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ARTICLE

Experimented methods to moderate the impact of climate change in Auroville

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Abstract – The city of Auroville was founded in 1968 on the Coromandel Coast of South India. It has gone through exemplary landscape rejuvenation during the past decades. The once heavily eroded area has become a green biosphere. Conscious water management, reforestation, coastal protection, sustainable agriculture, a holistic urban plan and the use of alternative energy have been thoroughly researched and implemented in Auroville.

Recent natural disasters have highlighted that the rehabilitated landscape and the conscious town planning of Auroville can offer certain protection from the impact of climate change. Auroville and its bioregion have experienced several natural disasters. A tsunami hit the coast in 2004, Hurricane Thane struck in 2012, a flood occurred in 2015, and a severe drought occurred in 2017. Over the last two decades, sea level rise and the disappearance of the coastline have been significant, as well as the intrusion of the seawater into the groundwater. Throughout these events Auroville environment remained noticeably more safe and healthy than its surrounding bioregions. Decades of cooperative projects with the villages in the bioregion have enabled Auroville to quickly act after disasters, avoiding aggravated situations such as outbreaks of epidemics. The achievements of Auroville can be a good example for cities of the Coromandel Coast and around the world.

Keywords–climate change, sustainable landscaping, reforestation, TDEF, India climate prediction, Coromandel Coast

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Introduction

On February 28, 1968, Auroville was solemnly founded on a 20 km^2 area of the Coromandel Coast on Bengal Bay in South India. The inauguration ceremony was held in the presence of more than 5000 people, among them representatives from UNESCO and 149 countries (Fassbender, 2018).

The aspiration of Auroville was to become “the city the Earth needs”, where a new form of human unity could develop with a maximum number of 50.000 inhabitants. (Thomas and Thomas, 2013).

The heavily eroded area was difficult to live in, so the landscaping work of the pioneering years was essential for the construction of a city. After the first 2 decades of intensive land-rejuvenation, the number of Aurovilians gradually increased, and today, 2806 people from 54 countries living there (Residential Service, 2018).

Figure 1. The Urban Design of Auroville

The city area is designed in a galaxy shape. Copyright: Auroville Archives

Figures 2 and 3. Landscapes of Auroville in the past and the present

Roads of Auroville before and after the reforestation and landscape rehabilitation work. Copyrights: Auroville Outreach Media

The area is characterized by a tropical monsoon climate, where long dry periods are followed by sudden heavy rainfalls. From the slightly sloping area, the water runs towards the sea, shaping canyons on its way. Archaeological research has shown that the Auroville area has been densely populated since ancient times but wildlife and forests were relatively undisturbed. During colonial times, forests were seen merely as opportunities for harvesting, and only the Sacred Groves were spared, where people for generations protected the trees through religious restrictions. Over the last 200 years, the native vegetation of the area, Tropical Dry Evergreen Forest (TDEF), has been largely eradicated (Nagy, 2018). In the absence of groundcover, the rain has quickly removed the soil, leaving behind a heavily eroded landscape. The area of once rich forests had become a large barren plateau that turned into a swamp when it rained and into a reddish desert during the dry seasons. The pioneering years of Auroville mostly focused on landscape rehabilitation through reforestation and water management. As the number of inhabitants increased, a sustainable city evolved with integrated urban development, organic agriculture and alternative energy plants. The aim to create an area suitable for human life is accomplished; today Auroville is considered an ecological wonder with its luscious, green environment (auroville.org, 2016)

Several extreme weather events have occurred in Auroville and its bioregion, and it is striking to explore the differences in the impacts of these events between Auroville and the surrounding area. These differences suggest that the landscape transformation and applied methods of Auroville not only offer a sustainable lifestyle but also give a certain degree of protection against extreme weather events such as excess or lack of rain (Bindu, 2016, 2017).

Discussion

Prediction of Climate Impact on the Coromandel Coast of India

Since the beginning of the 21st century, climate change has accelerated spectacularly and the human economic problems caused by extreme meteorological events have intensified throughout the world (Bozo et al., 2010). These tendencies are expected to continue.

According to various climate impact studies, the Coromandel Coast is expected to become drier and hotter, with shorter and more intense rainfall during the monsoon season. As a result, both droughts and floods will occur more frequently. Sea level rise and volatile rainfall are changing the quality and quantity of groundwater resources. It is also likely that hurricanes will occur more often in the future. The continuous population growth and changing weather patterns are likely to pose great threats to energy security (Potsdam Institute, 2013). The poorest will be the most affected and will find themselves in dire health situations due to malnutrition, natural disasters and possible epidemics. Some detailed descriptions are in the following text.

