

Traditional Knowledge on Weather Forecasting of the Mizo Tribe and Its Relevance in
Climate Change

By: Isaac Lalduhawma Chhangte

Bachelor of Science (HONS) Forestry, College of Horticulture and Forestry, Central
Agricultural University, Imphal, India

A Report Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Forestry
in the Graduate Academic Unit of Forestry and Environmental Management

Supervisor: Tom Beckley, Ph.D., Forestry and Environmental Management

Examining Board: Ron Smith, Ph.D., Forestry and Environmental Management

Paola Gatto, Ph.D., Department of Land, Environment,
Agriculture and Forestry, University of Padova

This report is accepted by the

Dean of Graduate Studies

THE UNIVERSITY OF NEW BRUNSWICK

February 2024

© Isaac Lalduhawma Chhangte, 2024

Abstract

Climate change has brought about global shifts in weather patterns resulting in drought, floods, landslide, and other disasters every year. Many researchers highlight the importance of traditional knowledge for combating climate change. However, studies regarding this topic are limited with only a few researchers studying the traditional knowledge of the people of the region. This study collects the traditional weather prediction methods of the Mizo tribe of India by interviewing 16 people. Different indicators were collected including animals, plants, and celestial bodies. This study highlights how the tribal population observe the changes in the environment around them and predict different weather. With modern weather prediction becoming more accessible and reliable there is a decrease on dependency of traditional weather predictions. With the increase on reliance on modern technologies the knowledge is not passed on to the newer generation and there is a risk of specific knowledge getting lost and forgotten.

Acknowledgement

Firstly, I would like to thank the Almighty God for guiding me and showering me with his continuous blessings. My undying love and appreciation to my parents who gave me a chance to thrive in life and gave me countless opportunities to grow. Without their unwavering support and faith in me I would not have reached this point.

I would like to express my gratitude Association for Environmental Preservation (ASEP) for facilitating connection with Mizo knowledge keepers and to all those who agreed to participate by sharing their valuable knowledge and time for this report. I would also like to specially thank Dr Tom Beckley my supervisor for guiding me through my report and being patient with me from the beginning to the the end of the report. I am also indebted to Dr Ron Smith for his assistance in editing and proofreading my report. I extend my gratitude to Dr Paola Gatto for coordinating the programme between the University of New Brunswick and University of Padova and for graciously serving as a member of the examining board.

Table of Contents

Abstract	ii
Acknowledgement	iii
Table of Contents	iv
List of Tables	vi
List of Figures	7
1 Introduction	1
2 Background	3
2.1 Colonization and Conversion	6
2.2 The history, famine, and revolution	6
3 Literature Review	8
3.1 Traditional Knowledge	8
3.1.1 Traditional Knowledge Definition	8
3.1.2 Risk of losing Traditional Knowledge	8
3.2 Traditional Weather predictions	9
3.2.1 Traditional Weather Prediction in Northeast India	10
3.3 Traditional Knowledge and Climate Change studies	10

4	Methodology.....	11
4.1	Participants Recruitment.....	11
5	Results and Discussion:.....	14
5.1	Predictions for onset of Rain	14
5.2	Plant indicators for rainy season	17
6	Other indicators	19
6.1	Reliance of Traditional Weather Prediction.....	22
6.1.1	Accuracy of the Traditional Weather Prediction and their limitations	23
6.1.2	Transfer of Traditional Knowledge	24
6.2	Study limitations.....	26
7	Conclusion.....	26
8	References.....	28
9	Appendix A: Research Consent Form.....	34
10	Appendix B: REB Application.....	40
11	Appendix C: Information Form for Participants	51

Curriculum Vitae

List of Tables

Table 1: Animal and insect behaviour indicating occurrence of rainfall.	14
Table 2: Indicators for onset of rainy season	17
Table 3: Indicators for end of rainy season	18
Table 4: Indicators for heavy rain that year	19

List of Figures

Figure 1: Map of India showing the state Mizoram. 5

1 Introduction

In my course of pursuing education outside of my home country India, I have acquired a different outlook and approach to how other countries manage their forests. One of the most important observations I have made is how western countries value their Traditional Knowledge. Finding a place for the traditional values knowledge, alongside modern science, is one of the most important topics being discussed by different researchers. Learning how Indigenous communities have managed their surroundings in harmony with nature for generations has piqued my interest. Many of the topics I learned and discussed in my North American studies, remind me of my tribe and how this new information would prove relevant. In many regions of the world, traditional knowledges are forcefully abandoned, and these effects are only recently being understood. Research on traditional knowledge has been increasing in recent years. This made me curious about my tribe's traditional knowledge. On self reflection I realised I have a lack of knowledge of my Tribe's traditional knowledge even though I have a degree in forestry. This made me curious, and I started to make enquiries regarding the Traditional Knowledge of my community. As a child I remember when we would go out to play and our elders told us that if we see fresh soil around a grasshopper's hole, it means that it is about to rain, and we should head home to avoid being drenched and getting ill. This memory reminds that the Mizo tribe has our own traditional method for weather prediction. However, I found that few people remain

who know the details about our tribe's traditional knowledge. Even in scientific studies, there seems to be a lack of studies done on the traditional knowledge of the Mizo community. Looking around for traditional knowledge that is still prevalent in the Mizo community I realised that they have lost their relevance as many favour the use of a more modern and a more convenient technology. Even with increasing trend on studies relating to traditional knowledge, this trend has yet to reach the Mizo traditional knowledge. One of the important characteristics of the Mizo Tribe is our practice of swidden agriculture also called Jhum cultivation, where a new patch of forest is cleared and burned for agriculture, where the area is farmed for one year and a new patch of land is cleared the subsequent year. This practice is done before the rainy season every year. I assumed that there would be a specific process to determine how and when slash could be safely burned. But, upon investigation, I found that the Government of Mizoram gave the order that this slash should be burned before 15th of March every year. I could not find any information on whether directions are given to the farmers for burning their patch of field. Because of climate change, weather patterns have shifted, and adverse climatic conditions have become more frequent. Every year there are reports of landslides and floods in Mizoram especially during the monsoon season. Unlike climate forecasting which makes prediction for a longer period, prediction for weather shows immediate results. With traditional knowledge being acknowledged as one of the important ways to combat climate change and releasing the gap in traditional practices traditional knowledge I decided to pick this report topic.

2 Background

Mizoram is a small state from the Northeast region of India (Figure 1). The state has the highest percentage of forest cover in India with a forest cover of 84.53% (*India State of Forest Report 2021 (ISFR), 2022*), however, due to the pressure of new forest areas cleared needed for swidden agriculture each year before the forest could regenerate properly it is also one of the regions with the highest rate of deforestation in all of India between 2019 and 2021. (Forest Survey of India, 2021). The region receives an annual rainfall of 2500 to 3000mm with an average temperature of 11° to 21°C during the winter months and 20° to 30°C during the summer months (Lalitha et al., 2018).

According to Meteorological Data of Mizoram, (2021) the region receives high amount of rain with the rainy summer monsoon starting from April, followed by a monsoon with heavy rainfall from May to September and even till October and dry to very little rainfall during the winter i.e., November to February. The forests of Mizoram are classified by Champion & Seth, (1968) as

- Cachar Tropical Semi-evergreen Forest (2B/C2): Even though the region is expected to have tropical evergreen forest, the forest is occupied by semievergreen tree species. The upper forest canopy usually is not dense apart from hilltops and ridges.
- Secondary Moist Bamboo Brakes (2/2S1): Mainly comprised of thorny bamboo brakes, forest floor is mostly devoid of tree regeneration apart from few scattered shrubs and thin grasses.

- Pioneer Euphorbiaceous Scrub (1/2S1): Comprised of mostly quick growing but short-lived small tree resulting from clearing of evergreen and semi-evergreen forests.
- East Himalayan Moist Mixed Deciduous Forest (3C/C3b): Tall closed forest with small group of mixed species. There is abundance of underwood and shrubby undergrowth which are replaced with grasses with burning.
- East Himalayan Subtropical Wet Hill Forest (8B/C1): Closed evergreen forest with large trees. The forest is generally mixed with a tendency to be dominated by oak and *Lauraceae*. On areas where top canopy is not closed evergreen underwood are found.
- Assam Subtropical Pine Forest (9/C2): Single pine stands or in groups with scattered lower deciduous tree story with few continuous low xerophytic shrubs.

