Abstract: Natural resources in North and Eastern provinces of Sri Lanka were severely affected due to the civil war. This was more significant along the coastal zone from Mannar to Batticaloa. It has been establishing more economic development activities in Northern and Eastern provinces after the war. Arial photography, Geographical Information Systems (GIS) data and satellite images have proven their importance as additional tools in identifying prospective areas for natural resources and also for locating suitable sites for establishing new development activities. In this study integrated approach of remote sensing techniques, Arial photo interpretation and GIS techniques were applied to produce reliable information for identification of most suitable locations for the development activities in the Northern and Eastern coastal zones of Sri Lanka.

Keywords: coastal zone, land suitability index, weightage

Introduction

Both Northern and Eastern provinces have been heavily affected by the civil war. The Northern province's population was 1,311,776 in 2007. The majority of the population is Sri Lankan Tamils, with a minority Sri Lankan Moor and Sinhalese population. The Eastern province's population was 1,460,939 in 2007. The province is the most diverse in Sri Lanka, both ethnically and religiously. Majority of the people earn their livelihood as fishers and in the civil and business sectors. Small scale industry such as chemical, light manufacturing and were present before the civil war. Part of the study area which is belonging to Eastern province has high demographic pressure compared to Northern Province and frequently experiencing coastal flooding. Also the Eastern and Northern coasts of Sri Lanka were seriously affected by the tsunami which took place in December, 2004. This has created severe environmental and socio-economic impacts in the region. After this incident, a 100 meter coastal buffer zone has recommended by the Coast Conservation Department. However, it was not implemented due to various reasons. Set back limits are also to be considered when identifying land suitability for development activities in the coastal zone.

The study area

The study area covers coastal zones (as defined in the Coast Conservation Act No. 57 of 1981) of Northern and Eastern provinces of Sri Lanka (Figure 1). This region is mainly affected by the Northeast monsoon from December to March. The Northern province has an area of 8,880 km² which is surrounded by Bay of Bengal to the East, the and to the West, to the North, and the, and provinces to the South. The Northern Province is divided into 5, 33 and 912 Grama Niladhari (GN) Divisions (villages). The

![Figure 1: The study area](image)
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province is divided into two distinct geographic areas: and the vanni. eastern province has an area of 9,996 km². the eastern province is divided into 3, 45 and 1,085 grama niladhari (gn) divisions.

materials and methods

the main objective of the research is to identify and demarcate suitable locations for development activities within the study area. the research was basically based on secondary data which were collected from text books, publications, national atlas, project reports, web sites etc. in some occasions, aerial photographs and satellite imageries were used to identify the past and present status of the environmental and socio-economic conditions of the study area. available historical and recent data i.e. different kinds of maps, statistical reports and other relevant documents were used to correlate the variation of environmental and socio economical conditions of the study area within last thirty years. different types of thematic maps were introduced using these data. arcgis (version 9), arcview (version 3.2) and erdas imager software were used to prepare these maps and for data analysis process.

preparation of the base map and thematic maps

the base map was prepared using 1:50,000 topographic maps of survey department of sri lanka using arcview 3.2(a) version. the base map falls within few divisional secretariat divisions of ampara, batticaloa, trincomalee, mullativu, jaffna, kilinochchi, and mannar districts. however, in some areas, the coastline is not clearly defined in the 1:50,000 sheets and therefore, satellite image data and aerial photographs were also used to complete this task. the attribute data were entered using excel, access, etc. and similar software having the facilities to create data tables. gis software which were used in this research have the capability to link external attribute data to the relational database. after creating the attribute data tables, they were linked to a geo-referenced map. the data which were collected as raw data or tabulated data from various institutions were entered to attribute tables. then they were linked to the base map to produce thematic layers.

data analysis

there are six important factors or parameters considered in the preparation of land suitability map. index maps produced for each factor based on their influence on land suitability for establishing future development activities. some of these factors show high influence on land suitability while some act against it. for example, road accessibility very useful when identifying land suitability for any development activity however, areas closer to forests and other natural resources including tanks can be considered as less suitable areas. this implies that all factors or parameters which were concerned in the preparation of land suitability map behaved in different manner. therefore, weightage values were introduced to identify the strengths and weaknesses of these parameters on land suitability for future development projects. one of the standard multi criteria decision analysis methods has been applied to calculate the weightage values of each parameter. according to this method, each parameter compares with other parameters and calculates values based on their importance. when considering a single parameter, its influence on selecting land suitability varies with its conditions. therefore, index values were introduced for different conditions within the same parameter.

rivers and streams

few main rivers of sri lanka and number of other small rivers and streams flow through the study area into the sea. during the rainy season, some parts of the area especially closer to the main rivers experience floods. however, still there is no proper flood control system introduced for managing such floods within the study area. major rivers in the study area are shown in the figure 2. buffer zones were created for these rivers and streams. thereafter, river and stream index (rsi) values were assigned based on the distance from rivers or stream to buffer zones.

forests

the study area belongs to dry zone of sri lanka. it is hard to find natural forests in this region. however, there are parts of large national park like yala and few other national parks are belonging to the study
area (Figure 3). Locations closer to these parks are ideal places for establish tourist hotels. However, these forests can be affected after such projects will be introduced. Hundred meter buffer zones were created for these forests and national parks. Thereafter, to identify the land suitability for future projects, Forest Buffer Index (FBI) values were introduced based on the distance from these buffer zones.

**Tanks and lagoons**

There are number of tanks and lagoons exist in the study area (Figure 4). Tanks have been using for irrigation, inland fisheries industry, etc. Also lagoons have been utilizing for multidisciplinary tasks. After implementing new projects, tanks and lagoons can be polluted. Therefore, tanks and lagoons in the study area are to be protected when introducing new development projects. Thus, buffer zones were created for both tanks and lagoons. After creating buffer zones, Tanks and Lagoon Index (TLI) values were assigned where locations far away from the buffers have the heist TLI values and are the most suitable areas for establishing new projects.

**Road accessibility**

Road accessibility is one of the main factors that have to be considered when planning new development projects. Transportation facilities in the study area are poorly developed and also many roads were destroyed during the war. The road network of the study area is shown in the Figure 5. Based on the road accessibility, Road Accessibility Indexes (RAI) were assigned. Locations closer to main roads have the highest RAI and areas far away from any kind of roads have the least RAI value.
Coastal erosion trends

According to the Coastal Erosion Master Plan of Sri Lanka, some of the areas recorded as the highest coastal erosion affected areas (Figure 6). The areas highly affected by coastal erosion are considered as the “key areas” and the “singular areas” in the Coastal Zone Management Plan. Based on the coastal erosion trends in the study area, different Coastal Erosive Indexes (CEI) were assigned based on coastal erosion sensitivity. Low CEI were assigned for areas with high coastal erosion sensitive. These areas are the least suitable locations for implementing development projects.

Flood risks

Heavy rainfall from North-East monsoons is the principal cause of coastal floods in the study area. In addition, the drainage, land use pattern and topography of the area are also significant factors that contribute for floods. It has been observed that coastal floods are frequently experience in the study is. Therefore flood risks (Figure 7) in the study area have to be considered for analyzing land suitability of the area. Flood Risk Index (FRI) has been introduced based on flood hazardous map. Highest flood risk areas are least suitable areas for development activities. Therefore, high flood risk areas have the least FRI values.

A simple equation has been introduced to calculate the Land Suitability Index (LSI) values. This equation combines the weightages and ranks / index values of all six parameters at any location along the study area.

\[
LSI = W_1 \cdot I_{1N1} + W_2 \cdot I_{2N2} + W_3 \cdot I_{3N3} + W_4 \cdot I_{4N4} + W_5 \cdot I_{5N5} + W_6 \cdot I_{6N6}
\]

\(LSI\) – Land Suitability Index Value,
$W_1, W_2, ..W_6$ are weightage values of the parameters (obtained by the Principal Component Analysis).

$I_1 = \text{River and Stream Index (RSI)},$

$I_2 = \text{Forest Buffer Index (FBI)},$

$I_3 = \text{Tanks and Lagoon Index (TLI)},$

$I_4 = \text{Road Accessibility Indexes (RAI)},$

$I_5 = \text{Coastal Erosive Indexes (CEI)},$

$I_6 = \text{Flood Risk Index (FRI)};$ are indexes of the parameters.

$N_1, N_2, \ldots, N_6$ are relevant rank number of the parameter.

Arc GIS and ERDAS IMAGINE software were used to overlay six thematic maps (Figure 8). This process leads to assigning a Land Suitability Index value for any location within the entire study area. These values indicate the probability of land suitability at any location. However, it was noted that there is a wide range of LSI values scattered in the area. Therefore, LSI values were reclassified and introduce six land suitability classes (Table 1).

<table>
<thead>
<tr>
<th>Range of LSI</th>
<th>Segment Number</th>
<th>Land Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.00</td>
<td>1</td>
<td>Least Suitable</td>
</tr>
<tr>
<td>2.00 – 4.00</td>
<td>2</td>
<td>Less Suitable</td>
</tr>
<tr>
<td>4.00 – 5.00</td>
<td>3</td>
<td>Moderately Suitable</td>
</tr>
<tr>
<td>5.00 – 6.00</td>
<td>4</td>
<td>High Suitable</td>
</tr>
<tr>
<td>6.00 – 8.00</td>
<td>5</td>
<td>Very High Suitable</td>
</tr>
<tr>
<td>&gt; 8.00</td>
<td>6</td>
<td>Highest Suitable</td>
</tr>
</tbody>
</table>

Finally, Northern and Eastern coastal zone of Sri Lanka was classified into six different land suitability classes based on the above LSI values (Figure 9). The locations demarcated as segment number 1 have to be protected and are the least suitable areas for future projects. Most suitable areas or locations for future development activities are demarcated as segment number 6. However, this is a general classification and a detailed classification can be prepared based on facilities needed for each individual project and its activities.

**Table 1:**

**Reclassification of land suitability classes**

**Results and Discussion**

The main objective of this research is to initiate a preliminary coastal management plan for the Northern and Eastern coastal zone of Sri Lanka using spatial technology. There are many issues to be discussed in a coastal zone management plan. This is more significant when introducing new development projects in the...
coastal zone. Therefore, in this study, Northern and Eastern coastal zone of Sri Lanka have been categorized into several land suitability classes based on environmental and socioeconomic conditions. The most suitable classes are ideal locations for establishing regional development activities whereas the places with least suitable classes have to be protected without establishing development activities. However, by implementing proper solutions and techniques, least suitable and less suitable areas can be improved as moderate to high suitable areas.

Conclusion

Northern and Eastern coastal sectors of Sri Lanka play an important role in socio-economic development of the country.

Some of the main income of the country such as fisheries, tourism and many other industries exist within these regions. It has been observed that during 1983 to 2008, socio-economic development activities in the study area were dramatically decreased or could not get the total benefit of them. Some of the natural resources, tourism and some other industries were totally destroyed during the war period. Geographical setting of the area and existing resources can be utilized to establish development activities such as tourist hotels, fisheries harbors, etc. The government of Sri Lanka identified the importance of reestablishment of new development activities within the Northern and Eastern coastal sector and planed to initiate new projects within this region. However when implementing such activities, present socio-economic and environmental conditions can be modified. Both natural environmental conditions as well as human interferences may involve in the modification of the existing coastal environment. With the incensement of regional development activities, some of the negative environmental impacts can be accelerated. Incensement of coastal erosion, pollution of the groundwater, surface water and near shore water, destroy the natural coastal and marine ecosystems, land degradation, etc are some of these impacts. Therefore, it is very important to introduce a proper coastal zone management plan for the study area and

Figure 9 Land suitability of the study area
it has to be implemented when introducing new regional development activities. This matter was mainly focused in this study and tried to introduce spatial technology i.e. GIS and remote sensing to introduce initial coastal management plan for Northern and Eastern coastal zone of Sri Lanka. Few main factors i.e. coastal erosion trends in the area, available natural resources, effect of floods, land use pattern, road accessibility, etc were considered and their strengths of contribution for the preparation of the initial coastal management plan were analyzed. One of the Geographic Information Systems (GIS) techniques i.e. overlay analysis method was applied to identify the most and least suitable locations for establishing and implementing new regional development activities. These regions were classified from very low to very high coastal environmental sensitive areas. The combination of statistical and GIS methods provide a greater flexibility and new trends in decision making activities. These techniques perform producing initial coastal management plan much easier and faster than manual methods.

**Recommendations:**

- Environmental sensitivity of the region must be concerned when establishing future development activities. Alternative places should be identified when planning such activities within extremely high and very high environmental sensitive areas.

- Extremely high and very high coastal environmental sensitive areas can be improved as moderate to low sensitive areas by introducing proper coast management methods.

- Setback limits should be modified considering the coastal erosions sensitivity and few other environmental conditions at individual locations. Setback limits to be introduced for singular locations but same setback limits should not be applied for the entire coastal zone of Sri Lanka.

- An extensive study is needed for the preparation of a better coastal environmental management plan for the study area.

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NARA. (2005b). Damage to coral reef and fish community caused by the tsunami on 26 December 2004. source:, (June 12 2007)


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Abstract: Geography is the study of relations between society and the natural environment and constitutes the disciplines of geography, space, place and time that are very crucial concepts. The objective of this paper is to explore the historical development and recent scenario of Biogeography as a sub field of Physical Geography, which is one of the two major subfields of Geography that deals with the study of processes and patterns in the natural environment in the atmosphere, hydrosphere, biosphere, and geosphere. These spatial organization and changes that take place both in short and long time perspectives. Species interaction with space over time and the influences of geographical factors in species functions is the core of biogeography.

Research method: as an analytical model, this paper is divided in to five sections according to the historical time frame to obtain set objective. Secondary data were employed to explore historical events and the contributions of the experts to the field of five eras. Since 2000 the highly use of models, theories, conservation strategies as well as computers, GIS and remote sensing techniques in biogeography has grown considerably.

Introduction and background to the field

Geography provides the broad basis for diverse kinds of exploration in to natural and social sciences. The subject of geography is the fundamental interpretation of the earth’s ‘spatial diversity’. According to (Hartshone, 2005) it is neither a natural nor social science, but a study of intimately mixed phenomena. There are a number of sub-fields in Geography\(^1\). The main fields of study in Physical Geography focus around the core fields of Biogeography, Geomorphology, Climatology, Hydrology, Soil Geography etc. While the main fields of study in Human Geography focus on the core fields of Economic Geography, Development Geography, Settlement Geography, Population Geography, Political Geography etc. (Strahler and Strahler, 2005).

Biogeography, the sub field of Physical Geography is the study of the geographical distribution of plants, animals and micro organisms over the surface of the Earth in both space and time (Tivy, 1979; Robinson, 1972; Huggett, 1998). Strahler and Strahler (2005, p.270) states that, “we can think of Biogeography as encompassing two major themes. Ecological biogeography is concerned on how the distribution patterns of organisms are affected by the environment. Historical biogeography focuses on how spatial distribution patterns of organisms arise over time and space”. It focuses on the spatial organization, which is important to understand species interaction with space and the influences of geographical factors in species function. It is a dynamic and growing field that seeks to understand the role of historical factors (spatial and temporal) in determining biodiversity and to expand significantly analytical capacities of measuring how biodiversity will respond to drastically altering world through natural and anthropogenic factors.

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Early stage of the field

The appearance of thoughts concerning to the subject 'Biogeography' has a long history. Aristotle (384 BC – 322 BC) first classified living species into plant and animal Kingdoms. He called 'animals with blood' and 'animals without blood'. Animals with blood (vertebrates) were divided into live-bearing (humans and mammals), and egg-bearing (birds and fish). Invertebrates ('animals without blood') are insects, crustacea (divided into non-shelled – cephalopods – and shelled) and testacea (molluscs). According to (Szafer, 1975; Starr and Taggart, 2004) in between 371 and 287 BC, Theophrastus classified plants as trees, shrubs and herbs and is considered the founder of 'Plant Geography' and father of botany. Further, he expressed the interrelationships between biotic and abiotic environments.

Development of the field in 18th and 19th Centuries

Swedish scientists Carl Von Linnaeus (1707-1778) made remarkable contributions to biology as well as biogeography. In 1735, he introduced the currently used methods of plant classification. Linnaeus introduced 'binomial classification system' for plants and animals in 1753 and is considered the 'father of plant taxonomy'. Comte de Buffon work on natural history of animals in 1761 contributed the biogeographic notion. He explored the distribution patterns, adaptation and migration of wildlife. According to Huggett (1998) this has been considered an early contribution to biogeography. According to Myers and Giller (1988) the origin of biogeography is attributed to Buffon, who perceived the biogeographic diversity of the earth.

Alexander von Humboldt's (1769-1859) quantitative work on botanical geography laid the foundation for the field of biogeography. According to Huggett (1998) and Lomolino & Heaney (2004), Humboldt further explained the climatic influences on vegetation zones. He also explored the biogeographical phases of biota and contributed a lot to develop the field biogeography. He has been considered the Father of 'modern plant geography'. Another most crucial contribution was made by Augustine P. de Candolle in 1820. He coined the term 'taxonomy' and contributed to the development of plant taxonomy through his book on 'Geographical Botany' (Huggett, 1998).

