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The Impact of Temperature and Rainfall Fluctuation on Climate Change in Lashio

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Abstract

The rainfall fluctuation and temperature changes play important effects to cause climate conditions all over the world. The climate changes are caused to destroy the people lives and properties. In this study, Myanmar is facing the climate change problem. Therefore, it is tempt to study the prediction of rainfall fluctuation by using linear, exponential and logistics regression analysis in SPSS Statistics Software. The temperature and rainfall data during 1990 to 2010 in Lashio Township is obtained from Meteorological Department. The dependent variable is defined as the average temperature changes and the independent variable is referred to as average rainfall fluctuation for this analysis. This is to be a useful tool for agricultural fields to consider for growing up the crops and government authorities to mitigate the people for saving life.

Keywords - Temperature, Rainfall, Linear regression, Exponential regression, Logistic regression

I. INTRODUCTION

Everybody living around the world is facing problems of climate change. It is destroying a lot of people and their properties causing severe weather conditions such as flood and cyclone. All organisms have been facing global warming problem [1]. The climate change problem have been caused too many reasons such as forest destruction and air pollution and so on. Most of the forests has been destroyed because of building infrastructures, bridges, and roads for developing a global communication system [2]. Air pollution problems have been caused by many reasons such as the automobile transportation system and fuel gas evolution. All of the above reasons, the global warming problem plays an important role for living all organisms.

Many researchers have been modified and developed mathematical models to analyze the relationship between temperature changes, rainfall, discharge flow, and time-period and so on [3]. Numerous studies had been investigated and revealed either climate conditions or global warming in Myanmar nowadays. The rainfall and temperature changes are the primary concepts to cause serious climate conditions [3]. These changes play important roles for the agricultural sector to grow the plant leaf and other vegetation.

In this research, Lashiotownship has been selected as the study area because it is located on the mountain land and it is agricultural land in Myanmar. Agricultural sector is dependent upon the temperature and rainfall condition during the growing season. The conditions of rainfall and temperature changes are important indicators for serious weather conditions. The prediction of temperature changes plays an important role in agricultural land. For this reasons, this study has to tempt to predict the temperature condition for affecting the agricultural sectors and protecting people's lives. Many researcher had been found to investigate either climate conditions or global warming in Myanmar nowadays. Therefore, the predicted equation is needed to help the essential tool for agricultural lands.

II. STUDY AREA

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Fig. 1 The location Map of Lashio Township (Source: Google Earth)

Lashio is the largest town in northern Shan State, Myanmar, about 200 kilometers (120 miles) north-east of Mandalay in Figure1. It is situated on a low mountain spur overlooking the valley of the Yaw River. LoiLeng, the highest mountain of the Shan Hills, is located 45 km (28 mi) to the south-east of Lashio. Lashio is the administrative center of Lashio Township and Lashio District; before April 2010, it was also the administrative center of Shan State (North). The population grew from approximately 5000 in 1960 to 88,590 in 1983. It is currently estimated at approximately 130,000. The population is made up of mostly Shan, Chinese and Burmans. Figure 2 shows thaeLashio Township is the agricultural land in Myanmar

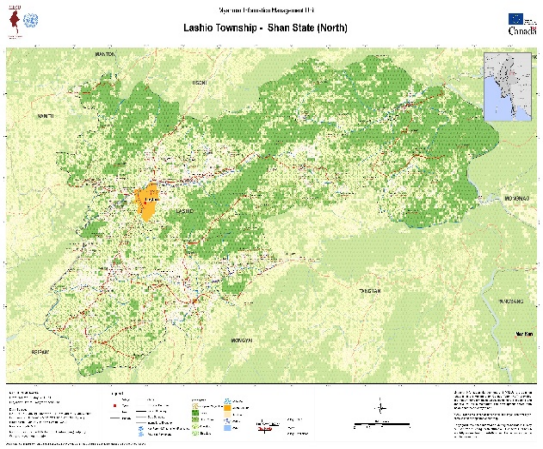

Fig. 2 Lashio Township Map (Source MIMU)

III. CURVE ESTIMATION REGRESSION MODELLING

The curve estimation model are used to determine which models are suitable for the data in the study area. Rainfall fluctuation and temperature changes data during 1990 - 2010 in Lashio Township were obtained from Meteorological Department. Average rainfall and average temperature changes were analyzed to determine the regression models for the prediction of temperature in that region. The regression models are obtained from using the SPSS Statistics Software. This software has to be a simplified statistical tool for curve estimation models. There are eleven regression analysis in this modelling. Among then, linear, exponential and logistics regression models are suitable for these data. The regression models are as following equation.

