Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.7, No.5, 2017

An Assessment of Suitability of Climate for Tourism in Northwestern Nigeria

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Abstract
Tourism is vital to national economies and income of its individual citizens. This paper investigated the suitability of climate for tourism in Northwestern Nigeria using the tourism climate index developed by Mieczkowski (1985). Parameters used for calculating the index include monthly average maximum daily temperature, rainfall, mean daily relative humidity, minimum relative humidity, total wind speed and sunshine hours. The stations used for the calculation of TC index include Kaduna, Kano, Katsina and Sokoto. The result is presented in the form of charts using excel, while GIS is used for zoning of tourism climatic conditions in different months. Result shows that the study area is suitable for tourism throughout the year, as all the TCI scores ranges from 94 to 41 ('ideal' to 'marginal') except for Kano in the month of June which has a TCI score of 39 ('unfavorable'). The months of January, February, November and December are the best months for tourism as they recorded higher TCI values of 73 to 94 ('very good' to 'ideal'). It is therefore concluded that the best time for tourist to visit Northwestern Nigeria is during the months of January, February, November and December.
Keywords: Climate, Tourism, Tourism Climate Index, Nigeria

1. Introduction

Tourism is vital to national economies and income of its individual citizens. There are an increasing number of people interested in tourism services for relaxation and personal rest as well as for health reason. Not only the social conditions and prices of a place should be put into consideration when choosing a location and period for tourism but also weather and climate should be considered. Weather and climate are keys for outdoor recreation abilities and affect our satisfaction or otherwise as well as human's health (Blazejczyk, 2000). Weather and climate as well as tourism are interconnected in different ways (Lecha and Shackleford, 1997). Weather and climate plays a significant role on the sector of tourism and recreation. Climate is an important resource in some regions, on which the tourism industry is predicated and in other regions has a major influence on the physical resources that are the foundation of tourism (Scott and McBoyle, 2001).

Tourism and climate studies often strive to explain where climatic considerations are placed within the set of factors that affect holiday location (and the timing of) decisions. According to some authors, such as Perry 1997, climate is an important aspect of the environmental context where recreation and tourism takes place. However, meteorological condition influence will be dependent on the selected activity and expectations of tourist. Climatic variables that affect tourist activities include; rainfall, sunshine duration and intensity, water and air temperature, humidity, long wave radiation, and wind speed. Weather and climate are factors that can increase or reduce the attractiveness of a specific tourism location. Weather and climate may also constitute risk factors, through extreme temperatures, air pollution, storms, etc. (Andrade *et al.*, 2007). According to Ijeoma and Aiyeloja (2009), cultural tourism is affected by rainfall because dates of cultural festivals were already fixed based on the indigenous knowledge of the pattern of rainfall. Also, the breeding status of species and the migratory pattern of animals are affected by changes in rainfall which in turn affects time for games sitting in Eco destinations.

Weather and climate play a vital role in selection of destination because of the sensitivity of tourist to climate and changes in climate (Maddison 2001). The length and quality of recreational season as well as the profitability of tourism industry are affected by inter-annual climate variability. Tourism is one of the biggest, fastest growing and most climate-dependent economic sectors of the world, yet interactions between this sector and climate change had been subject to only few and infrequent scientific investigation. Despite the increasing importance of the tourism industry to the global economy, comparatively few studies have assessed the relationships between climate and tourism and recreation (Dantata, 2011, Ijeomah and Aiyeloja, 2009, Mejabi and Abutu, 2015) hence the need to carry out this research. Therefore, this paper is aimed at finding the relationship between climate and tourism by using TCI developed by Mieczkowski (1985) to explore the spatio-temporal patterns of the tourism climate relationship in Northwestern Nigeria.

2. Study Area

The study area is located between 9^{o} 00N to 13^{o} 54N and 3^{o} 28E to 10^{o} 37E. It comprises of Sokoto, Kebbi,

Zamfara, Katsina, Kaduna, Kano and Jigawa states (figure 1). It covers an area of 216,065 Km^2 and has a population of 35,915,467 persons according to 2006 population census. The region lies within the tropical continental climate environment, characterized by a relatively long period of dry season and a short period of rainy season. It is characterized by relatively high temperatures throughout the year with the annual average varying from 28.4 ^oC in Sokoto to 25.3 ^oC in Kaduna.

