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TEN YEARS OF TECHNOLOGICAL CHANGE IN DRY ZONE AGRICULTURE

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INTRODUCTION

This report outlines recent (2007-2017) changes in agricultural practices for the main field crops grown in Myanmar's Dry Zone, based on information gathered from the Rural Economy and Agriculture Dry Zone (READZ) survey.

Myanmar's Dry Zone is a vast area in the North-Central part of the country, spanning three different regions (Sagaing, Mandalay and Magway) and including the country's second-largest city of Mandalay. The survey was carried out in April of 2017 in the townships of Budalin, Myittha, Magway and Pwintbyu.

One objective of the survey was to assess trends in production patterns and practices for four of the major field crops grown in the area: rice, groundnut, sesame, and green gram. This was done by collecting recall data for three time periods: the year of the survey (2017, corresponding to the 2016-2017 growing season), five years prior (2012), and ten years prior (2007). Each farmer was asked only about their most important crop, so the results pertain not to all farmers growing a given crop, but rather to those specializing in each crop.

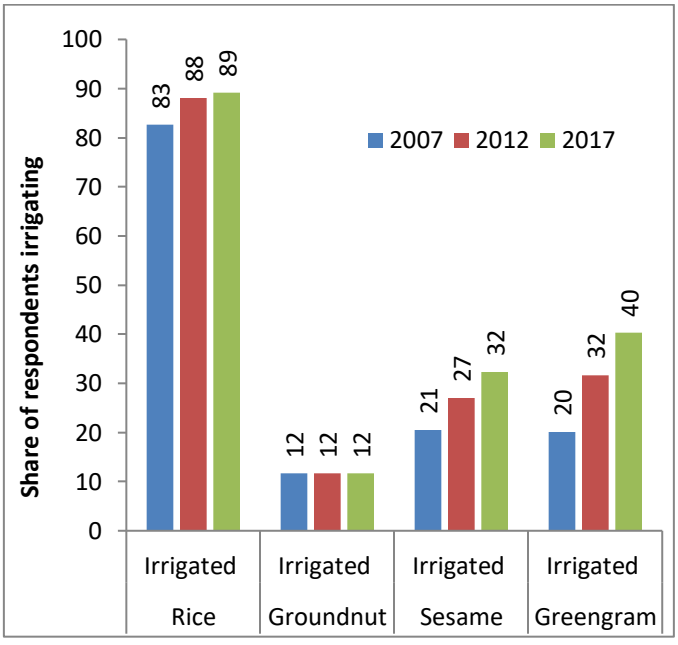
This analysis allowed us to compare how production of the four major crops has evolved over the past ten years in terms of seasonality, technology and input use, and yields, and to identify evidence of any technological change and modernization occurring.

Patterns of change in Dry Zone agriculture

1. Irrigation is expanding, particularly for sesame and green gram

Access to irrigation is a major constraint in the Dry Zone. It plays a critical role in crop choice, yield potential, and risk. Rice is by far the most commonly irrigated among the major crops. More than 80% of respondents focusing on rice had irrigated plots, and that share grew from 83% to 89% over the 10-year recall period. Irrigation was much less common for the other three crops (Figure 1).

