

The Salton Sea: A Case of a Dying Lake

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Abstract

The Salton Sea is an inland saline lake in Arizona. The lake was formed by an irrigation canal accident in 1905. Since then, the lake has deteriorated owing to agricultural chemical build up, increasing salinity, and mass water loss. Various issues stem from the lake's shrinkage such as potential public health risks, increased dust emissions, and wildlife loss. As such, saving the Salton Sea is beneficial. I support my argument by correlating the lake's shrinkage to increasing asthma rates and a decrease in regional air quality. Additionally, I demonstrate the dependence of bird species on the lake. I also consider counter claims suggesting that the location of the Salton Sea is incompatible. Furthermore, I address the cost concern by analyzing the expenses of restoration plans to show that prices decrease in the long run. I conclude my paper by recommending alternative water transfer proposals and calling for more awareness.

Keywords: Salton Sea, Californian desert basin, dust emissions, chemical exposure, asthma rates, migratory stopover

The Salton Sea: The Case of a Dying Lake

In this paper, I argue that saving the Salton Sea is critical. The Salton Sea is a saline inland lake first created by a poorly designed irrigation system in the south of Yuma, Arizona (DesertUSA.com, n.d.). Initially, the Salton Sea served as a tourist spot with added marine life for fishing activity. This thriving marine life later attracted migrating birds, making the lake one of their main migratory stopovers. However, over time, the salinity of the water drastically increased owing to agricultural runoff and decreased fresh water inflows. This change in water quality and quantity caused several fish species to die and affected the surrounding environment negatively (Kjelland & Swannack, 2018; Lyons et al., 2018). As such, the neighboring region, the Imperial Valley, is at risk as the lake's state worsens.

The Salton Sea is within the parameters of the Imperial Valley region. The Imperial Valley is a rural region with high agricultural activity directly supported by the Colorado River. The only water inflow source for the Salton Sea is irrigation runoff from the neighboring Imperial Valley agricultural lands (Deode & DeGuzman, 2020). The majority of the population of the Imperial Valley consists of Mexican-American communities with 21.4% below the poverty line. Additionally, medical reports of the Imperial Valley residents show substantially high asthma rates in children. Indeed, the shrinkage of the lake will likely worsen the public health of the residents (Juturu, 2021). Moreover, the Salton Sea's neighboring residents are already vulnerable to economic and health issues. Therefore, any harm stemming from the lake's shrinkage will affect them more severely. As such, stopping the shrinkage of the lake is crucial.

I support my position on saving the Salton Sea with the following three arguments. First, the shrinkage of the sea will expose the lakebed, which contains harmful materials. According to Doede and DeGuzman (2020), the lakebed of the Salton Sea contains accumulated amounts of pesticides, herbicides, DDT, and toxaphene. With mass water loss, the lakebed is exposed and the chemicals can spread to the neighboring residents. Second, the shrinkage of the Salton Sea will contribute to lower regional air quality. With an expected

38% exposure of the Salton lakebed by 2030, an increase in dust emissions is projected (Parajuli & Zender, 2018). Third, the Salton Sea has become an important habitat for migratory birds. According to Lyons et al. (2018), the sea is an important migratory stopover for the Caspian Terns as they visit prior and pre breeding migration.

I also consider alternative positions such as the cost of restoration of the lake. Additionally, I consider critics' perspective on the location of the lake being incompatible as it is in an arid climate with no natural source of water inflow. Moreover, mass water loss owing to the high temperatures will always occur, and so restoration will be relatively hard. While these positions have merit, I refute them by, for example, suggesting that the future ecological and health losses are greater than current restoration expenses (Deode & DeGuzman, 2020). While the location of the saline lake is certainly problematic, the existing alternative plans for the restoration of the Salton Sea still provide ways to reduce the limitations of the location (Levers et al., 2020).

This paper is of interest because the Salton Sea heavily affects the wellbeing of its surrounding region. The saline lake holds ecological value, while significantly affecting the health of the neighboring residents. Although the importance of restoring the lake is often debatable, it is likely that further ecological and health deterioration will occur if no action is taken.

Brief History and Background Information

The Salton Sea is an inland lake, filling the Salton Basin, created by an irrigation breach. Although the Salton Sea is relatively new, the Salton basin was home to various lakes during prehistoric times. According to Aschmann (1959), the basin would continuously fill and dry up as a result of Colorado River floods creating various lakes that were often bigger than the current Salton Sea. However, unlike prior lakes, the feeding source for the Salton Sea is irrigation runoff. As such, the water feed includes chemicals and harmful substances that accumulated over the years. This accumulation of chemicals makes the shrinkage of the lake a critical matter.