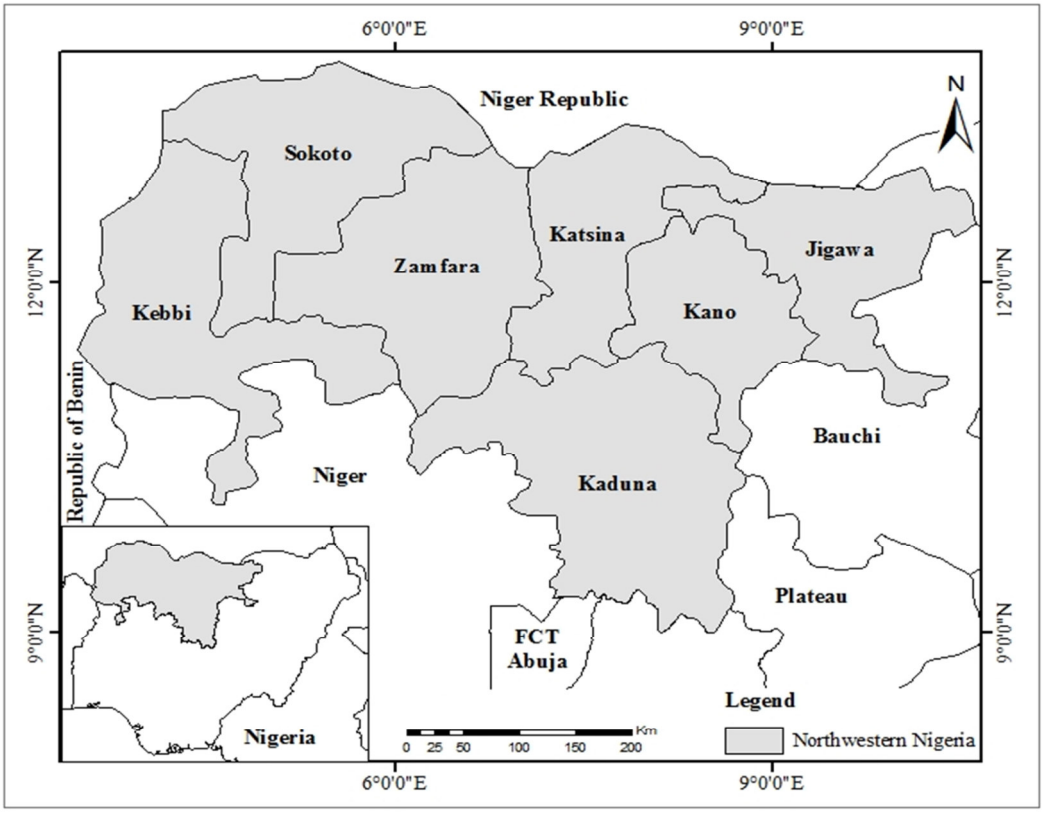

Figure 1: Location of the study area

3. Data and methods

Climatic data on rainfall, temperature and relative humidity for the period 1949-2014 and data on hours of sunshine and wind speed for the period 1990-2014 for four stations (Kaduna, Kano, Katsina and Sokoto) across Northwestern Nigeria were obtained from Nigerian meteorological agency (NIMET).

Tourism Climate Index (TCI) was used to evaluate the suitability of climate for tourism. It was designed by Mieczkowski (1985) as a method to quantitatively evaluate a climate suitability of a specific location for general tourism activities. The TCI assesses a location's climate suitability for tourism by grouping seven climatic variables relevant to tourism (amount of precipitation, mean air temperature, maximum air temperature, mean relative humidity, minimum relative humidity, average wind speed and hours of sunshine) into five sub-indices (Table 1).