Since the 1970s, a gradual increase in temperature and a lengthening of dry periods have been observed. By 2030, a temperature increase of approximate 0.5 °C is expected, while by the end of the century, a further 2-4 °C warming is predicted, causing dry periods to become hotter and drier, resulting in severe droughts (National Intelligence Council, 2009).

The rhythm of precipitation is changing, with summer rains becoming unpredictable and often lagging behind their normal pattern. The winter monsoon is becoming

shorter, while the total amount of rainfall is increasing. Changes in rainfall may increase the risk of landslides, sudden floods and other natural disasters (Potsdam Institute, 2013).

The overuse of freshwater resources is characteristic of all India, while little energy is expended on refilling the groundwater aquifers. The biggest water user is agriculture, as it is 60% irrigation-based; therefore, the success of plant production depends on the amount of freshwater resources. According to some estimates, approximately 15% of groundwater in India is already depleted (R. Suhag, 2016), and although future groundwater levels are difficult to predict, they are expected to continue to decline. Many parts of India experience water scarcity, and even without climate change it would be challenging to meet the future water demand. Urbanization, population growth, economic growth and the demand for agricultural and industrial water are likely to exacerbate the situation. The variability of monsoon precipitation will further increase water scarcity in some areas (National Intelligence Council, 2009).

Forecasts are uncertain about tropical storms (Figure 4), but it is likely that in the future, the strength and frequency of hurricanes and cyclones will increase (National Intelligence Council, 2009).

Satellite images show that sea level rise is ongoing (NIOT, 2012). Forecasts show that rising sea levels will continue or even accelerate in the future. The expected further increase is 0.35 m by the end of the century, and some coasts will become underwater. The rising sea level and the sinking groundwater level cause the intrusion of seawater, resulting in the salinization of the groundwater, making it brackish (study.com, 2018).

Srinkanthan studied the climate change impacts of a fishing village on the Coromandel Coast in 2013. He divided the climate changes into two subcategories: the above mentioned changes which can be statistically predicted he termed as predictable climate change, and the so called unpredictable climate changes such as the nature of wave, wind, and water current. He focussed his study on the latter, which he found had become more extreme in past decades, thus impacting the lives of the fishermen in the observed village immensely.

Food shortages can be expected partly due to population growth and a shift of agricultural orientation towards biofuel production. Seasonal water shortages, rising temperatures, and the penetration of seawater into the groundwater basin further endanger crop yields and food security. Increasing temperatures and changes in rainfall significantly impact the success of both rice and wheat production, so India may need to increasingly import these cereal staples. The incidence of droughts will have a major impact on agriculture, and yields are expected to fall significantly due to extreme heat starting in the 2040s (Potsdam Institute, 2013).

Figure 4. Auroville after Cyclone Thane

Cyclone Thane uprooted approximately 60% of the trees. Copyright: Zsolt Erdelyi

Energy scarcity is predicted because the increasing volatility and long-term decline of rainfall will challenge the productivity of hydro power plants, while limited water supply and increased temperatures represent significant risk factors for thermal power generation. Population growth and industrial development, however, are likely to require a great deal of energy in the future. A favourable change in India would be the spread of solar energy utilization. The Tamil Nadu government approved Solar Village Project of the Auroville Consulting Unit shows that government supports and promotes the solar energy movement (Auroville Today, 2015).

Climate change will have health consequences in India. Heat waves are likely to result in significant increases in death rates, and injuries caused by extreme weather events will also increase. Malnutrition and related health disorders will increase among poor people. Flooding creates favourable conditions for the emergence of certain epidemics. Cholera epidemics may occur regularly at coastal settlements due to the fact that cholera bacteria lives longer in seawater and the drinking water is becoming contaminated by seawater as the sea-level rises and the ground water level drops (National Intelligence Council, 2009).

Conflicts may rise as a result of social segregation, because people in poverty may find it increasingly difficult to provide safe livelihoods (Potsdam Institute, 2013).

Recent weather events in Auroville and its region

Recent weather events have affected Auroville and its bioregion, and it is striking to compare the different impacts caused by the same events between Auroville and it the neighbouring settlements.