Figure 1: Share of households using irrigation in pre-monsoon season, by crop



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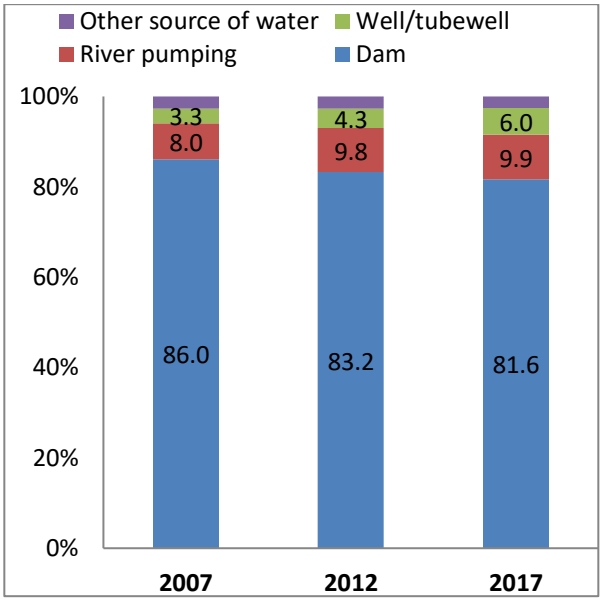
Only 11% of respondents irrigated groundnut, with no increase over time. The use of irrigation for sesame and green gram increased rapidly over the period: from 21% to 32% of respondents for sesame, and from 20% to 40% for green gram.

This increase in irrigation of non-rice crops is partly due to the adoption of new forms of irrigation, including tubewells and river pumping. These new types of irrigation are often used for sesame and green gram, which require less water than rice. Nevertheless, dam irrigation still dominates, with other forms gaining ground slowly. River pumping increased from 8.0% to 9.9% of all irrigation, and underground water pumping from 3.3% to 6% (Figure 2).

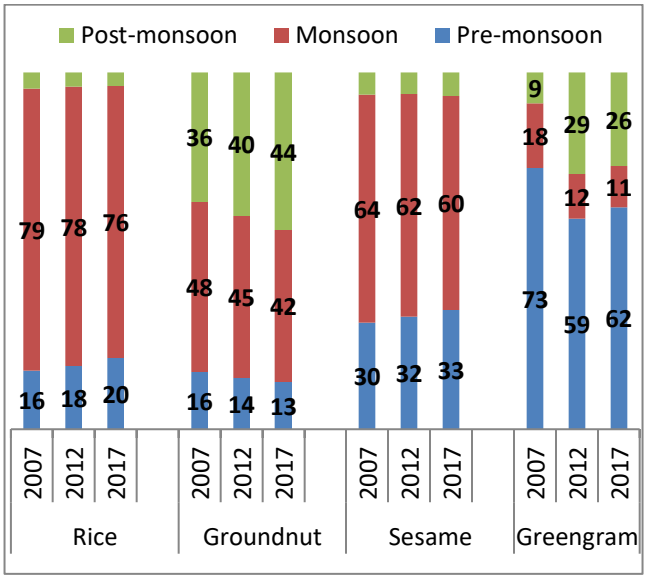
Figure 2: Types of irrigation used over time



2. Adjustments in seasonal cropping patterns for some crops

The Dry Zone cropping calendar is divided into three seasons: Pre-monsoon (March-May), Monsoon (June-October) and Post-Monsoon (November-February). The share of farmers growing the four crops of interest in each season, along with changes over the 10-year recall period, are shown in (Figure 3).

Figure 3 Main growing season for households growing major crops (percent of farmers).



Seasonal patterns for rice and sesame remained largely the same over the period, with monsoon being the main growing season for nearly 80% (rice) and 60% (sesame) of farmers, respectively.

Seasonal patterns changed somewhat for groundnut, which is increasingly a crop grown in pre-monsoon season. Pre-monsoon was the main growing season for 44% of groundnut farmers in 2017 (up from 36% in 2007). Similarly, pre-monsoon is now the main growing season for 26% of green gram farmers, up from 9% in 2007.

3. Rapid uptake of agricultural machinery

Agricultural mechanization is spreading rapidly through the Dry Zone. Figure 4 shows that the share of households who used either tractors, combine harvesters, or threshers increased from 20% in 2007 to nearly 90% in 2017. In terms of number of farmers using machines, this represented a fourfold-fold increase over ten years, from 16,000 farmers to over 70,000. The figure also shows that this dramatic increase is mostly due to flourishing rental markets, as only 6% of households own the machinery they use.

