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Tracking the damages of the Shaheen cyclone in the Sultanate of Oman

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ABSTRACT

The Sultanate of Oman is in the south-eastern part of the Persian Gulf. Oman's coast causes Oman to be exposed to tropical cyclones occasionally. The damages occur when hurricanes reach the land, but some hurricanes dissipate in the sea without any noticeable harm. Generally, these strong storms hit Oman every 3 or 4 years between June and October, and it is mostly in the southern part of the Sultanate. One of these cyclones was Gonu on June 1, 2007, which caused 50 deaths in total and the damaged areas cost around $4.2 billion (2007 US dollars). This paper reviews and tracks the tropical cyclone Shaheen, which hit the Omani coast on October 2, 2021. We have used the hydrological data of previous cyclones to state the level of damage the cyclone caused. As expected, the cyclone caused a lot of human and material losses in a very short period due to the inadequate flood drain systems in Al-Khaboura city. Results showed the necessity of a proper stormwater drainage system to be installed in the northern cities of Oman. These effects were followed by a 2-day holiday for both government and private sectors for the sake of people's safety.

Key words: cyclone, damages, flood, Oman, review, Shaheen

HIGHLIGHTS

- Shaheen cyclone is one of the special cyclones that happened in Oman.
- The risks that happened are so rare.
- The collected data are clear and very precise.
- The reading of this article is enough to get the cyclone documented.
- Studying this type of cyclone can save humans from the next cyclones by proposing different structures for protection.

INTRODUCTION

On September 24, researchers in Bengal noticed that there was a low-pressure area in the Gulf of Martaban, soon after that, they promoted that the drop in the atmospheric pressure became a tropical cyclone with a wind speed of 188–63 km/h (Henson & Masters 2021). The hurricane was formed due to the difference in the atmospheric pressure between an area with low pressure causing the center of the hurricane, and areas with high pressure bordering it making the wind run in circles. With continuous low pressure and high surface water temperature, the hurricane kept being fueled with energy.

As shown in Figure 1, the cyclone took its path from Bengal passing India, and reached the Omani coast on Saturday, October 2, making the competent authorities issue many alerts to avoid human losses as much as possible. The first alert was made on Friday, they classified the situation as a tropical cyclone with a possibility of it being a first-class tropical cyclone and expecting its effects to start showing on Sunday, October 3 (Ather newspaper 2021). At 9:30 pm on the same day, the relevant authorities scheduled a meeting to study the development and related decisions. On Saturday morning, the center of the cyclone was 500 km away from Muscat, with a continuous flow of clouds on parts of the Omani coast. At 11:00 pm on the same day, the hurricane was only 330 km away from the coast of Oman.

