TIMES HIGHER EDUCATION

HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

SUSTAINABLE DEVELOPMENT GOALS

REPORT ON THE SUSTAINABLE DEVELOPMENT GOALS

Reporting 2023

Contents

The UN Sustainable Development Goals

In 2015, the United Nations (UN) Member States embraced the Sustainable Development Goals (SDGs) as a pressing call to action, applicable to all nations, whether developed or developing, through a worldwide collaboration. These goals acknowledge the imperative of simultaneously eradicating poverty and other forms of deprivation while advancing healthcare and education, reducing disparities, stimulating economic advancement, and addressing climate change and its repercussions, such as forced migration, while also striving to protect our natural waters and forests.

The SDGs do not specifically target higher education, the attainment of these goals by 2030 necessitates a collective effort from various sectors and stakeholders, combining financial resources, knowledge, and expertise. This inclusive approach must encompass the assets and contributions of universities and institutions of higher education. The Times Higher Education (THE) Impact Rankings represent the inaugural global endeavour to assess universities' progress with regard to the SDGs. They have the potential to act as a catalyst for mobilizing action, serving as a mechanism to hold universities accountable, and providing them with an opportunity to showcase the significant efforts they are already undertaking in this regard.

In 2022, for the first time in its history, the Hungarian University of Agriculture and Life Sciences (MATE) has been qualified in THE Impact Rankings, a ranking of universities' performance in four areas: research, responsibility, outreach and education. This report aims to summarise the Sustainable Development Goals of MATE for the Impact Rankings 2025 for which the academic year of 2023 has been taken into consideration. We would like to emphasise that MATE, in addition to its scientific activities, has a strong social engagement in each SDG. This report aims to summarise the key research contributions, and to interview our key researchers and academics by SDGs.

About MATE

The Hungarian University of Agricultural and Life Sciences was established on the 1st of February 2021. At the same time, eleven research institutes and companies of the National Agricultural Research and Innovation Centre, the Agricultural Research Institutes of the University of Debrecen and the Research Institute of Karcag have been integrated. MATE is thus not only an educational institution but also a scientific, practical and innovation centre for the sector.

As the largest agricultural university in Hungary, Hungarian University of Agriculture and Life Sciences (MATE) is committed to sustainable development, so the THE Impact Ranking reflect the objectives that the university is committed to. MATE was ranked 601-800 in the 2024 ranking cycle, putting it in the top 30% of ranked universities in the world. This is already an outstanding performance compared to other Hungarian universities. MATE achieved the 4th best ranking among the eleven ranked Hungarian universities.

According to Scopus records, MATE has published more than 4 190 publications in the last five years. More than 49.6% of this was international and 30.4% national cooperation. Although the growth in the number of publications has moderated since 2021, it is clear that the number and proportion of articles published in top journal percentiles and quartiles has significantly increased. This trend is expected to continue.

Figure 1. depicts the topics and clusters to which the researchers have contributed most between 2019 and 2023. The field-weighted citation impact (FWCI), important parameter for describing the performance of the institution, fluctuates. A slight decreasing trend was observed between 2020 and 2022, while it is now on the rise again with a value of 1.28

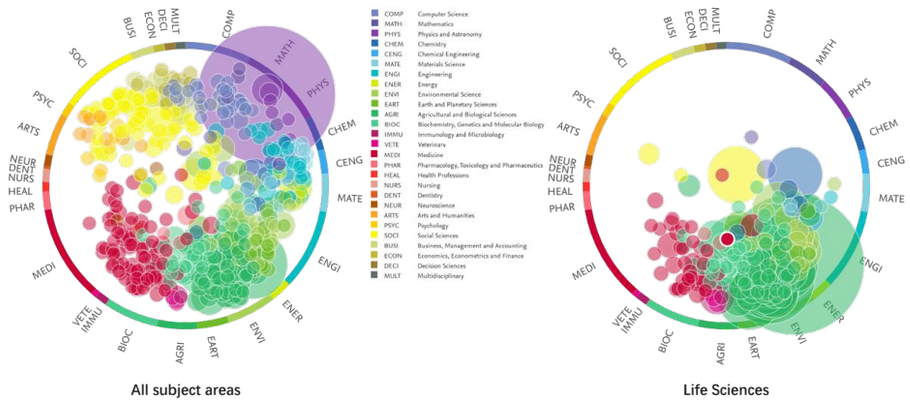

Figure 1. Research topics with significant publication activity between 2019 and 2023.