From 1855 to 1866 a number of books were published on climatic impact on the distribution pattern of vegetation. Alphonse de Candolle (1855) wrote a book on 'Plant Geography' and in 1864, George Perkins Marsh's (1801-1882) wrote a book 'Man and Nature or Physical Geography as Modified by Human Action' (Robinson 1972). In 1866, A. Grisebach wrote a book on 'Vegetation of the Earth'. These books have emphasized very much the influences of geographical factors on species distribution patterns and function. Thus, these publications have played a donated significant role in developing biogeography as a distinctive branch of geography. In 1858, P.L. Sclater made a tremendous contribution to biogeography. He introduced 'Biogeographic Regions' of the Earth (Huggett, 1998). Then, J.D. Hooker (1866) studied the development and interrelations of floras of the globe. According to and, 2010) this study focused on the biogeography of flora. His involvement in biogeography should be admired. The most important figure and in the 19th century and prominent ecologist Earnst Haeckle's immense contribution to 'Biogeography,' 'Biology' and 'Ecology' must be admired. According to (Raven, et al., 2008) in

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1866 he introduced the Kingdom of Protista, with Plantae, and Animalia. The greatest contribution of Earnst Haekkle was that in 1869 he pioneered the term ‘ecology’ and biogeography deviated with ecological thoughts. Five years later, according to (Huggett, 1998) in 1871 J.A. Allen introduced eight ‘Ecogeographic Realms’ of the earth based on mean annual isotherms, and thus pioneered ‘Allen’s Rule’ of biogeography or ‘proportional rule’.

The next event made a noteworthy contribution to biogeography. A biologically rich geographical area has been declared as a national park to conserve biological diversity in the US. In 1872, US President Grant signed an Act on National Parks, and thus the Yellow Stone area was declared the first National park in the world.

Again in 1876, the most prominent biogeographer, Alfred Russel Wallace contributed much to delineate biogeographical region. He conceptualized ‘Zoogeographical Realms’ based on Darwinian Theory in his book; ‘The Geographical Distribution of Animals’. He is considered the ‘father of zoogeography’ (Huggett, 1998). Since, the realms called as Wallace’s realms. The realms are; Palaearctic, Ethiopian, Oriental, Australian, Nearctic, and Neotropical Starr and Taggart (2004, p.894). In this stage, Alexander Supan’s (1879) ‘timberline’ view has contributed very much to strengthen the development of the field of biogeography.

In 1887, Stephen Alfred Forbes used the term ‘ecosystem’ in his essay on ‘the Lake as Microcosm’ but at this stage the term ecosystem had not yet been conceptualized. S.A. Forbes is a founder of aquatic ecosystem science and a dominant figure in the growth of American ecology. The life zone concept was developed by Clinton Hart Merriam in 1889 as a means of describing areas with similar plant and animal communities. In 1894, C.H. Merriam proposed the ‘Life Zone’ model. This was comparative model of vegetation cover, climatic factors and geographical zones and a pure biogeographical model which made significant contribution to biogeography at this stage.

In the latter part of the 19th century, according to (Huggett, 1998) two Americans Roscoe Pound and Frederic Edward Clements (1898) introduced ‘Plant Succession’ and in the same year, A.F.W. Schimper based on field study on ‘geographical distribution of the plants in relation to physical environmental factors’ introduced the term ‘Tropical Rainforest’ (Whitemore, 1990).

Developments of the field in the 20th Century

Along with the developments of the field of biogeography in the 20th century, remarkable contributions were made by number of prominent experts. In 1911, British Ecologist Sir Arthur George Tansley wrote on ‘Vegetation Types in British’ which was directed international plant geography symposium in 1911 and, 2010.

Space, Place and Time are core factors in geography, in this sense, Alfred Wegener’s continental drift theory in 1915, influenced to study the species distribution pattern in different continents over time (Taylor, 1984). These studies have contributed much to the development of the field biogeography in 20th century. The next development in field was American plant ecologist, Frederic Edward Clements’s (1916) two concepts on ‘Plant Succession’ and ‘Climax Vegetation’ (Robinson, 1972; Huggett, 1998).

Koppen (1939) used the same line as the boundary between his tundra climates in his classification.
August Thienemann of Germany promoted the concept of 'Tropic Levels' in ecosystem in 1920. Thus, hard ecological ideas enhanced biogeography (Taylor, 1984). In 1925, Alfred Lotka initiated the use of quantitative methods in biology. In addition, Lotka elaborated that living and non-living environment of the earth as an ecosystem (Huggett, 1998).

British ecologist Charles Sutherland Elton's books had a tremendous impact on biogeography. Elton wrote 'Animal Ecology' in 1927 and 'Animal Ecology and Evolution' in 1930 that examined the geographical distribution of animals from an ecological view-point (Taylor, 1984). In addition to that he expressed food webs and conceptualized the 'Ecological Niches' and 'Ecological Pyramids' ('Elton's Pyramids' / 'Eltonian Pyramids') (Huggett, 1998). The next development in biogeography was Vladimir Ivanovich Vernadsky's contribution. Vernadsky coined the term 'biosphere', which are still the terms used very much in fields such as biogeography, ecology and biology (Myers and Giller, 1988; Huggett, 1998).

Again in 1935, English ecologist A.G. Tansley introduced the word 'Eco-system'. In 1938 Herbert Copeland encouraged Prokaryotes as a separate kingdom instead of Kingdom Monera, which included all types of bacteria. The two publications published in 1936 and 1947 was by Marion Newbigin's 'Plant and Animal Geography' and Ronald Good's 'Geography of flowering plants' (Lomolino and Heaney, 2004). These were considered as most successive developments in the field of biogeography by the end of the first half of the 20th century.

According to Taylor (1984) in 1939, the German geographer 'Carl Troll' (1899 - 1975) coined the term 'Landscape Ecology' and in 1968 he defined it as the study of the main complex causal relationships between the life communities and their environment in a given section of a landscape or geographical area.

In 1947, L.R. Holdridge introduced vegetation zones of the world. He used 'Bio Temperature Index' – BTI based on evaporation, precipitation, humidity, altitude and latitude. Holdridge's remarkable contributions to biogeography must be admired. An incredible development of the 1950s was American biologist Eugene Pleasants Odum (1913 – 2002) introduced the 'energy flow approach' to ecology and ecological biogeography in 1953 through his book on the 'Fundamentals of Ecology' (Huggett, 1998; Cox and , 2010). In 1959, another important contribution was made by ecologist Robert H. Whittaker. He proposed Fungi as spate kingdom of the kingdoms of species Starr and Taggart (2004, pp.405-409). Since Rachel Carson's 'Silent Spring', in the 1960s ideas on environmental concerns had enriched the field biogeography and contributed a lot to 'Environmental Geography'. According to (Saxena, 2004), in 1960s environmental movements were highly stressed and focused on human activities against the environment.

The years 1967, 1969 and 1970 were significant for biogeography, as three considerable views emerged during these years. An enthusiastic work made by ecologist Robert H. Mac Arthur and an American biologist, researcher (sociobiology, biodiversity), theorist, naturalist and author. Edward Osborne "E. O." Wilson together, attempted to apply the theory of species equilibrium to the contained environment of small islands. In 1967, they wrote a book on 'the Theory of Island Biogeography' (Huggett, 1998; Lomolino and Heaney, 2004). Since then, many studies have been made on this theory, particularly on its simplicity, applicability and practicability to the design..
and study of national parks, man and biosphere reserves, biological corridors etc.

Two years later, in 1969, James Lovelock introduced ‘Gaia Hypothesis’. It was a very important contribution as it helped perceive the Earth’s biotic and abiotic systems as a whole. Then in 1970, Richard Levins introduced the “Theory of Metapopulation”\(^{17}\) (a population of populations) which consists of a group of spatially divided groups of population of similar species which interact at various levels, as a result of habitat fragmentation. All these views provided an incredible development to biogeography. Again another most crucial contribution was made by Robert H. Mac Arthur in 1972. He wrote a book on ‘Geographical Ecology’ which made remarkable contribution to enrich the field biogeography\(^{18}\).

In early 1971, UNESCO proposed the Man and the Biosphere\(^{19}\) (MAB) Programme. It is an Intergovernmental Scientific Programme focused on interdisciplinary research schema and capacity building that aim the ecological, social and economic scopes of biodiversity loss and conservation. In the same year, the international convention on wetland\(^{20}\) (Ramsar convention) was held in Iran. This convention directed to maintain, conserve and sustainable use of wetlands. And also it emphasized its role, ecological importance, functions and their scientific, economic, cultural, and recreational value. The declaration of these geographical areas conserves biodiversity and enriches the field biogeography.

The term and idea of ‘Deep Ecology’ were introduced by the Norwegian philosopher Arne Naass in 1973\(^{21}\). This was directly rooted in the ‘Gaia Hypothesis’. Next, the Journal of Biogeography was introduced in 1974. It covers aspects of spatial, ecological, and historical biogeography. In 1975, Miklos D.F. Udavardy introduced ‘eight biogeographic realms’\(^{22}\) on a classification of biogeographical provinces of the world. Again E.O. Wilson in 1978 published an outstanding book on ‘Human Nature’ which methodically examined the scientific arguments surrounding the role of biology in the evolution of human culture (Jeffries, 1997).

According to (Wilson, 1992) the term ‘Biodiversity’ had been conceptualized in 1980\(^{23}\). Walter Rosen of the National Academy of Science, USA, coined the word ‘biodiversity’ from the two words “biological-diversity Two important biogeography text books appeared in this era; The two documents which were published in 1980s, were directed to originate the concept of biodiversity, one by the Council of Environmental Equality (1980) and the other by Norse & McManus (1980). He used this terminology ‘biodiversity’ to describe a concept that incorporated both ecological and genetic diversity\(^{24}\).

In 1984, James A. Taylor wrote a book on ‘Biogeography: Recent Advances and Future Directions’ (Huggett, 1998). Taylor made a great contribution to biogeography by this book. In 1987, Our Common Future and the Brundtland Report published by the WCED influenced biogeography which expanded to address the conservation of biodiversity including genetic diversity at local, national and global levels. At this stage the thought on sustaining biodiversity was highly emphasized in biogeography.

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\(^{17}\) Amrita., 2013. [online] Available at: <http://amrita.vlab.co.in/?sub=3&brch=65&sim=772&cnt=1>[Accessed 08.03.2013].


The most significant figure in the second half of the 20th century was biogeographer and ecologist E.O.Wilson. Besides his contribution to develop the theory of island biogeography with R. H. Mac Arthur, he wrote a book in 1992 and used the term 'biodiversity' in his publication. His great contribution to 'Biogeography', 'Biology' as well as 'Ecology' should be admired. The concept of 'Biodiversity Hotspots' was introduced by Norman Myers in 1988. He introduced a biogeographic region in his articles on "The Environmentalist" (1988). A biodiversity hotspot is a biogeographic region with the most significant, biologically richest and most endangered (human pressure) global pool of biodiversity. In the 1980s, the conservation of biodiversity and related issues became very prominent at global, national and local levels (Jeffries, 1997).

In 1990, Carl Woese divided the kingdom Monera organisms into two kingdoms; Archaeabacteria and Eubacteria (Starr and Taggart, 2004; Raven, et al., 2008). In 1991, Hanski and Gilpin further explained certain additional characteristics on the theory of Metapopulation. 'Biodiversity' and related issues were discussed as one of the main themes at the United Nation's Rio Conference which was held in 1992. As result of the 1992 Rio Conference conservation of biodiversity was included in the international agenda and it has been understood that the conservation of biodiversity must deal with geographical perspective at global, national and local levels.

According to (Jeffries, 1997) in 1992, Wilson wrote a book entitled 'The Diversity of Life'. Again two years later in 1994, he wrote another book known as 'Naturalist'. Wilson is known for his scientific career, his role as 'the father of sociobiology'. As a theorists and a sociobiologist, his contributions to biogeography in its different stages must be appreciated. In the last decade of the 20th century, Michael Jeffries's views on 'biodiversity' in his book on 'biodiversity and conservation' in 1997 should be highlighted. Since 1997, Jeffries's thought on the conservation of biodiversity in a sustainable manner after agenda 21, highly influenced biogeography.

Recent scenario of the field

In the recent scenario: the International Biogeography Society, founded in 2001 and the inaugural meeting was held for biogeographers worldwide in 2003. The society hosts conferences, publishes, supports an online facebook community, delivers news on the blog, and fosters interaction among members. In 2013, 6th International Conference of the International Biogeography Society was held in Miami, Florida (USA). In this scenario, another important contribution was made by Lomolino and Heaney in 2004. They wrote a book entitled 'Frontiers of Biogeography: New Directions in the Geography of Nature' that book focuses on advances in historical biogeography and island biogeography.

Among the event of biogeographic importance of the recent scenario, in 2006, Al Gore's film on Climate Change and Global Warming ('An Inconvenient Truth'-2006) highly focused trend of species migration due to Global climatic change. His immense contribution to 'Biogeography' and 'Environmental Geography' should be respected. It gave a new direction to conserve biodiversity at global, national and local level. The next work was by on . This book has given much attention to ecological aspects of biogeography. Besides it has given emphasis to species isolation, species extinction, hotspots and biodiversity conservation. It gave a new thought to ecology via biogeography.

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The year 2010 was a milestone for biogeography. The United Nations declared 2010 as the International Year of Biodiversity30 (IYB). IYB is a unique opportunity to enhance understanding of the crucial role that biodiversity plays in sustaining life on Earth. It was meant to help raise awareness of the importance of biodiversity through activities and events in many countries. Conservation of biodiversity is vital for current and future human wellbeing. By the end of first decade of the 21st century, ’s book on was published as the 7th edition. This book series created quite a ripple in the field of biogeography. Again in 2010 the Convention on Biological Diversity was held in Nagoya, Japan and the Nagoya Protocol31 was adopted. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology, which was adopted in January 2000. On 22 December 2010, the UN declared the period from 2011 to 2020 as the UN-Decade on Biodiversity. They, hence, followed a recommendation of the CBD signatories during COP10 at Nagoya in October 2010.

The field Biogeography is historically mostly descriptive with theories, models, hypotheses and equations. But after quantitative revolution (1960s), and with rapidly developing technologies including GIS and remote sensing technique, together with the availability of complicated data (including e data) and increasingly sophisticated analytical tools, the field is incorporated with new technology. Specially paleontology, bioinformatics, global change biology, conservation biodiversity, and invasion biology, as well as genetically modified techniques, genetically modified food system, sustainable food systems and ecosystem services. In the recent scenario, the highly use of computers, GIS and remote sensing techniques in biogeography has grown considerably since 2000.

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Rainfall extremes have adverse impacts on the society and environment of Sri Lanka. The objective of this paper is to seek evidence spatio-temporal trends for rainfall variability on climate change in Eastern Province of Sri Lanka by analyzing long-term monthly data of rainfall received during the four rainy seasons - i.e. the Northeast monsoon, the first inter-monsoon and the second inter-monsoon during the period 1980-2010, from meteorological stations of the Department of Meteorology. Five stations of Eastern Province have observed either flooding in rapid sequence in recent years. Some studies attribute such extreme events to rainfall variability on climate changed induced by global warming. However, there is a dearth of climatological studies addressing the spatio-temporal trends in rainfall over Sri Lanka in support of such attribution. Using daily rainfall data collected at the 5 stations from Eastern Province of the Department of Meteorology, It interprets rainfall trends using different GIS techniques, so that the practical implications of rainfall variability on climate change in recent decades are clearly identifiable. The study finds that the number of rainy days has declined at all the rainfall stations except for the Trincomalee station.

**Keywords:** Climatology and Spatio-temporal

**Introduction**

Precipitation varies from year to year and over decades, and changes in amount, intensity, frequency, and type (e.g. snow vs. rain) affect the environment and society. Steady moderate rains soak into the soil and benefit plants, while the same amounts of rainfall in a short period of time may cause local flooding and runoff, leaving soils much drier at the end of the day. Snow may remain on the ground for some months before it melts and runs off. Even with identical amounts, the climate can be very different if the frequency and intensity of rainfall differ, highlight the fact to the characteristics of rainfall are just as vital as the amount, in terms of the effects on the soil moisture and stream flow.

Rainfall is of primary importance to the both physical and cultural landscape of any region. Of all the standard climatic parameters, rainfall is the most variable parameter in time and space. Rainfall received across Sri Lanka varies dramatically from year to year, ranging from dry periods that can persist for months, to periods of intense downpours, storms and flooding. The temporal and spatial diversities associated with rainfall have the basis for dividing the climate year in Sri Lanka into four seasons: two Monsoon periods and two Inter-Monsoon periods. The Southwest Monsoon (Summer Monsoon) prevails from May to September while the Northeast Monsoon (winter Monsoon) lasts from December to February. In between these two monsoon periods, two Inter-Monsoon periods exist: March to April - first Inter-Monsoon period and October and November - second Inter-Monsoon (National Atlas of Sri Lanka, 1988). Westerly winds prevail during the Southwest Monsoon and North-easterly winds prevail during the Northeast Monsoon. The seasonal variations of wind direction and rainfall have a marked influence on human activities.

Climate change has become a major concern to human society because of its potentially deleterious impact worldwide. It poses especially significant threats to sustainable development in developing countries, which have fewer resources and are more vulnerable (Munasinghe, 2001). Impacts on developing countries remain poorly understood because few
studies have successfully measured the effects of climate on developing country economies. Nonetheless, it is likely that a developing country will be more vulnerable because a greater fraction of its economy is in climate sensitive sectors (for example, agriculture), it is already in a hot climatic zone, and the economy relies on labor-intensive technologies with fewer adaptation opportunities (Mendelsohn et al., 2001).

Rainfall is a key determinant of the growing seasons and the types of agriculture practised. Rainfall plays an important role in agriculture as any shortages or excesses of rainfall gives way to a reduction in yields. For instance, rice is the main crop in Sri Lanka and is highly susceptible to rainfall variability. Other crops such as the plantation crops of tea and rubber are also dependent on the amount of rainfall received.

The number of rainy days in a season is of particular importance for tea and rubber crops. Yield decreases can be attributed to an increase in the frequency of droughts and reduction of the number of rainy days. Therefore, examining trends in the variability of the number of rainy days is vital as it is a decisive factor in agriculture. The number of rainy days is also important for industrial activities such as salt production.

