

“ROLE OF CLIMATE CHANGES & CHALLENGES TO SUSTAINABLE TOURISM DEVELOPMENT IN MADURAI”

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ABSTRACT:

This study has been designed to determine the familiarity on climate change and related terms and this study has been carried out in Madurai, commercial city in Tamil Nadu state, India. Questionnaire survey has been conducted in different places of the city among various age groups. The familiarity will give an outline of the public attention on environment. This study reveals that the students are more attentive than other age groups. This study reports that Climate change concept reaches to the public in different levels and they are having various conceptions about climate change. Madurai is a fascinating town located in the south Indian state of Tamil Nadu and occupies an important place on the itinerary of a tourist on a pilgrimage tour. Madurai is home to a large number of splendid temples that belong to the ancient and medieval era, and are recognized for their architectural grandeur. Tourism is now one of the world's largest industries and one of the fastest growing economic sectors. Tourism may have a positive economic impact on the balance of payments, on employment, on gross income and production, but it may also have negative effects, particularly on the environment. The environment, being the major source of tourist product, should therefore be protected in order to have further growth of tourism and economic development in the future. This is especially true with regard to tourism based on the natural environment as well as on historical-cultural heritage. Sustainable tourism has three interconnected aspects: environmental, socio-cultural, and economic. During the summer season, the temperature in Madurai tends to get extremely sweltering and muggy during this time of the year. During the Monsoon or rainy season in the months of September, October and November, Madurai meagre downpours rain shoot down the temperature levels to great degrees. The average rainfall received by the city is approximately 85 cm. During the winter season of December, January and February, the conditions are mildly pleasant with temperature hovering somewhere between 20° C - 36° C. Cottons are recommended during summer time and light woollen for winter. Temperatures during summer generally reach a maximum of 40 °C and a minimum of 24°C, although temperatures up to 42 °C are not uncommon. Winter temperatures range between 29.6 °C and 18 °C. The Best time to visit Madurai is October to March. A study based on the data available with the Indian Meteorological Department on Madurai over a period of 62 years indicate rising trend in atmospheric temperature over Madurai city, attributed to urbanisation, growth of vehicles and industrial activity. The maximum temperature of 42 °C for the decade of 2001 – 2010 was recorded in 2004 and in 2010.

Keywords: *Climate Changes, Sustainable Tourism, Sustainability, Religious Tourism, Cultural and Heritage Tourism, Attitudes of Domestic Tourist Madurai District.*

Introduction:

Extreme weather events and more frequent adverse weather events are bringing attention among people about climate change. Even though, the public awareness on climate change is not high except during extreme weather events. The human evolution is closely related with climate parameters, such as temperature, rainfall, humidity and solar radiation and having very low adaptive capacity for rapid and extreme climate change. But the human activities and urbanization leads adverse effects in local climate system, sometime it may be regional. Conferring knowledge and awareness about climate change can be a maiden step for the journey towards to save the green Planet. The topic like climate change and green house effects have added in school subjects for giving awareness on climate change among youths. The green activities are taken by the government and SHG's are familiarizing the term "Climate Change" among people. The purpose of this study is to investigate the familiarity about climate change and terms related with that. This study has carried out through questionnaire survey at 7 places in Madurai city, Tamil Nadu, India. Climate change is one of the complex problems facing mankind today. The overriding complexity of the problem is attributed to its deeper global ramifications on a vast range of issues impacting the very survival of life on Earth. Understanding such a complex issue with vast and varied dimensions and implications, assumes greater significance for all stakeholders, especially for our policy makers. There are varieties of perceptions regarding the exact, size and consequences of climate change. Yet, it is no secret that risks emanating from climate change are indeed profound, which call for urgent mitigation. There is now strong evidence that climate change is a reality. Today, it has been scientifically established that significant global warming is occurring. Warming of the climate system is 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 average sea level. There is no denying the fact that the problem exists and it is assuming alarming proportions, each passing day. Therefore, there is an imperative need to take urgent and strong measures in the interest of calibrating an appropriate response to meet the emerging challenges of climate change. Climate change is not an isolated issue. It has several aspects and inter-linkages namely, science and technology, economy and trade, diplomacy and politics - that makes it not just another issue in this complicated world of proliferating issues, but the mother of all issues. Climate change, however, is different from other problems facing humanity and it compels us to think differently at many levels. It obliges us to think about what it means to live as part of an ecologically interdependent human community. In the face of many diversities that characterize human society, climate change provides a potent reminder of one thing that we share in common - the planet Earth. All nations and all people share the same atmosphere. And, we only have one addressing the climate chaos by all the countries both individually and collectively, will be critical to the human well-being and prosperity of the present as well as the future generations. The tourism industry is the mainstay of Macao's economy. Tourism is travel for pleasure; Also the theory and practice of touring, the business of attracting, accommodating, and entertaining tourists, and the business of operating tours. Domestic tourism is as important for India as international tourism. The money spent by domestic tourist has the same impact on the local economy as the money spent by foreign tourist. Hence the present study concentrates the demographic profile of the respondents and the various attitude of domestic tourist in Madurai district. The various statistical tools used by the respondents are percentage analysis, chi - square test and so on. Sustainability is essential for any business forever. Meeting competition would be possible only when sustainability is attained. In the 2006-07 even though Madurai Meenakshi Temple gave a tough-competition in the first voting stage of new seven-

wonders of the world, this could not find a place in the second stage, regardless of the fact that this temple carries with it a huge cultural and religious heritage. This paper attempts to focus the issues faced / being faced by Madurai Meenakshi Temple that might have caused not to find a place in the new seven wonders of the world. Meanwhile, attaining the sustainability also becomes important in this modern era to preserve and maintain its heritage. Attention would also be also paid to list down suggestions for the same.

Study Area:

Madurai is the city, crossed by river Vaigai, which was the flooded river, but completely dry in recent. The ground water pockets are also giving water in lesser amount, when compared with population. Definitely, Madurai has greatly affected by the adverse characters of the climate. Though the industries and factories have grown in the city, the pollution and water quality problems are enabled in recent years. Based on this circumstance, the questions were prepared for the survey. The questionnaire was issued to 350 people in randomly chosen areas among different age groups.