Mizoram is mostly occupied by the Mizo people and are classified as Schedule Tribe under the Constitution of India. Mizoram has the highest percentage of forest and highest percentage of tribal population of any state in India (*Census of India, 2011*). Most of the tribal population is still employed in agriculture (National Informatics Centre, 2021). The dominant agriculture system in Mizoram follows shifting cultivation where forests are cleared, burned, and cultivated for a year after which it is then left abandoned for regeneration (Grogan et al., 2012). Subsequently a new area is selected

where the process is repeated. Crops rely on natural rainfall, not artificial irrigation systems. Therefore, both the amounts and pattern of rainfall are regarded as bringing either blessing or disaster. Because of this, prediction of rain is very important for the residents of the region.

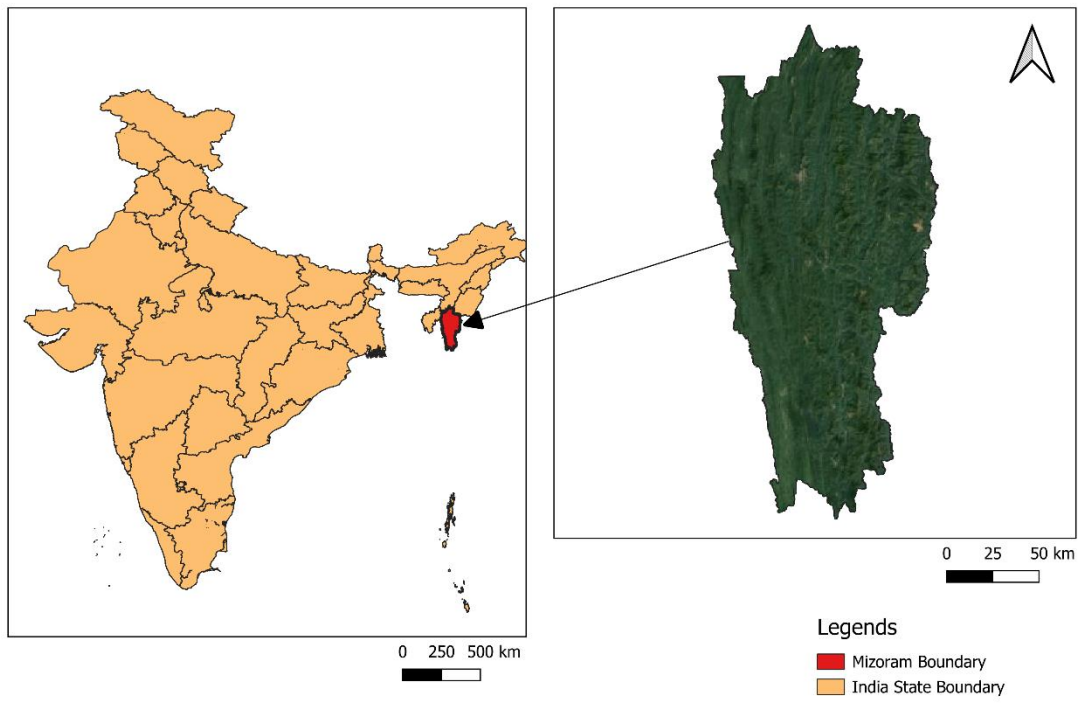


Figure 1: Map of India showing the state Mizoram.

2.1 Colonization and Conversion

Christianity was brought to Mizoram in the late 19th century by the British Missionaries, resulting in most of the population converting to Christianity. After the conversion, Mizoram was on a fast-track course to modernization and the changes it brought included the mixing of Mizo traditions with that of Christian traditions (Pachau, 2006). This meant that many of the tribal traditions were abandoned and forgotten, including much traditional knowledge. Traditional teaching places such as Zawlbuk where youth of the village would gather and be taught by the village elders were abandoned, and many of the festivals and celebratory practices that could be linked to tribal religion were also abandoned (Benjamin L Saitluanga, 2022). Any celebratory ways of traditional festivals were transferred over to Christian festivals such as Mim kut on Good Friday, Pawl kut on Christmas and new year (Angom, 2020). Although some traditions have been kept, many are passed through a Christian filter, and those that are filtered out are then abandoned. Since much of the traditional knowledge is intertwined with traditional beliefs, it is safe to assume that much of the traditional knowledge has also been lost.

2.2 The history, famine, and revolution

The history of the state is closely linked with the traditional knowledge of the people. After India's independence from the British rule, Mizoram was known as Lushai Hills and was a district of Assam. During the 1950s, the Mizo predicted the flowering of a specific species of bamboo called *Melocanna bacciferae*, which flowers gregariously

every 48 years. The fruit produced is eaten by the jungle rats, which is followed by a rat population explosion. After the bamboo fruit becomes unavailable, the rats then begin feeding on the agricultural crops of the tribal population, leading to crop failure and famine. Predicting the approaching of this event, the tribal leaders pleaded with the government to make preparation for the upcoming famine. Unfortunately, the proposal was declined saying that a famine could not be predicted and there is no relation between bamboo and rat, and it was only a tribal superstition(Nag, 2001). However, the bamboo flowered, and the famine came, food was scarce, and people starved. The government prepared for aid, but their unpreparedness resulted in the death of 10,00-15,000 Mizo because of the famine who at that time were only a few hundred thousand. After the event, the Mizo people felt unsatisfied with the government, lost trust, and declared independence. This resulted in the organization Mizo National Famine Front (MNFF) which helped in providing aid during the famine went underground and changed their name to Mizo National Front (MNF) demanding a sovereign independent Mizoram. This led to a 20-year revolution after which the Mizo state was established because of an agreement between the central government of India and the underground revolution organisation of the Mizo people(Van Schendel, 2016).

3 Literature Review

3.1 Traditional Knowledge

3.1.1 Traditional Knowledge Definition

According to The World Intellectual Property Organization (WIPO) Traditional Knowledge is “knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity” (The World Intellectual Property Organization, n.d.). The terms traditional knowledge and Indigenous knowledge are used interchangeably by different authors; however Indigenous knowledge belongs to a specific culture or society whereas traditional knowledge belongs to a wider group or community (Orlovic Lovren, 2020). Another commonly used term is Traditional Ecological Knowledge or TEK which is the Indigenous knowledge that can be practically applied in nature (Bruchac, 2014). We can conclude that TEK is a subset of Indigenous knowledge (McGregor, 2004). Since traditional knowledge covers a wider aspect, for this paper, the term traditional knowledge will be used to define the knowledges collected.

3.1.2 Risk of losing Traditional Knowledge

In modern times traditional knowledge is often known and only used by a small percent of the population such as older people in a community in favour of modern methods (Risiro et al., 2012a). However, in other parts of the world among different communities these traditional knowledges are at the risk of becoming lost because people prefer more modern methods and because their traditional knowledge becomes less reliable

and accurate due to climate change (Rautela & Karki, 2015; Risiro et al., 2012b).

Another reason for their loss is because traditional knowledge is not well documented and the people who possess this knowledge such as elders of the communities die without imparting it to future generations(Enock & Makwara, 2013; Salite, 2019).

3.2 Traditional Weather predictions

The ability to predict the change in climate and weather is very important for different communities around the world. In rural areas of Mozambique, farmers consider their traditional knowledge as inheritance which should be passed from one generation to the other and they still use it to predict drought since modern drought prediction methods are rarely available (Salite, 2019). Even in places where modern weather methods are available like the Ilocos Norte Province of the Philippines, farmers still prefer to rely on traditional methods of weather and storm prediction to plan for their farming activities because modern predictions are too generalised and lack details for localised areas (Evangeline & Criselda, 2009). Weather predictions based on local or traditional knowledge are often relied upon and are deemed to be often accurate. Farmers in Nigeria claimed that their prediction of rain was correct for 8 of the last 10 years(Sanni et al., 2012). Not just predicting the weather, depending on the time of

occurrence of the indicators, farmers of Tamil Nadu, India could also predict occurrence of disease in their crops and plantations (Anandaraja et al., 2008).

3.2.1 Traditional Weather Prediction in Northeast India

Farmers in India depend on their knowledge of their surroundings environment such as animals, plants, and other elements, observing their changes to predict the weather (Acharya, 2011). Especially among the Northeastern region of India which receives heavy amount of monsoon rain, the biodiversity of plants and animals, lives, food, and culture of the region is highly influenced by rain. The monsoon season brings water, rejuvenates the life of the region, and sustains many biological processes making Northeast India one of the richest and biodiverse regions of India. However, this season brings with it hydrological destruction in the in the form of heavy rain resulting in disasters such as floods and landslides (Goswami et al., 2010). Since the Northeast Indian region is one of the more vulnerable parts of the world for climate change which is reflected by the increase in flash floods, desertification, land slides, drought, and crop failure (A. Das et al., 2009), studying the traditional knowledge of the region is vital in preservation of culture and understanding the effects, risks, and threats of climate change. It could also aid in finding ways to combat climate change and to develop mitigation measures according to the needs to the region.

