

> Urban Greenhouse Challenge: exploring the potential of urban farming

Monica Vidal, Sarah Hoogenboom, Daniel He, Mees Deknatel and Patrícia Duarte de Oliveira Paiva



> Top 3 teams.

Feeding a growing population sustainably will require a global transition of our food systems, especially in urban areas. In the face of current demand and instability of supply chains, making these urban areas food resilient means producing food closer to people. Urban farming presents itself as one of many promising solutions to the urban food challenge. Since 2018, Wageningen University & Research (The Netherlands) explores the opportunities in the growing sector of urban farming through the Urban Greenhouse Challenge series, a series of extracurricular and multidisciplinary competitions for students throughout the world (<https://urbangreenhousechallenge.nl/>).

This Challenge series occurred every two years and was open to students from any university in the world enrolled in any study program. Students were encouraged to form multidisciplinary and multicultural teams to maximize their learning outcomes. The Challenge's objective was to develop talent among the participating students, and to stimulate sustainable and societal innovation across disciplines. Participating student teams developed their ideas with support from coaches in the private, public,

and social sectors. This ranged from corporations, governmental institutions, non-profit organizations or academia that were relevant for urban food production. The interaction between students and partner coaches, and the resulting co-creation are what made this competition worthwhile.

Each competition took place in a different socio-economic context within a major metropolitan area, giving the students a new set of variables and issues to resolve. This system captured a wide set of possibilities within the urban farming sector. The first Urban Greenhouse Challenge (2018) took place in Amsterdam with the ambitious task of rehabilitating a former prison building in the Bajes Kwartier. The second (2020) happened amid the COVID-19 pandemic in Dongguan, China, in one of the largest urban areas in the world. This Challenge was described in *Chronica Horticulturae* 60 (4), 33–37.

Following the success of the previous events, the third Urban Greenhouse Challenge brought in a new twist. Set in the heart of Washington, DC, in a low-income neighborhood, the aim was to empower the local residents to curb food apartheid and reclaim access to healthy food. This Social Impact

Edition was achieved in collaboration with the University of the District of Columbia (UDC), which brought local actors onto the scene to help students better understand their struggles.

Urban Greenhouse Challenge #3: The Social Impact edition

In November 2021, students were asked to develop an urban farming site that significantly improved the quality of life of local residents of Ward 7, Washington, DC. As usual, student submissions had to be underpinned by an economically sound business model. Around 30 teams of students, more than 260 in all, from 74 universities across 19 countries answered the call. For eight months, the students worked on their assignments with support from our partner network, our UDC partners, and a panel of local residents. After two selection rounds, the 10 finalist teams travelled to Wageningen, in the Netherlands, to experience the Grand Final of the Challenge on 29 June 2022, where they faced an international jury for the first time. Three teams emerged victorious racking up a total prize of 15.000€. The three winning concepts of the Urban Greenhouse Challenge #3, from



> Jury presentation during the Grand Finals.

Team LettUs Design, Team USC Stack (from University of Southern California), and Team AMS Caterpillars (from Amsterdam Institute for Advanced Metropolitan Solutions), are summarized below.

1st place – Team LettUs Design – The Mosaic Garden

In our effort to tackle Ward 7's challenges as a neighborhood with poor access to food, education, and economic opportunities, we propose a modular urban farming concept that can be tailored to the needs of the community.

Empowering communities block by block

Our approach would enable local participation during ideation, development,

modification, and expansion. This would be achieved via configurable modules for the functions of the site: food production, community engagement, education, and employment. Functions would be introduced at different community phases as they financially scale up to meet long-term urban farming goals.

Symbiosis

At its heart, our design includes a symbiotic and reliable, year-round aquaponic food production system that can be adapted to the required scale of operations and different crops. Mushrooms and fish provide year-round healthy protein to supplement leafy greens and tomatoes. Culturally connected produce can be grown in the indoor community garden and hydroponic research facility.

Without breaking the bank

The food production system is supported by a business model that serves and employs community members through strategies like a year-round subscription service, remote stalls, and partnering with local organizations for distribution. Modularity enables the community to finance the first few modules entirely from government funds and incentives.