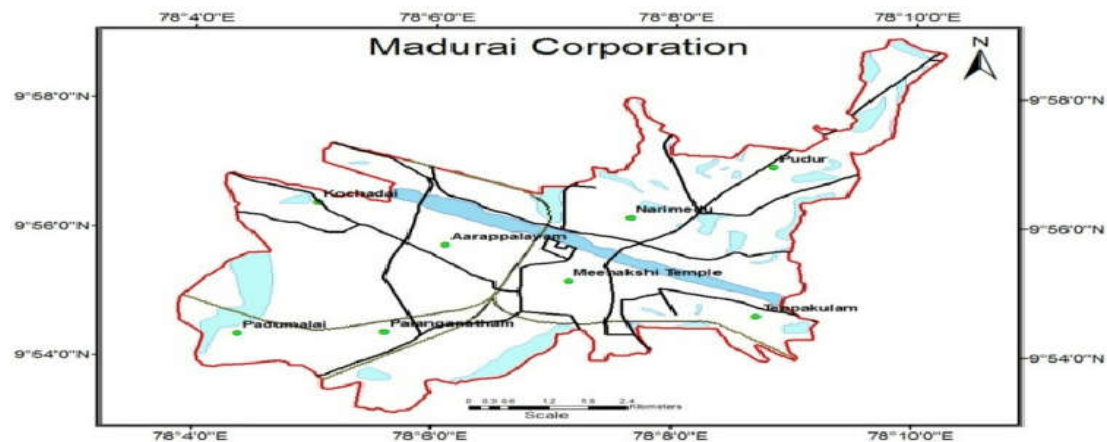


Fig.1 – Madurai Study Area

S. Vijayalakshmi, General Manager, NABARD, speaking in Madurai on Saturday. | Photo Credit: G_Moorthy

Climate change affecting farming activities in State:

National Bank for Agriculture and Rural Development (NABARD) has begun a marathon exercise across Tamil Nadu to sensitise farmers on climate change and need to focus on water conservation. Organising interaction meetings in every district, the NABARD managers offer expertise to the stakeholders on water conservation and efficient management techniques such as drip and sprinkler irrigation. Speaking at a campaign here on Saturday, NABARD General Manager S. Vijayalakshmi said agriculture, being climate-dependent, was adversely impacted by changes in climatic conditions such as temperature, rainfall and humidity. There were changes in cropping seasons, decreased availability of water for irrigation. Tamil Nadu had a high probability of increase in the frequency and intensity of climate-related natural hazards. The size of landholdings also was on the decline, thereby increasing the number of small and marginal farmers and their vulnerability to climate change. Water experts at the meeting voiced concern over failure of monsoon, poor water storage and natural calamities such as cyclones and droughts. While the irrigation efficiency was as low as 35%, groundwater was also over-exploited in most parts of the State, they said and called for adopting new strategies. There were a

number of crops which required less water and they could be popularised. Farmers should be taught to be self-reliant, instead of depending on the government. The NABARD was exploring the possibility of roping in business houses under their corporate social responsibility activities. To create awareness among students, a painting competition had been planned by Kendriya Vidyalaya students, said NABARD District Development Manager Mr. P.S. Harikrishnaraj.



Climate change affecting farming activities in State

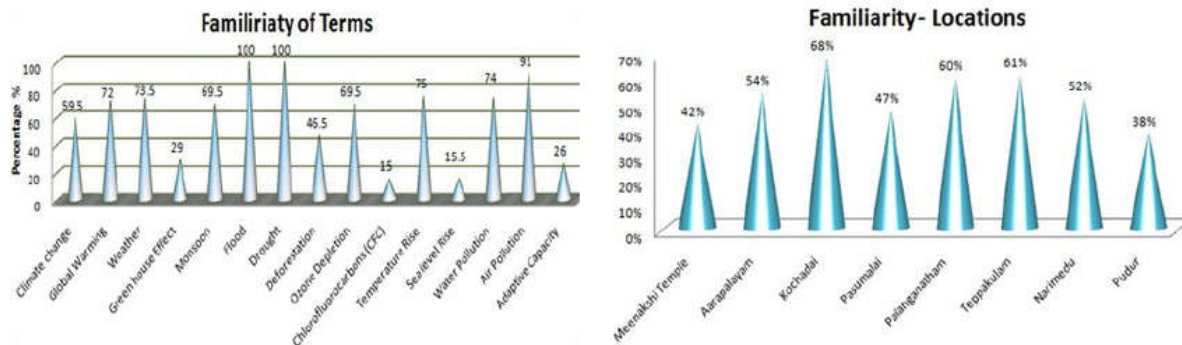


Fig. 2 Familiarity of terms in urban areas Fig. 3 Familiarity of terms in different locations

Understanding Climate Change:

Climate change refers to the variation in the Earth’s global climate or in regional climates over time. It describes changes in the state of the atmosphere over time scales ranging from decades to millions of years. Climate change1 Joint statement by 11 national science academies from Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, U.K. and USA to world leaders, 7 June, 2005 2 Climate Change 2007, Synthesis Report (A Report of the IPCC), p.22 has been defined by many in many ways. While some define it as an offshoot of Earth’s natural processes, others define it as a result of human activities. Striking a balance between these two varying perspectives, climate change is defined as “a change which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. Truly, the present changes in the Earth’s climate cannot be explained alone by the natural processes that explain Earth’s previous warm periods. There is a broad scientific consensus that most of the warming in the recent decades can be attributed to human activities. If humanity is, in large part, responsible for this change, then whatever choices we make today, will have a significant bearing on the climate of the future. This makes climate change a formidable concern.