3.3 Traditional Knowledge and Climate Change studies

Different researchers have highlighted how traditional knowledges proved to be beneficial in scientific studies and combating climate change. This culture-specific

knowledge aids in identification and observation of impacts and provides appropriate measures for adaptation (Williams & Hardison, 2013). Weatherhead et al., (2010b) highlight how the help from Inuit community and their Indigenous knowledge helped them in their studies on changes in weather persistence. Even though their final findings were different from report suggested by the Inuit hunters, it led them to increase their study area to the hunting areas. Leonard et al., (2013) reported that the Miriwoong people using their traditional ecological knowledge come to the same conclusion as scientists and they believed that the current crisis they face is the result of environmental management which moved away from their traditional methods.

4 Methodology

4.1 Participants Recruitment

In consultation with my supervisor Dr Beckley, we decided that the best way to study this subject was to interview traditional knowledge-holders in the region. However, travel to the region was prohibitively expensive, even though face-to-face interviews were preferred, due to this restriction an online interview was chosen. After we settled on the topic and methodology a proposal was submitted to Research Ethics Board at the University of New Brunswick (Appendix B) which was then duly approved. After potential participants were identified, they were contacted by the NGO representative who explained the research to them, including its purpose. I received contact information for 24 traditional knowledge holders from my partner at Association for Environmental

Preservation (ASEP) whom I reached out to and sent a brief detail about the research. From the people contacted, 17 replied and showed interest in participating in the research. After an interview was scheduled one participant opted out due to technical problems (there was a bad network connection, and I could not hear the audio during the call). A total of 16 people were interviewed for this research consisting of 14 men and 3 women. The interview was conducted in the Mizo language, which was recorded, and the data obtained was translated to English.

Potential participants for this study were identified with the help from a local NGO the ASEP. The people identified mainly comprised elders and knowledge keepers of the communities as they were expected to have insights and knowledge about traditional weather patterns and predictions. A semi-formal audio interview was conducted, which lasted approximately 30 minutes. Many of the participants were very enthusiastic about the research. Few of them suggested postponing the interview later so that they could take some time to think about the indicators to recollect their knowledge. They did their own information gathering, such as asking around their connections and reconfirming if their knowledge they possess was valid. Some participants also shared that they wanted to take more time to re-read books on traditional stories and folktales which reminded them of the traditional knowledge to make sure they fully remembered the details of the knowledge. Because of this, although the data gathered is from 16 people, I believe the data gathered is a good general representation of the tribe as everyone represented their own community and other resource available in the

tribe. After the participants were ready, an interview was scheduled, using the participants' preferred method, such as Zoom, Google meet and WhatsApp audio call. At the beginning of the online interview, I shared a summary of the research and informed them of the purpose of the interview, people involved, how the study design was submitted and approved by UNB REB and their rights (see Appendix B). The research was conducted only after all the steps were taken and an audio consent was given by the participant.

The participants were asked about the different weather prediction methods they knew related to rain, storms, drought, and other weather events. They were asked to identify the different indicators they used, such as animal behaviour, plants, or other methods. These indicators were identified and translated to their scientific name and botanical name using “The Book of Mizoram Plants” by Sawmliana (2003) and web searches. Although no mention of climate change was made, they were also asked if they had observed changes in the indicators which they mentioned during their lifetime. To enable a free flow of conversation and to get as much information as possible, there were no fixed pattern questions and only a few suggestive questions were formally maintained. To understand the transfer methods for this knowledge, they were also asked for the source of their knowledge and their methods of transferring their knowledge to others, mainly the younger generations and the challenges they faced in doing so. The participants shared that because of this interview, they realised the lack of data available to be found in traditional literature and how much of this knowledge is

at the risk of being lost. They realised the need for and importance of collecting and storing the traditional knowledge of the Mizo tribe.

5 Results and Discussion:

The indicators collected were mostly for predicting rain, its occurrence, absence, intensity, timing, and frequency. This can be attributed to the fact that the rainfall is observed throughout the year in Mizoram. Because of this, the traditions, myth, and lifestyle of the Mizo people are heavily influenced by rain.

Our data collection shows a variety of indicators that are used by the Mizo people. Most of them are animal indicators. Plant indicators were the least reported, followed by miscellaneous indicators such as astronomical indicators or local inanimate indicators. Characteristics and behaviour of different animals which could be easily seen and observed are one of the most common indicators mentioned. A deep understanding and connection to these indicators could be seen in the reasoning and story behind these different indicators.

5.1 Predictions for onset of Rain

Table 1: Animal and insect behaviour indicating occurrence of rainfall.

Name	Observation
Prediction that it will be raining soon	
Adult Termite(Phingphihlip), <i>Reticulitermes sp</i>	Leaving the ground on a dry day
Insects(Lei chiri/Khauangchiri/Khuangbai)	On dry days insect are chirping during the night
Field Cricket(Perhpawng), <i>Gryllus pensylvanicys</i>	Fresh soil are found on the ground near a field cricket nest

Common Frog(Uchang)	Croaking of frogs in a river during the evening before sunset
Mountain bamboo partridges(Vahlah), <i>Bambusicola fytchii</i>	Chirp of Vahlah during summer
Citica(Ruh na/Tha na)	The pain of a person with citica acting up
Great Barbet (Tuallawt), <i>Megalaima virens</i>	Different cry than normal
Frog(Chungu),	Sperm of frogs found in a watering hole at Rulpuihlum Village
Predictions for approaching storm and strong winds	
Ants(Fanghmir)	Long trail of ants carrying their prey and eggs
Large Indian Kite(Muchhia), <i>Milvus migrans</i>	Large Indian Kite flying around in days of dark clouds
Predictions that Continuous rainy days are ahead	
Domestic Chicken(Ar), <i>Gallus gallus</i>	Foraging food during rain
Birds(Sava)	Leaving its nest during rain
Prediction of rain stopping	
Domestic Chicken(Ar), <i>Gallus gallus</i>	Sheltering during the rain
Hollock gibbon(Hahuk), <i>Hoolock hoolock</i>	Howl in the morning
Adult Termite(Phingphihlip), <i>Reticulitermes app</i>	Leaving the ground during rain
Owl(Chhimbuk), <i>Bubo bengalensis</i>	Hooting during rainy night
Birds(Sava)	Sheltering during the rain
Prediction that storm and strong winds have stopped	
Blister beetle(Kut durh), <i>Mylabris spp</i> and <i>Hycleus spp</i>	During storm or when strong winds blow, this insect is spotted

The participants stated that in the past, each Mizo household would have their own chicken coop, which a member of the family oversees, making sure no chicken went missing and are in good health every day. With the prevalence of rain, the people observed that when it rains; the chicken knows if the rain will be long or short. Normally, a chicken does not like getting wet and will seek shelter if it rains to avoid getting wet. Only after the rain ceases will it go out and forage for food. However, if it believes that it will rain for a long duration, then it will brace the rain and forage even if it will get wet. This behaviour is shared by other birds, instead of foraging if birds are

seen up and about, especially in the morning when there is a light drizzle, it shows that the rain will continue, and it may even rain harder during the day. However, if they are not seen at all and are seeking shelter in their nest, then it shows that the rain will stop soon. The traditional explanation for this behaviour is that if the chicken and other birds know that the rain will stop soon, then it would rather stay dry and wait until the rain ceases so that they can go out. However, if the rain will persist for longer duration, they know the situation will be the same for the whole day and instead of staying in and be hungry, they will rather go out, get, and forage for food. This prediction is also shared by the Sumi tribe of Nagaland, India, as Sumi (2018) reported the use of domesticated chicken for predicting rain. Similarly, there are indicators which are used for both predicting the onset and the end of rain, such as the adult termites. According to Lainé and Wright, (2003) *Reticulitermes spp* generally swarm between March and June and this coincide with parts of the pre-monsoon and monsoon season. During these rainy seasons, if the adult winged termites are found to fly about on a dry day it shows that it will be raining soon and instead if, they are found flying around after a rainy day or during a rain, it indicates that the rain has stopped.