Given the importance of agriculture the number of rainy days affects growing patterns and yields. Therefore, it is important to investigate the factors determining the variability of rainfall. There is a dearth of studies on rainfall variability in Sri Lanka. Such studies are essential to evaluate the impact of climate change on agriculture.

Since late-1980s, there appear to have been changes in weather patterns in Sri Lanka with an apparent reduction in rainfall received and more intense dry spells. This study aims to assess the magnitude and significance of rainfall variability and change over time using statistical analysis techniques and spatial analysis techniques in Geographical Information Systems (GIS).

Objectives

The goal of this study is to obtain evidence of rainfall variability on climate change in Eastern Province in Sri Lanka over the last three decades. Although there are several climatic variables that could be included in a study of climate change, only rainfall has been selected for the current analysis from the 5 stations in Eastern Province in Sri Lanka. The study has the following specific objectives:

- To observe trends in annual rainfall in Eastern Province.
- To observe trends in the number of rainy days.
- To observe trends in the number of rainy days by rainy seasons

Materials and Method

This study is utterly based on secondary data available from the Department of Meteorology. Daily rainfall data were collected for the period from 1980 to 2010 for 5 rainfall stations from Eastern Province climate in Sri Lanka the minimum 30-year period required for climatological analyses. The 5 rainfall stations are well distributed over the entire Province by elevation and climatic regions, the stations under study, their elevations and the period.

Statistical analysis such as linear regression and time series analyses were utilized to examine periodic rainfall changes in both annual and seasonal contexts. GIS spatial analysis techniques such as Surface Interpolation, zonal statistics were utilized.

Results and Discussions

The result of trends in the number of rainy days, the annual number of rainy days was obtained from the original daily rainfall record at each station. Regression analysis was performed on the number of rainy days at each station (Table 01) for results.
It is observable that all the stations have a decreasing number of rainy days. It is shown that three stations have had a marked negative trend and it is more pronounced in the Eastern Province Sagamam Tank and Potuvil have recorded as having the notable decreasing trend while Trincomalee and Amparar Tank in the Eastern Province have shown a moderate decline in the number of rainy days received during the study period. Observations like Kantalai Tank and Batticaloa have slightly less decreasing trends. There is no station with the positive trends in the number of rainy days. These aspects can be clearly displayed in graphical form.

In the Eastern Province, the highest decline is recorded in Sagamam Tank at -0.474. The lowest decline is recorded in Batticaloa and Kantalai Tank as -0.000 and -0.001 respectively. Figure 01 to 03 demonstrates the decrease in the number of rainy days in Ampara Tank and Trincomalee, situated in the eastern part of the island, records a low decline of -0.013 and 0.0.28 respectively in number of rainy days. In both station, there has been a steady decline apart from few deviations between certain years. In both stations, the number of rainy days has not exceeded 140 days since the 1980s.
Trends Analysis in the number of rainy days by NEMS

With regard to the number of rainy days received in each season, the Northeast Monsoon Season (NEMS) has witnessed a negative trend in all the meteorological stations under study. Potuvil has depicted a remarkable decline in all seasons except in the Second Inter Monsoon Season (SIMS). In the NEMS the decline has been more pronounced in the Central to Eastern parts of the country. Out of the NEMS Inter-monsoon seasons, the FIMS has a comparatively higher rate of decline in the number of rainy days. In the NEMS the same phenomenon has correlated between the amount of rainfall and the frequency of the rainfall except in the station Sagamam Tank. All stations under study have negative trends in the amount of rainfall that received during a particular season. Despite the reduction in the number of rainy days at all stations during the NEMS, the total rainfall received at Batticaloa and Kantalai Tank has increased.

The annual rainfall of the eastern province is predictably considered as ranging between 1000mm to 5000mm. There is a marked spatial pattern associated with the mean annual rainfall over particular station in eastern part of Sri Lanka. Seasonally greatly varying distribution of rainfall throughout the year can be derived for the entire island. Monthly rainfall at each meteorological station was used to compute annual rainfall totals.
The above graphical format clearly shows that almost all the stations under study have recorded positive trends in annual rainfall over time. Only Sagamam Tank has shown a negative trend but it is not a significant relationship as the $R^2$ record for about 0.003. The positive trend is more remarkable in stations such as Ampara Tank, Batticaloa, Trincomalee and Kantalai Tank. It is seen that both Batticaloa and Kantalai Tank have demonstrated remarkable positive trends in the annual rainfall pattern just as in the number of rainy days (Figure 05). From these results it can be concluded that both these stations have experienced a boost in the amount of annual rainfall received. It is notable that Ampara Tank and Trincomalee have a moderate enhance in the number of rainy days but when it comes to the annual rainfall both stations are having remarkable enhance.

Conclusion

The study finds that although the number of rainy days has decreased except rainfall station included in the analysis. The total annual rainfall has not decreased in the all stations. This could indicate that the intensity of rainfall events may have increased together with increased durations of dry spells. The apparent increased incidence of flooding and droughts in the recent past could probably be attributed to such changes in the temporal pattern of rainfall distribution. Further studies are needed to investigate the relationship between the number of rainy days and total rainfall within a season. These studies should also establish the relationship between local rainfall and global drivers of climate variability and change. Such studies could provide invaluable guidance to decision making in agriculture and water resources management.

References:


Abstract: Coastal erosion is an earth process common in the coastal region of Sri Lanka. The research area comprises from Panama to Maruthamunai coastal area. The research area is coming under lowland type and 115 km of coastal belt with less than 15 m flat lands. Sea bed comprises mainly sandy type. Bays and sea upland coast types are concentrated along this region. The prime objective of this research is to identify the causes of coastal erosion. The primary and secondary data were used to achieve the objective.

The coastal erosion in the research area were subjected to physical as well as anthropogenic activities lead to destruct the coastal environment such as; sea water intrusion, destruction of biodiversity, etc. A better coastal conservation management plan has to be formulated in order to protect and conserve the coastal resources of southeastern coast of Ampara District.

Keywords: Coastal Erosion, Coast, Coastal Region.
அப்படி விளக்கம்

அப்படி விளக்கம்

1. முதலாம் நூற்றாண்டு கருவிகள்:
   இலங்கையில் பல்வேறு பொருளாதாரங்களுடன் பல்வேறு வடிவங்கள் பாதுகாப்பு பொருளாதாரங்களின் வடிவமைப்பு, அறிவியல் மற்றும் தொழில்நுட்ப வளையும் நிலை செயல்பாடுகளை உரை செய்யும் கொள்கைகளைப் பாதுகாப்பு நிலைகளின் மூலம் குழும்பாடுகள் அமைக்கும் வழி பாதுகாப்பு முறையிட்டு விளக்களித்து வைக்கிறது.

2. இணைந்த நூற்றாண்டு கருவிகள்:
   இலங்கையின் பல்வேறு பொருளாதாரங்களிலும் மனிதன் பொருளாதாரங்களின் வடிவமைப்பு, அறிவியல் மற்றும் தொழில்நுட்ப பொருளாதாரங்களுடன் தொடர்விளக்கைகளின் வடிவமைப்பு மற்றும் தொடர்விளக்கைகளின் வடிவமைப்பு விளக்களித்து வைக்கிறது.

3. பதினொன்றாண்டு விளக்கம்
   பதினொன்றாண்டு விளங்கைகளிலும் பொருளாதாரங்களின் வடிவமைப்பு பொருளாதாரங்களுடன் தொடர்விளக்கைகளின் வடிவமைப்பு விளக்களித்து வைக்கிறது.

அப்படி விளக்கம்

அப்படி விளக்கம்

1. முதலாம் நூற்றாண்டு கருவிகள்:
   இலங்கையில் பல்வேறு பொருளாதாரங்களுடன் பல்வேறு வடிவங்கள் பாதுகாப்பு பொருளாதாரங்களின் வடிவமைப்பு, அறிவியல் மற்றும் தொழில்நுட்ப வளையும் நிலை செயல்பாடுகளை உரை செய்யும் கொள்கைகளைப் பாதுகாப்பு முறையிட்டு விளக்களித்து வைக்கிறது.

2. இணைந்த நூற்றாண்டு கருவிகள்:
   இலங்கையின் பல்வேறு பொருளாதாரங்களிலும் மனிதன் பொருளாதாரங்களின் வடிவமைப்பு, அறிவியல் மற்றும் தொழில்நுட்ப பொருளாதாரங்களுடன் தொடர்விளக்கைகளின் வடிவமைப்பு மற்றும் தொடர்விளக்கைகளின் வடிவமைப்பு விளக்களித்து வைக்கிறது.

3. பதினொன்றாண்டு விளக்கம்
   பதினொன்றாண்டு விளங்கைகளிலும் பொருளாதாரங்களின் வடிவமைப்பு பொருளாதாரங்களுடன் தொடர்விளக்கைகளின் வடிவமைப்பு விளக்களித்து வைக்கிறது.
மாந்தூரிகள் குட்டங்களை காணல். பாதுகாப்பு. 

அட்சங்களை விள்ளைக்கப்பட்ட குட்டங்கள் குட்டங்களை காணல் மற்றும் விள்ளைக்கப்பட்ட குட்டங்களை காணல். இது மற்றும் குட்டங்கள் குட்டங்களை காணல் மற்றும் விள்ளைக்கப்பட்ட குட்டங்களை காணல். 

01. 1950 களில் தொடர்புப்படுத்தும் பன்னாட்டு. 
02. 1960 களில் தொடர்புப்படுத்தும் பன்னாட்டு. 
03. 1970 களில் நூற்றாண்டு பன்னாட்டுக் கையில் முன்னெடுத்து முன்னெடுத்து முன்னெடுத்து முன்னெடுத்து பன்னாட்டு. 

ஆசிய வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள வளிமாற்றக்கூடியதள 

1. விளைக்குறுக்கட்டுகள் 
- செயல் 
- கார்பூர் 
- நூல்லுநர் கார்பூர் 
- பொருளாதார கார்பூர் 
- போர்னாடு கலாச்சார 

2. முக்கிய கார்பூர் 
- பொருளாதார கார்பூர் 
- பொருளாதார கார்பூர் 
- பொருளாதார கார்பூர் 
- பொருளாதார கார்பூர்
கார்பியம் சேசு என்பது – பாசினீசியாவில் கி.மு. 6500–5500வரே இந்த காலகட்டத்தில் முதல் பெருமளவு மாவை கடைசிக் குடைவனவாகும் என்று கூறப்படுகிறது. உலகப் பார்வையாளர்கள் கார்பியம் யின் கார்பியச் சேசுவின் மையத்தில் யிங்குகின்றனர். தெற்கில் பாதையில் சேசு மண்டலம் வழியாக பந்து வரும் நீர்க் காலை சேசு மண்டலமும் உள்ளது. இவ்விடங்கள் சேசு மண்டலமும் கார்பியாச்சேசுவின் மையத்தில் வருவதுத் தோன்றுகிறது.

1984 இல் கார்பியம் பாதகம் சேசுச் சேர்களின் காலகட்டம் வழியாக வேட்டையாடியது. கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது. இப்பத்தி கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது. இப்பத்தி கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது. இப்பத்தி கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது. இப்பத்தி கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது. இப்பத்தி கார்பியின் பாதகம் சேசுச் சேர்களின் காலமும் வழியாக வேட்டையாடியது.
1. Coastal Zone Management Plan (CZMP)

- Coastal Zone Management Plan, 2003

2. Coastal Zone Management Plan (CZMP)

- Coastal Zone Management Plan, 2003

3. Coastal Zone Management Plan (CZMP)

- Coastal Zone Management Plan, 2003

02. Coast Conservation Department, Ministry of Fisheries and Ocean Resources, Coastal Zone Management Plan, Sri Lanka (2003).

03. Regional Technical Assistance for Coastal and Marine Resources Management and Poverty Reduction in South Asia (ADB RETA 5974), A Socio Economic Assessment Of The Puttalam Lagoon Area, IUCN-the world conservation


05. Regional Technical Assistance for Coastal and Marine Resources Management and Poverty Reduction in South Asia (ADB RETA 5974), Biodiversity in Puttalam Lagoon with Special reference to Poverty Alleviation, IUCN-the world conservation union, Sri Lanka (2003).
Abstract: Today, there are so many researchers have been conducted on Geographical aspects. The research titled on “Social, Economic and Environmental impact caused by the landslide – A study based on Kandy district” is an urgent reality to mitigate Geological disasters in Kandy District. Today, many natural disasters occur worldwide. According to that, the effects of landslide which occurs at world mountainous regions can be seen even in Sri Lanka. Though we generally focus on it as a Global Environmental Problem, we can see the gradual increase of this effect at hill country regions of Sri Lanka.

The purpose of this research is to find the areas in which the landslide occurs in Kandy district, the reasons for that, and identify the social, economic and environmental effects which are arisen from this critical condition. Hence, for this purpose primary and secondary data have been collected. Primary data is received by having discussions with the victims at specific research area. When we talk about secondary data, it is received through books, research articles, magazines, national building research organization and Divisional Secretariat.

This research explains about research area. Landslides in Sri Lanka, theory of slope elevation, the types of landslide in Sri Lanka, landslide in Kandy, the reasons for occurring landslide. Landslides are causing social, economical and environmental effects. This research identified the landslides and problems in Kandy District. The last comprises identified problems (findings) and evaluations, recommendation and management actions.

Keywords: Landslide, Natural Disaster, Mitigation

1.1 காட்டு அதிபரம்

விஷயத்திலிருந்து்ய நூற்றணவாண்டுக்குள் பெரும்பாலான பகுதிகளில் உள்ள வளர்ச்சியும் மற்றும் கூட்டம் வளர்ச்சியும் பெருமளவுக்குள். மூலம், மிகவும் முக்கியமான காலத்துவாக்கை வழங்க வேண்டும் லால்சுசரைகளை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. மேலும் முன்னால் வரும் குறைந்தும் வளர்ச்சியை வழங்க வேண்டும் லால்சுசரைகளை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. அல்லது லால்சுசரைகளை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. மேலும் லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. மேலும் லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்துவது குறிப்பிட்டுள்ளது. லால்சுசரையை வகைப்படுத்து

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Rikaza Faris and M.I.M. Kaleel

"One of the significant factors in determining the final soil properties is the use of different soil amendments in the field. The paper presents the results of a study carried out to determine the effect of adding various amendments to soil on the final soil properties. The study was conducted in arid regions of Jordan, where the soil is known to be of sandy type. The amendments used were: lime, gypsum, and dolomite. The results showed that the amendments significantly increased the soil's cation exchange capacity, water retention capacity, and soil fertility. The lime amendment was found to be the most effective in increasing the soil's cation exchange capacity and water retention capacity. The study also revealed that the amendments improved the soil's physical and chemical properties, making it more suitable for agricultural purposes."

1.2 Methods of Study

The study was conducted in arid regions of Jordan, where the soil is known to be of sandy type. The amendments used were: lime, gypsum, and dolomite. The results showed that the amendments significantly increased the soil's cation exchange capacity, water retention capacity, and soil fertility. The lime amendment was found to be the most effective in increasing the soil's cation exchange capacity and water retention capacity. The study also revealed that the amendments improved the soil's physical and chemical properties, making it more suitable for agricultural purposes.
1.3 அம்பலும் பிரித்தைகள்

அம்பலநூற்றாண்டுகளைச் சேர்ந்த மயல் குடியரகத்தாளரின் பிரித்தைகள் செயல்தொடர்ந்து சிறப்பான முறைகள் வழங்கப்பட்டுள்ளன. மது அம்பல் புனித கிருத்தம்போன் 41.52 எகுந்தங்கள் காட்சி அடைத்துள்ளது. மது அம்பல் பிரித்தைகளை அறிமுகப்படுத்தும் வாய்ந்த கோஷ்டமாக்கின்றார். மேலும் அம்பல் பிரித்தைகள் தற்கால முறையில் வழங்கப்படுகின்றன.

1.4 அம்பலில் நிறைந்து

அம்பலநூற்றாண்டுகளைச் சேர்ந்த மயல் குடியரகத்தாளரின் நிறைந்த காரணங்கள் பயன்படுத்தப்பட்டுள்ளன. அம்பலை நிறைந்து இந்த காரணங்கள் அடைத்துள்ளது. இந்த காரணங்கள் மது அம்பல் பிரித்தைகளை அறிமுகப்படுத்தும் வாய்ந்த கோஷ்டமாக்கின்றார். மேலும் அம்பலில் நிறைந்து பயன்படுத்தப்படுகின்றன.

1.6 அம்பலுக்குள் மூன்று வகைகள்

அம்பலநூற்றாண்டுகளைச் சேர்ந்த மயல் குடியரகத்தாளரின் மூன்று வகையான முறைகள் வழங்கப்பட்டுள்ளன. மது அம்பல் பிரித்தைகளை அறிமுகப்படுத்தும் வாய்ந்த கோஷ்டமாக்கின்றார். இந்த காரணங்கள் பயன்படுத்தப்படுகின்றன. இது அம்பலநூற்றாண்டுகளை அறிமுகப்படுத்தும் வாய்ந்த கோஷ்டமாக்கின்றார். மது அம்பல் பிரித்தைகளை அறிமுகப்படுத்தும் வாய்ந்த கோஷ்டமாக்கின்றார்.
1.7 Result and Discussion

In the context of the study, the authors observed that 20% of the forest area was captured by GIS technology in the GIS layers. This information was then used for the analysis. The results showed that the area covered by forest was 20% of the total area. The authors also discussed the implications of these findings for the management of the forest area. They concluded that further research is needed to understand the dynamics of forest cover in the region.
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Abstract: ‘Development’ refers to people living with economic, social and political well – being. The major factor that hinders the development of a poor country like Sri Lanka is its inability to eradicate the regional imbalance through its well – planned development. This imbalance exists in provinces, districts, and local levels. In this way, development imbalance in Jaffna district seems to be the obstacle of its development. The distribution of imbalance related to development can be seen in the sections of divisional secretariat on the basis of the factors related to population, health, economy, education and institutional bodies. This clearly shows the existing regional imbalance.

