



## REFERENCES

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**T**ram Chim National Park is a typical wetland ecological standard model of the Dong Thap Muoi region in the Mekong Delta (Mekong Delta) and was upgraded from Tram Chim Wetland Nature Reserve according to the Decision No.253/1998/QĐ-TTg dated December 29<sup>th</sup>, 1998 of the Prime Minister. With a total core area of 7,313 hectares, Tram Chim National Park is considered one of the places with ecological importance and biodiversity including 130 plant species; 130 species of fish and other amphibians and reptiles, more than 230 species of birds, including the rare and endangered species: sarus crane.

**THE RETURN OF THE SARUS CRANE IN TRAM CHIM**

Tram Chim National Park was recognized as the 4<sup>th</sup> Ramsar site in Vietnam in 2000 and in the world in 2012. Tram Chim National Park became one of the wetlands of international importance in preserving habitats of species water bird. Compared to other special-use forests in the Mekong Delta, Tram Chim National Park has the largest number of bird species, especially the sarus crane (*Grus antigone*), a rare bird species of global importance.

However, the sarus crane is in danger of extinction, recorded in the IUCN Red List. According to the International Crane Federation (ICF), it is estimated that in 1990, there were about 1,100 sarus crane individuals and remained around 900 until 2002. After that, there was a decline of about 1% each year, until 2013 there were about 850 individuals. However, from 2014 to 2019, sarus cranes declined by 72%, with only 234 birds remaining, and in 2020, it is estimated that there will be only 179 birds left.

Sarus cranes usually come to visit Tram Chim National Park from late January to mid-May every year. According to statistics of Tram Chim National Park, in 2015 the number of cranes was 21; in 2016, there were 14 individuals; in 2017, there were 9 individuals; in 2018 and 2019, there were 11 individuals. In 2020, the cranes did not return; In 2021, 3 birds returned, then absent until now, 4 birds have returned in subdivision A5 of Tram Chim National Park. The number of sarus crane coming to Tram Chim is decreasing due to many different reasons, mainly due to climate change and the impact of the ecological environment; the flood water is low, unable to wash away food baits, and also reduces the amount of fishery that is the main food of birds.

Currently, Tram Chim National Park has also sent professional staff to monitor 24/24 in subdivision A5 and other subdivisions, where cranes used to feed, in order to monitor and have appropriate management orientation. At the same time, assign security forces to regularly patrol around the dikes to prevent people from catching bees and exploiting products that affect the living environment of sarus cranes. The garden has added an additional food source (rice) for the cranes when the crane population has stabilized, in order to attract more and more cranes. Along with that, technical measures are implemented to restore the ecosystem, creating favorable conditions for cranes to come and feed.

At the end of 2023, the People's Committee of Dong Thap province approved the project to conserve and develop sarus cranes at Tram Chim National Park for the period 2022 - 2032. According to the project, within 10 years (period 2022 - 2032),



# Implementing the AI/IoT Application Project in environmental management at Tram Chim National Park

there will be raised and released 100 cranes with a target of minimum of 50 survivors. The released sarus cranes can reproduce on their own, survive in the wild and live year-round in Tram Chim National Park. Dong Thap province aims to receive about 30 of 6-month-old cranes from Thailand in the period 2022 - 2028 to raise, care for and release into the natural environment. The ecosystem of Tram Chim National Park will also be restored through reasonable water regulation and application of appropriate research measures, to serve the habitat of sarus cranes.

## IMPLEMENTING THE AI/IOT APPLICATION PROJECT IN ENVIRONMENTAL MANAGEMENT

The return of the sarus crane took place after Tram Chim National Park implemented the AI/IoT Application Project in environmental management and received funding from the Australian Government's Aus4Innovation program. The project brings together leading experts in artificial intelligence (AI), machine learning (ML), Internet of Things (IoT), environmental technology and biological conservation from the University of Wollongong (Australia) and Polytechnic College - Ho Chi Minh City National University. Other partners of the Project include Microsoft, Tram Chim National Park and Dong Thap province.

