Cumulative Share of Total Migration, 1990–2015



Widespread migration only began after 2009, accelerating particularly after 2011, with machinery purchases increasing at a similar pace (Figure 7). The scale of labor migration during this period is likely responsible for the acceleration of machine purchases as a response shortages of manual labor.

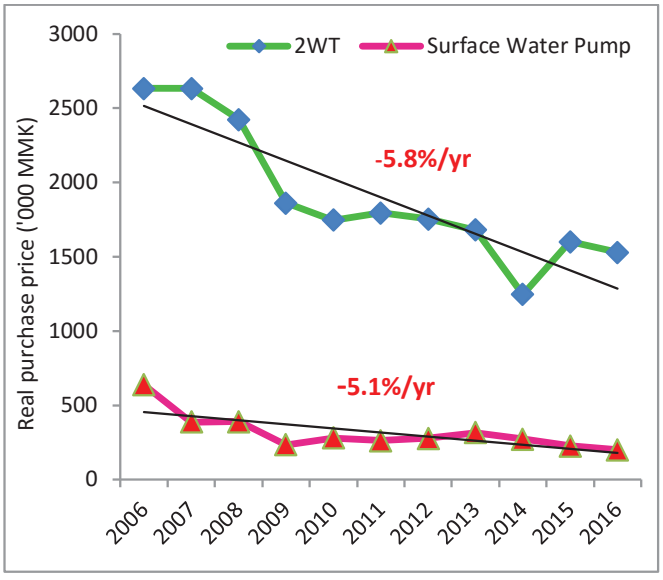
Figure 8 presents the real value of daily wages for casual male agricultural laborers for 2011, 2013, and 2016. The real wage rate increased 8% from 2011-2013, but jumped by 32% from 2013 to 2016. The timing of this change is consistent with the rapid rise of large-scale mechanization from 2013, and appears to be a major driver of this process.

Figure 8. Changes in Real Agriculture Wages, 2011–2016



Falling machinery prices have provided further incentives for mechanization in Myanmar. Figure 9 illustrates changes in the real price of two-wheel tractors and surface-water pumps over the decade 2006-2016. The purchase price of two-wheel tractors fell at a fitted average rate of around 6% per year over this period while that of surface water pumps declined by about 5% per year. China's low-cost manufacturing capacity appears to be a main driver of lower prices for these types of machinery.

Figure 9. Adjusted Purchase Price of Selected Machinery



CONCLUSIONS

Agricultural mechanization is already well advanced in the village tracts surveyed, almost completely replacing the use of draft cattle. Economic reforms and the growth in the non-farm sector from 2011 have stimulated an ongoing process of structural transformation, in which labor is moving from agriculture to the more productive urban industrial and service sectors. Resultant rural labor shortages and increases in real wage rates have been major drivers of mechanization in agricultural sector, particularly from 2013 onwards. The declining real price of some types of machinery has contributed to the acceleration of this process. The increasing availability of financial services following reforms post-2011 is also likely to have accelerated the adoption of large-scale agricultural machinery, particularly from 2013 onwards. The rise of rental markets, especially for large-scale equipment (combine harvesters and four-wheel tractors), has further improved access to these machines for farmers with small and large landholdings alike.

All research highlights are available for download at http://foodsecuritypolicy.msu.edu/countries/burma/research_highlights

A summary of the survey methodology is available here http://foodsecuritypolicy.msu.edu/countries/burma/research_highlights

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