

Climate Change Adaptation on Water Resource Management: a case study of Pakokku Township, Magway Region, Myanmar

Khin Maung Soe, Sangchan Limjirakan

Abstract— The Earth's temperature has increased in recent decades leading to changing of climate. The adverse effects of climate change on natural systems have also become evident since the mid of the twentieth century. Water resources are mainly affected by climate change, particularly in the central part of Myanmar that faced with water shortage. The objective of the research is to study climate change adaptation on water resource management at the Pakokku Township, Magway Region, Myanmar. The four villages, namely Shin Ma Kan, Pan Tine Chone, Paung Laung Kan and Kyee were selected as the study areas because of their strong drought and water shortage in the dry season for decades. The 61 respondents were selected by using a purposive sampling method. An in-depth interview using a set of semi-structured questionnaires was conducted to obtain relevant data. Data obtained were analyzed using descriptive and content analysis. The study found that 98% of the respondents knew about changing of climate. Regarding climate change adaptation, 100% of government officers mentioned changing seed varieties resisting to climate change in agriculture sector. Considering water resource management practices adapting to climate change, 92% of respondents mentioned using water efficiently and 86% of them mentioned water saving. All respondents (100%) mentioned that there was no policy on climate change adaptation that being implemented by the government in the study area. However, the Myanmar's National Adaptation Programme of Action, Myanmar National Water Policy and the water-related policy of Department of Rural Development would relate to climate change adaptation on water resource management. For examples, climate-smart agriculture and water-saving irrigation techniques. The study would recommend that climate change adaptation plans should be properly conducted on disaster risk reduction, preparedness, relief and rehabilitation on water resource to reduce impacts and to enhance the capacities of all stakeholders to combat climate change.

Keywords— Climate change adaptation, Water resource management, Pakokku Township, Myanmar

Khin Maung Soe
International Program of Environment, Development, and Sustainability,
Graduate School, Chulalongkorn University
Thailand

Sangchan Limjirakan
Environmental Research Institute, Chulalongkorn University
Thailand

I. Introduction

Climate change has impacted on human and natural systems. Its effects include alteration in precipitation patterns, sea level rise, heat extremes, drought, storm, monsoon cycles, ocean currents, sea surface temperature, and river flows [1]. According to the Intergovernmental Panel on Climate Change (IPCC) [2], the Earth's temperature has increased in recent decades. In the Southeast Asia region, temperatures have also increased at a range of 0.14°C to 0.20°C per decade since the 1960s. Regarding the global and regional temperature trends, Myanmar has noticed nationwide warming since the 1950s. Climate change has adversely affected Myanmar's natural resources and livelihoods [3]. The increasing temperature, variable precipitation, rising sea level, droughts, floods, and extreme storms, have already affected all aspects of lives in Myanmar [4]. According to the Global Climate Risk Index 2015, Myanmar ranked the second most vulnerable country affected by climate change in the world calculated based on the recent 20 years [5]. Recent extreme weather events such as Cyclone Nargis in 2008, extreme heat waves in 2010, and flash floods in 2015, impacted on society, ecology and economy of Myanmar [6]. Regarding the Myanmar's National Adaptation Programme of Action (NAPA) report [7], the temperature in Myanmar has increased at an average of 0.08°C per decade over the last six decades. Myanmar's income relies heavily on the agricultural sector. The central part of Myanmar is the most water-stressed region of the country. Seasonal water scarcity is very common in this area [8]. The temperature is in the range of 40 to 43°C. The mean annual rainfall is quite low of about 500-1000 mm per year [9]. Therefore, water scarcity always turns into a serious issue in this area. Water resources in the central part of Myanmar need to be managed necessarily for both domestic use and agricultural use purposes. The proper practices of water resource management in the context of climate change adaptation would need to be considered. The objective of this research is to study climate change adaptation on water resource management at the Pakokku Township, Magway Region, Myanmar.

The study area composed of the four villages, namely Shin Ma Kan, Pan Tine Chone, Paung Laung Kan and Kyee in the Pakokku Township, Magway Region, Myanmar. It is a dry area with few natural resources due to the geographical condition [10]. Pakokku Township is located in the latitude between 20° 54' 45" N and 21° 29' 40" N and the longitude between 95° 14' 00" E and 95° 10' 21" E with the altitude of 64.52 m above the mean sea level. The land area of the

Pakokku Township is 1258.3 km². Agriculture in Pakokku is highly climate-sensitive [11].

In Pakokku Township, the highest temperature recorded was 45.10°C and the lowest temperature recorded was 8.90°C between 1987 and 2016. The average mean temperature was

27.81°C. The highest average temperature was 35.87°C and the lowest average temperature was 19.68°C. The annual average rainfall was 631.66 mm [12]. The study area is shown in Figure 1.