Methodology:

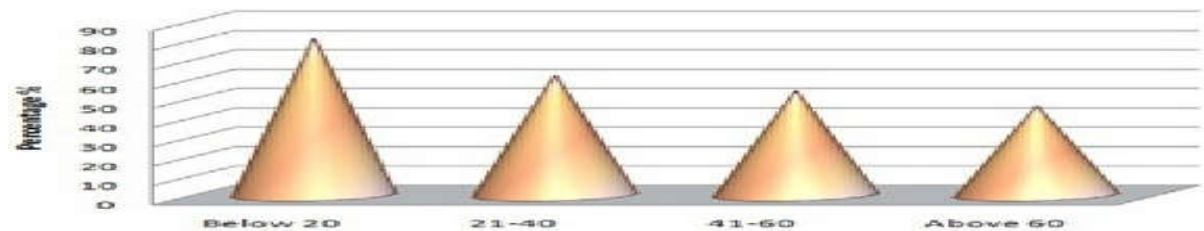
This is not a survey to draw the conclusion of the awareness of the public, but simply to show the range of thoughts and familiarity of terms through different sources. As like Driver et al, (1996), who has carried out a

qualitative survey on understanding about climate change, this study also framed to get qualitative data. The sample of this study has designed as 50 per age group and 50 per area. The age groups are, below 20, 21-40, 41-60 and above 60 and the areas are Meenakshi temple, Aarappalayam, Kochadai, Palanganatham, Pudur, Narimedu, Teppakulam and Pasumalai. The survey has carried out only the people who are living only in the city.

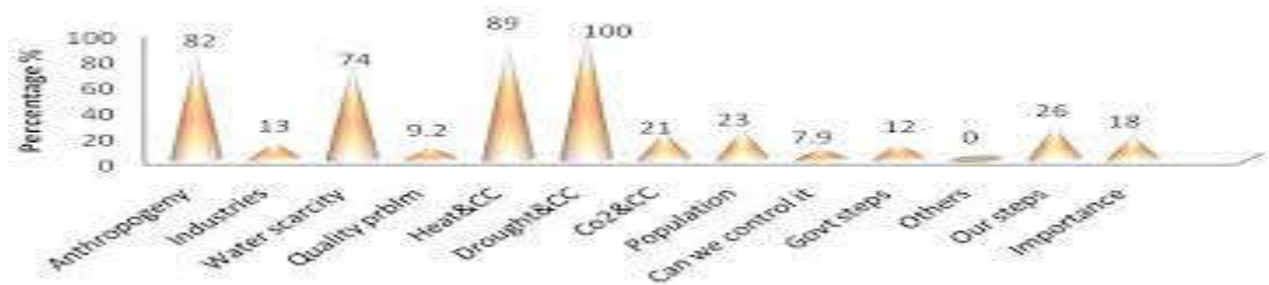
Results & Discussion:

The term climate change is having more familiarity among below 20 years people, especially school students. Attention given by the Government and actions taken for giving awareness through the students, made 86% of familiarity about Climate change and Global Warming (94%). Totally, 81% of the people belongs to this age group are having familiarity on climate change and related terms.

Familiarity – Age Groups



Conception on CC



Issues

Fig.4 -CLIMATE CHANGE CONCEPT FAMILIARITY IN URBAN AREA, MADURAI, 2013– A FIELD STUDY

In all age groups, flood, droughts and air pollution are the most familiar terms and 75 % of them have accepted that the water pollution and temperature rise are present in their environment. The terms Weather and Global Warming are having familiarity around 70 %. The people, living in city known the term Monsoon, are only 69.5 %. Ozone depletion, Green House effect, CFC, Sea level rise and adaptive capacity are not much familiar in city and the familiarity is falling lower than 30 %. (Fig.2) The survey has carried out in 7 locations and the familiarity of these areas is not so similar. In Kochadai (68%), familiarity reaches high, Pudur reaches low (38%), Aarapplayam (54%), Pasumalai (47%), Palanganatham (60%), Teppakulam (61%) and Narimedu (52%) having familiarity around 40- 60%. (Fig.3) As the school education and recent scientific development have thrown light on climate change, the people below 20 years old, especially School students have more familiarity

on Climate change (81%). This age group is more interactive during the survey and has good understanding on climate issues. (Fig.4) The familiarity goes down in other age groups, 62% among 21-40, 54% among 41-60 and above 60 years the people are having only 46% of familiarity. Shepardson et al., (2011) has conducted a survey among students to study the concept familiarity about climate change, global warming and green house effect and the students are greatly confused with global warming and climate change. In this study, students are familiar with the terms than other age groups. The recent scientific inputs in the school subjects have made awareness on environment and climate conditions. The student's conception studied by the Pruneau et al., (2001 & 2003) and the revealed that, the students do not believe the global warming and climate change will have a major impact on people or society. The similar findings were derived from many parts of the world. The people conception of global warming and climate change are limited and they are confused in the concept. But in Madurai, the public, are aware about pollution and weather events such as flood and drought but they are not much familiar about other terms. The students are having good familiarity and awareness on environment and weather like previous findings produced by Shepardson et al., (2011) and Preneau et al., (2001 & 2003). The overall familiarity in the study area attained 61%, this result acquaint with the success rate of climate change mitigation actions and policies.



Environmental Change:

The IPCC (2007) stated that “Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases”.

More specifically, there is very high confidence that:

- Changes in snow, ice and frozen ground have increased the number and size of glacial lakes, increased ground instability in mountain and other permafrost regions and led to ecosystem changes in the Arctic and Antarctic.
- Some hydrological systems have also been affected through increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers and through effects of warming rivers and lakes.
- Warming resulted in earlier timing of spring events and poleward and upward shifts in plant and animal ranges.
- Some marine and freshwater systems have seen shifts in ranges and changes in algal, plankton and fish abundance due to warmer water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation. All of the above ecosystem changes are indirectly affecting tourism, especially in destinations where