Simple linear regression is a method used for determining the relation between a dependent variable (Y) and one independent variables or explanatory variables, denoted by (X). For simple explanatory variable, the process is the definition of Simple Linear Regression. The general equation for a linear regression is given as

$$y_i = b_0 + b_1 x \quad (1)$$

Exponential. Model whose equation is [4, 5]:

$Y = b_0 \times (\exp(b_1 \times t))$ or

$$\ln(Y) = \ln(b_0) + (b_1 \times t). \quad (2)$$

Logistic. Model whose equation is [4, 5]:

$Y = 1 / (1/u + (b_0 \times (b_1 x t)))$ or

$$\ln(1/y-1/u) = \ln(b_0) + (\ln(b_1) \times t) \quad (3)$$

where,

y = the dependent variable,

t = the independent variable

b_0 = constant

b1 = model intercepts in the regression coefficient.

In this research, y is the average evaporation and t is the average temperature. Moreover, the data is transformed as the regression equations form to analyze the relationship between temperature and rainfall fluctuation. The data during 1990 to 2010 is obtained from the Meteorological Department as shown in Figure 1. In this figure, the graph is demonstrated to the relation between the rainfall and temperature changes.

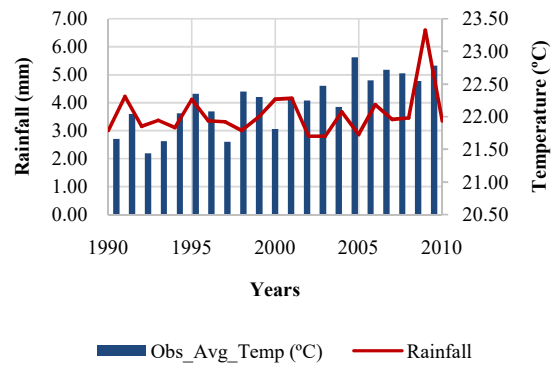

Fig. 3 Diagram of Average Temperature and Average Rainfall in Lashio Township

IV. RESULTS AND DISCUSSION

In this study, the data of the rainfall fluctuation and temperature changes are computed by using the regression analyses. The prediction of average temperature is evaluated by analyzing the curve estimation models. In this study, it is considered three regression models for these data. These regression models are linear, exponential and logistic analyses.

Firstly, first trial as linear regression model, the coefficient of determination (R^2) is 0.515 and significant error is less than 5% according to the 95% confident line interval. The standard error is less than 2. According to the above reasons, the model is good fit and it is suitable for these data. The predicted equation of average temperature is describes as follow in Table III:

Y = 19.341 + 0.805 (Rainfall)

In Figure 4, the graph show that the temperature changes are related to rainfall data. The observed maximum temperature was found in 2005 but the predicted

maximum temperature was found in 2009. It is a little different and it not effected the predicted equation.

Second trial as exponential regression, the coefficient of determination (R^2) is 0.497 and the significant error is not greater than 0.05. Therefore, the model is good fit one. The constant and intercept for the exponential equation is shown in Table VI. The values of b_0 and b_1 are 19.049 and 0.038 in this model. The temperature is directly proportional to the rainfall fluctuation in this model. The prediction equation is expressed as follows in Table VI:

Y = 19.049 exp (0.038 x Rainfall)

The Fig. 5 is revealed that the graph of the observed and predicted average temperature is obtained from the exponential model. This graph is demonstrated the different between observed and predicted temperature changes. In this analysis, the maximum temperature and maximum rainfall are 24.47ºC and 6.59 mm in 2009. Therefore, the temperature and rainfall are related each other according to the result using exponential regression analysis.