The calls of different animals have also been widely used for different predictions. The location and timing of these calls are very important in understanding these indicators. During summer or dry season, if the call of insects (Khuangbai) and Mountain bamboo partridges is heard during the night, it indicates that it will be raining soon. The Hoolock Gibbon is an endemic species of the region which have a distinct call which can be

easily identified. In regions where they are found during days of continuous rain, if their call is heard in the morning, then it indicates that the rain will stop soon. Islam & Feeroz, (1992) on their study of Hoolock Gibbon of Bangladesh reported that the Hoolock Gibbon call only between 8:00-12:00 is barely active during torrential rain and do not call from their sleeping tree. This behaviour could have been observed by the Mizo tribe, noticing the lack of Hoolock Gibbon activity during heavy rain and understanding that hearing their call during the morning means the rain has subsided. Other indicators such as croaks of frogs during sunset in a river indicates that it will be raining soon, and people are taught to leave the river immediately to avoid being swept away by flash floods. The presence of large Indian kite flying about during dark cloudy days and observation of long trails of ants carrying their prey and eggs shows that a strong storm is approaching. Whereas, if a blister beetle is observed after a storm and strong winds it indicates that the storm has ended.

5.2 Plant indicators for rainy season

Table 2: Indicators for onset of rainy season

Name	Indicator
Tree (Thingkha), <i>Derris robusta</i>	Flowering
Bauhinia (Vau), <i>Bauhinia spp</i>	Flowering
Coral tree (Fartuah), <i>Erythrina stricta</i> and <i>E. variegata</i>	Flowering
Termite Mushroom (Pasontlung), <i>Termitomyces microcarpus</i>	Appearance of Termite mushroom

Respondents described different indicators for the approaching rainy season. These indicators are mostly the flowering of tree species such as *Derris robusta*, *Bauhinia spp*, *E stricta*, *E variegata* which flowers between the month of February and April. An edible wild mushroom called Termite Mushroom *Termitocyces macrocarpa* is also used to determine the change in season where this edible mushroom would be collected in the wild. When they are in season, it determines that the monsoon season has not officially started yet.

Table 3: Indicators for end of rainy season

Name	Indicator
Freshwater Crabs (Chakai)	A crab blocks off its hole
Grasshopper species (Kawl ui)	This species of grasshopper crepitation can be heard at night
Dragonfly (Daidep)	A dragonfly flying close to the surface of a paddy
Asian green bee-eater (Fuanhawn/ Fuanhor), <i>Merops orientalis</i>	Appearance of Asian green bee-eater

The timing of the end of the monsoon season is very important as it means that the harshest season for the people is ending. It also indicates that it is time to harvest rice, which is done from August to September (S. K. Das, 2011). This change of season is showed by different elements such as different species of Freshwater crabs blocking off the entrance to their hole. This means that it will be harder to harvest them as they are an important part of the Mizo diet. Another indicator is the crepitation of a grasshopper species in Mizo language called “Kawl ui.” These grasshoppers are

reported to be found in the trees and among the cliffs of the forests and if they could be heard and seen, then it is a sign that the monsoon is ending. The presence of the Asian green bee-eater is an indicator that monsoon has ended, the presence of this bird is a sign that fishes have spawned, and the people get ready to go fishing.

Table 4: Indicators for heavy rain that year.

Name	Indicator	Prediction
Mango (Theihai), <i>Mangifera indica</i>	Increase flowering	Heavy rain and hail that year
Pear (Theite), <i>Prunus domestica</i>	Increase flowering	Heavy rain that year
Litchi (Theifemung), <i>Litchi chinensis</i>	Increase flowering	Heavy rain that year

Flowering of plants is also used for predicting the intensity of rainfall intensity that year. Mango, Pear, and Litchi are reported by the participants where high amounts of flowering is observed in that year before the monsoon season, then it is believed that there will be heavy rain that year. These incidents are also expected to be accompanied by heavy hail, causing destruction. Even though traditional knowledge is used for climate forecasting most of the predictions use what is observed in the present are for immediate or near future weather conditions which dictates their daily activity.

6 Other indicators

The participants also reported other indicators such as atmospheric, astronomical, and other miscellaneous indicators.

Crescent Moon (Thla de): During monsoon season, when a crescent moon stands vertically, it shows that it will rain heavily soon. If the crescent moon is horizontal, then even if it rains, it is believed that it will only be a light rain. The Crescent shape of a believed to depict a bowl containing water and when it stands vertical, it releases the water as rain.

Sunset (Tlai ni tla): During continuous rainy days, if the Sun set is clearly visible, it shows that rain will cease in the following days.

Thunder (Khawpui ri): Two of the respondents also mentioned that during the month of May, if thunder is heard three consecutive times at the onset of rain, it means rainstorm, whereas three consecutive thunders during a rainstorm show that the rain was stopping. This specific rainstorm is called Ruahthimpui. The name translates to darkened rain, and it is a phenomenon during a heavy rainstorm where the clouds block out the sun and the day is dark, resembling night.

During the month of June, by listening to the sound of thunder and it makes a particular distinct sound which they call moan of hail (rial ri rum) it is understood that the raincloud carries hail, and it will hail soon.

Dew (Dai): Apart from winter, if dew forms in abundance during the night and drops at the side of the house (kawm) it shows that there will be drought.

Temperature (Khaw lum leh vawt): During monsoon season, even if dark clouds cover the sky, if the temperature around them is still warm, many of the respondents mentioned that it is understood that it will not rain yet.

Rock (Falung): One respondent mentioned the use of falung which is a type of rock which is traditionally used for fortune telling. It is normally kept above the fireplace. If the Falung is clear and shiny, it shows that it will be a good year with proper rain. If it is dull, then it shows that it will not rain properly that year.

Rock on a Cliff (Kham a lung) in Tualpui Village: The people of Tualpui village use a rock found in a cliff near their village for predicting rain and its intensity. If the rock is especially yellow, it shows that there will be heavy rain.

Halo (Sar zam): Only a few of the respondents mentioned that if during monsoon, if a halo is observed around the sun on a clear day, then it showed that it will be raining soon.

The Pleiades (Siruk): Appearance and disappearance of the Pleiades are also used to indicate the change in seasons. Pleiades is a star constellation (technically a star cluster) we call the seven sisters. It happens regularly as a natural part of the seasons. During monsoon the Pleiades are barely visible during the night and are traditionally believed that even have been swept away by the monsoon winds. After the end of monsoon and when the night sky becomes clear, the Pleiades becomes visible again and this is associated with the beginning of winter.

6.1 Reliance of Traditional Weather Prediction

Traditional weather predictions were previously used for different agricultural activities. In shifting cultivation, it is very important to accurately predict weather from the beginning. When patches of forest land are cleared, they are left for some time to dry up so that they can be burned. If predictions are wrong and the slash is soaked by rain before burning, this could be highly detrimental to the farmer. Nowadays the burning of the slash is delegated to local leaders which normally follow a strict calendar which the Government announces all the jhum to be burnt before a certain date mainly March 15th. This is done so that preparations are done to prevent accidental spread of fire leading to forest fire and to shorten the timespan of air pollution due to smoke from the flames which leads to lesser visibility for airplanes. With modernisation and the easy availability of transfer of information, the participants stated that they rely mostly on modern weather prediction. Traditional weather predictions are now rarely used but they believe that these traditional indicators are still accurate and reliable when available. There is a strong belief that even with modernization and scientific methods available these indicators do not lose their accuracy and when there is a known traditional indicator observed. To a degree, they are still relied upon. The major reason why the traditional indicators lose their relevancy and become less utilised is because they are harder to find and are rarely observed now. In recent times, the timing of agricultural activities is done using Gregorian calendars and scientific predictions. Because of this, traditional methods are rarely used for major decisions.

Even though there is more reliance on modern weather prediction methods which are mostly received through daily news channels and radio, there is skepticism regarding their accuracy and one of the main reasons being that many of these predictions are for a wide area and even if a prediction is made it may not be true for that region. Mizo's also have different rains depending on the season which are associated with months on the calendar. Due to climate change the timing of these rains and their predictions which is based on the month has become obscure. The participants mentioned that rains which were believed to come which marks a certain season sometimes do not show up and some rain such as ai ruah which was believed to come at the end of monsoon shows up more than once. Many of the predictions which use observations of the sky and clouds have also been reported to no longer be as accurate as they once were. Rain clouds which were known to come from a certain direction previously are no longer accurate. Previously clouds from a certain direction were foretold to pass by and not bring rain have recently brought rain and such indicators are now considered unreliable. Since some of these traditional methods are very site specific for the local region, they tend to be more dependable and many times they are believed to end up being more reliable than modern predictions(Evangeline & Criselda, 2009) .