Table 1: Components of Tourism Climate Index (TCI)

Sub-index	Climatic variable	Influence on TCI	Weighting (%)
Daytime Comfort Index (CID)	Maximum daily air temperature (°C) Minimum daily relative humidity (%)	Thermal comfort when maximum tourist activity occurs	40
Daily Comfort Index (CIA)	Mean daily air temperature (°C) Mean daily relative humidity (%)	Thermal comfort over 24 hours period including night time	10
Precipitation (R)	Total precipitation (mm)	A negative factor on overall experience	20
Sunshine (S)	Total hours of sunshine (hours)	A positive factor on overall experience	20
Wind (W)	Average wind speed (km/h or m/s)	Highly depends on air temperature (evaporative cooling effect in hot climates rated positively, while 'wind chill' in cold climates rated negatively	10

Source: Adapted from Mieczkowski (1985)

The TCI is calculated as follows:

$$TCI = 2*(4CID + CIA + 2R + 2S + W)$$

The Daytime Comfort Index (CID) comprises of minimum daily relative humidity and maximum daily temperature to assess the level of daytime climate conditions when maximum tourists' activities occur. The Daily Comfort Index (CIA) comprises of mean daily relative humidity and mean daily temperature to assess the thermal comfort over the 24 hours. Daytime Comfort Index (CID) is giving the highest weight of 40% to reflect the fact that tourists are most active during the day. 20% is giving to each of the variables precipitation and sunshine, followed by the Daily Comfort Index (CIA) and wind speed with 10% each.

As for the original TCI design, each of the sub-indices was assigned a highest rating score of 5.0 to make the maximum TCI score 100 and the minimum score is -30 (when both CID and CIA were rated a score of -3). The index score calculated according to the TCI formula was then adapted to the classification scheme designed by Mieczkowski (1985) to describe a location's climate suitability for tourism (Table 2). There are eleven categories in the TCI's scheme, ranging from "ideal" (90 – 100) to "impossible" (-30 – +9). In order to produce climate tourism maps, the TCI scores were interpolated with Arc GIS 9.3 using IDW interpolation method.

Table 2: Rating Categories of Tourism Climate Index (TCI)

TCI score	Descriptive category
90 - 100	Ideal
80 – 89	Excellent
70 – 79	Very good
60 – 69	Good
50 – 59	Acceptable
40 – 49	Marginal
30 – 39	Unfavourable
20 – 29	Very unfavourable
10 – 19	Extremely unfavourable
9 – -9	Impossible
-10 – -30	Impossible

Source: Mieczkowski (1985)

4. Results

Figure 2 shows the TCI values of Kaduna in the all months. The TCI scores are higher during the months of January, February, March, October, November and December, which coincide with the period of dry season when there is no rainfall and the temperature is low. The months with lower scores are April, May, June, July August and September which coincides with the period of rainy season (table 3). The TCI scores ranges from 94 in the month of January to 48 in the month of May, the highest TCI Scores of 94 which is 'ideal' is due to the low temperature, low relative humidity and absence of rainfall in that month while the lowest scores of 48 in the month of May is due to high rainfall, high relative humidity and high amount of rainfall. In general, the TCI scores show that climate is favorable for tourism in all the months of the year.

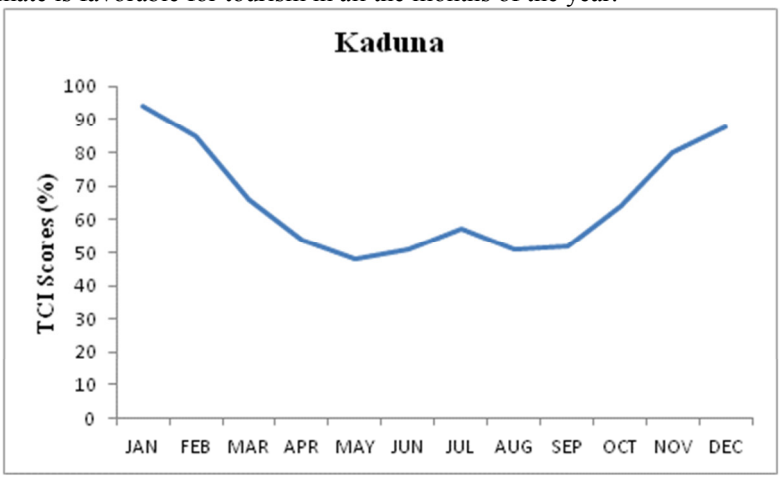

Figure 2: Monthly TCI for Kaduna

For Kano (figure 3and table 3), the TCI scores follows the same pattern with that of Kaduna. TCI scores are higher in the dry season months and lower in the wet season months. Scores ranges from 94 in the month of January to 39 in the month of June due to high temperature, high relative humidity and high amount of rainfall.