Figure 2. illustrates how MATE performed for the SDGs of interest to this ranking. This analysis supported our decision on which topics to apply for in the 2025 Impact Ranking data submission. The university provides information on SDG 2, SDG 6, SDG 8, and SDG 15 beside SDG 17.

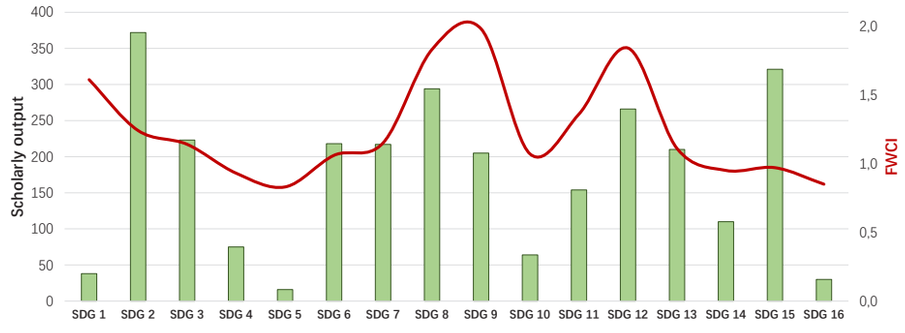

Figure 2. Scholarly output and FWCI evolution by SDGs (2019-2023)

SDG 1

No Poverty

At the Hungarian University of Agriculture and Life Sciences, we view Sustainable Development Goal 1 (SDG 1), "No Poverty," as a fundamental cornerstone of our commitment to sustainable agriculture and rural development. Agriculture is a key sector in Hungary and ensuring that rural communities thrive without facing poverty is central to our mission. We recognize that poverty in rural areas can be particularly challenging, with issues such as limited access to education, healthcare, and economic opportunities. To address this, our institution is dedicated to research, education, and outreach programs that empower rural communities, support sustainable farming practices, and promote equitable access to resources both within and beyond our borders. By fostering an interdisciplinary research environment, we aim to target poverty a lleviation, economic resilience, and resource accessibility, ultimately addressing critical areas such as income inequality and enhancing social equity on a global scale. We believe that by tackling the root causes of poverty and fostering economic growth in rural areas, we can play a vital role in achieving SDG 1 while simultaneously contributing to a more resilient and sustainable agricultural sector for the benefit of all Hungarians.

12
Publications

72
Citations

These commitments are further reflected in our key 2023 research contributions to SDG 1, where targeted studies drive impactful solutions for poverty alleviation and sustainable rural development.

Key 2023 Research Contributions to SDG 1

The university's strategic research initiatives focus on harnessing both economic and environmental sustainability to mitigate poverty in vulnerable populations.

Our research on biofuels as an economic driver for rural communities underscored the potential of renewable energy to foster economic growth and reduce rural poverty (Hasan et al. 2023). By supporting job creation and providing additional

revenue streams, such studies reflect the university's emphasis on sustainable economic development to improve livelihoods in disadvantaged areas. Complementing this focus on renewable energy, another key area of focus was on agricultural sustainability, which directly impacts poverty reduction by enhancing food security and increasing farmer incomes. Studies on sustainable intensification practices, including Climate-Smart and Conservation Agriculture, serve as evidence of the university's approach to enhancing productivity and resilience in agriculture (Ajibade et al. 2023). Such research not only aids smallholder farmers in adapting to climate variability but also aligns with our overarching goal of establishing food security as a foundation for poverty alleviation.