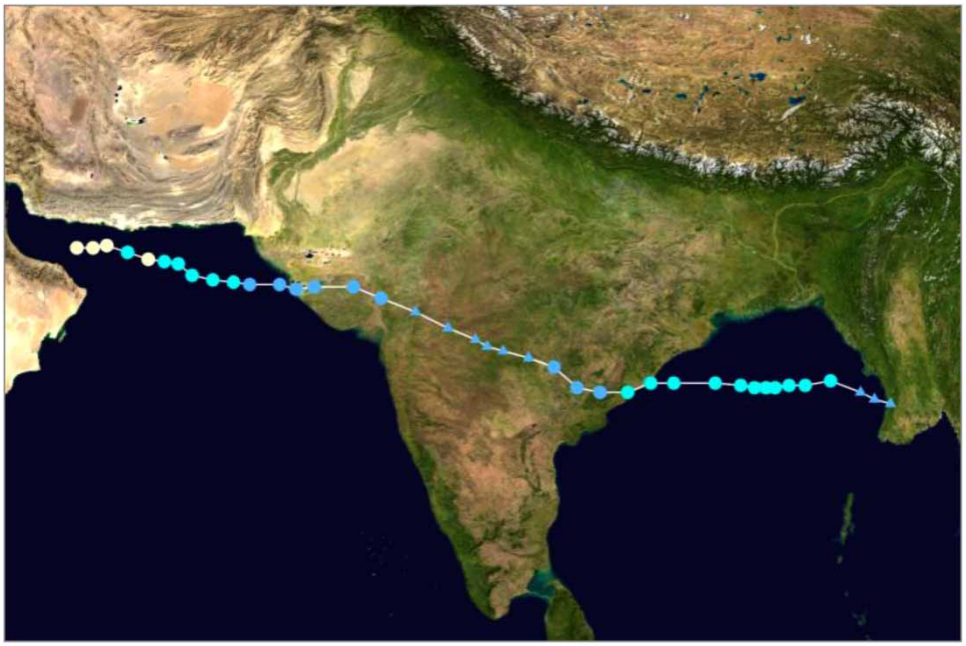

Figure 1 | Satellite image on September 24, 2021, of the Shaheen cyclone and its track reaching the Arabian Sea (Hafez 2021).

On Sunday, October 3 at 8:30 pm, the center of the tropical storm crossed between Al-Masanah and Al-Suwaiq with a wind speed of 102–116 km/h, it had direct effects with heavy rain and high-speed wind on most areas of the north and south Al-Batinah governorate (Hafez 2021). On Monday morning at 7:00 am, following the last issued alert, Meteorology announced that the tropical storm was concentrated in the Al-Dhahirah governorate.

On Monday at 2:00 pm, Omani Meteorology announced that the tropical cyclone (Shaheen) has ended finally in Al-Dhahirah near the borders of Saudi Arabia. Following the statement, Meteorology showed a picture of the concentration in the governorate. It issued that there would be a spread of clouds in the northern parts of the Sultanate and variable chances of heavy rain.

Figure 2 shows different satellite images of the Shaheen cyclone from the beginning to the end. These images are divided into the following stages. Stage 1 shows the cyclone entering the border of Oman. Stage 2 shows the cyclone entering with a low effect on the south Al-Batinah region and Muscat. Stage 3 shows the deep entrance of the cyclone with strong damage in the north and south Al-Batinah regions. In the final stage, the effect becomes very low with high rainfall.

HYDROLOGICAL DATA

On Sunday night, cyclone Shaheen made landfall in north-eastern Oman for the first time in more than 130 years. According to the BBC (2021), the storm caused flooding and high gusts and was responsible for at least 13 deaths as of Monday. Shaheen made landfall in Oman in Al-Khaburah and had a 3-min average sustained wind speed of 102 km/h at the time of impact. This caused high amounts of rainfall in all the northern parts of the Sultanate of Oman.

The average amount of rainfall fell all over some of the northern portions of Oman and was recorded as 75–150 mm (Gilbert 2021). This high amount of rainfall in less than 48 h caused flash flooding after the dry areas were quickly overwhelmed. The overflow covered the city partially and made noticeable damage to the infrastructure. What caused the overflow was that the soil underneath it became fully saturated in the first hours of the rainfall and most of the land is impermeable and the water could not infiltrate to go into the groundwater layer (ARAB NEWS 2021).

The chart in Figure 3 shows the rainfall amounts in seven areas in Oman recorded by the Civil Aviation Authority in some meteorological stations (Al-Ain 2021). These amount of rainfall affect negatively many regions in Oman, especially Al-Khaburah city. Figure 4 shows the overflow that happened in this city.