nature is a key attractor for tourists, as in the case of World Heritage Areas (e.g. Sagarmatha National Park in Nepal, Kilimanjaro National Park in Tanzania, the Wet Tropics of Queensland, Australia or Ichkeul National Park in Tunisia, UNESCO, 2007). Comparative research on tourists in Bonaire and Barbados in the Caribbean revealed that visitors to Bonaire were motivated by environmental attributes such as coral and fish diversity and abundance, whereas those to Barbados preferred beach features and other components of the terrestrial environment (Uyarraetal., 2005). The impacts of climate change will therefore likely be different in these two destinations. Climate change is likely to have a significant influence on the tourism economies of island countries by way of degradation of environmental features important to tourists (Becken & Hay, 2007). For example, during the El Niño event of 1998 surface water temperatures in Palau, South Pacific, exceeded 30°C from June through November. This resulted in a massive coral-bleaching event that killed one-third of Palau's reefs. Some populations declined to as much as 99% below pre-bleaching levels. The associated economic loss was estimated at US\$91 million, partly because of a 9% drop in annual tourism revenues (Hay *et al.*, 2003). Bleached coral reefs are mostly affecting the segment of upper-end expert dive tourists and are less likely to affect budget tourists who may not be able to distinguish healthy from bleached coral (Cesar, 1998). Small island destinations are also particularly exposed to water shortages due to climate change (IPCC, 2007) and rapid growth of tourism in many destinations is placing additional stress on local water supplies. Water availability has to be seen in the context of already occurring natural inter-annual and decadal-scale variability in precipitation, as well as the quality of water management systems. Periods of below average precipitation may be exacerbated by inadequate rainwater catchment facilities, or the sandy nature of the soil allowing the limited rain that falls to infiltrate rapidly and become difficult to access (Hay *et al.*, 2002). A study of water supply in Mallorca, Spain, found that while climate change is likely to exacerbate existing problems around water, it is the natural variation that poses the more immediate pressure on tourism (Kent *et al.*, 2002). Apart from small island destinations, the IPCC (2007) projects that dry regions will get drier (e.g. large parts of Africa or Australia), and wet regions are projected to get wetter (e.g. the West Coast of New Zealand). More precipitation will impact on road maintenance, disaster management (e.g. landslides) and flood prevention. More specific to tourism, more rain will increase the need for track maintenance in national parks. A recent study of tourism and climate change in Northern England noted that foot path erosion in the Lake District National Park is likely to increase as a result of more intense winter rainfall accompanied by the absence of snow cover. Footpaths were found to be particularly vulnerable when trampling by recreationists and rainfall alternate (McEvoy *et al.*, 2006). Changes in the hydrological schemes of glaciers will have severe impacts on the water supply of people that depend on seasonal glacial melting for their water supply. This has been observed in most alpine areas but is particularly concerning in the Himalayas as millions of people depend on water supply from the glacier fed rivers (Eriksson *et al.*, 2009). In the case of India alone, the Ganges, Brahmaputra and Indus river systems all originate from the Himalayas and contribute more than 60% to the total annual runoff for all the rivers of India (UNESCO, 2009). Climate change-related changes in ecosystems that are relevant for tourism have been observed in a range of situations, for example for forest-based recreation in North America (Loomis & Crespi, 1999, in Richardson & Loomis, 2004), tourism in wetland areas (Wall, 1998), or the implication of changing temperatures for a popular tulip festival in Canada (Jones *et al.*, 2006). A wide range of literature discussed the relationships between climate change and biodiversity, more generally (Green *et al.*, 2001; Taylor & Figgis, 2007) and specifically in relation to tourism (Christ *et al.*, 2003; Tratalos *et*

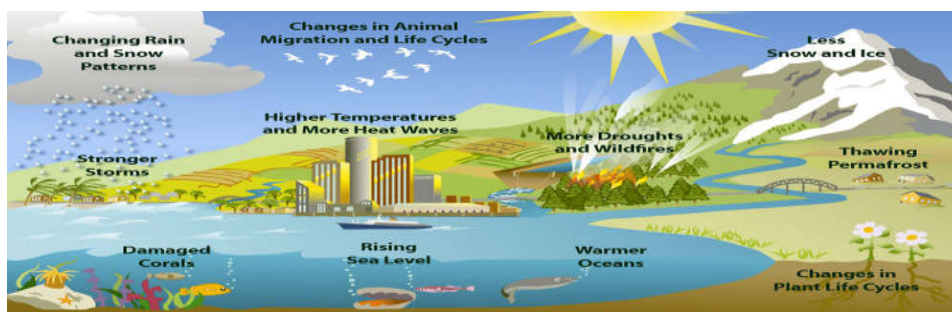
al., 2005). Changes to narrowly defined habitats are particularly concerning, for example in the case of wetlands in the Kakadu National Park, Australia, where sea level rise of up to 56 cm by 2070 will reduce the living space for alligators substantially (STCRC, 2009). Wildlife tourism in Africa, for example, is based on the current network of parks and reserves which in turn reflect current climatic conditions and distributions of species. Changing ecological conditions, such as precipitation, evaporation and flowering time have the potential to threaten populations or induce a shift in distributions and migration patterns. Reserves that are closely connected to seasonality like Lake Manyara National Park in Kenya with its 380 (largely migrating) bird species or the Serengeti with the 'great migration' of wildebeest and zebras are particularly vulnerable (Viner & Agnew, 1999). At a smaller scale, McEvoy et al (2006) discussed the impacts of climate change on the very popular dune systems in Sefton, Northwest England. It is likely that the hydrological system will lead to more mobile dune systems and a loss in biodiversity. The authors recommended that in the light of increases in visitor numbers due to warmer temperatures the management of the dunes need to be adjusted to protect the habitat for example through biological monitoring and careful visitor management (McEvoy et al., 2006).

Climate Change, Environmental Degradation, Water Scarcity Threaten Food Security:



Recent scientific studies have shown that the effects of climate change are already occurring and that these changes, as well as global warming, are predicted to increase the frequency and severity of droughts, heat waves, flooding, hurricanes and other weather events which will in turn have an enormous negative impact on our food supplies and human populations. Today, global warming trends and early frosts are decreasing crop yields. Soil mismanagement can also threaten today's food supplies. For example, over-plowing and deforestation have turned fertile land to arid wasteland. Overuse of chemical fertilizers has led to residual accumulation of salts, sterilizing soil microbes. Leaching of these residual nutrients into waterways can also cause eutrophication, resulting in the death of aquatic life.