Figure 4 Share of households who used agricultural machinery, by ownership status

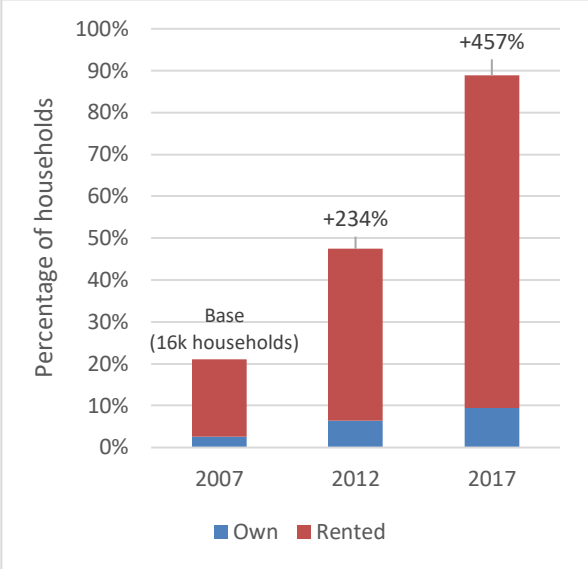
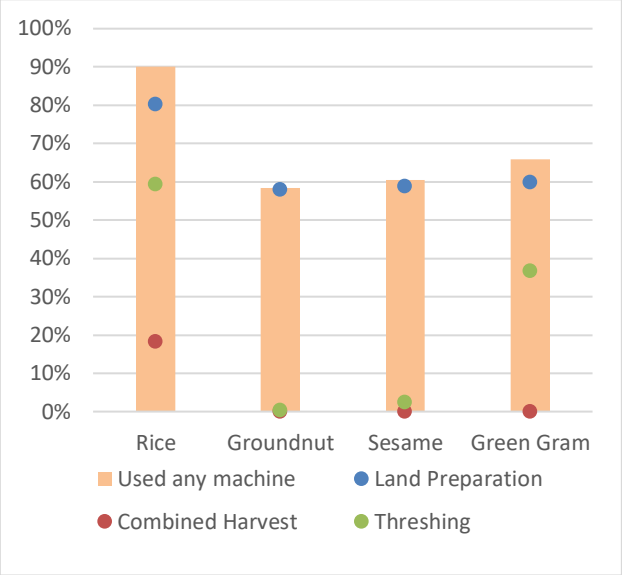


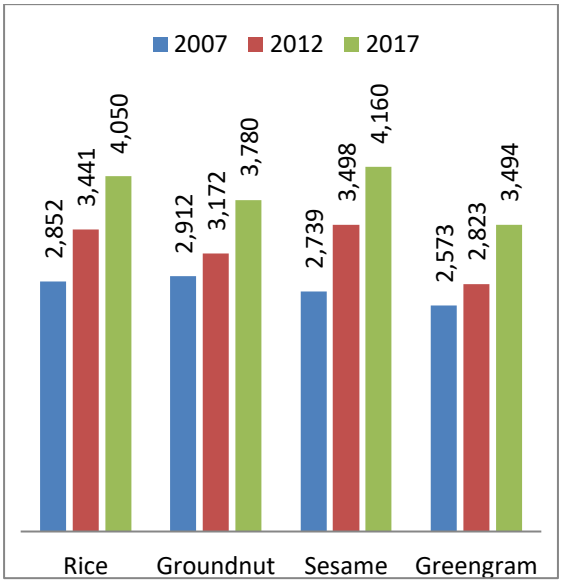
Figure 5: Share of households using different types of machines



Thanks to the availability of rental services, even farmers with small landholdings are able to use machinery for agricultural production. However, crops differ in the extent and type of crop management tasks that are mechanized. Figure 5 shows that rice farmers are much more likely to be using agricultural machinery (90%) than farmers of groundnut, sesame or green gram (around 60%). In addition, land preparation is more mechanized than other stages of the production process. Only 20% of rice farmers in the four townships surveyed use a combine harvester, but 60% harvest manually and thresh using a mechanical thresher. This tendency is even more pronounced for non-rice crops. Groundnut and sesame farmers only use machinery for land preparation, but continue to harvest and thresh manually. Less than 40% of green gram farmers thresh their crop mechanically.

