CLIMATE CHANGE ADAPTATION IN URBAN INDIA THROUGH TRADITIONAL PRACTICES

An empirical research on the impacts of climate change on the Mega cities of India and the institutional barriers or opportunities that exists to adapt to climate change by using traditional practices.

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An empirical research on the impacts of climate change on the Mega cities of India and the ways to adapt to climate change by using traditional practices

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Executive Summary

It has been observed scientifically that the effects of climate change are growing at a drastic level in today's world. The need to adapt to these effects is important socially, economically, politically and ecologically. Effects of climate change such as floods, droughts, cyclones, the rise in temperatures etc. are caused imbalances among the lives of living beings. It can be said that these effects are also caused due to human activities such as air pollution due to smog and GHG emissions from the industries as well as transportation, water pollution due to urbanization, soil pollution due to the use of fertilizers, pesticides and deforestation etc. This could bring in global warming and thus effect in climate changes.

Climate change is occurring slowly and steadily since the past few decades and the continuous activities of humans have led to a growth in the effects of climate change that is been observed. Since mitigation measures were taken and the countries who obeyed the mitigation strategies failed to cut down their emissions to the desired level. Thus, in the past decade, there has been a shift from mitigation measures to climate change adaptation. Based on the literature review, researchers have just begun to study effective ways of climate change adaptation. As adaptation measures are being explored, many developed countries have started adapting to some of the measures, but they are not yet cost – effective or completely energy efficient. These measures cost a lot of money, needs support and need to be a long-term investment, which is why many developing countries are not able to invest in these adaptive measures due to the economic crisis. Developing countries such as India face challenges that are not only economical but also political, social and ecological. Due to the diversity of geographical features, culture, ecosystems, and continuous growth in population; India is unable to find the suitable adaptive measure to implement in order to tackle the effects of climate change.

The purpose of my study is to understand the barriers and opportunities that exist in order to implement traditional practices as an adaptive measure in order to face the consequences of climate change based on the 4 dimensions of the Policy arrangement approach.

With this thesis, I will look at the challenges that are there for climate change adaptation measures if traditional practices are used in the Mega cities of India. Traditional practices were used in the olden days, in rural areas to adapt to climate change, but during those times the effects of climate change were not so severe as of what it is today. Traditional practices such and insulating houses by using clay and cob sand instead of using brick walls in the modern times. There were traditional methods of rainwater harvesting and crop rotation in order to adapt to climate change. Hence, I based my literature review in knowing if it was feasible to use traditional practices in the Mega cities of India as an adaptive measure towards climate change. After, reviewing the literature review, I found the theory of Policy arrangement approach as the most suitable concept on which I could base my concept on. The policy arrangement approach has four dimensions which are interconnected to one another and if one gets disrupted the entire approach falls out of place. The dimensions are the actors, rules and regulations, resources and power and discourse or barriers. My thesis objective is based on these for dimensions and this will prove if traditional methods of adaptation can take place in the Mega cities and if yes, then want can be done to implement them.

I decided to do a qualitative research by interviewing 6 participants based on purposeful sampling and snowball sampling. All the 6 interviewees were well connected and had experience in climate change adaptation in India. There was a total of 4 males and 2 female participants. I conducted the interview with them through Skype video call as I was based in Nijmegen, Netherlands and the participants were in different cities in India, Nepal, and Germany. After conducting the interview with the 6 participants, I critically analyzed and interpreted the data by using Atlas.ti 8 software.

The results of my analysis, fortunately, fit my theory and the conceptual framework of policy arrangement approach. It was seen that India was facing many challenges at all of these levels. The actors involved are lacking in making adaptive policy framework, they are lacking in taking the initiative to monitor the existing policies and make new stringent policies, they are lacking in planning and organization, they are basically not doing what they are supposed to do as their role. Thus, the rules and regulations are not up to the desired goal. There are barriers and challenges in terms of region-specific adaptation policies. In terms of resources and power, even though finance is not the issue, there are issues like corruption, investments, infrastructure, awareness, and behavior. Hence, with all these challenges and barriers it becomes impossible to implement traditional practices in urban India as an adaptive measure. The interviewees suggested a few methods of tackling these issues and help in making the Mega Cities of India more sustainable and progressive. Such as building more stringent bylaws and policies, monitoring the policies and implementing, finding a balance between traditional and technocratic practices in order to be more sustainable and energy efficient. This will also upsurge our development and be more climate resilient.

According to me, the future recommendations for this thesis will be initiating more research or case studies related to climate change adaption in India and the stringent policy frameworks that must be implemented along with it.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND CLIMATE CHANGE:

Climate change is the most complex issue that the world is facing globally. This will continue to be around us for centuries and decades to come. Climate change is caused due to the greenhouse gases present in our atmosphere such as carbon dioxide, methane, chlorofluorocarbon, water vapor etc. to absorb more heat from the sun and trapping that heat in the atmosphere preventing the heat to escape from the planet. This results in warming our planet. Greenhouse gases at a certain level are good for the earth to stay warm and for us to survive on it, but an excess of carbon dioxide can lead to the greenhouse effect and heating our planet which can cause many natural calamities (*Global climate change - US EPA*, 2016). In today's world, we emit an excess of carbon dioxide in our atmosphere by burning fossil fuels like coal, oil, and gas, using computers and other electronic devices as well as doing everyday chores like heating our homes and releasing toxic gases which are emitted from the industries and vehicles which also leads to air pollution. All these carbon dioxide traps more heat in the atmosphere, making the earth warmer and causes other climate changes too (*Global climate change - US EPA,* 2016). The temperature is getting warmer day by day, huge ice sheets have started melting which in turn leads to a rise in the ocean and sea levels. The fast depleting freshwater ice cap imbalances the salinity of oceanic water which in turn affects the ocean currents bringing in random shifts in seasonal climates (*Global climate change - US EPA,* 2016). Other changes that we see these days are that birds aren't migrating towards the far south for the winter, flowers are blooming sooner, and the snow is melting faster. If there is a constant rise in carbon dioxide then we will experience more natural calamities like heat waves, droughts, floods, and storms. Thus, it will lead to more problems like the wildfire, food and water shortages, and more spread of diseases. Climate change can endanger many coral reefs, plants, and animals which will, in turn, create an imbalance in the ecosystem and loss of biodiversity *(Global climate change - US EPA,* 2016). In figure 1, we can see a few examples of the effects of climate change.

Figure. 1 Jackson, R., (2018). *Global Climate Change: Effects. Climate Change: Vital Signs of the Planet*. Website., Retrieved 23 March 2018, from https://climate.nasa.gov/effects/

Regardless of the continuous increase of awareness about climate change, there is still a continuous rise in emissions of carbon dioxide in the atmosphere. According to the data collected by the United Nations and NASA, in 2013 it showed that the daily level of carbon dioxide exceeded about 400 parts per million in the atmosphere. The data suggests that it is for the first time in human history that there was such an increase in carbon dioxide in the atmosphere. The last time it was this high was during the Pliocene era which dates back to 3 to 5 million years ago (*NASA,* 2018).

Climate change involves a lot of aspects such as science and technology, economic, social, political, ethical questions etc. Thus, to come to a solution it was discovered that there are two approaches to control this climate change (*NASA,* 2018).

- **Mitigation** – It is an approach by which we stabilize the levels of greenhouse gases and reduce the emissions in the atmosphere. This can be done by either reducing the source of emissions like the industries, vehicles or burning of fossil fuels etc. or by improving the conditions of the oceans, forests, and soil which can store these greenhouse gases (*NASA,* 2018). According to the reports of 2014, on Mitigation of climate change by the United Nations Intergovernmental Panel on climate change, it has been said that the ultimate goal is to stabilize these greenhouse gases within a timeframe by which the ecosystem can automatically adapt to the changes without any threat to the biodiversity, food and water shortage and sustainable development leading to rising in economy (*NASA,* 2018). For example, Paris Climate change agreement in 2015, was one of the biggest approaches and initiative was taken by all important nations to fortify the threat of climate change by keeping the global temperature below 2 degree Celsius even at a pre-industrial level as well as the main aim is to maintain a temperature of 1.5 degree Celsius globally. This agreement also builds upon different countries ability to deal with the climate change impacts and mitigate them (*Unfccc.int,* 2016).

- **Adaptation** – It is the ability to adjust or adapt to the expected or actual changes that are caused by a changing climate. The goal is to create a resistance towards the events that occur during climate change, such as storms, food and water insecurity, a rise in water levels etc. It also incorporates high potential opportunities such as increasing the yield, crop rotation etc. to benefit us in the present and future. Since the earth has been stable for more than 1200 years as of now; this has been the most critical reason for the development of the modern civilization (*NASA,* 2018). Through centuries people and society have adjusted to the changes in the climate and adapted to the extreme climatic changes that have taken place over time. The faster then there are changes in the climate, harder it gets for the civilizations to adapt and cope with it. Different organizations and the governments, all over the world have come up with solutions to adapt and take precautions for extreme climate changes. Such as protocols, policies, conventions, agreements from the United Nations, building flood defences, heat stress plans to sustain in high temperatures or food and water shortages, risk management plans during extreme natural calamities, managing forests and agricultural lands, usage of more renewable resources rather than exploiting non- renewable resources, sustainable developments, eco- friendly or green infrastructure etc. *(NASA,* 2018). These adaptive ideas were decided by the United Nations Intergovernmental Panel on Climate Change according to the reports on Climate change impacts, adaptation and vulnerability in 2014 (*NASA,* 2018).

1.2 INDIA AND IT'S MEGA CITIES:

India is one of the 7th largest countries in the world by area and is one of the largest democratic countries in the world. It is situated in the continent of Asia and is surrounded by water on all three

sides by Indian Ocean, Arabian Sea and the Bay of Bengal. India is a very diverse country in its heritage, culture, traditions, food, geographical contours and languages. India has many large cities with the immense population. There are about 39 cities in India and each of these cities at least exceeds one million people. The total population of India is approximately about 1.32 billion people (*World Atlas,* 2015).

India's rapid urbanization, economic growth, and development have led to many mega cities in India. India is not only going through changes like social, political, demographic changes, but also environmental and traditional changes. There are issues like governance, town planning, social, economic, political and climate change challenges that India is growing through due to urbanization and development (Hoelscher & Aijaz, 2016).

According to the United Nations, the definition of a Mega city is to exceed the population by 10 million people. And based on this calculations India has 5 major Mega cities as of today (Torkington, 2016). They are as follows:

1. New Delhi- This city is also the capital city of India and has a population of 26.5 million people (Torkington, 2016).

2. Mumbai- This city is one of the busiest and the demanding city of India. It is also called as the financial hub of India, with a population of 21.4 million people (Torkington, 2016).

3. Kolkata- It was the former capital city of India. It is also an important trading hub with a population of 15 million people living in the urban city (Torkington, 2016).

4. Bengaluru- This city is called the Silicon Valley of India and it also has the largest IT hub in India, with a population of 10.5 million people living in the urban areas (Torkington, 2016).

5. Chennai- This city is called the Indian motor industry as it has many automobile industries. It has a population of 10. 2 million people (Torkington, 2016).

There are many other major cities in India which are turning into Mega cities due to economic growth and development. Due to urbanization, many people migrate from small cities and rural areas in India in search of Jobs and financial security. Thus, according to the UN, by 2030 there will be two other Mega cities in India due to urbanization (Torkington, 2016). The two cities which will soon become Mega cities of India are as followed:

1- Hyderabad- This city is another strong IT hub and is also well known for its tourism. It may have a population of 12.8 million people by the end of 2030 as predicted by the United Nations (Torkington, 2016).

2- Ahmedabad – This is a city of textile industry and as the United nation predicted, the population of this city might go up to 10.5 million people by the end of 2030 (Torkington, 2016).

Figure 2: E., (2018). *Green energy. audit* Contact Us. website., Retrieved on 15th April 2018, from http://www.greenenergyaudit.in/contactus.html

According to the United Nation's world city report, it states that all the major Mega cities generate a lot of wealth, job opportunities, economic and social development. But, they also have major issues and challenges such as climate change, inequality and the breaking down of traditions and culture, which creates vulnerable situations for the people and different communities (Torkington, 2016).

There was a recent study in 2013 by the European Association of National Metrology Institute, which stated that the Mega Cities mainly faces with 3 dimensions of challenges. One is the social dimension which includes traditions and variance in culture – ethos, living conditions and health care, sanitation, transport etc. The economic dimension consists of job and unemployment, technocratic practices, innovations, infrastructure, decentralization, distribution of capital and wealth etc. And the last dimension is the ecological dimension which consists of aspects such as energy resources, sustainable development, different types of air, water, soil and noise pollutions, waste management, carbon emissions, public transportation, urban agriculture, food security, urban environmental protection etc. And these three above mentioned challenges and issues must be dealt with utmost priority to have a successful, developed, healthy and an environment-friendly city *(Mgc; EURA MET,* 2013). Mega cities must not just focus on tackling the climate changes, such as climate variabilities and climate extremes but also take into consideration the adaptation measures that are needed to adapt to climate change.

1.3 SCIENTIFIC RELEVANCE:
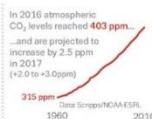
The world is facing severe damages because of climate change. And this is caused because of different actors of our society. Out of all the polluting nations such as China, the US, Japan, and Russia etc., India emits the most amounts of carbon emissions. The carbon emissions from India rose to 5% in 2016 (Carrington & Safi, 2017). According to the Nature climate change, environmental

research letters and Earth System Science Data Discussion journals, India's Carbon emissions globally projected to grow 2%, with a range between 0.2 and 3.8 percent annually averaged over the previous decade, because of significant governmental interventions in the economy. This fact was published by the journals in 2017 during the Global Carbon Budget by the Global Carbon Project ("Future earth, 2017"). The image below describes the rise in global emissions in 2017 due to the use of fossil fuels, which in turn increases the temperature risks and climate variability.
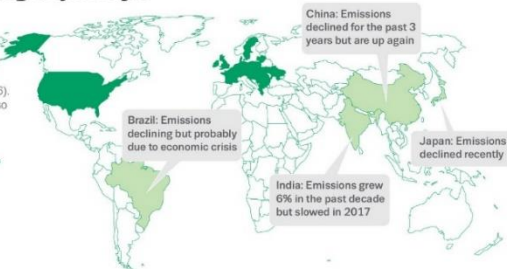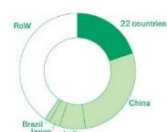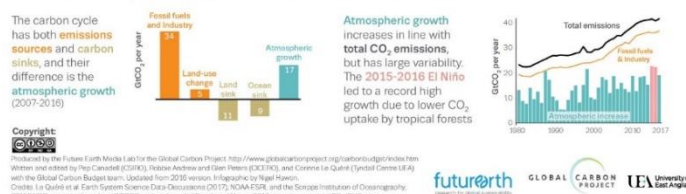
Figure 3: *Global carbon dioxide emissions projected to rise after three stable years.*, (2017). website., Retrieved on 15th April 2018, from https://phys.org/news/2017-11-global-carbon-dioxide-emissions-stable.html

An extensive study was carried out in India, in 2015, by IIM Ahmedabad, IIT Gandhinagar and the Council on Energy, Environment and Water based on energy and climate issues. According to the data it stated that India will be experiencing an increase in the annual mean air temperature from 1 to 1.5 degree Celsius, from 2016 to 2045 due to continuous greenhouse emissions (Aggarwal, 2018). This could impact the food and water security, infrastructure, health, natural resources and also could bring events like flood, drought, storms etc. to cause severe damages to the society. It stated that about more than 800 million people all over the country and about 450 districts in India are facing an increase of more than 2 degree Celsius in the annual mean air temperature (Aggarwal,

2018). As of now, India has spent 91.8 billion dollars from 2013 to 2014 for climate change adaptation and considering the scenario it is estimated that by 2030 India would need to spend 360 billion dollars. Adding up to the cost of the effects of climate change, India would spend at least 1 trillion dollars by 2030 on climate change adaptation. Hence, it is said by many experts and scientists, that there is an urgent need to keep a check on the greenhouse emissions, create more sustainable development and measures or policies in India that can lead to such adverse effects and cause damages all over the world (Aggarwal, 2018).