6.1.1 Accuracy of the Traditional Weather Prediction and their limitations

The participants believe that generally traditional predictions are still mostly accurate. The reason they are not relied on anymore is because they are rare and hard to observe. For example, one of the participants shared that if he sees new soil near a

field cricket, he believes that it will rain soon. Another shared that in instances where they hear a frog croaking in the river in the evening, they leave the vicinity of the lake immediately. There is a fear of flash flood in the river, which is termed as Sabereka khuangkaih, which is believed to occur when there is rain at the source of riverbed which collects rain leading to high volume of water collected and flows to the lower river. Even if it is not raining in their location people venturing along the river are advised to be careful and beware of flash floods. The traditional predictions which were considered less reliable are the ones denoting the beginning and the end of a season. These indicators are now associated with the Gregorian calendar and the events are predicted using the months and dates on the calendar. Among these predictions is the “Ruah thim pui” which translates to major dark rain, a rainstorm so intense that the rainclouds block out the sun making it dark was believed to happen normally in the month of March. This rainstorm has rarely occurred in the past years and similarly different rains have also deviated from their presumed pattern.

6.1.2 Transfer of Traditional Knowledge

Many of the participants stated that they obtained their knowledge informally from their parents, elders, or other members of their community through discussions and socialising. They stated that this knowledge is easily remembered because they could observe them and apply them for themselves. Some also credited obtaining their knowledge through their own observation throughout the years. These observations are made in their day-to-day activities as they frequently venture out into the forest for

gathering, farming and other activities. Many of the participants have their own traditional farm which would be a few hours of walk into the forest from their village. In days where intense work is required in the field, they would sleep in a small cabin built near their farms. They have more interaction with nature and have a more intimate knowledge. Currently, young people have less time to interact with elders and knowledge holders as they must go to school on weekdays and gain knowledge in a more formal setting. This decreases their time spent with elders, and their family in the farm or social events. In recent generations, parents want their kids to have a proper formal education and to have office jobs which do not require manual labour and better and more stable income instead of having to work in the farm (C. Nunthara, 1996). The participants stated that although there is no deliberate transfer of knowledge in a formal setting, in the same way as how this knowledge was imparted to them, they pass on this knowledge to others when it comes up in conversation and discussions in an informal setting. However, many of the elements for this knowledge such as some of the indicators mentioned in this research are rarely found. Because of this, they rarely come up in conversations and even in occasions that they are brought up they are not retained. Unlike the older generations the younger generations could not see or observe these elements and understand their working, their value diminishes and are forgotten. Chances where such conversations come up have also decreased because of modernisation informal gathering and socialising although still present are rarer.

6.2 Study limitations

This study offers an insight into the rich traditional knowledge and the depth of how the Mizo community understands and perceives nature. One of the biggest limitations to this study is the sampling approach. This research aims at collecting the knowledge and understanding of the tribal community and the participants were selected based on their perceived knowledge of the topic. Therefore, the data collected cannot be used as a solid representation of the community. One of the biggest limitations is that the data collected was done remotely and at times the participants were struggling to maintain a connection. Due to the nature of the interaction, there is a chance that some of the indicators are perceived differently by different people. Comparing the knowledge and having a focus group discussion would have provided a better understanding of and representation of the community's traditional knowledge.

7 Conclusion

The Mizo tribe have a deep understanding of nature around them. However, this knowledge has a great risk of being lost due to it not being passed on to the next generation. Because the traditions of the Mizo people are mixed with Christian faith, some of the traditional knowledge and contemporary knowledge have been mixed. This is clear on how certain rains and weather events which were once used to denote changes in season are now associated with months of the year and not the other way around. With climate change these weather patterns are becoming more unpredictable. Intergovernmental Panel on Climate Change predicts that there will be delayed and weakening of monsoon and increasing flood during monsoon in the region (Shaw R et al., (2022)). This is also noticed by the people with them being unable to

correctly identify the seasonal changes resulting on distrust to certain traditional weather predictions. The participants report that rain and storms no longer follow their past patterns. This is corroborated by the findings of Pandey et al., (2023) and Lochan Bora et al., (2022) who reported a decreasing trend in rainfall during the pre monsoon season in most part of Mizoram whereas the monsoon season showed increasing trend. Climate predictions are and will be important for predicting the weather in the future.

This research shows the need for additional research, especially related to the mechanisms behind many of these weather prediction indicators, and their validity would be very important for their conservation. The participants shared a similar sentiment that the traditional knowledge of the community is at a risk of being lost and forgotten. They showed appreciation for interest in the research and most importantly they showed willingness to participate in future research and help in any way they can. This is a great opportunity for a more in depth and specific research in the future.

8 References

- Acharya, S. (2011). Presage Biology: Lessons from nature in weather forecasting. In *Indian Journal of Traditional Knowledge* (Vol. 10, Issue 1).
- Anandaraja, N., Rathakrishnan, T., Ramasubramanian, M., Saravanan, P., & Suganthi, N. S. (2008). Indigenous weather and forecast practices of Coimbatore district farmers of Tamil Nadu. In *Indian Journal of Traditional Knowledge* (Vol. 7, Issue 4).
- Angom, R. (2020). *Christianization and its Impact on Mizo Culture*. www.jhsss.org
- Benjamin L Saitluanga. (2022). Mizoram through the ages. In R. Bhattacharyya (Ed.), *Northeast India Through the Ages A Transdisciplinary Perspective on Prehistory, History, and Oral History* (1st ed., p. 26).
- Bruchac, M. (2014). *INDIGENOUS KNOWLEDGE AND TRADITIONAL KNOWLEDGE*.
- C. Nunthara. (1996). *Mizoram: Society and polity*. Indus Publishing.
- Census of India*. (2011).
- Champion, H. G., & Seth, S. K. (1968). *A revised survey of the forest types of India*.
- Das, A., Ghosh, P. K., Choudhury, B. U., Patel, D. P., Munda, G. C., Ngachan, S. V., & Chowdhury, P. (2009). *ISPRS Archives XXXVIII-8/W3 Workshop Proceedings: Impact of Climate Change on Agriculture 32 CLIMATE CHANGE IN NORTHEAST INDIA: RECENT FACTS AND EVENTS-WORRY FOR AGRICULTURAL MANAGEMENT*.

- Das, S. K. (2011). Mizoram: an Insight. *International Journal of Bio-Resource and Stress Management*, 2011(4), 464–469.
- Enock, C., & Makwara. (2013). *Indigenous Knowledge Systems and Modern Weather Forecasting: Exploring the Linkages*. 2, 98–141.
- Evangeline, S. G., & Criselda, M. B. (2009). Traditional weather forecasting for sustainable agroforestry practices in Ilocos Norte Province, Philippines. *Forest Ecology and Management*, 257, 2044–2053.
- Forest Survey of India. (2021). *Indian State of Forest Report 2021*.
- Goswami, B. B., Mukhopadhyay, P., Mahanta, R., & Goswami, B. N. (2010). Multiscale interaction with topography and extreme rainfall events in the northeast Indian region. *Journal of Geophysical Research Atmospheres*, 115(12).
<https://doi.org/10.1029/2009JD012275>
- Grogan, P., Lalnunmawia, F., & Tripathi, S. K. (2012). Shifting cultivation in steeply sloped regions: A review of management options and research priorities for Mizoram state, Northeast India. *Agroforestry Systems*, 84(2), 163–177.
<https://doi.org/10.1007/s10457-011-9469-1>
- India State of Forest Report 2021 (ISFR)*. (2022).
- Islam, M. A., & Feeroz, M. M. (1992). Ecology of Hoolock Gibbon of Bangladesh. In *PRIMATES* (Vol. 33, Issue 4).