Addressing regional income inequalities is also central to the university's contributions toward SDG 1. By investigating income disparities and economic mobility at local levels, the university's research identifies effective policy interventions for equitable growth. Studies exploring the dynamics of income inequality, particularly in post-crisis settings, underscore the importance of resilient economic frameworks to protect vulnerable communities (Egri 2023b; 2023a). Additionally, the university recognizes the role of global economic integration in poverty reduction. Research examining the impact of foreign direct investment (FDI) on small-medium enterprises (SMEs) demonstrates the university's commitment to understanding how international economic opportunities can support local development and job creation (Bozsik, Ngo, and Vasa 2023). Such insights are crucial for formulating strategies that leverage investment to strengthen local economies and reduce poverty.

Equitable access to essential resources is another pillar of the university's commitment to SDG 1. Comparative studies on economic empowerment, which analyse resource access in diverse socio-political contexts, reveal the importance of equitable financial and technological inclusion in building community resilience and economic stability (Nassar, Naárné Tóth, and Vasa 2023). By prioritizing research that highlights the significance of resource equity, the university underscores its dedication to creating inclusive growth opportunities for marginalized regions.

By focusing on poverty-alleviating research, the university contributes to SDG 1 by tackling the complex factors that drive poverty. Advancing knowledge in renewable energy, sustainable agriculture, regional economic development, and resource accessibility, the university generates practical solutions while reinforcing a global commitment to poverty reduction and social equity. These collective efforts embody the university's mission to support sustainable development, with each initiative bringing us closer to a world free of poverty.

One of the authors of the study entitled *"Mobility and persistence in income inequality processes at the domestic settlement level, 2012–2019"*, **Dr. Zoltán Egri** said that "The study touches on the 'no poverty' SDG 1 topic through the topic of microregional income inequalities. According to the research results, income inequalities in Hungary are characterized by spatially concentrated clustering, which manifests itself in a geographically heterogeneous manner. In addition to the national growth boom after 2012, the income trends experienced in the external and internal socio-economic peripheries of the country show, on the one hand, a relative lag compared to more developed areas, and on the other hand, income inequality processes are characterized by a different mechanism of influence. The low-income situation is largely determined by the role of the past (path dependency), the presence of foreign direct investments, the sectoral structure, and the geographical location of the regions. Since the low-income situation typically characterizes rural areas in Hungary, the role of MATE is outstanding in the effective exploration of agricultural potential and thus in increasing territorial efficiency and reducing poverty."

SDG 2

Zero Hunger

Sustainable Development Goal 2, "Zero Hunger," is the Hungarian University of Agriculture and Life Sciences' most significant commitment, resonating deeply with our mission and expertise. Agriculture is at the heart of our institution, and we recognize that it plays a pivotal role in addressing hunger and food security challenges. We are committed to advancing sustainable farming practices, pioneering agricultural research, and fostering education that enhances food production while protecting the environment. Through outreach initiatives, we strive to boost agricultural productivity, optimize food distribution, and raise nutritional awareness. By equipping future generations with the knowledge and skills to address global food security, we actively support the achievement of SDG 2. Our collaborations with international partners and local stakeholders drive innovative solutions to eliminate hunger, extending our impact far beyond Hungary's borders.

Our dedication to SDG 2 extends beyond research and innovation, finding powerful expression in events like KÁN University Days, where agricultural excellence, community engagement, and sustainable food practices take centre stage.

106
Publications

537
Citations

Celebrating Agricultural Excellence: The Impact of KÁN University Days at MATE

The KÁN University Days, held annually at the Hungarian University of Agriculture and Life Sciences (MATE), is an extraordinary event that brings together nearly 40,000 visitors. 2023 marked the 15th edition of this vibrant celebration, which is not only a hallmark of agricultural innovation but also a platform that fosters collaboration among stakeholders in the agricultural sector.

Beyond serving as an exhibition, the KÁN University Days celebrate agricultural innovation and knowledge exchange. High-level conferences, such as the VI. Fisheries Round Table and the KÁN Precision Animal Husbandry Conference, underscore MATE's commitment to advancing agricultural practices.

Youth engagement is a key focus, with nearly 1,000 secondary school students participating through Vocational School Day. Initiatives like the I. MATE heifer preparation competition offer hands-on experience, inspiring students to pursue careers in agriculture, which is vital for ensuring food security.

