1. **PROPOSED RESEARCH**
2. **Research Title:**

* Smart Plantation; Preserving Air from adverse climate

1. **Research Area:**

In accordance with Science, Technology and Innovation Strategy 2014-2018, Smart Plantation comes in the category that encompasses the following goal

“To improve environmental quality by reducing containments, conserving energy and water”

Smart Plantation will contribute in achieving the mentioned goal as the focus of system is to better up the quality of air by suggesting appropriate plant that would be capable of lowering down the contaminating constituents present in the environment. As the necessity of areas varies widely, especially in a country like Pakistan, that has all types of climates. Varied requirements of locale will be addressed by the system in order to make prediction for plant.

1. **Research Objectives**

* To bring a system that will make suggestion for an appropriate plant in accordance the requirement of location.
* Protection and preservation of Air, especially in urban areas for climate change mitigation.
* Reduction in carbon emission by giving the base for correct placement of trees in an area.
* To make comprehensive database about the flora of Karachi that is reliable, searchable and applicable in differed scenarios.
* Ultimate goal is to work on reducing unusual rise is temperature so that to restore the biodiversity where it is in danger.

1. **Research Background**

**Introduction**

Our planet is warming, putting at risk not only our physical well-being, but the whole future. With the evolution in technology and other industries, there comes the need to manage their impact on the environment. All the terms that we hear these days like global warming, depletion of earth's resources (like air, water, soil, etc.), destruction in the ecosystem, are the result of this revolution. And it is noticeable that we can't keep ourselves away from the changes that are brought through technology but we can certainly lower down the worsening effect. During the course of the twenty-first century, scientific evidence points to global-average surface temperatures that are likely increasing by 2◦C∼4.5◦C. The current rate of global warming is 2◦C per century. The global mean temperature will rise by at least 1.5◦C by 2050 [[1]](file:///C:\Users\Surayya%20Obaid\Downloads\On_rising_temperature_trends_of_Karachi_in_Pakista.pdf).

Climate change has now become one of the most discussed issues in recent years. We can take the example of recent incidents like Amazon Rainforest fire [[2]](https://www.researchgate.net/publication/252295004_Fire_in_the_Tropical_Rain_Forest_of_the_Amazon_Basin), Australia bush fire [[3]](https://www.nature.com/articles/d41586-020-00130-4), heavy floods in Kerala (India), Bangladesh, Nepal, Sri Lanka & cyclones in Southern Africa [[4]](https://www.oxfam.org/en/5-natural-disasters-beg-climate-action). Another issue that world is witnessing, is the unanticipated number of climate refugees which has exceeded millions now. Since 2008, an average of 21.7 million people has been displaced each year by extreme weather-related disasters – the equivalent of 41 people every minute [[5]](https://helprefugees.org/news/climate-change-refugee-crisis/?gclid=CjwKCAiA-vLyBRBWEiwAzOkGVMDfToP2PFYx3q8ctwsRdGjGZxZV_xPDhF2oRsWHGEQFMbpq7LWbshoCCNUQAvD_BwE).

Karachi being home to 11% population of Pakistan has badly gone through impacts of climate change and now is most prominent contributor of CO2. If the temperature of Karachi continued increasing at the same rate, then it is possible that it will rise up to 3.9◦C till the end of this century.

**Potential Solution of Climate Change**

Although climate change isn’t reversible at all but there are still some ways through which its impact can be minimized. The Green City Concept is one of the latest responses to the diverse efforts and research conducted to address the problems caused by the dispersed model of city development and to help cities to become more sustainable (greener), less dispersed and more liveable [[6](https://www.mdpi.com/2071-1050/10/6/2031/pdf)].

**Pakistan’s Infrastructure for Preservation of Environment**

Pakistan has recently made progress in limiting climate change with the step like Billion Tree Tsunami [[7]](https://www.pc.gov.pk/uploads/pub/1st_five_pages_of_10_billion_Tree_Plantation.pdf) which promises for better Air in future. But if we talk about Karachi, which is a metropolitan city, then sadly there seems no infrastructure for preservation of environment. Air Quality Index has increased far from the hazardous level in most of the areas of the city [[8]](https://www.pakistantoday.com.pk/2019/11/05/pakistan-ranked-as-2nd-most-polluted-country-in-world-air-quality-report/). Firstly, the plantation is done up to a very limited extent and secondly, there seems no prior research in this regard. The heat wave of 2015 and 2016 was slight because of the massive plantation of a plant named Conocorpus. The tree has the characteristic of extending roots up to a considerable level. The tree itself isn't dangerous at all but it is said that it's not a suitable choice for plantation in urban areas [[9]](https://www.academia.edu/16302116/The_Reality_of_Damas_Conocarpus_spp._planting_in_AD_city?auto=download). It sucks the water from the soil due to its extended roots resulting in decreased water level. This was the cause that resulted in decreased humidity in the atmosphere that ultimately reduced rainfall in the city. This is a negative example in which the wrong plantation has result drastically. But numerous examples show that positive results can be obtained by planting appropriately. For instance, Spider plant is an outdoor plant that battles with the toxins like Carbon mono oxide present in the air.

