

Under the High Patronage of His Majesty King Mohammed VI



XIX WORLD WATER CONGRESS
International Water Resources Association (IWRA)
Marrakech, Morocco | 1-5 December 2025

Kingdom of Morocco



Ministry of
Equipment and Water

Enhancing Animal Wastewater Management with Satellite Remote Sensing

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Animal Wastewater Management



Dairy Tour



Wastewater Management



Manure Wastewater Lagoons





**CAREER
AWARDS**

Lagoon Management via Satellite Imaging



Monitoring Lagoons via Satellites



Across vast areas

Scalable & efficient monitoring

Prompt response

500+ large dairies

Dairy Lagoons



Dairy lagoon, Stephenville, TX



Dairy lagoon, Tipton, IN



Dairy lagoon, Arlington, WI



Dairy lagoon, Stephenville, TX

Space View of Lagoons



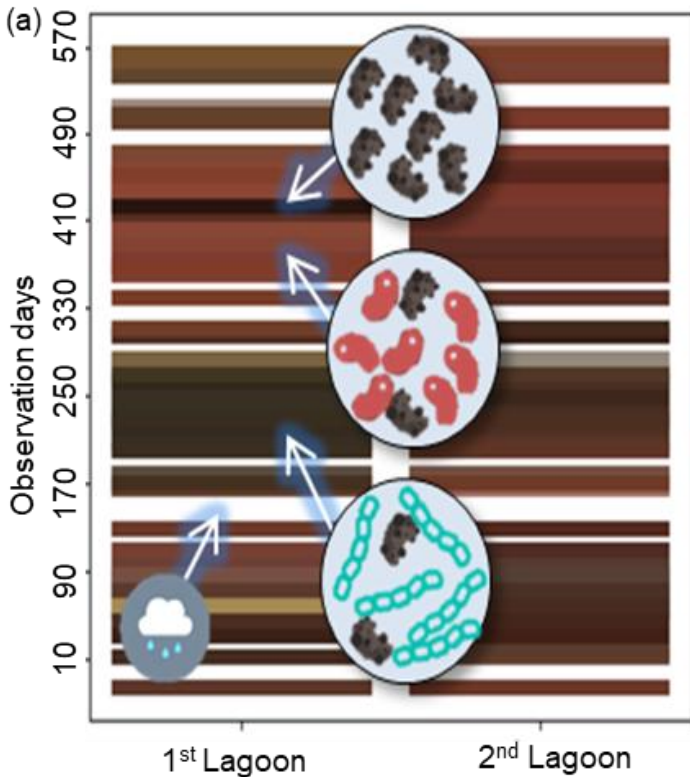
"Colorful" Lagoons



Variability in Lagoons

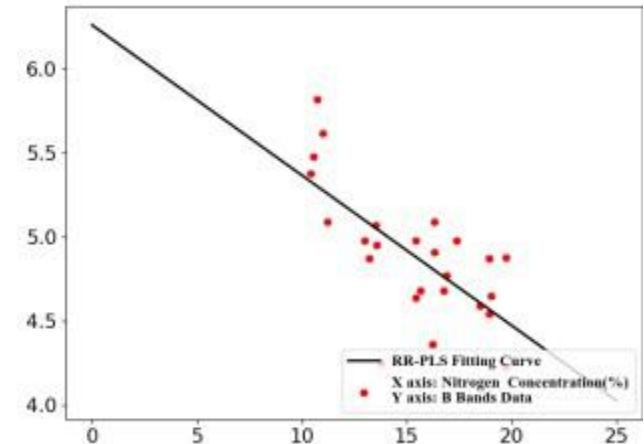
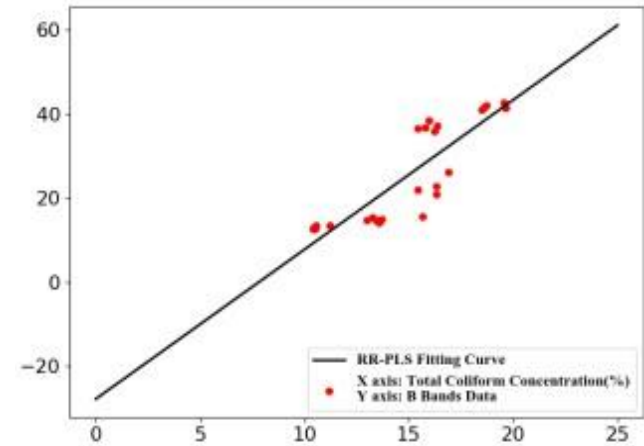
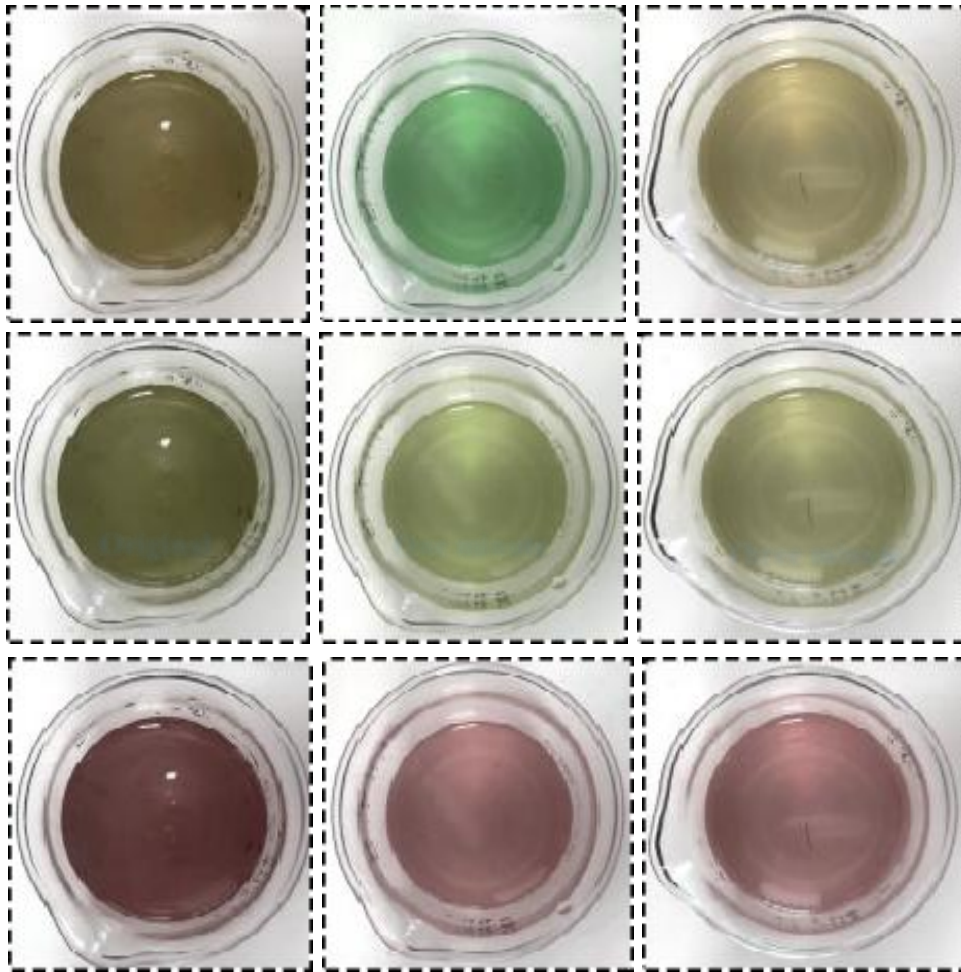