The event successfully blends tradition with innovation, featuring the traveling exhibition "My Untraceable Treasure" and the Street of Local Flavors, showcasing local products. Competitions such as the MA-HAL National Fishing Competition promote healthier diets and sustainable food practices.

With cultural offerings like concerts, the KÁN University Days proved to be a vital platform for education, community engagement, and support for Sustainable Development Goal 2: Zero Hunger, underlining MATE's commitment to advancing agriculture and food security.

Key 2023 Research Contributions to SDG 2

The university's research has made significant strides toward Sustainable Development Goal 2 (SDG 2), which focuses on achieving food security, improving nutrition, and promoting sustainable agriculture. A diverse range of studies illustrates this commitment, including enhancing crop resilience, sustainable farming practices, soil health improvement, and the development of renewable energy sources to support agricultural systems.

One notable area of investigation was on mycotoxin control due to climate change which highlights the importance of food safety. By developing advanced decontamination techniques, researchers aim to protect crops from contamination that threatens food security (Loi et al. 2023). Complementing this work is an exploration on crop genetics and domestication, such as the studies on grapevine traits which delivers insights into genetic adaptations that can improve resilience against climate-related stressors, ensuring crop reliability (Dong et al. 2023).

Similarly, studies on renewable energy sources from biofuels from agricultural waste explores their economic potential, reducing dependency on fossil fuels and supporting rural economies. This shift not only reduces environmental impact but also aids in the stability of food production systems by creating alternative income sources for farming communities (Hasan et al. 2023). Parallel research on energy efficiency in agriculture (Benedek, Rokicki, and Szeberényi 2023), and ecosystem service contributions (Lengyel et al. 2023) such as those from silica-scaled organisms that support water and soil quality—underscore the university's commitment to enhancing the efficiency and sustainability of agricultural systems. Together, these initiatives promote sustainable intensification—boosting productivity while safeguarding essential environmental resources.

Another area of focus was on addressing weed resistance and pest management, with a focus on sustainable weed management strategies. The researchers advocate for alternative, non-chemical approaches that protect crop yields while mitigating the environmental impacts associated with chemical herbicides, allowing for sustainable crop production (Ofosu et al. 2023). Additionally, studies on emerging plant pathogens and conservation tillage further highlight the university's commitment to safeguarding food supplies and improving agricultural practices that combat soil degradation (Mwangi et al. 2023).

SDG 2

Zero Hunger

The university's work on organic and sustainable farming practices, demonstrated in studies conducted in Bangladesh and Hungary, highlights the benefits of organic food systems. These practices are crucial for maintaining soil health, promoting biodiversity, and reducing chemical inputs, which in turn improve food quality and yield stability (Akter et al. 2023). Additionally, examining soil organic matter through reduced tillage and other techniques has shown promising results in enhancing soil fertility, which is foundational to sustainable agricultural productivity (Jakab et al. 2023).

Research comparing the effects of climate change on agricultural competitiveness brings valuable insights into how different regions may need unique adaptive strategies, especially in developing countries. The incorporation of indigenous agricultural knowledge supports low-impact, culturally relevant methods that sustain productivity and environmental health, especially in regions with limited access to modern farming technologies (Nugroho, Prasada, and Lakner 2023; Melash et al. 2023).

This extensive research demonstrates the university's proactive role in developing sustainable solutions, reinforcing global food systems, and fostering resilience against environmental and economic challenges in agriculture.
One of the authors of the study entitled "Antifungal mechanisms of volatile organic compounds produced by Pseudomonas fluorescens ZX as biological fumigants against Botrytis cinerea", Dr. Krisztina Takács said that "To explore the antifungal mechanisms of volatile organic compounds produced by Pseudomonas fluorescens ZX against Botrytis cinerea, biochemical analyses and transcriptomic techniques were employed in this work. We established that it occurs primary mechanisms: causing significant damage to the cell membrane, negatively affecting respiration, and interfering with amino acid metabolism. As these volatile organic compounds from natural sources can be potential antifungal agents, their use can reduce the usage of artificial preservatives and chemicals, leading to more sustainable, environmentally friendly technologies. Hungarian team provided the strains and got involved in the microbiological studies. Our collaboration with Chinese colleagues were very fruitful in this study (Yue et al. 2023)".