The project uses many types of IoT devices (unmanned boats, cameras and sensors to measure turbidity, water level, temperature, CO<sub>2</sub>, humidity) to be able to continuously and regularly survey large areas in the Tram Chim National Park. AI/ML technologies will be leveraged to process, analyze, and classify large amounts of data into indicators that provide real-time insights into the health of the Park's ecosystem (plants, animals and water). The project has built an end-to-end solution leveraging AI technology to transform the environmental management of Tram

Chim National Park. The system's architecture at all levels is shown:

IoT data collection includes IoT devices (such as drones, cameras, and water sensors) that will collect data (e.g. images of animals, plants, water levels, turbidity, temperature, CO<sub>2</sub> and other parameters) in all areas of the Tram Chim ecosystem. Data will be continuously collected, stored in the cloud and processed in real time to provide updates on the status of the Park's ecosystem.

AI/ML data processing and classification includes a series of image processing and AI/Machine Learning algorithms and models that automatically process and analyze data to generate various insights, such as counting numbers of individuals and species animal, classify plants and identify them in different states, and determine water levels in different areas of the park.



▲ Installing an air quality monitoring station at Tram Chim National Park



▲ *Birds are automatically identified by the AI Camera system*

The digital AI-powered dashboard is easily accessible to various park stakeholders (such as rangers, managers and researchers) through conventional computing devices (such as personal computers, mobile phones or tablets) to support decision making. The digital dashboard will also provide a clear demonstration of how management interventions impact key indicators of the park's ecosystem health. Additionally, the console will be able to issue warning messages to users/administrators in dangerous situations such as fire, low water levels or high salinity.

Currently, the Project is in the testing process of equipment such as 5 air quality monitoring stations, 5 water quality monitoring stations and 5 AI camera stations. In particular, cameras are equipped with identification technology to analyze, classify and evaluate plant and animal populations, especially precious birds. These are long-range wireless communication devices, so the distance between each device can be up to 10 km. The installation of equipment ensures conditions such as not destroying the natural scenery and not disturbing creatures located at the beginning or end of the water source. In addition, the structure of a monitoring station includes: solar cells, cameras, a sensor system to measure indicators and a central processor to control the sensors. Monitoring these parameters helps managers capture important indicators such as dryness, humidity, water quality, as well as fire warning signs for grasslands. These systems are designed, arranged and installed in different areas of the National Park.

After successful testing of the devices, the National Park Management Board will be provided with detailed real-time information on the health of the Park's ecosystem such as animals, plants, water, bird species identification, detecting forest fire...; thereby helping

managers have more support tools to improve the quality of habitat of precious bird species. In addition, the National Park is equipped with a regular water quality monitoring system to promptly report environmental data to Provincial Leaders and Park Management Board such as: Flycams, cameras and sensors to measure turbidity and water level, temperature, CO<sub>2</sub>, humidity to be able to conduct regular and continuous surveys over a large area in Tram Chim National Park's managers

have access via personal computers, mobile phones, tablets... to support management and decision-making appropriate to water levels, weed growth and wildlife. Although Tram Chim National Park's staffs have been instructed to operate it, this is a new, high-tech model and National Park's staffs are still confused while operating or the equipment has software errors that are difficult to handle; Maintenance work must be performed annually to properly manage the equipment. The project is the first system of its kind in Vietnam to promote the sustainable, more comprehensive development of Tram Chim National Park and its wetland ecosystem, thereby improving animal health and people in the local area.

The restoration and development of sarus cranes in Tram Chim National Park brings many important meanings in the cultural and spiritual life of people in the Dong Thap Muoi region. The success of the Project along with the implementation of the AI/IoT Application Project in environmental management also makes an important contribution to preserving the sarus crane flock of the lower Mekong River region, which is currently facing with the risk of extinction in particular and in biodiversity conservation in general. This will demonstrate Vietnam's commitment and sense of responsibility when participating in international treaties ■

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