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# Influence of Climate Change Impact on Agricultural Risks in Myanmar's Dry Zone

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## Climate change and its impact

Agricultural production still largely depends on weather conditions especially the availability of rainfall. Also, usage of physical inputs such as improved seeds, fertilizers, pesticides, insecticides, agricultural credit, land quality, method of cultivation, extension services, the relative price of inputs and outputs – all of these are fundamentally essential in agricultural production.

Myanmar has wide range of climatic condition favoring the domestication of numerous crop species. The climate is mainly tropical but is sub-temperate in areas like hills and plateaus. While rice is the staple food crop of the country, field crops are also common in most areas. The well-irrigated areas in the central plain are well suited for rice, oil seeds and other cash crops. Precipitation under monsoonal influence is now very erratic and thus mean annual precipitation is often fluctuating. The irregularity of monsoonal rain follows five distinct patterns: early onset of monsoon, late onset of monsoon, break in monsoon, early departure of monsoon and late departure of monsoon. This monsoonal behavior, which causes varying, amounts of precipitation in various parts of the country, determines crops production in particular years.

There are still many uncertainties in the climate changing scenarios, and several constraints and limitations are identified. At the primary stage, however, adaptation to climate change could be approached by intensifying the conservation of drought resistance varieties; by improving crop varieties to drought tolerant types; by improving cropping practices to conserve water, intensifying on multiple and mixed cropping and by promoting crop diversification.

While Myanmar is trying to achieve food security for domestic consumption as well as for regional and global use, it experienced the destruction of cycle Nargis in May 2008 due to climate change. It was the worst natural disaster in the country's history, which was least expected.

Because of Cyclone Nargis, agricultural, livestock and fisheries which are the major livelihood of the people, had been extensively damaged. As agriculture was the basic livelihood of the Cyclone hit areas, the State has soon given priority for agricultural rehabilitation.

In fact, the embankments were constructed since 1976 for the protection of the intrusion of saline water to the crop cultivated lands. Most of the embankments constructed were destroyed during Cyclone Nargis. At present, reconstruction of embankments are being carried out and some portions will be constructed to serve as storm shelters as well as road networks to connect one village to another.

Global climate change is well evident not only in the delta affected by Cyclone Nargis, but also in the central dry zone (Table 1.1). In some areas, the onset of monsoon was later than usual and precipitation pattern has also changed causing extreme weather phenomenon. In central dry zone, Meiktila Plain, of which agricultural production total rely on water supply from small dams and tank irrigation, for successful harvest, the impact of climate change is quite severe.

Although small dams and tanks could provide enough irrigation water for crop establishment, irrigation for the whole cropping season is not assured. Therefore, surveys and explorations had been made to exploit ground water and provision of supplement irrigation from tube well was made available to the farmers for successful crop production. The continuous efforts are being made to increase the number of tube wells to secure food production within the regions.

Table 1.1, Crop areas (in acre) damaged in 2010-11

| | Affected | Damaged | Re-sown |
|---|---|---|---|
| Flood | 462,495 | 96,732 | 903 |
| Drought | 129,811 | 2,844 | - |
| Pests & Diseases | 1,814 | 129 | - |
| Others | 207,149 | 196,787 | 347 |
| Total: | 801,269 | 296,492 | 1,250 |

Source: DAP, 2011

## Characteristics of dry zone

The dry zone is located in the central part of the country, situated at about 500 km north from the old capital Yangon. The Zone has merely 700 - 1,000 mm of annual precipitation since south-westerly monsoon was a way blown from Bengal Bay was intercepted by the mountain range of Rakhine that runs nearly south to northward at the western border of the country. Rainfall is concentrated in a few months of rainy season with erratic duration and with wide annual deviation in annual precipitation. This meteorological character not only very often brings about droughts with crop failure but also casual intense showers during mid rainy season also result in

floods in the watershed of Ayeyarwady River. Such climatic casualty makes the environment of agricultural production in country. The main concerns of dry zone are related to the fact that in the next decades the net primary production (NPP) would decline according to the estimation of FAO. In 2005-30, it would be decreased to 30% in Nyaung U and 44% in Meiktila.