India is a vast country which is filled with multi-socio cultural, multi-ethnicity, multilingual with a population of 1.3 billion people. This variance and pressure on the country are detrimental to the sources of the country (Carrington & Safi, 2017).

According to Christiana Figueres who was UN's former climate chief who had come up with the Paris agreement said that India is very crucial for everyone and that India will eventually play a key role at the UN summit which was held in Bonn, Germany (Carrington & Safi, 2017). Then again, according to a climate economist Lord Nicholas Stern who worked in India for 40 years there are high emissions of carbon that is released in India due to development and this would make it very tedious for the world to keep its global temperature below the danger limit of 2 degree Celsius (Carrington & Safi, 2017). Navroz Dubash who is another senior at the Centre for Policy Research in Delhi stated that 'whoever has claimed to predict that India's emissions will subside down by the year 2030, does not have much humanity in them' (Carrington & Safi, 2017). Research on India to reduce Carbon emissions has been going on since the past few years and it is believed that if India could manage to reduce these emissions and increase the awareness of using renewable resources instead of exploiting non- renewable resources, by the help of technology it would definitely make massive difference not only to prevent and conserve the climate change and biodiversity of India but also the world (Carrington & Safi, 2017). It is unlikely that climate change will be prevented by only mitigation methods, hence there is an urgent need to adapt to the consequences of climate change.

A research study called, "A theory and practice in assessing vulnerability to climate change and facilitating adaptation", was done in the coasts of Vietnam based on few approaches to adapt to climate variabilities and extremes. This research was done to analyze the socio-economic wellbeing of the livelihood of the society and the institutional constraints of the groups of society and the use of resources. These approaches had to be robust and the policy frameworks must relevant to the region- community-based approaches to adapt to the impacts of climate change and stress. This research study established that poverty reduction, common property rights, equal distribution of resources, promoting collective security, income diversification and a sustainable response practice to socio-economic and climate variability were the key to improve and adapt to climate change for many communities (Kelly & Adger, 2000).

A case study took place in East Kimberley, a northeast region of Australia in 2013 among an indigenous group of the community called 'Miriwoong' living there. The study discussed the various traditional ecological knowledge that these communities had in order to develop themselves and use the traditional practices and knowledge to adapt to climate variabilities. This case study documented all the information and knowledge about their use of resources and the system of management which was locally used among the indigenous community to cope with the changing

climate. In conclusion to their understandings, they stated that this traditional knowledge can develop the cultural values and also help in adapting to climate changes by using the traditional practices in the future (Leonard, Parsons, Olawsky & Kofod, 2013).

Not much research on traditional practices as an adaptive measure to climate change in urban India has been done and hence, that is why I am taking an innovative approach by analyzing the institutional barriers and applying the PAA (Policy arrangement approach and it's 4 dimensions) to this topic.

1.4 SOCIETAL RELEVANCE:

India lacks enough resources that need to be provided to hundreds of millions of people living in the country and thus climate change adaptation becomes a priority for India. Large-scale poverty in India makes it difficult for the poor to adapt to climate change and its impacts as they are severely affected by it due to their immediate exposure to calamities rising out of climate change (Henzler & Chaturvedi, 2016). Positive and active measures are to be taken in order to sustain the livelihood of the people which can reduce the effects of climate change and adapt to it. GIZ India in collaboration with Adelphi is one such organization that is helping the Indian government to implement new laws, policies and conventions on climate change adaptation and also the sustainable management of renewable resources in order to reduce carbon emissions (Henzler & Chaturvedi, 2016).

Research has been done on how urban population in India is a risk due to climate changes and how effective rural adaption will be to improve natural hazards by doing a risk assessment, management and traditional practices in rural areas (Revi, 2008).

Another paper talks about the experiences of community-based organizations and Non-governmental organizations in relation to climatic changes that are taking place. They incorporate designs and implementations of local adaptation strategies for adapting to new changes in the climate and hazardous issues (Blanco, 2006).

The effects of climate change are not only observed physically but also in the ecological systems. It is also seen among the humans to adjust to the availability of resources and the risk at various socio-economic levels. Many scientists have researched the adaptation procedure based on certain scales such as effectiveness, equity, efficiency, sustainable development and more (Adger., Arnell; et.al, 2005).

According to another research article, it stated that climate change adaptation also has some limitations of issues like the values, ethics, psychological risks, culture, socio-economic and political constructs in most of the endogenous societies. But these issues and limitations are also quite liable to the change in the future (Adger, Dessai; et.al, 2008).

1.5 TRADITIONAL PRACTICES TO ADAPT TO CLIMATE CHANGE:

Traditional and heritage practices in India are very common and India also had a history of low carbon footprint centuries ago. But, modernization and fast need for economic development and growth have ruled out these practices (Kumar & Bhatt, 2018). To curtail the harmful emissions, India

needs to encourage the society and spread awareness. There should be the policy of bracing green consciousness among the societies and having alternative models for sustainability by inculcating traditional and heritage practices. 70 percent of the population lives in the rural areas where they do not need high energy consumption of resources and technology. They generally fulfill their basic needs by organic farming, skilled labor, craftsmanship etc. This helps in reducing the dependency on electricity and other power sources (Kumar & Bhatt, 2018).

Children in India right from the early age are taught to respect food and not waste it. Thus, food wastage per capita in Europe is 95-115 kg/ year and South/Southeast Asia and Sub Saharan Africa is only 6-11 kg/year. This traditional practice can help in saving a lot of food and will, in turn, give us food security. A lot of greenhouse gas emission occurs during food transportation worldwide (Kumar & Bhatt, 2018). If the food is locally grown and preserved by using natural biopesticides like neem (Azadirachta indica) for grain storage, sun drying, a salt application on pickles etc. it will reduce transportation and packaging requirements. Meat consumption is another cause of the increase in greenhouse gas emissions due to demand for excess water and land. Over the last few decades, there has been a constant increase in meat consumption (Kumar & Bhatt, 2018). The Global meat consumption is 33.8 kg in the base period of 2011-2013. The per capita meat consumption in India only 3.3 kg in 2011-2013 which is about 1/10th of the global average of 42 percent of the families in India are vegetarians. This practice will help in reducing a lot of GHG emissions (Kumar & Bhatt, 2018).

Using transport for short distances can emit greenhouse gases and pollutes the air. In India, even in major cities 40-50 percent of the people either walk, use pedal rickshaws, use public transport or bicycle (Kumar & Bhatt, 2018). And recently the Prime Minister of India Narendra Modi has planned to change all cars to solar battery /electrically driven cars by 2030 to reduce carbon emission and reduce global warming. Thus, to achieve sustainability, it is essential to either use Solar battery/ electricity driven cars or promote non-motorized transports especially for short distances (Kumar & Bhatt, 2018).

A village named Rajghat near the borders of Rajasthan and Madhya Pradesh which are states in India has no electricity and there are about 240 million people living without electricity and remorse conditions of poverty. There have been only two weddings in that entire village in the past 20 years, as no one wants to get married and live there (Carrington & Safi, 2017). A resident named Rajesh, from that village, recently created a solar-powered battery to create electricity. This creation has not only helped the other citizens of that village but also created an inspiration of innovation among them to use the recent technology and the usage of renewable resources without creating any pollution or impacting the climate to change (Carrington & Safi, 2017).

Another example is Sonam Wangchuk, who is a teacher and an innovator in Ladakh. His school, SECMOL, is his greatest achievement. Over there, the teaching method does not rely on textbooks. Students learn by doing and through real-life experience and traditional practices. The study, play and innovate. Their school runs exclusively on solar energy; it is constructed sustainably, and it creates solutions to local (and global) environmental concerns (Rajendra, 2017).

India in the ancient times, suffered from floods and droughts on a regular basis. Which is why India had its own traditional ways of harvesting water. The basic technique of rainwater harvesting was

depending on the rain to fall at any place and time. This rainwater was then used for drinking, washing clothes, utensils, bathing, and even agriculture. Traditional ways of building rainwater harvesting practice are by building underground tanks, cisterns, reservoirs, lakes or ponds, aquifers, groundwater recharge, step wells, rooftop tanks etc. Rainwater harvesting is an essential method of adapting to climate changes based on the drastic change in the rainfall pattern in today's world. It also helps the community to prevent scarcity of water, especially when a lot of rivers and natural water bodies are getting dry in India (Pal, 2016).

In earlier days, houses were built out of cob earth dug, which is a mixture of clay or earth soil with straw and sand. These houses were excellent insulators and a few of the oldest cob houses are still standing strong which can be reported to 10,000 years ago. It was the easiest method of building houses which were completely freestyle by hand. Thus, it was the cheapest method of insulation as well as energy efficient which has the least carbon footprint (Fearn, 2015).

Thus, these are few of the examples of traditional practices that can be promoted worldwide to save up energy and emission of fewer greenhouse gases in the atmosphere to live in a sustainable environment as well as adapt to the climate change (Kumar & Bhatt, 2018).

Hence, based on the results of both scientific and societal relevance of climate change adaptation, I would like to find the gaps and the barriers that exist in the Mega cities of India, to adapt to recent climate changes that are taking place and how feasible are the traditional adaptation practices will be to implement them in the Mega Cities.

1.6 RESEARCH PROBLEM AND OBJECTIVE:

Based on the above-mentioned issues and challenges that the Mega cities of India are facing due to change in climate, the research problem of this paper will be climate variabilities and climate extremes such as the aggravation of seasonal imbalances, loss of biodiversity, rise in temperature, changes in rainfall patterns causing events such as droughts, floods and storms etc. Thus, there is an urgent need for us to act upon these climatic changes before it is too late. So, to face these changes, there is also a need to adapt to the climate changes and its consequences so that we are well prepared, and less damage will be done by the climate variabilities and the climate extremes on us.

Hence, the objective of this paper is to define a scope of opportunity and means to enhance adaptability to the growing climate change impacts by focusing on the use of traditional local practices in Mega Cities of India and in turn assessing the effects of using these local traditional practices. In this paper, I will also try to depict if the traditional practices which are mainly used in the rural areas are still feasible enough to implement them in the Mega cities of India. My focus will be to gather the most efficient and effective traditional methods for adapting to climate change in the Mega Cities and what are barriers or opportunities that exist in the cities and the ones that people face to put these practices in action.

1.7 RESEARCH QUESTION:

- What are the institutional barriers or opportunities for Mega cities in India to adapt to the consequences of climate change while using traditional local practices?

To answer my main research question, I will also try to explicate the sub-questions as followed:

1.7.1 Sub-questions:

Sub-questions are based on the Policy arrangement approach dimensions:

- What are the barriers and opportunities for implementing traditional practices in the Mega cities of India to adapt to the climate change based on the **discourse** dimension?

- What are the barriers and opportunities for implementing traditional practices in the Mega cities of India to adapt to the climate change based on the **actor** dimension?

- What are the barriers and opportunities for implementing traditional practices in the Mega cities of India to adapt to the climate change based on the **resources and power** dimension?

- What are the barriers and opportunities for implementing traditional practices in the Mega cities of India to adapt to the climate change based on the **rules and regulations** dimension?

- Is it feasible to implement traditional practices in large Mega cities to adapt to climate change?

CHAPTER 2: LITERATURE REVIEW

2.1 CLIMATE CHANGE AND ADAPTATION:

In today's world, one of the major challenges that we are facing is Climate Change. The climate variabilities such as changes in rainfall patterns causing floods and droughts, increasing in the intensity and the frequency of cyclones, the climatic extreme conditions such as the weather, rise in temperature and many other natural calamities that are taking place are the impacts of climate change. The intensity of these climate changes is getting severe day by day. Hence, there is an urgent need to pay attention to these changes and consequences of climate, to live a safe, environment-friendly and better life (Ahmed & Long, 2010). In order to cope with these changes, there is an urgent need to establish adaptive policy frameworks and methods to adapt to the effects of climate change which can also affect us socially, economically and environmentally. To eliminate the risks and the socio-economic vulnerability due to climate change, adaptation is the key aspect to cope. Even though adaptation is not a new aspect, it has been only come to our attention lately due to the drastic climatic changes. Recently there has been a development in terms of adaptation as to how to cope with the impacts of climate change and the socio-economic vulnerability. Adaptation gives us a direct and indirect model of measures to be taken in order to diminish the risks and effects of climate change. Although Mitigation was the most effective and key measure as of now to tackle climate change, most of the countries have failed to set their goals and achieve the mark of reducing the carbon emissions. There is still a constant rise in temperature of the earth and many ecosystems and communities are getting affected by it due to all the climatic changes that are taking place (Ahmed & Long, 2010).

This lead to an urge to research more about adaptation and the ways to implement them among the environmental practitioners, researchers, policy makers, and implementers. But, there is still a large gap in how to, what way to, and where to adapt to climate change. Many researchers explained what adaption means and its characteristics of adaptive measures to cope with climate change, by their work and papers, such as Burton (1992), Smit (1993), Carraro (1998), Leary, Fankhauser, and Smith (1999) (Ahmed & Long, 2010). Adaptation measures are happening, but it is taking a lot of time to find the optimal adaptive measures for coping with the effects of climate change (Ahmed & Long, 2010).

Since the early 1990's the term adaptation was talked about for climate change communities. But, according to the United Nations Framework Convention on climate change (UNFCCC) in 1992, stated that mitigation and adaption are both essential features of tackling climate change. Since there was no progress and not much effort was put on adaptation, it became stagnant. Although after IPCC working group II in 1995, confined the second assessment report where it stated that both mitigation and adaptation measure is absolutely necessary on a technical basis, the attention shifted on adaptation. The main reason for this shift was in (Lisa, Schipper; et al, 2007), due to lack of policy frameworks for mitigation and the result of failure to reduce the carbon emission (Ahmed & Long, 2010). Thus, since then there have been researches on adaptation. In 2001, IPCC (TAR) came up with another report on the impacts and the methods of adaptation and mitigation. Another report was realized by IPCC(AP4) on 2007 related to the adaptive capacity, vulnerability,

and risks of human influence on climate change sensitivity and consequences of climate change (Ahmed & Long, 2010). Green papers on adaptation and climate change were also released by the European Union in 2007. Action plans such as the Bali action plan in 2008 and the COP13 have also confirmed the response of action towards the IPCC fourth assessment which concerns with adaptation, risk management policies and approaches, disaster management and economic diversification on resilient future approach (Ahmed & Long, 2010). The research and the studies on adaptation are still at the infant stage and a lot of effective and efficient policies are needed to put this in action.