Keywords: Regional Imbalance> Well – being, well – planed development.

1. Introduction of Research

Imbalanced Development in intra Divisional Secretariat Divisions in Jaffna District: a Statistical Research

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Proceedings of the Third International Symposium,
SEUSL: 6-7 July 2013, Oluvil, Sri Lanka

2. Research Area

Map: 01
Location of Research Area

Map: 02
D.S Divisions of Research Area

The research area was located within the coastal zone of Sri Lanka, covering an area of 7954.5 km². The area is characterized by a tropical climate with high humidity and heavy rainfall. The coastline forms the northern boundary of the region. The main research activities were conducted in the coastal areas, including coastal erosion, mangrove ecosystems, and marine resources.

The map shows the detailed divisions of the research area, including the D.S divisions and the location of the research areas. The data collected and analyzed were used to develop a comprehensive understanding of the coastal features and resources in the region.

The research activities included surveys, sampling, and monitoring of the coastal environment, with the aim of improving the management and conservation of coastal resources. The findings contributed to the development of sustainable management strategies for the region.

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3. Research Problem

- The research problem examines the development of divisions within the intra-divisional secretariat divisions in Jaffna District, focusing on statistical research.

4. Research Objectives

- Objective: One. The research objective is to analyze and compare the development of divisions within the secretariat.

5. Research Methodology

- The methodology includes descriptive statistical analysis to study the development of divisions.
6. Findings and Acknowledgments

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Population indicators

![Population indicators graph](image)

Figure 1: Imbalance in population of Research Area
Imbalanced Development in intra Divisional Secretariat Divisions in Jaffna District: a Statistical Research

Figure 2: Imbalance in Economic Factors of Research Area.

Figure 3: Imbalance in Health indicators of research area
Figure 4: Imbalance in education of pre schools’ students.

Figure 5: Imbalance in Education of students.
7. Discussion and Acknowledgments

Figure 6: Imbalance in institutional aspects.
8. References


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Changes Made in Growth of Road Transportation in the Urban Development in Galle Kadawath Sathara

Abstract: Transportation is most important to fulfill the public’s needs and wants to encourage business activities among the people. Since Stone Age period transportation is not complete and very poor development in this world and difficult to transferring the people and services to another place that time. But, now a day’s transportation achieved top development level with better transport networks. Road transportation is one of the important factors in the transportation. According to this transportation, most of the city place faced major development changes and providing better services to people. According to this research study, Galle Kadawath sathara is research area and this particular place is centre part of the Galle. Here, roads are getting fast growing development earlier. Most of the roads are connect with Galle district and it’s engaged with other cities and districts in Sri Lanka.

The research objectives are clearly identified to response of idea to this problems and essentially this research will be carried out base on the identified objectives to take ideas and solution. According this research study, the objectives are to identify the Galle Kadawath sathara social economical and environmental changes by road transportation development, to measure basic and current situation of the road transportation in urban development and to identify the critical factors and problems of the road transportation to this road transportation growth.

This research data collection method is generally based on the type of the research objectives and the type of the data required. The data could be divided into two major elements as primary data and secondary data. Primary data is obtained from interviews, observation and discussion. To get interviews from public country planners, engineers, drivers and pedestrians for this primary data. Secondary data is the data which is already available for through Divisional secretariat, RDA journals, research articles, books and internet access. In this study data and information has been gathered using both methods of data collection.

According to this research study conclusions and findings, Galle district is one of the major population areas and it has narrow short land for livings. Here most of the roads are divided though A, B, C, D types to transport. These types of road transport development make major changes on transportation. Vehicle amounts are increasingly by this transportation and road development. According to this transportation development most of the areas affected by environmental pollution and increasing vehicle traffic problems in day today. There pollute activities are affected on Galle Kadawath sathara people. IVHS, traffic management measure and other methods are best managing planning for decrease these problems through the urban development and road transportation. Such methods we will reach the better target on based road development and transportation activities in this Galle Kadawath Sathara urban area.
அப்பானித் தேசியம்

பட்டையில் தகரைக் குருக்கிய பாதுகாப்பான, பெருநூற்றாண்டு, பெருநூற்றாண்டு ஆக்கிரமியம் கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.

நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.

அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.

அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.

அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.

அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கியம் நூற்றாண்டு கருத்துருக்கியம். புகழ்பெற்று அப்பானித் தேசியம் நூற்றாண்டு கருத்துருக்கிய நூற்றாண்டு குறுக்கியம் குறுக்கியம்.
M.T.F. Zinha and M.I.M. Kaleel
Changes Made in Growth of Road Transportation in the Urban Development in Galle Kadawath Sathara

Abstract

This paper examines the changes made in the growth of road transportation in the urban development of Galle Kadawath Sathara. The study presents findings from both quantitative and qualitative data analysis.

Keywords: Urban Development, Road Transportation, Galle Kadawath Sathara

1. Introduction

1.1 Background

1.1.1 Urban Development

Urban development is a critical aspect of modern society, influencing various aspects of human life including transportation. The study of urban development involves understanding the processes that lead to the creation and evolution of urban areas, as well as the impact of these processes on the residents and the environment.

1.1.2 Road Transportation

Road transportation is a fundamental component of urban development, contributing significantly to the economic activities, social interactions, and daily commutes of urban residents. The growth and development of road transportation systems reflect the changing needs and demands of urban areas.

2. Methodology

The methodology adopted for this study involved collecting data from various sources, including quantitative and qualitative data. The quantitative data was primarily obtained through statistical analysis of transportation patterns and urban development metrics. Qualitative data, on the other hand, was gathered through interviews and observations, providing insights into the socio-economic contexts of the urban development.

3. Results and Discussion

3.1 Changes in Road Transportation

The study reveals significant changes in road transportation within the urban development of Galle Kadawath Sathara. These changes are attributed to both external factors such as urbanization and infrastructure development, and internal factors such as population growth and economic activities.

3.1.1 Quantitative Data

Quantitative data analysis showed a notable increase in road transportation usage, with a rise in the number of vehicles and the frequency of travel. The data also indicated a shift in transportation modes, with an increase in the use of private vehicles and public transportation.

3.1.2 Qualitative Data

Qualitative data provided deeper insights into the reasons behind these changes. Interviews with residents and officials highlighted the role of economic growth in stimulating urban development and increased road transportation demands.

4. Conclusion

The study concludes that the changes in road transportation within the urban development of Galle Kadawath Sathara are a result of a complex interplay of factors. It is essential to continue monitoring these changes to ensure sustainable urban growth and effective transportation management.

References

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- Town Planners (RDA) 05
- Civil Engineers 05
- GN Officers 05
- Drivers 10
- Pavement Sellers 10
- Information, Notification and Strictly Speaking (INSS) 05
- Expressionways 05
- Highways 05

Further information regarding the symposium can be found in the Statistical Package for Social Sciences (SPSS) and GIS Geographic Information System (GIS).
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The Impact of Modern Technology in Paddy Cultivation: A Study Based on Thamankaduwa Area.

Abstract: Polannaruwa district depends on paddy cultivation. Thamankaduwa is research area and this place especially for paddy cultivation and related employments. Here 80% of peoples doing paddy cultivation. Thamankaduwa land water and Suitable weather conditions are the most valuable resources for Agricultural activities. These Agricultural activities are main economics in this area. This dissertation is submitted on a partial fulfillment with special References on polannaruwa district in the impacts of modern Technology in paddy Cultivation; According to this research clearly identified objectives to take idea and solution by Agricultural activities and current condition of the Agricultural changes and to identified how modern Technologies effects on farmers in this research areas.

They use Modern Technologies on Agricultural activities for increasing food production to equal with population capacity in this reach area. According to this modern Technologies are effects on human straingt in agriculture. They lose most calculated energy for paddy cultivation activities through modern technologies. Agricultural activities are very expensive and most of the farmers have very poor knowledge about this modern technologies they don’t have economic resource, how to use these modern technologies on agricultural activities. There modern technologies are main reasons for the environmental pollution and health problems when they using modern technologies in Agriculture. There are some research problems to identify in this research area.

According to this research study, they required providing funds for farmers to collecting Agricultural machineries on this research area. Furthermore, they should issue knowledge about modern Agricultural machineries and builds mutual relationship between farmers and agricultural officers, executives and increasing fertilizing using systems. So, must solve the each and every farmer’s individual and common problems when they face Agricultural activities, and providing better solutions to farmers about agriculture & new technologies. The solutions are to develop paddy cultivation and increasing capacity of rice production in this particular research area.

Key words: Paddy Cultivation, Modern Technology, Effects.
நாளீந்த காலத்தில் காணப்பட்டுள்ள பொருள்களின் மொத்த உள்ளேரமைப்பு வளங்கலையில் வகித்துநிற்கவும் ஆக்கமானது. இக் காலத்தில் பெரும்பாலான அலகுகளின் பொருள்களை மறுபட்டிருக்கும் முறையாக குறிப்பிட்டுநிற்கவும் ஆக்கமானது. இக் காலத்தில் பெரும்பாலான அலகுகளின் பொருள்களை மருநிலைத்தான் என்று கண்டது. இக்காலத்தில் பெரும்பாலான அலகுகளின் பொருள்களை மறுபட்டிருக்கும் முறையாக குறிப்பிட்டுநிற்கவும் ஆக்கமானது.
M.I. Sihana and M.I.M Kaleel
The Impact of Modern Technology in Paddy Cultivation: A Study Based on Thamankaduwa Area.

Result & Discussion

By way of conclusions, it is evident that the adoption of modern technology in paddy cultivation has led to significant improvements in the productivity and efficiency of the farming process. The implementation of new technologies has resulted in increased yields, reduced labor costs, and improved quality of the produced paddy. Furthermore, the use of technology has led to a more sustainable farming practice, reducing the environmental impact of traditional methods.

Acknowledgments:

This study was supported by the Ministry of Agriculture, Sri Lanka, through its various programs and initiatives. Special thanks are extended to the farmers and researchers who participated in this study, providing valuable insights and data.

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8. "njhopEl;g cl;fl;likg;Gk; tpUj;jpAk; tptrhaKk; cyf uPjpahd Nghf;F > Gtp mUtp > fpof;Fg; gy;fiyf;fofk;> ,yq;if.

9. "jdghy> m.p., (1997) ;;;> ,yq;ifapy; new;gapu;r;nra;if-New;W> ,d;W> ehis > nefahs Nehf;F > kf;fs; tq;fp> ,yq;if.

10. "cs;ehl;L Ntshz;ik" > kj;jpa tq;fp Mz;lwpf;if> (2007>2010) > ,yq;if.

11. "fkry Nrit> jkd;fLit > (2012) Gs;sptpguf; ifNaL.
Abstract: Urban tourism has become one of main stream in tourism research since more and more urban areas promoted themselves as the most charming, sparkling or touching place on earth (Wendy Yang 2011). Tourism is becoming of increasing importance for economic growth and has led to wide research advances in several areas of the industry. The major focus of this study is identification, planning of urban tourism its policy and strategies in Tamil Nadu.

Key words: Arc GIS, Statistical analysis, Sustainable tourism, Eco tourism, Medical Tourism and Educational Tourism

Introduction

Urban tourism brings together people, place and consumption and mixes cultures, valvices, expectations and experiences it provided an exciting landscape for exploration. Tourism is travel for a recreational, leisure, or business purposes. Tourism has become a popular global leisure activity. In 2011, there were over 983 million international tourist arrivals worldwide, representing a growth of 4.6 percent when compared to USS 940 billion in 2010. (UNWTO Tourism Highlights 2012) Tamil Nadu is being promoted as an enchanting destination for holidaying in southern India and Tourism is a major contributor to the state’s economy. More than 25 million domestic tourists and 1.8 million foreign tourists visit the state every year. Statistics show that 30 percent of the foreign tourists visiting India also visit Tamil Nadu. Recognized with three National Tourism Awards for the year 2006-2007, the Tamil Nadu Tourism is keen on implementing innovative strategies to improve the Tourism Growth of the state.

Tourism is a major growth engine for economic development in terms of providing employment and eradication of poverty. The economic significance of tourism in terms of employment, income, foreign exchange earnings and regional development is a major driving force to place tourism appropriately in development. Tourism economic liberalization, open-sky aviation policy, luxury cruises, improved surface transport, tourist trains, increased business travel and e-booking facilities have created a paradigm change in the tourism sector. From a mere service industry, tourism has transformed into a major revenue generating industry. The term urban tourism defines as the tourism which takes place in urban areas. These urban areas are classified into major urban areas and other urban areas. Major urban area is where the population is 100,000 and more and other urban area where population is 1000 to 99,999.

Study Area

Tamil Nadu is one of the most urbanized states of India. A state in southern India is bordered by the states Pondicherry, Kerala Karnataka and Andhra Pradesh. The state, lying on the southern tip of the Indian Peninsula, is surrounded by the Bay by Bengal on the east, Indian Ocean on the south, Kerala and Karnataka on the west and Andhra Pradesh on the north the native language spoken here is Tamil which has become the official language with effect from January 14, 1958. It is the sixth most populous state of the India Union and a leading producer of both agricultural and industrial products.

The State extends latitudinal between 8°05’N to 13°09’N and longitudinally between 76°15’E to
80°20′E, the state of Tamil Nadu is a triangular landmass at the south-eastern end of the main continent. It is the eleventh largest state in India by area (about the size of Greece). It is a home to many natural resources, rare flora and fauna, cool hill stations, grand Hindu temples of Dravidian architecture, beach resorts, multi religious, pilgrimage sites and few UNESCO world Heritage sites. It is one of the foremost states in the country in terms of overall development. Total area of Tamil Nadu is about 1,30,058 sq.km which is a 4 percent of the total land area of India. For the purpose of administration, the state has been divided into 32 districts.

**Objectives**

The present paper has a set of two objectives. They are:

1. To study Planning of Urban Tourism in Tamil Nadu, and
2. To analyse the Government Policy and Strategies in Tourism Industry.

**Map No 1:**

Tourism in Tamil Nadu

Tamil Nadu is a state with several distinguished tourism genre. It has cerulean mountains, silver falls, verdant vegetation, sandy beaches, mammoth monuments, timeless temples, fabulous wildlife, scintillating sculptures and reverberating rural life. It has picturesque spots, continuing heritage, cultural confluence and aesthetic magnificence. Tourism enhances the performance of the tourism sector in an environmentally and culturally sustainable and socially inclusive manner. This would be reflected in

- Increase in the tourist arrivals and duration of stay.
- Distribution of income and benefits from tourism.
- Enhancement of management of natural and cultural heritage sites, which results in integrated development of high-priority tourism infrastructure in high potential tourism circuits.
- Enhanced connectivity and improved environment, utilities, and tourist services.
- Improvement of institutional and regulatory frameworks that will ensure coordinated efforts of multiple agencies.
- Promotion of environmentally and culturally sustainable and socially inclusive tourism development.
- Encouragement of private sector and community participation in tourism.
- Capacity building and human resources development for sustainable tourism and destination management through employment generation, poverty alleviation, environmental regeneration, advancement of woman and disadvantaged groups.
- Sculptures reflect artistic excellence and cultural splendor Tamil Nadu which has its unique culture and abundant tourism potential.

**Tourism Products in Tamil Nadu**

Tamil Nadu is ethnically a state of multifarious tourist attractions. The state has a versatile tourist segments which have special heritage grounds, which can be seen as different tourism products.
Pilgrimage Tourism

The state excellence is brought by symbol of spirituality which is important for national integration and community harmony. This spirituality belief in the state as formed many world famous Temple Towns which attract the tourist national and international tourist. The state tourism department corporation gives priority to provision of infrastructure facilities and basic amenities for the tourist at pilgrim centres.

Temple Towns of Tamil Nadu

Tiruchi, Madurai, Chidambaram, Rameswaram, Tiruvanamalai, Thanjavur, Kumbakonam, Nagapattina.

Heritage Tourism

Tamil Nadu state has a strong cultural heritage influence on the living of the people. This cultural heritage harmony prevailing in the state and the people attracts a large number of foreign tourist all over the globe. The state as announced nearly 49 destinations as heritage tourist spots. Tamil Nadu Tourism Department is conducting Indian Dance festivals, Chithirai festival, summer festivals and Cultural festivals to cater a large number of domestic tourists as well as foreign tourists.

Eco–Tourism

The state is rich in natural resource, has helped the state to promote eco-tourism. Tamil Nadu Tourism Department has a separate eco-tourism wing, with various are included on sustainable basis without disturbing the environment and wild life.

Table 2: Schemes Sanctioned: 2011-2012

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of the Scheme</th>
<th>Amount Sanctioned (Rs.in lakh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Development of Botanical Garden at Yercaud</td>
<td>365.00</td>
</tr>
<tr>
<td>2.</td>
<td>Development of Kolli Hills in Namakkal District</td>
<td>274.33</td>
</tr>
<tr>
<td>3.</td>
<td>Desilting and beautification of Yercaud lake</td>
<td>87.00</td>
</tr>
<tr>
<td>4.</td>
<td>Provision of infrastructural facilities at the Lagoon in Muthupet</td>
<td>58.88</td>
</tr>
<tr>
<td>5.</td>
<td>Establishment of Kurinji Park at Kodaikanal</td>
<td>15.20</td>
</tr>
<tr>
<td>6.</td>
<td>Tourist Reception Centre at Udhagamandalam</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Medical Tourism

Tamil Nadu being an ethical, cultural and environmental influenced state, of this reason large population comes to the state for various recreational promotions. This in the present day has influenced in maintaining the wellness of the tourist, which as lead to the branch of ‘Medical Tourism’. Medical Tourism comprises yoga, meditation, ayurveda, spa and nature cure is promoted in co-ordination with reputed institutions. The state has well skilled medical professionals and well equipped corporate hospitals. Government has issued orders constituting a Core Committee for promotion of Medical Tourism and Wellness Tourism.
Urban Planning/Governance Model of Urban Tourism

Fig: 1

State Funded Schemes

The state of Tamil Nadu has made an allotment of about Nine hundred and Eighty Six Lakh Rupees towards tourism development in most of the districts in the state during the year 2011-12. Among the states Rameshwaram being one of the most tourist attracted place in Tamil Nadu, also had the highest amount of fund of 200 lakh Rupees was allotted for the development of the district tourism (Table No.3).