Lagoon Color vs. Water Quality

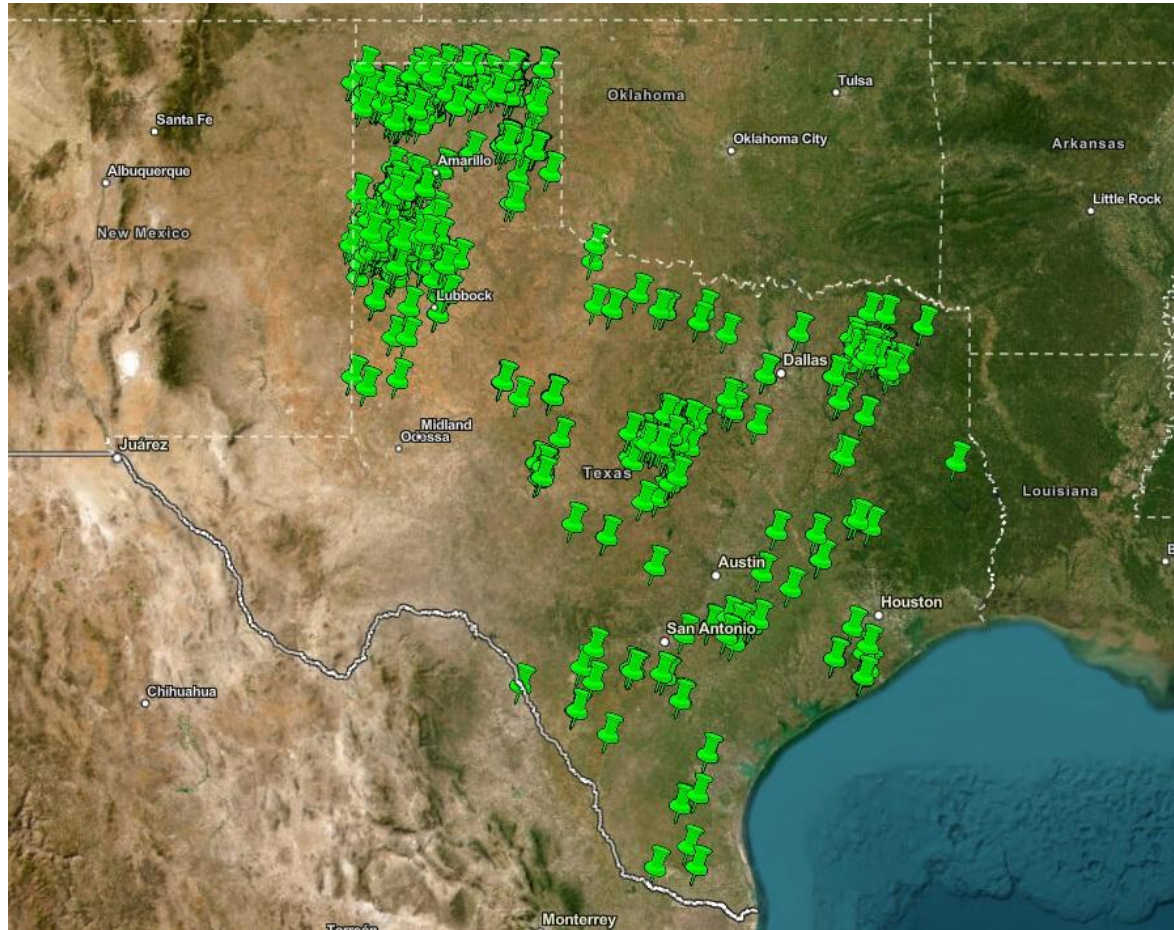


Appearance	Potential mechanism	Potential underlying problems
Brown	Small flocs	None
Green	Green algal bloom or blue-green bacterial bloom	pH>9, excessive detention time, organic underloading
Red streak	Daphia bloom	Daphia overgrowth
Red or pink	Sulfur bacterial bloom	Organic overloading, under-aeration

