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AIR-WATER GENERATORS AND SUITABLE CITIES IN INDIA FOR ITS IMPLEMENTATION

Soorya Narayan
Research Associate, International Centre for Technological Innovations

ABSTRACT----------
Climatic tuning is the future key for developing water from the atmosphere. India faces an acute shortage of drinking water. Several riots have also taken place due to the non-availability of drinking water. Even though the authorities are trying their level best to eradicate the problem of drinking water shortages, many issues regarding the same are arising every day in various parts across India. When comparing the annual humidity rates throughout India. Southern parts and eastern parts of the country have a significantly higher percentage of annual relative humidity than other regions. In such an environment an atmospheric water generator that condenses humid air on the evaporator surface of a heat pump will effectively work for producing safe and clean drinking water. The water thus formed is then processed through various filtration tanks.----------

1.0 INTRODUCTION

1.1 Water Scarcity in India

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This image is evidence of active riots occurring in India in the name of water. These incidents repeatedly shatter peace and public life in several Indian states over years. This truck from Tamil Nadu was burnt by agitated pro-Karnataka activists as an aftereffect of the battle between the states over Cauvery river water. About 80% of Karnataka is drought-prone followed by Tamil Nadu at 65%. So there is a need for a constant water source for drinking and agricultural uses for both the states, not only both the states but throughout the country. (Nilima Pathak 2016)

We all know about 97% of available water is present in the ocean and is unfit for drinking purposes. The remaining 3% accounts for consumable water. Out of this, about 68.7% of freshwater is distributed among icecaps and glaciers which is almost difficult to access. According to the United Nations World Water Development report released in 2015, there will be an almost 40% shortage of drinking water in 2030. According to NITI Ayog (2018), about 600 million Indians are facing extreme water stress and 2,00,000 people die every year because of inadequate access to freshwater. It also says that about 21 major cities including Delhi, Bangalore, Chennai, and Hyderabad will run out of Ground Water very soon. The report also depicts that up to 70% of India's water supply is contaminated. The drinking water available now has an undesirable concentration of elements. 500ppm to 35,000ppm is the variation of salt concentration in freshwater. World Health Organization (WHO) depicts that detectable taste in water is due to excessive concentration of sodium and chlorine in it. To meet freshwater drinking requirements people have practiced various technologies out of which is obtaining water from the atmosphere.

1.2 Humidity and Human Health

Simply Saying humidity is the amount of water vapor in the atmosphere air. The higher the humidity higher will be the moisture content in the atmosphere. Usually on all-weather reposts humidity is explained as Relative Humidity which is the amount of water vapor the air can hold at the same temperature. Another interesting fact is that high humidity is also associated with hurricanes. Air with high moisture content is necessary for hurricanes to develop. Our body is also related to humidity on the factor of internal temperature regulation. When our bodies start to heat, sweat is released, this sweat gets evaporated from the surface of the skin to the atmosphere which cools the body. This is the natural temperature regulation method of the human body. In the case of humid weather, the air holds high moisture content making it difficult for the sweat gets evaporated into the atmosphere, leaving our body hot and sticky. As a result to cool our body a significant amount of work is required. This results in excessive sweating, increased rate and depth of blood circulation, and increased respiration and turns causes the loss of required water and chemicals that the body needs to function properly, putting our health in jeopardy. According to the American Society of Heating, Refrigerating and Air-Conditioning Engineers the ideal humidity range for human comfort is between 30 to 60 percent. (ASHRAE).

2.0 LITERATURE REVIEW

2.1 Available Technologies for Obtaining Water from Air

Atmospheric water harvesting is an emerging technology and water obtained by this method is expected to be soft, neutral, and also natural water with low content of minerals and metals. Rajavanshi (1981) examined a scheme for large scale dew collection as a source of water supply. It is based on the idea of pumping cold seawater (278K) from about 500m depth and 5km far from the shore. The cold seawater would be used in a heat exchanger which condenses water from the atmosphere. The next technique which extracted water from the atmosphere was using metallic nets for fog or dew collection. This process is experimented with in various places such as Sweden, France, and Bahrain. All these experiments even though conducted in different places generated almost the same amount of water that is 11.4L/m^2 of the collector surface. Ghandidasa and Abdulhamayel (2005) developed a mathematical model that is based on energy balance and was tested in Saudi Arabia (dew collector). The maximum yield of water obtained in this experiment was 0.22 L/ m^2 per night. Another technology is the Warka water technology which is made up of bamboo and a biodegradable plastic grid (S. Sangita Mishra 2018).