Table 3: Tourism Climate Index for Some Stations in Northwestern Nigeria

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kaduna	94	85	66	54	48	51	57	51	52	64	80	88
Kano	94	91	67	55	42	39	46	47	47	70	83	93
Katsina	93	88	66	54	49	48	46	48	55	70	86	90
Sokoto	84	80	63	54	43	41	42	42	46	63	73	80

The months of January, February and December are 'ideal' for tourism, November is 'excellent', October is 'very good', and April is 'acceptable', others are the months of May, July, August and September which fall under the category 'marginal'. Out of all the 12 months of the year it is only the month of June that fall under the category 'unfavorable' as such the month is not favorable for tourism.

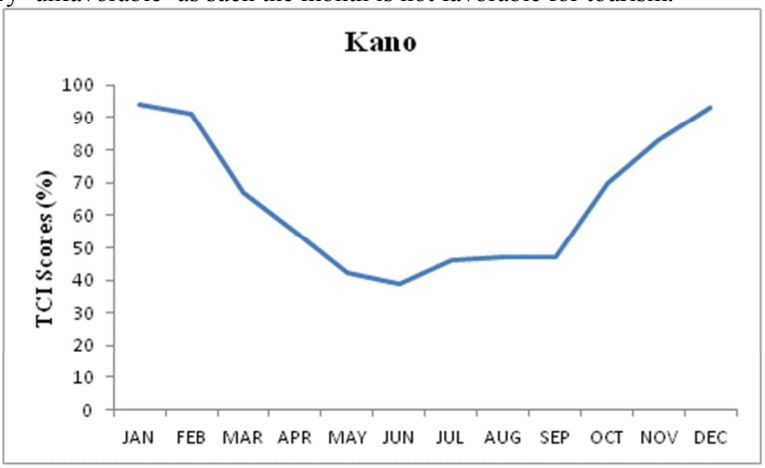

Figure 3: Monthly TCI for Kano

The TCI scores for Katsina ranges from 96 in the month of December to 46 in the month of July Figure 4 and table 3), the scores are grouped into six categories with the months of December and January having the highest TCI scores (above 90) which is 'ideal', February, March and November belongs to 'excellent' category, April is 'good' September is 'acceptable' while the months of May, June, July and August fall under the category 'marginal'.

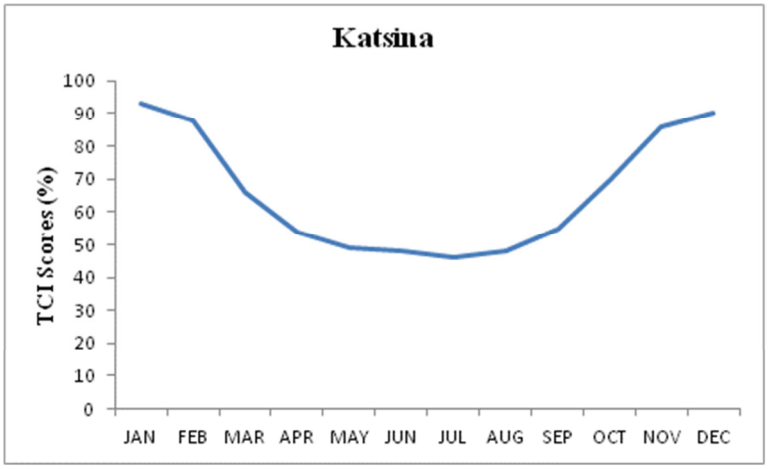

Figure 4: Monthly TCI for Katsina

Low rating in CID (minimum relative humidity and maximum temperature), high amount of precipitation and short sunshine duration is responsible for the low TCI scores in the months under the category 'marginal'. Climatic condition for all the 12 months is therefore favourable for tourism but better in the months of dry season.

