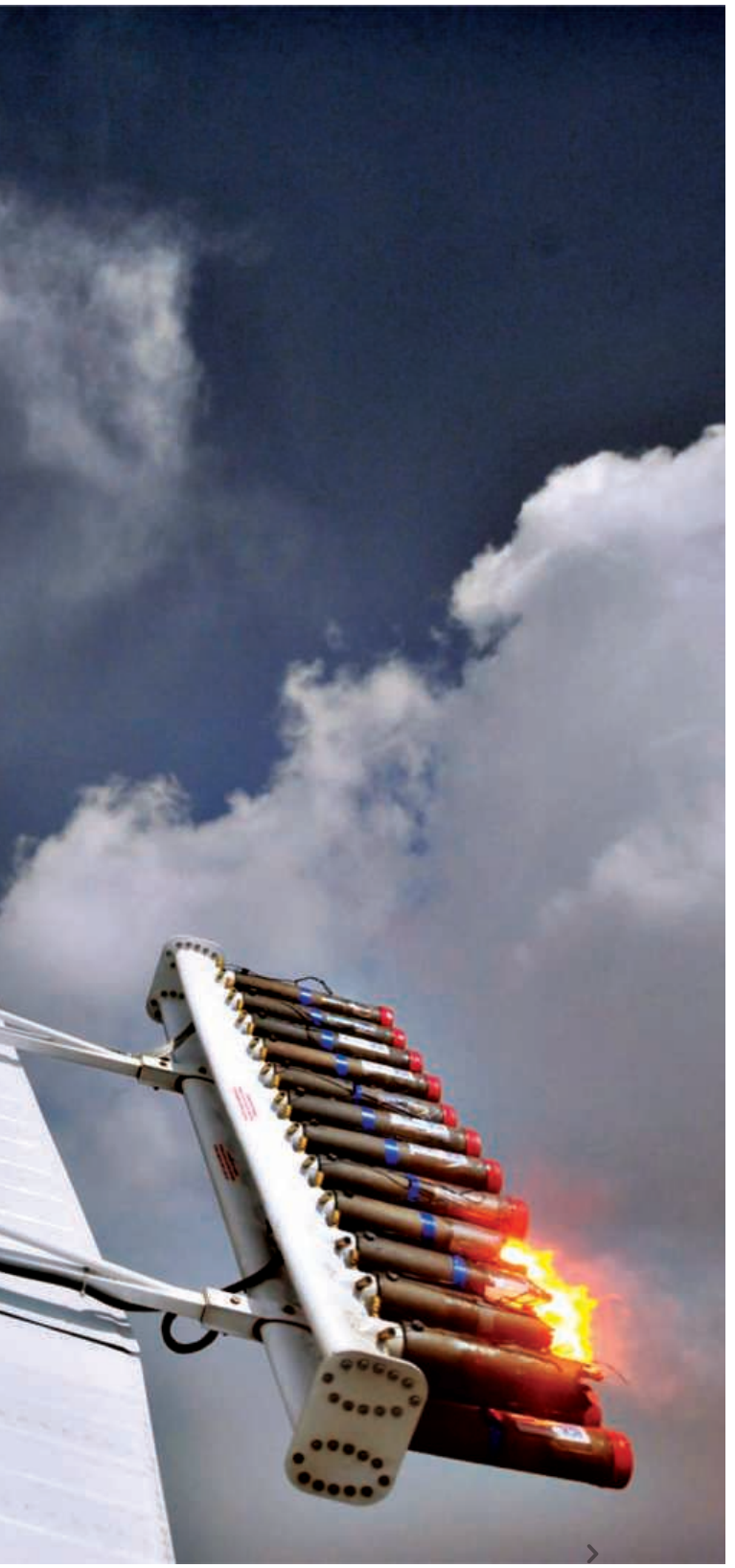
LET IT RAIN

Fresh water scarcity is a serious issue facing the planet. The UAE is playing a leading role in developing solutions through its research into rain enhancement.



According to the World Health Organisation, half of the planet's population could be living in water-stressed areas by 2025. That's just seven years away.

Water scarcity is real. What's more, its impact could be catastrophic. Climate change, population growth and urbanisation have only exacerbated what the World Economic Forum has described as the largest global risk in terms of potential impact over the next decade.

Just ask the UAE. It knows all about water scarcity. Its climate is arid, with an average of only 100mm to 120mm of rainfall per year, and has high levels of surface water evaporation. Its groundwater recharge rate is also low. What's more, rapid population growth and economic expansion have put pressure on existing water supplies.

One of a handful of possible solutions to this scarcity is rain enhancement, or cloud seeding. The UAE has been utilising this form of weather modification for the best part of two decades, running 242 cloud seeding missions in 2017 alone.

At the forefront of research into this frequently misunderstood technology is the UAE Research Program for Rain Enhancement Science, which is managed by the National Center of Meteorology (NCM). The former is responsible for an annual $5 million grant that covers a three-year period and can be shared by up to five winning research proposals.

"The programme is already advancing scientific understanding through new knowledge of cloud formation, precipitation production, and other relevant physical processes," says its director, Alya Al Mazroui. "Through these activities we are also fulfilling the equally important goal of developing local and global capacities while encouraging and supporting productive research collaboration."