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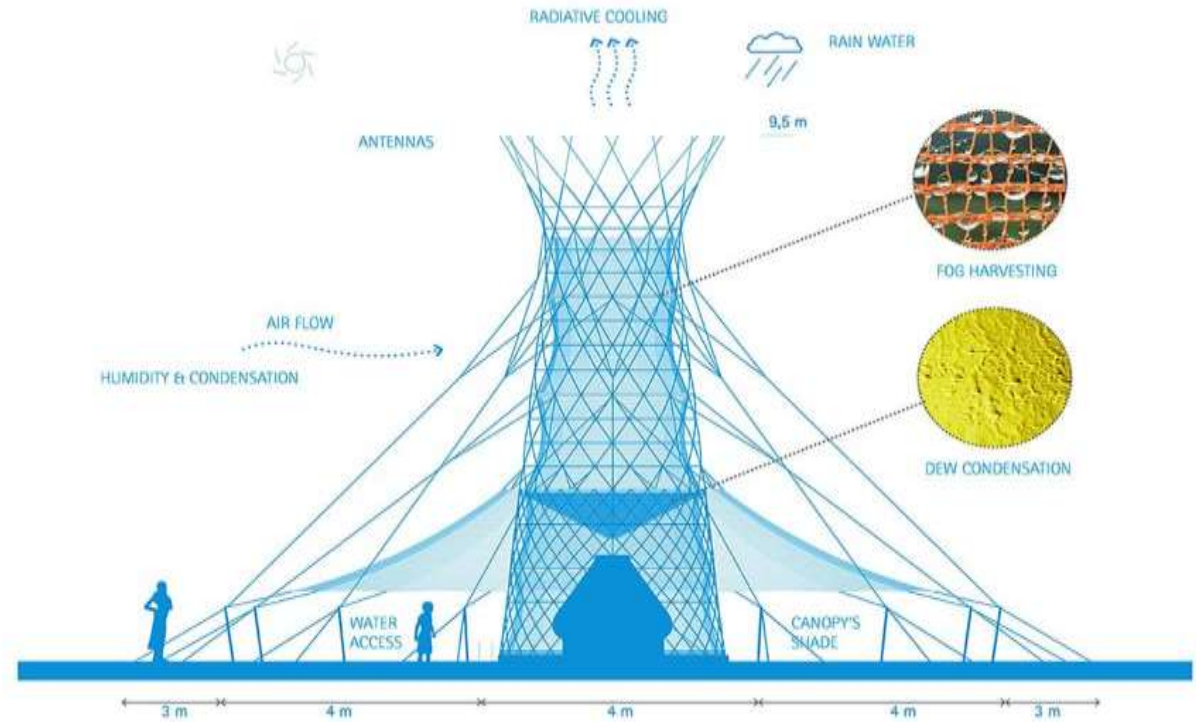

Image of Warka Water technology (S. Sangita Mishr, 2018)

The process is trapping and collecting dew drops. This happens mostly during the night when the temperature is below dewpoint and condensation allows for a greater water quantity collection. The tower then pumps the water to a collection tank and are directed to the same using a nozzle. The whole tower is of sustainable concept as it does not need electricity to work and the structure is built in a way that the members of the community can even perform the maintenance works. Apart from other fog collectors cloud harvester designed by Choiniere Shields has a unique design (Saffa Riffat and Hasila Jarimi, 2020). The unique part of the design is that it uses steel mesh instead of polypropylene nets with an extra sheet under the net for water collection.


