FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Food Security Policy Project Research Highlights
Myanmar

*January 2018* #13

# COMMUNITY PERCEPTIONS OF THE IMPACTS OF CLIMATE CHANGE ON AGRICULTURE IN MYANMAR'S CENTRAL DRY ZONE

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## INTRODUCTION

Myanmar is ranked second in the list of countries most affected by climate change (Kerft et al., 2014). Myanmar's Central Dry Zone (CDZ) is subject to extremes of climate including high temperatures, droughts, floods and storms. The CDZ occupies more than two thirds of Myanmar's agricultural land (JICA, 2013), and livelihoods there are highly dependent on agriculture, rendering them potentially vulnerable to a changing climate. With this in mind, a questionnaire was designed to capture data on climate change and its impacts on crop production in the CDZ, and to identify the adaptation measures being taken by communities.

The survey was carried out in the three main regions of the CDZ; Magway, Sagaing and Mandalay. Group interviews were conducted with knowledgeable long-term residents of 300 villages in 14 townships as part of a larger community survey.

### Community perceptions of changing climate conditions

Communities overwhelmingly reported the perception that the average intensity or frequency of a wide range of climatic conditions had changed during the past 30 years.

Ninety-eight percent of communities reported a change in the average amount of rainfall received over this period, and 94% reported the perception that average temperatures had changed.

Eighty-nine percent of communities reported that there had been a change in the frequency of drought in their region the past three decades, and 81% reported that the frequency of late monsoon seasons had altered.

Just under half of communities felt that the frequency of hailstorms had changed, and a little over one third thought that the frequency of flooding and storms was different (Figure 1).

Communities reporting changes in the intensity or frequency of these climatic conditions or events were asked to report their perceptions of the severity and direction of the changes.

Almost all communities that reported average temperatures had changed within the last 30 years felt they had increased. Among these, 52% of communities reported that average temperatures had increased "a lot", and 48% said that they had increased "slightly". Among communities reporting that average rainfall had changed, 43% felt that it had become "more erratic", while 38% reported that it had "decreased slightly", and 13% reported that it had "decreased a great deal" (Figure 2).

Figure 1. Perceptions of change in the frequency of climate conditions and events over the past 30 years