In third trial as logistics regression analysis, the coefficient of determination (R^2) is 0.497 and significant error is less than 5%. The standard error rate is not greater than 2. Therefore, the model is good fit and has to be suitable to use as the prediction equation. In this analysis, the average temperature is directly proportional to the average rainfall fluctuation. The prediction equation is expressed as follow in Table IX:

Ln (1/y) = 0.052 + 0.962 (Rainfall)

The graph between the observed and predicted average temperature is shown in Fig. 6. In this figure, this graph is demonstrated that it is related between temperature and rainfall.

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Table I. Model Summary for Linear Regression

R	R Square	Adjusted R Square	Std. Error of the Estimate
.718	.515	.513	2.707

Table II. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1943.787	1	1943.787	265.294	.000
Residual	1831.729	250	7.327		
Total	3775.516	251			

Table III. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Rainfall	.805	.049	.718	16.288	.000
(Constant)	19.341	.246		78.700	.000

Table IV. . Model Summary for Exponential Regression

R	R Square	Adjusted R Square	Std. Error of the Estimate
.705	.497	.495	.134

Table V. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.

Regression	4.415	1	4.415	246.971	.000
Residual	4.469	250	.018		
Total	8.884	251			

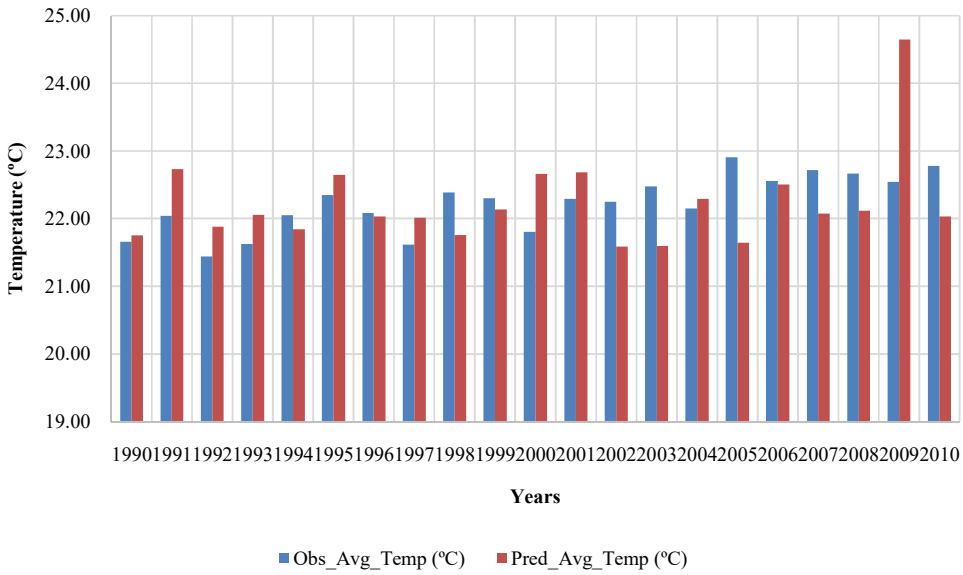

Fig. 4 Diagram of Observed and Predicted Average Temperature by using Linear Regression Analysis

Table VI. Coefficients

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
Rainfall	.038	.002	.705	15.715	.000
(Constant)	19.049	.231		82.377	.000