- Lainé, L. V., & Wright, D. J. (2003). The life cycle of *Reticulitermes* spp. (Isoptera: Rhinotermitidae): what do we know? . *Bulletin of Entomological Research*, 93(4), 267–278. <https://doi.org/10.1079/ber2003238>
- Lallianthanga, R. K., Lalmalsawma, S., Lalnunzira Hrahsel, J., & Lalthanpuia. (2018). *CLIMATE PROFILE OF MIZORAM*.
- Leonard, S., Parsons, M., Olawsky, K., & Kofod, F. (2013). The role of culture and traditional knowledge in climate change adaptation: Insights from East Kimberley, Australia. *Global Environmental Change*, 23(3), 623–632. <https://doi.org/10.1016/j.gloenvcha.2013.02.012>
- Lochan Bora, S., Bhuyan, K., Hazarika, P. J., Gogoi, J., & Goswami, K. (2022). Analysis of rainfall trend using non-parametric methods and innovative trend analysis during 1901-2020 in seven states of North East India. In *CURRENT SCIENCE* (Vol. 122, Issue 7). <https://indiawris.gov.in>
- Mcgregor, D. (2004). *Coming Full Circle: Indigenous Knowledge, Environment, and Our Future*.
- Meteorological Data of Mizoram*. (2021).
- Nag, S. (2001). Tribals, Rats, Famine, State and the Nation. *Economic and Political Weekly*, 36(12), 1029–1033.

National Informatics Centre, M. of E. & I. (MeitY) | G. of I. (2021, November 24).

Mizoram.

Orlovic Lovren, V. (2020). Traditional and Indigenous Knowledge: Bridging Past and Future Sustainable Development. In W. L. Filho, A. M. Azul, L. Brandli, A. L. Salvia, & T. Wall (Eds.), *Encyclopedia of the UN Sustainable Development Goals Series Editor: Life on Land* (pp. 1033–1040). <https://www.springer.com/series/15893>

Pachua, L. (2006). *Mizo "Sakhua" in Transition Change and Continuity from Primal Religion to Christianity' LALSANGKIMA PACHUAU.*

Pandey, V., Pandey, P. K., Chakma, B., & Ranjan, P. (2023). Influence of short- and long-term persistence on identification of rainfall temporal trends using different versions of the Mann-Kendall test in Mizoram, Northeast India. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-023-29436-2>

Rautela, P., & Karki, B. (2015). Weather Forecasting: Traditional Knowledge of the People of Uttarakhand Himalaya. *Journal of Geography, Environment and Earth Science International*, 3(3), 1–14. <https://doi.org/10.9734/jgeesi/2015/19016>

Risiro, J., Mashoko, D., Tshuma, T., & Rurinda, E. (2012a). Weather Forecasting and Indigenous Knowledge Systems in Chimanimani District of Manicaland, Zimbabwe. *Journal of Emerging Trends in Educational Research and Policy Studies*, 3(4), 561–566.

- Risiro, J., Mashoko, D., Tshuma, T., & Rurinda, E. (2012b). Weather Forecasting and Indigenous Knowledge Systems in Chimanimani District of Manicaland, Zimbabwe. *Journal of Emerging Trends in Educational Research and Policy Studies*, 3(4), 561–566.
- Salite, D. (2019). Traditional prediction of drought under weather and climate uncertainty: analyzing the challenges and opportunities for small-scale farmers in Gaza province, southern region of Mozambique. *Natural Hazards*, 96(3), 1289–1309. <https://doi.org/10.1007/s11069-019-03613-4>
- Sanni, S. A., Oluwasemire, K. O., & Nnoli, N. O. (2012). Traditional capacity for weather prediction, variability and coping strategies in the front line states of nigeria. *Agricultural Sciences*, 03(04), 625–630. <https://doi.org/10.4236/as.2012.34075>
- Sawmliana, M. (2003). *The Book of Mizoram Plants* (Second Edition).
- Shaw, R., Y. Luo, T.S. Cheong, S. Abdul Halim, S. Chaturvedi, M. Hashizume, G.E. Insarov, Y. Ishikawa, M. Jafari, A. Kitoh, J. Pulhin, C. Singh, K. Vasant, and Z. Zhang, 2022: Asia. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1457–1579, doi:10.1017/9781009325844.012.

Sumi, A. (2018). Birds as Bioindicators of Traditional Weather Forecasting among the Sumi Tribe of Nagaland, India. *Asian Journal of Environment & Ecology*, 7(4), 1–7. <https://doi.org/10.9734/ajee/2018/45208>

The World Intellectual Property Organization. (n.d.). *Traditional Knowledge*. Retrieved October 24, 2023, from [https://www.wipo.int/tk/en/tk/#:~:text=Traditional%20knowledge%20\(TK\)%20is%20knowledge,its%20cultural%20or%20spiritual%20identity](https://www.wipo.int/tk/en/tk/#:~:text=Traditional%20knowledge%20(TK)%20is%20knowledge,its%20cultural%20or%20spiritual%20identity).

Van Schendel, W. (2016). A War Within a War: Mizo rebels and the Bangladesh liberation struggle. In *Modern Asian Studies* (Vol. 50, Issue 1, pp. 75–117). Cambridge University Press. <https://doi.org/10.1017/S0026749X15000104>

Weatherhead, E., Gearheard, S., & Barry, R. G. (2010). Changes in weather persistence: Insight from Inuit knowledge. *Global Environmental Change*, 20(3), 523–528. <https://doi.org/10.1016/j.gloenvcha.2010.02.002>

Williams, T., & Hardison, P. (2013). Culture, law, risk and governance: Contexts of traditional knowledge in climate change adaptation. *Climatic Change*, 120(3), 531–544. <https://doi.org/10.1007/s10584-013-0850-0>

9 Appendix A: Research Consent Form

Introduction

You are cordially invited to participate in the research project by Isaac Chhangte, Faculty of Forestry and Environmental Management, University of New Brunswick. This research is Supervised by Dr. Tom Beckley, a Professor in the Faculty of Forestry and Environmental Management, University of New Brunswick. This document describes your rights as a research participant and seeks your consent to participate in the research. This research will be conducted in cooperation with the help of ASEP (Association for Environmental Preservation). Your participation is voluntary, and you may withdraw from the interview at any time. This research will be published in a graduate thesis and may also be published in an academic article. Any questions should be directed to Isaac Chhangte or through ASEP.

Isaac Chhangte, Faculty of Forestry and Environmental Management, University of New Brunswick a research project a tel tura hian kan rawn sawm che a. Hemi document ah hian research-a in tel chhunga in dikna chanvo te tar lan a ni. He research hi Dr. Tom Beckley, Professor, Faculty of Forestry and Environmental Management, University of New Brunswick, supervise a ni. ASEP (Association for Environmental Preservation) puihna nen a hma lak a ni a. In duhthlanna tel tur nih bak ah in duh duh hunah a in hnuh dawh theih a ni e. He research hi graduate thesis ah publish a ni dawn a hemi bak ah hian academic article a publish tum bawk a ni. Zawhna in neih chuan Isaac Chhangte hnen ah emaw ASEP kaltlang a zawh tur a ni e.

Purpose of Research

This research aims to study and collect the Traditional Ecological Knowledge of the Mizo tribe on understanding weather and climate change predictions.

He research hi Mizo te Traditional Ecological Knowledge (Kan pi leh pu te khawvel thaimna) khawm awm dan hrilh lawk dan lak khawm a zir chian tumna a ni.

Research Methods

This research will be conducted in a semi-structured format with Isaac Chhangte and will last approximately 30 minutes. The interview will be through an audio call using Facebook or WhatsApp call. The call will be recorded using a recording software which

will be transcribed and translated to English with your consent at the beginning before the interview is started. During the interview I will ask you about the traditional methods of weather prediction and discuss in detail some of the aspects as necessary.

Research hi Semi-structured format hmanga buatsaih tum a ni a. Minute 30 vel Isaac Chhangtean interview na hi kaihruiin Facebook emaw Whatsapp cal hmanga neih tur a ni. Interview hi kan tan hmain in phal na kan lak thlap hnu ah zaih chhuah a English a leh anih theih record tum ani. Kan interview chung hian khaw awm dan hrilh lawk in hriat te ka zawt dawn che u a, a remchan dan angin in sawt thenkhat te sawi thuk deuh tum a ni.

Compensation

There is no compensation for participating in this research and there should be no expense from your side aside from your time.

Compensation engmah kan pe thei dawn lo che u a, in hun hlu tak bak chu engmah in sen a ngaih lo kan beisei.

Privacy and Data Security

The audio recordings are for transcription and translation purposes and will not be shared. Only the research team will have access to identifiable research material. Any identifiable information will be removed from any of the research outputs.

Kan interview na audio emaw kan ziah thlak na hi tu hnen ah mah kan pe kual dawn loa, research team te chiah in chhui tehina kan nei dawn ani. Tunge in nih leh in nihna engmah pho lan a ni lo ang.