One explanation for the rapid uptake of machinery in agriculture is the increasing cost of labor. Wages at harvest time have risen significantly for all crops (Figure 6). The increase has been most dramatic for sesame harvesting, with real wages jumping from 2,700 Kyaday in 2007 to 4,200 Kyats/day in 2017, but all four crops display a similar pattern. This is likely due to an increasing range of employment options, from local opportunities in construction and services, to more distant jobs in regional urban centers or abroad, resulting in a tightening of the rural labor market.

Figure 6: Average daily wage for men at harvest time of major crops (Kyat/day, real terms base 2016)



4. The use of modern inputs is expanding
This section details changes in the use of improved varieties, pesticides and herbicides, and fertilizer.

Improved varieties: The use of improved seed varieties remains limited in the surveyed areas. Only 24% of farms report using improved varieties, but the trends show a net increase in usage over the past ten years. The share of rice households in the sample using improved rice varieties rose from 25% to 42% since 2007. Sesame farmers also increased their uptake, from 14% to 23%. The increase was more modest for groundnut farmers (from 8% to 12%). The lowest rate of use was among green gram farmers, who reported starting to use improved varieties only after 2012, and reached 8% uptake (Figure 7).

Pesticides and herbicides: Reported use of pesticides on rice, groundnut and sesame increased rapidly over the recall period. The share of household using pesticides doubled for all major crops except green gram (Figure 8).

Figure 7: Share of households using local and improved varieties

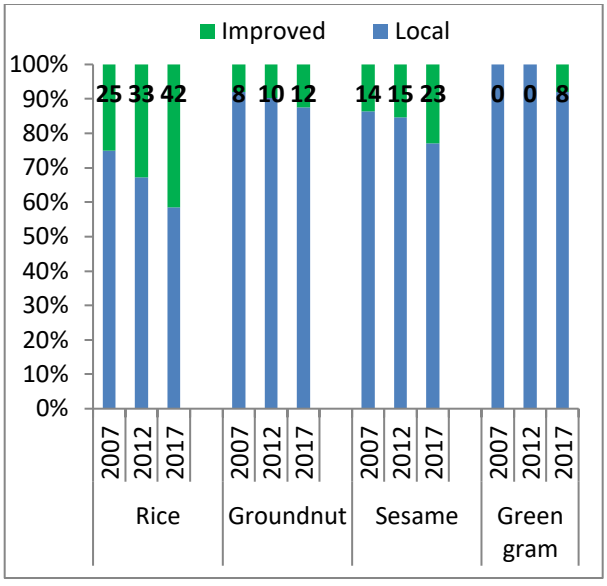
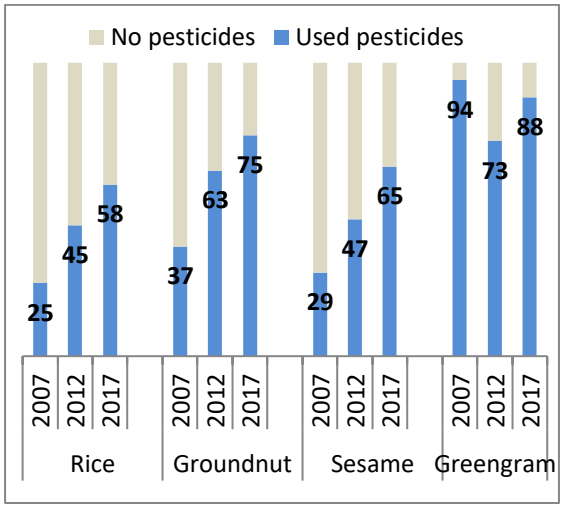