**Way to better Air**

Almost all of studies that illuminate the relation between Air Quality and plantation, are based on NASA Clean Air Study which was done in association with Associated Landscape Contractors of America (ALCA) in which they evaluated the impact of certain plants on the Air quality within a controlled environment. The results confirmed that those plants lowered the toxins level in the air.­­­ Plant named Gerbera jamesonii lowered approx. 4486 μg/h of Benzene [[10]](https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19930073077.pdf) which confirms that planting when done with prior research, can be beneficial for the surrounding.

**Bringing Precision to Plantation**

Plants are notoriously adept at absorbing gases through pores on the surface of their leaves. It's this skill that facilitates photosynthesis, the process by which plants convert light energy and carbon dioxide into chemical energy to fuel growth [[11](https://www.livescience.com/38445-indoor-plants-clean-air.html)]. In the past 30-40 years a wide spectrum of plant species has been scientifically examined for their capacity to purify air. Many plants can to a certain extent clean the air by uptake of Volatile Organic Compounds (VOC) and fine particles.[[12](https://edepot.wur.nl/423129)]

The aforementioned scenarios have led us to the idea of **Smart Plantation**. Research so far has compelled to categorize the impact of plants on the environment. Plants belonging to different species lead to mark different aftermaths. Few are helpful in lowering down temperature; some effectively absorb Carbon dioxide, while some are beneficial in decreasing VOCs level.

As Pakistan’ urban and rural areas have varied climate, requirements of areas differ too. For this, Smart Plantation will predict/ suggest the plant that conform the environment’s needs. This will be done by collecting data of temperature, humidity, the concentration of oxygen and carbon dioxide in the air, concentration of salt, nitrogen, water and related parameters from soil using sensors.

Based on the gathered data, the system will suggest a plant enlisted in the database of the system that has the most matched features with the environment. Real-time data will be collected relating to the requirements of plants like water and fertilizer with the help of sensors deployed for monitoring purposes. Alerts for such requirements will be generated for appropriate maintenance.

There are tens of data sets for plants but unfortunately, it isn't available specifically for the flora of Pakistan. Because we need it along with details of what conditions are necessary to be true for the survival of the plant such as temperature, humidity, atmospheric pressure, water level in soil.

Research will categorize plants in following ways:

* Capability of absorbing carbon in Air
* That remove toxicants from Air
* That lower down temperature
* That improve soil fertility

1. **Research Methodology:**

Research will be conducted in three stages. As prediction of appropriate plant needs data about plant itself as well as of surrounding, therefore, data will be collected first which will be followed by sorting and processing of data.

**Data Collection**

As refined form of data for native plants isn’t available online, therefore, Government sources like Sindh Forest Department[[1]](#footnote-1) and UNAP’ Sindh Plantation Project[[2]](#footnote-2) will be approached. As well as, a few non-government sources like data.world[[3]](#footnote-3) and Kaggle[[4]](#footnote-4) will be used.

**Data Sorting**

As the focus is Pakistan, plants that are relevant and well matched with the conditions of Air will be included. For example, Sindh is dominated by Fabaceae family [[1](https://www.researchgate.net/publication/286890933_VEGETATION_IN_SINDH_AN_ANALYTICAL_AND_LITERARY_STUDY/link/566ef06208ae4bef406123fe/download)3] while Punjab is dominated by Poaceae family [[1](https://www.researchgate.net/publication/255995730_Floral_biodiversity_and_conservation_status_of_the_Himalayan_foothill_region_Punjab_Pakistan/link/00b495215c6e6e5b8b000000/download)4]. Features of plants like water requirements, sunlight requirements and electrical conductivity will be sorted out for prediction.

**Data Processing**

The sorted data will be then used to apply search algorithms that will work to make suggestion for appropriate plant. Naïve string-search algorithm will be used for prediction of appropriate plant as Naive Bayes is very useful when the features are “counts” based or “discrete measurements” based, where the features are independent of each other.

1. **Research Plan**

|  |  |  |
| --- | --- | --- |
| **Milestone** | **Start Date** | **End Date** |
| Data Collection for the native plants of Pakistan | **10-Jan-2020** | **31st-March-2020** |
| Data Collection of preferred plants for Pakistan | **1st-April-2020** | **30th-April-2020** |
| Integration and sorting (features-wise) of collected data | **1st-May-2020** | **20th-June-2020** |
| Implementation of Search Algorithm | **21st-June-2020** | **30th-September-2020** |

1. **Expected Outcomes of Study:**

* The research will end with a formulated database that will include native and non-native plants with their categories, features and benefits.
* System that suggests the right plant according to the needs of locality.
* Plant tracking system

**References**

[[1]](file:///C:\Users\Surayya%20Obaid\Downloads\On_rising_temperature_trends_of_Karachi_in_Pakista.pdf) SAJJAD, Dr. Sajjad Hussain & Hussain, Babar & Khan, M. & Zaman, B. & Ahmed, Ijaz. (2009). On rising temperature trends of Karachi in Pakistan. Climatic Change. 96. 539-547. 10.1007/s10584-009-9598-y.