Table 1.2: Expected changes in compound annual average growth rate in selected dry zone

| District | Regions | Growth rate 2005-2015 | Growth rate 2005-2030 |
|---|---|---|---|
| Nyaung U | Mandalay | -0.30 | -0.30 |
| Meiktila | Mandalay | -0.48 | -0.44 |

Source: FAO, 2007

The Dry Zone is characterised by low rainfall with high variability and uneven distribution and the risks and uncertainties associated with rainfed agriculture are high. The majority of the farm-households in the Dry Zone cultivate a variety of crops in intercropping and sequence cropping systems. The principal crops are sesame, groundnut, pigeon pea, chickpea, sunflower, cotton and sorghum. Livestock is important to the Dry Zone economy and in particular sheep, goats and pigs.

The dry climate and erratic rainfall result in short cropping seasons and low yields. Very few opportunities exist locally for off-farm employment and alternative income generating activities from cottage industry are limited by low local demand. The lack of surplus cash available for purchased inputs and the relatively low quality of the land results in a vicious cycle of low-input low-output farming leading to a low volume of marketable produce. To survive most smallholders have to borrow money at high rates of interest from informal sources for both consumptive and productive needs.

In the Study Area, such small-sized cottage industries as weaving, spinning, dying, masonry, carpentry, tapestry and their expertise have been developed as the dynasty emerged. Small-scaled as it may be, these cottage industries have been rooted in almost all villages, providing precious cash-earning means for smallholder farmers and also landless villagers in rural areas. In most cases, these industrial activities have been developed as cottage industries and the products have been marketed within the villages or at nearby townships, though in some cases the scale has partly been escalated by the investment of surplus gained from agricultural production by lead-farmers. There is high potential of value addition by installing co-managed stores or introducing new techniques, but it has not been realized due to very limited assistance from administrative sources and other reasons.

## Pulses in the dry zone

Pulses can be grown in suitable season on ya lands (high land) of the dry zone area (Table 1.3 and Figure 1.1). Production and export of major pulses were found in Table 1.4. Compared to paddy, pulses are low in terms of cost of production with high cost-benefit ratio. Many varieties of pulses are being grown in the dry zone for different soil pH values and by choosing the suitable season for light- and temperature-sensitive varieties. As pulses can be grown easily, the low cost of cultivation can be grown as multiple crops and intercropping, farmers prefer it to grow very willingly.

Variety selections for three kinds of crops (pigeon pea, chickpea and groundnut) were conducted in dry zone areas of Sagaing, Magwe and Mandalay from 2007-2008 to 2009-2010 under ACIAR Project. They were conducted using Farmers' Participatory Varietal Selection Method after selecting potential varieties which had been already tested in research centers. This is a selection method carried out by growers themselves after test growing these selected varieties in their fields and then comparing them to standardized local good yielding variety. Varieties selected by the growers are distributed under the project of distribution of certified varieties. Moreover, new (11) soybean varieties imported from Thailand and local good yielding varieties were compared in a test plot under Thai-Myanmar Soybean Research and Development Project during the years 2005-2006 and 2006-2007. An advantage of these activities, Yezin – 8 (White chickpea) for Mon Ywa, Red chick pea (big) for Tat Kone, Yezin – 4 for Pwint Phyu and CA – 2-24 for Chaung Oo were selected from several varieties of chickpea. In the selection of soybean varieties, MJ 9518-2 and MJ 9520-21 for southern and northern Shan states, MJ 9518-2 for Sagaing, KKU – 35 for Magwe and Mandalay divisions have come out.