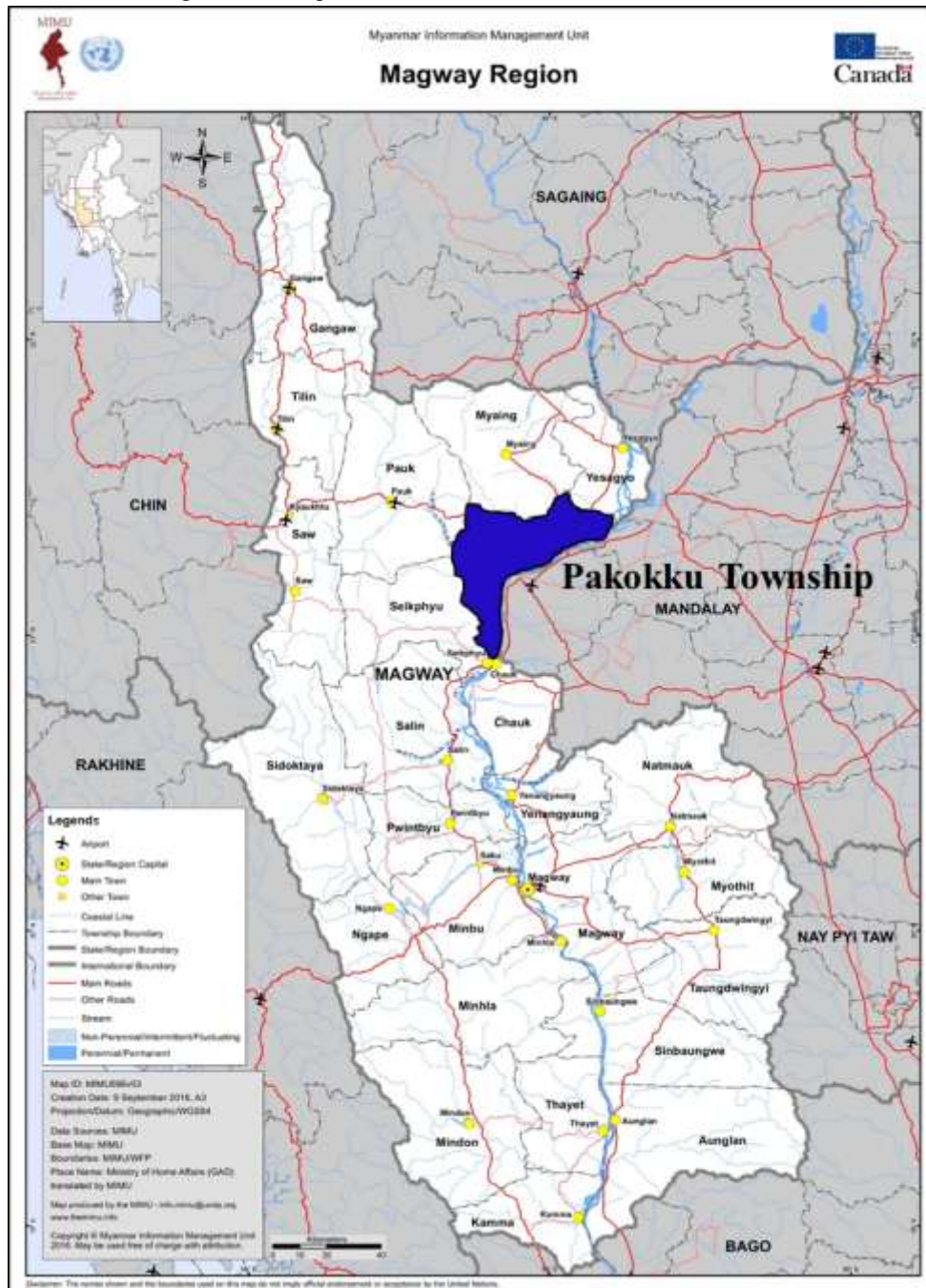


Figure 1. The study area; Pakokku Township (blue colour shaded), Myanmar [13].

II. Methods

The study areas were drought and faced with water shortage in the dry season. The respondents of the study were selected by using a purposive sampling method, which concentrates on

people with particular characteristics who will better be able to assist with the relevant research [14]. The total respondents were 61 including governmental officers, non-governmental organizations (NGOs) officers, and local peoples who are farmers, village heads, teachers, traders and employees. An in-

depth interview was conducted between December 2018 and January 2019 by using a set of semi-structured questionnaire to obtain relevant data. The questionnaire was composed of three parts, including general information of respondents, climate change adaptation, and water resource management. Data obtained were analyzed using descriptive and content analyses.