According to IPCC, 2007, adaptation strategies should be planned by the governmental organizations, private decision makers, and investors or NGO's. Adaptation measures are not guaranteed, but it also costs money for the implementation of adaptive practices. Any adaptive practice will be effective if we consider the estimated value of circumvented risks and damages in relation with the amount of money that was spent to implement the adaptive measure (Ahmed & Long, 2010).

Adaptation policies and measure will differ from different places to different regions in various other sectors. Different kind of climatic changes is seen in Iceland as compared to the climatic variabilities in Africa, for example, the agricultural sector. Thus, there is a gap of finding the optimal adaptive measure to climate change as a whole. The policymakers are trying to come up with an adaptive policy which is efficient and cost-effective. Most of the developing countries are more vulnerable to climate change and there is also a limitation in these countries due to their poverty and illiteracy. The policies as well the cost of implementing the adaption strategies is limited in the developing countries (IPCC, 1996; IPCC, 2001; IPCC, 2007; Ahmed & Long, 2010). In developing countries adaptation strategies are supported by international agencies. There are 3 dimensions for building an adaptation strategy and they are The objective of the adaption measure, the subject of the adaptive measure and the procedure of implementing the adaptive practice (EPA, 2009; Ahmed & Long, 2010).

There are many ways of classifying adaptation based on intent, time, human systems and sequential aspect (Malik, Qin & Smith, 2010).

1. Based on intent:

    - Autonomous adaptation- this adaptation is also called the spontaneous adaptation and is generated by either economic changes human systems or ecological changes in the natural system. It is not an attempt to respond to the climatic changes. (IPCC, 2001; Malik, Qin & Smith, 2010).

    - Planned adaptation- This type of adaptation is based on the policies that are made to adapt to climate change due to the changes occurring or the changes that are going to take place in order to cope, maintain and achieve the anticipated state.

2. Based on time:

    - Anticipatory adaptation- This type of adaptation is also called the proactive adaption and its implemented before the changes or impacts of climate change actually takes place, in order to protect the ecosystems and the communities.

- Reactive adaptation- This type of adaptation only takes place after we face the consequences and impacts of climate changes that can be pragmatic (Malik, Qin & Smith, 2010).

3. Based on human systems:

- Private adaptation- These type of adaptation measures is mainly done because of their self -interest by the private agencies, individuals or individual communities.

- Public adaptation- This type of adaptation takes place because of the collective needs of the society as a whole or any sectors. The main actors who initiate and implement these adaptation measures are the Government at all levels and Governmental organizations (Malik, Qin & Smith, 2010).

4. Based on the sequence:

- Short-run adaptation- This type of adaptation measure depends on the variable inputs of the production and thus the policy maker's decision on climate change is based on the restricted finance. So, the implementation of this adaptive measure only runs until there is finance and the desired state is attaining.

- Long-run adaptation- In this type of adaptation, the policymaker can adjust the finance and the response based on the impacts of climate change (Stern, 2007; Malik, Qin & Smith, 2010).

After critically analyzing the risks and the vulnerability of climate changes, a particular type of adaptation measure must be implemented keeping in mind that it should also be cost effective and energy efficient. According to the recent literature the developing countries and the non-market sectors are affected by impacts of climate change (IPCC, 2007; Stern, 2007; Ahmed & Long, 2010). Since the developing countries have a continuous growth in their population and are less technically advanced, they mostly depend on the natural resources to fulfill the needs of the community and thus, have a very less adaptive capacity (Downing, 1997; Magistro and Roncoli, 2001; Ahmed & Long, 2010). And most of the adaptation measure must be region specific (Adger et.al, 2003; Ahmed & Long, 2010). Another limitation to cope and adapt to climate change that the developing countries face are policy options, as most of their resources are spent on fulfilling the basic needs of the people and the development of the nation. There is seen a gap in acknowledging the impacts of climate change and risks, among the people and different communities in these developing countries (Ahmed & Long, 2010).

2.2 ADAPTATION STRATEGIES/PRACTICES:

According to (Agarwal and Perrin, 2009) there are about 5 categories of adaptation practices and most of the empirical literature research on adaptation of climate change fall into these 5 categories mentioned below (Malik, Qin & Smith, 2010):

1. *"Mobility- pools or avoids risks across space.*

2. *Storage- It pools/ reduces risks experience over time.*

3. *Diversification- It reduces risk across assets owned by households or collectives.*

4. *Communal pooling- It involves joint ownership of assets and resources; sharing of wealth, labor or incomes from particular activities across households, or mobilization and use of resources held collectively during the time of scarcity. It reduces the risks experienced by individual households.*

5. *Exchange- It is usually viewed as a means to promote specialization and increase revenue flows, but it can equally substitute for the first four classes of adaptation strategies."* - *(Adapted from Agarwal & Perrin, 2009; Malik, Qin & Smith, pg. 8, 2010)*

2.3 EFFECTS OF CLIMATE CHANGE IN URBAN CITIES:

Based on the research and empirical studies, they have found the types of potential effects of climate change in Urban cities (IPCC Third Assessment Report (TAR), 2001; Bigio, 2003; McEvoy, 2007; Wilby, 2007, IPCC Fourth Assessment Report (AR4) 2007b; Huq et al, 2007; Hunt & Watkiss, 2007). Such as:

1. The rise in the sea level on the coastal cities results in high intensity and frequency of cyclone and storms,

2. Due to extreme conditions of climate change like the temperature rise, cyclones, floods, and droughts caused by varying rainfall patterns etc. the infrastructure is damaged drastically.

3. Climate variability and the extremes affect the health of living beings such as disease spread by food and water, vector-borne disease, heat and cold relate mortality (Hunt & Watkiss, 2007).

4. Tourism and cultural heritages are affected drastically due to impacts of climate change.

5. Access to water and other natural resources becomes difficult.

6. There is a direct effect of the energy use for heating or cooling and the energy for water.

7. Severe effects are seen on the urban bio-diversity (Hunt & Watkiss, 2007).

8. Additionally, there are different types of pollution which get enhanced due to climate change such as soil pollution, water pollution, air pollution etc.

9. Due to the effects of climate change, every sector at each level has a negative impact on it. Such as water sector, agricultural sector, health sector and more in both rural and urban areas.

10. Different ecosystems are also severely damaged because of the effects of climate change (Hunt & Watkiss, 2007)

According to IPCC TAR (2001), the effects of climate change impacts on urban cities were mentioned in a complete report. It was concluded by stating that, "*Climate change is more likely*

to have important impacts on the development of settlements in resource-dependent regions or coastal or riverine locations. Most of the concerns were of possible negative impacts on development (e.g., on the comparative advantage of a settlement for economic growth compared with other locations), although impacts on some areas were considered likely to be positive."- (Adapted from IPCC TAR, 2001; Hunt and Watkiss, pg. 13, 2007).

2.4 POLICIES RESPONSE AND BARRIERS FOR ADAPTATION:

According to Stern's review on "The economics of climate change – Policy response on adaptation" in (Stern,2007), he stated few aspects of tackling climate change and ways to cope with its risks. According to (Stern, 2007), the important aspects of reducing emissions through policies are: creating a policy for a carbon tax, climate change adaptation regulation, technology policy and the barriers of behavior/ attitude policy change. Policies should be made conserving the two major aspects such as the development of low carbon efficiency and the use of highly efficient technologies on an urgent time limit. Behavioral change among the individuals, decision makers, investors, implementers, and the government to adapt to climate change is the most essential aspect to achieve the desired goal of tackling climate change. The capital stock must be a prolonged investment because if the climate change policies have to exist then the investors might not take the carbon pricing into account for their business. Thus, in the long run, they will have to pay much more, and it will be extremely difficult to cut down the emissions then, due to high carbon infrastructures (Stern, 2007). Even though there are few measures and policies to reduce emission but there are still some barriers of behaviour to prevent these measures to take place, such as lack of awareness about the problem, finance, decisions based on easy and cheap methods which are only profitable to the investors, attitude problem among the organisations to understand the urgency of the situation and act on it (Stern, 2007).

Thus, there is a failure to implement these policies and measures which are cost effective and energy efficient. These failures occur mainly if there is also a regulatory issue, awareness issue, and an economic problem because of transaction costs. Policies should be made in such a way that it gives clarity and certainty to the investors, implementers and the other actors involved in acting towards adaptive measures. International support for finance can also be of help. Spreading awareness about climate change impacts and its consequences for each and every individual to bring a behavioral change is important. The government needs to create policies, monitor them, comply with them, persuade the investors and the decision makers, generate more revenue for adaptive measures and initiate more discussions on how to tackle climate change (Stern, 2007).

Another aspect that is to be looked into is the town planning and resilient energy efficient buildings and infrastructure. It would cost about 10 to 20 billion dollars approximately, which becomes difficult for the developing countries due to poverty and thus become more vulnerable to climate change risks. Crop rotation and resilient crops through advanced technology which is low carbon emission is another example to adapt and cope with climate change. All of these would need the long-lasting capital stock support initially. But, if these adaptation measures are not put in action now, then the risks and impacts of climate change will increase and the consequences will be devastating ecologically, economically and socially. A lot more expense will incur to cut down the carbon emission later on when it is too late. Risk-based insurance policies are also an important

way of tackling climate change based on the size of the impact and risk and it is an essential management system. which most countries should adopt (Stern, 2007).

2.5 GOVERNMENT'S ROLE AND POLICIES:

According to Stern Nicholas (2007), the government has the most important role to play in terms of policies and implementing adaptive measures. The Government must act as a catalyst in making the long-term policy framework and decisions which must be a guide for effective adaptation measures. The policy framework is generally formed after a lot of research and discussions by individuals, firms, investors, policymakers, practitioners, researchers and many other actors who are involved in this procedure. The final decisions and policies are filed by the government and it is important that the Government follows up on these policies, to act upon implementing the measures and monitoring them frequently (Stern, pp.21, 2007). The essential areas policy framework is:

1. *"High-quality climate information and tools for risk management will help to drive efficient markets. Improved regional climate predictions will be critical, particularly for rainfall and storm patterns.*

2. *Land-use planning and performance standards should encourage both private and public investment in buildings and other long-lived infrastructure to take account of climate change.*

3. *Governments can contribute through long-term policies for climate-sensitive public goods, including natural resources protection, coastal protection, and emergency preparedness.*

4. *A financial safety net may be required for the poorest in society, who are likely to be the most vulnerable to the impacts and least able to afford protection (including insurance) Sustainable development itself brings the diversification, flexibility and human capital which are crucial components of adaptation."- (*Adapted from Stern, pg.21-22, 2007*).*

Hence, adaptation is not only to tackle the risks of climate change but is also an excellent development practice. Any country with adaptive measures will have a good economy, overall development in all sectors, improved risk and disaster management and better emergency response. Thus, adaptation policies must be encouraged and supported especially for the developing countries by international development funding policy. Adaption policy must be combined with development policy and planning at every sector and each level (Stern, 2007).

2.6 CASE STUDIES:

Developing countries like India, the cities have to face different challenges and at different levels. There is a constant rise in the population and because of the poverty, the vulnerable group of people is living in the most vulnerable and risky areas of the city, which has the direct impact of climate change on them and their society (Alankar, 2015). At the same time, there is also an economic growth and development happening in the developing countries, which results in an increase of Carbon emissions and GHG emissions. As, a vast and dynamic country, India is diverse in its climate, topography, culture and everything else. Each state in India is different than the others in terms of landscapes, traditions, effects of climate changes and the challenges or the barriers faced to tackle climate change also differs from place to place and region to region. India's top two Mega cities are

Delhi and Mumbai. Delhi is the capital city of India. It is a landlocked on all sides as its almost in the north center of India, surrounded by other states and cities (Alankar, 2015). The main challenges that Delhi faces are water scarcity, dried up water bodies, the drastic rise in temperature, energy consumption of fossil fuel and electricity resulting in the rise of carbon emissions and issues related to waste management. On the other hand, Mumbai is at the Arabian Sea- coast, thus, there are issues related to the rise in sea level causing floods in certain areas. Mumbai is also facing changes in the rainfall pattern, which becomes the key reason floods, soil erosion and landslides (Alankar, 2015).

Delhi Building Sector- In Delhi, TERI- A energy and research institute took the initiative to develop new building codes such as GRIHA- Green Rating Integrated Habitat Assessment wherein all the types of buildings must become green buildings (Alankar, 2015). Moreover, the Bureau of Energy Efficiency (BEE) has also launched new building codes to set the energy efficiency levels for designing and constructing any building, with a minimum area conditioned is 1000m2 and the power supply of 500 kW or 600 KVA. This building code was termed as Energy Conservation Building Code (ECBC) (Alankar, 2015).

Water and Heath sector- Due to the recent observations of climate variabilities and climate extremes, seen as frequent floodings and droughts which causes scarcity of water, in the long run. And this leads to greater distress causing migration and stress for the urban cities and resources (Thakkar, 2012; Alankar, 2015). A recent study was conducted in Mumbai by National Environmental Engineering Research Institute (NEERI) on the topic of "Climate change and its economic impact on Mumbai". Mumbai faced a lot of damage due to the frequent flooding and rise in sudden temperature which caused outbreaks of many diseases which were vector-borne disease, asthma, allergies and deaths caused due to natural calamities and diseases (Alankar, 2015). Thus, there was more loss financially and the death rates went high. This situation is not only alarming now but also dangerous at every level of the society and the ecosystem. According to the recent study in World Bank, out of 27 cities in Asia, in terms of water availability per hour, Delhi and Chennai were ranked 1st and Mumbai was ranked 2nd, while Kolkata was ranked 4th (Government of India, 2001; Alankar, 2015). This situation will get worst in the future and thus there is a need to act upon it.

Adelphi, a network organization in Germany, conducted a project called, "The AdaptCap" to promote issues like the climate change adaptation, climate change mitigation, and risk/disaster management to the coastal areas in states such as Andhra Pradesh and Tamil Nadu in India. The project was based on specific regions and selected communities and societies (Chakrabarti, Kabisch, et. al.,2013). This project dealt with innovative pilot research strategies. Am empirical research on detailed vulnerability and the need for assessment study was first carried out in different local settings. This study was mapped to see the initial status and situation of the place and setting. Based on the results of this empirical research, after analyzing the data, the researchers then developed specific region- based adaptation, mitigation and risk/ disaster management strategies and approaches in order to implement them in the local plan and settings (Chakrabarti, Kabisch, et. al.,2013). There was a lot of 18 innovative pilot strategies that was created and implemented which was the link to address the effects of climate variability and climate extremes. Thus, it was a measure taken in consideration for adaption and mitigation strategies towards climate change, for example, the zero-emission adaptation measure and this supported the technology to take place in the specific region. The pilot measures that were developed by Adelphi researchers consisted of

drinking water filtration, distribution system improvements for cyclone resistant causeway constructions, solar power back through reverse osmosis in plants, coastal bund constructions, pond renovations, water efficient horticulture, floriculture irrigation systems, climate-smart lighting strategies, and many others. After critically assessing all these pilot measures successfully, the researchers the implemented these strategies in other local areas of the country with similar geographical terrain and climatic conditions (Chakrabarti, Kabisch, et. al.,2013).

