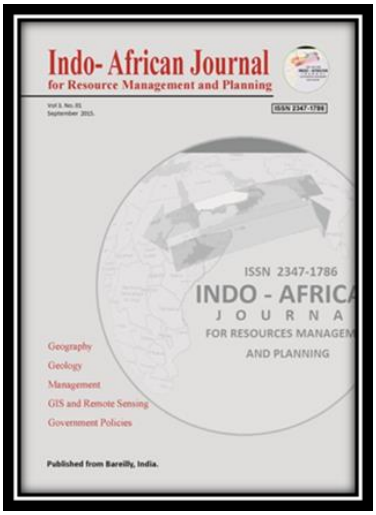

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Ranking of Towns based on Tourism Climate Index in Ethiopia

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Abstract

Tourism is very important for the development economic sector, and it is deeply affected by climate. Ethiopia is a developing country with less income from the tourism sector in spite of favorable climatic conditions for tourism development. So, the specific objective of this study was to rank Ethiopian towns based on Tourism climate index developed by Mieczkowski (1985) with modifications to fit climatic data in GIS environment. Seven climatic variables based on monthly means were integrated into the TCI. Climate data of 112 points was collected and processed to create the images with Inverse distance weighted model. The data of each climate variable was classified using conditional statements following TCI's rating scheme. The monthly TCI score value was extracted to the point features of 870 towns of Ethiopia. To find annual TCI monthly TCI values were added. Finally, Towns were ranked based on unique annual TC values. As a result, all the towns were grouped in 44 rank classes. The results reveal, Ethiopia has very high potential for the sustainable development of tourism as 190 towns were found in an ideal category ≥3 months per annum. This work will be useful for policymakers to plan and project sustainable development of tourism in Ethiopia.

Key words: Tourism, climate, tourism-climate index (TCI), IDW, Ethiopia.

Introduction

Climate, attractive landforms and cultures are the important resources for the development of tourism. These resources are not equally distributed in all the counties of the world. Ethiopia is rich in cultural and natural attractions for the development of tourism. It is known as land of origin with its fabulous 3000 years of history, diverse ethnic groups with their own languages, cultures, and traditions (MOCT, 2017). But it is not very popular that Ethiopian highlands present largest area under ideal and excellent climatic conditions in the tropical world suitable for tourism development.

Though there has been unprecedented tourism growth in Ethiopia in the recent years. International tourist arrivals have been on a growth trajectory since the 90s rising from 64,000 in 1990 to 681,249 in 2013.

The travel and tourism sector's direct contribution to the country's GDP was 4.2% in 2013, translating to ETB 35,766.6m and is expected to grow by 4.8% p.a. reaching ETB 59, 495.2m (3.6% of GDP) by 2024. The total contribution of Travel & Tourism to GDP including wider effects from investment, the supply chain and induced income impacts, was ETB 88, 691.2 million in 2013 (10.3% of GDP). The total GDP contribution is forecasted to rise by 4.9% pa to ETB149, 832 million by 2024 (9.0% of GDP) (MOCT, 2015).

Ethiopia obtained from international visitors who travelled to Ethiopia in 2011, collectively injected $ 411.6 million into the Ethiopian economy. Though in the year 2012, the total gross revenue generated by tourism industries recorded an annual turnover of $333 million, a decline of 19.05 percent(MOCT, 2013).

Top ten major source of tourism markets in Ethiopia are United States, China, UK, Germany, Kenya and Italy, followed by France, Sudan, India and Saudi Arabia (MOCT, 2013). The highest number of arrivals was recorded in December, followed by January and on the other hand, the lowest number of arrivals was recorded in June and July in the years under considerations (MOCT, 2013).

For the present research work Preliminary studies were undertaken to understand Tourism (Cîrstea,Dragos, 2014; Szpilko, 2017; Xiao et al., 2017; Shah, Haji, & Wei, 2016; Boers, 2005; Bob, Situmorang, & Raafaldini, 2012; Besana & Maria, 2014; Williams, S. 2003) , Tourism climate indexes (Daniel Scott & Mcboyle, n.d.; Cracu, G., Prefac, Z., & Tofan, L. 2009) and human comfort indexes (Honjo, 2009; Boukhelkhal & Fatiha, 2016; Honjo, 2009; Gourbi, 2010). These studies have analyzed climate parameters for tourism activities.

According to Wyllie (2011) Tourism are the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business, and other purposes. Tourism has become one of the most significant forces for change in the world today. Regarded by many as the world's largest industry, tourism prompts regular mass migrations of people, exploitation of resources, processes of development and inevitable repercussions on places, economies, societies and environments (Williams, 2003).

Travel & Tourism is an important economic activity in most countries around the world. As well as its direct economic impact, the industry has significant indirect and induced impacts (Wttc, 2011). The regional policy-makers should prepare and develop competitive and developmental strategies of shaping tourism in the next several years (Szpilko, 2015). Tourism has also proven to be one of the world's leading job creators (UNWTO, 2010). Ohlan, (2017) study investigates relationship between tourism and economic growth in India by considering the relative importance of financial development over the period of 1960–2014. The results of newly-developed Bayer and Hanck combined test indicate that tourism, economic growth and financial development are cointegrated.

The demand of sustainable tourism has become an important aspect that must be considered by local government. Therefore, nature-based tourism resources assessment is important in order to determine the appropriate region in the planning of a sustainable tourism destination (Rahayuningsih, Muntasib, & Budi, 2016).

Africa represents a continent of almost infinite tourism potential and yet it lags far behind the rest of the world as a tourist opportunity. Ethiopia, regarded as the cradle of human origin, has substantial historical attractions, exemplified by the Historic Route (Frost & Shanka, 2002).

Hippocrates recognized that health is influenced by the external environment (Rogers et al., 2010). From the perspective of tourism supply, climate has been identified as an important natural resource for the tourism sector. Some of the key characteristics of climate as a tourism resource include: it is free, renewable and non-degradable, as well as cannot be transported or stored (Cracu, Prefac, & Tofan, 2009).

Tourism destinations and tourism operators are affected by climate variability and change in a number of ways. All tourism destinations are climate-sensitive to a degree, in that they are influenced by natural seasonality in demand, are affected positively or negatively by inter annual climate variability that brings heat waves, unseasonable cold,

drought or storms and heavy rain, which can affect not only tourist comfort and safety (and thereby satisfaction), but also the products that attract tourists (snow cover, coral reefs, wildlife, for example) (D. Scott & Lemieux, 2010).