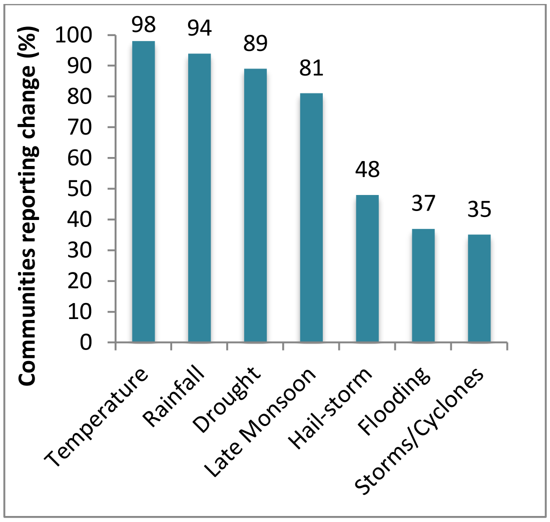


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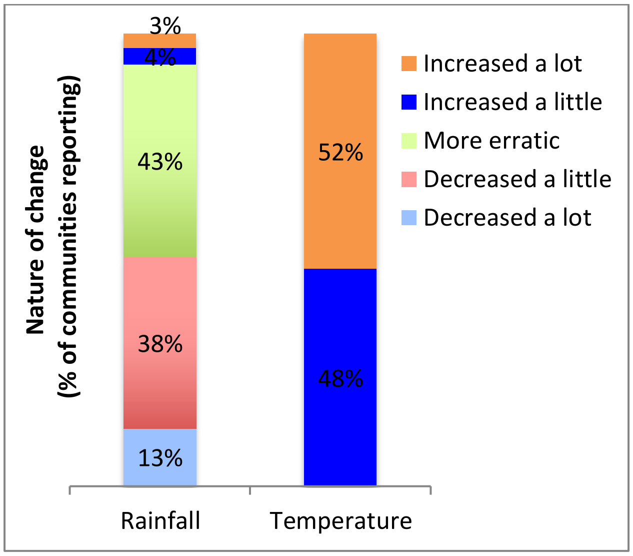
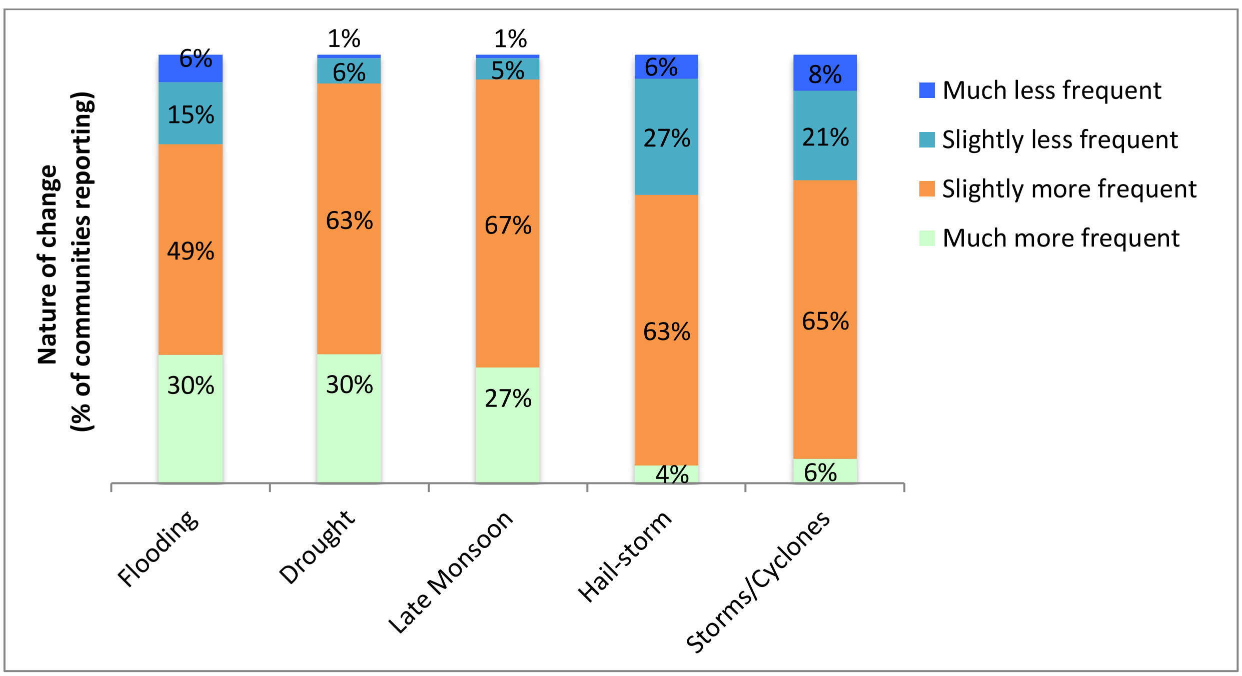
Figure 2. Community perceptions of changes in average temperature and rainfall over the past 30 years




For all types of extreme climatic event, the majority of communities reported that the frequency of occurrence had increased during the past 30 years (Figure 3). Between 49% and 67% of communities that had experienced these events reported that their frequency had increased slightly. Flooding, drought and late onset of the monsoon were reported to have become much more frequent by 27% to 30% of communities. Hail storms and storms/cyclones were reported to have declined in frequency by 33% and 29% of households, respectively.