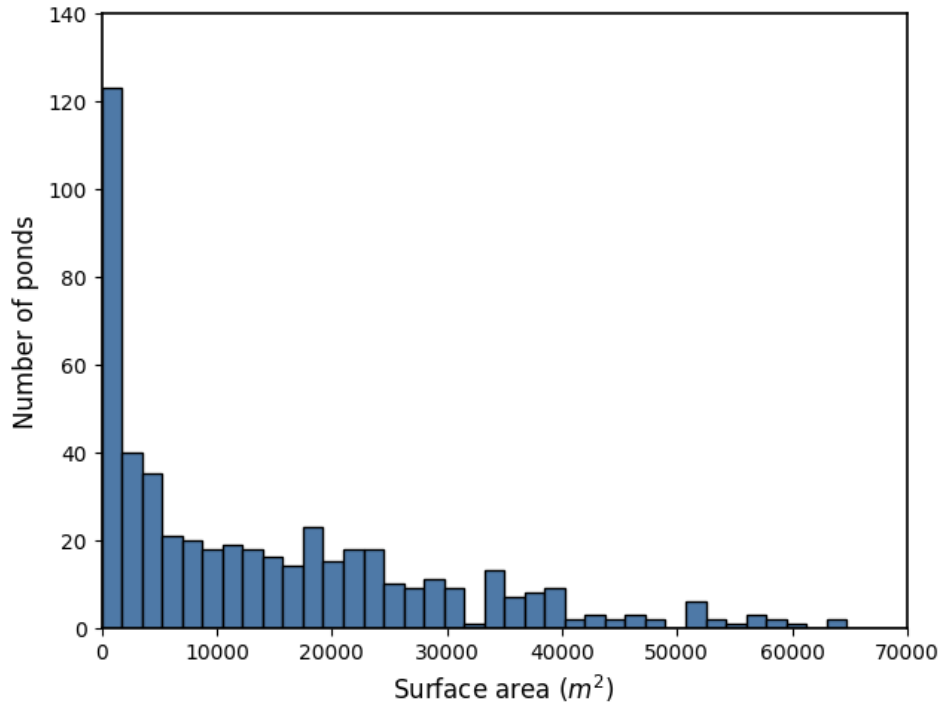
Color as Proxies of Water Quality



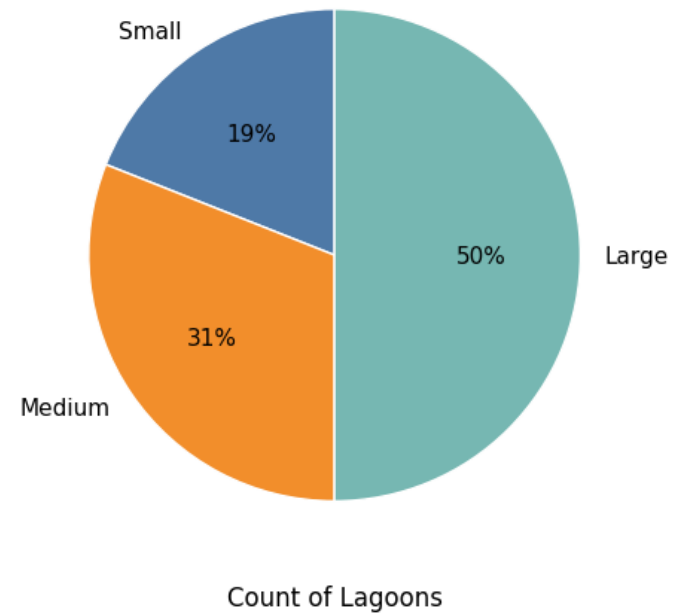
Mapped Locations in Texas



Lagoon sizes

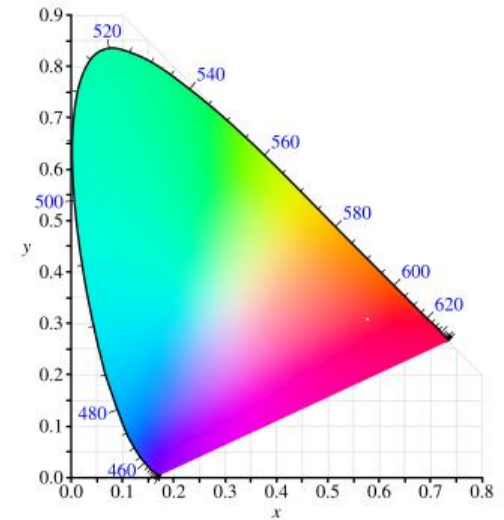
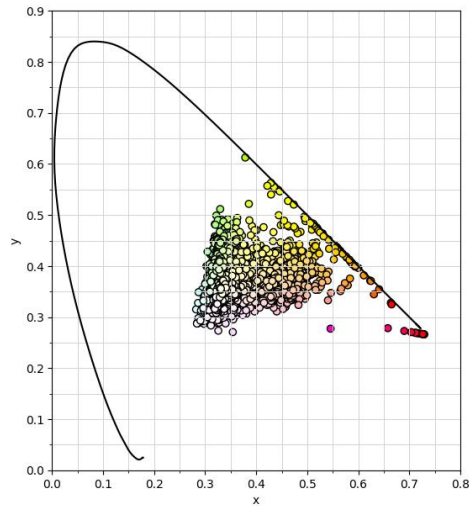
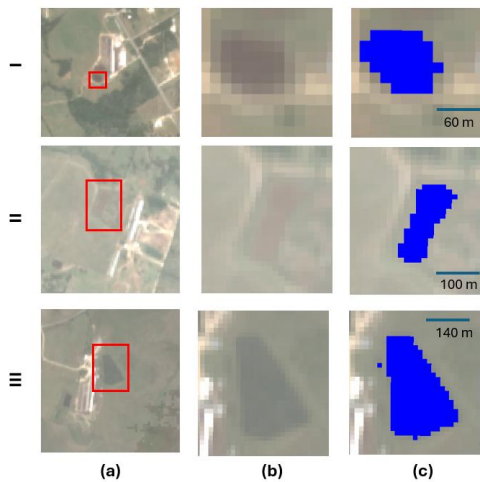