Image of cloud harvester (Saffa Riffat and Hasila Jarimi, 2020)

This process has more efficiency. Another form of wet desiccant water generation involves the use of salt in a concentrated brine solution. This is done to absorb humidity. These systems then extract water from the solution and purify it for consumption. The next method for obtaining fresh water from the atmosphere is by condensing the air moisture on the evaporator surface of a conventional heat pump.

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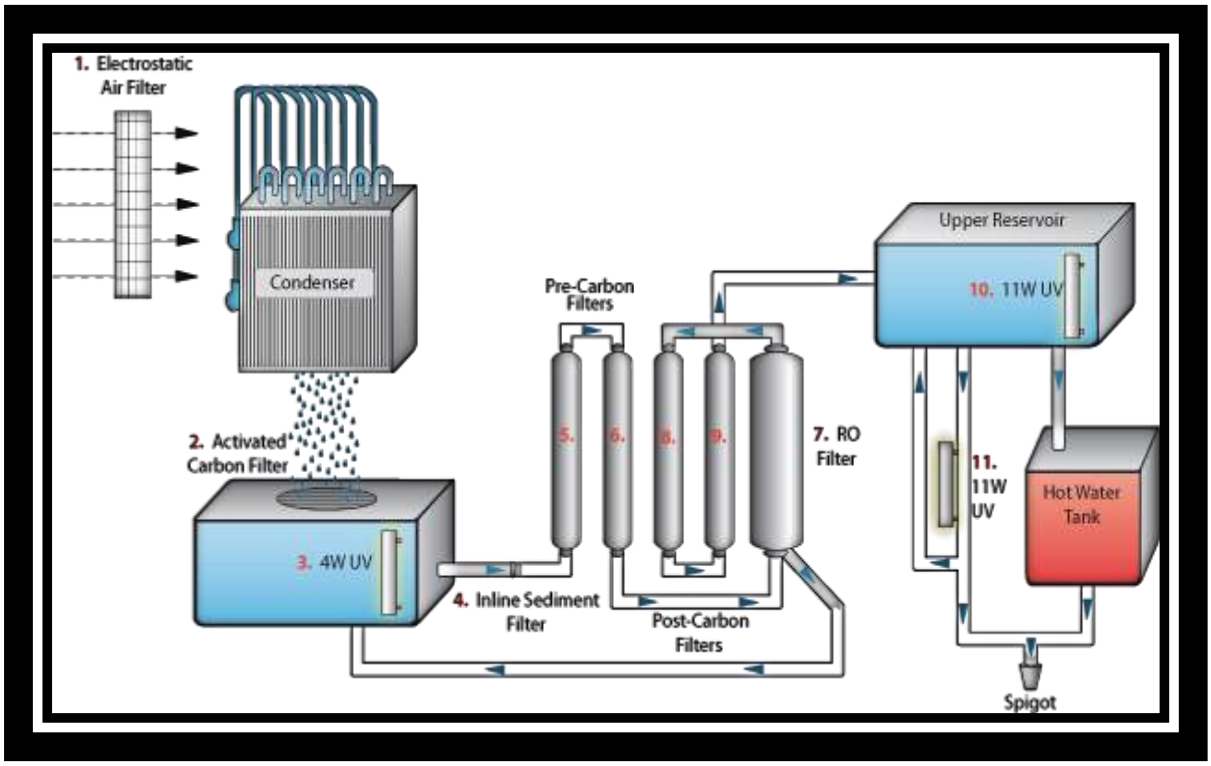

Image of Water harvester from a conventional heat pump (Badr A. Habeebullah, 2019)