Climate is a decisive tourism resource and plays key role in the attractiveness of tourist destinations and the seasonality in tourism demand. The suitability of climate for general tourism purposes (i.e., sightseeing, shopping, and other light outdoor activities) is most frequently expressed by the Tourism Climatic Index (TCI), which combines several tourism-related climatic elements (Kovács & János, 2014).

It is important to study climate as resource for tourism activities because tourists and tour operators can use climate indices to select the best time and place for a particular vacation, or plan activities appropriate to weather expectations (Bakhtiari & Bakhtiari, 2013).

Relatively few studies on thermal comfort for outdoor environments have been done compared to indoor environments, although the importance of the former is increasingly recognized with changing climate and increase of heat stress in cities (Honjo, 2009). Kovács & János (2014) applied Physiologically Equivalent Temperature (PET) instead of effective temperature (ET) in the part of the index related to thermal comfort conditions. Hassan, Varshosaz, & Eisakhani, (2015) studied Khuzestan Province, located in southwestern Iran, There aim of this study was to determine tourism climatic index (TCI) and compare with THI index.

Ruiz & Correa, (2015) developed a new thermal comfort index to predict more accurately the thermal sensation of the local residents. There model is based on lineal relation of air temperature, relative humidity, wind speed and solar radiation, generally all available weather variables.

The paper of Moonen, Defraeye, Dorer, Blocken, & Carmeliet, (2012) addresses the role of Urban Physics in the study of wind comfort, thermal comfort, energy demand, pollutant dispersion and wind-driven rain.

Scott & Mcboyle used a modified version of Mieczkowski's (1985) 'tourism climate index' (TCI) to explore the impact of projected climate change on the tourism climate resource of a sample of tourism destinations in North America. Tang, (2013) assessed both current and projected future climatic conditions of the 15 selected European cities via application of Mieczkowski's (1985) TCI.

The study by Barakat, Ayad, & El-sayed, (2017) was limited to the microclimate at urban open space and was conducted in New Borg El-Arab (hot arid city according to Middleton and others, Alexandria, Egypt). They adopted methodology based on the use of ENVI-met 4.0 software to measure four thermal indices (air temperature, relative humidity, MRT and PMV) and assess outdoor human thermal comfort in an existing neighborhood.

The climatic data required for the calculation of climatic suitability using tourism climate index, however, provide limitations for its adoption in much of the African continent, for which regular measurement of the complete set of variables does not occur (Fichett, Hoogendoorn, & Robinson, 2016).

The importance of culture and heritage is also becoming more and more obvious, both in regionalists and regional development. Cultural factors are important because they directly affect economic performance and development, and therefore the competitiveness of the region. The study by Bujdosó et al., (2015) gives an overview of relevant literature, aiming to introduce the complex relations between culture, heritage, geography, tourism, economy and experience economy.

The Travel & Tourism Competitiveness Report 2015 features the latest iteration of the Travel & Tourism Competitiveness Index (TTCI). The TTCI measures "the set of factors and policies that enable the sustainable development of the Travel & Tourism (T&T) sector, which in turn, contributes to the development and competitiveness of a country." Published biennially, the TTCI benchmarks the T&T competitiveness of 141 economies. The rank of Ethiopia at regional (East and Southern Africa) level is 17th; while at global level it is only 114th during 2015 (*The Travel & Tourism Competitiveness Report 2015*).

Planning of sustainable tourism development actually concerns planning of preserve the environment, and it encompasses a variety of research and analysis before making a decision on any determination of the direction of development (Angelevska-Najdeska & Rakicevik, 2012).

GIS could be used to identify specific developmental sites based on a set of criteria using economic, social, environmental, and business-related data. GIS can bring all that data together quickly and let users analyze and visualize information in a way people value it (Rachel J C Chen, 2007). This spatial relevance makes the field of GIS an ideal environment to analyze tourist phenomena (Luberichs, 2009). With its capabilities for business mapping, geospatial analysis and its contribution to decision making, Geographic Information System (GIS) seems to be a valuable tool especially applicable in the discipline tourism geography (Luberichs & Wachowiak, 2010).

The Specific objective of the work was to rank the Ethiopian towns based on TCI in GIS environment. This work was needed because this part of the world is under researched in the same field

Material and Methods

2.1 Introduction to Study Area

A total of 870 towns were selected for this study covering an extent of latitude 3° 19' 19.56" to 14° 53' 59.85"N and longitude 32° 59' 59.78" to 47° 59' 10.24" E within the international border of Ethiopia. Ethiopia has great geographical diversity; its topographic features range from the highest peak at Ras Dashen, 4,550 metres above sea level, down to the Afar Depression, 110 metres below sea level (CSA, 2009).

The climate varies with the topography, from as high as 47 ^{0}C in the Afar Depression to as low as 10 ^{0}C in the highlands. Ethiopia's total surface area is about 1.1 million square kilometres. Djibouti, Eritrea, the Republic of the Sudan, the Republic of the Southern Sudan, Kenya, and Somalia border the country (CSA, I. 2012).

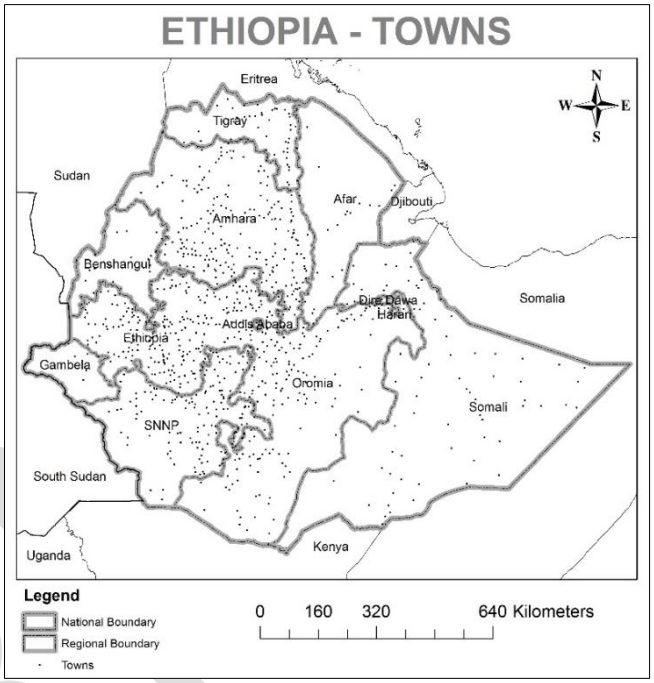

Figure 1 Study Area

2.2 Methodological framework

First of all, literature was reviewed carefully for additional details pertaining to the conceptual and methodological development of the TCI. Standard climatic data was required to calculate TCI. So, data was collected, tabulated and added to GIS environment. Climatic data in point format was interpolated to develop raster images, these images were classified as per the scheme. Finally, Annual TCI values were extracted to towns features. Figure 2 illustrate the work flow.