Lagoon surface areas
across Texas



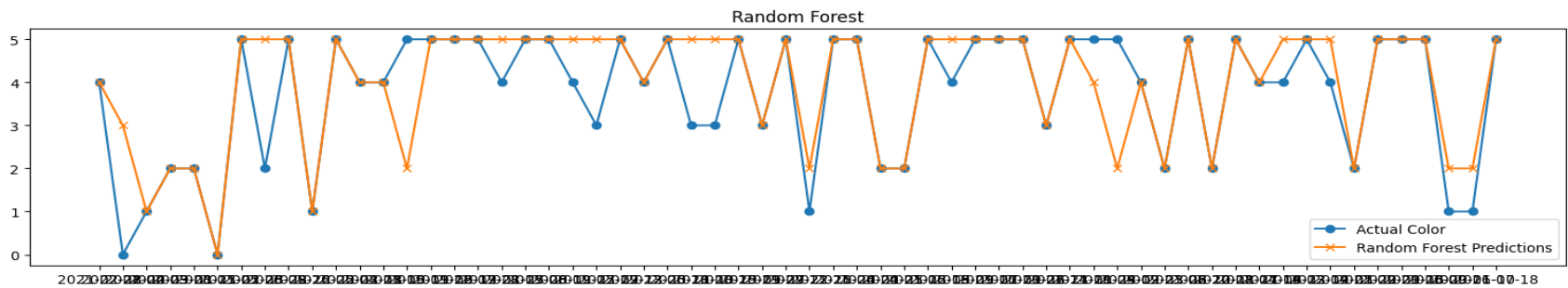
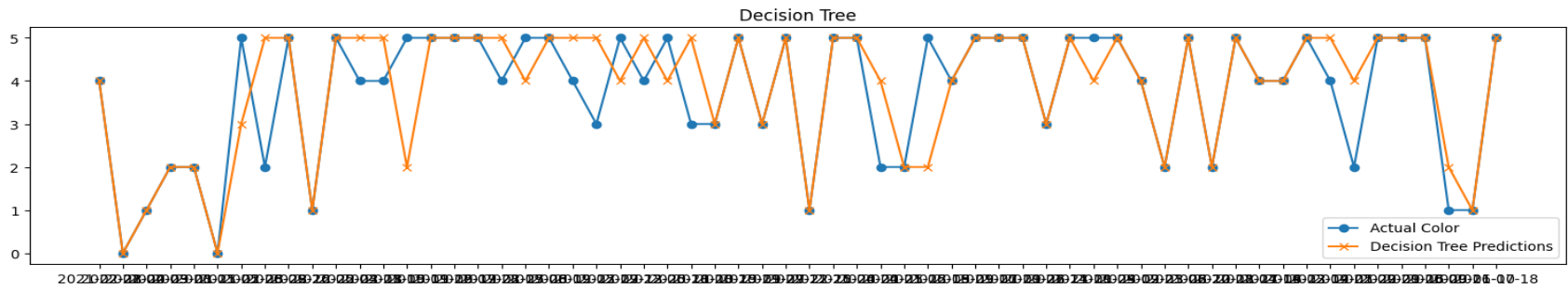
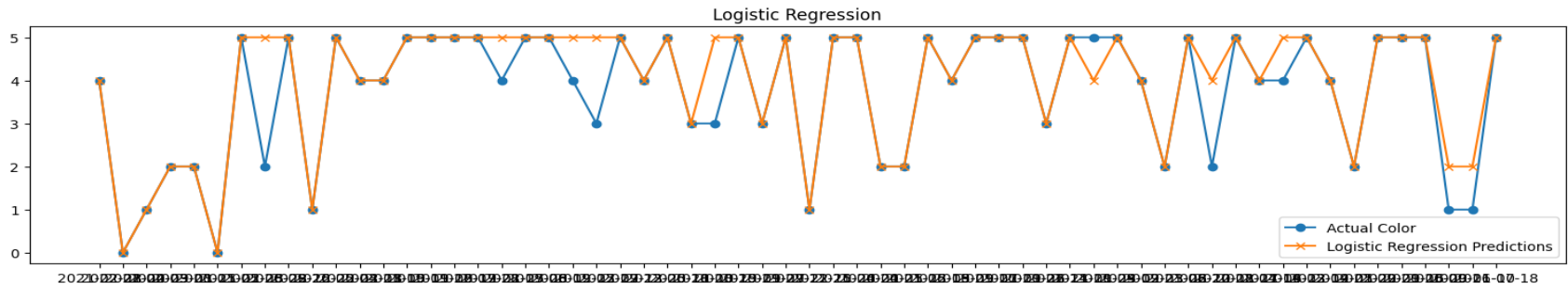
Proportions of small (<900 m²),
medium (900–10,000 m²), and
large (>10,000 m²) lagoons