To date, international researchers and institutions from across the US, Europe and Asia have connected with the programme, which now has a network of more than 1,200 researchers from over 500 global institutions, including the European Organisation for Nuclear Research, the European Space Agency and NASA.

Traditionally, cloud seeding methods have involved seeding with specific materials. Research has suggested that hydroscopic materials are the best option for warm, convective clouds, while silver iodide is more appropriate for use on cloud formations in colder climates. Scientists are

Above: Planes on standby to seed overcast skies

continually testing the efficacy of seeding such materials and how these can be more effectively deployed.

In the UAE, specialised cloud seeding aircraft target cloud formations in the Hajar Mountains in the north east of the country. When a suitable cloud is identified, the seeding materials are dispersed at the base of the clouds so that they can be carried upwards by updrafts. Once a seeding flare is ignited, it takes two to three minutes for the material to be ejected and up to 15 minutes for the material to interact with the cloud molecules.

"The technique offers the promise of cost-effective and sustainable water supplies with far fewer environmental impacts than costly solutions such as desalination," says Al Mazroui. "Technological advancements could ensure that rain enhancement becomes even safer and more affordable."

In contrast to water desalination plants, which are energy intensive, rain enhancement techniques are relatively cost effective. In 2015, for example, a total of $558,000 was spent on rain enhancement missions in the UAE. A large-scale desalination plant producing about 100,000 cubic metres of water per day costs $100 million.

NCM meteorologist Sufian Farrah told *Arabian Business* that desalinating one cubic metre of water from the sea costs about $60, whereas the same amount of water extracted through cloud seeding costs just $1.

The problem with cloud seeding, however, is measuring success, which is difficult to gauge and almost impossible to quantify. Just as it's hard to predict the weather, it's also hard to know if a cloud seeding mission caused rain or whether it would have rained regardless.

For proof of success, Al Mazroui points to a three-day period in 2010, when the UAE experienced heavy rainfall. During those three days cloud seeding operations were intensified. As a consequence, the amount of water collected in the country's dams was equal to nine years' worth of water output from a single desalination plant.

"There is a scientific consensus today that rain enhancement accounts for a minimum of 10% more

Left: A cloud seeding operation managed by the National Center of Meteorology

rainfall after cloud seeding operations," says Al Mazroui. "Direct economic benefits from effective rain enhancement include improved crop yields. For instance, a study in North Dakota in the US found that seeded farmlands increased agricultural wheat production by 5.9%."

In January this year the NCM announced the success of six cloud-seeding missions – the first of 2018. They had been carried out across the eastern and northern areas of the UAE, leading to substantial rainfall.

"Years of research and experiments conducted in the UAE by the NCM have proven that rain enhancement is a viable and cost-effective alternative water source," adds Al Mazroui. "Scientists in the UAE have estimated that cloud seeding operations can enhance rainfall by as much as 30% to 35% in a clean atmosphere, and by up to 10% to 15% in a turbid atmosphere. Such an increase in rainfall levels illustrates the potential of the science to increase water supplies for countries and regions at risk of drought."

Yet enhancing precipitation is only one weapon in the fight against water scarcity. Of arguably greater importance are the improved management of all water resources, greater irrigation efficiency, the reduction of domestic consumption, and the building of fresh water resilience.

"There is a lot of interest in the world for harvesting fresh water and there are several strategies being investigated; rain enhancement is one them," says Mohammad Al-Sayah, a professor at the American University of Sharjah. "The effectiveness of these technologies is yet to be seen in providing a real relief of water shortages. However, there is also a lot of development in technologies for effective use of water, such as in agriculture, and treatment of wastewater to be reused. Thus, the combination of new sources of water and effective usage and treatment may have a positive effect on water shortage in different places in the world, including the UAE, within the next decade or so."

For the UAE, rain enhancement is not only a cost-effective and environment-friendly source of fresh water, it has the potential to increase the quantity of harvestable land, which in turn could enhance rainfall, says Al-Sayah. "There are several studies which indicate that pollen grains produced by plants lead to cloud seeding," he adds.

The UAE Research Program for Rain Enhancement Science has already had success, with one of its supported projects filing for a provisional patent with the United States Patent and Trademark Office in February last year. It was for a new application of nanotechnology in cloud seeding. Led by Dr Linda Zou of the Masdar Institute of Science and Technology, the groundbreaking project has already led to innovative sub-micron hygroscopic cloud seeding materials being designed and fabricated.

"The team's experiments have involved coating a pure salt crystal with a thin coating of titanium dioxide to enhance the condensation process," explains Al Mazroui. "Experimental results obtained so far suggest that this process improves the salt's condensation efficiency to the extent that the crystals could adsorb enough water vapour to form droplets that could fall as rain."

Going forward, the UAE aims to consolidate its status as an international centre of excellence for rain enhancement, with the project supporting the growth of a knowledge and innovation-based economy.

"The new insights and technologies we are developing will have wider applications for countries suffering from a shortage of natural water resources," says Al Mazroui. "The programme is already making a significant contribution to the overall goal of encouraging innovators and investors to co-operate to push the frontiers of research, development and innovation, and ensure that rain enhancement contributes to a more complete portfolio for water security."