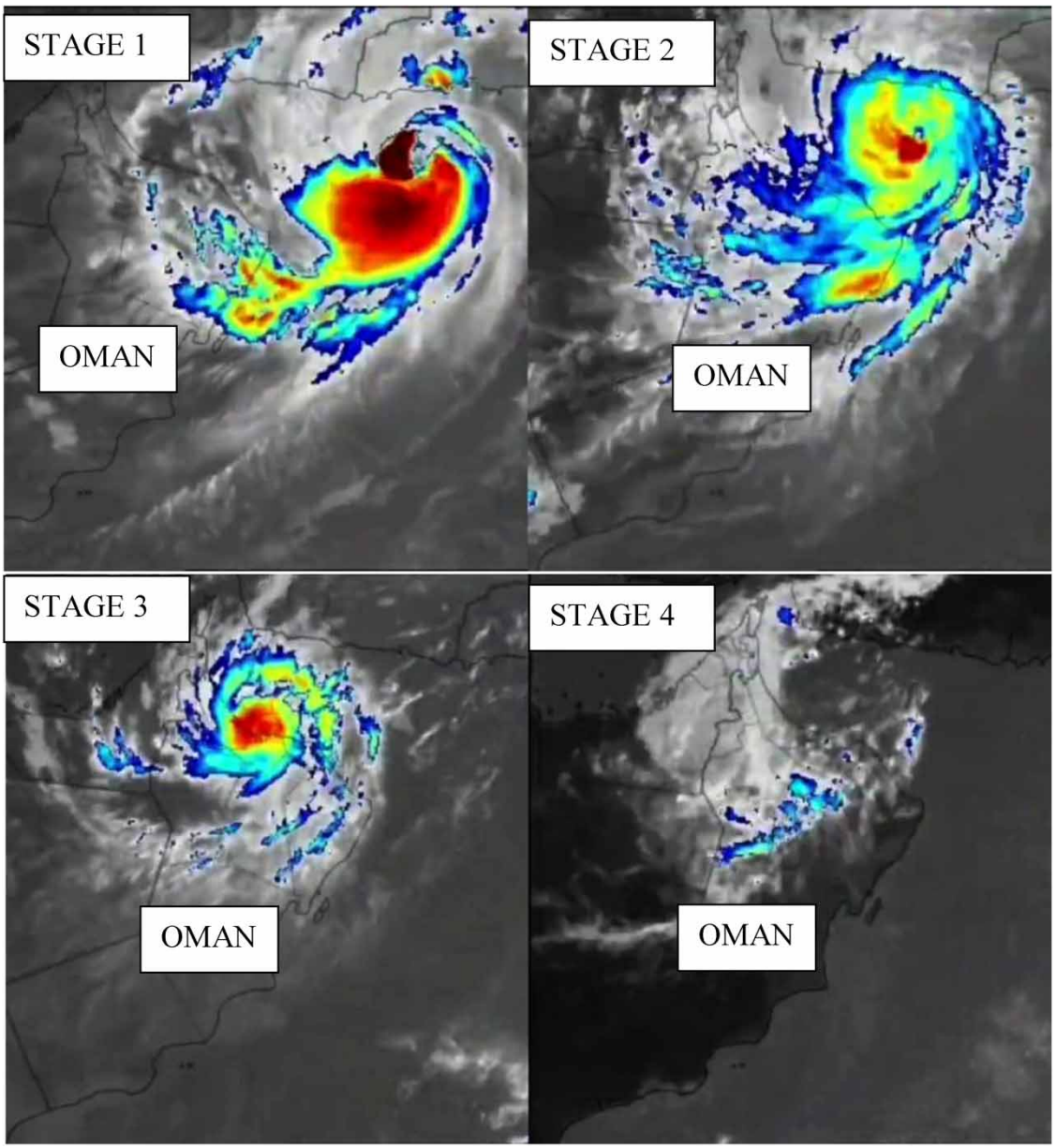

Figure 2 | Satellite image on October 4: the Shaheen cyclone ending in Al-Dhahira (The Arabian Stories 2021).

