Case Study

Journal of Diversity Studies

Climatic Factors Influence the local rice varieties in Thoubal (Valley) and Ukhrul (Hill) Districts of Manipur

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ABSTRACT

Weather patterns are playing an important role in the agricultural sector in this era. The production of crops is much lesser than compared to a decade ago. We the people of Manipur are dependent on agriculture and agricultural activities for our socio-economic survival. Besides, rice is the staple food crop of both the plain and hill areas and accounts for 95 % of the total food grain production in the state [1]. At present, the scenario of erratic rainfall, heavy rainfall, little rainfall, or sometimes no rainfall is disturbing the local rice varieties in terms of planting, diseases and pests, phenology, etc. The IPCC, scientific, and other research report suggests the decrease in crop production to climatic change and other several factors (Natural/Artificial). As a result, people prefer more on high-yielding crops more than traditional varieties for better agricultural productivity. Therefore, the need for time is to study, review, and explores the imbalance challenges of local rice varieties to overcome the issues and problems.

Keywords: *weather pattern, agriculture, IPCC, rice, decline, changing climate*

Citation: Onil Laishram, Sanamacha Meetei, Mohd Habibullah Khan, Ashem Rahul Singh, MD Zahir Shah, SW Yuingamla (2023). Climatic Factors Influence the local rice varieties in Thoubal (Valley) and Ukhrul (Hill) Districts of Manipur: A case study. Journal of Diversity Studies.v1i2. **11-15. https://doi.org/10.5281/zenodo.7827272**

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Article History: *Received on: September 23, 2022 | Revised on: November 27, 2022 | Accepted on: December 26, 2022*

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INTRODUCTION

For the people of Manipur, agriculture is the lifeline as well as the socio-economic development. As the agricultural system is rain fed, the mono cropping system is commonly used as a preference [2]. According to the India 2011 census, the agriculture sector contributes the maximum percentage to the entire territory's financial resources/output/gross national income along with providing livelihood to about 22.13 percent of the whole employees in Manipur. Presently, Agriculture is one of the sectors being affected by the changing scenario of climate. The valley districts practices mainly rain-fed agriculture and permanent cultivation while shifting cultivation or Pamlou in Manipuri is predominantly adopted in the hill's districts along with terrace cultivation in some pockets. The India Census 2011 revealed that the agriculture sector contributes a major share to the State's Domestic Product; and engages 52.81% of workers as cultivators and agricultural labourers. Despite having a huge potential for promising agriculture, the state imports food grains to meet its people's demands. The estimated requirement of household consumption of food grains (excluding livestock, poultry, fisheries, etc.) and its production shows a considerable shortfall of 108.6 thousand tonnes in 2017-18. With the variability in the current climate condition and its strong linkage with the agricultural sector, for a region like Manipur, agriculture in the state is at risk. The unprecedented dynamism in climate variability increases the vulnerability of the people depending on agriculture for their livelihood. Thus, to prepare for future climate, prioritizing our action through vulnerability assessment to simplify the adaptation process. Agriculture sector in most hill districts is vulnerable to climate risks and since vulnerability is relative, the districts under low agrarian vulnerability are not such in an absolute sense. As a result, High Yielding Varieties (HYV) are widely chosen at present as it increases yield production and is disease resistant. Studies suggest that the replacement of local varieties by HYV leads to large-scale ecological disasters and social inequity. However, most local varieties have drastically declined since the 1970s as most cultivators shift to different activities and modern techniques and varieties. This article suggests measurable steps to increase local rice production and weather-based crop insurance products to address the variability (risk) in Thoubal and Ukhrul districts of Manipur.

MATERIALS AND METHODS

1. Materials collection

i. Study on literature review, published journal, and unpublished reports

ii. The random household surveys and oral interviews related to temperature and rainfall in the study area

iii. Studies on weather reports of the study area collected from the Directorate of Environment and Climate change

Study Area

Thoubal (Valley district); Ukhrul (Hill district)

Selection of district

The selection of districts is done on the vulnerability status. All valley districts are connected. Agriculture is the dominating land use class in this terrain due to the favorable elevation as well as the slope. Land elevation is between 600-1000m and the slope is 0-4%. As weather pattern change, the district receives floods inundating many of the agricultural fields losing different varieties of crop species. The worst case happens when there is a drought-like situation after the post-floods. Most people suggest the reduction of rice production and infection of diseases in many vegetable crops. During this time, women, children, and elderly people affect the most. Whereas, Ukhrul is one of the eastern districts of Manipur. All three classes of elevation are spread widely in the district but the higher elevation class 100-3000m covers most of the area. Shifting cultivation is a practice in terrain/contour farms. Due to elevation variation and high slope conditions, the district is difficult to identify the small patches of agriculture. The hill district reflects floods and landslides at regular intervals of time.