Possible Risks

We anticipate that there will be no risk or if any, minimal risk to our participants in this research. If you are uncomfortable discussing any topics, you may ask to terminate and the interview without any penalty.

In tan engmah in tih palh theihna tur awmin kan hre loa, topic emaw zawhna chhan duh loh chuan in duh duh hunah interview na atang hia in in hnuk daawk thei bawk ang.

Possible Benefits

There may be no direct benefits to you, but this research will help record and study the Traditional Ecological Knowledge of the Mizo tribe. Your participation and sharing of your valuable knowledge will help in preserving the Mizo culture, knowledge and help in management and conservation of nature.

He research kal tlanga mimal hlawkna dawn tur awm lo mah se Mizote Traditional Ecological Knowledge (Kan pi leh pu te khawvel thaimna) vawnhim na kawng ah in puih mai bakah Mizo culture leh thiamna te vawng nung nan leh nungchate enkawl a venhim ka nawng ah a tangkai dawn ani.

Questions or Concerns

This project has been reviewed by the UNB Research Ethics Board and is on file as REB 2023-078. If you have any questions or concerns regarding this research, please contact Isaac Chhangte or ASEP. If you have any questions or concerns regarding your rights or welfare as a participant in this research, please contact Research Ethics Board (UNB Fredericton) by email at ethics@unb.ca or by calling +1 506-453-5189.

He project hi UNB Research Ethics Board in a ennawn thlap a, REB 2023-078 ah dah that a ni. Zawh chian duh emaw hriat belh duh in neih chuan in neih chuan Isaac Chhangte emaw ASEP kal tlangin a zawh theih reng e. He research in tel na atana in dikna chanvo neih in hriat chian emaw in zawh belh duh chuan Research Ethics Board (UNB Fredericton) ah email in ethics@unb.ca emaw +1 506-453-5189 ah call in a zawh chian theih e.

Contact Information

Isaac Chhangte

Graduate Student, Faculty of Forestry and Environmental Management
University of New Brunswick
Email: isaac.chhangte96@unb.ca
Phone: +1 506-897-5277

Dr. Tom Beckley (Research Supervisor)
Professor, Faculty of Forestry and Environmental Management
University of New Brunswick
Email: beckley@unb.ca
Phone: +1 506-453-4917

ASEP (Association for Environmental Preservation)
AIZAWL, MIZORAM
Phone: +91 98620 17018

I have read this consent form in full and have been granted the opportunity to discuss any questions or concerns I have.

Consent form hi ka chhiar chhuak a zawhna leh hriat ka hriat chian duh ka neih ang te zawh na hun pek thlap ka ni e.

I consent to participating in this research/He research ah hian ka remtihna in tel ka duh e:

Yes (Aw)/No(Aih)

I consent to this interview being recorded/He interview hi record ka remti e:

Yes (Aw)/No(Aih)

I would like to receive an electronic copy of any research outputs that result from this study. /He rsearch atanga hmuh chhuah hrang hrang te electronic copy dawn ka duh e.:

Yes (Aw) /No(Aih)

I would like to be contact primarily by/Hemi hmang hian biakpawh ka duh e

: Phone / Email

Name of Person giving Verbal Consent/Aw ka a remtihna pe tu hming: __

Phone: _____

Email: _____

Date of Verbal Consent/Aw ka a remtihna pek ni: _____/_____/2023_____

Time(Dar zat): _____ (IST)_____

Obtained Verbal consent via/Aw ka a remtihna pek na: _____

Person Conducting Verbal Consent /Aw ka a remtihna la tu

Date _____/_____/2023_____

Signature _____

Investigator:

Date: _____ Signature: _____

10 Appendix B: REB Application

University of New Brunswick

Application for Review of Research Involving Humans

Principal Investigator(s): Name(s); Academic Status (Faculty, Undergraduate Student or Graduate Student); Academic Unit, e-mail Address, Office Telephone, Home Telephone:

Isaac Lalduhawma Chhangte, Master of Forestry Student, Faculty of Forestry and
Environmental Management

Email: Isaac.chhangte96@unb.ca Tel: 506-897-5277

Title of Proposed Research:

Traditional knowledge on weather forecasting of the Mizo tribe and its applicability
in climate change.

Commencement Date: 1st June, 2023
December, 2023

Completion Date: 30th

Co-Investigator(s): Academic Unit, e-mail address, Office Telephone

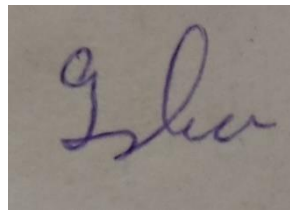
Supervisor(s) (if Principal Investigator is a student); Academic Unit, e-mail address,
Office Telephone:

Dr. Tom Beckley, Professor, Faculty of Forestry and Environmental Management

Office: Forestry and Geology 211, UNB Fredericton

Email: beckley@unb.ca Tel: 506-453-4917

The undersigned parties certify that they have read, and undertake to comply fully with, the Tri-Council Policy Statement "Ethical Conduct for Research Involving Humans." (Original signatures required)



Principal Investigator(s): _____

Co-Investigator(s):

Supervisor(s):_



The undersigned certifies that the proposed research has been reviewed by, and is acceptable *in all respects* to, the academic unit(s) responsible. (*Original signature required*)

Dean/Director/Chair(s) Typed Name Michelle Gray

Signature Michelle Gray

Date submitted to the REB:

1. Summary: Provide here, in approximately 300 words, a summary of the proposed research, indicating clearly the role of the research subjects and any procedures to which they will be subjected.

Mizo tribes are mostly found in the state of Mizoram, India. Mizoram is a small agrarian state in India. It is a tropical, wet, evergreen forest with an annual rainfall of 2500-3000mm per year and it has the highest percentage of forest cover as well as the highest tribal percentage in India. The history of the state is closely linked to Forest and its Traditional Ecological Knowledge as the birth of the state could be attributed to it. This research will collect biological indicators that were traditionally used by the tribes for predicting weather changes by conducting a semi-structured interview with 10-20 knowledgeable tribe members. Knowing this Traditional Ecological Knowledge could help in understanding the effect of climate change of the region. With the introduction of modern-day technology and weather predicting devices that are easier to understand, traditional methods for predicting weather and climate patterns are slowly being abandoned and forgotten. This leads to the loss of valuable traditional knowledge, and even cultural identity. With the world now realizing the importance of traditional knowledge, valuable knowledge, and ways of knowing among the Mizo tribe could be lost because they are not properly transferred, recorded, or otherwise documented. Existing studies on Mizo Traditional Ecological Knowledge were mostly related to medicinal plants. Traditional Ecological knowledge on weather changes remains unrecorded. This research will aim at collecting this knowledge, studying, and preserving it.

2. Risk: In your opinion, does this research pose more than minimal risk (Tri-Council Policy, Chapter 2, Section B) to participating subjects? **Yes** **No X**

If yes, provide here a statement that describes in detail the aspects of the research procedure that pose a risk to subjects, and provide your assessment of the risk of harm (probability and severity). Note that not only physical injury but also anxiety or embarrassments are included in the concept of harm. Describe means adopted to minimize risk, and means (such as provision of counseling) to deal with harms, which subjects may experience. Describe as well the potential benefit, which will result from this research, which justifies the above risk of harm.

NA

3. Deception: Does this research involve deception or partial disclosure? **Yes**
No X

If yes, refer to the Tri-Council Policy Statement, Chapter 3, specifically Article 3.7 and subsequent commentary, and provide here an explanation of how you plan to comply with the requirements of that Section for debriefing. Describe as well the potential benefit, which will result from this research, which justifies waiving the normal requirements for full disclosure.

4. Funding: Has funding been received for this research? **Yes** **No X**

If yes, **from** what agency and for what period?

If yes, **from** what agency and for what period?

5. Research Subjects:

5.1 Number of Subjects: How many subjects will participate in this research? 10-20

5.2 Recruitment: How will they be recruited, and from what population?

Participants will be elders and/or traditional knowledge holders from the Mizo tribe. Participants will be identified with the help of an NGO from Mizoram, India called Association for Environmental Protection. Members from the NGO as well as knowledgeable tribe members from the contact list of the organization will be contacted and invited for an. The interview will be conducted through Facebook or WhatsApp call depending on the preference of the volunteer. The call will be recorded using recording software which will be transcribed and translated. Prior consent will be obtained at the beginning before the interview starts in the form of a consent letter which will be read orally to the participants. It will contain the purpose of the research and how the data will be used and handled, how their anonymity will be guaranteed.