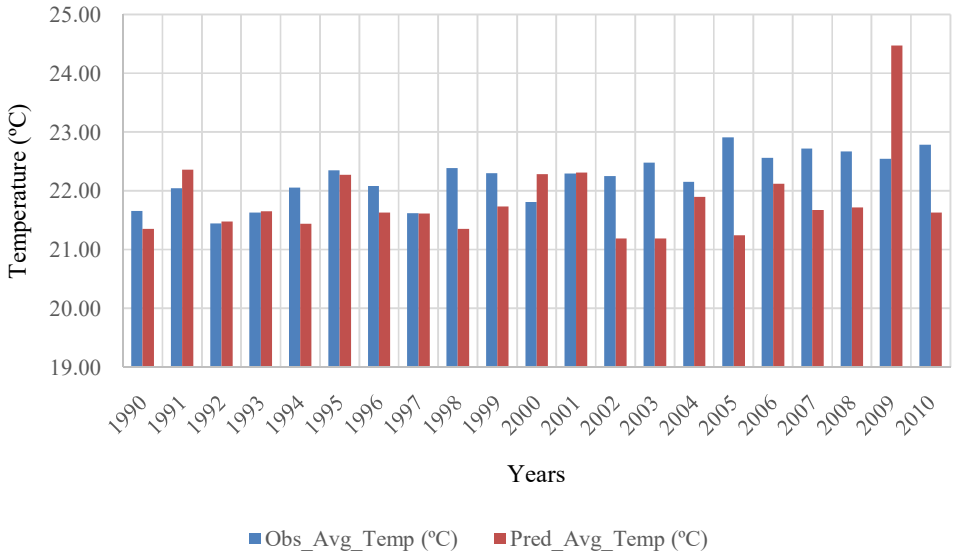

Fig.5 Diagram of Observed and Predicted Average Temperature by using Exponential Regression Analysis

Table VII. . Model Summary for Logistics Regression

R	R Square	Adjusted R Square	Std. Error of the Estimate
.705	.497	.495	.134

Table VIII. Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.415	1	4.415	246.971	.000
Residual	4.469	250	.018		
Total	8.884	251			

Table IX. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Rainfall	.962	.002	.494	409.630	.000
(Constant)	.052	.001		82.377	.000

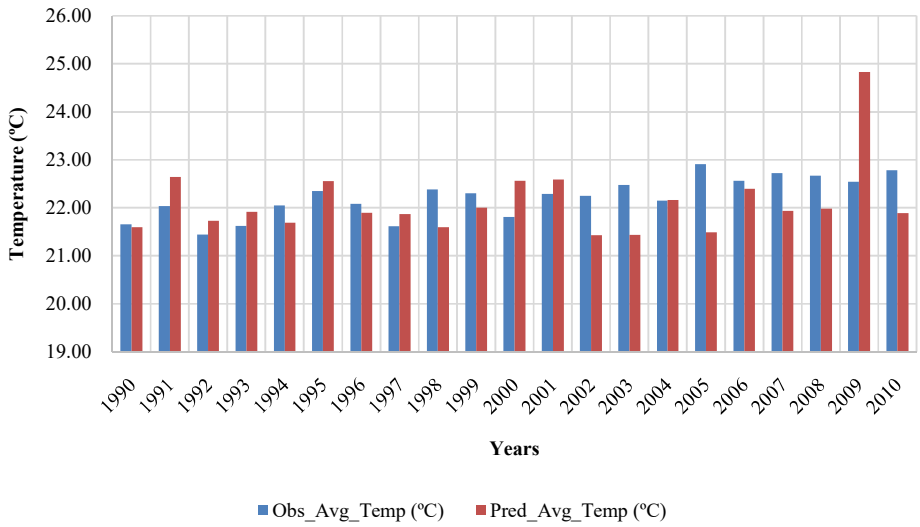

Fig. 6 Diagram of Observed and Predicted Average Temperature by using Logistics Regression Analysis

As show in the above figures, the observed values are nearly equal to the predicted values. These differences are not effect as a problem for this analyses. According to the result, the average temperature and rainfall are directly proportional to each other. The linear, exponential and logistic models are to forecast temperature conditions related to rainfall fluctuation

V. CONCLUSION

Form the result, the temperature in the study area is best explained by linear, exponential and logistics regression model. The decade wise rise and fall the temperature were possible to be covered by these models and these model was able to relate between temperature and rainfall. The regression models are assumed to predict the temperature changes concerning with rainfall fluctuation for forecasting weather conditions. The best fit model will be proposed for future work. In this study, the predicted equations are beneficial issues for local government authorities and agricultural sectors and so on.

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