And around it goes

Circularity on site is realized by recycling all primary waste flows into the food production chain. Rainwater harvesting and solar energy generation will further increase the site's self-sufficiency. At the same time, the site, as a biodiverse green space, serves as a buffer for floods and heat, thus contributing to the resilience of the site and its surroundings.

Educating for the future

Members will be engaged through the community garden, square, playground and market. The site also facilitates education for all age groups. An inclusively accessible interactive education path highlights the farming and sustainability practices on site. The site includes an extended campus for UDC Workforce Development and Lifelong Learning division, focusing on employment upskilling and personal development workshops.

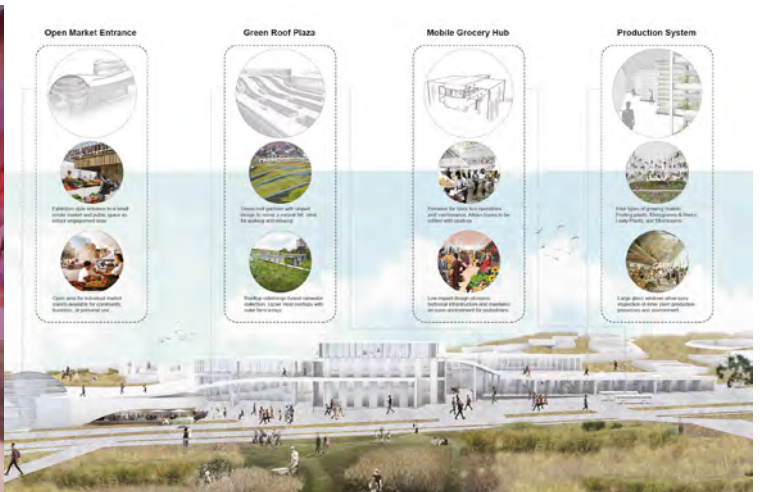
A guarantee

As a team, we acknowledge the current local governance efforts to address the challenges of Ward 7 as well as the efforts of local community members. Our farm aims to create programs that safeguard the current and future vibrant character of Ward 7 by empowering communities block by block.



> 1st place – Team LettUs Design – The Mosaic Garden.





> 2nd place – Team USC Stack – USC Smart Farming.

2nd place – Team USC Stack – USC Smart Farming

In addressing food insecurity and promoting wellness in both Ward 7 and beyond, the issue isn't about building more grocery stores and growing more produce; rather it's about building a smarter network for food distribution and positively redefining the relationship that consumers maintain with their food supplier. This is the Stack vision.

More than food production

In many neighborhoods, obtaining fresh and healthy produce is disproportionately more expensive and difficult due to poor transportation infrastructure compared to other regions. This is especially true in food deserts. Thus, to truly combat the root issue, the solution must address not just food production, but also distribution and education and it must encourage the active engagement and investment of the community and its stakeholders.

Three verticals for a holistic vision

Stack is holistically designed with supply chain self-sufficiency and environmental circularity in mind while maximizing the three following verticals: 1) the total distribution capacity of our produce; 2) the creation of empowering employment opportunities; 3) the capture of high-value produce markets.

Mobile Market Model

To accomplish this, Stack introduces the “Mobile Market Model” – a new paradigm for scalable food distribution and community engagement. Instead of burdening customers with travelling to food suppliers, we bring the grocery store directly to them in the form of a dynamic, electric market bus. Freed from the need to build expensive, low-efficacy physical stores, Stack passes these savings to the community, along with increased accessibility and a far more

enjoyable shopping process. Being a “grocery store on wheels,” our model is designed to scale far beyond our allotted three-acre site. On site, we allocate far more acreage to growing plants and increasing our yield and stand-alone profitability. We create countless jobs with long-term career opportunities centered around food production, agri-tech operations, green-energy collection, and a full-scale mobile grocery store business. Integrating automation and machine learning agents, we combine smart farming with a streamlined market and supply chain ecosystem.

A healthier food supply chain

Utilizing the proven scalability of our produce delivery business models and leveraging our triple-bottom-line approach, Stack ensures the creation of first-layer distributional infrastructure in Ward 7 and a platform to develop a healthier food supply chain while maximizing opportunities for community engagement, empowerment and long-term growth. Farm On!