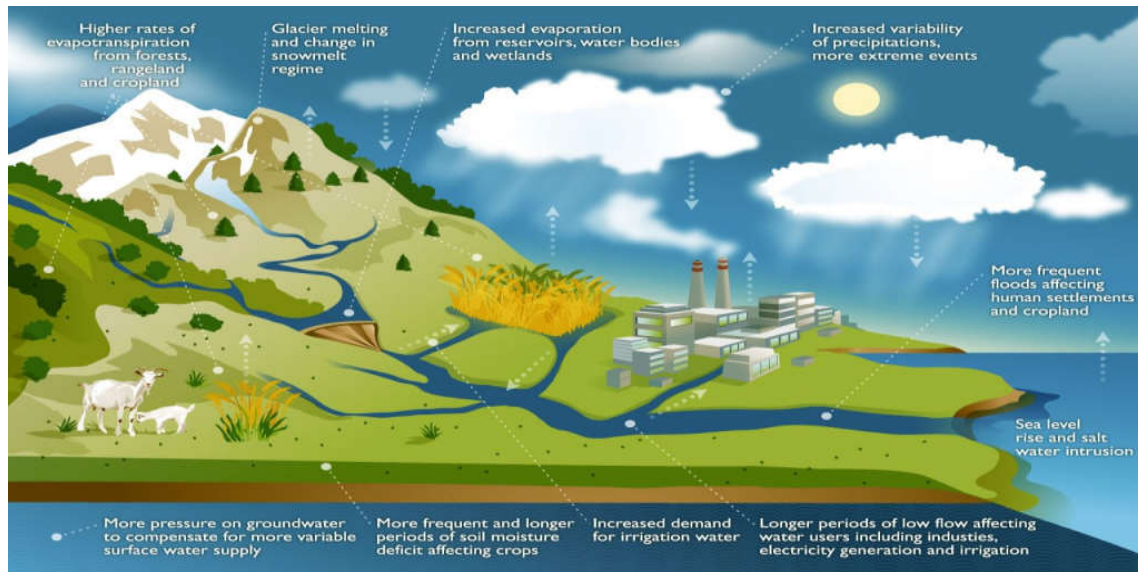
CLUES OF CLIMATE CHANGE



INFOGRAPHIC BY THE ENVIRONMENTAL PROTECTION AGENCY

Other natural resources like potable drinking water are being depleted at rates faster than natural processes can restore them. In the United States, 80-90 percent of fresh water is used for agricultural irrigation alone, and removal of this water from streams and aquifers is threatening many species with local extinction as well as exacerbating the evaporation of water from the land into the atmosphere.

EFFECTS OF CLIMATE CHANGE ON WATER



INFOGRAPHIC BY THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO.ORG)

There is no doubt that food and water shortages will threaten our infrastructure in the near future. Genetically modified (GMO) crops, pesticides, and herbicides could potentially offer more biodiversity to our food supply by making plant species more tolerant to changing weather conditions, more tolerant of drought, less susceptible to pests, and easier to manage weeds growing around them, but these solutions may come at a high price, due to their associated human health and environmental risks. For example, the build-up of pesticides and herbicides in our soils can lead to the death of microbes that are responsible for soil fertility. Animal and insect pollinators, which are required for 35 percent of the global food supply, are being potentially threatened by GMO crops and chemical use. Predators of pests also come under threat when they eat tainted pollinators. Reports have concluded that some animal compost is still laden with persistent-herbicides from the animals' plant feed, and this compost has in turn caused crop failures when incorporated into the soil. Human and animal livestock that feed off of pesticide- and herbicide-laden GMO and non-GMO crops are also at serious health risks. Alternative organic and sustainable farming strategies and systems will help to reduce the health and environmental risk associated with today's problematic industrial agricultural model.



Rising population is yet another future challenge to the security of our food systems.

By the year 2050, the earth's population will be at 9 billion, and this growth will include widespread "infilling" of desolate inner cities and a concomitant increase in food requirements, fossil-fuel consumption, and global urban poverty. By growing food closer to where it is consumed, regional food systems that decrease food miles and provide inner-city jobs will help combat the problems associated with this projected build out. Sustainable agriculture faces many challenges, and solving these problems will require collaboration between many groups including farmers, consumers, industries, and policymakers. The need for large-scale urban food production that conserves water and is environmentally sustainable is crucial. Using sustainable farming practices like aquaponics to grow food in the city, for the city, will not only create a new labor market for today's urban farmers, but it will play a pivotal role in the ecology of social food justice. Aquaponic farming and how it might be one very important step in helping achieve sustainable food security, while protecting the earth's resources that we depend on for our very life.

NATURAL RESOURCES PROFILING:

HYDROGEOLOGY:

The district is underlain predominantly by crystalline formations and alluvium is found along the courses of the river. Ground water occurs under phreatic conditions in weathered residuum and interconnected shallow fractures and under semi-confined to confined conditions in deeper fractures. The depth of weathering varies from 20-25 m bgl in Usilampatti, Sedapatti and Kottampatti area, while it varies from 30 to 40 m bgl in remaining parts of the district. The depth to water level in the district varies from 3.13 to 7.66 m bgl during pre-monsoon (May 2006) and 1.86 to 5.74 m bgl during post monsoon.

GEOMORPHOLOGY:

The prominent geomorphic units in the district are structural and denudated land forms such as structural and denudation hills, residual wells, linear ridges, uplands and barred pediments.