Correct time of growing is very important for light- and temperature-sensitive varieties and winter varieties, which are grown with residual moisture. For example, green gram varieties are sensitive to temperature so they can give high yields if sown early in the winter season and low yield if sown late because of its difficulty to sprout under temperature 8ºC. Utilization of machineries in harrowing and timely sowing should be practiced to catch residual moisture left over after paddy harvest.

Table 1.3: Major pulses production in Myanmar (2010-11)

| Pulses | Sown area (000 ha) | Production (000'tons) | Main surplus producing regions |
|---|---|---|---|
| Green gram | 1121 | 1410 | CDZ,DR |
| Black gram | 1055 | 1604 | DR |
| Pigeon pea | 633 | 837 | CDZ,HR |
| Chickpea | 332 | 467 | CDZ |
| Cowpea | 159 | 191 | CDZ,DR |
| Lablab bean | 109 | 126 | CDZ |
| Butter bean | 66 | 84 | CDZ |
| Garden pea | 55 | 68 | CDZ,HR, DR |
| Rice bean | 48 | 50 | CDZ,HR |
| Others | 923 | 431 | |

| | | | |
|---|---|---|---|
| Total | 4501 | 5268 | |

Source: Myanma Agriculture at a glance 2011, DAP, MOAI and MAS

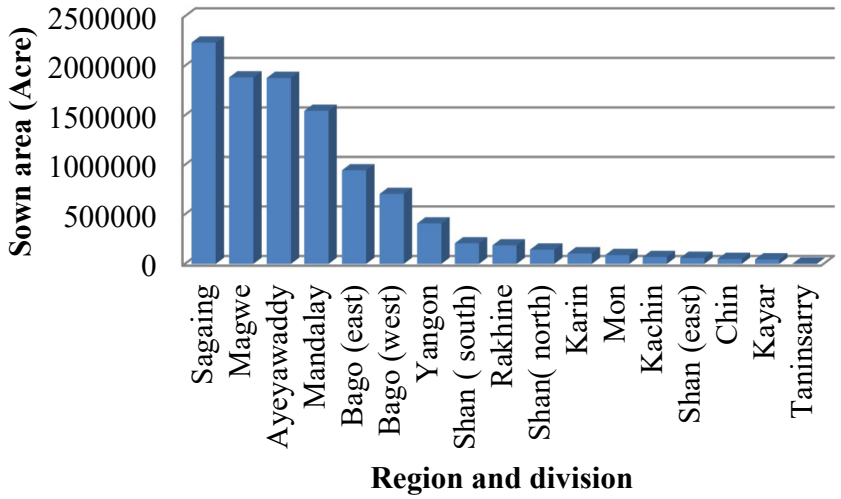


Fig. 1.1. Production of pulses in regions and divisions of Myanmar ( 2009-10)

Table 1.4. Production and export of pulses in Myanmar ('000 metric tons)

| Year | Total production | Black gram production | Green gram production | Pigeon pea production | Other pulses production | Export | Export as % of total production |
|---|---|---|---|---|---|---|---|
| 1999 | 1828 | 421 | 471 | 182 | 754 | 561 | 30.69 |
| 2000 | 2263 | 532 | 519 | 320 | 892 | 831 | 36.72 |
| 2001 | 2656 | 625 | 569 | 458 | 1004 | 1035 | 38.97 |
| 2002 | 2759 | 654 | 607 | 435 | 1063 | 1038 | 37.62 |
| 2003 | 3095 | 728 | 662 | 478 | 1227 | 1211 | 39.13 |
| 2004 | 3530 | 914 | 790 | 556 | 1270 | 873 | 24.73 |
| 2005 | 4008 | 1021 | 945 | 609 | 1433 | 878 | 21.90 |
| 2006 | 4443 | 1201 | 1055 | 655 | 1532 | 1156 | 26.02 |
| 2007 | 4975 | 1381 | 1197 | 731 | 1666 | 1141 | 22.93 |
| 2008 | 5269 | 1446 | 1240 | 777 | 1806 | 1467 | 27.84 |
| 2009 | 4740 | 1411 | 1211 | 763 | 1355 | 1232 | 25.98 |
| 2010 | | 1604 | 1410 | 837 | | 829 | |