Another case study which was conducted by the researchers of TERI- A technical energy research institute in Delhi. In the year 2013, within a span of two months Andhra Pradesh and Odisha states situated in the east coast of India where hit by the deadliest cyclones called "Phailin" and "Helen". Around the same time in the same year, June 2013 the northern states of Uttarakhand in India experienced a huge destruction, where large human communities and their settlements were wiped away due to the melting of a massive glacier lake above Kedarnath1. As the glacier melted it cause a rise in the water levels and to add to it there was a massive storm and rain during the same time (PTI, 2013; TERI, 2018). These damages and the impacts of climate change was so severe that it was high time to develop strategies which were climate resilient by climate proofing settlement and adaptive practices toward harsh climate changes. This was an indication for better policies for town planning and preparedness to deal with new effects of climate change and uncertainties in future. Thus, it was important to understand such severities that can be caused due to climate change and it will only get worst in the future (Sharma, 2014; TERI, 2018). Hence there is a need for cities to have a climate resilient management and planning. This will, in turn, reduce the vulnerability and help us achieve our desired development goal for the future (Sharma, 2014; TERI, 2018). A policy for sustainable development, climate resilient adaptive and mitigation strategies and better town planning is the most important aspect that every individual must look into in order to build sustainable – climate resilient towns and cities (Sharma, 2014; TERI, 2018).

2.7 TRADITIONAL PRACTICES:

There were few case studies in the past regarding traditional practices based on the international literature review on the role of traditional ecological knowledge among indigenous groups of people for the purpose of monitoring, retorting to and managing ecosystem processes and functions with the main focus on climate and ecological resilience (Berkes, Colding & Floke, 2002). After the research on this topic and conducting their study on the indigenous groups it was found that diversity of local traditional practices does exist in their ecosystem and community for ecosystem management. The traditional practices that were found to adapt to climate change and to manage their ecosystem were multiple tree or crop species management, resources rotation, succession management, landscape unevenness management and many other ways of dealing with pulses and effects of climate changes (Berkes, Colding & Floke, 2002). The method of using these traditional practices has been going on for generations, accumulation and transferring the knowledge to the next generation. In this case study, it was proven that traditional systems have an immense quality of being an adaptive measure to learn and prevent the ecosystems from uncertainties and impacts of climate changes. It also helps in resource management (Berkes, Colding & Floke, 2002).

Another recent case study and research was done in the savanna zone of central Senegal. For decades it has been observed that the farms of Sahel Africa are facing climatic variabilities and climate extremes. Traditional crop rotation and diversification, mobility migration, livelihood

diversification was considered as adaptive strategies. In this case study, the researchers decide to use focus group interviews and household surveys to get the perspective of the farmers who are using these methods as a coping and adaptive strategy (Mertz, Mbow, et. al., 2008). In the results analysis, they inferred that the household was aware of all the effects and variability of climate changes and the factors which attribute towards it (Mertz, Mbow, et. al., 2008). But, in terms of livelihood and land use changes they, attributed it to the influence of economic, social and political factors rather than climatic factors. By this, they could interpret and conclude that rural communities and communities closer to nature have a better understanding of the climate and its issues. But in the case of land use and livelihood strategies for adaptation purpose, they mentioned a range of factors other than climate not being one of the factors. Thus, the researchers recommended the implications of agricultural and economic development policies to face the uncertainties of climate change (Mertz, Mbow, et. al., 2008).

2.8 POLICY ARRANGEMENT APPROACH:

Policy arrangement approach is one of the major key factors in environmental policymaking and its functions at a "Meso level". It helps in understanding the modification and steadiness in policy-making procedures (Leroy and Arts, 2006). The approach talks about both social and political changes that take place in our day to day practice. Policy arrangement approach gives a structure to the policy development process. This approach was established by Van Tatenhove et al. (2000). It consists of 4 organizational dimensions such as:

1- The actors involved in the policy domain.

2- Both formal and informal rule and regulations that plays a role in the policy.

3- Resources and power that are needed to make the policy.

4- The 4th dimension is substantive as it talks about the discourses that are occurred (Liefferink, 2006; *Publicwiki.deltares.nl, 2018).*

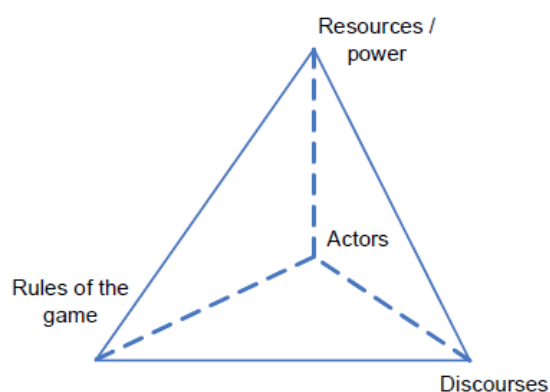These dimensions are all interconnected and inter-linked with one another.

Figure 4: Publicwiki.deltares.nl. (2018). *Knowledge and policy arrangement - Building with Nature Deltares Public Wiki*. website., Retrieved on 8th June 2018, from https://publicwiki.deltares.nl/display/BWN1/Knowledge+and+policy+arrangement

A policy arrangement approach is defined as *"The temporary stabilization of the content and organization of a particular policy domain at a certain policy a level or over several policy levels"* (Leroy and Arts, 2006; *Publicwiki.deltares.nl, 2018*). The first three key aspects mentioned above are related to the structure and the nature of the organization and the fourth points is related to the constituent or the element of the policy arrangement. If even one of the dimensions of the arrangement changes all the other three dimensions also change accordingly and that is why it is in the shape of a tetrahedron (Liefferink, 2006; *Publicwiki.deltares.nl, 2018*).

DIMENSIONS	ELEMENTS
Problem definition	Use of traditional practices in Mega cities of India for adaptation of climate change. And also, to find the barriers and opportunities that are present in order to implement these practices in the Mega cities of India based on the theory of policy arrangement approach and its 4 dimensions such as the actors, discourses, resources or power and rules and regulations.
Actors	Primary actors (Government and Governmental organizations at every level, Policymakers) Secondary actors (Investors, Researchers, Implementers, Scholars, Practitioners, International development assistance, Funding agencies, Big cooperate agencies, NGO's both local and national and the local people/individuals)
Rules and Regulations	Formal (waste management system, risk, and disaster management, rainwater harvesting system in buildings etc.) Informal (Education on climate change, spreading awareness, advertising etc.)
Resources and power	Technology, time, awareness, willingness, finance, manpower, incentive, knowledge and renewable resources. Power- Primary actors to implement stringent policies on climate change adaptation.
Discourses	lack of initiative, lack of awareness and behavioral change, fewer research studies, lack of stringent policy frameworks, lack of finance, lack of community- based adaptation policy and region-specific adaptation policies.

Table1: Explaining the PAA dimensions and elements in this research thesis.

According to my research, this approach fits completely. The actors that play a role in determining the policies and implementing for adaption practices to tackle the effects of climate change in the Mega cities of India are; The government, State government, Municipality, Researchers,

Implementers, Scholars, Practitioners, Investors, International development assistance, Funding agencies, Big cooperate agencies, NGO's both local and national and the local people/individuals. These actors are then divided into primary and secondary actors. The government and the policymakers are the primary actors as they are the ones deciding the final vote of the policy. Whereas, the others are playing a role in implementing the adaptation policies and researching the most cost-effective and energy efficiency policy that can be implemented. The actors have the most important role to play in this approach.

Based on the second point of this approach there must be both formal and informal rules and regulations to set the policy. The actors who are in a regulatory organization must set stringent rules and regulations that can be monitored to set the policy for adaptation towards climate change. In this research, the rules and regulations will be based on the implementation of traditional practices in Mega cities of India such as rainwater harvesting, urban agroforestry etc. These rules and regulations can be informal such as spreading awareness among the people about the effects and consequences of climate change, educating students about climate change, advertising the effects of climate change through media, bringing a change of behavior and attitude among individuals to act upon climate change and tackle it by adaption strategies. The formal rules and regulations will be something like waste management system, risk and disaster management, rainwater harvesting system in buildings etc. The rules and regulations are generally set by the regulatory organizations to make up a policy which is on a large- scale basis.

Resources and power are needed to initiate these policies of traditional practices and continue using them. Energy efficient adaptation measures need a long-term capital stock. According to the literature review, the resources required are a lot of finance and international funding, sufficient time, incentive and willingness, manpower, renewable resources, knowledge, and awareness among people will be needed to accomplish the desired goal of adaption to climate changes. The power lies in the hands of the actors to ensure that there is enough finance to establish adaptation strategies which will help us to cut down the carbon emissions and in the long run, it will be cost-effective, cheaper and beneficial for the society.

According to my research and literature review, there will be many discourses that might play a role as a barrier or challenge to implement traditional practices in the Mega cities of India. Discourses will be the narratives of the actors mentioned above and the complete view as well as the implementation of this policy. Based on the literature review, not many types of research or studies have been done on adaptation strategies – use of traditional practices in Mega cities of India. This results in very less existing policy frameworks in India. Discourse such as lack of initiative, awareness and behavioral change is also mentioned in the literature review which can play a major role in acting as a barrier for adaptation measures towards effects of climate change. And since India is a developing country another discourse based on the literature review mentioned above will be capital stock and lack of region-specific or community-based policies for adaptation measures.

Thus, the Policy arrangement approach and its 4 dimensions fit perfectly into the application and the practicality of this research.

CHAPTER 3: OPERATIONALISATION

3. 1 RESEARCH MODEL:

To successfully conduct my thesis, I first came up with the following research model. Where I focused on the main aspects of my research such as the effects of climate change that is occurring in today's world, the need to drift from mitigation to adaptation methods, the recent scenario of India's Mega cities and the effects of climate change in them, use of traditional practices to adapt to climate change. I then researched on the literature review of climate change adaptations, adaptation strategies, and methods, policy responses and barriers attached while implementing the policies, need for adaptation measures on Mega cities of India, the role of the government and few case studies related to climate change adaptation measures with traditional practices. The theory that was best suitable for my research was the Policy arrangement approach by Van Tatenhove et al. (2000). My entire research for this thesis revolves around this approach. Based on the above-mentioned research, literature review and theory, I based my interview guide on it. Thus, I choose participants for my data collection who were directly related to the field of this research topic. Through this process, I will find the results and analyze the data in order to draw the conclusion towards my research problem.
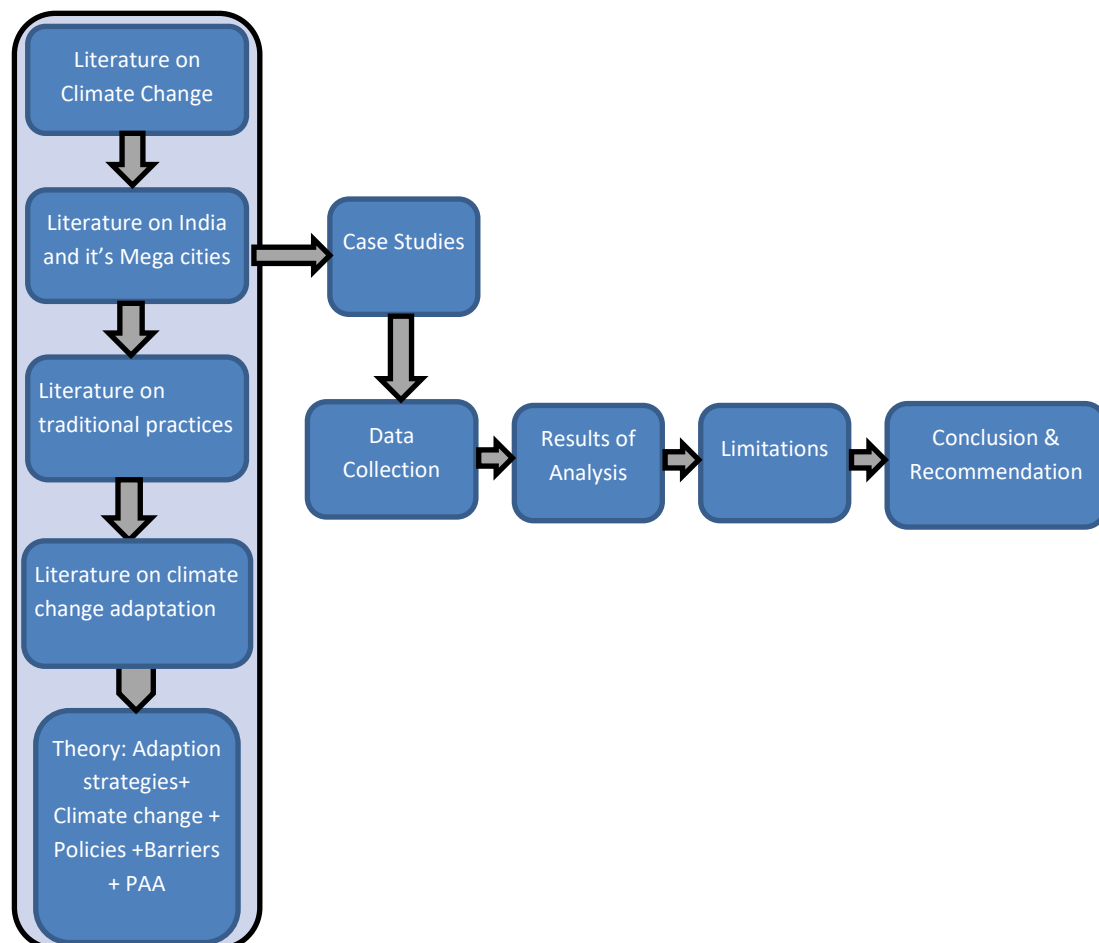
Figure 5: Research model