3rd place – Team AMS Caterpillars – Chrysalis

Fostering community spirit through an adaptive, self-sustaining urban farm that ensures local food security and economic viability, infrastructure longevity, and meaningful public space. Like the flap of the wings of a butterfly, we hope to initiate a process that adds value to the community spirit of Ward 7.

Holistic design

Guided by our vision, we propose a holistic concept design. It incorporates the social, organizational, agricultural, economic, and spatial elements needed to establish an innovative, self-sustaining urban farm that improves the food access and social cohesion of Ward 7, DC.

Triggering change

The AMS Caterpillars aim to trigger a butterfly effect. Our proposal is the single flap of a wing of a butterfly, which sets in motion a chain of events. The concept implemented by the community establishes a flourishing urban farm and educational hub for Ward 7. The building is shaped like a butterfly, and we want to let the community fill in its vibrant colors.

A living lab

Our community-centered design draws from AMS Institute's Living Lab approach that brings research into society-wide implementation through incorporating co-creation by different disciplines and stakeholders. The AMS Caterpillars consider the following five topics to be our unique differentiators, which integrate community needs and challenge outcomes with the UN Sustainable Development Goals (SDG). Through an internal integrated design framework (IIDF), we pair our living lab approach with year-round food production, circularity and sustainable design, organizational structure and economic planning.

Inspire to create

Finally, we draw on inspiration from urban farms in the US and state-of-the-art innovations developed in Amsterdam. Our proposed combination of SDG alignment, interdisciplinary high-tech proposals and global inspirations increases access to fresh produce, meaningful public space and economic opportunity, thus contributing to improving the quality of life.

Metamorphosis

Our concept embodies the metamorphosis of a caterpillar to butterfly, and the core of our mission is to preserve and support community spirit. We hope to provide the cocoon from which Ward 7's butterflies can mature.



> 3rd place – Team AMS Caterpillars – Chrysalis.

Local jury choice

Unlike other editions of the Urban Greenhouse Challenge, the Social Impact Edition was marked by the participation of local actors in the selection process. From the very beginning, Advisory Neighborhood Commissioner, Mr. Antawan Holmes, and the President of the Deanwood Citizens' Association, Mrs. Jimell Sanders, were part of the local selection committee, one of two committees designed to judge the student submissions on several criteria. For them, this meant evaluating the potential for social impact in their community, and awarding the "Local Residents' Prize" to a lucky team. "What I most look for in a proposal is a strong city symbol that shows the transformation in Ward 7, and simultaneously brings job opportunities, benefits local entrepreneurship, and generates economic development," says Commissioner Holmes. When asked about what she expects from her involvement in this Challenge, Mrs. Sanders mentions "We do the best to give them (the students) local context and it is amazing to see what they are able to come up with."

The concept that made the biggest impression on the local jury was that of Team AMS Caterpillars (3rd place), valued for its clear focus on creating social impact. "It is convincing and coherent, and it offers innovative solutions to local challenges. It is a very attractive design with a lot of functionality built into each room. The building has a modest profile and would be considered a landmark due to its unique design." This earned the AMS Caterpillars the "Local Residents' Prize" besides their podium qualification.

International jury winners

Ranking the three winners of the challenge was left in the hands of an international jury. Chair Nona Yehia (founder and CEO Vertical Harvest), together with Thera Rohling (Program Director Sustainable Urban Delta), Patrícia Duarte de Oliveira Paiva (ISHS Board

member) and Harry Webers (Wageningen Urban Ambassador), picked out three outstanding teams after hearing their pitches during the final of the competition.

When justifying the choice to award the 1st place to Team LettUs Design, the jury praised them for having "by far the most inclusive proposal from the outset." As the team puts it, "the local community are the real architects," because the proposed modular urban farming concept can be tailored to their needs. But what really drove the winning concept home was the idea that this replicable and scalable approach could be easily customized to other communities within the most diverse socio-economic contexts.

The 2nd place by Team USC Stack, on the other hand, was "innovative in the way they concentrated in their food distribution network," but "they also addressed the site as a landmark, creating something that the community recognizes." For the team, the goal was to redefine consumer relationships with their food suppliers. After all, the food truck experience carries more than just food; it is also a symbolic return to the origin.