Source: Department of Agricultural Planning (2011) and MAS

## Utilization of certified seeds and distribution of new varieties in the dry zone

After selecting seeds adapted to local conditions by the growers, seed distribution must be carried out. Distribution of certified seeds for peas and beans is not adequate because most of state-owned breeding farms emphasize more on new rice varieties rather than on peas and beans. Therefore, village seed banks were established in 2007-2008 and the distribution of certified seeds has been under way since then. In 2010-2011, seed banks are managed in two systems: (1) Village-based seed bank, and (2) Farmer-based seed bank.

***Village-based seed bank***

In this system, village seed-bank committees were formed. They are responsible for growing certified varieties, elimination of different varieties, controlling pests and diseases, cleaning of seeds purchased, storing and selling them at the time of growing. For chickpea and pigeon pea, village seed banks one each in Mandalay, Sagaing and Magwe Divisions were established in 2007-2008. Seed distribution of each village seed bank is as follows:

Table 1.5. Village based seed banks

| No. | Village seed bank | Kind of Crop | Growing acre | Distribution of certified seeds (bsk) | |
|---|---|---|---|---|---|
| | | | | 2008-2009 | 2009-2010 |
| 1. | Shauk Kone (Mandalay ) | Chick pea | 5 | 79 | 84 |
| 2. | Le Zin ( Sagaing) | Chick pea<br>Pigeon pea | 5<br>5 | 87<br>90 | 47<br>62 |
| 3. | Sar Daikan ( Magwe) | Pigeon pea | 5 | 38 | 37 |

***Farmer-based seed bank***

In village-based seed bank system, it is required to have fund for purchasing and redistributing certified seeds. But it is difficult to raise the fund. Members of village seed-bank committee were spending their own money for the activities so that progress of activities is slow. Therefore, to become rapid in distribution of certified seeds, ( 38 ) seed banks for chickpea, pigeon pea, black gram and green gram would be established in Mandalay, Magwe, Sagaing and Bago Divisions by the system of farmer-based seed bank during 2010-2011. Planning for farmer- based seed bank is as follows.

1. Select farmers for farmer based seed banks and train them for seed multiplication system by means of on farm trials;
2. Local adaptable purified seeds are borrowed from farmers. Then growing, cleaning, storing and distribution were conducted by farmers;
3. Farmers from the next village will be selected again to distribute the certified seed after 2 years of the first village seed production program;
4. Replacement of newly purified seeds after 3 years of planting season to avoid seed degeneration; and
5. MAS will nominate the seed grower farmers as certified seed producers.

Village based seed banks and farmers based seed banks are initialized with for black gram, green gram, chickpea and pigeon peas, soybean and cowpea will be extended in the coming years in Yangon and Ayeyawaddy division.

## Crop loss due to low rainfall

Given the nature of climate change droughts, hazards among others, the stresses they create for rural livelihoods have two major aspects: reduction of existing livelihood options, and perhaps more importantly in the short to medium run, greater volatility and unpredictability in streams of livelihoods benefits, especially in the semi-arid environments. The major uncertainties in specific locations that could be affected by climate change would push policy interventions to focus on improvements in adaptive capacity of disadvantaged rural populations rather than on identifying specifically how a given group of rural poor in a particular village or district will be affected by climate change. It is proved in **Table 1.6** that there were crop losses by 81.43% of farm household in Nyaung U and by 94.29% of farm household in Meiktila. Out of 10 years, 3-4 years are probably facing the crop loss in selected survey areas of dry zone.