Hurricane Thane hit the Auroville area on December 31st, 2011. In Auroville, the storm uprooted 60% of the trees in

some areas, and some Auroville foresters noted that the indigenous trees were less effected due to the fact that their roots penetrates vertically deep into the soil as oppose to the non indigenous varieties. While the roads were impassable for days, and most of the electric cables were damaged (Alan, 2012), households with solar systems in Auroville could continue functioning, whereas the neighbouring villages had no electricity and found it difficult to obtain basic life needs like safe drinking water (Electricity Department, Government of Puducherry, 2012).

According to Narayan, the 2015 winter monsoon brought the most rainfall in a hundred years to the state of Tamil Nadu. The floods killed more than 470 and displaced 1.8-2 million people in Tamil Nadu (2017). Other sources, like Wikipedia, mention an estimated 3-16 billion US$ worth of damages occurring only in Chennai, the capital of Tamil Nadu (2018). Narayan also writes that the Chennai Floods Examining Parliamentary Committee reported that one main reason that caused the catastrophe was the 'unplanned nature of urbanization itself that has rendered the city incapable of handling flood events' (2017). Auroville on the other hand just 140 kilometres from Chennai, escaped the floods which occurred along much of the Coromandel Coast due to the exceptionally long and rainy winter monsoon. In Auroville, the rainwater catchment system made it possible to safely divert the excess water and to use it to refill the underground water supplies and thus life could continue almost unaffected. In neighbouring villages the extreme rainfall caused significant damage to buildings, and the inadequate sewage and garbage treatment systems resulted in the threat of post flood epidemics. Thus, Auroville village workers sprayed EM (Effective Microorganism) on the areas and distributed treatment sachets to create clean drinking water (Auroville Today, 2016).

In 2017, a severe drought hit South India. Conflicts have occurred over water scarcity, and the agriculture has been so strongly affected that 144 farmers have committed suicide due to the depression caused by their financial loss (Waghmare, 2017). Meanwhile, in Auroville, the drought passed with smaller crop losses possibly due to decades of conscious water management and alternative agricultural methods (Bindu, 2017).

The giant waves of the Tsunami of 2004 reached the coast of Auroville, and since then the waves are noticeably higher during monsoon. Although the major cause of the local sea level rise is significantly related due to the Pondicherry Harbour (NIOT, 2012), the fact remains that sea-level is rising globally. The coast has been declining at an ever-increasing rate, and coastal settlements have been destroyed. The rise of the coastline endangers the safety and livelihoods of fishermen. Srikanthan's interesting case study of a fishing village on the coastline of Aurroville examined the traditions of fishermen. He found that the profession of fishermanship is a traditional knowledge based vocation, in which different fish occurred and different nets used each month; and these traditions are even shared in the village folksongs, proverbs and narratives. Srinkathan explains that since the Tsunami the fisherman's work has become unpredictable, as the fish, water currents, waves and winds no longer follow the old pattern (Srinkathan, 2013).

Another major problem is that salt water intrudes into aquifers if the groundwater level is very low, thus causing salinization of the groundwater. Although efforts were made in the past few years to reduce the effect of sea level rise, these programmes resulted in little success. Separate experiments were conducted and cooperation is needed whereby local fishing villages and the Tamil Nadu and Pondicherry States are actively involved together (NIOT, 2012). Unfortunately, such efforts are often lost in political battles. For decades, Auroville has worked to build good relationships and to initiate cooperation with local villages and national decision-making departments and ministries. An interesting experiment was carried out in 2007-2009 that included 18 villages in which combined efforts were made to protect the groundwater (Figure 5). Certain parts of this project have been successfully implemented, while others have failed due to tensions arising within the villages (Bonnet, 2007).

Figure 5. Sustainable groundwater restoration and management project at a neighboring fisherman's village