Figure 5 shows the TCI values of Sokoto in all the months. The TCI scores are higher during the months of January, February, March, October, November and December, which coincide with the period of dry season when there is no rainfall and the temperature is low. The months with lower scores are April, May, June, July August and September which coincide with the period of rainy season (see table 3). The TCI scores ranges from 84 in the month of January to 41 in the month of June, the highest TCI Scores of 84 which is 'excellent' is due to the low temperature, low relative humidity and absence of rainfall in that month while the lowest scores of 41 in the month of June is due to high rainfall, high amount of rainfall and high relative humidity. In general, the TCI scores show that climate is favourable for tourism in all the months of the year.

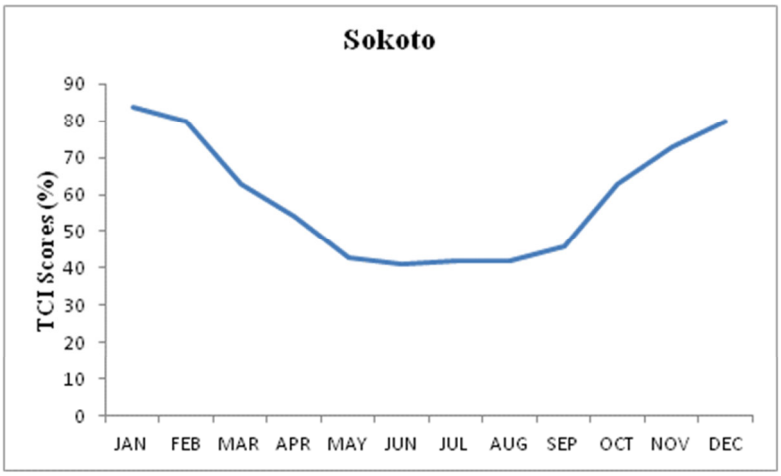

Figure 5: Monthly TCI for Sokoto

Figure 6&7 shows the spatial distribution of TCI across the northwestern region, the scores for various months are shown in different maps. In all the 12 months, scores are usually higher in eastern and southeastern than in western part which is due to low scores in Daytime Comfort Index (CID) in western part of the study area. CID has the highest Weight of 40% in the TCI as such any difference in CID will affect the overall TCI scores. Relief also plays an important role as southeastern part which bordered plateau state has higher scores in all the months than the surrounding area.