SDG 3

Good Health and Well-being

Recognizing the critical role that health plays in sustainable development, the Hungarian University of Agriculture and Life Sciences is dedicated to advancing Sustainable Development Goal 3, "Good Health and Well-being." Our institution operates at the intersection of agriculture and life sciences, emphasizing the importance of enhancing food production while also prioritizing the health and well-being of individuals and communities. We understand that a sustainable food system is essential for achieving good health outcomes, and our research, education, and outreach initiatives are strategically designed to support this objective. Through innovative agricultural practices, nutrition education, and interdisciplinary collaborations, we strive to improve access to nutritious food and promote overall well-being, both locally and globally. By aligning our efforts with SDG 3, we aim to foster a healthier and more sustainable world, acknowledging that the health of individuals is intricately connected to the health of our planet.

Our commitment to SDG 3 is further embodied by initiatives like the Hortus Medicus Project, which uniquely combines nature and community to support mental and physical well-being.

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Publications

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The Hortus Medicus Project

The Hortus Medicus project is a pioneering initiative aimed at enhancing the quality of life for individuals facing mental and physical health challenges. By establishing therapeutic gardens, the project addresses barriers to inclusion for disadvantaged populations, harnessing the healing properties of nature to improve mental well-being and foster social connections.
Since its inception, the project has achieved notable milestones, including the development of community gardens designed to create supportive environments for social interaction and personal growth. These spaces not only promote well-being but also serve as venues for educational activities, skill-building, and community engagement, effectively bridging gaps between individuals and society.

The project's interdisciplinary approach is exemplified by its collaboration with a diverse array of partners, including the Hungarian University of Agriculture and Life Sciences, which contributes valuable expertise in agriculture and environmental science. This collaboration fosters a comprehensive understanding of how green spaces can be integrated into therapeutic practices, drawing on insights from psychology, social work, and horticulture.

Aligned with Sustainable Development Goal 3 (SDG 3), which focuses on ensuring healthy lives and promoting well-being for all, the Hortus Medicus project exemplifies the transformative power of nature in supporting mental health and building inclusive communities. Through its ongoing efforts and partnerships, it showcases a commitment to creating nurturing spaces where individuals can thrive and recover.

Key 2023 Research Contributions to SDG 3

Research initiatives from MATE's university scholars significantly contribute to Sustainable Development Goal 3 (SDG 3), "Good Health and Well-being," through diverse areas such as safe water access, pollution control, chronic disease management, and mental health support. One significant study in Yemen's Al-Jawf Basin assessed groundwater quality for safe irrigation by integrating geochemical modelling and machine learning models. This research provides vital data for sustainable water management in arid regions, supporting public health and reducing waterborne illnesses (Al-Mashreki et al. 2023).

Environmental health risks from pollutants were extensively examined, with a study analysing pesticide residues in bee-derived products like propolis and beeswax. This investigation evaluated the health implications of these residues on human consumers and offers critical data to guide policymakers in minimizing chemical exposure risks across food chains, in line with SDG 3's focus on mitigating hazardous chemical exposure (Végh et al. 2023). Another study focused on heavy metal contamination in Hungary's Danube River, identifying toxic elements such as lead and cadmium through advanced simulation models. This research illustrates the ecological and public health impact of pollution and advocates for environmental protections, aligning with SDG 3's emphasis on reducing illnesses from chemical hazards (Saeed et al. 2023).

Addressing chronic diseases, research demonstrated the potential of Lactiplantibacillus plantarum as a preventative measure against conditions like diabetes and obesity. Through animal models and human clinical trials, researchers showed how this probiotic supports gut health by regulating inflammatory responses and improving microbial balance, emphasizing non-pharmaceutical approaches to disease prevention (Tian et al. 2023). This work underlines SDG 3's goal to reduce mortality from non-communicable diseases by promoting affordable health solutions.

The pandemic underscored mental health's role in public health, as reflected in studies on burnout among healthcare workers, particularly oncology nurses and radiographers. Findings highlight the mental health strain experienced in intensive care settings, suggesting resilience strategies essential for healthcare system stability (D. Sipos et al. 2023). Developing mental health support systems and addressing occupational stress aligns closely with SDG 3's goal of ensuring mental well-being across critical workforce sectors.