This method is nowadays gaining much attention and many people are working on the same technique. Coastal areas generally have a high ambient temperature and humidity. With the help of heat pumps, a continuous stream of air is cooled and dehumidified to obtain fresh drinking water. Thus, the process of direct climate tuning can be extended to become a source of freshwater. As the water gets condensed into fins or tubes made of copper in evaporator coils. Surface tension will cause the water to be collected in water trays. The water extraction units have the same components as that of a refrigeration system and the only other requirement is a forced draft of a humid air stream. When the surface temperature falls below the dew point the moist air experience a drop in temperature and vapor condensates on surfaces and gets collected in collection trays. The evaporator is made up of parallel copper tube coils (Badr A. Habeebullah, 2019). The next method is the most advanced method that is by using the Peltier effect(Amir Hossein Shourideh and Wael Bou Ajram, 2018). A Peltier cooler module is generally manufactured by using two thin ceramic wafers with a series of p and n semiconductors doped bismuth telluride semiconductor materials sandwiched with to wafers. The additional benefit of the ceramic materials is the rigidity and necessary electrical insulation which is referred to both the sides of the thermoelectric module. One type p-type and one n-type semiconductor from a thermocouple. An array of these p and n-type semiconductors are connected thermally in parallel and electrically in series. When DC flows through the device, heat flow from one side of the junction to the other resulting in one side becoming cooler and the other side warmer. The heat sinks used in the process were high surface area commercial CPU heat sinks. The cold surface generated by the Peltier effect cools down humid atmospheric air resulting in the formation of clean drinkable water. (Amir Hossein Shourideh, Wael Bou Ajram, 2018)

2.2 Humidity Pattern in India

Surface humidity and temperature regulate the evaporation and transpiration process and are also connected to both the hydrological cycle. Humidity is a general term that indicates the amount of moisture in the atmosphere. The specific is the mass of water vapor contained within a unit mass of moist air which means the higher the amount of water vapor higher will be the specific humidity. Also, another commonly used term is relative humidity which means the ratio of the actual vapor pressure of the air to saturation vapor pressure at the same pressure and temperature. According to current results weather and science facts, the following data shows the humidity pattern across the country.

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Northern India

Place	State	%
Agra	Uttar Pradesh	56
Allahabad	Uttar Pradesh	59
Amritsar	Punjab	65
Indore	Madhya Pradesh	50
Ludhiana	Punjab	63
Mukteshwar	Uttarakhand	66
New Delhi	Delhi	54
Srinagar	Jammu and Kashmir	70

Eastern India

Place	State	%
Bhubaneshwar	Orissa (Odisha)	70
Cherrapunji	Meghalaya	81
Dibrugarh	Assam	79
Guwahati	Assam	77
Kolkata (Calcutta)	West Bengal	71

Southern India

Place	State	%
Bangalore	Karnataka	65
Chennai	Tamil Nadu	70
Hyderabad	Telangana	56
Minicoy	Lakshadweep	77
Pamban Island	Tamil Nadu	76
Port Blair	Andaman & Nicobar	79
Thiruvananthapuram	Kerala	78
Vishakhapatnam	Andhra Pradesh	72

Western India

Place	State	%
Ahmedabad	Gujarat	55
Kota	Rajasthan	44
Mumbai	Maharashtra	75
Nagpur	Maharashtra	53
Panaji	Goa	76
Pune	Maharashtra	59

This is a detailed list of annual relative humidity across different regions of India.

3.0 RESULTS AND CONCLUSION

India has an extraordinary range of climatic regions. From the reports, it is crystal clear that the climate in northern India is generally hotter than southern India whereas southern India and eastern India get more humid due to nearby coasts. The coastal belt of south India holds more than 1000kms. As a solution for the drinking water crisis, we can implement a plant in the coastal belt of south India and eastern India. This plant will be working by condensing air moisture on the evaporator surface of a conventional heat pump. Since southern coastal areas and eastern India have high ambient humidity, heat pumps can ensure continuous production of safe drinking water. This machine has all the components of a refrigeration system. In a cooling condensation type atmospheric water generator, a compressor will circulate a refrigerant through a condenser and the air

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surrounding it is cooled by an evaporator coil, which causes the air temperature to its dew point causing water to condensate. Thus formed water is then passed into a tank which holds them for the further purification process. This process is mainly passing the water through pre-carbon filters, post-carbon filters, reverse osmosis tanks, and ultraviolet tank filters. The purified water also reduces the high risks of viruses and bacterias. When installing such a plant in low humid areas excessive power will be spent to increase the humidity near to dewpoint condition. These plants in southern coastal areas and eastern India will increase the yield to compensate for the extra demand for water.

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