In recent times, the villages receive heavy rainfall during the pre-monsoon season causing landslides. Moreover, the destruction and degradation of surrounding forests led to the problem of water scarcity during the lean season of the year. In most cases, spring is near to threatened due to the felling of trees for unreasonable purposes. Moreover, erratic rainfall, no rainfall, and even heavy rainfall disturb agriculture and agricultural activities.

RESULT AND DISCUSSION

Rising temperatures, erratic rainfall, and the drought-like situation are slowly affecting rice cultivation in Manipur. Studies reported that temperature is projected to rise by over 1.70 C by the end of the 21st century [3]. Some research articles suggest the increase of green house emissions in Manipur from 1980 to 2005 in terms of CO2 (2274 Gg/year rate of increase with 3.85% CGR), CH4 (0.419 Gg/year rate of increase with 0.85% CGR), and N2O (0.008 Gg/year rate of increase with 8.49% CGR [4]. Kavikumar and Parikh [6] using the Ricardian approach suggested that changes in temperature and rainfall in India could reduce an average rice yield by 15 to 25 percent. According to Welch et al. [7] there will be a decline in rice yield by 322 kg per ha due to a 10-degree Celsius increase in minimum temperature during the ripening phase. Peng et al [8] indicated a rice yield reduction of 10 percent due to a 10-degree Celsius increase in minimum temperature. As evident from household surveys in the Thoubal district, the authors found that most farmers prefer high -yielding rice varieties in comparison to traditional local varieties due to the changing weather pattern in the district. Most traditional varieties have low yields, are infected with diseases, and have difficulty in the planting system. Whereas, high-yielding varieties have disease resistant, medium to high productivity according to their field size (Lourak, Sangam, or Pari). Some of the identified high-yielding varieties from the ICAR complex are:

Table 1: Details of Rice Varieties of Manipur -I Evolved at Rice Research Station, Wangbal, Deptt. of Agriculture, Manipur

Sl. no.	Name of Variety with the designation	Parentage	Year of release/ notification	Eco-system	Recommended for
1	Pari Phou (WR 3-2-1)	Phougak x Neela	2006	HYV area for early cropping and terraces	Manipur
2	Gin Phou (KD 5-2-8)	Phouren x IR 22	2006	HYV area irrigates and rainfed lowland	Manipur

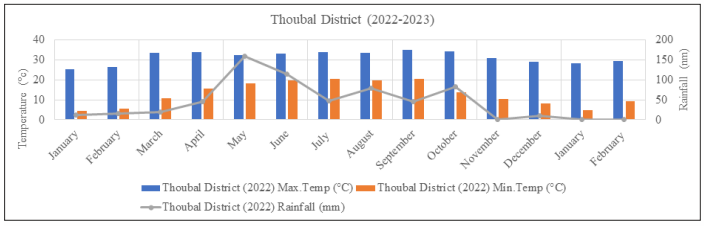
Table 2: Details of Rice Varieties of Manipur -II Evolved at ICAR Complex, Imphal, Manipur

Sl. No.	Name of Variety with the designation	Parentage	Year of release/ notification	Eco-system	Recommended for
1	*RC Maniphou 6* (RCM-5)	CH 988 x IR24	2000 2000	HYV area irrigated/ Rainfed lowland	Manipur and NE States
2	*RC Maniphou 7* (RCM-9)	The mutant of Punshi (gamma irradiation)	2000	HYV area irrigated/ Rainfed lowland	Manipur and NE States
3	*RC Maniphou 10* (Lungnila phou) (RCM-10)	Prasad x IR 24	2005	HYV area irrigated/ Rainfed lowland	Manipur and NE States

Table 3: Monthly Temperature and Rainfall Data at Thoubal District

Thoubal District (2022-2023)			
Month	Max.Temp (°C)	Min. Temp (°C)	Rainfall (mm)
January	25.32	4.28	11.4
February	26.54	5.6	16
March	33.35	10.78	18.8
April	33.82	15.42	45.4
May	32.28	18.12	159.2
June	33.32	19.85	114.6
July	33.9	20.41	48
August	33.48	19.68	79.4
September	34.82	20.33	46.2
October	34.27	13.84	81.8
November	30.84	10.3	1.4
December	29.06	8.12	10.6
January	28.23	4.73	0.00
February	29.34	9.22	0.00