ADVANTAGES AND DISADVANTAGES OF THE CYCLONE

Any natural phenomenon has its effects, and these effects could be beneficial and harmful to society and the environment. Since hurricanes are natural phenomena, that means that despite the devastation that comes with them, they also have advantages (U.S. Department of Commerce 2013). These are some of them:

- The advantages of cyclones:

Advantages include the fact that hurricanes bring rainfall to those areas that need water, and they are also one of the most important ways to cause precipitation. Moreover, floods caused by hurricanes help in bringing fertile soil from mountains to coasts, where more people can benefit from it (Charabi 2010). Strong wind following hurricanes also helps spread the surface soil, which helps the agriculture sector in the long term.

Another important advantage is that water sneaking to the ground recharges the aquifers (groundwater tanks). It also helps clean and wash waste and sediment as well as reduces erosion in seabed levels and balances the temperature between the poles (north and south) and the equator.

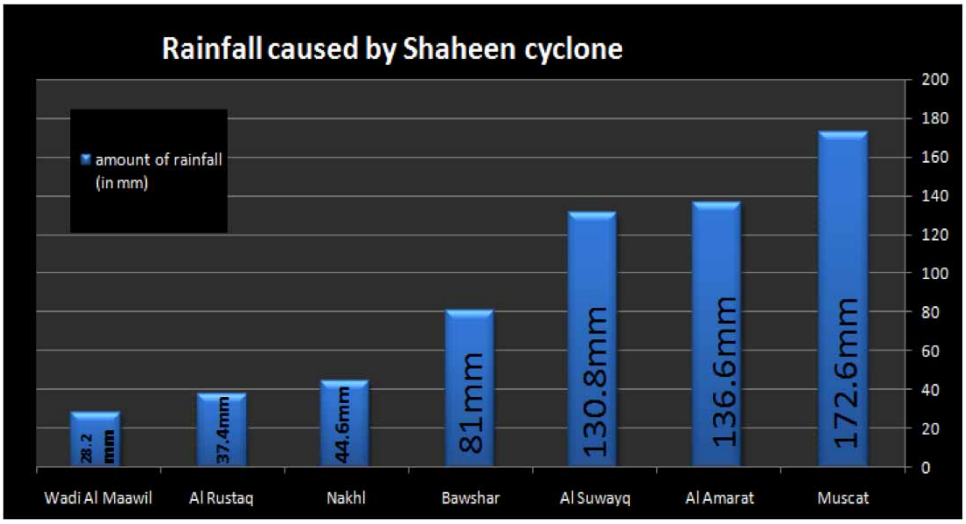

Figure 3 | Rainfall amounts recorded in different regions in Oman (Al-Ain 2021).

Figure 4 | Different pictures for damage in Al-Khaburah (BBC 2021).

- The disadvantages:

The main disadvantage is the loss of lives. In this case, 9 people were dead (Al Jazeera 2021). Additionally, rain accompanying hurricanes can submerge a whole city in less than a day as shown in Figure 5. Floods can also destroy large areas, which produces human and material losses, and strong winds hitting the sea can kill the animals in it. All this damage requires the governments to spend high costs on repairing the damaged places (Al-Maskari 2012).

Figure 5 | Cyclone damage in the northern parts of the Sultanate (Al Jazeera 2021).

CONCLUSION

This review paper aimed to track the effects and damages of the Shaheen cyclone and the government's response and actions. As mentioned before, the geographic location of the Sultanate of Oman exposes it to hurricanes during winter every 3–4 years (Abri 2021). Hurricanes caused a lot of damage in the sultanate back then, because of the lack of technologies that predict when they are coming, and the buildings' structures were not strong enough to resist the type of sudden Earth disasters. There are surely still damages, but these damages are getting less every year because the relevant authorities have been predicting them using satellite images, hydrographs, GIS products, and Google Earth products. In the case of the Shaheen cyclone, high amounts of water were precipitated in a very short period of time, which caused flooding in the city. Hydrological data collected show that wind had a speed of 102 km/h and average rainfall amounts of 70–150 mm, which are relatively high for an arid region such as the Sultanate of Oman. Since the soil in the affected regions is mostly clay with poor permeability, a solution recommended reducing the flooding that happened in Al-Khaburah city, that they have to adopt a proper stormwater drainage system to be constructed for the whole city. Underground water tanks can be installed to get the benefit of these high amounts of water. Moreover, proper hydrological study of the watersheds in the northern region of Oman is required to be conducted to obtain the expected flow amounts in the current pressure of global warming that is increasing the frequency of flash floods. Overall, there were fewer losses in the lives of the civilians compared to the other cyclones hitting Oman, which shows the improvement in the management techniques used in flood warning systems. However, further development and improvements are recommended, especially in the field of using satellites as effective flood-predicting systems.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