The Salton Sea has an influential topography. Topography is the study of a region's landmarks and foundations. A topographic mapping system usually includes contour lines that indicate the elevations within a specific region ("*What is topography?*", 2021). In the case of the Imperial Valley region, the Salton Sea is the lowest point with its deepest point at 71 meters below sea level. Additionally, the Salton Sea has a total surface area of about 343 km² making it the largest water body in the region (Salton Sea Authority, n.d.). The Imperial tract has similar elevations to the Salton Sea ("Salton Sea topographic map," n.d.). As such, any projected changes in the lake will directly affect the neighboring cities since they both share similar elevations and the Salton Sea has a considerably large surface area.

The Imperial Valley Region

The Imperial Valley region mainly consists of agricultural lands. It has several cities; however, the highest populated city is El Centro, which is the largest populated city with the lowest elevation in the United States ("*U.S Census Bureau,*" n.d.). According to Deode and DeGuzman (2020), agricultural activity of the valley has been supported by the Colorado River, with an increase in the agricultural activity after a particular wet year. The authors add that the seemingly endless water supply from the Colorado River encouraged farmers to invest in water inefficient crops relative to the geographic location. To elaborate, water intensive crops were farmed in a dry climate, which required large masses of irrigation.

The unsustainable water use of the Imperial Valley is still an ongoing issue. Water inefficient crops are grown using unsustainable irrigation methods, which put more strain on the amount available for the neighboring counties. Deode and DeGuzman (2020) note that government incentives promoting sustainable water use were almost unattainable because of the already thriving agricultural industry owing to flood irrigation methods used by farmers. Further reasons why sustainable water use regulations are difficult to implement include legal reasons.

Important Legal Background

Water agreements and general water use laws are important to be aware of in the case of the Salton Sea. First, water prices of the Colorado River are relatively low. According to Deode and DeGuzman (2020), as of 1922 the price for a gallon stands at \$0.20, which is fairly cheap. This price encouraged farmers to use more water without considering sustainable irrigation methods. Additionally, the authors suggest that the government was unable to hold sustainable water incentives because of the “political chokehold held by local farming lobbies on the government's sustainability efforts” (Deode & DeGuzman, 2020, para. 19). Indeed, this political situation implies that government efforts and regulations would be impossible to implement as the river waters were inherently the farmers’ ‘birthrights.’

An important agreement that directly affected the Salton Sea is the Quantification Settlement Agreement (QSA). Signed in 2003, the QSA is considered the largest agricultural to urban water transfer in the history of the United States (*Quantification settlement agreement*, n.d.). According to the agreement, the Imperial irrigation use will be constricted to 3.1 million acre-feet annually, which is considerably lower than the previous allowance of 4.4 million acre-feet. The agreement also established over 100,000 water transfers to both the Coachella Valley district and Metropolitan. Post the Quantification Settlement Agreement, fresh water inflow from the Colorado River to the Salton Sea became almost none, meaning that the only remaining source of water inflow was irrigation runoff. This decrease in freshwater inflow ensured future mass water loss.

Potential Public Health Complications

The Salton Sea contains large amounts of harmful chemicals accumulated on its lake bed. The agricultural activity in the lands surrounding the Salton Sea meant that agricultural use chemicals will contaminate irrigation runoff. Additionally, the main feeding source of the Salton Sea is irrigation runoff as a result of the Quantification Settlement Agreement (*Quantification settlement agreement*, n.d.). With the shrinkage of the waters already in progress, the accumulated chemicals are exposed and likely to spread to the surrounding residents.

A study by Deode and DeGuzman (2020) focused on the effects of exposure to large quantities of agricultural-use chemicals on the public health. The authors mention that exposure to large amounts of agricultural-use chemicals such as toxaphene, DDT, and pesticides will potentially result in relatively higher rates of cancer, hepatic and renal diseases, pregnancy complications, infant mortality, and respiratory diseases. This expectation is drawn from a similar case to the Salton Sea, the Aral Sea, in which the water almost completely dried up. In the case of the Aral Sea, the neighboring residents were fully exposed to the agricultural-use chemicals after the complete shrinkage of the lake. Medical reports of the neighboring residents documented the previously mentioned health effects. Since both terminal lakes considered are almost parallel cases, the same health hazards are expected to occur with an increased exposure of the Salton Sea's lakebed.