SDG 3

Good Health and Well-being

In sustainable agriculture, a study documented Ethiopian indigenous agricultural practices, such as using natural pest deterrents like cow urine. These techniques show potential for reducing reliance on harmful pesticides, promoting both food security and environmental health (Melash et al. 2023). Sustainable agricultural practices contribute directly to the health of rural populations and the ecosystems they depend on, promoting health-focused agricultural methods under SDG 3.

Additional research has explored how the COVID-19 pandemic and geopolitical events, like the Russia–Ukraine war, affected financial asset volatility. Such economic stressors can indirectly influence public health by impacting livelihoods and access to healthcare (Taera et al. 2023). Furthermore, studies on customer perceived value in hotel management during the pandemic highlight the importance of maintaining customer trust and satisfaction, which is vital for economic resilience and mental well-being in the tourism sector (Ghorbani, Mousazadeh, et al. 2023).

Overall, these studies highlight the university's dedication to a holistic approach to SDG 3, fostering healthier communities and sustainable practices to protect human health across local and global contexts.

SDG 4

Quality Education

The Hungarian University of Agriculture and Life Sciences (MATE) holds a profound appreciation for Sustainable Development Goal 4, "Quality Education." As a leading institution in agricultural and life sciences education in the region, MATE recognizes education as the cornerstone of progress and development, serving as a fundamental catalyst for a sustainable future. Our commitment to delivering high-quality education fosters a learning environment that empowers students with the knowledge and competencies needed to tackle the complex challenges of today's world. We believe that education goes beyond the mere transmission of information; it cultivates critical thinking, creativity, and a strong sense of social and environmental responsibility. Through our academic programs and research initiatives, we are dedicated to enhancing education in agriculture and life sciences, empowering individuals and communities alike. Our objective is to promote quality education as a driving force toward a brighter and more sustainable future, fully aligned with the principles and goals encapsulated in SDG 4.

Advancing SDG 4, the university exemplifies quality education through initiatives like the Danube AgriFood Master (DAFM), which brings quality education to life by equipping future leaders with essential skills in sustainable agriculture and food systems.

20
Publications

70
Citations

The Danube AgriFood Master (DAFM)

The Danube AgriFood Master (DAFM) program at the Hungarian University of Agriculture and Life Sciences (MATE) exemplifies a commitment to quality education in the agrifood sector, closely aligned with Sustainable Development Goal 4. This innovative two-year, 120 ECTS joint degree program is taught in English and offers a comprehensive curriculum that addresses the entire food supply chain.

DAFM stands out for its internationalization, bringing together students from diverse backgrounds to learn from top-tier educators and researchers across participating universities in Hungary, Austria, Slovenia, and Romania. This collaborative approach enhances the learning experience, providing students with access to unique insights and expertise in ecological and conventional agriculture, food safety, biotechnology, and climate issues.

The program's multidisciplinary focus prepares graduates for critical roles in advancing sustainable practices within the agrifood sector. Students are exposed to best practices and cutting-edge research, empowering them to contribute effectively to global food security and sustainability challenges.

Through the DAFM program, MATE not only cultivates academic excellence but also fosters an environment where students can engage with industry leaders and participate in practical learning experiences, positioning them at the forefront of innovation in agriculture and food technology.

Key 2023 Research Contributions to SDG 4

The university's research initiatives are actively contributing to Sustainable Development Goal (SDG) 4 by fostering inclusive, equitable education and lifelong learning opportunities through interdisciplinary studies that integrate education, sustainability, and health. A series of studies exemplify this commitment by addressing key challenges and opportunities within the realms of sustainability and education.

For instance, studies on sustainable teaching practices, such as the Reflective Teaching Model for Reading Comprehension (RTMRC), have shown how reflective, iterative learning methods can enhance reading comprehension and promote sustainable teaching methods across education sectors (Oo, Habók, and Józsa 2023). This model supports SDG 4.1 and 4.6 by contributing to quality education and literacy.