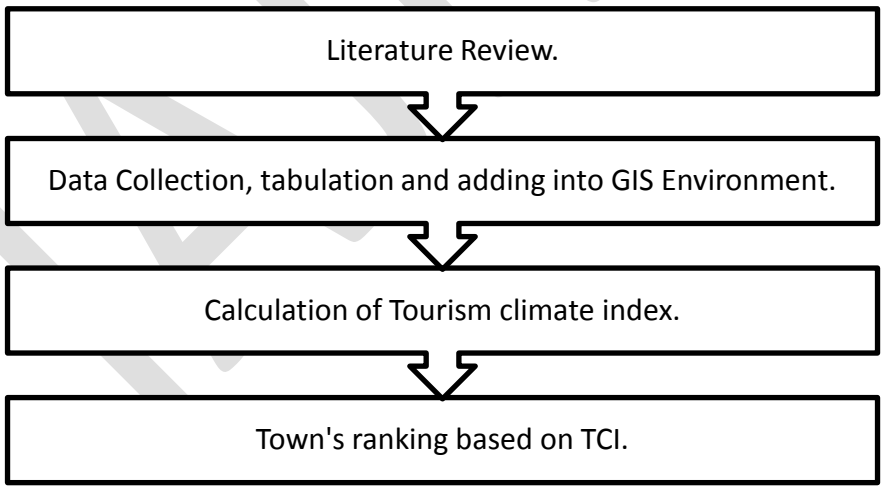

Figure 2 Workflow

2.1 Data use

Climate data for 120 stations at the interval 7x7 km covering whole Ethiopia starting from 1st January, 1979 ending to 31st December, 2014 was obtained from CLIMWAT 2.0 (Muñoz & Grieser, 2006). It is a joint publication of the Water Resources, Development and Management Service and the Environment and Natural Resources Service of the Food and Agriculture Organization of the UN. Long-term monthly mean values of climatic parameters, namely:

mean daily maximum temperature in °C, mean daily temperature in °C, mean relative humidity in %, mean wind speed in km/day, mean sunshine hours per day and monthly rainfall in mm/month were collected for each station.

2.2 Data Analysis

The Tourism-Climate Index (TCI) designed by Mieczkowski (1985) was used to quantify TCI with some modification. The TCI assesses a location's climate suitability for tourism by grouping seven climatic variables relevant to tourism (maximum air temperature, mean air temperature, minimum relative humidity, mean relative humidity, amount of precipitation, hours of sunshine and average wind speed) into five sub-indices (Table 1). The weighting systems for the five sub-indices within the TCI were retained for this analysis.

Table 1. Components of Tourism-Climate Index.

Sub-index	Climatic variable	Influence on the 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)	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: Mieczkowski (1985)

The Daytime Comfort Index (CID) is a combination of maximum daily temperature and minimum daily relative humidity to assess the level of daytime climate conditions when maximum tourists' activities occur.

The Daily Comfort Index (CIA) is a combination of mean daily temperature and mean daily relative humidity to assess the thermal comfort over the 24 hours.

The highest weight is given to the Daytime Comfort Index (CID) (40%) to reflect the fact that tourists are most active during the day. The variables of sunshine and precipitation are given the second highest weight (20% each), followed by the Daily Comfort Index (CIA) (10%) and wind speed (10%).

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 while the minimum score is -30 (when both CID and CIA were rated a score of -3). The rating scheme of the TCI climatic variables are outlined in Table 2.

2.2.1 Modification and Implementation of the TCI

Mieczkowski (1985) used climate data or climate normal from 1951 to 1980. The climate data used in this study are from 1979 to 2013. Rating systems for the five sub-indices was multiplied by two of original rating for this analysis.

Table 2 TCI's Rating Scheme

Original Rating	Modified Rating	Effective Temperature(^{0}C)	Monthly Precipitation (mm)	Mean Monthly Sunshine (Hrs./Day)	Wind Speed (km/h)
5.0	10	20/26	0.0-14.9	>10	>2.88
4.5	9	19/27	15.0-29.9	9	2.88 – 5.75
4.0	8	18/28	30.0-44.9	8	5.76 – 9.03
3.5	7	17/29	45.0-59.9	7	9.04 – 12.23
3.0	6	16/30	60.0-74.9	6	12.24 – 19.79
2.5	5	10-15/31	75.0-89.9	5	19.8-24.29
2.0	4	5-9/32	105.0-119.9	4	24.30 – 28.79
1.5	3	0-4/33	106.0-104.9	3	28.8 – 38.52
1.0	2	-5--1/34	120.0-134.9	2	--
0.5	1	35	135.0-149.9	1	--
0.25	0.5	--	--	--	--
0.0	0	>36/-10--6	>150.0	<1	>38.52
-1.0	--	-15--11	--	--	--
-2.0	--	-20--16	--	--	--
-3.0	--	<-20	--	--	--

Source: Mieczkowski (1985)

The original TCI was calculated using equation 1.

TCI = 2*(4CID + CIA + 2R + 2S + W) ……. Eq. 1

Equation 1 was modified to Equation 2 for the present work.

TCI = 4CID + CIA + 2R + 2S + W) ……. Eq. 2

Where CID is Daytime Comfort Index, CIA is Daily Comfort Index, R is Precipitation, S is Sunshine hours, W is Wind speed.

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 3). There are eleven categories in the TCI's scheme, ranging from "ideal" (90 – 100) to "impossible" (-30 – +9).