[[2]](https://www.nature.com/articles/d41586-020-00130-4) Fearnside, Philip. (1990). Fire in the Tropical Rain Forest of the Amazon Basin. 10.1007/978-3-642-75395-4\_7.

[[3]](https://www.pc.gov.pk/uploads/pub/1st_five_pages_of_10_billion_Tree_Plantation.pdf) Lewis, D. (n.d.). Catastrophic Australian bushfires derail research. Retrieved from nature: <https://www.nature.com/articles/d41586-020-00130-4>

[4] Natural Disasters beg climate action

<https://www.oxfam.org/en/5-natural-disasters-beg-climate-action>

[[5]](https://helprefugees.org/news/climate-change-refugee-crisis/?gclid=CjwKCAiA-vLyBRBWEiwAzOkGVMDfToP2PFYx3q8ctwsRdGjGZxZV_xPDhF2oRsWHGEQFMbpq7LWbshoCCNUQAvD_BwE) Climate change refugee crisis Retrieved from helprefugees:

<https://helprefugees.org/news/climate-change-refugee-crisis/?gclid=CjwKCAiA-vLyBRBWEiwAzOkGVMDfToP2PFYx3q8ctwsRdGjGZxZV_xPDhF2oRsWHGEQFMbpq7LWbshoCCNUQAvD_BwE>

[[6](https://www.mdpi.com/2071-1050/10/6/2031/pdf)] Brilhante, Ogenis, and Jannes Klaas. "Green city concept and a method to measure green city performance over time applied to fifty cities globally: Influence of GDP, population size and energy efficiency." Sustainability 10.6 (2018): 2031.

[[7]](https://www.pc.gov.pk/uploads/pub/1st_five_pages_of_10_billion_Tree_Plantation.pdf)10 Billion Tree Plantation Financing. (n.d.). Retrieved from pc.gov.pk: https://www.pc.gov.pk/uploads/pub/1st\_five\_pages\_of\_10\_billion\_Tree\_Plantation.pdf

[[8]](https://www.pakistantoday.com.pk/2019/11/05/pakistan-ranked-as-2nd-most-polluted-country-in-world-air-quality-report/) Pakistan ranked as 2nd most polluted country in World Air Quality Report. (n.d.). Retrieved from Pakistan today: <https://www.pakistantoday.com.pk/2019/11/05/pakistan-ranked-as-2nd-most-polluted-country-in-world-air-quality-report/>

[[9]](https://www.academia.edu/16302116/The_Reality_of_Damas_Conocarpus_spp._planting_in_AD_city?auto=download) AlMashhanadi, D. (2014). The Reality of Damas (Conocarpus spp.) planting in AD city. Abu Dhabi.

[[10]](https://ntrs.nasa.gov/search.jsp?R=19860005888) Sheldon, Linda S., and Jeffrey Keever. "Collection and analysis of NASA clean room air samples." (1985).

[[11](https://www.livescience.com/38445-indoor-plants-clean-air.html)] Indoor plants clean air. Retrieved from livescience

<https://www.livescience.com/38445-indoor-plants-clean-air.html>

[[12](https://edepot.wur.nl/423129)] van Berkum, Siemen. Prospects of an EU-Mercosur trade agreement for the Dutch agrifood sector. No. 2015-036. LEI Wageningen UR, 2015.

[[13](https://www.researchgate.net/publication/286890933_VEGETATION_IN_SINDH_AN_ANALYTICAL_AND_LITERARY_STUDY/link/566ef06208ae4bef406123fe/download)] Hussain, Faisal & Laghari, Inayat & Naveed, Sharjeel. (2015). VEGETATION IN SINDH: AN ANALYTICAL AND LITERARY STUDY. KAROONJHAR Research Journal. 7. 11-28.

[[1](https://www.researchgate.net/publication/255995730_Floral_biodiversity_and_conservation_status_of_the_Himalayan_foothill_region_Punjab_Pakistan/link/00b495215c6e6e5b8b000000/download)4] Hameed, Mansoor & Nawaz, Tahira & Ashraf, Muhammad & Ahmad, Farooq & Ahmad, Khawaja & Ahmad, Muhammad & Raza, Syed & Hussain, Munawar & Ahmad, Iftikhar. (2012). Floral biodiversity and conservation status of the Himalayan foothill region, Punjab. Pakistan. Pakistan Journal of Botany. 44. 143-149.

1. https://sindhforests.gov.pk/page-publications [↑](#footnote-ref-1)
2. <http://una.org.pk/sindh-plantation-project/> [↑](#footnote-ref-2)
3. <https://data.world/> [↑](#footnote-ref-3)
4. <https://www.kaggle.com/datasets> [↑](#footnote-ref-4)