6. Informed Consent:

6.1 Informing Subjects: How will the nature of the research be explained to potential subjects, in compliance with Chapter 3, specifically article 3.2 and the subsequent commentary of the Tri-Council Policy? Attach a copy of any document(s), such as an explanatory letter, to be used for this purpose.

The initial contact will include the aim and purpose of the research along with the researcher's background and how the research data will be used.

6.2 Consent: If written evidence of informed consent will be obtained, attach a copy of the consent form. (See Requirements for Informed Consent Forms.) **If written evidence of informed consent will not be used, explain here, in detail, how you intend to comply with the requirements of Chapter 3, Article 3.2 and the subsequent commentary of the Tri-Council Policy:**

Before the start of the interview vocal consent will be attained from the participants through a consent letter which will be read orally to the participants. The interviewer will provide information about the research and its purpose. how the data will be used and how their anonymity is guaranteed. The interviewer will also make sure that the interview is voluntary.

6.3 Children as Research Subjects: If the proposed research involves children as subjects, provide here a statement indicating how compliance with Chapter 3, Section C, and specifically with Articles 3.9 and 3.10 of the Tri-Council Policy, will be achieved.

No children will be used as research subjects.

6.4 Incompetent Adults as Research Subjects: If the research involves adults of diminished competence as subjects, provide a statement indicating how compliance with Chapter 3, Section C, and specifically with Articles 3.9 and 3.10 of the Tri-Council Policy, will be achieved.

No incompetent adults will be used as research subjects.

7. Inducements: Will any inducements (money, grade points, etc.) be offered to encourage participation? **Yes** **No X**

If yes, indicate here how compliance with Chapter 3, Article 3.1 and the subsequent commentary of the Tri-Council Policy (concerning voluntariness) will be achieved. If academic rewards are to be used, give details of alternative means of achieving equivalent rewards.

8. Private Information: Does the proposed research involve accessing identifiable personal information about subjects by means of surveys, questionnaires, etc.? **Yes**
No

If yes, indicate here, in detail, how you propose to meet the requirements of the Tri-Council Policy, Chapter 5, Section B and C. A copy of any questionnaire, survey document or interview schedule to be used should be attached as well.

Participants' image and voice may be identified through audio recordings. All participants will be asked if they consent to recording of audio at the consent process. All the recordings will be stored on password protected computers. After translation and transcription of the interview the recordings will be destroyed.

9. Feedback: Describe the measures, which you propose for providing feedback to research subjects concerning the outcome of the research.

No specific standard feedback will be provided, but the contact information of the interviewer will be given for future contact.

10. Data Security: Describe the measures, which you propose for ensuring the security of any identifiable personal data, which will be retained after completion of the research.

All participants will remain anonymous in future reports and publications. All data collected will be kept in locked file cabinets or password protected computers.

11. Continuing Review: All research requires brief annual reports and a brief report upon completion of the research. Suitable report forms are included at the end of this file. **Research involving more than minimal risk may require additional measures for continuing review.** If your research involves more than minimal risk, describe here the measures you propose for facilitating continuing review of this research, in compliance with Article 2.8 of the Tri-Council Policy.

NA

12. Additional Information: Please feel free to append any additional information, which you feel may be helpful to the REB in evaluating this application.

The primary investigator for this research is a Member of the Mizo tribe as well as the NGO.

Checklist for Attachments to Application for Review of Research Involving Humans

For items that are attached, indicate X; for items that are not applicable, indicate.
N/A.

Provide the following attachments where applicable:

X or N/A	
N/A	Where the academic unit responsible for the research has a process of formal ethics review , a copy of the approval notice from that process, together with any substantive comments provided by the reviewers.
N/A	If external funding has been sought or obtained for this research, one copy only of the complete application form as well as two copies of any reviewers' comments which have been received.
N/A	For student research , one copy of the full research proposal if one has been submitted to the relevant academic unit.
X	A copy of any proposed information letter and/or informed consent form. (Do not duplicate if already included in above material.)
X	A copy of any questionnaire(s), survey documents or interview schedules to be used in the research. (Do not duplicate if already included in above material.)
N/A	A copy of any debriefing material to be provided to subjects.
N/A	For research under the jurisdiction of more than one institution , an indication of which other REBs will review the research, and the results of such review if available (see Tri-Council Policy, Chapter 8, Section A).
N/A	For all research (including student research) that exceeds minimal risk, which has not been approved by a sanctioned peer review process , the applicant must recommend two reviewers competent to undertake a

	“scholarly review” of the proposed research. “Scholarly review” in this context refers to the process of determining whether the design of the research project is capable of addressing the questions being asked in the research.
X	In all cases, a full description of the proposed research, if this is not already contained in the material listed above.

11 Appendix C: Information Form for Participants

English Version

My name is Isaac Chhange, and I am a graduate student in a dual degree program with the goal of achieving a Master of Forestry from the University of New Brunswick, Canada and a Master of Science in Forest Science from the University of Padova, Italy. This research is part of my thesis which is a requirement to obtain my master’s degree in both Universities. My supervisor for this research is Dr. Tom Beckley, who is a Professor in the Faculty of Forestry and Environmental Management, University of New Brunswick. This research will be conducted in cooperation with the help of ASEP (Association for Environmental Preservation).

We are looking to interview around 10-20 Mizo knowledge holders who are knowledgeable about the traditional methods of weather prediction. This research will record the Traditional Ecological Knowledge of the Mizo tribe and preserve this knowledge in written form.

Interviews will be conducted via an audio call using Facebook or WhatsApp for approximately 30 minutes. This interview will be recorded and translated to English with your consent for further analysis. During the interview I will ask you about your knowledge on predicting weather, methods, components, indicators used, their accuracy as compared to modern weather prediction. I will also ask you if you have observed any changes in them in recent years. This project has been reviewed by the UNB Research Ethics Board and is on file as REB 2023-078.

If you are willing to participate in this interview, please contact me through my phone number +1 506-897-5277, my email:isaac.chhangte96@unb.ca, or through ASEP phone number +91 98620 17018. We will set a timing for the interview accordingly.

Yours sincerely

Isaac Chhangte

Mizo Version

Ka hming chu Isaac Chhangte a ni a, tunah hian graduate student ka ni mek a, University of New Brunswick, Canada ah Master of Forestry leh University of Padova, Italy ah Master of Science in Forest Science, TRANSFOR-M programme kal tlang in ka zir mek a ni. Tuna he research hi master's degree ka University te pahnih atanga ka hmuh theih nan a ti ka ni a. Ka research na atana ka supervisor chu Dr. Tom Beckley, Professor, Faculty of Forestry and Environmental Management, University of New Brunswick a thawk lai a ni. Hemi research hi ASEP (Association for Environmental Preservation) puihna hmanga hmalak a ni e.

Mizo mi 10-20 vel khaw chin hrilh lawk dan thiam kawm kan duh a. He research hi Mizo te Traditional Ecological Knowledge (Kan pi leh pu te khawvel thaimna) dah that a zir chian mai bakah ziak ngei a vawn nun duh vanga rawn ti kan ni e.

Interview hi Facebook emaw WhatsApp call hmanga minute 30 vel neih tur ani a. In rem tih na hmangin he interview hi record a English a leha zir chian chhunzawm theih tura buatsaih tum a ni. Khaw chin awm dan in hrilh lawk theih dan, a ken tel, tunlai hrilh lawk na nen tehkhin in eng zawk nge dik rin talak zawk tih leh heng thiamna te hi tun hnai ah an inthlak in hmuh leh hmuh loh ka zawt dawn che u a ni. He project hi UNB Research Ethics Board in a ennawn thlap a, REB 2023-078 ah dah that a ni.

He research a tel in duh chuan khawngaihin phone number +1 506-897-5277 emaw ka, email: isaac.chhangte96@unb.ca emaw ASEP phone number +91 98620 17018 kaltlangin min rawn hriat tir ula interview hun in remchan dan angin kan in ruat dawn nia.

I Rintlak

Isaac Chhangte

Curriculum Vitae

Candidate's Full Name: Isaac Lalduhawma Chhangte

Universities Attended: Master of Forestry (September 2022- Present), University of
New Brunswick

Master of Science in Forest Science (September 2021- Present), University of Padova,
Italy

Bachelor of Science (HONS) Forestry, College of Horticulture and Forestry, Central
Agricultural University, Imphal, India

Publications: N/A

Conference Presentations: N/A