Table 3 Rating Categories of TCI

TCI score	No Assigned	Descriptive category
90 -100	11	Ideal
80 - 89	10	Excellent
70 - 79	09	Very good
60 - 69	08	Good
50 - 59	07	Acceptable
40 - 49	06	Marginal
30 - 39	05	Unfavourable
20 - 29	04	Very unfavourable
10 - 19	03	Extremely unfavourable
9 - -9	02	Impossible
-10 - -30	01	Impossible

Source: Mieczkowski (1985)

Results and Discussion

Table 4 shows RMSE values produced with IDW model applied for generating the images from point data. Root Mean Square Error (RMSE) indicates how closely your model predicts the measured values, the smaller this error, the better the results (ArcGIS, 2017).

Table 4 Root Mean Squire Error (RMSE) values from cross validation results

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max daily air temp. (°C)	0.98	0.99	0.95	0.97	0.94	0.97	0.95	0.94	0.97	0.99	0.95	0.94
Mean daily air temp. (°C)	1.21	1.02	1.34	1.72	1.22	1.04	1.05	1.52	1.32	1.02	1.32	1.25
Mean daily RH (%)	1.45	1.25	1.10	1.52	1.24	1.35	1.42	1.24	1.26	1.56	1.42	1.25
Total precipitation (mm)	1.10	1.20	1.02	1.12	0.99	1.05	1.21	1.32	1.12	1.25	1.11	1.14
Sunshine hours	1.65	1.75	1.95	2.08	2.06	2.07	1.86	1.87	1.58	1.85	1.95	2.04
Wind speed (km/h or m/s)	1.24	1.99	1.97	1.85	1.75	1.82	1.48	1.77	1.98	1.85	1.92	2.10

Table 05 shows the descriptive statistics of monthly TCI values of Ethiopian towns. The mean values range from the excellent to Good state of TCI. Mode values give more idea as during winter season most of the towns are in excellent condition of TCI. If we compare TCI of Ethiopian towns, it is much better than rest of the world. The Study of Bigano et. al., (2006) reveals that Tourists prefer countries with a sunny yet mild climate, shun climates that are too hot or too cold and climate of Ethiopian highlands is alike. According to Perch et.al., (2010) Currently, climate resources are best in Southern Europe and deteriorate with increasing latitude and altitude. So, Ethiopia highland can offer a good tourist's market for the people of North Europe.

Table 5 Statistics of TCI of Towns in Ethiopia

Statistics	*JAN*	*FEB*	*MAR*	*APR*	*MAY*	*JUN*	*JUL*	*AUG*	*SEP*	*OCT*	*NOV*	*DEC*
Mean	10.06	9.68	9.04	8.85	8.58	8.63	8.20	8.18	8.57	9.45	10.14	10.30
Median	10.00	10.00	9.00	9.00	9.00	9.00	8.00	8.00	8.00	10.00	10.00	10.00
Mode	10.00	10.00	9.00	9.00	9.00	8.00	8.00	8.00	8.00	10.00	10.00	10.00
St. Deviation	0.76	0.81	0.86	0.94	0.89	0.82	0.74	0.72	0.80	0.88	0.76	0.74

The TCI distributions in the Ethiopian towns examined were varied on the basis of their situation at height from mean sea level. The towns located at highlands have higher tourism climate index. The highlands and mountains of Ethiopia above 1,500m comprise 43%, or 0.53 million km^2, of Ethiopia, which has a total area of 1.22 million km^2. These highlands provide excellent human habitat due to Favorable climatic and ecological conditions (Hurni, 1988). Simple linear regression model was developed to identify role of elevation in the variability in Annual TCI. The predictive model for elevation and Annual TCI had a squared correlation coefficient (R^2) of 0.2414 (Figure 3).

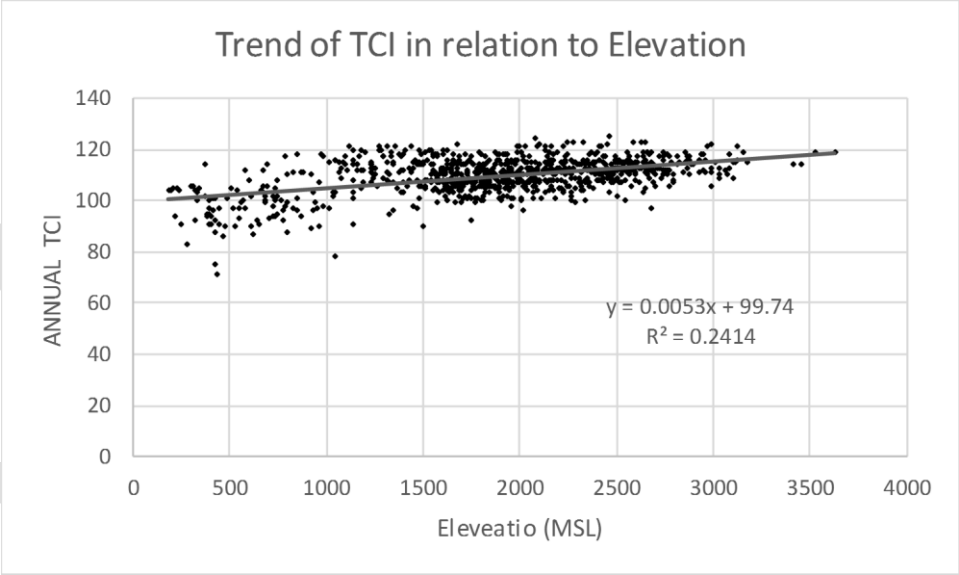

Table 06 and annexure 01 displays number of towns with unique rank based on annual TCI. The first rank was recorded of Adigrat town located at longitude and latitude 14°16′N 39°27′E, with an elevation of 2,457 meters above sea level. The second rank was recorded of Mekelle city located at a latitude and longitude of 13°29′N 39°28′E, with an elevation of 2084 meters above sea level. Annexure 2 shows the Towns ranking based on ideal tourism climate index.