Image Analysis for Lagoon Colors



CIE 1931 chromaticity (x-y)

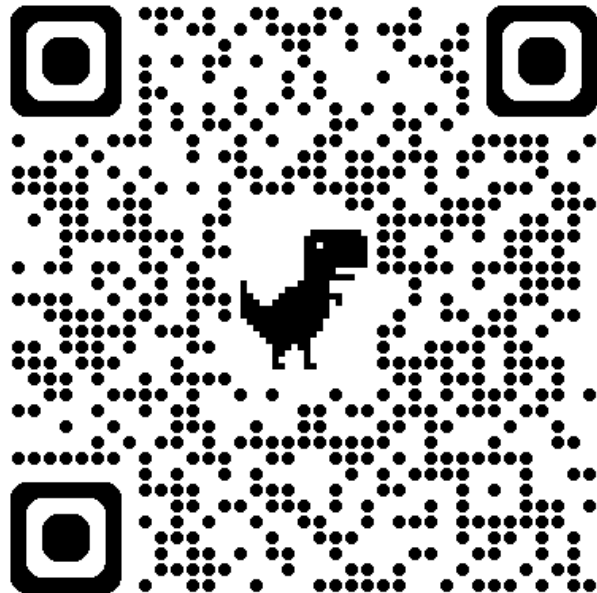
Predictive Modeling for Lagoon Changes



More on Animal Wastewater



Texas Manure



Texas Manure

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<p>Don't landfill it, compost it</p> <p>716 views</p>	<p>Cotton gin byproduct to compost in weeks ...</p> <p>534 views</p>	<p>Don't be scared... we take care of the ...</p> <p>1.2K views</p>	<p>How to set up a compost tumbler for ...</p> <p>866 views</p>
<p>Happy Cows, Better Milk! The cutest #cow ...</p>	<p>TAMMI Conference 2025: Sep 16-17 at ...</p>	<p>Assessing Manure Management via ...</p>	<p>How to set up a composter tumbler at ...</p>
<p>1.6K views</p>	<p>415 views</p>	<p>1.4K views</p>	<p>1.2K views</p>

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Thank you!

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