Domestic and Foreign Tourist Arrivals to Tamil Nadu

Domestic Tourism is when people take holidays, short breaks and day trips in their own country.

- State – State
- District – District
- Town – Town
- Village – Village

International tourism is when people travel globally outside of their region and home country. This means a temporary movement of people from the resident place to another place for different reasons such as recreational, health, business or some other reason. The number of foreign tourist has increased on 2007 to 2011 in Tamil Nadu. (Map No.1,2,3,4)

Table No4: Tamil Nadu Domestic and Foreign Tourist: 2007 – 2011

<table>
<thead>
<tr>
<th>No</th>
<th>Years</th>
<th>No of Domestic Tourists (in Lakhs)</th>
<th>No of Foreign Tourists (in Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2007</td>
<td>622.6</td>
<td>15.23</td>
</tr>
<tr>
<td>2</td>
<td>2008</td>
<td>695.44</td>
<td>18.11</td>
</tr>
<tr>
<td>3</td>
<td>2009</td>
<td>780.38</td>
<td>23.69</td>
</tr>
<tr>
<td>4</td>
<td>2010</td>
<td>1030.1</td>
<td>28.04</td>
</tr>
<tr>
<td>5</td>
<td>2011</td>
<td>1367.51</td>
<td>33.08</td>
</tr>
</tbody>
</table>

Source: Development of an Australian Tourism Research Agenda

Source: Tamil Nadu Tourism Development Corporation
Growth Rate of Tourist Arrivals to Tamil Nadu

Growth rate is estimating future growth. The growth rate of tourist arrivals in Tamil Nadu as highly increased during the year 2010 when compared with other years from 2001 to 2011 (Chart No. 1).

Chart 1

Growth Rate-Tourist Arrival

<table>
<thead>
<tr>
<th>Year</th>
<th>Foreign Arrivals</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>18.4</td>
<td>21.2</td>
</tr>
<tr>
<td>2008</td>
<td>24.4</td>
<td>31.6</td>
</tr>
<tr>
<td>2009</td>
<td>32.4</td>
<td>31.6</td>
</tr>
</tbody>
</table>

Source: Tamil Nadu Tourism Development Corporation

Tourism influence on Business

Foreign Exchange Profitability in Tamil Nadu

Foreign exchange is business that allows customers to exchange one currency for another currency. The currency exchange profits from its services either through adjusting the exchange rate or taking a commission. Particularly 2011 the amount has highly increased in foreign exchange (Table No. 5)

Hotel Division Profitability in Tamil Nadu

Accommodation is main component of tourism industry. The hotel division is increased year by year and 2011 and 2012 profit is highly increased. (Table No. 5)

Transport Division Profitability in Tamil Nadu

The Transport division when compared with all the years it’s profit has been high during the year 2008-09 (Table No. 5)

Fair Division Profitability in Tamil Nadu

Fair trade in tourism is a key aspect of sustainable tourism. It aims to maximise the benefits from tourism for local destination stakeholders through mutually beneficial and equitable partnerships between national and international tourism stakeholders in the destination. It is clearly seen that the profit has been increasing from 2007 to 2012. (Table No. 5)

Tamil Nadu Tourism Development Corporation Profitability in Tamil Nadu

Tourism has grown a lot today as the standard of living of Tamil Nadu has grown too. The below table shows there has been a 50 percent increase in the turnover when compared to 2007-08 from 2011-12. (Table No. 5)

Table 5:
Tamil Nadu Profitability by Tourism during 2007 – 2011

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Year</th>
<th>Foreign Exchange (Rs. in Crore)</th>
<th>Hotel Division (Rs. in Crore)</th>
<th>Transport Division (Rs. in Crore)</th>
<th>Trade Fair (Rs. in Crore)</th>
<th>TTDC Profitability (Rs. in Crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2007</td>
<td>4987</td>
<td>6.6</td>
<td>1.47</td>
<td>1.29</td>
<td>4.22</td>
</tr>
<tr>
<td>2</td>
<td>2008</td>
<td>5422</td>
<td>9.38</td>
<td>1.89</td>
<td>2.97</td>
<td>2.25</td>
</tr>
<tr>
<td>3</td>
<td>2009</td>
<td>6796</td>
<td>10.65</td>
<td>0.89</td>
<td>2.43</td>
<td>3.66</td>
</tr>
<tr>
<td>4</td>
<td>2010</td>
<td>9889</td>
<td>13.83</td>
<td>1.24</td>
<td>2.86</td>
<td>2.64</td>
</tr>
<tr>
<td>5</td>
<td>2011</td>
<td>10383</td>
<td>16.38</td>
<td>1.41</td>
<td>3.45</td>
<td>10.69</td>
</tr>
</tbody>
</table>

Source: Tamil Nadu Tourism Development Corporation

Recent Development of Urban Tourism

The Tamil Nadu government received a fund from the Asian Development Bank (ADB) under a programme called the Infrastructure Development Investment Program for Tourism as Multi-tranche Financing Facility (MFF) for Tamil Nadu. Total outlay of ADB assisted Project is US$ 100 million (Rs. 500 Crore approximately) for the period of five years. The Project will be funded through the assistance of ADB.
to an extent of 70 percent (Rs.350 Crore) and balance 30 percent (Rs.150 Crore) through States funds. Investment Programme target enhanced economic growth and provision livelihood opportunities for local communities through tourism infrastructure development. The Investment Program consists of five components viz.

- Quality Enhancement of Natural and Cultural Attractions.
- Urban Infrastructure and Service Improvement.
- Connectivity Improvement and Signage's.
- Community-based activities.
- Capacity Development, Community Participation and Project Management.

The outcome of the project will strengthen the tourism sector in the state which will be measured by the increase in arrivals, length of stay of tourists in the destinations and increased spending of tourists. All these are expected to result in additional employment, economic development and improved living conditions for the local population, including the poor. The government of Tamil Nadu initiated the plan by forming two circuits for strengthening tourism in the state.

The East-Coast Circuit will be taken up first, followed by Southern Circuit. ADB Team has identified nine Sub-Projects and submitted Sub-Appraisal Reports (SAR) for East Coast Circuit for implementation in Phase-I. The State Government has issued orders constituting the “State Level Steering Committee” under the Chairmanship of Minister for Tourism and “Empowered Committee” under the Chairmanships of the Chief Secretary, for the speedy implementation for the ADB assisted Projects. The Project Loan Agreement has been signed by the State Government with the Asian Development Bank on 2-4-2012 at New Delhi.

Strategies For Promotion Of Tourism Announcement by Government December 2011

G.O. No. (4D) 1, Tourism and Culture (T1) Department, dated 23-9-2011 has been issued for promotion of Tourism in the State by implementing the following 7 strategies.

- Development of Tourism Parks.
- Development of Rural Tourism clusters.
- Integrated Development of Tourist destinations /Circuits /Cities.
- Skill Development.
- Wayside Toilet Campaign.
- Promotion of Heli Tourism, Cruise Tourism and Cable Car Project.

Master Plan

The Government of Tamil Nadu in 2006, introduced "Tourism Master Plan" for the State, which will be prepared to improve the infrastructure facilities required by the rapidly growing tourist traffic and to realize the potential of this sector. M/s. HUDCO, Chennai, was entrusted the task of preparing "Tourism Master Plan" for Tamil Nadu. After detailed surveys, M/s. HUDCO has submitted Tourism Master Plan. Based on the Master Plan, the unique selling packages for various destinations will be finalized and
accordingly, the infrastructure and facilities will be developed by seeking required budgetary support.

Meetings, Incentives, Conferences and Exhibitions (MICE Market)

In 2009-10, Tamil Nadu Tourism conducted three Seminars and Conferences namely, Medical Tourism, Responsible Tourism and Protecting monuments, for posterity in Chennai. MICE tourism (Meetings, Incentives, Conferences and Exhibitions) will be promoted through Chennai Trade Centre. The renovated Beach Resort Complex at Mamallapuram is staging many MICE events conducted by various Government departments, schools, colleges and NGOs.

Participation in the International Travel Marts

1. SAARC Trade Fair
2. PATA Meet (Pacific Asia Travel Association)
3. WTM (World Travel Mart)
4. ITB (International Tourism Bourse)

SAARC Trade Fair

SAARC Travel Fair is an annual event held in different member countries every year to promote Intraregional trade and enhance co-operation. Tamil Nadu tourism participated in SAARC Trade Fair held at Thimpu, Bhutan in September 2009.

PATA

Tamil Nadu Tourism participated in PATA held at Hangzhou-China in September 2009 and showcased the tourism wealth of Tamil Nadu and the benefit and cost-effective world-class medical facilities available in Tamil Nadu. There was a tremendous response from abroad for Medical Tourism in addition to other tour packages. Opportunity was given to Tamil Nadu Tourism to address the International Press on the final day of the Conference.

World Travel Mart – London

World Travel Mart is held at London every November. Tamil Nadu Tourism participated in the WTM, London in 2009. More than 100 countries participated. Tourism wealth of Tamil Nadu and the steps taken for promotion of Tamil Nadu were highlighted. The tourism stakeholders of Tamil Nadu were encouraged to participate in WTM and necessary assistance was rendered. This effort resulted in the considerable increase in foreign tourist arrivals.

ITB (International Tourism Bourse) – Berlin

Tamil Nadu Tourism participated in the International Tourism Bourse meet held in Berlin, Germany, in March 2008. It helped Tamil Nadu to showcase various segments of the State among the visiting delegates. The folk dance organised in the Tamil Nadu Pavilion showcasing the art forms of Tamil Nadu was well received. In 2010 also, the Tamil Nadu Tourism participated in the ITB Meet held in Berlin, Germany. The Tamil Nadu enclosure generated more interest as indigenous sweetmeats and savouries were distributed and a light entertainment of Tamil music and dance was organized with participation of local Tamils. With a view to inviting foreign tourists in more numbers, Tamil Nadu Tourism proposes to participate in

1. Pacific Asia Travel Association Meet
2. World Travel Mart, London
3. International Tourism Bourse, Berlin

and organize a marketing Meet at Mauritius and South Africa.

Participation in National Travel Marts

These objectives are met through an integrated marketing strategy and campaigns synergised in association with the travel trade. Tamil Nadu Tourism has been participating in most of the tourism travel marts Tourism fairs organised by Tourism departments of other States and stakeholders.
Pravasi Bharatiya Divas

Tamil Nadu Tourism participated in the Pravasi Bharatiya Divas held in Chennai in January 2009 and in January 2010 at Delhi and contributed a cultural show which had the blend of all artistic and aesthetic elements of Tamil Nadu.

SATTE, New Delhi

Tamil Nadu Tourism participates in SATTE (South Asia Travel and Tourism Exhibition) regularly so as to have interaction with buyer-seller from upcountry and abroad.

Great India Travel Bazaar, Jaipur

Tamil Nadu Tourism took part in a big way in the Great India Travel Bazaar, Jaipur organised by FICCI and Rajasthan Tourism. There was a tremendous response from buyers, for the buyer-seller meetings.

Fairs and Festivals

Tamil Nadu is a State known for several festivals and fairs with life affirmative attitude. Celebration is a part of Tamil culture and they make every moment a great benediction. Therefore, the fairs and festivals act as mechanisms to attract large number of people in the vicinity and offer them an avenue to relax and rejoice. Cultural programmes, musical events and dance performances suit the festive mood and provide the crowd with healthy entertainment.

Tamil Nadu Tourism Development Corporation (TTDC)

TTDC was opened on 30th June 1971 for providing infrastructure development in all the tourist destinations of the state. The growth of TTDC over the past forty two years was rapid and at present is grown having a chain of 55 hotels and youth hostels in all major tourism destinations.

E-Governance in TTDC

TTDC has earned the distinction of being the first State Tourism Corporation to introduce on-line booking of Tours and Hotels. TTDC has earned a sum of Rs.280 Lakh through on-line bookings during 2011-12 compared to Rs.215 Lakh during the previous year.

Boat Houses in TTDC

TTDC is having Boat houses at Muttukadu, Mudaliarkuppam, Pichavaram, Yercaud, Kodaikanal, Courtallam, Ooty and Pykara. TTDC had launched a 32-seater Cruiser at Boat House, Mudaliarkuppam on 12.1.2012 Action is being taken to replace old Boats with new Boats. To ensure safety of the passengers, wearing of Life jackets has been made mandatory during Boat rides in all the Boat Houses of TTDC.

Special Package Tours in TTDC

Rashtriya Mathyamaik Shksha Abhiyan (RMSA) Schemes TTDC has organized Special Package Tours for School Teachers under Rashtriya Mathyama Shikshka Abhiyan (RMSA) Scheme during February and March 2012, fetching revenue of Rs.3 Crore in co-ordination with the School Education Department. Apart from the regular Package Tours, TTDC is also organizing tailor-made Package Tours for various groups of Tourists catering to their specific requirements. Special package Tours are organized for the Corporate Sector and also for the group Tourists from Malaysia.

Medical Tourism in TTDC

Tamil Nadu, is a leader in providing medical care on par with the finest hospitals in the West in almost all the medical fields, and has implemented many policies for cheap medical tourism. It has plush corporate hospitals especially in Chennai, the capital. There are many world-class institutions and hospitals in Chennai, Madurai, Coimbatore and other cities in Tamil Nadu.
The state has performed best and first of its kind in many medical surgeries, heart transplantation to cataract operations. The state as multi-specialist hospitals, corporate hospitals and Transplantation centres. Medical Tourism Brochures with useful tips on health care are being planned for medical tourists. The State Government is also aggressively promoting Medical/Health Tourism. It is a much more peaceful state than any other state in North India. It is a leader in India especially in Eye Care, Oncology, Orthopaedics, Dialysis and Kidney Transplant. Today, practically every town has a good nursing home with attending consultants. Nursing has evolved as a specialty and Indian Nurses handle patients with a humane and personal touch that is the main reason why they are so much in demand in the West.

One can come to Tamil Nadu for a specific treatment or even go for a Master Health Check Up while on holiday. Everything is taken care of by the concerned hospital in liaison with the Travel Agency. Cardiac Care, Dialysis and Kidney Transplant, Eye Care, Cosmetic Surgery is available in all hospitals in Tamil Nadu and at very reasonable rates. Medical tourism is been in action since 2007 and performed many surgeries and treatments to several thousand international tourist from all over the world.

Symposium on promotion of Medical Tourism

Symposium on Medical Tourism was organised on 27-2-2009 in Chennai to create awareness on the potential of medical tourism. A seminar on “Role of Corporate sector in Tourism Promotion” was organised on 6th March 2009 in Chennai. Presentation on health tourism, cultural tourism, highway tourism, education tourism and rural tourism was made by the officers of the various Departments and stakeholders. During October 2009, Medi-Tour Meet was organized by the Tourism Department, so as to increase the tourists coming to the State to avail excellent medical facilities.

R. Kalaivani, V. Madha Suresh, S. Sanjeeve Prasad and M.I.M. Kaleel
Urban Tourism: A Role of Government Policy and Strategies of Tourism in Tamil Nadu

Human Resources Development in TTDC

Guide Training Programme

Guides play a vital role in tourism promotions. They are responsible for projecting the right image of the country, giving factual information, caring for the safety of the tourists and ensuring their pleasant stay. Tamil Nadu Tourism in co-ordination with the Anna institute of Management, Chennai conducts Guide Training Programmes for the unemployed youth and retired govt. officials Identity cards have been given to the 264 trained Guides so far. During 2012-13, Guide Training will be given for 482 persons.

Capacity Building Training

Training is imparted for the local community in Rural Tourism Sites. Front office staffs in Corporate Hotels, Drivers of Taxies, Auto-rickshaws and personal handling tourists at Airports and Railway Stations.

Skill Development Training

Under Hunar Se Rozgar Tak scheme of Government of India, Skill development training is imparted in Hospitality Sector through Catering Institutes. So far 3337 persons have been trained in Food Craft and Culinary arts, House Keeping, Room Service etc. by the Government Catering Institutes at Chennai and Trichy.

Tourist Security Organization

Tourist Security Organization is functioning in the Tourism Department. It has a Chief Tourist Warden stationed at Chennai to co-ordinate with the Station Tourist Wardens at five centres, namely, Mamallapuram, Rameswaram, Kanniyakumari, Kodaikanal and Udhagamandalam. Each centre has 5 Wardens. The existing strength of 30 Wardens will be increased and women will also be recruited for each centre. It will be expanded to other important tourist centre. Five two wheelers have been provided to the
Tourist Security Wardens. Ministry of Tourism, Government of India encourages the establishment of Tourism Security Organization and has appreciated the lead role played by Tamil Nadu Tourism Performance of the Tourist Security Organization has been well appreciated by the visiting tourists and local public and it has been published in print media.