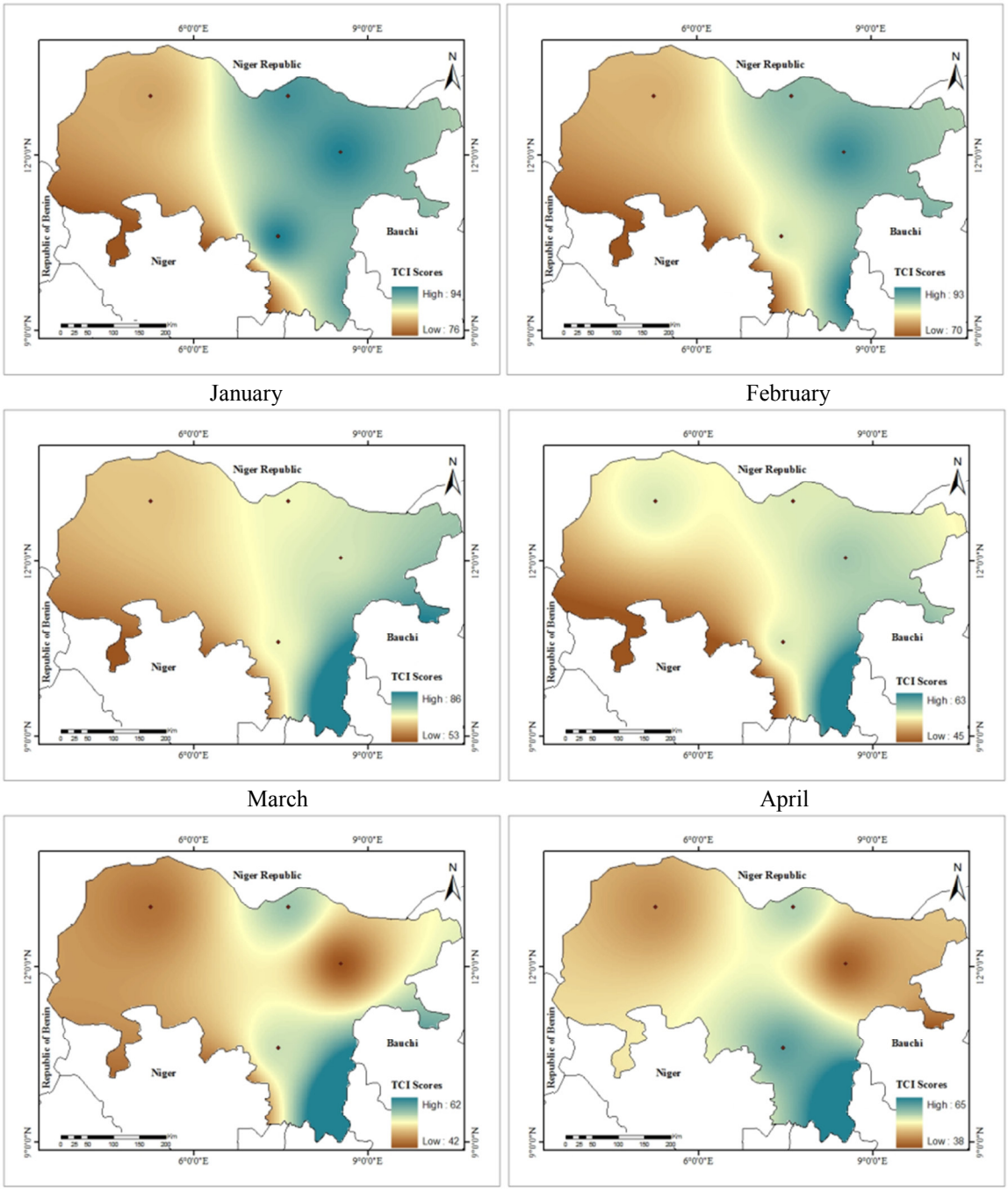

Figure 6: Distribution of TCI over Northwestern Nigeria in months January to June.

