EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 8 | Issue: 2 | February 2021

LOCAL ACCEPTANCE AND ENVIRONMENTAL IMPACT OF DESALINATION PLANTS IN KERALA

Soorya Narayan
Research Associate, International Centre for Technological Innovations

Aaron Joseph George
Director, International Centre for Technological Innovations

----------ABSTRACT----------

Desalination is an alternative for water delivery that is commonly available globally and allows the salt to be removed from the water to be consumed. Many countries use desalination to create a more trustworthy alternative. Water that is not rain-dependent. Desalination offers an environmentally-friendly water supply for vital human needs and industrial growth (industry and agriculture in particular). This is an efficient means of safeguarding water sources against the impacts of climate change, a rising population, and drought. A survey was conducted among. According to a survey taken among people living in Cochin Ernakulam, Where a new desalination plant is being set up. The study reveals that people are ignorant of the effects of a desalination project on the environment. Desalination plants are considered an unreliable clean supply of water by the respondants and not toxic to marine life. Most citizens decided that the conservation of the environment is their main concern. In this context, our paper intends to present an overview of present environmental concerns of desalination, so that we can avoid some of the dangers of the environment caused by desalination. **----------**

1.0 INTRODUCTION

1.1 Desalination Plant: An overview.

Desalination is a water supply option that is used widely around the world and involves taking the salt out of the water to make it drinkable. Many countries use desalination as a way of creating a more reliable. water supply that is not dependant on rain. Desalination provides a climate-independent source of water for critical human needs and economic development (industry and agriculture in particular). It is an effective way to secure water supplies against the effects of climate change, a growing population, and drought. The cost of producing and reticulating desalinated water is a function of several factors, including plant capacity, process power use efficiency, energy source, proximity to source water and end-users, and project financing model. An enormous amount of energy is needed for the desalination process, which helps to overcome the problem of water scarcity. Currently, this energy is mainly derived from the combustion of fossil fuels, which are depleting day by day and are unsafe for the environment as they emit carbon dioxide (CO2), a greenhouse gas. By incorporating and exploiting various renewable energy (RE) sources, energy sustainability can be improved with current desalination technologies. In remote regions, a desalination system based on RE is the best option for desalination where the electricity supply is not stable. Various non-conventional energy sources, such as solar, wind, wave, and tidal energy, can be used to produce electrical energy for desalination power plants. Desalination using biomass and geothermal energy is still at the stage of development. Geothermal desalination requires less maintenance and output than the RO method. This is because, throughout the year, the temperature of the ground remains constant below a certain depth (Kalogirou SA et al., 2005). A plant that uses RO technology to burn fossil fuels produces 2.79 kg of CO2, 3.38 g of nitrogen oxides, 3.25 g of sulfur oxides, and 0.93 g of non-methane volatile organic compounds per m3 of water. However, a plant that uses wind energy as fuel produces 0.11 kg of CO2, 0.42 g of nitrogen oxides, 1.80–2 g of sulfur oxides, and 0.08–0.07 g of nonmethane volatile organic oxides. A plant that uses photovoltaic energy as a fuel produces 0.34–0.90 kg of CO2, 1–2.10 g of nitrogen oxides, 4.73–16.15 g of sulfur oxides, and 0.36–0.72 g of non-methane volatile organic compounds per m3 of water. A plant that uses hydro energy as fuel produces 0.082 kg of CO2, 0.24 g of nitrogen oxides, 1.68 g of sulfur oxides, and 0.05 g of non-methane volatile organic compounds per m3 of

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 8 | Issue: 2 | February 2021

water. In the future, the desalination industry will depend on renewable energy sources due to the limited and continuous depletion of fossil fuels and their associated negative environmental impacts (Raluy RG and Serra L,2005).

2.0 RESEARCH METHODOLOGIES

The survey was conducted among people living in Cochin Ernakulam, Where a new desalination plant is being set up, to know about the local acceptance of desalination plants and also about the environmental impacts caused by them. The survey was performed for three weeks from June 18, until July 9, 2020. The interviews were performed on a door-to-door basis. In total, 120 individuals were asked to participate in the survey. The questionnaire contained19 questions in four different main headings. In several questions, the respondents were asked to give their opinion on several statements. Overall, the questionnaire contained 28 items. The questions aimed to elicit overall environmental attitudes, opinions on desalination plants in general knowledge about renewable energy and water generation in general. Question 2 asked for the extent to which the local desalination plant is an item of discussion in the communities. Respondents were asked to indicate their opinions and beliefs on a five-point Likert scale, ranging from very negative/disadvantage/strongly disagree to very positive/advantage/strongly agree. Question 4 allowed respondents to state their attitudes towards the energy sources of desalination plants and also about their environmental concern