3.2 CONCEPTUAL FRAMEWORK:

After reviewing the literature and the theory, I decided to use PAA- policy arrangement approach as my basis of the conceptual framework. My main aim of this research is to find the possibility to adapt to climate change effects by using traditional practices in the Mega cities. And what are the barriers and opportunities that exist during the implementation of such practices in urban India to adapt to climate change and link them to the 4 dimensions of the Policy arrangement approach? By doing this, I will also get know the actors who will be involved in making such implementation of adaptive measures, what are the barriers and discourse that occur or already exists in not letting traditional practices come into action in the Mega cities. This will also give me a clear view of the resources and the power needed to initiate such adaptive policies. As per the policy arrangement approach all of the 4 dimensions are interlinked with one another and if one of these dimensions are disrupted the entire system goes down. This will prove how these dimensions influence each other and how traditional adaptation measures can be implemented in Mega cities of India.
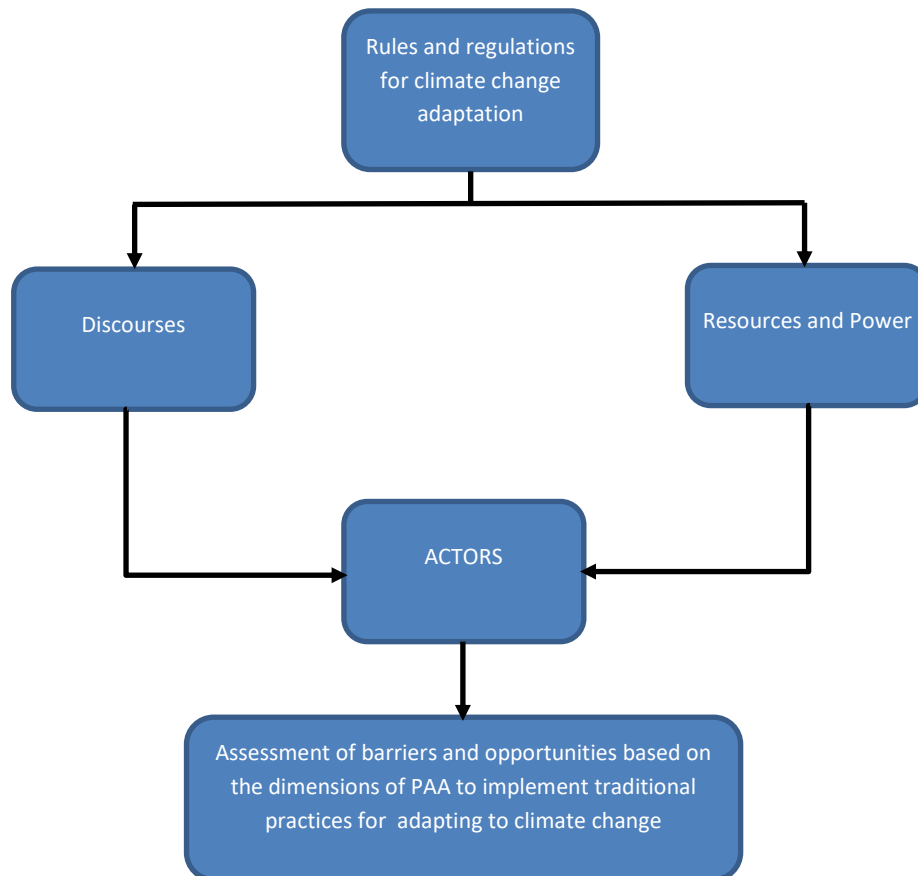
Figure 6: Conceptual framework

3.3 INTERVIEW GUIDE:

The interview guide is completely based on the concepts I incurred from the literature review. The overview of the dimensions discussed in the theory of policy arrangement approach will be presented in the interview guide and this will help me get a clear perspective in operationalizing the

thesis. With this process, we will get to know the fundamental criteria of the concepts and the influence of each dimension on each other that are present.

Following are the question's I formulated based on the literature review and the PPA theory dimensions, to conduct a semi-structured interview with the participants, so as to solve my research problem. The questions of the interview guide below will give us a clear understanding and the purpose of the questions asked of the participants.

1. What is your perspective on climate change adaptation in India?
   -To understand the participant's perspective on climate change adaptation and why would it be so important for us to adapt to the climatic changes.

2. According to you, what are the most important climate-related challenges in India?
   -To get a clear understanding of the effects of climate change in India and the challenges that are faced due to impacts of climate change.

3. In your perspective, what are the most effective ways of adapting to the recent climate changes that are taking place and how can we adapt to them?
   -To optimize my knowledge about adaption strategies that can be used.

4. What do you think of the idea of implementation of traditional practices such as rainwater harvesting, composting, food storage, plant breeding, biogas, low – carbon traditional ways etc. Are they beneficial for adapting to climate change?
   -To comprehend the participants perspective of traditional practices as an adaptive measure. And the types of traditional practice which will be beneficial for us to adapt to.

5. How can Mega cities in India adapt to the consequences of climate change while using traditional practices?
   -To understand the challenges present to implement traditional practices in Mega cities. And the efforts that can be taken to implement them in the Mega cities of India.

6. What are the types of traditional practices that can be implemented in India which are effective and easy to use, especially the Mega cities like Mumbai, Delhi, Kolkata, Bangalore etc. and why?
   -To get a clear perspective on the traditional practices that are energy efficient and cost-effective to be able to implement them as an adaptive measure.

7. Is it feasible enough to implement local traditional practices in Mega cities of India? Why/ Why not? What would need to change for traditional practices to be implemented?
   -To get a detailed information about the challenges and barriers that are present in terms of implementing traditional practices in the Mega cities and the ways we change it.

8. How might these traditional practices be useful for people in India in order to adapt to the climate change?
   -To get an overview of the benefits of traditional practices which can benefit different communities to adapt to the effects of climate change.

9. What are the barriers that people can face in order to implement these practices?
    -This question was asked to fit into the dimension of barriers and discourses. To understand the hindrances of implementing traditional practices in Mega cities.

10. Are there any regulations that prevent the implementation of traditional practices? And do people in India have the financial resources or the knowledge to implement these traditional practices?
    -This question was asked to fit into two dimensions of the Policy arrangement approach. One is the rules and regulations that are existing and the ones that are not, and the reason why such rules and regulations are not prevailing. The other dimension was to understand the resources and power that are needed to implement traditional practices.

11. What could be the role of the Government and NGO's to facilitate the implementation of traditional practices?
    -Based on the literature review the government must establish policies. Thus, to understand the role of the government of India and the things that could be done by the government to initiate in starting policies that could help us adapt to climate change.

12. Since India is such a vast and diverse country with different culture, traditions, and religions; will the use of some traditional practice play any role in different regions?
    -To get a clear perspective on region-specific adaptation policies and community-based adaptation policies as it was mentioned in the literature review and the necessities of it.

13. What can be done to implement these practices in Mega cities?
    -To understand the necessary action that needs to be taken to implement traditional practices in the Mega cities.

14. What are the opportunities of having traditional practices in Mega cities?
    -To comprehend the benefits of traditional practices.

15. What are the modes of facilitating climate change adaptation in the Mega cities of India?
    -To understand the challenges and the steps that can be taken to facilitate adaptation strategies in Mega cities which are beneficial for us.

16. What kind of actors influences this discussion of implementing traditional practices in India? And how do they influence it?
    -Based on the dimensions of Policy arrangement approach this question was asked to know the actors who are involved in making such policies of adaptation to originate.

17. What are the different kinds of resources and rules/regulations that are needed in order to go make this change or support the implementation of practices?
    -To get a better understanding of the two dimensions (rules and regulations and resources and power) and the link between them according to the theory of policy arrangement approach.

18. What are the problems that can occur if these practices are put into action?
    -To evaluate if there can be any issues or challenges with the traditional practices being used in the Mega cities or not.
19. Will combining technocratic practices and traditional practices be beneficial for people to adapt to climate change as well as be more progressive?
    -To understand that for developing advanced energy efficient technology is also necessary for developing nations and if it will be a better fit to adapt to a mix of both traditional and technocratic practice. This question was also based on the literature review.

Hence, the interview guide was based on the literature review and the theory of policy arrangement approach, considering all four dimensions and concepts. After I received the answers from the participants from this interview, I will analyze the data and find the link between the concepts and the theory. Based on the theory my hypothesis is that traditional practices are beneficial for us to adapt to climate change, however, there are challenges and barriers that affect the implementation of practices in the Mega cities. And the hindrances would be the policy framework, lack of resources and power and lack of regulations. Thus, the policy arrangement approach will be affected if two out of 4 dimensions are disrupted. Hence, this might be the reason why traditional practices are not being implemented in the Mega cities of India. Once, I finish the data analysis I will then accept or reject my hypothesis based on the results inferred after analyzing the results.

CHAPTER 4: METHODOLOGY

4.1 RESEARCH STRATEGY:

There are many ways to conduct a research. The most important two methods of conducting a research are, 'Qualitative research strategy and Quantitative research strategies'. To perceive an idea of gathering the data and measuring them, it is important to use either of these methods (MacDonald & Headlam, 1986). Quantitative research strategies deal with quantifying any subject by gathering data from a group of people. Whereas the qualitative method is to understand the basic concept of the problem, create a way to deal with the problem and interpret people's experiences in that situation. This study gives us a quality of information to conduct a research. According to my research qualitative research strategy was the most suitable strategy to conduct my research. Based on a few key features, I will explain the purpose of choosing a qualitative method instead of the quantitative method for this research.

- AIM- In qualitative research method the aim based on the description of what is observed whereas in the quantitative method the aim is to calculate the observed data by quantifying it. According to my research, the aim is to describe the concepts of climate change adaptation by using traditional practices in them Mega cities of India and the institutional barriers and opportunities which exists in urban India for these practices to be implemented. Hence, a qualitative method was more suitable in this case.

- PURPOSE- In a qualitative research method, it deals with interpreting results and understanding the perspective and concepts by gathering descriptive information. Whereas, in the quantitative method, it deals with collecting data by surveys and evaluating numerical data based on the outcome of the information gathered. In my case, all my data is based on gathering descriptive information and understanding the perspective and concepts. Thus, a qualitative method was more appropriate in this case.

- OUTPUT- In qualitative research method, the output is interpreted from words, pictures or objects, whereas in quantitative it is always numerical and based on statistics. In my research the outcome of interpretation is based on the word, hence the qualitative method was more suitable.

- SAMPLING- In quantitative research methods there is random sampling based on research whereas, in the qualitative method, sampling is done on purpose, based on experience. In my research study, the participants were directly related to the major aspects of my research which is climate change adaptation and traditional adaptive practices based on their experience on and off the field. Hence, I choose a qualitative research strategy for my study.

- APPROACH- In the quantitative method, the approach is objective which is based on accurate calculations and analysis, whereas in the qualitative method the approach is very subject based on the interpretation of the participants perspective. In my case, the participant gave their perspective on climate change adaptation, the use of traditional

practices in Mega cities in India and the barriers and opportunities based on the four dimensions of PAA. And hence, the conclusion was drawn by me after interpreting the results. Thus, a qualitative approach was a better fit for my case of research.

- ANALYSIS- In a quantitative research study, the analysis of data is statistical based on numerical data collection, whereas in the qualitative method the analysis is based on interpreting the outcome which is subjective on the perspective of the participants. Since there was no statistical data in my research I chose to do a qualitative method which was more suitable in my case of research.

Research on climate change adaptation can be done by both quantitative and qualitative research method. Statistical data for carbon emissions and interpreting results out of people's perspective is possible in both cases of research strategy. But, since we had limited time period for our Bachelor thesis, and the fact that I conducted this research by skype interview since I was not there in India for my study the best option I felt was to do a qualitative research method for my case study.

4.2 DATA COLLECTION TECHNIQUE:

The technique of collecting data is by gathering information from objects like people, a phenomenon etc. and this technique is needed to answer the research question which can be difficult the according to Elmusharaf, (2012). The method of collecting data is very important to answer the research question. It can be done through surveys, interviews, observation etc. It can be a face to face interview which is observed, it can also be textual or visual. There are three types of methods by why a research interview can be conducted. Structured interview, semi-structured interview and unstructured interview (Gill, Stewart, et.al., 2008). According to (Bernard, 1998) the best way to do an interview is a semi-structured interview. As there will be no other chance to take the interview again.

- Semi-structured interview- This style of the interview consists of key questions that can be helped to explore and get a wider perspective, but at the same time, it doesn't allow the interviewer or the participant to diverge from the topic of discussion. It creates an outline of the interview. The semi-structured interview gives us the flexibility compared to the structured interview which has on a guideline of questions and is limited. It allows us to discover and elaborate on the information that the participant feels are important rather than structured interviews. And it is also better than the unstructured where it gives us an idea of key questions to be asked which has a structure to it, instead if diverting from the subject (Gill, Stewart, et.al., 2008). The interviewee and the interviewer have to maintain a formal relationship. The interviewer always follows the questions in the interview guide which gives a structure to the interview and covers all the topics of discussion in a sequence. In a semi-structured interview, the interviewer can also ask follow-up questions whenever required to get the more detailed perspective of the topic from the participant. In a semi-structured interview, the most important aspect for the interviewer is to prepare a structured interview guide, covering all the topics of discussion. This will help the interview to be well prepared for the interview and have a clear idea of how to conduct the interview. (Cohen & Crabtree, 2008; Gill, Stewart, et.al., 2008). Thus, I chose to do a semi-structured interview instead of an unstructured or a completely structured interview which would have limited my research and discussion of the topic with the interviewees.

- Open-ended questions- While designing the interview guide it is important to keep in mind that the aim should be to get as much information that is possible from the participant which covers both the aim and the objective of the research topic. The best way to do a qualitative research which good questions are to structure a set of open-ended questions

in the interview guide. Open-ended questions require more than just a yes or a no, unlike closed-ended questions. Open-ended questions must be structured in such a way that the participant inbound to give an elaborative perspective of the topic and this also is sensitive and understandable, which in turn brings ease to the participant to respond and build a rapport as well as confidence. This helps in generating data which is not biased and is rich in content (Gill, Stewart, et.al., 2008). Hence, I chose to have open-ended questions while conducting the interview to get an in-depth understand of the topic.

- Video call interview- Since I was in Nijmegen for my studies, it was difficult to conduct a face to face interview with the participants who were based in India. Thus, I opted to do a Skype video call interview, along with I could see the participants gestures and understand the emotions and behavior through a video call. At the same time get a detailed perspective of my topic of research from them. To analyze the data I, asked the participants if I could record the voice of the interview. Recording the voice of an interview helps in interpreting the results and transcribing the data in words for the analyze. During an interview, taking down key important points as notes in important, but often there is a chance of missing out on some information. Which is why if we record the interview, we can refer to it anytime while transcribing and analyzing the data collected.

- Sampling- I chose to do a purposeful sampling of the participants, which means I contacted them through email if they were willing to set an interview with me based on my research topic. I chose these participants through research, by checking their credentials and experience in my field of research. All the participants were directly related to climate change adaptation on the field and off the field as researchers, practitioners, government officials and people from the NGO's. I also tried to do a snowball sampling which means asking the participants, if they knew anyone who would be ready do an interview with me regarding my research topic.

- Instruments used- Instruments: Laptop (to contact the participants through email, conduct the interview through Skype video call collect data and transcribe it on Atlas.ti software) smartphone (to record the voice of the participants during the interview), Atlas.ti software (for analysing the data by coding and transcribing the voice recordings in words), Excel (to keep the list of participants and their experience), camera (to observe the participants gesture and behaviour while conducting the interview) and a notepad and a pen (to take notes of important key points during the interview and my observations)

Hence, for my research study, I conducted and skype video call interview which was semi-structured with open-ended questions.