III. Results and Discussions

A. Demographic of respondents

The majority of respondents were male of 92% and female of 8%. The ages of the respondents were divided into five groups. 30% of respondents were in the age range of 51-60 years old, 26% in the age range of 61 years old and above. 25% of them were in the age range of 41-50 years old and 16% of them were in the age range of 31-40 years old. Only 3% of them were in the age range of 18-30 years old. In terms of education, 30% of respondents graduated from a secondary school, while 26% graduated from a primary school. The number of respondents who obtained a bachelor degree presented 20%, a high school 11% and did not go to school 10%. The occupations of the respondents were farmers (67%), government officers (15%) and the rest were teachers, employees, livestock husbandries, traders, and non-governmental organization officers.

B. Climate change adaptation

According to collected data on climate change adaptation, the study found that 98% of respondents knew about changing of climate. 100% of government officers mentioned that temperature has increased, rainfall patterns have changed, late onset and early withdrawal of monsoon have occurred in Myanmar, while 93% of farmers mentioned that they were getting more hotter days. 100% of respondents including teachers, employees, and non-governmental organization officers mentioned temperature increasing and sea level rising. In terms of the climate change impacts, 100% of respondents knew the impacts such as freshwater shortage, heat waves, crop production decreasing. 100% of non-governmental organizations officers mentioned that climate change impacts were heat waves and freshwater shortage. To adapt to those kinds of climate change impacts, 100% of government officers adapted to climate by living properly in extreme weather conditions, 95% of the farmers adapted to climate change by changing seed varieties resisting to climate change. Regarding the effects of climate change in the villages, 96% of the farmers mentioned heat waves and less water retained ponds in summer. The major impacts that are affecting in their villages were also heat waves and rainfall variation.

Regarding climate change adaptation, government officers mentioned changing seed varieties resisting to climate change, water-saving irrigation in agriculture and making good tillage in farms to maintain soil moisture content. While farmers mentioned living properly in extreme weather conditions, changing seed varieties resisting to climate change impacts as

well. All respondents who work in livestock husbandries, traders and NGOs officers mentioned harrowing and ploughing before monsoon coming, changing seed varieties resisting to climate change impacts, changing sowing dates of crop plantation, and staying properly in extreme weather conditions. By altering planting dates and choosing seed varieties with different growth duration, farmers can adapt to climate change to some extent [15]. Changing planting dates would be a practical adaptation to drought and water scarcity causing from changing of climate [16]. In semi-arid and arid regions, introducing new seed varieties would be made farmers' livelihoods better with more food security under climate change situation [17]. Stakeholders participation in climate response actions are very crucial in conducting adaptation strategies to climate change [18].

It can be concluded that climate change impacts in the study area were temperature increasing, rainfall patterns changing, people migrations, flash floods, storm frequency increasing, droughts, rainfall variability, late onset and early withdrawal of monsoon. However, the respondents did not know governmental policy to reduce climate change impacts. They need some researches on climate change, climate change awareness, and stakeholder participation in climate change response actions.

C. Water resource management

The study found that 100% of respondents used water from rainwater, pond water, deep tube well water, and water from river pumping project for their consumption. The ways to manage water resource in their villages were using water efficiently, reducing water leakage and water saving. 100% of respondents have faced with water resource problems such as less water retained ponds in summer and distances to water sources. In order to solve such problems, they took water from other villages and renovated village water ponds in summer by local government offices.

The United States Environmental Protection Agency (USEPA) stated that using water efficiently would benefit on environmental, health, and economy benefits [19]. Moreover, it would help to improve water quality, conserve aquatic ecosystems, and control drinking water resources. Using water efficiently, through behavior, if practiced broadly, would reduce effects of drought. The water metering system and piping networks have an advantage to encouraging water conservation, enhancing allocatively efficient distribution, and reducing water leakage.

D. Policy on climate change adaptation on water resource management

The study found that policies related to climate change adaptation is Myanmar's National Adaptation Programme of Action (2012). All respondents mentioned that there was no policy on climate change adaptation that being implemented by the government. However, the study found that the Department of Rural Development implemented its policy by digging deep tube wells to reduce water shortage for domestic

water use conducted in Shin Ma Kan and Pan Tine Chone in 2017. Myanmar's National Adaptation Programme of Action, Myanmar National Water Policy (2014), and the policy of the Department of Rural Development (2017) would relate to climate change adaptation on water resource management in the study area. Myanmar Climate Change Policy (2019), Myanmar Climate Change Strategy (2018-2030), and Myanmar Climate Change Master Plan (2018-2030) have been launched in June 2019.