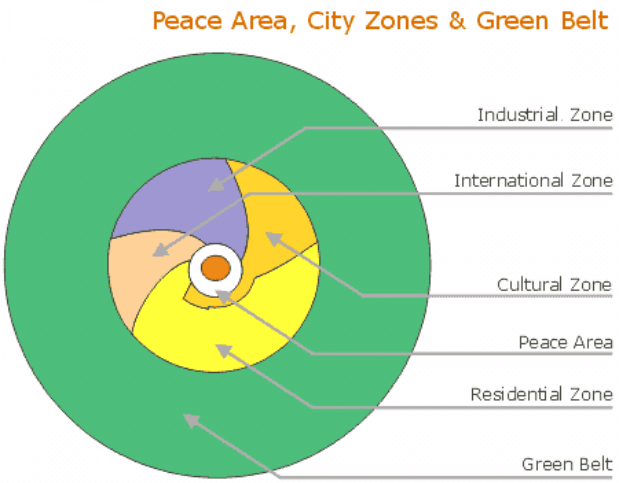
Auroville is ready to help the neighbouring villages with its resources and professional support as well as bringing global attention to the situation. Copyright: Auroville Village Action Group

Shared common sources and risks oblige Auroville to try to improve the lives of the local people in the 80 villages of the surrounding area through projects and education. In cases of natural disasters, Auroville acts quickly to support those villages to avoid epidemics. The Auroville Village Action Group (AVAG) assists village communities and organizations to strive towards sustainability and find integrated, practicable solutions to the pressing problems of contemporary village life (AVAG, 2003).

Auroville the Living Laboratory

Scientists have warned: mankind is on a path of self- and environmental destruction that can lead to disaster. Despite the warnings, we are sad to note that in the past decades the process has not reversed, stopped, or even slowed down. It has become clear that in order to achieve sustainability it is not enough to look at the impact of mankind on its environment, but also to investigate what encourages man to his future destruction and how to shape humanity's attitude.

Figure 6. The Zones of Auroville



The green belt around the city is planned to occupy at least 75% of the area. It ensures clean water, food, clean air and a healthy environment for the citizens of the inner area. Copyright: Tensi

The international city of Auroville was built to research and understand humanity and help its evolution. The philosophy behind Auroville is the Integral Yoga of Sri Aurobindo, which focuses on the evolutionary as well as the involutionary processes that manifest life on Earth and aspire to create unity in diversity (A.S. Lithman, 2003). Aurobindo's supporter Mirra Alfassa has created several laboratories for the Integral Yoga, with quite different conditions, Auroville is one of them. She prepared the charter of Auroville, as it is written bellow

The Auroville Charter:
1. Auroville belongs to nobody in particular. Auroville belongs to humanity as a whole. But, to live in Auroville, one must be a willing servitor of the Divine Consciousness.
2. Auroville will be the place for an unending education, a constant progress, and a youth that never ages.
3. Auroville wants to be the bridge between the past and the future. Taking advantage of all discoveries from without and from within, Auroville will boldly spring towards future realisations.
4. Auroville will be a site of material and spiritual research for a living embodiment of an actual human unity. (Alfassa, 1968)

In Auroville, a continuous experiment takes place in many areas to investigate the most urgent issues of humanity and earth. Thanks to the great international attention, the city enjoys the support of professionals, organizations, universities and governments.

According to Alfassa's guidelines, French architect Roger Anger divided the area into 6 zones and designed the structure of the settlement. The inner 5 zones form a galaxy shape and a 1.5 kilometre wide Green Belt surrounds it (Figure 6).

The centre part of Auroville is the Peace Area that hosts the Matrimandir (Temple of the Mother) and its gardens, and offers space for a quiet meditation and restoration (Figure 16). From this centre originate the roads and other zones of the residential activities.

The 189 acres Residential Zone with parks and various height buildings offer space for individual and community life. The area can be built up to 45% and is designed for at least 55% green (Thomas and Thomas, 2013).

The Cultural Zone is the centre of education and artistic expression. Here are the schools, concert halls, theaters and sports facilities.

The 109 acre Industrial Zone focuses on Auroville's self-sustainability and environmentally friendly development through the development of "green" industries.

The 74-acre International Zone is home to national and cultural pavilions and events by continent grouping (Fassbender, 2018).

Figure 7. Green surfaces of the city

The shade of the trees creates a pleasant microclimate for the cottage and its habitants. Copyright: Zsolt Erdelyi

The Green Belt is Auroville's lungs, which surround the inner areas and protect them as a buffer zone and create a unique microclimate. This zone is an area of organic farms and forests that create a living space for wildlife and provide food, herbs and timber for the inhabitants of Auroville. The area has gone through exemplary

landscape rehabilitation and has become a rich ecosystem. Further extension and proper management of new areas can ensure soil and water quality conservation and groundwater conservation. In the Green Belt a small group of Auroville farmers and foresters live, who only use the solar energy. Their work is done in cooperation and they call themselves Farm and Forest Group. (Nagy, 2018).