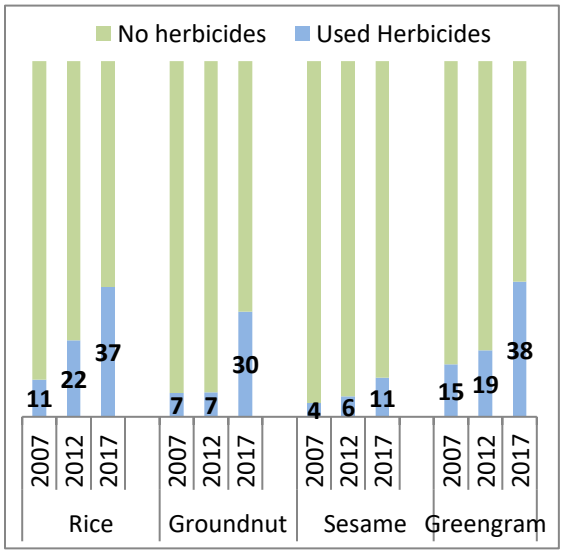
Figure 8: Share of households using pesticides use by year and crop



The share of households using pesticide increased from 25% to 59% for rice, 37% to 75% for groundnut, and 29% to 65% for sesame. Pesticide use in green gram production was already highest among all crops (at 94% in 2007), and fluctuated over time while remaining high (73% in 2012, then 88% in 2017).

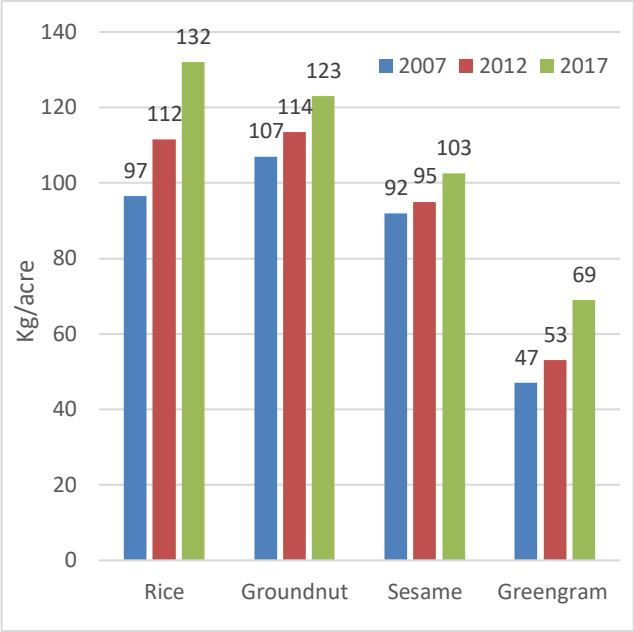
Herbicide use is less prevalent than pesticide use overall, but all crops have also seen a major increase in use (Figure 9). Herbicide use in rice increased from 11% to 37% over ten years, and use in groundnut rose from 7% to 30%. Use among sesame farmers remained low, increasing from 4% to 11%. Green gram showed the highest use rates, jumping from 15% to 38%. Increasing use of herbicides may be linked to rising wage rates as a labor saving strategy that minimizes the need for manual weeding.

Figure 9: Share of households using herbicides, by year and crop



Fertilizer: Inorganic fertilizer use was already widespread in 2007, with over 95% of farmers reporting applications of either urea or NPK (Nitrogen, Phosphorous, Potassium). Nevertheless, farmers report using higher quantities per acre than in the past. Figure 10 presents trends in the total quantities of fertilizer used, showing a clear and steady increase for all crops.Overall, the trends in input use paint a picture of an agricultural sector in the midst of modernization, with increasingly widespread use of improved varieties and agro-chemicals. Nevertheless, overall use levels of mod-ern inputs remain relatively low, suggesting significant potential for further change.