GROUND WATER QUALITY:

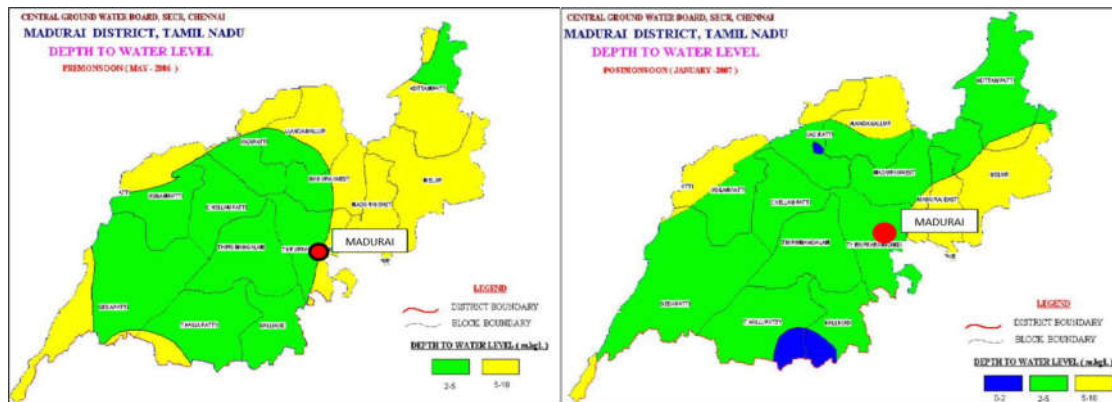
Ground water in phreatic aquifer in general is colorless, odourless and alkaline in nature. The specific electrical conductance of ground water in phreatic zone during May 2006 varied between 632 -6520 $\mu\text{s}/\text{cm}$ at 25°C and in major part of the state it is less than 2200 $\mu\text{s}/\text{cm}$. It is observed that ground water is suitable for drinking and domestic uses in respect of all constituents except TH and NO₃. It is found to be excess of permissible limit in 34% of sample analysed in respect of TH and in about 66% in respect of NO₃. The high incidence of TH can be

attributed to geogenic causes while NO₃ excess may be due to either excess use of fertilisers or due to improper waste disposal. In reference to irrigation suitability based on EC and Sodium Absorption Ratio (SAR), the ground water in phreatic zone may cause medium to very high salinity hazard and medium to high alkali hazard. Hence proper soil management practices are to be adopted when the ground water from phreatic aquifer is to be used for irrigation purposes. In case of deeper fractures, the ground water is suitable for domestic and irrigation purposes. However, the data of State Ground & Surface Water Resources Data Centres shows that ground water in Pulipatti, Chinnalatalai.

GROUND WATER QUANTITY:

The estimation of dynamic ground water resources (as on 31.3.2004) have shown that out of 13 blocks in the district, 3 blocks have been categorized as over exploited and 2 blocks as critical. Dug wells are most common ground water abstraction structure with depth range of 10 – 20 m bgl. The yield of dug wells may vary between 45-135 lpm and can sustain for 4-6 hrs of pumping.

PRE-MONSOON WATER TABLE IN MADURAI: POST-MONSOON WATER TABLE IN MADURAI

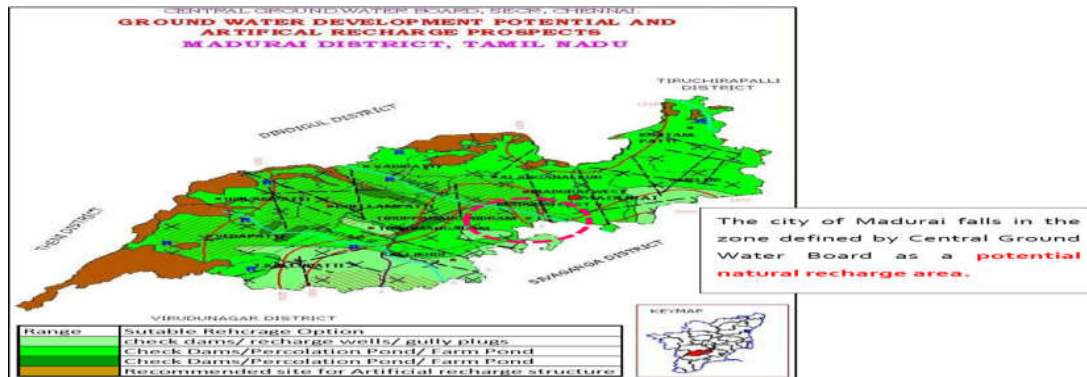


WATER CONSERVATION AND ARTIFICIAL RECHARGE:

The topography of Madurai district, in general, is suited for construction of various artificial recharge structures such as percolation ponds, check dams and sub-surface dykes. However, detailed studies are necessary to formulate a comprehensive scheme for artificial recharge of phreatic ground water in the district in view of the variations in the geomorphic setup and the complex hydrological and hydrogeological conditions.

The number and type of artificial recharge structures recommended for all the blocks in Madurai district. The exact locations of these structures, however, are to be decided on the basis of detailed field investigations. The implementation of the schemes may be taken up in phases, giving priority to blocks where the development of ground water resources is comparatively high.

GROUND WATER DEVELOPMENT POTENTIAL AND ARTIFICIAL RECHARGE PROSPECTS IN MADURAI



PHYSICAL CHARACTERISTICS:

GEOGRAPHY:

Madurai is located at 9.93°N 78.12°E. It has an average elevation of 101 meters. The city of Madurai lies on the flat and fertile plain of the river Vaigai which runs in the northwest-southeast direction through the city dividing it almost into two equal halves. The Sirumalai and Nagamalai hills lie to the north and west of Madurai. The city has grown on the either side of the Vaigai river and lies at the low attitude and its about 100 M from mean sea level.

GEOLOGY:

The land in and around Madurai is utilized largely for agricultural activity which is fostered by the Periyar Dam. Madurai lies southeast of the Eastern Ghats; the surrounding region occupies the plains of South India containing several mountain spurs. The soil type in central Madurai is predominantly clay loam, while red loam and black cotton types are widely prevalent in the outer fringes of the city. Paddy is the major crop, followed by pulses, millet, oil seed, cotton and sugarcane

DRAINAGE:

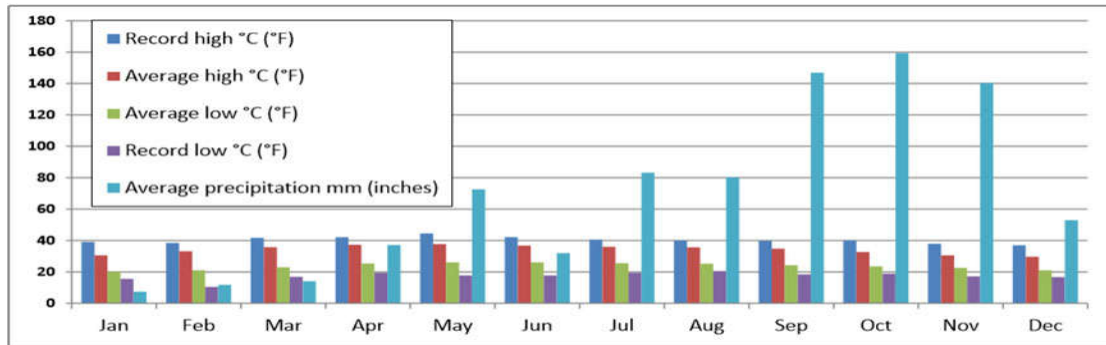
Vaigai, a major ephemeral river originates in Western Ghats of Theni district flow in NW-SE direction, in the central part of the district. In addition, tributaries of Vaipar and Gundar drain in south-western part of the district, while the tributaries of Pambar drained in north eastern part. The general flow direction of the drainage is NW-SE.