Fig 1: Monthly Temperature and Rainfall Data at Thoubal District



While in the Ukhrul district, agriculture is the main source of livelihood in Ukhrul. More than 70 per cent of the total population of the district directly or indirectly depends on agricultural and allied activities. The people believed that shifting cultivation is the first and foremost agricultural practice by the Tangkhul Naga before the introduction of terraced cultivation. The people practice primitive agriculture. Some of the important rice varieties are *Anuza, Asham Ju Ngao, Aso, Champo Salak, Kongsam, Kum Saya Mora, Lamjang, Lamyang, Lasham, Ranchaza, Seventhei, Sirima, Siroima, Torongza, Utteibi, Yangkhoni, Zurai, etc.* Studies suggest that using high-yielding varieties can cause certain ecological disasters and social inequity [9, 10, 11, 12]. Moreover, climate change has directly affected temperature and precipitation, leading to water deficit and floods in the future, changing soil moisture status, and pest and disease incidence [13]. Furthermore, increasing temperature or hotter night temperatures can cause increased spikelet sterility in rice and reduce grain yield [14]. In the next decade, the State will face drier spells that can damage young plants, and floods at the end of the wet season that will affect the harvest. Therefore, to maintain the crop, most farmers of Thoubal and Ukhrul districts prefer to go with the high-yielding varieties. They are cost-effective, and ecologically more sustainable [9, 10, 11, 12] and are found to be more productive in stressful environmental conditions [15, 16]. Preserving and registering the morphological and agronomic characteristics of these traditional rice land races thus become extremely valuable for their conservation and cultivation. [17, 18, 19, 20]. Thus, ecologically informed agricultural science, adaptive management, and conservation of heirloom seeds can only sustain crop productivity in a time of climate change by maintaining local biodiversity and achieving sustainable goals by reducing hunger, and poverty and empowering farmers [21, 22, 23, 24].

Table 4: Monthly Temperature and Rainfall Data at Ukhrul District

Thoubal District (2022-2023)			
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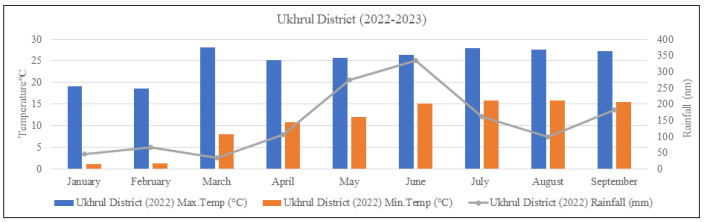

Moreover, studies reported (climate data analysis and precipitation rate) that northern parts of Manipur are likely to increase the rainfall pattern by ≥19%. It is projected that extreme rainfall events (100mm/day) would become more and more frequent in the coming days. As a result, most crops' yield including the rice varieties will be projected to decline by 10%. On the other, the temperature will rise in the southern parts of the State in comparison to the northern side.

CONCLUSION

An increase in temperature alone due to global warming can impact crop yields directly, and increase evapotranspiration and moisture stress, ultimately contributing to increased water demand and irrigation needs for agriculture. Further, in extreme cases, high temperatures can lead to heat stress, harming humans and animals. Temperature projections for the summer months (March to May -MAM) and winter months

(December to January-DJF) for the short- and long-term periods are presented in this section for two climate change scenarios namely, RCP 4.5 and RCP 8.5. As from the above Table (Thoubal and Ukhrul), there is a sign of fluctuation in the weather patterns resulting in the fatally derail of food production in the State. Therefore, the need of the time is to introduce awareness, programmes, and policies related to sustainable agricultural development with focussing on conservation agriculture, organic farming, System of rice intensification (SRI) methods, climate-proof planning (CPP)' integrated with disaster preparedness or risk reduction, etc. According to Pathak, he suggested that climate-ready crop varieties, changing planting dates, growing resistant/tolerant crops varieties, conservation agriculture, intensifying crop production, intercropping/mixed cropping, organic farming, integrated farming system (IFS), integrated pest and disease management (IPM and IDM), improved integrated nutrient management (IINM), water-saving technologies, procession farming, waste land management, increasing irrigation facility, improved weather-based Agro-advisory, creation of seed bank, crop insurance, Agro-horticulture, Agro-forestry, use of non-conventional energy and indigenous technical knowledge for adapting to climate change [5]. The Directorate of Environment and Climate Change has established the weather station in Thoubal and Ukhrul districts to prepare for the weather extremes. As a climate change programme, the assessment of village-level vulnerabilities is important to build the resilience of the local people and their livelihoods. Most farmers must be equipped with capacities and capabilities to combat climate change through local automated weather stations. The conservation and utilization of indigenous crop varieties need to be promoted, while making a balance with the use of high-yielding and hybrid varieties.

ACKNOWLEDGMENT

Authors are thankful to the National Mission on Himalayan Studies, GB Pant National Institute of Himalayan Environment and Sustainable Development, Ministry of Environment, Forests and Climate Change, Government of India for providing financial assistance to carry out this research work. The authors are very thankful to the Director, Directorate of Environment and Climate Change, Government of Manipur for his time-to-time valuable support and cooperation during the implementation of the research project.

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