Figure 3. Perceptions of changes in the frequency of climate events over the past 30 years

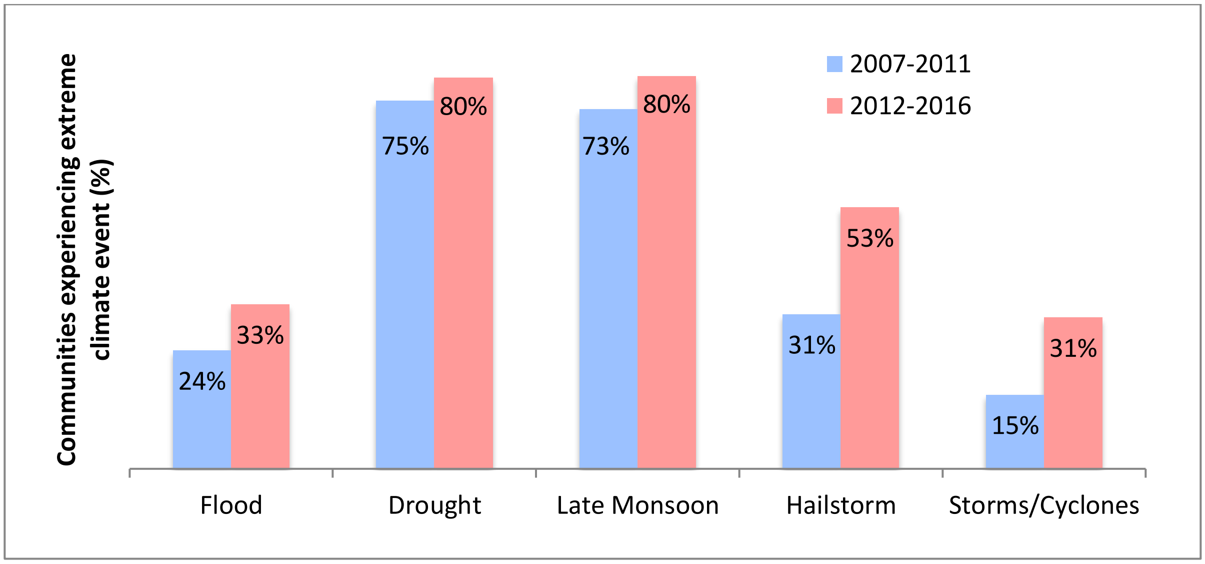



**Changes in the frequency of climate events from 2007 to 2016**

Communities were asked whether they had experienced any extreme climate events within the past five years (2016-2012) or the five-year period preceding that (2011-2007). For every type of extreme climate event, com-munities reported that the number of occurrences was higher in the more recent of the two periods (Figure 4).

Most notably, 80% of communities were affected by drought or late monsoon during the years 2012-2016, as compared to 75% during the period 2007-2011. The share of communities impacted by flooding increased from one quarter to one third, while the share of communities experiencing hailstorms and storms/cyclones doubled to 31%. These results indicate that observed (as opposed to perceived) changes in the frequency of extreme climatic events have taken place in recent years.

Figure 4. Percentage of communities reporting the occurrence of extreme climate change from 2007-2011 and 2012-2016