4.3 CASE SELECTION AND PARTICIPANTS:

According to the literature review that I discussed, the actors involved in climate change adaptation are primary actors (Government and Governmental organisations at every level, Policymakers) and the secondary actors (Investors, Researchers, Implementers, Scholars, Practitioners, International development assistance, Funding agencies, Big cooperate agencies, NGO's both local and national and the local people/individuals). The actor's dimension based on the policy arrangement approach is the main key aspect of the approach, because the actors will be the one who needs to put the policy in action and thus, they can give an overall perspective of all the other dimensions mentioned in the literature review and policy arrangement approach. Since the Bachelor thesis is for a short period of time, I could not interview all the actors on different levels as mentioned above. But, my main focus was to get a clear perspective on my research aim and objective from the selection of

the participants. Thus, I targeted participants who work with the government, research institutes, national and international Ngo's who help in funding and other developmental assistance to India and practitioners. I assure the participants that the interview can be completely anonymous if they would like it to be. None of the participants had an issue with the anonymity or recording the interview. In this qualitative research, I interviewed 6 participants in total. Following are the list of 6 participants who I contacted and conducted the interview with.

- **Participant A:** Dr. Ajay Mathur – *"He is Director General of TERI - The Energy & Resources Institute, and a member of the Prime Minister's Council on Climate Change. He was Director General of the Bureau of Energy Efficiency in the Government of India from 2006 till February 2016, and responsible for bringing energy efficiency into our homes, offices, and factories, through initiatives such as the star labelling programme for appliances, the Energy Conservation Building Code, and the Perform, Achieve and Trade programme for energy-intensive industries.Dr. Mathur was earlier with TERI from 1986 to 2000, and then headed the Climate Change Team of World Bank in Washington DC. He was President of Suzlon Energy Limited, also headed the interim Secretariat of the Green Climate Fund. He has been a key Indian climate-change negotiator and was also the Indian spokesperson at the 2015 climate negotiations at Paris. He is a global leader on technological approaches to address climate change; recently, he joined the global group of industrial, financial and think-tank leaders to co-chair an Energy Transitions Commission which will suggest ways for companies and countries to move towards climate-friendly energy futures" – (*Adapted from TERI, 2018)

  Gender- Male

  City – Delhi, India

  Experience- Researcher, Scholar, Activist, Practitioner, Professor, and Government official

- **Participant B:** Ms. Suruchi Bhadwal- *"She leads research activities in the area of climate change, focusing mainly on impacts, vulnerability and adaptation assessments and works in close association with communities. She has been with TERI since October 2000 and has contributed to several projects. Some of the key projects she has worked on include a study on vulnerability to climate change in the Indian agricultural sector in the context of economic globalization, (supported by CIDA and the Government of Norway), contributions to India's first and second national communications submitted to the UNFCCC and World Bank supported study on vulnerability to climate variability and change through an assessment of issues and options for adaptation. Ms. Bhadwal is also listed as a UNDP regional roster of an expert on vulnerability and adaptation. Furthermore, she has been identified as a Member by the Planning Commission as part of a Working Group on Climate Change and Environment for the XIIth V Year Plan (2012-2017). She has also been closely associated with the International Human Dimensions Programme attending numerous open meetings and Institutes organized by them. At COP events she has been actively involved, as an observer, organizer, and contributor. She has published several papers on related issues and has contributed as a Lead Author for the IPCC AR4 WGII Report. She is also a Review Editor for the IPCC AR5 WG II Report and the IPCC Special Report on Extreme Events."* *–* (*Adapted from TERI, 2018)

Gender- Female

City- Delhi, India

Experience- Researcher, Scholar, Activist and Professor

- **Participant C:** Ms. Ajita Tiwari – She is a national facilitator at INECC- Indian Network on Ethics and Climate change, which is a national network of organizations for climate change (NGO), Policy and content advisor.

Gender- Female

State- Andhra Pradesh, India

Experience- National Facilitator for climate change and policy, Content advisor and Researcher

- **Participant D:** Dr. Anjal Prakash- "*Dr. Prakash joined ICIMOD as the Programme Coordinator of HI-AWARE in April 2014. Dr. Prakash has worked in the areas of policy research, advocacy, capacity building, knowledge management, networking, and implementation of large-scale and multi-country environmental development projects in South Asia. His expertise is groundwater management, gender, natural resource management, water supply and sanitation, climate change, and adaptation. He has extensive work experience in six South Asian countries of Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. He is also an Executive Director of SaciWATERs.*"- (Adapted from ICIMOD, 2018)

Gender- Male

Country- Nepal

Experience- Policymaker, Implementor, and Researcher

- **Participant E:** Dr. Ronjon Chakrabarti – "*Ronjon Chakrabarti is a Senior Scientist and Senior Project Manager at Adelphi- Germany (It is an organization leading independent think tank and public policy consultancy on climate, environment, and development. It also forges alliances to many nations and organizations.) His research and work focus on integrated water resource management, water supply, and innovative water treatment technologies, climate change and renewable energies, technology cooperation and participatory approaches. Ronjon Chakrabarti is currently working as a collaboration manager and leading senior scientist for the Indo European water treatment research collaboration project "ECO-India", aiming at developing energy-efficient community-based water supplies. He also works as a technical expert for climate change adaptation measures in the water sector and for their participatory development with public and private stakeholders. Ronjon Chakrabarti has much experience in advising and consulting ministries and corporations.*" – (Adapted from Adelphi, 2001)

Gender- Male

Country – Germany

Experience- Researcher, Implementer, Scholar, Practitioner, Advisor, and Consultant for Ministries.

- **Participant F:** Mr. Samir Nazareth- Specialist in Development and Environment Sector. He is also a Manager at Greenpeace India which in an NGO. He holds 3 patents in the Indian patent office.

  Gender- Male

  City- Delhi, India

  Experience- Author, Activist, and Researcher

Thus, based on the participant's knowledge and experience mentioned above, I decided to take the interviews with them in order to get maximum information related to my research.

4.4 DATA COLLECTION AND ANALYSIS:

To conduct my research, I did a qualitative research method I interviewed 6 participants as mentioned above. All of these participant's selection was based on purposeful sampling and snowball sampling. In order to get adequate information from the participants which link to all the dimensions of the policy arrangement approach and my conceptual model, I focused my interview guide questions towards the 4 dimensions such as actors, discourses, rules and regulations and resources and power. My entire analysis is based on these 4 dimensions and the literature review discussed before, to achieve the desired outcome of my hypothesis research. The process of writing down verbal information during the interview in text form is called transcribing and its one of the main steps to analyze the data (Stuckey, 2018). The process of analyzing the data starts after reviewing the recording and transcribing the information into text and interpreting the results and the outcome of the interview if it matches the aim of the research and solves the objective of the research problem. After the first interview is taken and analyzed, we get a much clearer view on how to conduct the other interviews ahead and if the questions need to be refined in order to get the desired outcome for the research.

- **Analysis:** This is the most critical aspect of any research to interpret the results and find the relation between the concepts and theories discussed in the literature review. The entire research depends on the outcome of the information gathered and interpreted. To analyze my data of information gathered from the interviewees and after transcribing them I used a software tool called Atlas.ti 8 for my research. This software is a tool where you can find the relations between concepts, theories, phenomenon and meaning based on the information gathered. It helps in coding the transcription on the basis of the factors and dimensions that the research is based on. This then makes it easier to interpret and find the links between the code which are conceptual to the research. According to my thesis, my main focus is to show the link between the 4 dimensions: actors, rules and regulations, resources and power and discourses in order to determine that climate change adaptation is possible by using traditional practices in Mega cities of India. In Atlas. ti is also possible to code extra or irrelevant points discussed in the interview and can be put as memo quotations. The codes created in Atlas.ti can help us compare as many documents, photos or transcripts to find a link between them in terms of similarities and dissimilarities. In order to analyze my data following are the steps that need to be taken:
  - Upload all the 6 transcripts of the 6 interviews conducted on Atlas.ti 8 software.

- Start coding each one of them based on the concepts and dimensions of the research.
- Create memo quotations for irrelevant information.
- Add descriptions for the main headings of the codes, in order to distinguish between similar codes or subcodes
- Create code groups to generalize them in one type of category.
- Compare all 6 interviews conducted and analyze the codes created for all 6 of them.
- Find the link between the codes and the concepts or dimensions of the research.
- Write the results and analysis based on the interpretations of these codes and the literature review.

- **Source of information:** According to Elmer E. Rasmuson library, it is important to evaluate the source of information which confirms the validity and reliability of the research. It is also important to read my literature related to the research topic to get an in-depth knowledge of the research topic *(Mary Woodley, CSUN Oviatt Library).* There are three types of source of information.

  - **Primary Source:** This kind of source gives us the first-hand information about any object, subject, art etc. It includes a list of things such as interviews, surveys, legal documents, experiments, statistical data, audiovisual recordings, historical documents, speeches, fieldwork, blogs, newsgroups and many more. Primary sources are empirical studies that are mainly found in scholarly articles and research papers (*Ithaca Library*). In my research primary data source would be compatible to conduct the research based on the interviews conducted for this thesis and the case studies as well as the scholarly articles mentioned in the literature review.

  - **Secondary sources:** These sources are second-hand information. They are mainly based on primary sources such as commenting, describing, interpreting, evaluating and summarizing primary resources. Secondary sources are discussing and evaluating someone else's work such as book articles, magazines, articles in the newspaper etc. *(Ithaca Library).* Desk research is also called secondary sources, wherein the main focus is to find a new dimension and understanding the research by reviewing previous research topics (Travis, 1989). For this research, some of the data will also be collected from secondary sources to have a better understanding and a reliable thesis.

  - **Tertiary sources:** tertiary sources are basically condensed form or summaries of primary and secondary sources *(Mary Woodley, CSUN Oviatt Library).* Few of the case studies will be on the basis of the tertiary data source to back up the secondary and primary data that has been used in this research.

According to the literature review, climate change adaption may not be new but in the past decade itself, it has been recognized. India is still a developing country and not much information is hence available on climate change adaptation and the use of traditional practices to adapt to climate change in the Mega cities of India. Since not much of a primary source is available for my research topic to conduct this research, I will focus on the secondary and tertiary sources of information. By reviewing previous literature work, I will have a stronger understanding of my research and the procedure to analyze it.

CHAPTER 5: RESULTS

5.1 RESULT ANALYSIS:

The main focus of my study is to find the link between the four dimensions of the policy arrangement approach, such as the actors involved in making the policies for climate change adaptation, the discourses that are present for implementing traditional practices in the Mega cities of India to adapt to climate change, rule and regulations that exists or needs to be exist to allow such policies to come into action and the resources and power that are required to get the desired goal of adaptive measures and policies to be implemented in the Mega cities of India. All these above-mentioned dimensions are stated below with the barriers and opportunities or solutions for each of the dimensions. Based on these 4 dimensions, I incurred the following results after conducting interviews with 6 well-known researchers, practitioners, government members, and activists of climate change and adaption from India.

5.1.1 RESOURCES AND POWER:

In terms of resources, the participants stated international support for finance and green technology is necessary for the implementation of climate change adaptive measures. The spread of awareness among the citizens of India and behavioral change is also an important aspect for understanding the need to adapt to climate change. India has enough finance, but international funding and support are needed for making climate change adaptation schemes and programmes in order to develop the sustainable economy of the country and also to comply with the policies of climate change adaptation conscientiously. And in terms of power in this dimension, the participants specified that the ultimate power lies in the hand of the government to initiate any policy or operations. The powerful big cooperate companies who help in financing and investments also have the power to make the changes. But, these companies are only present for the quick profit and not the betterment of the society (See actors and rule dimension). In this dimension, the participants discussed the different resources and power in terms of traditional practices by relating them to the barriers and opportunities that exist or can be implemented. According to the participants, traditional practices are local, region-specific and contextualized. The two major traditional practices discussed by all 6 participants were rainwater harvesting and building insulations.

Traditional rainwater harvesting barriers:

According to all the participants that were interviewed, they stated that even though there are policies that rainwater harvesting should be implemented in most of the buildings, there is still no evidence of it being enforced (See in actor and rules dimension). Rainwater harvesting also has some challenges that are attached to it as it is space intensive, costly, high maintenance and is depended on rain completely which could be an issue where there is less rainfall. Treating the water will be a big challenge if the harvesting is done on the rooftops of the buildings as it will get polluted with contaminants. There is also a lack of infrastructure for water collection and water treatment infrastructure in India. And if the water is been treated by the local government then it will be an extra pressure or burden on the municipality (See in actor and rules dimension).

Rainwater harvesting opportunity: The only suggestion made by the participants regarding rainwater harvesting was building storage tanks, cisterns, aquifers or groundwater recharge could be an adaptive measure that can be put in the bylaws of every building in the cities to prevent water scarcity and at the same time build water treatment systems to solve the contamination of water problem.

Traditional building insulation barriers: Most of the participants mentioned that the real- estate in India opts for a cheaper and faster way to finish building and infrastructure projects. This later becomes an economic issue as they want to make a quick profit and in turn harming the society. Participant A, B, C, D, and F stated that traditional methods of insulating buildings can be more expensive than modern insulation in terms of maintenance. And it can also be space intensive as it will occupy more space due to thicker walls, rather than modern insulation techniques which require only thinner walls. Building ledges on windows as an adaptive method are still not applicable in the Mega cities of India because of the urban authorities count the area of the protruding ledges from the window as the footprint of the floor and thus the prices of the houses shoot up. Houses in the Mega cities are already very expensive and if the window ledges are also counted as the carpet area then the real estate business and the market will go down as no one will buy such expensive houses. Thus from this, we can infer that the real estate companies in India are only there to make a short-term profit at a cheaper expense and lesser time period (Also see rules and actor dimensions).

Traditional building insulation opportunities:

Participant E mentioned than insulation could be done with thicker walls built with clay materials which are proven to be better insulators for heat and cold than brick modern walls and that this could be useful to use in city houses as a traditional adaptive measure to climate change. Participant A suggested a method for better insulation in buildings and managing heat effect by making ledges on the windows so that there is light but no glare. And overall all the participants stated that to overcome the issue of cheap, quick profit for a lesser period of time, the real estate and the green technology must go together simultaneously.

General barriers to implementing traditional practices and other adaptive measures in India:

Most of the interviewees mentioned that it is difficult to implement traditional practices in urban India. They said that the Mega cities are overly populated, thus there is no space to implement traditional practices as they are concrete jungles. Traditional practices are limited and that's why it is a big challenge to adopt them in Mega cities. In terms of rainwater harvesting, participants stated that there will be potential water quality issues, possible water contaminations, high maintenance, and technical issues. And in terms of insulation of walls, there will be less space available and thus more resources will be used. The participants also stated that the real estate companies are only there for short-term profit at a cheaper expense at a lesser period of time which ultimately harms the society and the climate (See in rules and actor dimension). According to participants A, B, C, D, and F India lack of risk and disaster management operations as well as adaptive strategies. The participants stated that India lacks in the adaptive measure is the water and agricultural sectors. Participant A specified that India has no cost hierarchy which means that India lacks in their classification system for activity-based costing for tracing their products easily. Thus, these are the few barriers that the interviewees mentioned in the resources and power dimension.