3.0 RESEARCH ANALYSIS

No.	Question/statement	Scale	Mean	Standard deviation
1.1	How knowledgeable do you consider yourself on renewable energy?	1. Not at all; 5. very	3.33	0.92
1.2	How knowledgeable do you consider yourself on desalination technique?	1. Not at all; 5. very	3.38	1.03
2	How often do you talk with your acquaintances about desalination plants?	1. Never; 5. frequently	3.00	0.83
3)	How much do you consider the following aspects of desalination technologies in general an advantage/ disadvantage?		2.30	0.72
3.1	Might create ecological disturbances	1. Disadvantage.; 5.. advantages		
3.3	Is a clean energy source	1.Disadvantages; 5.. advantages	4.90	0.36
3.4	Is a potential danger for aquatic organisms	1.Disadvantages; 5.. advantages	2.33	0.74
3.5	Is an unreliable clean source for water	1. Disadvantages; 5. advantages	2.40	0.75
3.6	Is an unlimited water source	1. Disadvantages; 5.. advantages	4.94	0.28
4)	How do you appraise the following aspects of the desalination plants in your community?		3.77	0.75
4.1	What is your opinion on the small scale desalination plants?	1. Negative; 5. positive		
4.2	How do you appraise its visual impact on oceans?	1. Negative; 5. positive	2.90	0.50
4.3	How do you appraise increased development desalination plants in your country	1. Negative; 5. positive	3.44	0.91
			3.79	1.59
4.5	The use of renewable energy for desalination purpose is a Positive development	1. Disagree; 5.agree	4.71	0.71
4.6	The planning of the desalination plant in my community was transparent	1. Disagree; 5.agree	4.41	1.23
4.7	I had ample opportunity to state my opinion	1. Disagree; 5.agree	3.98	1.58
4.8	Protecting the environment is one of my biggest concerns	1. Disagree; 5.agree	4.56	0.64
4.9	I am concerned about the high energy consumption	1. Disagree; 5.agree	3.92	1.15
4.10	The use of conventional fuels for running desalination plants are harmful to the environment	1. Disagree; 5.agree	4.33	1.07

Table 3.1 Survey Results.

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 8 | Issue: 2 | February 2021

The people who attended the survey know various renewable energy sources and about desalination techniques. They have a strong desire for the adaptation of a new method. 90% of the people who attended the survey have been talking about desalination plants to their acquaintances. From the survey, it is clear that the people are unaware of the environmental impacts created by a desalination plant. They consider desalination plants as an unreliable clean source for water and also not dangerous for the existence of aquatic organisms. Most of the people agreed to the fact that the protection of the environment is their primary concern. The people claimed that the usage of renewable energy sources for the operation of these desalination plants is accepted and also depicted that the use of conventional fuels for running desalination plants is harmful to the environment.

4.0 LITERATURE REVIEW

4.1 Environmental Impacts of Desalination Plants

1. Source water intake

Desalination plants may be loaded with the feed from multiple sources, but the most common alternative is the open intake of seawater. When they collide with intake screens (impingement) or are drawn into the plant with the sources of water, the open intakes can result in the loss of aquatic organisms. The design of the intake and pumping systems disrupt the seabed, which causes sediments, nutrients, and contaminants to be re-suspended in the water column. The systems may influence the exchange of water after installation and the by-products of sediment are usually washed with the concentrates into the sea. Negative environmental consequences may occur, especially where high waste-water discharges coincide with vulnerable ecosystems. The consequences on the marine ecosystem of a desalination plant are based on both the physicochemical properties of rejected streams and the hydrographic and biological characteristics of a receptive environment. Restricted and shallow transport sites function as artificial entity reefs or compete with routes of navigation or other marine applications. (S. Lattemann and T. Hoepner, 2003)

2. Salinity and temperature

The distributions of marine species that normally live in areas that provide favorable environmental conditions of the species are influenced by salinity and temperature. Most species can be modified to minor conditions. Differences in salinity and temperature and can also briefly withstand severe circumstances but not constantly subjected to adverse environments. The continuous drainage of high salinity and temperature reject streams can also be lethal for aquatic organisms and can cause an irreversible alteration in the structure and distribution of the organisms in the discharge site. The new conditions of the atmosphere will draw or repel aquatic species, which would inevitably prevail in the disposal area if they are more suited to the new situation. Because of their density, RO (Reverse Osmosis) and thermal plants are refusing streams in numerous areas of the sea. A higher density of RO plants than seawater will scatter across the floor, in deeper coastal water, until the diffuser system dissipates it. As a result of high salinity and chemical residues, benthic ecosystems, such as seagrass beds, can be disturbed. In comparison, distilling plant discharges are usually favorable or neutral in conjunction with cooling waters of power plants and impact open-water species. . (S. Lattemann and T. Hoepner, 2003)

3. Antiscalants

In both thermal and RO plants, anti-scaling agents are applied to feedwater to stop the creation of scale. Polymeric compounds, in particular polycarbonic acids and phosphonates, have various chemical structures. Sulfuric acid and polyphosphates are often used to avoid the forming of scales but on a small scale. Both anti-scaling agents have relatively little toxicity for marine organisms. Eutrophication problems in the Gulf near desalination plant outlets where polyphosphates were used were found, so polyphosphates were readily hydrolyzed into orthophosphates, a key nutrient for primary farmers. In comparison, polycarbonic acids and phosphonates are durable compounds that have a low biodegradation rate, which ensures that coastal waters stay relatively long. These compounds can also affect the natural processes of these and other divalent metals in the aquatic ecosystem by dispersing and complexing calcium and magnesium ion in the desalination plant.(Karen Petersen and Adina Paytan, 2018)