Figure 10: Average quantity of fertilizer applied (urea + NPK), by crop

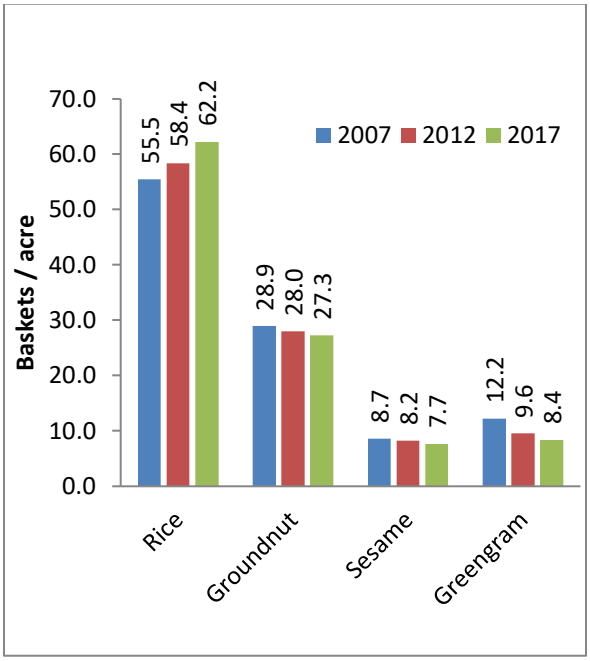


5. Despite modernizing practices, only rice yields have increased

Although adoption of irrigation, mechanization, and modern inputs increased to varying degrees, reported crop yields showed limited response. The average yield of rice in 2017 was 62.2 baskets per acre 1,300 kg/acre) , as shown in Figure 11. This represents a slight but statistically significant increase from 10 years ago (55.5 baskets/acre, or 1,150kg/acre). This trend existed in all growing seasons (pre-monsoon, monsoon, and post-monsoon).

In contrast, average yields of groundnut remained stable over the past ten years at around 28 baskets/acre (319 kg/acre). Average reported sesame yields decreased slightly from 8.7 to 7.7 baskets/acre (213 kg/acre and 189kg/acre); a significant difference. Green gram yields also appear to have fallen from 12.2 baskets/acre in 2007 to 8.4 baskets/acre in 2017 (275kg/acre), but the difference was not statistically significant.

Figure 11: Change in average yield of major crops grown in the sample over the past decade



[1] Conversions for baskets are as follows: rice 20.9kg, groundnut 11.4kg, sesame 24.5kg, and green gram 32.7.

Since yields are highly subject to the variability of weather conditions, these results do not necessarily reflect a worsening trend. A longer-term time-series with multiple observations would be necessary to draw more definitive conclusions.

CONCLUSIONS

The analysis of changes in agricultural practices over the past ten years reveals several important trends:

1. The agricultural sector is modernizing. Irrigation is expanding gradually and mechanization is occurring rapidly. The use of improved varieties, and agro-chemicals is spreading, and the intensity of fertilizer use per-acre is also increasing. These latter trends in input use are likely to reflect simultaneous improvements in availability of agricultural inputs, and access to agricultural credit.

2. Changes in technology are accompanied by slight shifts in seasonal cropping patterns, with pre-monsoon increasingly gaining ground as the main growing season for ground nut and green gram, likely reflecting increasing access to irrigation from sources other than dams.

3. Yields do not appear to follow a similarly rising pattern. Yields of rice have increased modestly, but yields of green gram and groundnut showed no significant change. Meanwhile, sesame yields were significantly lower in 2017 than 2007. This may reflect poor weather conditions, as sesame is a climate sensitive and hence risky crop. Since irrigation, improved varieties, and commercial inputs can have a role to play in reducing risk, continued increases in the use of modern inputs may help mitigate some of this vulnerability. Nevertheless, the yields reported in the survey suggest that this is outcome is by no means inevitable, and that the profitability of farming may be declining over time.

4. Investment in better adapted, higher yielding key crop varieties and dissemination of improved crop management practices are needed to increase the efficiency of input use, and raise agricultural productivity and profitability.

ABOUT THE AUTHORS

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