One significant focus is the intersection of sustainability and education, as seen in the exploration of green insurance policies aimed at promoting sustainable projects in developing countries. This research identifies the barriers to investment in sustainable initiatives, such as limited awareness and inadequate infrastructure, highlighting the critical need for educational programs that inform and empower stakeholders to engage with these policies effectively.

Another key study investigates Green Human Resource Management (GHRM) within the hospitality sector, focusing on the role of sustainable human resource practices. This research underscores the importance of training and education within organizations, thus addressing SDG 4.7 by promoting environmental education and sustainability within workplace culture (Alreahi et al. 2022).

Furthermore, studies on food consumption behaviours among agrarian school students explore how sustainable education can lead to environmentally conscious food choices, supporting SDG 4.7 by integrating sustainability into practical learning (Khademi-Vidra and Bakos Phd 2023). Similarly, research on motivations among Generation Z students for eco-conscious entrepreneurship aligns with SDG 4.4 by emphasizing sustainability-oriented entrepreneurial education (Papp-Váry, Pacsi, and Szabó 2023).

SDG 4

Quality Education

The university also prioritizes health in education, as demonstrated in a longitudinal study on burnout reduction among medical students during the COVID-19 pandemic. Findings underscore the importance of resilient learning environments, advancing SDG 4.4 by contributing to effective learning strategies in health education (David Sipos et al. 2023). Research on educational collaboration models and pro-environmental behaviours further enriches the university's commitment to comprehensive quality education.

Together, these interdisciplinary studies highlight the university's contribution to SDG 4 by embedding sustainable practices, fostering lifelong learning, and promoting well-being across academic and practical learning environments.

One of the authors of the study, *"Reduced burnout in medical and health science students during the pandemic COVID-19 - a follow-up study of a single institution in Hungary"*, **Dr. Melinda Petőné Csima** said: "The COVID-19 pandemic has had a significant impact on the lives of students enrolled in medical and health sciences training worldwide. In Hungary, education largely shifted to online platforms, and a considerable portion of students were required to participate in medical deployments. Increased stress, uncertainty, and the demands of these medical assignments may have contributed to premature burnout among students. Our research aimed to assess burnout among students pursuing medical and health sciences studies, exploring the effects of medical deployments and the COVID-19 pandemic on their mental health through a quantitative, descriptive, and longitudinal study. Our findings highlight that medical deployment positively influenced students' burnout scores. This suggests that practical experience in real-world settings enhances students' sense of self-efficacy, making them less prone to burnout. Therefore, when designing training programs, it is essential to incorporate more real-world practice opportunities from the early stages of education. Although our study focused specifically on students in the medical and health sciences fields, we believe that our findings may be extrapolated to other training fields as well".

SDG 5

Gender Equality

Gender equality is a core principle at the Hungarian University of Agriculture and Life Sciences, guiding our values and practices. We strive to create an inclusive environment where everyone has equal opportunities and is treated with respect. This commitment reflects our belief that gender equality is vital for social and economic progress. Our educational programs, research initiatives, and policies focus on empowering women and eliminating gender-based discrimination. Through education and collaboration, we aim to ensure that all individuals can reach their full potential and contribute to a sustainable and equitable society, in line with the goals of SDG 5.

One of our standout initiatives supporting gender equality is the AGRIGEP Horizon Europe project, a collaborative effort to implement Gender Equality Plans across agriculture and life sciences institutions, paving the way for lasting change.

AGRIGEP Project

The AGRIGEP Horizon Europe project launched on January 1, 2023, is a vital initiative coordinated by the Hungarian University of Agricultural and Life Sciences (MATE). With a grant of €218,413, the project aims to assess and implement the first Gender Equality Plans (GEPs) in agriculture and life sciences universities across widening countries.

5
Publications

5
Citations

MATE leads a consortium that includes the Czech University of Life Sciences (CZU), the University of Primorska, Universitat Politcnica de Catalunya BarcelonaTech, Yellow Window, and the Association of Hungarian Women in Science (NaTE). This project addresses gender inequality, which significantly limits the potential of research and educational institutions in Research and Development (R&D).