Some Auroville experiments that reduced the impact of climate change

Methods used in Auroville to counteract the effects of climate change are mainly local, but have the potential to indirectly result in global effects. When we investigate the ways in which the effects of climate change are reduced in Auroville, a complex, holistic system takes shape. In this system, man transforms the landscape and his interactions with it to best suit environmental conditions. The stressed water situation, which occasionally creates abundance and sometimes scarcity, can be remedied by a consciously developed system in which boulders, dams and lakes prevent both floods and drought. With the help of the green plant coverage such as forest, a hot environment can be converted into a pleasant microclimate. Certain agricultural methods can allow food production to continue under extreme weather conditions. Well designed building methods can create comfortable homes without air-conditioning, and energy security is sustainable through renewable energy. Auroville cannot exist separate from the 80 villages in its immediate vicinity, and must strive to cooperate with these villages as well as with state leaders. The basis of the AVAG's work is to identify old traditions and to recognize and respect local interests.

1. Reforestation

The success of reforestation in past decades has contributed substantially to the development of a pleasant microclimate and the refilling of groundwater aquifers. It has been estimated that there are approximately 5 million trees in Auroville today. In the beginning, fast-growing trees were planted that were mostly Acacia varieties imported from Australia. Later, the focus moved to indigenous trees, and plant propagating materials were collected from temple gardens and sacred groves where strict religious restrictions have preserved the trees for centuries. The young trees required thorny fenced protection and watering for the first 3-4 years. With the return and proliferation of the indigenous animal species, the forest became self-sustaining because the seeds are dispersed by the animals. Auroville's reforestation work accounts for 4% of the total area of TDEF in India (Land and Nature, 2017; auroville.org, 2017). According to the city plan, the urban area is to be surrounded by a wide green belt, which is mainly composed of forest. Presently only 25% of the green belt land is actually owned by Auroville, the remaining 75 % is yet to be bought. In the future, while the conservation of nature will continue, trees may also be utilized as building materials.

Figure 8. Rainwater catchment

Rainwater catchment ponds are created in a systemic way, and follow the surface level. Copyright: Kireet

2. Sustainable Water Management

Auroville lies on a slightly sloping plateau, and sudden rainfall tends to rush towards the sea. The goal of water management is to achieve zero rainwater runoff and to refill the underground water resources, thus creating water reserves and preventing flooding or erosion.

2.1. Rainwater catchment system of ponds, dams, bunds and canyons

The aim is to divert precipitation away from buildings and agricultural lands and to avoid the loss of water to the sea. The system collects the water in permeable water bodies, from which it slowly leaks into the soil and recharges groundwater resources. The system comprises ramparts, dams, natural canyons, and natural and artificial lakes and ponds. The development of this system needed time, energy and learning through trial and error. Occasionally, the inadequately constructed barriers suddenly broke, and the accumulated water caused damage to young trees and homes. From the failures of the first years, methods became more precise and well-developed, and today the system is resistant even to particularly heavy rainfalls. The dams in the canyons are staged, and the boulders and rainwater catchment ponds follow the natural contours and levels of the landscape. This system captures precipitation, gradually refilling groundwater resources and avoiding floods (Kireet, 2017). Kireet warns that although the ponds are sufficient now, new rainwater catchment tanks need to be added, whenever new buildings are erected (2018).

2.2. Wastewater treatment and reutilisation

Auroville has more than 60 types of sewage treatment systems in operation. They usually include a vortex vent,

Figure 9. Integrated waste water treatment plant

One of the many wastewater treatment systems used in Auroville. Copyright: Auroville Outreach Media

root zone cleaning, and sedimentation. The effluent is pure and odourless and can be stored or reused in the immediate vicinity of the buildings. The use of biodegradable cleaning agents such as soap nut extract or bamboo ash soaps and the use of Effective Microorganism (EM) make the grey water easily reusable. The use of dry compost toilets and vacuum flush toilets in private households significantly decrease water usage (CSR, 2005). There are efforts today to make a centralized waste water treatment plant at a compost field, from which the cleaned waste water would be used for the irrigation of Auroville landscapes. In those settlements where grey water is already reused for gardening and landscaping, only half as much water usage is measured as in those where such facilities are not available.