CLIMATE AND RAINFALL

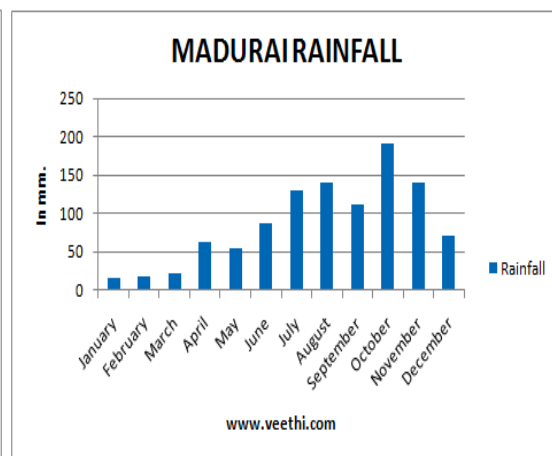
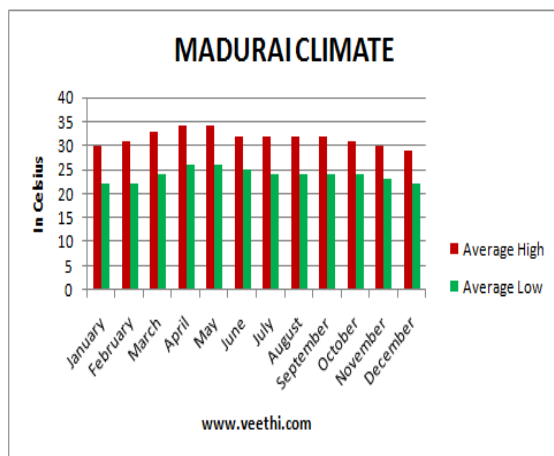
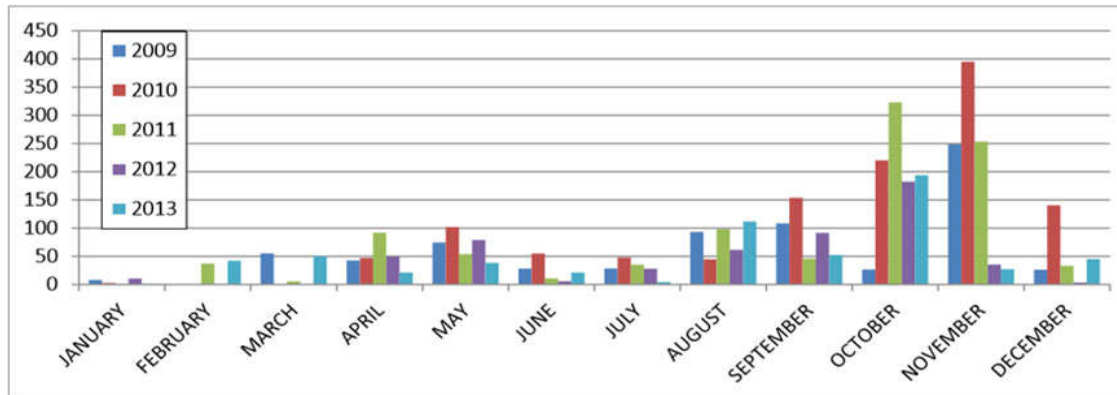
Madurai is hot and dry for eight months of the year. Cold winds are experienced during December to March as in the neighboring Dindigul. The hottest months are from March to July. The city experiences a moderate climate from August to October, tempered by heavy rain and thundershowers, and cool and climate from November to February. Fog and dew are rare and occur only during the winter season Being equidistant from mountain and sea, it experiences similar monsoon pattern with Northeast monsoon and Southwest monsoon, with the former providing more rain during October to December. The average annual rainfall for the Madurai

district at large is about 85.76 cm. Temperatures during summer reach a maximum of 40 °C and a minimum of 26.3 °C, though temperature over 42 °C is not uncommon. Winter temperatures range between 29.6 °C and 18 °C. A study based on the data available with the Indian Meteorological Department on Madurai over a period of 62 years indicate rising trend in atmospheric temperature over Madurai city, attributed to urbanization, growth of vehicles and industrial activity. The maximum temperature of 42 °C for the decade of 2001- 2010 was recorded in 2004 and in 2010