Table 1.6. Crop loss due to low rainfall and years faced by farm households in selected dry zone

| Item | Unit | Nyaung U (n=70) | Meiktila (n=70) |
|---|---|---|---|
| Farmers having crop loss due to low rainfall | % | 81.43 | 94.29 |
| Number of years facing crop loss during last 10 years | years | 4 | 3 |

Crop loss was due to insufficient rain during growing season even though starting and stopping rainfall was on time in Nyaung U, however Meiktila was found as too late at the start and end of rainfall (Table 1.7).

Table 1.7. Percentage of farm household answered as what is the rainfall condition in study area

| Item | Nyaung U (n=70) | | | Meiktila (n=70) | | |
|---|---|---|---|---|---|---|
| | Enough | Too much | Too little | Enough | Too much | Too little |
| Enough rain at the beginning | 42.86 | 4.29 | 27.14 | 35.71 | 2.86 | 55.71 |
| Enough rain during growing season | 37.14 | 0 | 37.14 | 32.86 | 8.57 | 54.29 |
| | On time | Too late | Too early | On time | Too late | Too early |
| Start of rainfall | 40.00 | 31.43 | 5.71 | 38.57 | 51.43 | 18.57 |
| End of rainfall | 32.86 | 22.86 | 15.71 | 25.71 | 55.71 | 21.43 |

| | Yes | No | | Yes | No | |
|---|---|---|---|---|---|---|
| Rain at harvest time | 70 | 30 | | 87.14 | 12.86 | |

Rainfall is a major concern for agrometeorology but it is variable in both space and time and many applications are more sensitive to the timing and amounts of rainfall through a season than they are to the total amount.

With respect to this crop loss, development strategies and institutional interventions that focus simply on improving benefits to households without taking into account how households can address fluctuations in their livelihoods seem to be bad to address the impacts of climate change. On the one hand, they ignore the most important characteristics of climate-related stresses – increased risks in livelihoods. On the other hand, they ignore the very real concerns of the rural poor about preventing hunger and destitution. Given that many rural households have only limited access to markets – for reasons both of less developed infrastructure and of limited purchasing power, high levels of risks in the environment cannot in a vast number of cases be ameliorated by engaging in market exchange.

To strengthen the adaptive capacity of the rural poor, therefore, governments and other external actors need to strengthen and take advantage of the already existing strategies that many households and social groups use collectively or singly. Examining the environmental risks that rural populations have historically faced, their cultural responses to these risks, and the institutional configurations that facilitate individual and collective adaptation strategies is therefore a fruitful area of inquiry and policy analysis for generating effective coordination with external interventions.

Burton and Lim (2005) note that national agricultural policy is developed in the context of local risks, needs, and capacities, as well as international markets, tariffs, subsidies and trade agreements. Stakeholder participation in policy development is frequently recommended as a measure that can help to reduce the distance between national policy processes and the farm and community level.

Agriculture can be described as highly adaptable and resilient, or as resistant to change, and is related to the diffusion and success of technical innovations at the farm level. Even if the net sown area has increased, the fallow area and other forest areas have decreased in Nyaung U (Figure 1.2). Successful adaptation over decades and centuries at this level goes a long way toward explaining the confidence now being expressed in the ability of agriculture to cope with the potential impacts of climate change. On the other hand, there are concerns that the modernization of agriculture is having serious environmental and social consequences.