2.3. Collection of water from building surfaces

Rainwater from building surfaces is collected in underwater tanks. Some containers are completely covered, and there are also semi-open rainwater collecting tanks, where small fish are added to prevent the growth and spread of mosquitoes. In some experiments, the sloping tanks are filled with tiny stones or sand, and a pit is placed at the end for water collection. In other cases the water is diverted to the catchment ponds.

3. Integrated town planning and alternative building technologies

To create a pleasant, cool environment without the use of air conditioning, the buildings are carefully placed according to the direction of the sun and the characteristic wind direction. The locations of windows allow sufficient air circulation, so no further ventilation or air conditioning is needed. It is also important that the heavy monsoon rains stay out of the living area, which is why the roofs are much wider than the underlying buildings.

Green surfaces

Auroville's city plan focuses on green surfaces. Crippers on the building surfaces offer natural cooling as well as pleasing aesthetics. The plan for the Auroville town is to be surrounded by a 1.5-km wide green belt where woods and farms are located and where wildlife is ensured tranquillity. Large parks and forest lanes are also planned within the residential areas to ensure the free movement of animals. In the developed area, the green surface is required to be at least 50% of the area. The forest creates a healthy micro-climate for the city that is essential for the wellbeing of the inhabitants, especially due to the predicted temperature increase (TDC, 2017).

Use of alternative construction materials

Due to the tropical climate, not all natural building materials are suitable for Auroville. The Auroville Earth Institute produces rammed earth bricks with excellent heat isolation properties. This method uses the local earth with added 5% cement. Buildings made of this material are pleasantly cool, so no air conditioning is required (Figure 11).

4. Alternative energy resources

Today Auroville produces, from renewable sources, six times more energy than it uses. The recent trend is less use of batteries with excess electricity being directed into the grid system. Electricity is free in most households.

Figure 10. Solar Bowl

The Solar bowl is on the top of the community kitchen. Copyright: Auroville Outreach Media

4.1. Solar cooking

An interesting experiment is the "solar bowl" in the community kitchen which produces 1200 meals a day. It is a 15-meter-diameter concrete bowl on the kitchen roof, the inside of which is covered with 11.000 mirrors. The sunlight reflected off of the mirrors heats a water-filled steel tub, where steam is produced and the converted energy is used to cook the local organic vegetables (Akker and Lipp, 2004).

Figure 11. Auroville's Solar Kitchen

The solar kitchen and its dining hall were built of earth bricks. Copyright: Auroville Archives

There are several experiments regarding smaller solar cookers for homes, but they are not in everyday use.

4.2. Solar Energy

A local legend tells of the Aurovilian who brought the first solar panel to India in the early 1980s, saying that it had taken him several hours to get through the airport customs. Nowdays Auroville-based workshops and companies are well-developed, and they offer solar energy training and products both locally and throughout India. Aurovilians have developed devices such as solar street lamps and a solar water pump. A large solar power station is located in the Peace Area of Auroville, and it fully supplies the area with electricity. There are also several residential communities whose energy is supplied by smaller solar power plants or a combination of solar and wind power plants.

4.3. Biogas

The 1950s biogas model of India was further developed by the Auroville Centre for Scientific Research. This system incorporates prefabricated elements and can be assembled on site in one day. Small farms are ideal for biogas production, with a capacity of 2-4 m3 of biogas produced per day (CSR Auroville, 2014).

4.4. Wind energy

Auroville utilizes wind energy in several ways. AV55 is a windmill plan that was developed here and is used for pumping the wells. This water pump is still the most widely used pump in Auroville and the surrounding area.
Another significant wind energy experiment is the Varuna Project which has installed 3 wind power plants at a suitable location on the Bengal Coast, 500 km from Auroville. The produced energy flows into the Tamil Nadu Electricity Network, and so every private household and public institution in Auroville receives free electricity through the power grid. This free electricity encourages many Aurovilians to move from petrol based private vehicles to electric vehicles. Unfortunately a growing tendency of installing air conditioning machines into households, has also been observed.

5. Alternative agricultural methods

Various alternative agricultural methods and proper water management allow Auroville to produce food even in the most challenging weather conditions. Laying hens, dairy cows and work bullocks are kept and the cultivation of

Figure 12. Wind Energy

The AV55 windmill at work. Copyright: Auroville Outreach Media

various plants occurs on Auroville's 22 farms. Each farm is organic and utilizes only environmentally friendly products for pest and disease control such as Neem tree extracts or EM. There are ongoing studies and experiments in the field of food production, including

different types of permaculture and aquaponics systems. Below, I mention a few of the most successful practices.