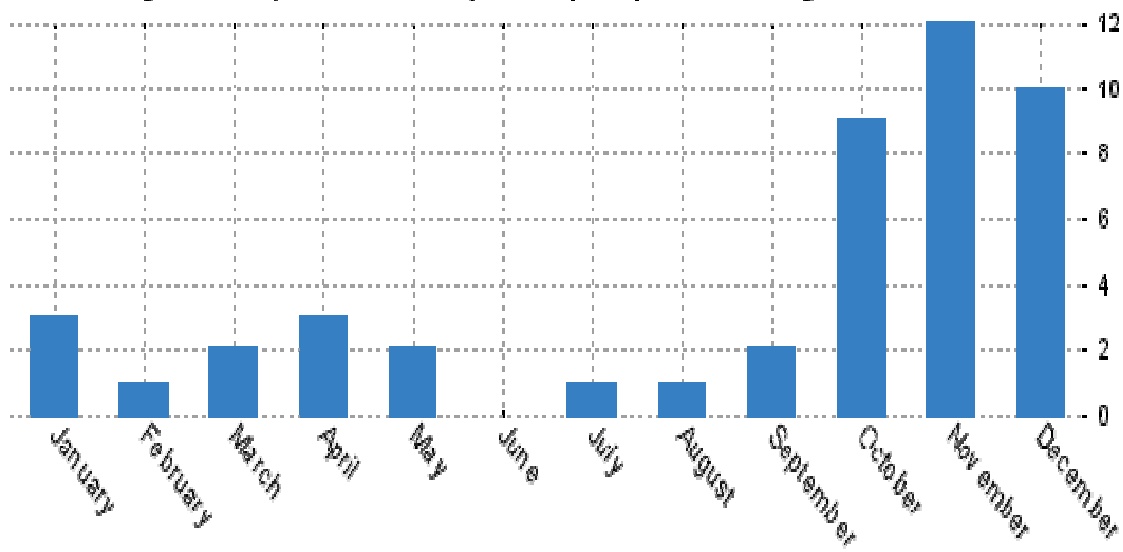
CLIMATIC CONDITION OF MADURAI



DISTRICT RAINFALL (MM) FOR LAST FIVE YEARS



The average rainfall, number of days with precipitation in a given month



Tourist Demand and Climate:

Madurai is hot and dry for eight months of the year, Cold winds are experienced during February and March as in the neighbouring The hottest months are from March to July, The city experiences a moderate climate from August to October, tempered by heavy rain and thundershowers, and a slightly cooler climate from November to February, Fog and dew are rare, occurring only during the winter season. The average annual rainfall for the Madurai district is about 85.76 cm. This section provides a review of the international literature on the importance of climate and weather for tourism demand. First, climatic conditions influence destination choice and as a result national and global tourist flows. They also are important factors in tourists' satisfaction and activity participation, as well as safety.

The Gandhian Approach Towards Sustainable Development:

Mahatma Gandhi, an ardent champion of sustainable development, advocated harmonious existence of mankind with nature and ecology based on equity and justice. He said long ago in 1924, "Earth provides enough to satisfy every man's need, but not any man's greed".⁵⁶ With this world view, Mahatma Gandhi was engaged in criticizing the colonial modernity which went beyond the carrying capacity of the planet earth and exploited people and resources across the planet. Therefore, our freedom struggle under his leadership was in a way the first ever struggle in history for sustainable development. Gandhiji's ideal life was an enlightened unselfish ethical life of plain living and high thinking. He wrote in 1938: "Man's happiness really lies in contentment. He who is discontented, however much he possesses, becomes a slave to his desires The incessant search for material comforts and their multiplication is an evil. I make bold to say that the Europeans will have to remodel their outlook, if they are not to perish under the weight of the comforts to which they are becoming slaves...". Mahatma Gandhi was so peeved of the western culture and civilization that he wrote 'if India followed the western model of development she would require more than one planet to achieve the progress they had attained'. The Nicolas Stern Committee Report on Global Warming and Global Economy also underlined the Gandhian philosophy when it observed that at the current rate of consumption of resources and energy of the planet, mankind would require more than one planet for survival. The Stern Committee Report, therefore,

stressed on reduction of green house gas emissions by remodeling life style and by transiting from a carbon economy to a non-carbon economy. We need to remodel our outlook and achieve the goal of sustainable development. By adopting a combination of factors which include the adoption of clean technologies, equitable distribution of resources and addressing the issues of equity and justice, we can make our developmental process more harmonious with nature.

Conclusion:

This study has revealed the attention and awareness on environment in urban region among various age groups. The scientific thinking about climate change and natural phenomena will give a meaningful awareness among public. The determination of awareness and understanding level in public is the base work for the Climate change impacts mitigation policies because climate change is not an issue of scientific society, as National oceanic and atmospheric Administration (2007) says, Climate is an ideal interdisciplinary, integrating theme for education and important topic and make use of this knowledge in people's life and in their communities. Even though the concept familiarity in Madurai urban area is 61%, the awareness is poor except youth especially students. Lack of environmental education and attention on environment leads low awareness and high sensitivity to climate change. The awareness programmes and students contribution will assist to increase the awareness level among public. Climate change is the defining issue of our times. It is perhaps, the greatest challenge to sustainable development. It should be addressed by all countries with a shared perspective, free from narrow and myopic considerations. The developed countries need to look beyond their narrow self interests and work jointly with the developing countries to evolve cooperative and collaborative strategies on the issue of climate change, which is of immense relevance for the future of mankind. However, the efforts so far in the direction of meeting the challenges of climate change have been sporadic and incoherent. We urgently need a new economic paradigm, which is global, inclusive, cooperative, environmentally sensitive and above all scientific. According to Jeffrey Sachs, a perceptive commentator, "The world's current ecological, demographic and economic trajectory is unsustainable, meaning that if we continue with "business as usual" we will hit social and ecological crises with calamitous results". Sustainable development based on addressing the needs of the poor and optimal harnessing of scarce resources of water, air, energy, land, and biodiversity will have to be sustained through more cooperative endeavours. Then alone, we could make some headway in saving our lone planet from the brink of climate disasters. Both weather and climate are extremely important for tourism, and it is often the perception of climate that may be more important than the reality. Tourists make decisions based on what they believe the climatic conditions of a destination are. As a result tourists will learn over time and adjust their decision making (Ehmer & Heymann, 2008). This is not only relevant with respects to perceived temperature and precipitation (e.g. "too hot", Gossling & Hall, 2006) but also in relation to perceived safety, for example in response to the (perceived) risk of hurricanes or other extreme events. As such there may well be "Winners and Losers" as suggested in a Deutsche Bank (2008) report. Actual impacts of climate change on tourist destinations are potentially much further reaching, as they affect the resource base of tourism, both directly and indirectly. Already, challenges such as water shortages or increased incidence of forest fires pose themselves to destinations. Environmental changes, for example the distribution of wildlife or coral bleaching, are also of fundamental importance for tourism. Understanding these changes is a first step towards managing them and adapting to new circumstances.

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