Table 6 Town's ranking based on annual TCI

Rank	TCI	No. of Town	Rank	TCI	No. of Town	Rank	TCI	No. of Town
1	125	1	16	110	53	31	95	4
2	124	1	17	109	31	32	94	6
3	123	6	18	108	50	33	93	2
4	122	5	19	107	61	34	92	5
5	121	15	20	106	37	35	91	6
6	120	11	21	105	28	36	90	5
7	119	22	22	104	23	37	89	1
8	118	25	23	103	22	38	88	2
9	117	27	24	102	15	39	87	1
10	116	43	25	101	19	40	86	1
11	115	48	26	100	15	41	83	1
12	114	68	27	99	9	42	78	1
13	113	57	28	98	5	43	75	1
14	112	66	29	97	9	44	71	1
15	111	55	30	96	6	--	--	--

Source: Study

Table 7 and annexure 2 shows Town's ranking based on ideal TCI. The first rank towns are five in number mostly found in highlands of Tigray region.

Table 7 Ethiopia Town's ranking based on ideal TCI

Rank	No. of Towns	No. of Months
1	5	7
2	14	6
3	23	5
4	56	4
5	92	3
6	115	2
7	126	1

Frequency and cumulative percentage based annual TCI is given in figure 4. Large number of towns have annual TCI 100 to 114. Figure 5 shows number of towns as per the rank.

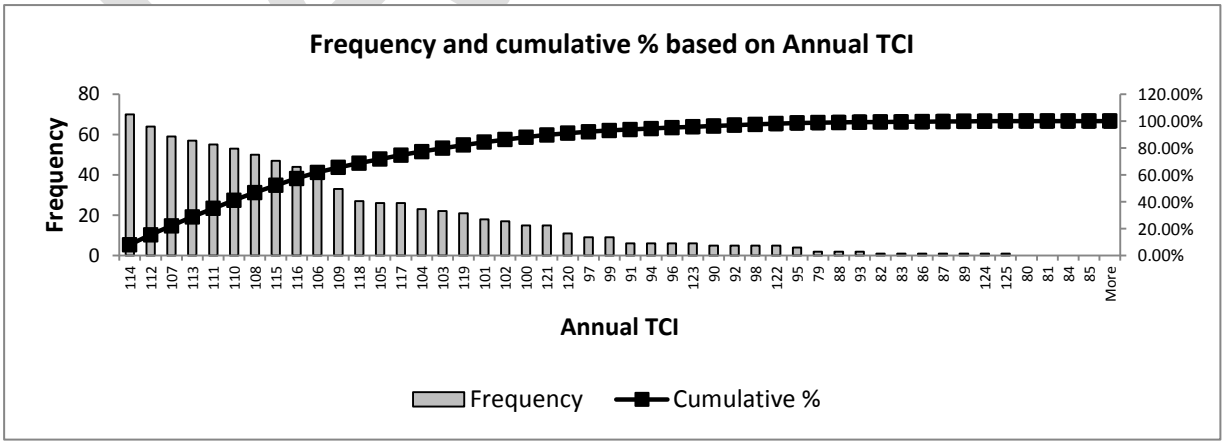

Figure 4 Frequency and cumulative Percentage

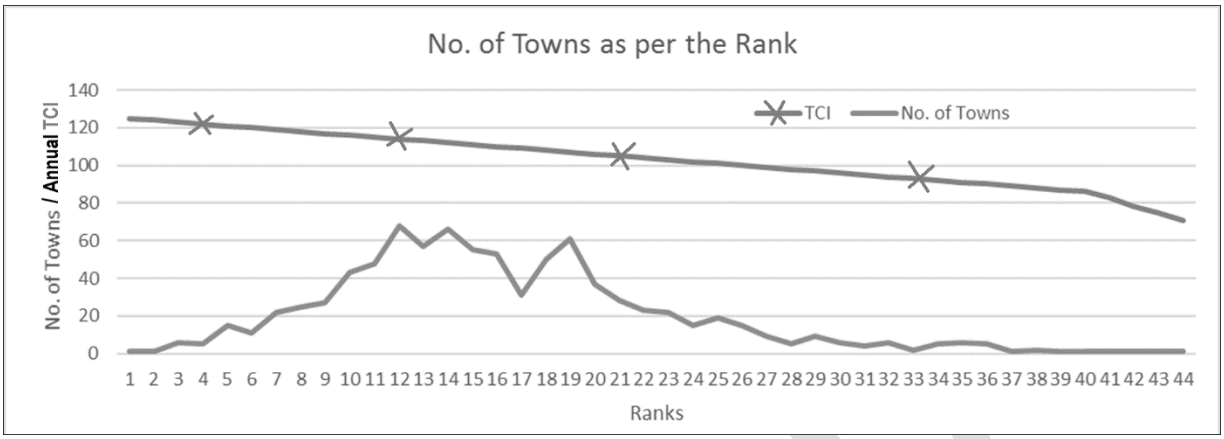

Figure 5 Rank wise number of town

Conclusions

As per the information from official document of sustainable tourism master plan (2015 – 2025) that Ethiopia is a country with untapped tourism potential and the results of present research work reveal this fact. Today, the government is more focused on the growth of Tourism sector for more economic development. There is large potential to develop tourism in Ethiopia because of its highlands have suitable climate specially in winter season when there is high out flow of tourists from higher latitudes developed states as Canada, USA, Scandinavian, Russia, China and Japan of northern hemisphere. In this research it is found the most favorable months for tourist activities are winter months. The results of this study will contribute significantly to present state of knowledge of researchers in the same field. Further research is needed to improve the tourism climate index. One direct task for upcoming research could be to further subdivide homogeneous climate zones and to conduct similar analyses for these smaller zones. The climatic data input could be more refined by future research. In the future we plan a more detailed study of the climatic resources of Ethiopia for the tourism.