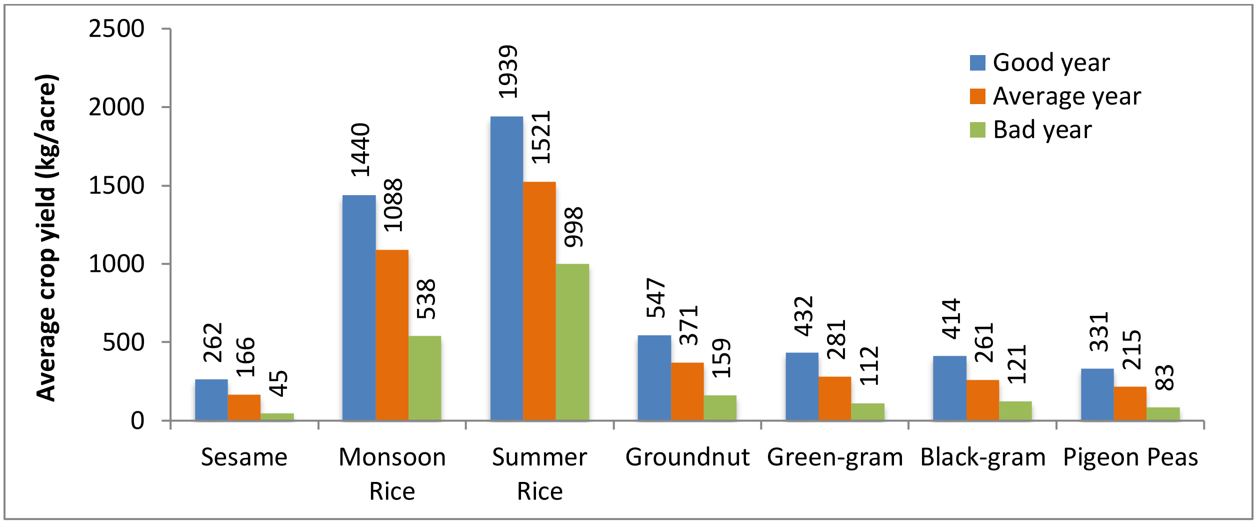

**Crop yield variability under different climate conditions**

We assessed the impact of climate on crop productivity by asking communities about typical yields for seven major crops in years when climatic conditions for the production of each of each crop were "good", "average" or "poor". Non-climatic factors like fertilizer use and irrigation access that influence the productivity of the crops at the level of individual farms were assumed to be constant. This analysis indicated that crop yields in the dry zone are extremely strongly affected by prevailing climatic conditions during the growing season.

Figure 5 presents data on average crop yields in "good", "average" and "poor" years. Monsoon rice yields are unstable, fluctuating between 1440 kg/acre under good climate conditions, and 538 kg/acre in poor years. The gap is less pronounced, but still large, for irrigated summer rice (1939 kg/acre, as compared to 998 kg/acre).

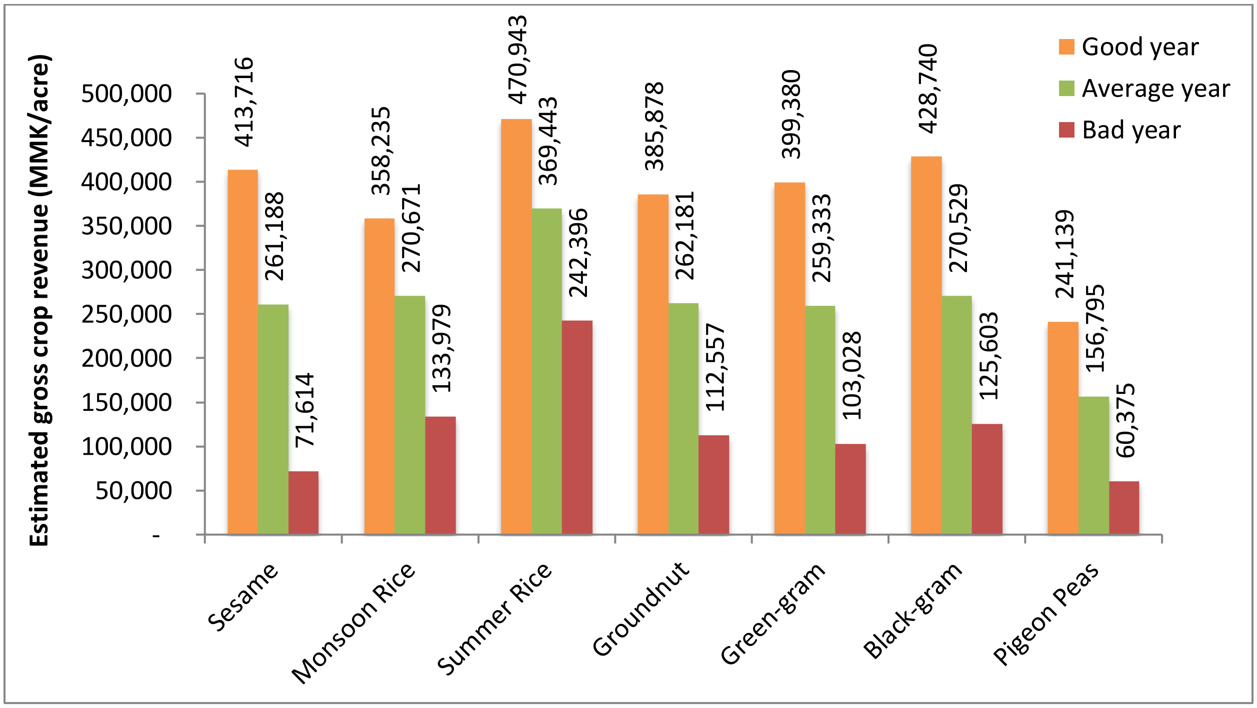
Yields of pulse and legume crops fluctuate even more widely. "Good" years for the production of groundnut and black gram produced yields 3.4 times higher than "poor" years, while good years for green gram and pigeon pea production gave yields 3.9 times higher than bad years. The most extreme climate related yield variability was reported for sesame, which gave average yields of just 45 kg/acre in poor years, but 262 kg/ha in good: a differential of 5.8 times.