Publicity and Marketing in TTDC

A large number of Tourists are coming from foreign countries. The state needs to be highlighted internationally so the visit of foreign tourist would be increased. The government introduced FAM tours (familiarization tours) to promote international tourist. An aggressive marketing campaign in these countries can make a major impact in realizing the tourism potential. At International Travel Marts, all important members of travel and hospitality industry congregate under one roof. Tourism Department promotes the destinations at these Marts. Tamil Nadu is ranked second in foreign tourist arrivals. Special efforts are taken to attain number one position. Tamil Nadu will be showcased in major International Travel Marts like International Tourism Bourse (ITB-Berlin-March 2013) and World Travel Market (WTM- London-November 2012).

Marketing meets are planned in source countries- Netherlands, Switzerland and France in co-ordination Tours for overseas Tour Operators and Travel will be arranged to promote Tamil Nadu. According to India Tourism Statistics for the year 2010, 11.16 Crore domestic tourists and 28.05 Lakh foreign tourists have visited Tamil Nadu. The tourist arrivals have further gone up in the year 2011. 13.68 Crore domestic tourists and 33.08 Lakh foreign tourists have visited the State in 2011.

New Urban Tours in TTDC

In addition to operation of regular Tours to various Tourist destinations by TTDC, the Government has issued orders for launching the following 10 new Tours for the benefit of Tourists during 2012-2013.

- Tour to Nagarathar Temples.
- Tour to Divya Desam Temples in Kancheepuram and Thiruvalpurur Districts.
- Tour to Thirukkadaiyur Temple
- Tour to Thiruvudai Amman, Vadivudai Amman and Kodiyyudai Amma temples.
- Madurai City Tour
- Tiruchi City Tour.
- Tour to Courtallam and nearby areas.
- Tour to Yealigiri Hills
- Tour to Kolli Hills
- Freedom Fighters Circuit Tour
- These Tours will be launched shortly.

Some of the major initiatives taken by the government to boost Tourism in Tamil Nadu include:

- Tourism has been declared as an industry.
- To encourage private investment, the Department of Tourism co-ordinates with different departments for early clearance of projects and prepares plans to improve infrastructure facilities in tourist centres obtaining central assistance, and securing the active participation of the local public by providing better economic avenues.
- The Tamil Nadu Tourism Development Corporation is providing travel circuit plan to tourists.

Conclusion

In the contemporary society the tourism represents one of the most dynamic economic sectors. Nowadays Tamil Nadu is about to become an important touring destination. According with the data providing by the Tamil Nadu Tourism Development Corporation shows clear structure of urban tourism planning and policy, strategies. For clarity, the tourism elements presented in this article have been largely treated however it is important to point out that there
is a high degree developing by cities for a variety of reasons including new developing policy, attracting visitors and stimulating the urban economics.

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குறிப்பிட்டுள்ள கணினியியல்
பிரித்திகழகம் அற்றும்
மொழிதுறுப்புப் பரிசும்
அழுத்த நூற்றாண்டுப் பரிசு

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(email: fowzulameer@seu.ac.lk)
Annual averages of PM-10 at Colombo Fort ambient air quality monitoring Station (1998-2007).

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<thead>
<tr>
<th>Location</th>
<th>Annual Average (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombo Fort</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>1</td>
<td>250</td>
</tr>
</tbody>
</table>

Source: Central Environmental Authority (Year 2007).
Monthly mean sulfur dioxide concentrations at Colombo Fort (June 2003 - December 2007)

Source: Central Environmental Authority 2007).

Monthly mean of one-hour averages of nitrogen dioxide concentrations at Colombo Fort (June 2003 - December 2007)

Source: Central Environmental Authority 2007).
M.L. Fowzul Amer

Purity and Cleanliness in Colombo, Sri Lanka

Source: http://www.numbeo.com/-03.04.2013

Pollution in Colombo, Sri Lanka

Source: http://www.numbeo.com/-03.04.2013


Tourism Industry for Regional Development – Post War at Jaffna District in Sri Lanka

Vinayagamoorthy Mathivathany

Abstract: The tourism industry plays a key role in regional and destination development. Jaffna district has more tourist potentials to develop the region. Tourism image in Northern province had changed by war during the last three decades. This research analyses the potential for regional development of tourism industry in Jaffna district. SWOT analysis and descriptive statistical analysis were used. The finding of research reveals that Jaffna district can benefit much more than present context of tourist industry by promoting tourism industry.

Keywords: Regional development, tourism industry, sustainable development.

General background of Tourism industry and situation of Jaffna District in Sri Lanka

The Island of Sri Lanka is a small universe, it contains as many variations of culture, scenery, and climate as some countries. But Sri Lanka was seen as a low budget tourist attraction during the war period. Tourism Industry collapsed mainly due to the war conditions throughout last 3 decades. The war is mostly over, and Sri Lanka is now stable and safe — and as beautiful, tropical, and friendly as ever. The Government done much in the past four years to fulfill the needs of the tourism industry. Tourists started pouring in to the country after the end of civil war. Now Major infrastructure development projects are undergoing in the country. The Government identified tourism as a fast emerging potential growth sector. The upliftment of the tourism industry not only benefits the industry, but also supports many other sectors. The setting up of hotels and restaurants will increase income and business opportunities for the self-employed, small and medium enterprises and farmers. It is important to enrich the tourism industry that will directly and indirectly help many other economic activities to achieve a higher growth rate.

Jaffna has already become a popular destination for tourists. Today instead of the brain drain; brain gain rate has increased. With the beginning of a new era with peace and stability it is vital that the business community recognize the possibilities and re-build the country’s economy.

Jaffna has enormous potential for development in the North. Jaffna is a resource land, which was untouched for the past three decades and it is vital to adopt the concept of being green since it is timely to have a sustained tourism in the country. There is immense potential for tourism and hotel industry in the Northern province. Over 500 people visit Jaffna daily from various parts of the country with the dawn of peace. With the opening of the A-9 road for the public, the number of tourists visiting Jaffna has increased rapidly. Several investors, who are very keen to invest in the hotel and tourism industry in Jaffna peninsula. Most said there are no Star Class hotels in Jaffna and considering the opportunity the investors are ready to set up Star Class hotel.

Objectives of research

The main objective of the study is to identify the recent salient features of the tourism sector or potential generations of tourism industry for the regional development. Second one is reveal the strategies plans for increasing regional development in future. Those are increasing the long term sustainability for regional development.
Research Area

Jaffna District is one of the 25 of . The headquarters is located in city. Jaffna District is located in the far north of Sri Lanka in the Northern Province and occupies most of the Jaffna Peninsula. The following map shows the research area.

Methodology

Information was gathered through visit to tourist areas, conducting interviews and relevant documents for the extensively study. Descriptive research type and descriptive statistical analysis and SWOT analysis were used for the result. Non probability sampling was used. The following figure show about the SWOT for tourism industry of Jaffna.

Result and Discussion

Few proposals to develop nature and tourism in Jaffna. Some tourism places are identified as the most attraction places in Jaffna. They are categorized under four themes namely, places. Events, recreational services and other services. Historic Places and Buildings, Parks, Natural Areas or features & beaches, and religious centres are identified as places.

Also, given below are some other tourism potentials which are prevailing at present in the Jaffna and which have the potential to develop further. Geographical features and resources are any other potentials to develop. Such as Sand, mineral resources, old valuable buildings, wells, places, and thinks, trees, mangroves, long beaches, seas, and harbours. University of Jaffna, Public Library of Jaffna and Tilko city Hotel are some of the most tourist’ attraction buildings and famous centers.

Conclusions

Tourism has become one of the major sector of the economy in Jaffna. Basically, tourism should ensure the following three basic necessities.

1. Have something for visitors to see:- Animals, birds, farms and nature are the few things which tourism could offer to the tourist to see. Apart from these, culture, dress, festivals and rural games could create enough interest among foreign tourists in tourism.

2. Have something for visitors to do:- Participating in many types of operations and swimming, bullock cart riding, pony riding, buffalo riding, cooking and participating in the rural games are the few activities in which tourist can take part and enjoy.

3. Have something for visitors to buy:- Rural crafts, dress materials, farm gate fresh agriculture products, processed foods are the few items which tourist can buy as souvenir for remembrance.

However, in Jaffna tourism is at an infant stage and is poorly organized. In most of the farms, hotels, infrastructure facilities are not sufficiently available. This is one of the factors that determined the success of the industry. Therefore, provision of basic infrastructure such as road facilities, clean water, and electricity is very important. Moreover, there is low awareness of tourism and its attractiveness with stakeholders. Making them well aware of tourism and creating a positive attitude towards opportunities of tourism is essential in order to have tourism operations. Although people have basic knowledge and skills in tourism, they are poor in business management skills namely entrepreneurship, management skills, interpersonal and communication skills etc. Therefore, tourism education and training in these areas are very much important for the successful and sustainable tourism operations.

Finding proper remedies for the above mentioned problems is an essential prerequisite as the potential entrepreneurs will face difficulties to start a business without external support. After that, introduction of tourism under the themes suggested earlier would be of great significance and would improve the overall economic, social, cultural, and aesthetic level of the areas. If the tourism industry develop in many ways, the many sectors and actions will be improve to the regional development.
References


Table 1: SWOT for tourism industry of Jaffna

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Weak public sector management</td>
</tr>
<tr>
<td>Nature – Sea/Bio diversity/wildlife</td>
<td>High local and foreign debts</td>
</tr>
<tr>
<td>Historical places</td>
<td>Tarnished image of SL during last three decades</td>
</tr>
<tr>
<td>Rehabilitate the A9 road</td>
<td>Seasonal business</td>
</tr>
<tr>
<td>High inflow of foreign remittances</td>
<td>poor infrastructure facilities (transport, telecommunication, quality of Hotels)</td>
</tr>
<tr>
<td>District less natural disasters</td>
<td>Not plans and guidelines for tourism places</td>
</tr>
<tr>
<td>Government intentions to support industry</td>
<td>Not awareness for people</td>
</tr>
<tr>
<td>The good relationship among western country</td>
<td></td>
</tr>
<tr>
<td>Resources for large and small industry</td>
<td></td>
</tr>
</tbody>
</table>

**Threats**

| Inappropriate usage of funding on development                            | Financial times                                                                                                                             |
| World economic down turn                                                 | Employment generation in the tourism sector                                                                                                 |
| Diluted spending power of travelers                                     | Improve large and small industry                                                                                                             |
| High security zones                                                      | Increasing of inter regional development                                                                                                   |
| Registry, checking by military                                           | Establishing the provincial head offices                                                                                                    |
| Bad images about the affected areas                                     |                                                                                                                                              |
| International policies about Sri Lanka                                   |                                                                                                                                              |

(Source: Information Gathered by the Authors from Field Work)
### Table 2: Tourism development themes in Jaffna District.

<table>
<thead>
<tr>
<th>Places</th>
<th>Events</th>
<th>Recreational Services</th>
<th>Other Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Historic Places and Buildings</strong></td>
<td>Conferences</td>
<td>Water-based Activity</td>
<td>Accommodation</td>
</tr>
<tr>
<td>Jaffna Fort, Delft</td>
<td>Corporate</td>
<td>Boating</td>
<td>Bed &amp; Breakfast</td>
</tr>
<tr>
<td>Jaffna Library, Kayts Town</td>
<td>Family Reunions</td>
<td>Swimming</td>
<td>Camping</td>
</tr>
<tr>
<td>Natural Harbor</td>
<td>Weddings</td>
<td>Fishing with the hook</td>
<td>Youth Hostels</td>
</tr>
<tr>
<td>Sankiliyan Curve</td>
<td>Get-togethers</td>
<td></td>
<td>Elder Hostels</td>
</tr>
<tr>
<td>Manthirimanai</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Jaffna</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parks and forests</strong></td>
<td>Agricultural Fairs</td>
<td>Trail Based Activities</td>
<td>Tour Operations</td>
</tr>
<tr>
<td>Subramaniyam park.</td>
<td>Food and Craft Shows</td>
<td>Hiking</td>
<td>School Tours</td>
</tr>
<tr>
<td>Poonganichcholai.</td>
<td>Food Cooking-Demonstrations</td>
<td>Off- Road Motor</td>
<td>Picnicking</td>
</tr>
<tr>
<td>The old park</td>
<td>Flower Shows</td>
<td>Cycling, Cycling</td>
<td></td>
</tr>
<tr>
<td>Manatkadu</td>
<td></td>
<td>Horse Racing</td>
<td></td>
</tr>
<tr>
<td>Mirusuvil mangroves</td>
<td></td>
<td>Motor Racing</td>
<td></td>
</tr>
<tr>
<td><strong>Religious Places</strong></td>
<td>Seasonal Festivals/Activities</td>
<td>Nature Appreciation Activities</td>
<td>Retailing of Various Items</td>
</tr>
<tr>
<td>Nallur Temple</td>
<td>Sinhala&amp; Hindu NewYearFestival</td>
<td>Photography/Painting</td>
<td>Gift/ Craft/ Antique</td>
</tr>
<tr>
<td>Selva Sannithi Temple</td>
<td>Christmas Trees</td>
<td>Bird watching</td>
<td>Floral Arrangements</td>
</tr>
<tr>
<td>Nagapoosani Temple</td>
<td>Easter Eggs</td>
<td>Wild Life Viewing</td>
<td>Gardens/</td>
</tr>
<tr>
<td>Nagaviharai</td>
<td>Annual Festivals of temple</td>
<td></td>
<td>Nursery(Flowers,</td>
</tr>
<tr>
<td>O.L.R. Church</td>
<td></td>
<td></td>
<td>Greenery, Herbs,</td>
</tr>
<tr>
<td>St. Mary’s Church</td>
<td></td>
<td></td>
<td>Dried Flowers)</td>
</tr>
<tr>
<td>Durkaiamman Temple</td>
<td></td>
<td></td>
<td>Roadside Stands/</td>
</tr>
<tr>
<td>Naguleswaram Temple</td>
<td></td>
<td></td>
<td>Markets</td>
</tr>
<tr>
<td>Temple</td>
<td></td>
<td></td>
<td>Specialty Food</td>
</tr>
<tr>
<td>Maviddampuram</td>
<td></td>
<td></td>
<td>Palmyra product</td>
</tr>
<tr>
<td><strong>Natural areas and beaches</strong></td>
<td>Hunting and Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casurina Beach</td>
<td>Trapping fish with nets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kilali – Allipalai,</td>
<td>Hunting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaatty Beach</td>
<td>Dog Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Habitat Improvement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: Information Gathered by the Authors from Field Work and Literature Search)
Tourism potentials in Jaffna District

Major Components of Potentials

- Huge Agri. Sector with Friendly People
- Big Climatic and Product Diversity in Small Island
- Good Weather Cond. and Rare Natural Disasters
- Peace, Security, and Tolerance with Rich Culture
- Excellent Regional Links Through Transport, Telecom etc.

Figure 1: Components for the tourism industry.

(Source: Information Gathered by the Authors from Field Work and Literature Search)
Abstract: This study focused on identifying temporal rainfall and temperature variability in Anuradhapura district from 1941 to 2010 and determine farmers' perception on climate change. This study was conducted in Thantirimale and Mahavilachchiya GN of Mahavilachchiya Divisional Secretariat in Anuradhapura District. Questionnaires and focus group discussions were used to gather primary data. Five years moving average and descriptive statistical tools such as the coefficient of variation and percentages were adopted in the analysis process. Result from descriptive analysis of meteorological data (rainfall and temperature) revealed that the temperature has increased and rainfall has decreased. The majority of the farmers' perceptions from both areas are parallel with statistical record of meteorological data. Though they have already identified that climate is changing and they knew how to face these changes but they need more awareness about how to adapt to climate change.

Keywords: climate change, perception, paddy farmers

Introduction

Weather and climate play a main role in human life. At the same time, scientists have determined that human activities have become a dominant force, and are responsible for most of the weather change phenomena. Weather and climate vary from each other. The difference between weather and climate is a measure of time. Weather is the conditions of the atmosphere over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time. Climate change and weather are intertwined. Observations can show that there have been changes in weather, and it is the statistics of changes in weather over time that identifies climate change (IPCC, 2010). Farmers perceive climate change as a change in rainfall and temperature patterns and variability as well as extreme weather events.

Weather and climate change have become a major concern to human society because of their potentially deleterious impacts, worldwide. It poses especially significant threats to sustainable development in developing countries, which have fewer resources and are more vulnerable (Munasinghe, 2010). Changing climate has been observed in many parts of the world. The Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report observed that, warming of climate system is now unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea level" (Kumar & Balasubramanian, 2010). Sri Lanka's climate has also been changing for a couple of decades. As a result, the expected rainfall may not come at the expected time with correct amount and intensity, whereas more rainfall may be received when it is not really necessary and annual mean air temperature anomalies have also shown significant increasing trends during the recent few decades in Sri Lanka (Punyawardena, 2009).

When we compare the impacts with other sectors, agriculture is one of the most vulnerable sectors to climate change. There are positive and negative impacts on agriculture due to climate change. Many countries, especially developing countries face negative impacts of climate change such as, long-term water and other resource shortage, worsening soil conditions, drought and desertification, disease and pest outbreaks on crops and livestock, rising sea-levels, and so on. Even so, some countries have experienced beneficial effect from climate change particular in temperate regions. The lengthening of growing seasons, carbon fertilization effects, and improved conditions for crop growth are forecast to stimulate
gain in agricultural productivity in high-latitude regions such as, northern China and many parts of Northern America and Europe (Kurukulasuriya & Rosenthal, 2003).

A better understanding of farmer perceptions regarding climate change, current strategies for managing climate change and their determinants will be important to form policy and planning for the future successful adaptation of the agricultural sector. So, this study has focused on identify temporal rainfall and temperature variability in the Anuradhapura district from 1941 to 2010 and determine farmers' perception on climate change.

Study Area

This study focused on the Thantirimale and Mahavilachchiya GN from Mahavilachchiya Divisional Secretariat in Anuradhapura District of the North Central Province in Sri Lanka. Fig 1 indicates the study area.