Abbreviations

TCI: Tourism Climate Index
IDW: Inverse Distance Weighted

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Annexure 1

Annex 1 Ethiopia - Town's ranking based on annual tourism climate index – 1971-2000			
Rank	**TCI**	**No. of Town**	**Towns**
1	125	1	Adigrat
2	124	1	Mekelle
3	123	6	Idaga Hamus, Inda Tekle Haymanot, May Mekdan, Kwiha, May Keyah, Ambalage
4	122	5	Bizet, Inticho, Adi Gudom, Adi Shoh, Boku
5	121	15	Debre Damo, Axum, Idaga Arbi, Senkata, May Tsamri, Adi Arkay, Zarima, Hintalo, Sankaber, Deresge, Maychew, Hurso, Harer, Bisidimo, Wukro
6	120	11	Rama, Adi Mendi, Shehet, Adi Zeyla, Hiwane, Aberqele, Tikil Dingay, Siska, Melka Jeldu, Babile, Bulbula
7	119	22	Selekleka, Inda Baguna, Atsbi Inda Silase, Adi Teweld Medhin, Gich, Chennek, Dib Bahir, Samre, Dilibza, Kedamit, Zuna, Amde Werk, Ayna, Lalibela, Sela Dingay, Anchekorer, Dire Dawa, Ankober, Sodo, El Melbana, Sasit, Adi Abun
8	118	25	Adwa, Inda Silase, Mahbere Tsige, Mesfinto, Yechilay, Amba Giyorgis, Sekota, Muja, Kulmesk, Filakit, Ajibar, Werk Amba, Tarmaber, Shinile, Godo Beret, Funyan Bira, Majo Weldya, Arsi Negele, Bekawile, Bolekedo, Metagefersa, Arero, Tiltek, Dubuluk, Fetire
9	117	27	Kersa, Adi Awalo, Adi Da-iro, Debark, Asketema, Gende Bune, Rema, Alem Ketema, Jihur, Harawa, Dinbaro, Mendida, Chacha, Alem Maya, Sheno, Keber, Bura, Segen, Gato, Soda, Dawa, Kolme, Gemole, Hudat, Sogiya, Gundo Meskel, Meranya
10	116	43	Shiraro, Gonder, Azezo, Guhala, Debre Zebit, Nefas Mewcha, Kon, Wegel Tena, Firida Mareja, Wegeda, Mekane Selam, Kurkura, Wegeti, Kelela, Hibino, Hose, Lemi, Weberi, Melka Rafu, Muger, Duber, Chelenko, Asagirt, Water, Ogokho, Jembero, Koshe, Gonde, Ziway, Adami Tulu, Tora, Dalocha, Degaga, Aje, Kuyera, Adaba, Bidire, Surupa, Tedim, Wachile, El Gof, Inewari, Ejere
11	115	48	Deneba, Wehini, Bir Afaf, Debr, Amba Lamba, Tenta, Mertule Maryam, Jiga, Debre Werk, Ligwama, Mida, Gosha Tsiyon, Mezezo, Debre Sina, Biriti, Kere Dobi, Debre Birhan, Erer, Muke Turi, Kembolcha, Kulubi, Debra, Ketket, Gina Ager, Deder, Shola Gebeya, Ambo, Balchi, Debre Genet, Kondaltiti, Ombole, Bu-i, Aqena, Butajira, Dugda, Meki, Sheki Husen, Asasa, Chelchel, Jelo, Arguba, Kilenso, Negele, Teltele, Dekewat, Debre Libanos, Genet, Arb Gebeya
12	114	68	Berahile, Abiy Adi, Wekin, Seraba, Meksenyit, Gwaliya, Ibnat, Yifag, Woreta, Kulf Amba, Bete Hor, Segora, Koke Ager, Kabe, Finote Selam, Were Ilu, Kuyi, Inewend, Shil Afaf, Lumame, Yekoza, Yejube, Tulu Miki, Kewo, Gebre Guracha, Dedu, Jemo Lefo, Chinaksen, Gota, Gorfo, Shikute, Mulo, Jijiga, Shino, Bedeno, Debre Zeyt, Welenchiti, Adulala, Nazret, Alem Tena, Gololcha, Indibir, Wolonkomi, Shashemene, Tula, Dila, Beto, Tore, Mele, Wadera, Gerba, Alona, Birbirsa Bera, Melka Jewe, Hare Kelo, Bitata, Fasha, Mugayo, Filtu, Yabelo, Omorate, Moyale, Fiche, Fogera, Chancho, Kobo
13	113	57	Dembecha, Molale, Adi Remets, Aykel, Robit, Amed Ber, Weldiya, Hamusit Mender, Mekane Eyesus, Jara Gedo, Agta, Hayk, Adet, Boru, Ancharo, Gunde Weyn, Bichena, Dogolo, Webrje, Bete Nigus, Ali Doro, Debre Tsige, Chulute, Minare, Mekoda, Koremas, Harawacha, Sendafa, Ginchi, Adis Alem, Chefe Donsa, Guder, Arerti, Weliso, Adis Hiywet, Koka, Sodere, Dera, Iteya, Arkit, Sagure, Jara, Kulito, Dodola, Birbir, Chencha, Harodibe, Gerese, Kercha, Cheketa, Megado, Agere Mariyam, Gewada, Finchawa, Degem, Gola, Hamus Gebeya
14	112	66	Wacha, Kombolcha, Dabat, Genda Wuha, Kola Diba, Chandiba, Adis Zemen, Amistiya, Debre Tabor, Wanzaye, Sirinka, Anbesame, Mersa, Wirgesa, Wichale, Kuta Ber, Keraniya, Harbu, Achewa Bado, Felege Birhan, Mekoy, Anjeni, Shelel, Rabel, Amanuel, Yebokile, Debre Markos, Yetmen, Mehal Meda, Chemoga, Arabi, Denbel, Achane, Kachisi, Fincha-a, Lefe Isa, Chobi, Inchini, Wenoda, Goja, Rob Geba, Godino, Tefki, Shenen, Melka Kunture, Dilela, Bantu, Mojo, Wenji, Arboye, Chole, Gunchire, Asela, Digelu, Morsito, Hako, Selam Ber, Morka, Bule, Hana, Otolo, Shakiso, Gidole, Kose, Robe, Sede
15	111	55	Densha, Mahbere Silase, Chwahit Mender, Zobl, Gasay, Yismala, Bahir Dar, Tis Abay, Gonj, Dese, Tame, Mankusa, Jimate, Yewla, Eliyas, Dejen, Jangir, Armanaya, Jardega, Welenkombi, Hadew, Bicho, Aleltu, Bitile, Golo, Mesela, Irensa, Dukem, Tulu Bolo, Lemen, Silk Amba, Abomsa, Dire Godu, Bulala, Legehida, Fonko, Hosaina, Jajura, Meraro, Hada, Medula, Ropi, Wendo Genet, Wijigra, Abela Lida, Yirga Chefe, Solemo, Chelelektu, Zembaba Wiha, Belesa Koricha, Dedertu, Dimeka, Arjo, Sire, Bele
16	110	53	Korem, Gorgora, Meshenti, Merawi, Mota, Feres Bet, Digo Tsiyon, Senyin, Filikilik, Alibo, Aydora, Sombo, Togochale, Aliyu Amba, Gimbi, Adami, Nekemte, Kolobo, Gedo, Ijaji, Bandiro, Alga, Koma, Angada, Tedele, Toley, Welkite, Fik, Gubre, Abelti, Gore, Hamda Diskis, Kula, Gobesa, Durame, Shire, Mazoriya, Dinshu, Hogiso, Werka, Arbe Gona, Teferi Kela, Mena, Toom, Wenago, Koti, Fiseha Genet, Kibre Mengist, Kele, Kaka, Key Afer, Ginir, Kofele
17	109	31	Wetet Abay, Durbete, Agemsa, Dire, Bike, Hirna, Mekenejo, Goben, Kebri Beyah, Holota, Jogir, Gute, Alem Gena, Akaki Beseka, Seyo, Botor Keta, Botor Bocho, Bege, Habe, Adele, Siltana, Gasera, Angecha, Gimbite, Ali, Guguma, Goro, Mejo, Kemba, Arba Minch, Gedeb
18	108	50	Boneya, Dimtu, Alamata, Waja, Tewodros Ketema, Weranso, Dangla, Pawe, Mandura, Kidamaja, Dabi, Agut, Dibate, Kilaj, Karakore, Obera, Kiremu, Kokofe, Ayana, Gelila, Teferi Ber, Deboko, Inango, Guji, Addis Abeba, Fechase, Kewisa, Bilo, Mote, Guto, Koye, Aba Bor, Atnago, Tawula, Uka, Fofa, Seru, Sedika, Gimbichu, Agarfa, Gemesha, Yirba Moda, Belta, Bonke Beza, Wib Hamer, Kulu, Sebeta, Nopa, Bure, Tibe