REFERENCES

Abri, M. A. 2021 *Oman Observer*. Available from: https://www.omanobserver.om/article/55741/Main/history-of-cyclones-in-oman. (accessed 8 October 2021).

Al-Ain 2021 *Rainfall Amounts*. Available from: https://al-ain.com/article/suwaiq-oman-highest-rainfall-world. (accessed 4 October 2021).

Al Jazeera 2021 *Cyclone Shaheen Strikes Parts of Oman and Iran*. Available from: https://www.aljazeera.com/news/2021/10/3/cyclone-shaheen-approaches-oman-flights-delayed. (accessed 3 October 2021).

Al-Maskari, J. 2012 How the national forecasting centre in Oman dealt with tropical cyclone Gonu. *Tropical Cyclone Research and Review* **1**(1), 16–22. https://doi.org/10.6057/2012TCRR01.02.

ARAB NEWS 2021 *Oman Braces Itself as Tropical Storm Shaheen Worsens*. Available from: https://www.arabnews.com/node/1939716. (accessed 1 October 2021).

Ather newspaper 2021 *Cyclone Shaheen*. Available from: http://nabdapp.com/t/94257663. (accessed 6 October 2021).

BBC 2021 *Shaheen: Tropical Cyclone Batters Oman and Iran, Killing 13*. Available from: https://www.bbc.com/news/world-middle-east-58783992. (accessed 4 October 2021).

Charabi, Y. 2010 *Indian Ocean Tropical Cyclones and Climate Change*. Springer, Dordrecht, Netherlands, Muscat, Oman.

Gilbert, M. 2021 *AccuWeather*. Available from: https://www.accuweather.com/en/hurricane/oman-tropical-cyclone-shaheen-landfall-flooding/1027547. (accessed 6 October 2021).

Hafez, S. A. 2021 *Shaheen Cyclone Path*. Available from: https://www.aljazeera.net/news/science/2021/10/3/%D8%A5%D8%B9%D8%B5%D8%A7%D8%B1-%D8%B4%D8%A7%D9%87%D9%8A%D9%86-%D9%83%D9%8A%D9%81-%D8%AA%D8%B7%D9%88%D8%B1-%D9%85%D9%86-%D9%85%D9%86%D8%AE%D9%81%D8%B6-%D8%AC%D9%88%D9%8A-%D8%A5%D9%84%D9%89. (accessed 5 October 2021).

Henson, B. & Masters, J. 2021 *Shaheen Pushes Onshore as First Tropical Cyclone on Record in far North Oman 'Yale Climate Connections'*. Available from: https://yaleclimateconnections.org/2021/10/shaheen-pushes-onshore-as-first-tropical-cyclone-on-record-in-far-north-oman/. (accessed 1 October 2021).

The Arabian stories 2021 *Tropical Storm Shaheen 590 km Away From Oman Coast*. Available from: https://www.thearabianstories.com/2021/10/01/tropical-storm-shaheen-590-km-away-from-oman-coast. (accessed 1 October 2021).

US Department of Commerce 2013 *What is a Hurricane?* Available from: https://oceanservice.noaa.gov/facts/hurricane.html. (accessed 5 October 2021).

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