5.1. Seed preservation

In Auroville's early years, indigenous plants were still grown in local villages. Today, the seeds from those plants are extremely rare. Aurovilians have collected and preserved the seeds of local cereals such as samai, kombhu, varagu and ragi and have consistently saved the seeds in private and community seed-banks. These crops produce smaller yields than rice, but they require less water, grow well during dry seasons and drought, and have excellent nutritional content.

Figure 13. Organic tomato varieties at the Auroville Botanical Garden

Copyright: Auroville Outreach Media

Garden vegetables have also been introduced since the 1990s. By collecting and replanting the seeds of imported vegetables and fruits, tasty and abundant new varieties have been developed that are adapted to the local conditions (Figure 13).

5.2. Irrigation methods

A combination of different irrigation methods is available for different crops. Rice is grown with flood irrigation during and after the monsoon season, while drought-resistant crops are planted for the dry season. Mulch-covered drip irrigation systems preserve the soil moisture in the vegetable gardens and orchards. In the Buddha Garden farm a computer calibrates and monitors the quantity of water used for each plant.

5.3. Spirulina farm

Figure 14. Buddha Garden vegetable bed

Mulching and drip irrigation is combined in the vegetable garden. Copyright: Auroville Outreach Media

The number of spirulina farms in Auroville is gradually increasing. Spirulina is a fresh water algae containing high concentration of micronutrients and is labeled as a superfood due to its extremely high nutritional value. In fact it is said, that spirulina is the food of the future, and NASA is experimenting with it as a basic source of nutrition for space travel. Spirulina farms require relatively little water and little space for the production and the plants grow well in brackish water. The predicted sea level rise may result in an increase in the popularity of this type of farm along the coasts (Aurospirul, 2017).

Figure 15. A Spirulina Farm in Auroville

Copyright: Aurospirul

5.4. Agroforestry

Experiments are underway in several Auroville forests to plant and propagate tree varieties that are suitable for food and biofuel production. Ayurvedic medicinal herbs are successfully grown in the forests and are used as nutritional supplements and medicines. Herbs are also used for the production of soaps, detergents, and environmentally friendly sprays for agricultural pest and disease control.

5.5. Vertical agriculture

As the trees grew, their shade made it possible to lengthen the production period and to grow vegetables and fruits for a longer portion of the year. In this concept of vertical horticulture, the heat-sensitive vegetable gardens are located so that only the morning sunlight reaches them, while during the afternoon they are protected by natural shade.

6. Awareness programs in the bioregion of Auroville

Established in 1988, the Auroville Village Action Group oversees and supports the rural development of 80 villages in the Auroville bioregion. Its aim is to lead the villages towards sustainability and to find integrated solutions to everyday difficulties. Cooperation is bilateral, the Aurovilians and village people learning from each other. The AVAG programmes offer clean drinking water, health care, hygiene solutions and sustainable energy. Training sessions are held to encourage the development of community-based decision-making systems and self-reliance within the villages, while improving the situation of women and Dalit (out of caste) people.

Assistance with disasters

Natural disasters have impacted the villages in Auroville's bioregion. A tsunami, Hurricane Thane and the 2015 flood are recent examples which highlight the lack of disaster management knowledge in the villages of this bioregion. Auroville is often the first to act and reach out, providing clean drinking water and spraying EM in wastewater-polluted areas to avoid epidemics. Auroville also assesses damage, raises funds and offers aid.

Conclusions

Over the past 50 years, Auroville has created an exemplary landscape restoration programme. The once desert plateau has become a lively, green environment. The original idea was to create an environment that would allow humans to settle in a city and work for the good of humanity. Recent climate change events have suggested that Auroville's methods help to minimize climate change impacts. Auroville's next task is to share its achievements with others. So far, several national and international programmes have taken place in India, Egypt, Kenya and Haiti. It is time now for town planners to observe the work done in this international experimental city South India, and to consciously incorporate its results into urban planning concepts.

Open access statement

Public interest statement

This Opinion paper is written to invite scientists for a discussion on the sustainable methods that moderates the impact of climate change.

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Figures 16 and 17. The change of the Auroville Landscape

The once heavily eroded land became a luscious forest with the Peace Area in its centre. Copyrights: Dominique Darr and Auroville Outreach Media

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