In addition to the potential health risks of lakebed exposure, the aerosol emissions of the Salton Sea are potentially harmful. In order to understand the full extent of the harmful health effects of the Salton Sea, a study by Biddle et al. (2021) was conducted on the aerosol emissions of the lake. Biddle et al. collected a sample from the Salton waters and filtered out the solid components to focus solely on the aerosols. The samples were exposed to mice and the results revealed that the Salton Sea's sprays can cause serious progression in asthma cases and other respiratory complications. The study also suggests that these medical complications are because of the soluble chemicals such as heavy metals and DDT present in the waters. As such, both the lake bed and the aerosols of the Salton Sea can cause potential health hazards.

The Salton Sea and the Regional Air Quality

The shrinkage of the Salton Sea will likely result in adverse deterioration in the air quality of the Salton region. As the lake shrinks, more lakebed is exposed meaning that dust and other chemicals are likely to spread. This spread of substances can occur through wind emissions, reaching residential areas (Parajuli & Zender, 2018). Furthermore, these dust and chemical emissions increase the particulate matter of the air. Particulate matter refers to solid or liquid particles found in air. Additionally, particulate matter is an effective way to

determine air purity, with a lower particulate matter indicating higher air quality (Environmental Protection Agency, n.d.). As the particulate matter of the Salton region's air increases, the regional air quality will likely decrease.

Dust emissions are expected to increase in the future. A study conducted by Parajuli and Zender (2018) expected an 11% increase in the particulate matter. This increase is owing to a 38% exposure of Salton Sea's lakebed expected to occur by the year 2030. Additionally, the study expected an increase in the exposed lakebed emissions from the southeastern side relative to the southwestern side of the saline lake. According to the geographic mapping of the region, the results expect a direct impact on Calipatria, though the entire Imperial Valley region will be affected. This expectation is rather concerning as the affected region has economically struggling residents.

General Assessment of the Salton Sea Residents

The Imperial Valley Regional is mainly known for its agricultural, retail, and wholesale industries. The population of Imperial County mainly consists of Mexican-Americans with relatively high rates of poverty and unemployment (Johnston et al., 2019). Furthermore, about 21.4% of that population is living below the poverty line, which already creates economic stress (Juturo, 2021). With the deteriorating state of the Salton Sea, further public health complication will severely affect the population.

The Imperial Valley residents already have high asthma rates. According to Johnston et al. (2020), Imperial County's population contains one in five asthma patients. Additionally, Johnston et al. state that emergency paediatric asthma cases reported in Imperial County are about three times the number recorded elsewhere in California. Furthermore, the shrinkage of the Salton Sea is expected to increase the severity of the asthma conditions. This expectation is based on evidence supporting a potential decrease in the regional air qualities and showcasing the allergic properties of Salton sprays. As such, the public health of the Salton Sea residents is expected to worsen if no actions were taken.

Assessing the availability of health services to Salton Sea residents is important. In order to properly assess the extent of damage the shrinkage of the Salton Sea has on the neighboring residents, determining the feasibility of accessing emergency health centers when needed should be evaluated. A study by Juturo (2021) assessed the spatial access to emergency health centers such as transport routes and geographic barriers. The study found that the average travel time to reach an emergency healthcare facility from the Salton Sea region was about 14 to 20 minutes longer on average with respect to other Imperial County tracts. As a result, it was concluded that the individual cost for accessing emergency healthcare centers for asthma patients of the Salton Sea region is higher. This finding is concerning as the shrinkage of the Salton Sea will not only affect the residents' public health, but they will also be unable to afford recovery costs because of their economic status.

The Salton Sea's Ecology

The Salton Sea developed its own ecology. The lake is home to various avian species, one fish species, and various invertebrate species. According to Kjelland and Swannack (2018), there were other fish species present in the lake. However, the increasing salinity levels caused every fish species, excluding the Tilapia, to die. The authors also note that the present marine life supports many of the visiting bird species. Though, Tilapia, the only remaining fish species, are expected to disappear from the lake in 12 to 15 years. Additionally, the invertebrate species population will significantly decrease by the year 2077 as the salinity levels would be intolerable. To elaborate, the remaining fish and invertebrate species are expected to disappear in the near future owing to the continually increasing salinity levels. This loss of species suggests a potential decrease in both fish eating and invertebrate eating bird species.