19	107	61	Bako, Soyema, Adis Kidane, Fogota, Gish Abay, Chagni, Kesa, Gimja Bet, Tilili, Achigi, Zigin, Shindi, Bulen, Galesa, Kuch, Ataye, Korka, Biye Anod, Surge, Haro, Mendi, Benguwa, Kober, Debeka, Jarso, Hena, Begi, Muklemi, Guliso, Girawa, Keki, Bube, Wama Adere, Nunu, Kone, Dega, Elemo, Bedele, Abdela, Kumbabe, Yayu, Hurumu, Ulawarta, Gechi, Burusa, Kumbi, Leka, Natri, Ticho, Munesa, Tocha Sodo, Shone, Areka, Selka, Kindo Halato, Wajifo, Bore, Laska, Jinka, Bila, Genji
20	106	37	Bati, Injbara, Azena, Kurmuk, Gomer, Senbete, Shewa Robit, Nejo, Tobi, Hunde Lafto, Yara, Alem Teferi, Getema, Debeso, Meko, Alge, Dembidolo, Sibo, Mecha, Sekoru, Sigamo, Dusta, Bekoji, Durgi, Goba Robe, Gesuba, Chuko, Jemu, Goche, Chereti, Harqele, Fejel, Rob Gebeya, Kemise, Seka, Tulema, Kelo
21	105	28	Toba, Sulula, Weyra Wuha, Mile, Gizen, Gogti, Meteh Bila, Kelem, Ano, Melka Jilo, Chanka, Supe, Timuga, Becho, Babo, Yembero, Gent, Tiro, Birbirsa, Kebechi, Welde Hane, Boditi, Loma Bale, Aleta Wendo, Zefne, Maji, Bur, Suftu
22	104	23	Asosa, Harshin, Sichawo, Sheboka, Yubdo, Kake, Dupa, Metu, Yanfa, Bido, Gesecha, Gatira, Wishwish, Waka, Soddo, Bachuma, Yirga Alem, Afker, Lema Shilnich, Burkale, Woldya, Bedesa, Omedila
23	103	22	Komosh, Jewha, Afdem, Gidami, Setema, Ambuye, Masha, Chira, Metoso, Dara, Bita Genet, Aba, Tocha, Gowa, Meri, Wishaye Bele, Mizan Teferi, Tebela, Sawla, Kere, El-Kere, Bare
24	102	15	Debre Zeyit, Adi Gala, Adigala, Dulecha, Gibe, Jimma, Nada, Sembo, Dedo, Gimbo, Deri, Chida, Gachit, Imi, Asbuli
25	101	19	Bonga, NA, Dewele, Bambesi, Dawo Kebe, Sedi, Sineso, Dembi, Ageyo, Beshash, Yebu, Asendabo, Serbo, Gecha, Shebe, Ameya, Bebeka, Badhi, Temenja Yazhi, Godere
26	100	15	Didigsala, Asbe Teferi, Micheta, Kurmis, Domo, Choche, Senyo Gebeya, Segeg, Danot, Tepi, Anderacha, Felege Selam, Shewa Gimira, Bulki, Bekolmag
27	99	9	Arba Reketi, Mechara, Deror, Gashamo, Agaro, Gembe, Boh, Gura Ferda, Adadile
28	98	5	Ayisha, Debel, Obele, Degeh Medo, Chiri
29	97	9	Loqiya, Tendaho, Guba, Biye Gurgur, Abadir, Mugi, Agere Weyin, Hagere Selam, Welwel
30	96	6	Aroresa, Chelekko, Dihun, Dino, Geladin, Mankush
31	95	4	Dubti, Melka Sede, Mieso, Serdo
32	94	6	Benado, Dehabo, Dubub, Jikawo, Melka Werer, Mustahil
33	93	2	Punydo, Shekosh
34	92	5	Birkot, Deday, Gelemso, Hayu, Manda
35	91	6	Aware, Debe Weyin, Geledid, Kelafo, Shelabo, Wanke
36	90	5	Gewane, Kebri Dehar, Korahe, Metehara, Shebel
37	89	1	Awash
38	88	2	Denan, Hamero
39	87	1	Abderafi
40	86	1	Abobo
41	83	1	Gode
42	78	1	Degeh Bur
43	75	1	Itang
44	71	1	Gambela
			Source: Study based on Mieczkowski (1985)

