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MECHANIZATION AND CROP PRODUCTIVITY, PROFITABILITY AND LABOR USE IN MYANMAR'S DRY ZONE

David Mather and Ben Belton

INTRODUCTION

This research highlight analyzes differences in productivity, profitability and labor use for four major crops produced in Myanmar's Dry Zone, namely monsoon paddy, dry season paddy, sesame, and groundnut, comparing farmers using mechanized land preparation with those using draft animal power alone, and farmers using mechanized harvesting/threshing with those using manual and/or mixed methods. Analysis is based on data collected by the Rural Economy and Agriculture in the Dry Zone survey (READZ) from 1,578 rural households in four townships in Myanmar's central Dry Zone in 2017 (see Belton et al., 2017). This research highlight summarizes the findings of Mather and Belton (2018).

LAND PREPARATION

This section present findings on mechanized land preparation for the production of the four crops referred to above.

Extent of adoption: The majority of producers of all four crops have begun to use tractors (power tillers or four wheel tractors) during land preparation. Adoption is more advanced among paddy farmers than oilseed producers (93% and 80% of dry season and monsoon paddy cultivators, versus 65% and 63% of sesame and groundnut growers). However, for all these crops, a large majority of households using tractors do so mainly for initial plowing, and continue to use animal draft power for subsequent harrowing.

Cost structure: Most tractors are rented in, whereas most draft animals are owned by the household using them. For example, among 80% of households that used a tractor for monsoon paddy cultivation, 81% rented them in. Conversely, among 20% of monsoon paddy growers who used only draft animals for land preparation, 78% used their own. Use of draft animals usually entails opportunity costs (opportunity cost of capital tied up in purchase of cattle, own-produced feed, and the family labor needed for husbandry), but requires no cash outlay at the time of land preparation. In contrast, renting-in tractors requires cash outlay around the time of use, but entails few fixed or opportunity costs.

Yields: Farms using a tractor during land preparation report average yields of dry season paddy and groundnut that are 19% and 18% higher, respectively, than those obtained by households using only animal draft power. There is little difference in monsoon paddy and sesame yields between these two groups. The yield gap between users and non-users of tractors in dry season paddy cultivation is 214 kg/acre (equivalent to $49/acre). For groundnut farmers, the gap is 118 kg/acre ($30/acre). However, these differences are not statistically significant, and are not attributable to differences between tractor and draft animal tillage.

Adoption of complementary inputs: Dry season paddy and groundnut cultivators appear to adopt tractors as part of a portfolio of improved inputs. This is not the case for monsoon paddy and sesame farmers. Dry season paddy and groundnut farmers who use tractors report higher fertilizer application rates than non-tractor users. Tractor users are more likely to apply inorganic fertilizer during dry season paddy cultivation, than non-users (92% vs 69%), and use more on average (119 kg/acre vs 75 kg/acre). In groundnut production, 87% of tractor users apply inorganic fertilizer (vs 75% of those using draft animals only), applying 50 kg/acre (vs 40 kg/acre).

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Interestingly, groundnut farmers who use tractors are also significantly more likely to use an improved variety than those using only draft animals (24% as compared to 7%). For all other crops, tractor users are marginally more likely to use improved varieties, but these differences are not significant.

Crop losses: Growers of dry season paddy and groundnut who used a tractor were less likely to report any pre- or post-harvest crop losses (most of which result from heavy rainfall, flooding or drought) than those using only draft animals. Twenty-nine percent of dry season paddy farmers using a tractor reported crop losses, as compared to 40% of those who did not use tractors. Among groundnut growers the numbers are 16% and 33%, respectively. Tractor users are presumably able to plant earlier on average than households reliant entirely on draft animals, enabling them to harvest in time to avoid events such as heavy rains at the end of the dry season cropping period.

Labor savings: Labor savings obtained from the use of tractors are quite small, ranging from 1 person-day per acre for groundnut, to 3.5 person-days per acre for sesame. Most of the labor saved is family labor, so direct cash savings are limited. This finding may imply that one of the major advantages of tractors, as perceived by farmers, is to reduce the drudgery associated with plowing with draft animals. Plowing requires much greater physical effort than harrowing.

Production costs: Using only a tractor for land preparation is cheaper than using only draft animal power (by between $3.00 and $11.50/acre, depending on the crop), but using both a tractor and draft animal costs approximately $7.50/acre more than using draft animals alone. This difference is minor, being worth less than 5% of the average total cash costs of production of these crops Profitability: Net margins are similar among growers of monsoon paddy, groundnut and sesame on farms using tractors and those using only draft animals. Tractor users producing dry season paddy earn higher net margins than non-tractor users, but this difference is not statistically significant.

HARVESTING & THRESHING

This section presents findings on mechanization of harvesting and threshing paddy in the Dry Zone. Two simultaneous transitions are taking place. First, the shift from manual harvesting and manual threshing of paddy to manual harvesting and mechanized threshing. Second, the shift from manual harvesting plus (manual or mechanized) threshing to combine harvesting. Neither sesame nor groundnut are mechanically harvested at present, and only 1-2% is threshed mechanically by farm households.