IV. Conclusions

Myanmar has already affected by climate change impacts. Presently, the study area has no direct policy related to climate change adaptation on water resource management implemented. Climate change adaptation on water resource management includes climate-smart agriculture practices and water-saving irrigation techniques. The study would recommend that the action plans on disaster risk reduction, preparedness, relief and rehabilitation on water resource management should be properly conducted to reduce impacts occurred and to enhance the capacities of all stakeholders to combat climate change.

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References

- [1] R. Horton *et al.*, "Assessing climate risk in Myanmar: Technical Report," New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US, WWF-Myanmar2017.
- [2] IPCC, "Summary for policymakers. In Climate change 2013: The physical science basis," *Working group 1 contribution to the IPCC fifth assessment report of the Intergovernmental Panel on Climate Change*, pp. 1-27, 2013.
- [3] S. Kreft, D. Eckstein, L. Dorsch, and L. Fischer. (2016). *Global Climate Risk Index 2016: Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2014 and 1995 to 2014*. Available: www.germanwatch.org/en/cris
- [4] J. T. Slagle, "Climate Change in Myanmar: Impacts and adaptation," Master Naval Postgraduate School, Monterey, California, 2014.
- [5] S. Kreft, D. Eckstein, L. Junghans, C. Kerestan, and U. Hagen, "Global Climate Risk Index 2015: Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2013 and 1994 to 2013," Germanwatch e.V., Office Bonn, 2015.
- [6] MOECAF, "Myanmar's Intended Nationally Determined Contribution-INDC," 2015, Available: www4.unfccc.int/ndcregistry/.../Myanmar%20First/Myanmar%27s%201NDC.pdf.
- [7] NAPA, "Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change," 2012, Available: <https://unfccc.int/resource/docs/napa/mmr01.pdf>.
- [8] MNPED and MOH, "Myanmar multiple indicator cluster survey 2009-2010 Final Report. Nay Pyi Taw, Myanmar: Ministry of National Planning and Economic Development; and Ministry of Health " 2011,

Available: http://www.childinfo.org/-les/MICS3_Myanmar_FinalReport.pdf

- [9] K. Egashira and A. A. Than, "Cropping characteristics in Myanmar with some case studies in Shan State and Mandalay Division," *Journal of the Faculty of Agriculture-Kyushu University (Japan)*, 2006.
- [10] (2015). *The 2014 Myanmar population and housing census*. Retrieved from themimu.info/census-data.
- [11] L. Fee, M. Gibert, R. Bartlett, P. Capizzi, R. Horton, and C. Lesk, "Scenarios for building resilience in Pakokku township: Climate Change Vulnerability Assessment (2016-2050)," UN-Habitat2017, Available: <http://myanmarcalliance.org/en/mcca-partners/documents/>.
- [12] Ministry of Transport and Communications. (2018). *Temperature and rainfall data of Pakokku Township, Department of Meteorology and Hydrology, Pakokku District*.
- [13] Myanmar Information Management Unit, "Magway Region Map, Myanmar," ed, 2018.
- [14] H. R. Bernard, A. Wutich, and G. W. Ryan, *Analyzing qualitative data: Systematic approaches*. SAGE publications, 2016.
- [15] X. Zou, Y.-e. Li, Q. Gao, and Y. Wan, "How water saving irrigation contributes to climate change resilience—a case study of practices in China," *Mitigation and adaptation strategies for global change*, vol. 17, no. 2, pp. 111-132, 2012.
- [16] L. M. M. Swe, R. P. Shrestha, T. Ebberts, and D. Jourdain, "Farmers' perception of and adaptation to climate-change impacts in the Dry Zone of Myanmar," *Climate and Development*, vol. 7, no. 5, pp. 437-453, 2015.
- [17] Z. James and M. Julius, "Determinants of choice of crop variety as climate change adaptation option in arid regions of Zimbabwe," *Russian journal of agricultural and socio-economic sciences*, vol. 15, no. 3, 2013.
- [18] A. Manyani and U. Bob, "Stakeholder participation in climate change adaptation in Chadereka Ward 1 of Muzarabani Rural District in Zimbabwe," 2018.
- [19] USEPA. (2000). *Using Water Efficiently: Idea for residents*. Available: <https://www.epa.gov/sites/production/files/2017-03/documents/ws-ideas-for-residences.pdf>

About Author (s):



Mr. Khin Maung Soe is an M.A. student in the International Program on Environment, Development and Sustainability at Chulalongkorn University, Bangkok. He is also working as a Staff Officer at Environmental Conservation Department in the Ministry of Natural Resources and Environmental Conservation, Government of Myanmar, Nay Pyi Taw. He did his bachelor's degree in Agricultural Science from Yezin Agricultural University, Nay Pyi Taw, Myanmar.