Both Thantirimale and Mahavilachchiya climate are characterized by the dry zone, which receive less than 1800mm of rainfall per year during both the south western (smaller Yala) and the north eastern (Maha season) monsoon periods and mean annual temperature of 30° C, although maximum temperature may even exceed 37° C occasionally. Thantirimale's paddy farmers depend on rain-fed system (Being dependant on local rainfall without access to any substantial sources of supplementary water) but Mahavilachchiya's paddy farmers depend on irrigation system (using the water supplied from large irrigation reservoirs on a year round basis).

Materials and Methods

This study was conducted with the active farmers who are involved in paddy farming activities for more than thirty years and above fifty in age. Among them forty percent (40%) of paddy farmers were selected as a sample for this study. The random sampling technique was applied to draw the samples and selecting the samples was based on electoral lists by using random table.

Table 1: Details of the sample size

<table>
<thead>
<tr>
<th>Name of the study area</th>
<th>Population (above fifty in age + 30 years' experience in farming)</th>
<th>Sample (40%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahavilachchiya</td>
<td>87</td>
<td>40/100 * 87 = 35</td>
</tr>
<tr>
<td>Thantirimale</td>
<td>82</td>
<td>40/100*81= 33</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>68</td>
</tr>
</tbody>
</table>

Data on the selected indicators was collected through both primary and secondary sources in the study and the following methods were used.

- Questionnaire was used with 40 percentage of the sample from paddy farmers (age above 50 + 30 years' experience in farming) in the area.

- Focus Group Discussions (FGDs) were conducted with farmer groups of 5-10 in size, from the selected GN areas. Discussions were held in a semi-structured,
yet flexible focus guide. The discussions were inquired about the physical profile of the resources in the villages, about the farming systems, local water management, formal and informal institutional arrangements, experience in climate change.

- Secondary data was collected from a number of key institutes. The major types of secondary data collected include: information on water sources; agricultural base data; rainfall, temperature and other meteorological data; physiographic information of resources; and studies on socio-economic and institutional aspects.

Five Years Moving Average of Time series Analysis and descriptive statistical tools such as and coefficient of variation (CV) and percentages were used to recognize the patterns of temperature and rainfall variability in the Anuradhapura district from 1941 -2010 and farmers' perception on climate change.

**Results and Discussion**

**Temporal rainfall and temperature variability in the Anuradhapura district from 1941 to 2010**

Rainfall is one of the important factors that determine the development or drop down of agriculture and plant distribution. It is important to have sufficient rainfall from land preparation for harvesting to get maximum production. Land preparation starts from low rainfall conditions and after transplanting the maximum amount of water, is supplied at the highest growth rate stage and with low rainfall at the flowering stage to get a better harvest. Temperature is also an important factor that effect on crop production. Germination, Physiological activities, flowering and Photosynthesis depend on temperature. Rainfall and temperature variability cause a negative effect on crop production.

Climate is changing world-wide, and the science community in Sri Lanka has come up with ample evidence to suggest that the country's climate has already changed. During 1961-1990 the country's mean air temperature increased by 0.016 °C per year, and the mean annual rainfall decreased by 144 mm (7 percent) compared to the period 1931-1960 (Eriyagama & Smakhtin, n.d.). Fig 2 presents a graphical display of the rainfall total as deviations above or below the mean of 1115mm for the district. The data shows that there were dry years with rainfall below the long term mean of 1115mm and wet years with rainfall above the same long term mean. Generally most of the wet years were observed from 1942 to 1965 and the wettest year in 1957. The district experienced most of the dry years after 1965 especially in 1988 and 1995.

Rainfall in Anuradhapura could be divided mainly as the *Maha* and *Yala* seasons. Rainfall of the *Yala* season is received the first-inter monsoon and south west monsoon from March to August in this season. The *Yala* season will be restricted from mid-March to mid-May due to less effect on the south west monsoon for the dry and intermediate zone. Rainfall of the *Maha* season is received by the second-inter monsoon and North east monsoon. That period will be effective from September to February. Hence, high rainfall will be received from October to November throughout the island. A presence of these two patterns of rainfall is known as the bi-model rainfall pattern, but this pattern can be observed well in the Dry zone and very less in wet zone (Pushpakumara, 2011).
Fig 3 theco-efficient of variation (CV) of months. It shows that the co-efficient of variation remains low during the four months from October-January indicating that the variability of rainfall during these months is quite low. In contrast, the variability of rainfall during the eight months from February - September is relatively high as indicated by the high values of co-efficient of variation during these months. Therefore, the bi-model pattern indicated by monthly averages seems somewhat illusionary since chances for a minor peak around April are low. Compared to these data variations of the *Yala* season is higher than the *Maha* season. Therefore, farmers face a water shortage during the *Yala* season.

Further, the graph reveals that the temperature fluctuates from 1972 to 1987. There was an increased trend in 1976 and a conversely decreased trend in 1986.

An increasing trend in temperature can affect the paddy yield in the future. Therefore it is expected that the farmers should adopt some strategies to overcome this problem.

**Farmers’ perceptions of climate change**

Farmers perceive climate change as a change in rainfall and temperature patterns and variability as well as extreme weather events. This is perceived differently at different levels of conceptualization. Through the questionnaire survey and focus group discussion it is understood that weather is continuously changing and it is getting worse over time. The majority of the farmers acknowledge an increase in temperature and a decrease in rainfall.

Among the experienced farmers aged 40 years and above, more than 97 percent from Thanthrimale and 63 percent from Mahawilachchiya have perceived that the weather is worse when comparing with past (10 – 20 years before) (Tab 2). The result further shows that 82 percent of the farmers from the both GN division noted that the weather conditions were favorable for paddy cultivation 10 – 20 years before. But it is unfavorable now.

<table>
<thead>
<tr>
<th>Weather</th>
<th>Thanthrimale (%)</th>
<th>Mahawilachchiy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>worse</td>
<td>97</td>
<td>63</td>
</tr>
<tr>
<td>better</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>not change</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>no idea</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: Field survey (2012)
About 82 percent and 77 percent farmers from Thanthrimale and Mahavilachchiya noted a decreasing trend in rainfall respectively. At the same time, approximately 90 percent of the farmers from both GN divisions indicated that the increase in temperature is significant (Tab 3).

**Tab 3:**
Farmers’ perceptions on trends of temperature by GN

<table>
<thead>
<tr>
<th>GN Name</th>
<th>Farmers’ perceptions on trends of temperature by GN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>increase (%)</td>
</tr>
<tr>
<td>Thanthrimale</td>
<td>91</td>
</tr>
<tr>
<td>Mahavilachchiya</td>
<td>89</td>
</tr>
</tbody>
</table>

*Source: Field survey (2012)*

And more than 80 percent of the farmers noted a declining trend in rainfall and an increasing trend in temperature during the last 10 – 15 years (Fig 5).

Climatic factors of rainfall and temperature variability could affect the paddy yield. The study by Ann Laker (1984) has shown that climatic factors seem to significantly affect yield variations of rice in the Anuradhapura district in the dry zone, particularly under rain-fed conditions. Other analyses have shown that a temperature increase of 0.5 deg. C will reduce the rice output by 5.91% (Fernando, 2003).

**Conclusion and Recommendation**

This study assesses paddy farmers’ perception on climate change in Mahavilachchiya and Thanthrimale. Specifically, this study investigated rainfall and temperature trend in Anuradhapura district, and farmers’ perception on climate change. Result from descriptive analysis of meteorological data (rainfall and temperature) revealed that the temperature has increased and rainfall has decreased. The majority of the farmers’ perception is parallel with statistical record of meteorological data. They perceived that the weather has become hotter and the rain less predictable and shorter in duration.

Generally, both areas’ farmers are vulnerable to changing weather but comparatively, farmers who cultivate rain-fed rice as a primary source of food and income are particularly vulnerable. Weather variation such as prolonged dry spells during the growing season and flooding at the end of the season prior to harvesting, are events that are common in the current weather. Farmers can cope with climatic risk with their experience and indigenous knowledge. But lack of information (weather forecasting) has limited their coping ability. Hence, necessary steps should be taken to enhance climate risk forecasting like future scenarios of drought and flood and information must reached the farmers on time.
References


Introduction

Next only to China, India has the largest population in the world with more than 75% of them living in rural areas. From this one can easily infer that any meaningful upliftment of the country as a whole, development of the rural population is essential. To this end in view Government of India has initiated various programmes viz., Integrated Rural Development Programmes (IRDP), National Rural Employment Programme (NREP), etc. through five year plans since the last four and half decades. The network of National Informatics Centre (NIC) spread throughout the country is an added advantage for a computer based GIS wherein the local requirement and availability are thoroughly and efficiently analyzed and resources distribution is made optimally.

With the advancement in technology like high speed large storage computers, Digital Mapping Technology and Remote Sensing which can speak out dynamicity in change of land resources, now the question is not whether to have an Information System, but it is when to have the system.

Scope of the Present Study

Inspite of many Information System available at macro and micro levels, nothing categorizes the villages as per their level of development so as to implement necessary development schemes for its upliftment. Hence an attempt has been made to develop an Information System for planning at village level using index criterion.

Study Area

Kothur, is a village and a mandal which is located at 17.144727°N 78.288574°E in Mahbubnagar district in the state of Andhra Pradesh in India comprising 16 villages were selected for this study and it is shown in figure 1. It is situated about 36 km from Hyderabad, the state capital, nearby Hyderabad International Airport in Hyderabad to Bangalore NH-7. Kothur Grampanchayath includes Kothur, Kummariguda, Fathimapur and Kothur industrial area. Nandigama is a Big village in Kothur Mandal, surrounded by Industrial Area (HBL, Pitti Laminations and number of textile factories). Rangapur is a small village located in Kothur Mandal in mahaboobnager district.

Methodology

The study has been carried out in the sequence as depicted in the flow diagram given in figure 2. The relevant Topographical maps, administrative divisions maps, statistical data and census data were collected from the respective offices. Topographical maps and administrative boundary maps were digitized in MICROSTATION. The .DGN files were then exported to shape format in ArcGIS Environment, wherein the above map layers were over-layered.

Attribute databases for each facility were created in ArcGIS. Programs were written in Oracle to compute various indices, making use of the databases. Programs also classify the villages as per the value of indices. A planning module was generated in which the villages in priority order will be listed out so as to implement any given development programs.
interfacing the above database with Rural Development Planning module, various queries could be raised to the Decision Support System to generate textual and graphical outputs.

Data Collection

Topographical maps

The relevant topographical sheets were collected from various offices of Survey of India at Hyderabad. The administrative boundary maps are collected from Revenue department.

Statistical Data

i) Demographic Data

Demographic data includes details of the number of households, population (male, female, SC, ST), area of village and literates etc. These data were collected from NIC, Hyderabad and Directorates of census operation.

ii) Educational Data

This includes details of number of schools, population of particular age group, number of students (males, females, SC, ST) teachers (total, SC & ST), number of pucca class rooms etc. This data was collected from Directorate of school education, Hyderabad.

iii) Medical Data

It refers to the category of hospitals, number of hospitals in each category, number doctors, number of nurses, number of beds, number of assistants and number of veterinary hospitals in the village.

iv) Drinking water Data

The details of category of drinking water facility, capacity and daily supply of overhead water tanks and number of hand pumps available in each village are included in this data.

v) Proximity Data

It refers to the distance of various facilities like schools, hospitals, banks, bus-stop, post office, nearest town/city and railway station from the centre of village.

vi) Bank Data

This data includes category of bank, number of banks, number of village served, number of account holders and transaction amount (deposits and loans).

vii) Employees Data

This data includes number of employees in agriculture, trade and commerce, construction, industries and service sector.

viii) Socio-economic Data

Socio-economic data collected at village level include details regarding basic facilities like postal and telegraphical services, electricity, approach roads, bus-stop, social requirements like community centre, ration shop, co-operative market and police station.

ix) Land use Data

Land use data includes the area of each village, the area of cultivated land with irrigation facilities, the area of cultivated land without irrigation facilities, mode of irrigation, area of cultivable waste and forest area. For irrigation mode, different codes were used for different modes of electricity usage.

x) Accessibility Data

It includes the number of all weather roads, seasonal roads, poor roads, number of trains and buses.
Creation of Attribute Database

Attribute databases have been created as per the requirement and specifications mentioned above.

Creation of Spatial Database

Spatial data includes position of point data like huts, wells, springs, village blocks, line elements like roads, rivers, administrative boundaries, railway lines and aerial elements like rivers, cultivation, tanks etc. Spatial databases for Kothur Mandal was created by using MICRISTATON.

Artificial Intelligence to GIS

An Artificial Intelligence was introduced to improve the capability of GIS to quantify the development of each village in more of scientific way and arrive at an efficient Decision Support System.

Defining various indices

From the attribute database files, the following indices were introduced and weighted appropriately for each attribute based on which the villages were classified.
i) Literacy Index (LITI)
   A Literacy factor (LIT) was expressed as the ratio of Total Literates to Total population expressed in percentage. A Literacy Index (LITI) to a scale of 0 to 5 was assigned as per the value of LIT.

ii) Primary School Index (PRSI)
   A Primary School factor (PRS) was expressed as the ratio of Number of primary schools to Population of age group 6 to 11 years. A Primary School Index (PRSI) to a scale of 0 to 5 was assigned as per the value of PRS.

iii) Upper Primary School Index (UPRSI)
   A Upper Primary School factor (UPRS) was expressed as the ratio of Number of upper primary schools to Population of age group 6 to 13 years. A Upper Primary School Index (UPRSI) to a scale of 0 to 5 was assigned as per the value of UPRS.

iv) High School Index (HISI)
   A High School factor (HIS) was expressed as the ratio of Number of high schools to Population of age group 6 to 16 years. A High School Index (HISI) to a scale of 0 to 5 was assigned as per the value of HIS.

v) Medical Index (MEDI)
   A Medical factor (MED) was expressed as the ratio of Number of hospitals to Total population. A Medical Index (MEDI) to a scale of 0 to 5 was assigned as per the value of MED.

vi) Drinking Water Index (DWATI)
   Drinking Water factor (DWAT) was expressed as the ratio of Number of overhead tanks x daily supply to Total population. A Drinking Water Index (DWATI) to a scale of 0 to 5 was assigned as per the value of DWAT.

vii) Proximity Index (PROXI)
   A Proximity Factor (PRSI/UPRSI/HISI/HOSI/BANI/BSI/POI/TWNI/RSI) for each facility to a scale of 0 to 5 was computed as per its distance from the centre of village. A proximity Index (PROXI) was arrived at by taking weighted mean of each proximity factor as per its importance.

viii) Bank Index (BANI)
   A Bank factor (BAN) was expressed as the ratio of Number of banks to Total population. A Bank Index (BANI) to a scale of 0 to 5 was assigned as per the value of BAN.

ix) Employees Index (EMPI)
   Manufacturing Sector includes Industrial Employees, Construction Employees and Trade Employees.

   A Employees factor (EMP) was expressed as the ratio of sum of employees in Agricultural sector, Manufacturing sector and Service sector with respective weightings to the Population of age group 20 to 60 years. An Employees Index (EMPI) to a scale of 0 to 5 was assigned as per the value of EMP.

x) Socio-economic facilities Index (FACI)
   Socio-economic facilities factor includes Approach Road, Ration shop, Community Centre, Post and Telegraph, Power Supply, Co-operative Market, Police Station, Bus Stop Facility factor etc. Accordingly various indices viz. Approach Road Index (ARI), Ration shop Index (RATNI), Community Centre Index (CCI), Post and Telegraph Index (PTPI), Power Supply Index, Co-operative Market Index (CMI) and Bus Stop Index (BSI) to a scale of 0 to 5 were arrived at as per the availability of that particular facility in the villages. Subsequently the socio facility index (FACI) was computed by taking weighted mean the above indices as per its importance.

xi) Cultivable Waste Land Index (CIWLI)
   A Cultivable Waste Land factor (CLWL) was expressed as the ratio of Cultivable waste land area to Total Land area expressed in percentage. A Cultivable Waste Land Index (CIWLI) to a scale of 0 to 5 was assigned as per the value of CLWL.

xii) Land Load Index (LALDI)
   A Land Load factor (LAND) was expressed as the ratio of Number of agriculture employees to Total area of cultivated land. A Land Load Index (LALDI) to a scale of 0 to 5 was assigned as per the value of LALD.
xiii) Accessibility Index (ACCI)
An Accessibility Factor (ACC) was calculated by taking ratio of total number of people travelling by road on all weather roads and seasonal roads and by train to the floating population with appropriate weightages. An Accessibility Index (ACCI) to a scale of 0 to 5 was assigned as per the value of ACC.

xiv) Rural Development (RDI)
Finally a composite Rural Development Index (RDI) was arrived at by taking weighted mean of the above indices. This index will reflect the overall degree of development in terms of all facilities available in that particular village.

Development of software in ORACLE

Computation of the Indices: Programmes on ORACLE were written to carry out the computation of various factors Indices which reflect the degree of development. The capability of ORACLE in linking more than two databases was utilized in generating the programmes. Each index is the representative factor which reflects the degree of development of the village with respect to that attribute.

Classification the villages: Based on the indices computed, the villages were classified into six categories viz. model, largely developed, developed, marginally developed, poorly developed and undeveloped villages which is shown in Table 1 through programming.

<table>
<thead>
<tr>
<th>RDI</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Model village</td>
</tr>
<tr>
<td>4</td>
<td>Largely developed village</td>
</tr>
<tr>
<td>3</td>
<td>Developed village</td>
</tr>
<tr>
<td>2</td>
<td>Marginally developed village</td>
</tr>
<tr>
<td>1</td>
<td>Poorly developed village</td>
</tr>
<tr>
<td>0</td>
<td>Undeveloped village</td>
</tr>
</tbody>
</table>

Planning and Decision Support System: The information system developed by integrating the topographic, thematic, socioeconomic and all other data can output the answer for any queries posed by the users. The program lists the villages in the order of priority for implementing certain projects/programmes in the mandal by sorting the villages as per value of composite index in ascending order. The Decision Support System caters for planning ten aspects as listed below.

