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Researchers explore Plant Nanobiotechnology by adopting nanomedicine and digital twin technologies in smart-agricultural practices

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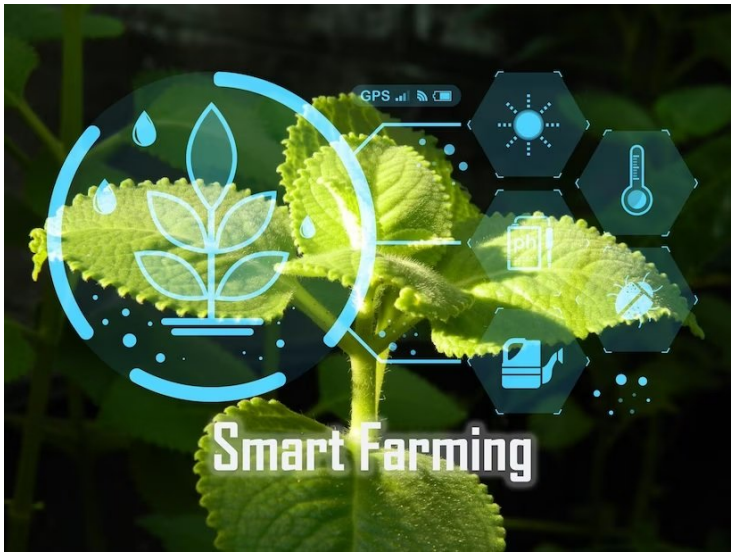
Carnegie Mellon researchers develop sustainable solutions for Global food security



Carnegie Mellon researchers develop sustainable solutions for Global food security

Researchers in the Department of Civil and Environmental Engineering at Carnegie Mellon University are using findings from nanomedicine and digital twin technologies to understand the new field of Plant Nanobiotechnology, address unsustainable agricultural practices, and meet increasing global food demands.

Currently, agriculture accounts for 14-28% of global greenhouse gas emissions and 70% of all freshwater withdraws. This, in addition to a range of other factors from extreme weather events, rampant crop pests, and rapidly degrading soil underlines the need for new agricultural practices and technologies.

Researchers highlight that Plant Nanobiotechnology approaches can be used to deliver nanoforms of active agents, such as micronutrients or plant protection products, to specific biological targets. As a result, plants become more resilient against disease and harmful environmental factors like extreme heat or salt contents in soil, thus increasing crop yield and overall efficiency. However, because the field of Plant Nanobiotechnology is still in its nascent stages, many of the challenges to implementing new tools like nanocarriers are still unknown to researchers.

To overcome this obstacle, civil and environmental engineering professor Greg Lowry, in collaboration with co-corresponding author Juan Pablo Giraldo at University of California Riverside, colleagues, and students, is looking beyond plants and

agriculture to find solutions inspired by nanomedicine.

Similar to nanomedicine, researchers found that nanocarriers are most successful when they interact well with the organism theyâ??re targeting, navigate key biological barriers, and take advantage of natural processes while minimizing unintended consequences. The study also explored the potentially transformative approach of creating â??digital twinsâ? of plants for assessing the efficacy of different nanocarrier designs.

Digital twins are breakthrough modeling technologies that have been widely used throughout infrastructure management, predictive maintenance, and manufacturing. Their unique ability to analyze a structure and its surrounding conditions, process the information, and use it to inform, predict, and modify what happens in the physical world has revolutionized the way researchers process data.