Figure 5. Crop yields (kg/acre) in years with "good", "average" and "poor" climatic conditions



These results are significant for two reasons. First, they show that farm households in the Dry Zone operate under circumstances of high climate related risk and uncertainty that are likely to influence strongly their production and investment decisions. Second, they indicate the potential for increasing frequency and intensity of extreme climate conditions and events to negatively impact crop yields and amplify risk and uncertainty.

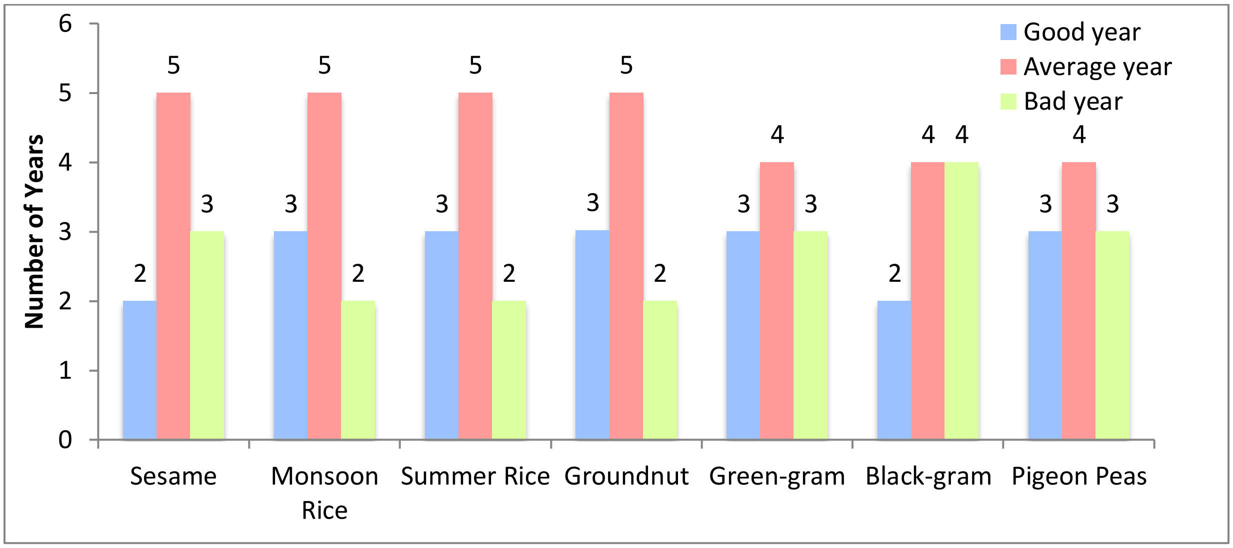
Figure 6. Estimated gross crop revenues (MMK/acre) in years with "good", "average" and "poor" climatic conditions




Survey respondents were asked to report the average unit value of the main crops sold in their communities during the past 12 months. In combination with the yield data presented above, this information allows us make a crude estimate of the potential impact of climate variability on gross revenues from crop production. Holding other factors constant, periods of crop scarcity (poor climate years) should increase the unit price of a crop, whereas times of abundance (good climate years) will reduce it. The estimates derived here therefore likely over(under) estimate the impacts of good(bad) climate conditions. Never the less, they give a sense of the possible range of climate related income variability.