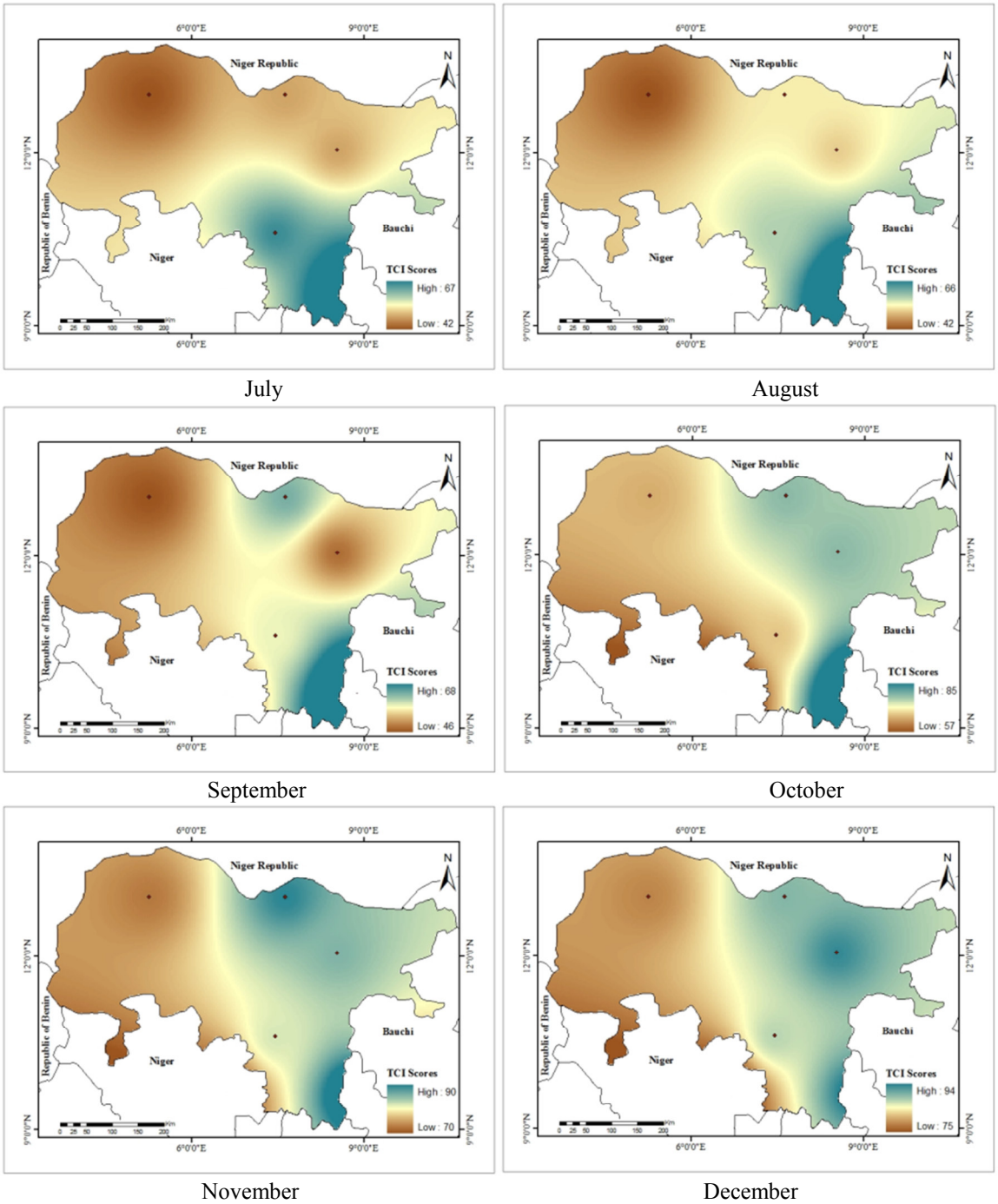

Figure 7: Distribution of TCI over Northwestern Nigeria in months of July to December.

5. Discussion

The results of this study are important for both domestic and international tourism activities in northeastern Nigeria. The most suitable period in terms of climatic comfort conditions is dry season. All the four stations (Kaduna, Kano, Katsina and Sokoto) had evaluations showing winter peak distribution. In these stations dry season weather made them climatically comfortable for tourists. The most suitable month for tourism activities in northwestern Nigeria is the month of January as 3 out of the four stations fall under the TCI descriptive category of 'ideal' (TCI>90), only Sokoto has 'excellent' (TCI>80). The month of December is the next suitable month with Kano and Katsina having 'ideal' category while Kaduna and Sokoto having 'Excellent'. The months of February and November also fall within the 'ideal', 'excellent' and 'very good' categories. These favourable conditions in the months of January, February, November and December are due to absence of rainfall and low temperature and relative humidity when compared with other months of the year.

The months of April to September fall under the categories 'acceptable' and 'marginal' except Kano that has 'unfavourable' in the month of July. These months coincide with the period of rainy season as well as high temperature and relative humidity hence the result in low TCI scores.

Conclusion and Recommendations

Tourism Climate Index is an important index not only because of the combination of climatic variables into a single index that is easily interpretable by the tourists, but also because it is designed to measure climate resource suitability for the most popular tourism activities in towns and cities such as shopping and sightseeing (Jansen-Verbeke, 2001). Another advantage of the TCI is its applicability. It can be easily applied anywhere because the climatological data needed are usually available for most places. This study found that the best times of the year to attract visitors are the months of January, February, November and December based on TCI result. The TCI curves and maps provide insight to tourist on places to visit at the appropriate time. However, some aspects of the TCI require modifications in order to be more suitable in some places. For example northern Nigeria suffers from poor visibility due to Harmattan during the months of November to January, which affects transportation and causes some ailments.

The paper has the following recommendations:

- There is need for improvement on the TCI so that each climatic zone will have a fair representation. For example harmattan should be incorporated into the index to cover places with harmattan such as northern Nigeria.
- Weather average of 5 to 10 days should be used instead of the monthly average, so that extreme weather events of few days should not be used as a representative measure of a whole month.
- More researches on climate and tourism should be carried out in the study area.
- Researches such as this should be used by relevant agencies to create awareness for tourists.

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