Annexure 2

Annex 2 Ethiopia Towns ranking based on ideal tourism climate index (1971-2000)			
Rank	**No. of Towns**	**No. of Months**	**Name of the Towns**
1	5	7	Adigrat, Mekele, Zarima, Sankaber, Dib Bahir
2	14	6	Idaga Hamus, Inda Tekle Haymanot, May Mekdan, Kwiha, May Keyah, Ambalage, Bizet, Debre Damo, May Tsamri, Adi Arkay, Deresge, Tikil Dingay, Adi Teweld Medhin, Debark
3	23	5	Inticho, Adi Gudom, Adi Shoh, Senkata, Hintalo, Maychew, Adi Zeyla, Aberqele, Siska, Gich, Chennek, Samre, Dilibza, Kedamit, Amde Werk, Ayna, Lalibela, Mesfinto, Amba Giyorgis, Muja, Kulmesk, Sheno, Wekin
4	56	4	Boku, Axum, Idaga Arbi, Hurso, Harer, Bisidimo, Adi Mendi, Shehet, Hiwane, Babile, Bulbula, Selekleka, Inda Baguna, Atsbi Inda Silase, Zuna, Sela Dingay, Anchekorer, Ankober, Sasit, Inda Silase, Mahbere Tsige, Yechilay, Sekota, Filakit, Ajibar, Werk Amba, Tarmaber, Godo Beret, Funyan Bira, Fetire, Adi Awalo, Adi Da-iro, Asketema, Gende Bune, Rema, Alem Ketema, Gundo Meskel, Meranya, Gonder, Azezo, Hibino, Weberi, Duber, Ogokho, Bir Afaf, Debr, Jiga, Kere Dobi, Gina Ager, Debre Genet, Kondaltiti, Meki, Yejube, Kewo, Dedu, Chulute
5	92	3	Wukro, Rama, Melka Jeldu, Dire Dawa, Shinile, Majo Weldya, Arsi Negele, Jihur, Alem Maya, Keber, Bura, Shiraro, Guhala, Debre Zebit, Nefas Mewcha, Kon, Wegel Tena, Firida Mareja, Wegeda, Mekane Selam, Kurkura, Wegeti, Kelela, Hose, Lemi, Melka Rafu, Muger, Chelenko, Water, Jembero, Koshe, Tora, Dalocha, Inewari, Wehini, Amba Lamba, Mertule Maryam, Debre Werk, Mida, Gosha Tsiyon, Mezezo, Biriti, Erer, Muke Turi, Kembolcha, Kulubi, Ketket, Shola Gebeya, Balchi, Ombole, Bu-i, Aqena, Dugda, Debre Libanos, Seraba, Meksenyit, Kulf Amba, Bete Hor, Finote Selam, Kuyi, Inewend, Lumame, Yekoza, Tulu Miki, Gebre Guracha, Jemo Lefo, Mulo, Indibir, Dembecha, Molale, Gunde Weyn, Bichena, Webrje, Bete Nigus, Ali Doro, Debre Tsige, Minare, Mekoda, Weliso, Dabat, Achewa Bado, Felege Birhan, Yebokile, Yetmen, Mehal Meda, Achane, Kachisi, Dilela, Jangir, Jardega, Filikilik
6	115	2	Sodo, El Melbana, Adi Abun, Adwa, Kersa, Harawa, Dinbaro, Mendida, Chacha, Segen, Gato, Asagirt, Gonde, Degaga, Aje, Kuyera, Ejere, Tenta, Ligwama, Debre Sina, Debra, Deder, Ambo, Butajira, Sheki Husen, Arguba, Genet, Arb Gebeya, Abiy Adi, Gwaliya, Yifag, Woreta, Koke Ager, Were Ilu, Shil Afaf, Chinaksen, Gorfo, Shikute, Shino, Bedeno, Welenchiti, Adulala, Nazret, Alem Tena, Gololcha, Wolonkomi, Shashemene, Tula, Fiche, Fogera, Kobo, Daleti, Adi Remets, Aykel, Robit, Amed Ber, Mekane Eyesus, Jara Gedo, Dogolo, Sendafa, Ginchi, Adis Alem, Chefe Donsa, Guder, Arerti, Koka, Arkit, Jara, Degem, Gola, Keraniya, Shelel, Rabel, Amanuel, Debre Markos, Chemoga, Fincha-a, Chobi, Inchini, Goja, Rob Geba, Shenen, Bantu, Gunchire, Hana, Densha, Yewla, Eliyas, Dejen, Armanaya, Welenkombi, Bicho, Bitile, Golo, Mesela, Irensa, Tulu Bolo, Silk Amba, Dire Godu, Legehida, Hosaina, Alibo, Sombo, Adami, Nekemte, Kolobo, Ijaji, Alga, Koma, Tedele, Abelti, Gore, Dire, Mejo
7	126	1	Bolekedo, Metagefersa, Arero, Tiltek, Dubuluk, Soda, Dawa, Gemole, Ziway, Adami Tulu, Adaba, Bidire, Surupa, Deneba, Asasa, Ibnat, Segora, Kabe, Debre Zeyt, Dila, Beto, Alona, Chancho, Mega, Hamusit Mender, Agta, Adet, Koremas, Harawacha, Adis Hiywet, Sodere, Dera, Sagure, Chencha, Hamus Gebeya, Kombolcha, Genda Wuha, Kola Diba, Chandiba, Amistiya, Debre Tabor, Wanzaye, Anjeni, Wenoda, Godino, Tefki, Mojo, Wenji, Arboye, Chole, Asela, Digelu, Morsito, Hako, Bule, Gidole, Kose, Mahbere Silase, Chwahit Mender, Zobl, Gasay, Gonj, Tame, Mankusa, Jimate, Aleltu, Fonko, Jajura, Meraro, Wendo Genet, Wijigra, Abela Lida, Solemo, Arjo, Korem, Gorgora, Mota, Feres

			Bet, Digo Tsiyon, Aydora, Aliyu Amba, Gimbi, Gedo, Bandiro, Toley, Welkite, Gubre, Kula, Teferi Kela, Wenago, Agemsa, Bike, Hirna, Mekenejo, Goben, Jogir, Gute, Seyo, Botor Keta, Botor Bocho, Siltana, Dabi, Obera, Kiremu, Kokofe, Ayana, Gelila, Deboko, Inango, Guji, Fechase, Kewisa, Koye, Atnago, Tawula, Uka, Yirba Moda, Wib Hamer, Kuch, Benguwa, Keki, Munesa, Getema, Dembidolo, Bekoji
			Source: Study based on Mieczkowski (1985)