Extent of adoption: In the four townships surveyed, in both paddy growing seasons, more than two thirds of paddy farming households used either a thresher or combine (71% in monsoon and 67% in dry season). Use of threshers predominates during the monsoon (the main growing season), when 58% of farms used a thresher and 13% used a combine. This pattern is reversed in the dry season, when 41% of paddy cultivators used a combine and 26% used a mechanized thresher.

Seasonal differences: High rates of combine harvester use during the dry season growing period (which precedes the monsoon season) appear to be linked to the ability to harvest and thresh paddy quickly, allowing the following monsoon paddy crop to be planted in time.

An additional reason why combine harvesting is more common in the dry season is that it can reduce the yield and palatability of rice straw that farmers use as fodder for their draft animals. The monsoon paddy crop provides the bulk of paddy straw for the year, making some farmers unwilling to use combines on this crop.

Higher levels of combine use during the dry season than in the monsoon may also occur because large contiguous expanses of paddy are usually found in areas with access to dry season irrigation. In locations where only monsoon paddy is grown, land use patterns are more fragmented. Areas with dry season irrigation are most attractive to rental service providers, as they can achieve economies of scale by serving many customers at a single location.

Yields: In both seasons, farmers using combine harvesters enjoyed higher yields than those using mechanized threshers. Users of mechanized threshers also achieved higher yields than households who threshed their crops manually. Based on interviews with combine users, the yield gains from combine use appear to be achieved mainly as a result of reduced losses of grain during harvesting and threshing.

During the dry season, combine users obtained 259 kg more paddy per acre than households practicing manual harvesting/threshing (a 19.5% higher yield, worth $60/acre). The yield gap between households using combines and those using mechanized threshers stood at 162 kg/

acre (11%, or $37/acre). Differences in yields are of similar magnitude during the monsoon season (202 kg/acre and 141 kg/acre for the same groups of households). However, none of these differences was found to be statistically significant.

Adoption of complementary inputs: During the monsoon season, combine harvester use appears correlated with the adoption of other modern inputs. Use of improved varieties among combine users is greater than among users of mechanized threshers or households who thresh paddy manually (63% vs 45%, vs 40%, respectively). This difference is statistically significant. Use and applications rates for inorganic fertilizer are also higher among combine users relative to those using only manual harvesting and threshing.

A different pattern is evident during the dry season, when use of improved varieties is highest among users of mechanized threshers (56%), followed by users of combines (39%), and households who harvest and thresh manually (30%). Use and application rates for inorganic fertilizer and irrigation are similar across these three sub-groups.

Labor savings: As expected, use of a combine saves a significant amount of labor in harvesting/threshing. In the monsoon season, this is equivalent to 7.3 labor days/acre relative to manual harvesting and mechanized threshing, and 11.2 labor days/acre relative to manual harvesting and threshing. Levels of labor savings during dry season are very similar to those in monsoon.

Production costs: Contrary to expectations, the average cost of harvesting/threshing dry season paddy by combine was found to be higher than either manual harvesting and mechanized threshing (by $12/acre) or manual harvesting/threshing (by $19/acre). A rather similar pattern is found in the monsoon season, when the average cost of harvesting/threshing by combine is approximately $13/acre higher than manual harvesting and mechanized threshing, and $10/acre higher than manual harvesting and threshing.

However, the additional cost of combine use is considerably less than the value of the difference in yields, whether the yield gains are due to combine use, higher rates of improved input use, or both.

Profitability: For dry season paddy cultivation, the gross and net margins earned by combine users are similar to those obtained by households using mechanical threshers, and those harvesting/threshing manually. Net margins range from an average of $211/acre for combine users to $161 for users of mechanical threshers to $220 for users of labor power alone, but these differences are not statistically significant. During the monsoon season, net margins earned by combine users (mean $142/acre) are higher than those of households using mechanized threshers ($92/acre) or manual labor alone ($116/acre) for harvesting/threshing paddy.

CONCLUSIONS

We draw the following conclusions:

1) Mechanization of land preparation is associated with higher yields in dry season paddy cultivation and groundnut farming, but not in sesame or monsoon paddy cultivation.

2) Productivity increases associated with mechanized land preparation appear to result from: 1) Adoption of complementary inputs (inorganic fertilizer and improved varieties); and 2) Increased timeliness of planting that enables farmers to avoid events such as heavy rains late in the cropping period, which may cause yield loss.

3) There are no observed differences in crop profitability for tractor or draft animal land preparation.

4) Mechanization of paddy harvesting and threshing is associated with higher realized yields as a result of reduced losses of grain during harvesting and threshing and (during the monsoon season) greater propensity to use improved varieties and inorganic fertilizers.

5) Surprisingly, despite substantially reducing labor requirements, mechanized harvesting and/or threshing does not appear to lower average production costs or result in significantly higher average gross or net margins.

6) Together, these findings suggest that some of the main advantages that mechanization provides to farm households result from: 1) Improved reliability and timeliness of planting and harvesting in a context where farm labor is increasingly difficult to obtain; 2) Reduction of risk associated with weather-induced crop losses; 3) Reduced grain loss during harvesting/threshing by combine, and; 4) Minimization of the physical drudgery associated with farming.

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