General opportunities for implementing traditional practices and other adaptive measures in India:

All the 6 participants stated that the mix of both technocratic practices and the traditional practices with being the perfect adaptive strategy as they can take only the positive aspects of both the methods and ignore the negative aspects to build the perfect adaptive measure. By this, we can ensure that no mistakes are made or repeated. Technocratic practices are scientific, more database is available about climate change and adaptive measures with the help of new technology, accuracy of traditional practices can be calculated with technocratic practices, easily available information on climate change and combining this with traditional practices after revising and updating them, thus, it will be the most sustainable and progressive adaptive strategy for climate change. All the interviewees state that we must find a balance between traditional and technocratic practices in order to be more sustainable and energy efficient. This will also upsurge our development and be more climate resilient. The interviewees also specified few bylaws that must be implemented in every building in the cities of India related to better engineered rainwater harvesting systems and insulation of buildings which can be done either by using clay instead of bricks or by making ledges on the windows. The participants discussed a few solutions to tackle the effects of climate change and some of them are; building energy efficient technologies and implementing adaptive policies in smaller towns first instead of big cities, which will help in shifting the load of migration from Mega cities and building these technologies or adaptive measures will be easier and cheaper in smaller towns where there won't be space issues. Developing better risk management and disaster management systems in India is very important and should be done more effectively and immediately. Spreading awareness and educating people in India about climate change and its consequences are the most important aspect that needs to be taken care of urgently before it's too late. Getting more financial aid from industries which help in projects, creating more policies, adaptive measures and green technologies related to climate change adaptation is one more suggestion that was given by most of the participants.

5.1.2 ACTORS:

In this dimension, the interviewees spoke about the actors who play a role in making policies, implementations and changes in adapting to climate change in India. And they also stated the barriers and opportunities that are present to be successful in implementing traditional practices in India, especially the Mega cities to cope with climate change. India has a parliamentary form of government with a dominant federal structure and a bit of unitary feature as well. India is a secular democratic sovereign socialist and republic country due to its large diversity in geographical terrains, culture, language and many more *("Governance & Administration | National Portal of India",* 2018). The Indian governance is divided into three sections such as the Central government, State and the local government. The Prime Minister who is the constitutional head of the country, with the Council of Minister's advice the President (Central Government). For the State Government the Council of Ministers with the Chief Minister of each state advices the Governor of the State *("Governance & Administration | National Portal of India",* 2018). The local administration consists of the Municipality and the local police etc.

Actors involved and their role:

According to the interviewees they mentioned that the municipality or the local government, government of India (central government), state government, Ngo's, implementers, practitioners, researchers, scholars, activists, international development and funding assistance, corporate companies and the local people are all the major actors that are involved in making decisions and implements practices for adapting to climate change in India. The major players according to the interviewees are the central government, local government, and the big corporate companies for the implementation of policies in general. All the participants mention the role of the actors in order to run the system. The municipality or the local government has the discretionary power which means that they are supposed to make changes and take care of implementation activities, but at the same time, they can bend the rules keeping the society and the community in mind and change the implementation policies according to them. The government of India is supposed to create and model the bylaws and policies. The State government makes the proposal for financing after the municipality has evaluated the situation and the cost of implementation. But, the ultimate power lies in the hands of the central government. The role of the Local Ngo is to support the actors, the bring out issues and problems and figure out a way to solve them by making changes in the rules. NGO's work as the actor is to share their knowledge, technology and implementation ideas with other partners. The Municipality and the NGO's role is to operationalize and implement the rules.

Barriers related to the actor's role:

According to participants E, F and D corruption in India is increasing, where big companies bribe the NGO's and Government officials to take a bribe in order to make a profit and not implement sustainable policies which can put the companies at loss. Most of the interviewees such as B, C, D, E, and F mentioned that in India no one takes the initiative to bring the change to implement adaptive practices in general, that's why there is no implementation of actions. There is a lack of awareness, willingness and the sense of urgency among individuals and the major players. Participant E, F, and D also specified that big infrastructure companies or corporate companies are there to make a quick profit with less investment so that it is cheap. And that is the reason why these powerful actors hinder the growth of activities such as the implementation of traditional practices or any adaptive measures to cope with climate change for the betterment of the country. Participant E stated that the implementation of adaptive traditional practices becomes difficult to make rules depending on the market which means the developers who want only a quick profit see to it that they benefit from the rules that are being implemented and thus the implementation of traditional practices in Urban India depends only on the market value which can benefit the developers. According to the interviewees, the actors who play the major role in making the policies and implementing the practices, lack in leadership to implement the traditional practices in Urban India (See rules and regulations dimension).

Opportunities related to the actor's role:

Few suggestions that all the interviewees thought was necessary in terms of the actor dimension for the implementation of traditional adaptive measures to take place in India was that, the Indian government that is the central, state and the local government must establish strict stringent policies and bylaws for adaptation to climate change and monitor them until the adaptation

measures are implemented successfully. Building models and policies for cost-effective and energy-efficient community-based adaptation measures and region-specific adaptive strategies is also necessary for the actors to take into consideration. The interviewees stated that is necessary to have a more decentralized system for governance to create strict laws and diligently monitor them to implement the rules. By having a decentralized governing system especially for climate change adaptation measures and strategies the implementation of these traditional practices will take place without any corruption as all the power and responsibility will lie in their hands and thus, they will have to comply with the policies.

5.1.3 RULES AND REGULATIONS:

Based on actor's dimension, the interviewees spoke about the rules and regulations in this dimension, that needs to be implemented and few challenges that exist in India in terms of policies and rules for the implementation of traditional practices in Mega cities of India for adapting to climate change.

Barriers related to rules and regulations for climate change adaptation:

According to participants B, C and F India lack in establishing policy frameworks for adaptation to climate change. And this is one of the biggest challenges that India faces. Most of the participants such as B, C, D, E and F specified that there are many regulatory (lack of policy frameworks, execution, and law enforcement issue), economic (corruption and quick profit, cheap investments among the developers) and infrastructural issues (lack of climate resilient infrastructure and green technology) that exists in India for the implementation of traditional practices in Mega cities. According to the interviewees, the barriers in the roles of the actors such as the big corporates and the government are lacking in taking the leadership stand to implement adaptive practices as they want to make a quick profit with less investment within a short period of time. Hence, there is an increase in corruption as well, which prevents the process of building policies and implementing adaptive measures in India. The interviewees stated that there are existing rules for implementing adaptive practices such as rainwater harvesting etc. in India but there are an execution and law enforcement issue along with it. The actors do not take any initiative to implement such climate change adaptation policies and since the laws are not strict, there is no one to comply with the implementation of practices nor is there anyone to monitor or maintain the existing rules that need to be implemented (See actor dimension). For example, Kiran Bedi who is the lieutenant governor had said that Pondicherry University buildings should all have rooftop rainwater harvesting systems to decrease the gap between the rich and poor for the resource availability. But this act failed as there was no proper infrastructure available for rooftop rainwater systems and the water treatment plants *(Times of India, 2018)*. Thus, there was no action taken after this incident, which also proves that there is a lack of leadership, initiative, enforcement and execution issue.

Opportunities related to rules and regulations for climate change adaptation:

To overcome the barriers in this dimension the interviewees gave few suggestions or opportunities that will help India to become a climate resilient country which means have green technology, climate resilient infrastructure in general and having better risk/disaster management systems to cope with climate change. Building codes for green space, rainwater harvesting in every building, energy efficient insulation techniques are the few rules and regulations that need to be

implemented according to the participants. Rules and regulations must be monitored and must be carried forward in diligence and strictness. Region-specific adaptive strategy policy, community-based adaptive policy, ecosystem-specific bylaw, bylaws for better building insulations for all the buildings, better-engineered rainwater harvesting systems/ groundwater recharge bylaws and rules and regulations for urban agroforestry in the cities of India must be initiated and established by the government. The existing rules and policies should also be maintained and monitored along with the new climate change adaptation policies to implement traditional practices in Mega cities in India. And all of these opportunities mentioned above will only take place if the policy framework is strict, the actors play the part of their role diligently and have a decentralized system for climate change adaptation.

5.1.4 DISCOURSES:

In this dimension, the interviews have stated the problems according to their knowledge and experience. The interviewees spoke about their perception of climate change adaption in general and the barriers or opportunities which are linked to it.

The general perception of climate change adaptation in India:

According to all the interviewees, climate change is a serious issue that needs to be considered and paid urgent attention to. The 6 interviewees discussed the impacts of climate change such as; the rise in temperature, changes in rainfall patterns causing floods or droughts, due to which the coastal areas of India are also facing high intensity and high-frequency cyclones. And this disrupts the urban accommodation, in terms of the infrastructure disasters, social and health problems that are caused due to the effects of climate change. Participant B stated that very little research has been done on climate change adaptation in India, to find all the causes and effects.

Barriers related to the climate change adaptation in India:

All the 6 participants who I interviewed said that India is not designed to take care of climate variability and climate extreme changes. India lacks in the level of preparedness for impacts of climate changes for most of the cities and rural areas. They also said that India is still not adaptive to any kind for climate changes. There is very less of adaption in India than mitigation measures that are recently taking place. Participants also agreed that India lacks in risk/ disaster management. Participant A, E, F, D, C said that the main issue that India is facing as of today is that, India lacks in recognizing the problem and developing a solution for it. Participant B, E, F, D, C also mentioned that India also lacks in basic town planning for cities are villages. All the interviewees mentioned that these barriers occur at different points in time and place depending on the economic, political and social situations. Due to these challenges mentioned above India is still lacking in adaption measures or strategies, in general, to cope with climate change and this also includes the use of traditional practices as an adaptive measure.

Opportunities related to climate change adaptation in India:

According to all the interviewee's point of view, following are the suggestions to bring about change in India for adapting to climate change and building a more climate-resilient country. They said that there is a need to conduct more studies and researches on realistic adaptive measures to cope with climate change. Spreading awareness and educating more people about the growing effects of

climate change and the adaptive measures is necessary. They also stated that we must promote more green spaces in cities for heat stress management. Having better governance and decentralized systems will benefit the societies and communities to adapt to climate change. Moreover, we must invest in low carbon usage of green technologies. The cities and towns of India must improve in town planning and have a more climate-resilient infrastructure. The participants also mentioned that there is a need to combine both the positive aspects of traditional practices and technocratic practices to develop a more climate resilient and advanced country (See resources and power dimension). The participants also stated a few examples of solutions that we could adapt to in order to cope and protect ourselves from the effects of climate change in general. For example; cities should promote kitchen gardens or rooftop gardens, plants on wall for insulation (China), PIEZO electricity (China) on tiles which converts from mechanical energy to electrical energy once you step on the tiles, promote public transport or work from home in office in India, promote alternative power from renewable energies, separate grey water from black water at homes. These examples mentioned above by the interviewees could be a mitigative or adaptive measure to cope with climate change in general in India.

According to my conceptual model which is based on the theory of policy arrangement approach, all 4 dimensions (the **actors** involved in making the policy for climate change adaptation, the **discourses** faced to implement traditional practices in the Mega cities of India to adapt to climate change, **rule and regulations** that exists or needs to be exist to allow such policies to come into action and the **resources and power** that are required to get the desired goal of adaptive measures and policies to be implemented in the Mega cities of India) are interlinked with each other. And if one of the dimensions is disrupted the entire policy arrangement system gets disrupted. Few of the barriers and opportunities stated by the participants in the interview also overlap with one another in the above-mentioned dimensions. Hence, after critically analyzing the data I can interpret that the reason why traditional practices cannot be implemented in mega cities of India to adapt to climate changes is that there are too many barriers and challenges in every dimension mentioned above, prevents these practices to take place. But, at the same time, since my size of the participants was only 6, and it is not adequate enough to conclude the results only based on these participants. This research can be only concluded fairly if there are enough participants to do this research as it will be more reliable and valid. However, based on the results incurred, I could analyze and infer that traditional practices in Mega cities of India are not being implemented and neither can it be implemented easily in the future. There are many barrier and challenges in every dimension of the PAA that exists, but there are also many opportunities and suggestions that can be taken seriously into consideration by the actors, for such adaptive measures to take place in order to cope with the consequences of climate change.

The interviewees were very polite and motivated to answer the questions that were asked during the interview. They shared their immense knowledge and perspective with me to be able to conduct this thesis. The participants also suggested a few methods by with we can still adapt and tackle the impacts on climate change.

5.2 OBSERVATION:

According to my observation, I noticed that all 6 participants were very decent, professional and polite. They were very interested in the topic of discussion and hence were motivated to talk and

explored all the different dimensions of my research. Participant C and D were a little bit in a hurry as they had other meetings scheduled, but never the less all the participants gave as much information as they could in the allotted time frame as they could answer almost all the dimensions of my research topics and the questions in the interview guide. The interviewees shared their professional experience as examples to back up their answers.

CHAPTER 6: CONCLUSION AND DISCUSSION

6.1 CONCLUSION:

The increase in climate change and its severe impacts on the different ecosystems are an alarming cause to start adapting to climate change. It is important that we realize the consequences of climate change now and act upon it before it becomes too late. The effects of climate change such as the sudden rise in temperature, heat stress, floods, cyclones, the rise in the water levels and many more natural calamities that occur due to climate changes impact the communities and different ecosystems. For, this reason there is an immediate need to develop adaptive policies and strategies for adapting to the risks and vulnerability of climate change.

My aim for this thesis was to look into climate change adaptation measures by using traditional practices in the Mega cities of India and find the institutional barriers and opportunity that exists in these Mega cities for the implementation of such practices. Traditional practices were used in the olden days, by the rural areas to adapt to climate change, but during those times the effects of climate change were not so severe as of what it is today. Traditional practices such and insulating houses by using clay and cob sand instead of using brick walls in the modern times. There were traditional methods of rainwater harvesting and crop rotation in order to adapt to climate change. However, due to the advancement of technologies these practices are becoming extinct slowly and more carbon emissions are emitted due to the burning of fossil fuels and advanced technologies.

Hence, I based my literature review in knowing if it was feasible to use traditional practices in the Mega cities of India as an adaptive measure towards climate change. Very little literature is available on climate change adaptation by using traditional practices in general. And no literature is available on climate change adaption in Mega cities of India by using traditional practices. Never the less, after reviewing the literature review, I found the theory of Policy arrangement approach as the most appropriate concept on which I could base my research study on. The policy arrangement approach has four dimensions which are interconnected to one another and if one gets disrupted the entire approach falls out of place. The dimensions are the actors, rules and regulations, resources and power and discourse or barriers. My thesis objective is based on these for dimensions and this will prove if traditional methods of adaptation can take place in the Mega cities and if yes, then want can be done to implement them.