As for Team AMS Caterpillars, which took home the 3rd place and the "Local Residents' Prize," the international jury was impressed by their "balance between a productive and realistic budget and a framework for the community that was place-thinking." With their butterfly inspired community space, the team offers a design pillared by economic viability, infrastructure longevity, and a meaningful public space. A sound proposal that, in the end, was awarded by both the international and local juries.

The end of an era

After three successful competitions, we say goodbye to the Urban Greenhouse Challenge series. In total, more than 1,000 students including more than 100 teams from over 170 universities in 36 countries participated. The Challenges left their mark in the urban farm-

ing innovation world resulting in 34 finalist designs and nine winning concepts. Besides keeping pace with a fast-evolving sector, we helped expand possibilities of growing food in the city.

We are incredibly proud of the development of the Challenges, from the increased complexity of each event, to the extension of the partner network supporting it. We are proud of the student teams who had the task of presenting information with creativity and ingenuity.

Some of the opinions of our students included: "The Urban Greenhouse Challenge was a very intense, yet rewarding and fun experience." "The Challenge taught me to think outside of the box and work in a dynamic and intercultural setting." Please read about the rest of the submissions, together with an overview of all the student concepts in the latest edition of our challenge magazine (https://issuu.com/nieuweveluwe/docs/student_challenges_2022_def-issuu).

Final remarks

Both the organizers and the jury were amazed to see the student's commitment and investment in learning, expansion of their knowledge base, and creativity in seeking the best solution for the Urban Greenhouse Challenge #3. Participating in competitions such as these allowed the students to unlock professional opportunities for their future.

The ISHS fully supports this initiative because these events meet the Society's Young Minds Program goals. These competitions energized students and early career scientists to confront present-day challenges in horticultural science. Each of the participants from the three winning teams received an ISHS Young Minds Award certificate and one-year membership in the Society. ●

> About the authors



> Monica Vidal

Monica Vidal is a Project Assistant at WUR Student Challenges, a work group of Wageningen University and Research (WUR). As part of a small team, she supports the implementation of signature Challenges organized by WUR in the Netherlands. Signature WUR Student Challenges include the Urban Greenhouse Challenge series, the upcoming ReThink Waste Challenges, and the Nature-based Future Challenges. E-mail: studentchallenges@wur.nl



> Sarah Hoogenboom

Sarah Hoogenboom from Team LettUs Design is a recent Master's graduate from the Architecture Faculty at Delft University of Technology (TU Delft) in Building Technology with a thesis on bio-based materials and urban agriculture. She is interested in tackling interdisciplinary challenges in a circular economy and data-driven design in the built environment. Like many on the LettUs Design Team, she aims for holistic community-building solutions to urban challenges. E-mail: sarahhoogenboom09@gmail.com



> Daniel He

Daniel is the project lead at USC Stack: USC Smart Farming, and second year computer science student at the University of Southern California (USC) in Los Angeles. Daniel seeks to uncover the intersection between modern food systems, scalability in sustainability, and automation of CEA (controlled environment agriculture) techniques. Farm smarter, Farm On! E-mail: hedaniel@usc.edu



> Mees Deknatel

Mees Deknatel from Team AMS Caterpillars is a Master student on the MSc MADE (Metropolitan Analysis, Design and Engineering) program at the Amsterdam Institute for Advanced Metropolitan Solutions (AMS), a joint degree of Delft University of Technology and Wageningen University & Research, The Netherlands. He believes that urban challenges demand smart and interdisciplinary solutions, which can only be developed in collaboration with citizens, research and industry. E-mail: mees.deknatel@ams-institute.org



> Patrícia Duarte de Oliveira Paiva

Patrícia Duarte de Oliveira Paiva is ISHS Board Member responsible for the Young Minds Program and Professor at the Federal University of Lavras, Brazil. As a professor, she teaches Landscaping and Floriculture and has authored many publications and books on these topics. The Young Minds program aims to engage students and early career scientists in Horticulture, supporting different initiatives worldwide. E-mail: patriciapaivaishs@gmail.com