In addition to the Salton Sea being a habitat to the Tilapia and various invertebrate species, the Caspian terns are highly dependent on the Salton Sea. According to Lyons et al. (2018), the Salton Sea is an important migratory stopover for the Caspian Terns. The sea is a convenient stopover for the birds as it is in the middle of their migratory routes. Additionally,

the authors note that the Caspian Terns stop by the saline lake prior and post their migratory breeding seasons. As such, the authors hypothesized that the presence of the Salton Sea as a migratory stopover offered relatively more opportunities. These opportunities occur as the lake allows the birds to recover robust nutritional states rapidly following breeding seasons. This hypothesis also suggests that the presence of the lake has a positive effect on the population dynamics of the Caspian Terns. Furthermore, it is important to note that since the Caspian Terns are dependent on the lake, the lake's state matter. To elaborate, Lyons et al. note that poor conditions of a migratory stopover directly constrain the activities of the bird population. As such, the deteriorating state of the lake has a negative effect on the Caspian Tern population.

Oppositions to Saving the Salton Sea

Some critics argue that the restoration expenses of the Salton Sea are expensive. According to Hayden (2016), the price for the state's restoration program was estimated to be more than three billion dollars as of 2016. Additionally, Hayden notes that various fundraisers offered aiding money. However, the amount provided was far less than the amount required. Although the cost concern is valid, Levers et al. (2020) note that the estimated health care expenses directly relating to the shrinkage of the lake amount up to 37 billion dollars. If both the estimated restoration expenses and future health care expenses were compared, future health care costs are about 12 times more than estimated restoration expenses. As such, saving the Salton Sea is relatively cheaper in the long run.

The Salton Sea's location

Critics also note that the location of the lake is incompatible. The Salton Sea is located in the California desert (DesertUSA.com, n.d.). As such, the climate is a hot desert climate and so mass water evaporation will occur. This mass evaporation is a cause of concern as the lake has no natural source of water inflow (Deode & DeGuzman, 2020). This position holds merit as the location of the lake is rather problematic; however, some restoration plans have been proposed with different costs and methods. As such, there are

various options to choose from that can decrease the location's limitation. Some of these plans include water transfer plans.

Some water transfer proposals were suggested to stop the shrinkage of the Salton Sea. According to Levers et al. (2020), some of the proposed water transfer plans include ocean water transfers and agriculture-to-environment water transfers. Levers et al. mainly assess the costs of both water transfer options. For the ocean water transfer option, the authors found that it would be relatively cheaper to transfer water from the Cortés Sea than from the Pacific Ocean. This water transfer, however, will need international agreements as it involves crossing international borders. As for the agriculture-to-environment water transfer option, leasing agricultural water from nearby farmers was found to be the cheapest and most efficient way. When compared to one another, the ocean water transfer option is cheaper though it will require more time and the environmental impacts on the Cortés Sea should be accounted for. Although the Agriculture-to-environment water transfer plan is more expensive, it is a better short run solution since it requires less time and infrastructural efforts.

Conclusion

The Salton Sea is an important water body that has deteriorated since the 1990s. It is important to address the mass water loss of the lake in order to prevent potential public health hazards, great ecological loss, and chemical storms sprawling the surrounding areas. Although the issue has gained traction within the scientific community, not enough public attention is given to the problem and so it loses its sense of urgency. As such, acknowledging the seriousness and urgency of the situation is vital in order to find an effective solution. Additionally, saving the Salton Sea is beneficial to the surrounding residents, the region's ecology, and overall wellbeing of the region.

Saving the Salton Sea is crucial for various reasons. These reasons include preventing potential public health problems, maintaining the regional air quality, and conserving the local ecology. However, alternative positions suggest that the restoration of the sea is not plausible as it is rather expensive. Furthermore, some critics argue that the location of the

lake is great limitation. While these positions have merit, they do not consider the future expenses from ecological loss and health treatments, which are respectively more than the restoration expenses. Additionally, various conservation plans were suggested that can decrease the liability of the lake's location. As such, the saving the Salton Sea is advantageous.

Immediate action is required in order to prevent further destruction and damage. One proposed solution that would be particularly useful in short term would be water transfers. This solution will fill the Salton Basin and prevent further lakebed exposure. Although this proposal will not help with the increased salinity levels, it is enough to prevent dust storms and resident exposure to agricultural chemicals. However, it is important to note that water transfers alone are not enough for an effective restoration of the lake. They should be accompanied with water treatments to solve the issue of increasing salinity levels. Although there are few water treatment strategies, chemical engineers and specialists will have to conduct further research to find an efficient water treatment plan with the most suitable economic aspect. As such, saving the Salton Sea should be one of our priorities though further research is needed.

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