As urbanization is increasing daily, there is also a constant need to fulfill the demands for space, infrastructure and basic resource needs. These activities negatively impact the climate and the other ecosystems, which in turn causes the effects of climate change. After conducting the interviews with 6 professional climate change experts from India, a lot of critical analyze had to be done to fit the results into the 4 dimensions of the Policy arrangement approach. Each of these dimensions had their own barriers and opportunities according to the participants based on their knowledge and experience. The table below represents few of the main barriers and opportunities on the basis of my interpretation of the 4 dimensions of the PAA, which exists in the Mega cities of India such as Mumbai, Kolkata, Delhi, Chennai, Hyderabad, Ahmedabad and Bangalore for the implementation of traditional practices as an adaptive measure to climate change.

SR. no.	DIMENSIONS (PAA)	BARRIERS	OPPORTUNITIES
1.	**Resources and Power** *(Traditional practices and other resources)*	-Lack of cost hierarchy in India -Lack of risk/disaster management adaptive organizations, adaptive or migration strategy plans, awareness among individuals. -Traditional practices are problematic to implement in cities as they are space intensive, costly, high maintenance and get polluted easily. -India lacks in adaptive measures in water and agricultural sectors -Economic, political, social and regulatory issues exist in the implementation of traditional practices in urban India. -Corruption - Lack of climate resilient infrastructure, lack of water collection and water treatment systems. - Behavioral and execution issues for implementing traditional practices in Mega cities of India.	-Real estate and the green technology must go together. -Bylaws and policies for every building in the city for construction of engineered rainwater harvesting systems, using clay instead of brick walls and making ledges for the windows resulting in better insulation and will eradicate water scarcity issues. - Combining technocratic and traditional practices. - Generating models which are crop specific, land specific and region specific. And also promoting crop rotation, urban agroforestry and green spaces in the cities. -Building energy efficient technologies, developing better risk/disaster and resource management systems, changing the behavioral issue by spreading awareness and educating people, getting international support financial to aid climate change adaptation programmes. -Developing smaller towns and villages first to reduce the load of migration from Mega cities.
2.	**Actors** *(Actors involved and their roles)*	-Increase in corruption among the actors to make a quick profit with less investment. -Government officials and big corporate companies make policies and build infrastructure for short-term quick profit with less investment at a lesser time period.	-Establish strict policies and bylaws by the Indian Government. -Monitor these policies and comply with them for the implementation of adaptive measures. -Building models and policies, cost-effective and energy efficient community or region based adaptive

		-Difficult to make rules depending on the market. -No sense of willingness or urgency among the people to take initiative actions to cope with climate change. -Lack of leadership and execution or enforcement barriers. -Lack of maintenance and monitoring policies for implementation of practices.	measures should be developed.
3.	*Rules and Regulations*	- India also has regulatory, economic, political, social and behavioral issues. -India lacks in policy frameworks for adaptive measures to cope with climate change. -Lack of maintenance and monitoring policies for implementation of traditional practices. -Execution of rules and enforcement of laws is an issue in India. -Increasing corruption in India to make a quick profit in a short period of time.	-Building codes for green space, rainwater harvesting in every building, energy efficient insulation techniques must be developed. -Strict monitoring of rules and regulations as well as comply with the existing policies and bylaws diligently. -Region-specific adaptive strategy policy, Community-based adaptive policy, Ecosystem specific bylaws, bylaws for better building insulation, better-engineered rainwater harvesting systems/ groundwater recharge and urban agroforestry in the cities of India must be initiated and established by the government.
4.	*Discourses* *(General perception of climate change adaptation in India)*	-India lacks in adaptive measures, preparedness for climate change, recognizing the problem and developing a solution for it. -India also has regulatory, economic, political, social and behavioral issues.	-More research studies on climate change adaptation measure to adapt to new practices and prevent ourselves from the effects of climate change. -Spread awareness and educate people about climate change adaptation measures. -Promote green space, risk/ disaster management, and heat stress management systems.

			-Decentralised systems -Climate-resilient infrastructure for transport and societies, better town planning to cope with climate change and improved stringent governance to eliminate corruption and comply with the policies diligently.

According to the literature review of Stern Nicholas (2007), and other case studies on traditional practices mentioned in this paper, it clearly states that I can confirm that my findings of the institutional barriers and opportunities related to those that are mentioned in those research papers. A study conducted in Western Nepal by (Jones & Boyd, 2011) on climate change adaptation by exploring the social and institutional barriers also confirm my findings such as lack of awareness, behavioural issue, lack of government policy frameworks, lack of monitoring and maintenance of adaptive measures, regulatory issues, lack of finance, resources and space for implementing practices etc. Another study by Lindsey Jones (2010) based on overcoming the social and intuitional barriers of climate adaptation in different countries had the same findings. Thus, I can confirm my findings based on the results of other literature studies which have been done in previous years.

The findings of my research are relevant for Mega cities in India because they describe the broad policy arrangement that is applicable for all the Mega cities in India. Obviously, further research may zoom into only one particular Mega city to compare all the aspects between different Mega cities, so as to compare the differences and analyze the data at a more micro level.

Some recommendations based on my findings, to make India a sustainable, climate resilient, progressive and risk-proof country, we have to look into this matter sincerely and make changes on our part which will one day in return help us achieve our desired goal. More studies and researches on realistic adaptive measures should be taken into consideration and spread awareness or educate more people about the growing effects of climate change. There is a need for better town planning and climate resilient infrastructure. The Government should make stringent policies for effective and efficient adaptation measures and also generate bylaws for groundwater recharge, engineered rainwater harvesting, urban agroforestry, and better-insulated buildings and infrastructure. Combing the technocratic practices and the traditional practices in Mega cities will be beneficial and progressive for the country to adapt to climate change.

The main institutional barriers that exist in implementing traditional practices in mega cities of India are lack of enforcement and execution of policy frameworks, lack of initiative among actors, lack of maintenance and monitoring of practices that are needed to be implemented and also the existence of corruption present in every level of the actors. According to my point of view, the first step to take in order to bring about change is to spread awareness and change the attitude of the people in India. There must be a willingness or a thought of taking initiative to make the desired changes to make India strong, progressive, climate proof and sustainable. The main three aspects that we should work on is the strict and decentralized governance, development and regulations according to my perspective.

After successfully conducting this research, I am curious to know about the ways by which we can implement more adaptive energy efficient strategies in not only the Mega cities of India but all over the world, as the effects of climate change are upon all of us.

6.2 REFLECTION REPORT:

As a pre- master's student at the Radboud university studying in the Department of Geography, Planning and Environment Science, I am obliged to get an opportunity like this to conduct the research and submit the thesis. I was allocated to do a thesis on climate change. As climate change is one of the most important aspects in today's world, it was exciting for me to come up with some challenges that I could take upon and research more about climate change in order to make this world a better place to live in. Thus, I choose to do a research, based on my country India on the basis of Climate change adaptation and the implementation of traditional practices as an adaptive measure to climatic changes in the Mega cities of India. I chose to do this because I felt it would be interesting to know if the old traditional practices could be still used in the Mega cities of India to adapt to the growing effects of climate change. I also wanted to know the barriers and challenges that people face in order to implement such practices. Hence, to begin with, my research, I had to take a few interviews with people who can give me enough information related to my research topic, as I was using a qualitative research methodology. The qualitative research method was the most suitable research that I could do to conduct my thesis. I first started researching this topic through research studies, literature reviews, case studies and policies related to climate change in India and the world. During this process, I realized that there were very few research or studies that were done in the Mega cities of India related to climate change adaptation and the use of traditional practices in urban India. That's when I realized that I might face some limitations during my research and the fact that it will be difficult for me to do this research. Never the less, I was still very much interested in this topic and was motivated to conduct this research and gain as much knowledge and experience while conducting my study.

After this, I tried to contact people in India through email who were in the related field of my research discipline and the actors who play a role in climate change adaptation. Out of many emails sent, I received on 4 replies after a brief period of time who agreed to do the interview. I then started conducting interviews with them and also did a snowball sampling. Contacting the interviewee and conducting the interviews was over a span of 2 months, many of them were busy with work. With this, I finished with 6 interviews through Skype video call as I was in Nijmegen and the participants were in India. Before conducting the interview, I had prepared a semi-structured interview guide which was very useful for me to conduct the interviews, as it gave me a structure and outline of the topics of discussion.

Thereafter conducting all the interviews, I started to get a fair idea of the topic and began to transcribe the interviews. While conducting the interview I also asked the participants that if it was okay to record the audio of the interview as I needed to use it only for my purpose of analyzing the data and if they wanted I could keep their names completely anonymous. The Interviewees agreed to the recording to the audio and had no issue with the anonymity. To begin the interview, I always greeted the participants and introduced myself and gave a little introduction to my background. I then explained what my research topic was and the details of the interview. I did this to build a rapport and have a comfortable conversation with them. After which I asked them the permission

to begin the interview. I recorded the audio on a smartphone so that I could use it later to transcribe the interviews. I made sure I sat in a quiet place, with good internet connection and lighting, so that there are no disturbances in the interview. The only difficulty I faced during conducting the interviews was the technical problem for connectivity from the other side, which made me lose out on some of the time allotted for the interview and some of the information that the interviewee spoke during the time of technical difficulty. But none the less, at the end I could gather most of the information as they could answer all the questions I had in the interview guide.

All the interviewees seemed very interested in the topic of discussions and motivated to answer the questions. After gathering all the information about my research topic, I began to transcribe the interviews word by word. I then realized that most of the interviews spoke about the challenges and barriers that are present in India in order to adapt to climate change issues. Hence, there was a gap in the implementation of traditional practices in urban India. I then started coding the interviews on Atlas. ti software, which helped me analyze and interpret my data. Based on the literature review and theory dimensions, I made a conceptual model which fitted the policy arrangement approach which was the theory base of my research. I used this concept to code and interpret the results of the interview to get a clear understanding of my research topic. My interview guide was also based on the policy arrangement approach theory and its 4 dimensions, which helped me to gather information from the participants and then interpret them. Policy arrangement approach was useful for my research as it consisted of the most important dimensions which my thesis is based on. The 4 dimensions which are interlinked with one another are rules and regulations, resources and power, actors and the discourses. All of these dimensions build a link between climate change adaptation measures, the role of implementing traditional practices as the adaptive measure to cope with climate changes and the barriers that are faced to implement these practices. The PAA theory is compatible with my research as it is both analytical and normative in nature. It is a reflective approach to policy evaluation and design which helped me interpret the results which I gathered from the interview and find the barriers and opportunities linked with the discourses, resources or power, rules and policy frameworks, the actors involved in order to implement traditional practices in Mega cities of India. Thus, PAA was the right choice of approach to base the theory of my research topic as it could address the research problem. Thus, I could conclude the thesis by linking all the barriers and opportunities that exist in the Mega cities of India to implement traditional practices as an adaptive measure with the 4 dimensions of the PAA. And this helped me to reject the null hypothesis and find all the barriers and opportunities which play a role in the implementation of traditional practices in urban India. But, according to me, this research would have been more reliable and valid if I could do data triangulation by extracting more data statistical from policy papers and making use of primary data such as surveys and interviews. This could have made a strong conclusion for this thesis topic.

Overall, I had an amazing experience and gained a lot of knowledge while doing this research. It taught me aspects of time management, interpreting data, conducting interviews, transcribing the interviews and writing a research thesis. I enjoyed every bit of my research process.

6.3 LIMITATIONS:

There was quite some amount of limitations that I faced while conducting this research. The bachelor thesis was given to be completed in a short span of time, which is why collecting the

adequate amount of data and the satisfactory number of participants to conduct the thesis was not possible. This was one of my main limitations. The sample size is too small to conclude the thesis. As there were only 6 participants, it is difficult to conclude the thesis based on the information gathered from them. A larger sample size would be more reliable and valid to conclude this thesis. For my research, I had only, 4 males and 2 females to take the interview and this could also be a limitation as there was no equal number of genders present in the research conducted. Since, I had to contact people in India through email to ask permission to conduct the interview on the basis of my research topic, out for 42 emails sent out to people in India who could be potential participants only a few agreed to do the interview. Most of the potential participants disagreed or did not respond. Finding suitable participants for a short period of time was the biggest challenge and also one of the limitations of my thesis. Another limitation was that, since I was conducting the interviews through Skype, there were many times that I faced technical difficulties due to internet issues. The video, as well as voice, was distorted because of low connection and thus, a lot of data was lost due to this. Conducting a face to face interview would have been a much better option, but since that was not possible due to time constraints I had to face this limitation. Few of the participants were also busy with work and thus, I had to cut short on the discussion and the interview to fit into the time frame that the participants offered me to conduct the interview, in order to finish it on time and get as much as information that was possible in the given time period. One of the major challenges that I faced in this research was to gather information on traditional adaptive practice to climate change in the Mega cities of India. Very few literature on adaptations to climate change are present in India. And moreover I couldn't come across any literature review on traditional practices as an adaptive measure used in the Mega cities of India to cope with climate change. Thus, I faced a literature and information barrier during my thesis. Another issue with this research was that I did not do a data triangulation that is to acquire more information statistically from government policy papers, surveys etc. I only based my conclusion after interviewing only 6 professionals as my participants. Due to this, the research can lack in reliability and validity.

Hence to summarise; limited period of time, small sample size, gender of the participants, the method of conducting the interview through Skype, no literature review and no data triangulation on climate change adaptation by using traditional practices in the Mega cities of India were the most important limitations and challenges I faced while conducting the research.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH:

There are a few recommendations for the future that I would like to mention which could help us in making a safe and climate-resilient society. The first recommendation concerns awareness and education. There is an urgent need to spread more awareness about climate change adaptation in India and also educate more people about the consequences of climate change and the ways to tackle them. There is a need to understand the rate at which climate change is occurring and how it can affect our ecosystems, in order to achieve the power of willingness among people, to act upon it and make adequate changes accordingly. This will help India to become more climate resilient country. Another recommendation would be to look into one particular Mega city in India to conduct a similar research as this for implementing traditional practices as an adaptive measure to cope with climate change. This will help in getting in-depth knowledge of the practices that can be implemented based on the type of geographical features, climate, socio-economic, political and ecological aspects of that particular city. The third recommendation would be a need to do more

case studies and research on climate change adaptation strategies in India and also find a balance between technocratic and traditional methods of adaptation in the Mega cities as well as rural India in order to cope with climate change. More the research on this topic, more advance the country will be. Based on the government roles and policy frameworks, another recommendation would be that the government should consider establishing more stringent policy frameworks for adaptation to climate change and comply with them, in order to improve the management and eliminate corruption from the country. If there are more stringent laws or policies that are implemented in India, then the entire country could benefit from it by becoming more advanced and climate resilient. The fifth recommendation concerns with the scope for developing community- based adaptation policies and region-specific adaptation policies, by different stakeholders which will not only be cultural but also socio-economical, ecological and political and can fulfill all the needs of the society as well as be well protected from any climatic changes. There is also an urgent need to strengthen the previous integrated policies and complete the analysis to maintain steadiness in the country. Last but not the least, there is a need to find more realistic adaptive measures which will be cost-effective and energy efficient at the same time. This will also bring development due to the rise in the economy of the country.

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