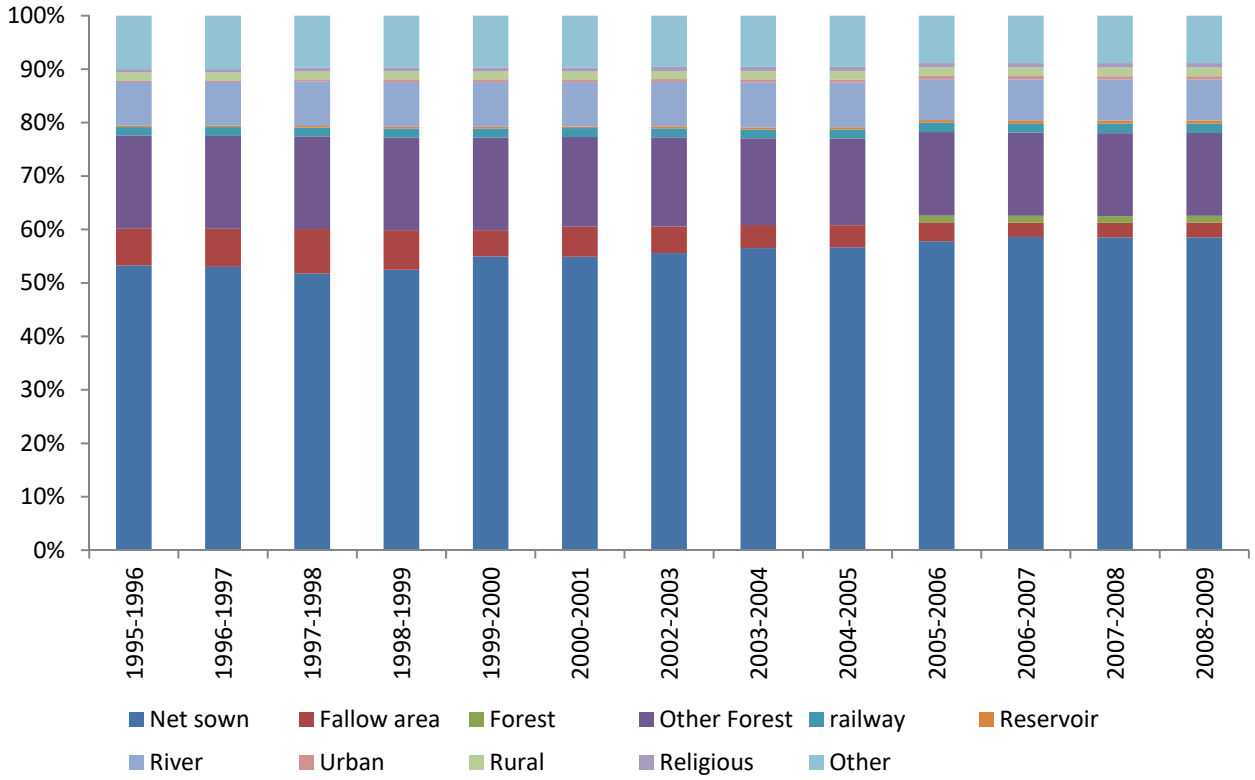


Fig. 1.2. Land use change in Nyaung U Township

## Conclusion and policy implication

Extreme climatic events such as severe drought can often cause devastating damage to agriculture and consequently to rural communities. The overall goal of this study is to investigate the relationship between agricultural production and the occurrence of meteorological droughts over time, given the variability in climate conditions in selected dry zone.

The study indicates how farmers perceive drought but farm-level adaptation needs to be done research to support the farm households in identifying and implementing appropriate changes to their farming systems in the context of the constraints that they face, the resource-use strategies they can follow, and the assessment of risks that they undertake. A range of farm-level adaptation options exist, which include the following:

- Diversifying cropping systems into higher-value crops or improving crop productivity, particularly if supplementary irrigation becomes available;
- Reducing risks of crop production through supplementary irrigation to minimize the impact of wet-season drought and to extend cropping seasons; supplementary irrigation can be sourced from water harvesting, establishing tube wells, or gaining access to irrigation canals;

- Developing and disseminating crop varieties that are better adapted to drought, temperature stress, emerging pests and diseases,
- Combining existing farming activities with non-farm and off-farm activities, such as provision of services, handicrafts, and marketing.

The preferred adaptation options should ultimately be those that offer immediate benefits to farm households in terms of increased productivity or reduced risk of production under current climatic variability.

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