Estimated gross revenues per acre under good, intermediate and poor climatic conditions are presented, by crop, in Figure 7. Because of the method of calculation, income variability is directly proportional to yield variability. Thus, gross revenues for sesame were estimated to be vulnerable to the greatest variability, ranging from between MMK 413,716/acre in good years, to MMK 71,614/acre in years with poor climatic conditions.

Figure 7. Frequency of good, average and poor climate conditions in the last 10 years, by crop




The survey also elicited information on the frequency of the occurrence of good, average and bad climate conditions for each crop over the past 10 years. These results are presented in Figure 6. Paddy, groundnut, and sesame growers experienced "average" climate conditions during five of the past ten years, while producers of g reen gram, black gram and pigeon peas experienced these conditions in four years in the last ten.

Climate conditions were "good" for the production of monsoon and dry season paddy, groundnut, green gram and pigeon pea in three of the past ten years, but good for sesame and black gram in only two out of ten years. Conditions for production were poor in 4 years for black gram, in three years for sesame, green gram and pigeon pea, and in two years for groundnut and paddy. This suggests that sesame and black gram are more sensitive to climate variability than the other main crops, but paddy and groundnut are somewhat less affected by these variations.

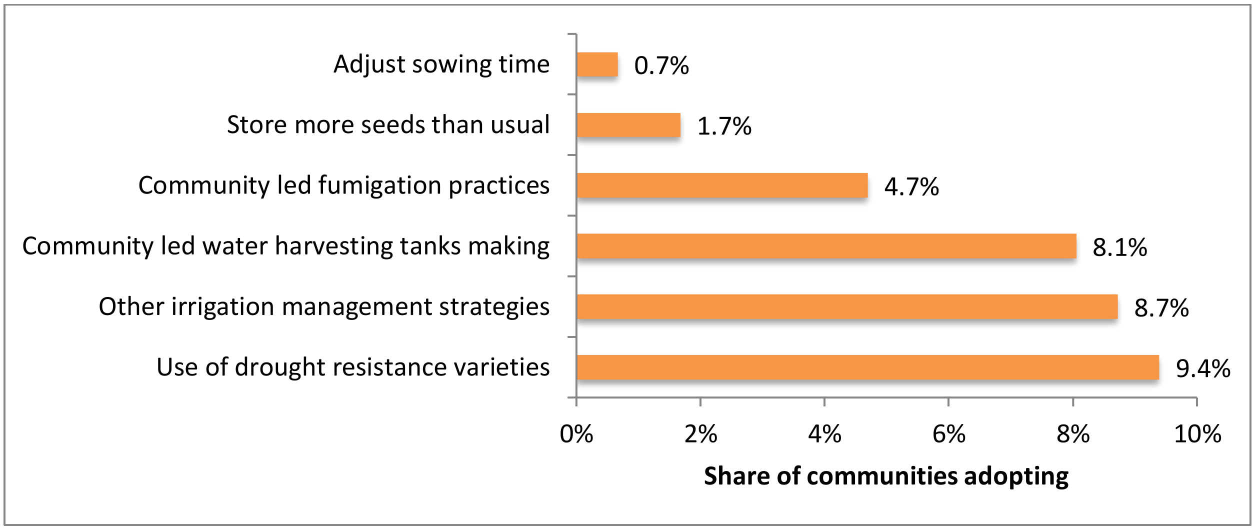
**Adaptation**

Communities were asked about any adaptation measures taken in response to changing climatic conditions. This data is presented in Figure 8. Rather few communities reported adopting most adaptation strategies.

The most common strategies reported were adaptations to water shortages or irregular/late rainfall. Between eight and nine percent of communities each reported using drought resistant crop varieties, constructing communal water harvesting infrastructure, or implementing other irrigation strategies such as digging wells in fields or excavating irrigation canals.