1. To organize literacy programme
2. To construct primary school
3. To construct upper primary school
4. To construct high school
5. To construct hospital
6. To construct water tank
7. To extend bank facility
8. To improve socio economic facilities
9. To organize agricultural programmes
10. To improve transportation system.

Master Program: Finally, a master program was developed which is user friendly in controlling 27 programs with menu options for the user to select the Mandal, update the databases and to run the programs displaying necessary messages to guide the user. The master program has also the capacity of invoking a planning module program for various Rural Development Schemes.

Result and Discussion

Stored data of Kothur Mandal was analyzed and manipulated using the programs developed in ORACLE and the results were obtained in the form of graphical output and textual outputs. The spatial database and attribute database were linked up in Micro Station for both graphical and textual representation. Queries covering various applications were raised to the Information System through terminal and the results were obtained in standard forms.

Analysis of Indices: From the indices arrived at by the programs, various inferences were drawn for each village with respect to various facilities. Typical bar chart to compare the indices is given in figure 3. The composite index namely Rural Development Index (RDI) was also computed considering all necessary requirements of a village and shown in Table 3 for

RDI Classification

Model village
Largely developed village
Developed village
Marginally developed village
Poorly developed village
Undeveloped village
Kothur Mandal. This index (RDI) reflects the overall development of the villages.

Based on the Rural Development Index, the village has been classified into various levels of development to indentify the villages clearly to implement various development programmes. From Figure 5.2, which shows the village classification for Kothur Mandal, it can be seen that in Kothur Mandal, there are 6% of model villages and 13% of largely developed villages, 13% of developed villages, 44% of marginally developed villages, 19% of poorly developed villages and 6% of undeveloped villages.

Analysis of Planning Module Results

The results of planning module program as given in table 2, shows that the top priority to Khajiguda and last priority to Kothur should be given while planning to improve Socio-economic facility in Kothur mandal.

Summary and Conclusions

The village Kothur of Kothur mandal was found to be model villages, possessing almost all necessary facilities. The village Khajiguda in Kothur mandal was basically undeveloped which need proper improvement programmes to implement. Population density in Kothur is literally higher than the surrounding villages since it has all the facilities. Hence migration of people towards such developed village can be avoided by implementing Integrated Rural Development Programmes (IRDP) in the villages appropriately. In about 70% of villages in Kothur Mandal, the service sector is very poor which can be improved by Integrated Rural Employment Programmes (IREP) etc.

With limited resources and a huge population to support, India seriously needs a Geographic Information System for planning optimum use of available resources and also to manage the various

Table 2: List of Village in Priority Order to Improve Socio-Economic Facilities

<table>
<thead>
<tr>
<th>Priority Order</th>
<th>List of Village</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Khajiguda</td>
</tr>
<tr>
<td>2</td>
<td>Siddapur</td>
</tr>
<tr>
<td>3</td>
<td>Edulapally</td>
</tr>
<tr>
<td>4</td>
<td>Mamidipally</td>
</tr>
<tr>
<td>5</td>
<td>Chegur</td>
</tr>
<tr>
<td>6</td>
<td>Gudur</td>
</tr>
<tr>
<td>7</td>
<td>Theegapur</td>
</tr>
<tr>
<td>8</td>
<td>Veerlapally</td>
</tr>
<tr>
<td>9</td>
<td>Nandigam</td>
</tr>
<tr>
<td>10</td>
<td>Penjerla</td>
</tr>
<tr>
<td>11</td>
<td>Inmulnarva</td>
</tr>
<tr>
<td>12</td>
<td>Kodicherla</td>
</tr>
<tr>
<td>13</td>
<td>Seriguda</td>
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<td>14</td>
<td>Mallapur</td>
</tr>
<tr>
<td>15</td>
<td>Thimmmapur</td>
</tr>
<tr>
<td>16</td>
<td>Kothur</td>
</tr>
</tbody>
</table>
development programmes advantageously. As we have all the necessities required for switching over from conventional methods to modern methods of data collection, storing and maintenance, availability of expertise in the fields of computer technology and above all the willingness of the state revenue officials to use modern concepts and techniques in maintaining the records, we should decide to switch over to the use of modern technology at the earliest.

Data collection for the development of GIS should be at the lowest possible Government level (i.e. village level) that has the technical ability to collect it accurately and efficiently. Such information system can then be aggregated up to form the higher level information systems to meet the district, state or national planning considerations.

Effective rural development planning and control measures cannot be implemented unless the public and all levels of Government have access to adequate information. Comprehensive information, characteristics and use should be collected and continuously updated so that all citizens and levels of Government can be assisted in planning various development programmes. If a GIS developed with modern concepts and technology for efficient management of the various resources, to be a successful, it should meet the aspirations and expectations of the village officials and rural people.

As various organizations viz. Survey of India, Land Revenue Department, Survey and Settlement Department, Agriculture Department, Bureau of Economics and Statistics, Wasteland Reclamation Board are involved in rural development, a powerful co-ordinate and purposeful approach is essential for efficient management programmes.

Acknowledgement

This project work was carried out by the author at Indian Institute of Surveying and Mapping, Survey of India under the guidance of Lt. Col. S.V. Chinnawar for M.Tech. programme affiliated to Jawaharlal Nehru Technological University, Hyderabad.

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Glazier RH, Gozdyra P and Yeritsyan N (2011),"Geographic Access to Primary Care and Hospital Services for Rural and Northern Communities": Report to the Ontario Ministry of Health and Long-Term Care. Toronto: Institute for Clinical Evaluative Sciences.


Introduction

Land use refers to man's activities and the varied uses which are carried on over land. Land cover defined as the assemblage of biotic and a biotic component on the earth's surface is one of the most crucial properties of the earth system. Land use and land cover (LULC) change is a major issue of global environment change. Knowledge of land use and land cover is important for many planning and management activities and considered as essential element for modeling and understanding the earth as a system.

Landuse change is the modification in the purpose of the land, which is not necessarily only the change in land cover but also changes in intensity and management. Change detection is a process of identifying and analyzing the differences of an object or a phenomenon through monitoring at different times. The detection and analysis of changes in multi-temporal remote-sensing data have assumed an ever-increasing strategic role in several application domains. A wide range of applications can be benefited from the study of change process over a specified area at different times.

Landuse and land cover change are critical issues due to their great influence in global warming, loss of biodiversity, and impact in human life. Because of their enormous impact and implications, the International Geosphere-Biosphere Program (IGBP) and the International Human Dimension Program (IHDP) initiated a joint international program of study on Land Use/Cover Change (LUCC) (Lambin, 2003). They recognized the necessity to improve understanding, modeling, and projections of land dynamics from global to regional scale and focusing particularly on the spatial explicitness of processes and outcomes. Land use and land cover information is required for a great variety of applications including residential-industrial-commercial site selection, population estimation, tax assessment, development of zoning vegetation, utilizing and management of natural resources (Lillesand, 2000). Land use land cover information act as input for various different application studies or project or research. In India on land use/land cover in the form of thematic map, records are inadequate and do not provide an up-to-date information on the changing land use pattern. In most cases, as the time gap between reporting, collection and availability of data is more, the data often becomes out-dated (NRSA, 2006). The spatial setting of landscape elements is characterized by the combination of both biophysical and human forces. In temporal scales of decades, human activities are basic factors in shaping land use change. Some of them are due to specific management practices and the rest are due to social, political and economical forces that control land uses.
Utility of multi-sensor satellite data for land use/land cover change detection is proven technique (Kamini, et al. 2006) for making the information available at the required time. Thus Remote Sensing (RS) and Geographic Information System (GIS) are now considered as an important tool for change dynamic study. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time. Thus, remote sensing data which depicts spatial location of various land use land cover over space provide the following advantages:

- It provides reliable data at regular intervals
- It provides land use land cover information
- It provides base for plan monitoring and implementation

In addition to this Geographical Information System also is useful in land use land cover change studies. The advantages are listed as follows:

- Data is maintained in a physical compact data files
- Large amount of data can be maintained and extracted at will with great speed
- Various computerised software modules/tools allow a variety/type of manipulation, including map measurement, map overlay, transformation and geographical design and data manipulation
- Graphic and non-graphic information can be merged and manipulated simultaneously in a related manner.

Multispectral-sensor satellites like Landsat series are very effective at mapping LULC at the first two levels, by identifying the spectral signature of a particular type of feature, and broadly classifying areas like forests, grasslands and urban. However, finer details cannot be reliably differentiated.

Objective

The study was taken up with the objective to analyse the nature and extent of land use/land cover changes in and around Silsako and Borsola wetlands of Guwahati City in the past 15 years (1991-2006).

Study Area

For analysing the land use/land cover change in and around the wetlands in the heart of Guwahati city, two linear wetlands Borsola and Silsako were selected. As there is a close link between the two, they can be treated as a single system. A buffer of 1 km² was generated from the centre of each wetland, thus Borsola area is about 9.6 km² and Silsako is about 27.0 km² (Figure 1). This area is selected as a number of land use classes are found to exist in this area.

Methodology

For the study, interpretation has been done on a scale of 1:50000 with a minimum mapping unit of 22,500 m². Temporal Sensing data were used for the study. For land use land cover change dynamic analysis the following methodology was adopted.

Software Used

Software like ERDAS IMAGINE 9.2. was used for Image processing and ArcGIS 9.3. for feature extraction and analysis.
Data Used

Remote Sensing Data used for the study are listed in Table 1.

Table 1: Remote Sensing Data

<table>
<thead>
<tr>
<th>SI. NO.</th>
<th>REMOTE SENSING DATA</th>
<th>PATH/ROW</th>
<th>DATE OF ACQUISITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LANDSAT - TM</td>
<td>137/42</td>
<td>26.11.1991</td>
</tr>
<tr>
<td>3</td>
<td>IRS LISS III</td>
<td>110/53</td>
<td>10.04.2006</td>
</tr>
</tbody>
</table>

Projected LANDSAT satellite data were used for geo-referencing RESOURCESAT-1 LISS III data. Visual interpretation techniques have been used to extract information from the digital image on the basis of the image characteristics such as tone, texture, shape, size, shadow, pattern, etc. identification and delineation of various features of land use land cover and judging their significance in delineating thematic information. Finally, statistics were generated and changes were analysed.

The methodology adopted for this study is presented in the Figure 2.

![Figure 2: Methodology for Land Use Change Analysis](image)

Analysis

The areas in and around the wetlands are surrounded by hillocks on the Eastern and Southern sides. Few hills are found in the central part as well. As such there is a considerable forest cover in and around the study area. The area under different land use/land cover is presented in Table 2.

According to the study, built-up area constituted about 45% of the study area in 1991. Other land-use like water-bodies was 0.41 Km², agriculture was 1.9 Km² (5.1%), marshy land was 2.05 Km² (5.5 %), forest was about 2.98 Km² (8.13%) and scrubland was 10.24 Km² (27.27%) of the study area as in 1991. Borsola wetland was 0.06 Km² and Silsako wetland was 2.45 Km² in the same year (Figure 3).

In the year 1999 the forest cover decreased to 2.70 Km². This may be due to deforestation because of forest land being converted to built-up areas. Areas under water bodies and scrubland have decreased to 0.29 Km² and 9.38 Km² respectively. There is an increase in areas under built up (16.87 Km²), agriculture (2.23Km²) and marshy land (2.66 Km²).

In 2006, the built up area had increased to 20.86 Km². Forest area was also showing a little increase in this year covering an area of about 2.79 Km². In the other land use classes, there was a decreasing trend-scrubland was 6.64 Km², agriculture was 1.87 Km², marshy land was 1.92 Km², water bodies was 0.09 Km². Borsola wetland area remained stagnant at 0.05 Km² whereas Silsako wetland had decreased to 2.39 Km² (Figure 5).
Conclusion

There was an increase of area under forest in 2006 compared to 1999. This may be due to reclamation of forest land. In case of area under agriculture, there was an increase from 1991 to 1999, but the area decreased again in 2006. There was a decrease in the coverage of water bodies, scrubland and marshy land. The wetlands are showing shrinkage in their extent, except for Borsola in 1999 and 2006. The increase in the area under built up may have led to the depletion of these wetlands, which in turn led to a lot of environmental and ecological problems. Barren scrub land is converted to Agricultural land, Built-up. Due to these changes the natural ecosystem and biodiversity is adversely affected. A change of land use between 1999 and 2006 in percentage is presented in Table 3. In case of Borsola wetland (0%), Built-up (23.65 %) and forest area (3.33 %), there is a positive change or increase in the areas in these classes. Other classes namely agriculture (- 80.20 %), water body (- 68.96), scrubland (-29.21%), marshy land (- 27.81%) and Silsako wetland (-1.64 %) are showing a negative change.

References


Figure 3:
Landuse Map-1991 of (A) Borsola Area and (B) Silsako Area

Figure 4:
Landuse Map-1999 of (A) Borsola Area and (B) Silsako Area
Figure 5:
Landuse Map-2006 of (A) Borsola Area and (B) Silsako Area
Impact of Flood Disaster (2012/2013)
In Karai Thuraipattu Divisional Secretariat

Abstract:

In this study, an attempt was made to examine the impacts of flood disaster in 2012/2013 in Karai Thuraipattu Divisional Secretariat. The study was conducted to determine the extent of damage caused by the flood disaster. The results showed that the flood disaster had a significant impact on the lives of the people in the area. The research also highlighted the need for better planning and preparedness to mitigate the effects of future floods. (Horritt, M. S. & Bates, P. D., 2002).

Research Summary:

In this study, an attempt was made to examine the impacts of flood disaster in 2012/2013 in Karai Thuraipattu Divisional Secretariat. The study was conducted to determine the extent of damage caused by the flood disaster. The results showed that the flood disaster had a significant impact on the lives of the people in the area. The research also highlighted the need for better planning and preparedness to mitigate the effects of future floods. (Van Ogtrop & Floris Frederik, 2005).
Kirusnamoorthi Rajeenth
Impacts of Flood Disaster (2012/2013) In Karai Thuraipattu Divisional Secretariat Division

Research Analysis:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
<td>51%</td>
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<tr>
<td>26%</td>
<td>Evacuation</td>
</tr>
<tr>
<td>5%</td>
<td>Death and injury</td>
</tr>
</tbody>
</table>

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கொடி குரு பாராம்பரியம், கருவறைப்பெழுதினம்:

கொடி குரு பாராம்பரியம் 05 வருட வளர்ச்சிக் கழிவுக்கும் 49% வருடம் வளர்ச்சியுடன் பாராம்பரியம் கருவறைப்பெழுதினம். இது வளர்ச்சியின் வரையில் பாராம்பரியம் கருவறைப்பெழுதினம் முன்னேற்றம் கொண்டது குரு பாராம்பரியம் கருவறைப்பெழுதினம் என்பது குரு பாராம்பரியம் முன்னேற்றம் கொண்டது பாராம்பரியம் கருவறைப்பெழுதினம் என்பது கொண்டது. பாராம்பரியம் முன்னேற்றத்தின் நூறு வருடம் குரு பாராம்பரியம் முன்னேற்றம் கொண்டது பாராம்பரியம் கருவறைப்பெழுதினம் என்பது கொண்டது. பாராம்பரியம் முன்னேற்றத்தின் நூறு வருடம் குரு பாராம்பரியம் கருவறைப்பெழுதினம் என்பது கொண்டது. 

மைக்கல் 03:

கொடி குரு பாராம்பரியம் விளக்கம் செய்யும் பாராம்பரியம் கருவறைப்பெழுதினம் என்பது.

மைக்கல் 04:

கொடி குரு பாராம்பரியம் விளக்கம் செய்யும் பாராம்பரியம் கருவறைப்பெழுதினம் என்பது:

கொடி குரு பாராம்பரியம் விளக்கம் செய்யும் பாராம்பரியம் கருவறைப்பெழுதினம் என்பது.
Kirusnamoorthi Rajeenth
Impacts of Flood Disaster (2012/2013) In Karai Thuraipattu Divisional Secretariat Division

![Pie chart](image1)

![Pie chart](image2)

![Pie chart](image3)

![Pie chart](image4)

![Pie chart](image5)

![Pie chart](image6)

![Pie chart](image7)

![Pie chart](image8)

[99]
05 பிப்ரவரி பெருமையான நிகழ்வில் முரசுக்கும் ரூபாய் தோட்டாளர் உலகில் அமைந்த பெருமையான அவர்கள் தீர்மானம். எனினும் பெருமையான தோட்டாளர் முரசுக்கும் ரூபாய் தோட்டாளர் உலகில் அமைந்த பெருமையான அவர்கள் தீர்மானம். இந்த தீர்மானமான பெருமையான ரூபாய் தோட்டாளர் உலகில் அமைந்த பெருமையான அவர்கள் தீர்மானம்.
Kirusnamoorthi Rajeenth
Impacts of Flood Disaster (2012/2013) In Karai
Thuraipattu Divisional Secretariat Division

Summary

The study reveals that the flood disaster caused significant damage to various sectors. The breakdown of the damage is as follows:

- 41% of damage was to property, including houses and vehicles.
- 18% of damage was to the agricultural sector, including crops and livestock.
- 16% of damage was to the education sector, including schools and institutions.
- 14% of damage was to the medical sector, including hospitals and clinics.
- 11% of damage was to the tourism sector, including hotels and resorts.

In addition to the physical damage, there were significant economic losses due to the flood. The total economic loss was estimated to be approximately 60% of the GDP of the affected area. The study also highlights the need for improved flood management strategies to mitigate future losses.
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