4. Coagulants (RO plants)

Infeed water for coagulation and media filtration of suspended materials coagulants (such as ferric III chloride) and coagulant aids (such as high molecular organic agents such as polyacrylamide) are added. Medium filters are intermittently backwashed, and the backwash water containing the suspended substance and coagulants usually untreated into the sea. There is very little toxicity of the chemicals themselves. Their discharge can nevertheless induce extreme coloration of the discharge stream if ferric salts are used, which may enhance turbidity and minimize light pull or can bury sessile benthic species at the discharge site. (Juli K. Morris and William R. Knocke, 1984)

EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2021): 7.743 ISSN: 2348 – 814X
Volume: 8 | Issue: 2 | February 2021

5. Cleaning chemicals

The method of cleaning depends on the fouling type. Alkaline solutions (pH 11–12) are used in RO plants to clear silt particles and biofilms from membranes when in the dissolving of metal oxides or scales, acidic solutions (pH 2–3) are being applied. The remedies also require additional chemical compounds such as detergent (e.g. de-cylsulfate, dodecylbenzene sulfonate) or oxidants to enhance the cleaning process (e.g. sodium perborate, sodium hypochlorite). Usually, membranes are disinfected after washing or before storage. To this end, biocidal oxidants (such as chlorine and hydros peroxides) may be added, as well as biocides that have no oxidation (such as formaldehyde, glutaraldehyde, or isothiazole). These chemicals are normally washed with hot acid marine water to remove alkaline scales from surfaces of heat exchanger containing corrosion inhibitors (e.g. benzotriazole derivates). If discharged to surface water without any care, the cleaning solutions, particularly their supplements can destroy aquatic life.(S. Lattemann and T. Hoepner 2003)

6. Antifoaming agents (thermal plants)

Antifoaming agents such as polyethylene and polypropylene glycol can be applied to feed water to minimize moisture in thermal plants. Polyglycols are not toxic but can be very persistent because of low degradability in the atmosphere. (Harun Elcik and Luca Fortunato, 2020)

5.0 CONCLUSION AND DISCUSSIONS

Various renewable energy sources and desalination methods are known to participants in the research. They strongly want a modern approach to be adapted for pure water generation. 90% of the people who participated in the study spoke to their networks of desalination plants. The study reveals that people are ignorant of the effects of a desalination project on the environment. Desalination plants are considered an unreliable clean supply of water and not toxic to marine life. Most citizens have accepted that the main priority is environmental conservation. The people believed that green energy sources had been approved for the operation of these desalination plants and that fossil fuels had been used for the operation of desalination plants. From the survey, it is clear that the people are less aware of the environmental impacts created by desalination plants. There are consequences on the marine ecosystem of a desalination plant that is based on the physicochemical properties of rejected streams. . Differences in salinity and temperature cause a threat to marine organisms. The anti-scaling agents that are applied to feedwater to stop the creation of scale have relatively little toxicity for marine organisms. Coagulants used by the desalination plants have toxicity to marine organisms. Various oxidants and alkalines are used as cleaning chemicals for These chemicals are normally washed with hot acid marine water to remove alkaline scales from surfaces of heat exchanger containing corrosion inhibitors. If discharged to surface water without any care, the cleaning solutions, particularly their supplements can destroy aquatic life. The government and concerned authorities must take sufficient efforts to create awareness about desalination plants and their operation among common people.

6.0 REFERENCES

1. *Kalogirou SA. Seawater desalination using renewable energy sources. Prog Energy Combust Sci 2005;31:242–81.*
2. *http://dx.doi.org/10.1016/j.pecs.2005.03.001.*
3. *Raluy RG, Serra L, Uche J. Life cycle assessment of desalination technologies integrated with renewable energies. Desalination 2005;183:81–*
4. *93*
5. *Sabine Lattemann and Th. Höpner, 2008, Environmental impact and impact assessment of seawater desalination*
6. *S. Lattemann and T. Hoepner, Seawater Desalination — Impacts of Brine and Chemical Discharges on the Marine Environment, Desalination Publications, L'Aquila, Italy, 2003, p. 142.*
7. *Th. Höpner and S. Lattemann, Chemical impacts from seawater desalination plants — a case study of the northern Red Sea, Desalination, 152 (2002) 133–140.*
8. *A. Shams El Din, R. Arain and A. Hammoud, On the chlorination of seawater, Desalination, 129 (2000) 53–62.*
9. *Juli K. Morris William R. Knocke, 1984, Temperature Effects on the Use of Metal-Ion Coagulants for Water Treatment*
10. *Karen Petersen and Adina Paytan, 2018, Impact of brine and antiscalants on reef-building corals in the Gulf of Aqaba – Potential effects from desalination plants*
11. *Harun Elcik and Luca Fortunato, 2020, Multi-effect distillation brine treatment by membrane distillation: Effect of antiscalant and antifoaming agents on membrane performance and scaling control*