Five percent of communities reported carrying out community-led fumigation to reduce the effects of pest infestation on farms. This activity was considered to be an adaptation measure because the frequency of pest outbreaks was perceived to have risen along with increasing temperatures in the region. Late monsoon rains can damage seedlings, resulting in the need for farmers to replant. However, only 1-2% of communities reported adjusting sowing times or storing more seeds than usual to help cope with such eventualities.

Figure 8. Communities' adaptive measures to the changing climate conditions




Forty percent of communities reported that they had begun to use short-duration crop varieties as a climate adaptation measure, indicating that a major change in farming practices has taken place. These seeds were most likely short duration paddy varieties. During pre-survey scoping research informants frequently reported that farmers had begun using a 90-day duration rice variety to minimize the risk of crop losses due to water shortages late in the production cycle or heavy rainfall during flowering.

In addition, 92% of communities reported growing local or indigenous varieties as a climate risk mitigation strategy, considering it as such on the basis that these seeds are well adapted to local climatic conditions. However, given that local seeds are far more widely available than improved seeds, it is not clear whether this represents a climate change adaptation strategy per se, or simply a default practice.

## CONCLUSION

Our research paints a troubling picture. Communities in the CDZ overwhelmingly report that climatic conditions have changed over the past 30 years. More erratic or decreasing rainfall and increasing temperature are the most widely reported changes. Climate events including flooding, drought, late onset of the monsoon, hailstorms and cyclones/storms, all of which have the potential to impact agricultural production negatively, are all reported to have increased in frequency in large numbers of communities.

Crops yields were found to vary very significantly with climatic conditions. All major crops had yields between two and 5.8 times lower under bad climate conditions than under good conditions. Among all crops, dry season rice yields varied least between good and bad years, likely reflecting the attenuating effects of irrigation access. Sesame yields were most severely affected.

Years with “average” climate conditions were most common, but the reported trends described above suggest that conditions may be worsening over time. Our rough estimate of the range of gross farm revenues under differing climatic conditions suggests that farm incomes could by impacted significantly by these trends.

The uptake of a variety of adaptation measures was reported, indicating that communities have not responded passively to the observed impacts of climate change on agriculture. The adoption of short-duration rice varieties is the most significant of these, being reported in 40% of communities. This suggests that farm households are receptive to the adoption of new innovations that can help them to minimize climate risk, when these prove effective and appropriate to local conditions.

A variety of improved water management practices and the use of drought tolerant varieties were also identified as adaptation measures in significant numbers of communities. The importance of local crop varieties adapted to local climatic conditions was also apparent.

These findings highlight the need for greater attention to the challenges posed to agriculture in the CDZ by a changing climate, but they also show that farmers and the communities of which they are part are capable of adapting to these pressures. To support this process, further research on locally adapted climate tolerant crop varieties is required. This effort should take into account existing indigenous knowledge, farming practices and genetic resources.

The increasing intensity and variability of climate events and reductions in rainfall must also be consciously incorporated into the design of irrigation strategies and irrigation infrastructure development and renovation plans.

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FSP and this brief are made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the study authors, who are affiliated with Michigan State University, the Center for Economic and Social Development, and the International Food Policy Research Institute, and do not necessarily reflect the views of USAID or the United States Government. The brief was also supported with financial assistance from the Livelihoods and Food Security Trust Fund (LIFT), supported by Australia, Denmark, the European Union, France, Ireland, Italy, Luxembourg, the Netherlands, New Zealand, Sweden, Switzerland, the United Kingdom, the United States of America, and the Mitsubishi Corporation. We thank these donors for their kind contributions to improving the livelihoods and food security of rural people in Myanmar. We also thank Patricia Johannes for her editing and formatting assistance. The views expressed herein should in no way be taken to reflect the official opinion of any of the LIFT donors.



Published by the Department of Agricultural, Food, and Resource Economics, Michigan State University, Justin S. Morrill Hall of Agriculture, 446 West Circle Dr., Room 202, East Lansing, Michigan 48824