While the EU mandates GEPs in R&D, unique challenges in agriculture and life sciences require tailored solutions. AGRIGEP

aims to assess the capacities of partner institutions for effective GEP implementation, enhance these capabilities through training, and promote long-term structural reforms.

The project will develop training materials focused on gender equality, particularly for international students from developing countries with pronounced gender disparities. Additionally, it seeks to establish a knowledge-sharing network to sustain GEP efforts beyond the project's duration.

By contributing to Sustainable Development Goal 5 (Gender Equality), AGRIGEP aims to promote an inclusive environment in agricultural education. Ultimately, it strives to ensure that all individuals can thrive in academia and contribute to sustainable development, advancing social equity within the European Research Area.

Key 2023 Research Contributions to SDG 5

The university's research significantly advances SDG 5, "Gender Equality," by addressing gender disparities and empowering women in various educational, economic, and social domains. Research exploring fine motor skills development in young children highlights notable gender-based differences in skill acquisition, underscoring the need for equitable and inclusive educational frameworks (Józsa et al. 2023). Additionally, studies in music education show that mastery motivation and self-concept differ across genders, promoting insights to support equal participation and foster confidence in music learning among female students (Janurik et al. 2023).

Further research addresses economic empowerment through agritourism, focusing on rural Tunisian women's entrepreneurial behaviour, demonstrating how targeted training and support networks can lift women's socio-economic status (Khazami, Nefzi, and Yahyaoui 2024). Another study examines women's social cooperatives, emphasizing the importance of community support in enabling women's economic independence and leadership (Durmishi, Bazsik, and Farkas 2023). Lastly, gender differences in career planning among young adults reveal disparities in career preparedness, urging policies that promote equal access to career resources and address gender-based career expectations (Rudnák et al. 2023).

Together, these studies illustrate the university's commitment to SDG 5, advancing gender equality through research that informs policy, encourages gender-sensitive educational practices, and promotes women's economic and social empowerment. The university actively contributes to reducing gender disparities across various cultural and economic contexts through these impactful research endeavours.

Two of the authors of the study, *"Exploring the Growth and Predictors of Fine Motor Skills in Young Children Aged 4–8 Years"*, **Prof. Dr. Krisztián Józsa** and **Dr. Gabriella Zentai** said: "In this study, Józsa et al. (2024) investigated various aspects of fine motor skills (FMS) development among 3050 young children from Hungary and Slovakia from age 4 to 8. The Fine motor skills (FMS) are fundamental for children's growth, influencing their writing progress and everyday activities. The findings from this study clearly demonstrate that gender and age levels significantly impact the FMS development of young children from both countries. The higher FMS development observed in female students aligns with existing literature on gender differences in motor abilities during early childhood. Understanding the influence of gender and age on FMS development can aid in tailoring educational practices to cater to the specific needs of children at different developmental stages".

The Hungarian University of Agriculture and Life Sciences prioritizes Sustainable Development Goal 6, which centres on "Clean Water and Sanitation." Clean water is vital for life, agriculture, and the environment. We emphasize research, education, and innovation in water management, environmental science, and agriculture to foster sustainable practices that safeguard water resources for future generations.

Through our academic programs, research initiatives, and community outreach, we address clean water and sanitation challenges in Hungary and beyond. We understand that access to safe and clean water is essential for health and well-being. Our commitment to achieving SDG 6 underscores our mission to promote a more sustainable and equitable world.

This dedication to clean water and sanitation is exemplified by our innovative wastewater treatment collaboration with Chinese researchers, aimed at mitigating antibiotic contamination and ensuring the sustainable management of water resources.

38
Publications

206
Citations

Innovative Wastewater Treatment: Hungarian-Chinese Collaboration Tackles Antibiotic Resistance

Hungarian and Chinese researchers from the Energy Research Centre, the MATE Institute of Food Science and Technology, and Tsinghua University in Beijing have collaborated to develop an innovative wastewater treatment technology aimed at tackling the growing concern of antibiotic contamination. Supported by the National Research, Development and Innovation Fund through the Sino-Hungarian TéT tender program, this project focuses on post-treatment techniques that utilize high-energy ionizing radiation to treat effluent from wastewater treatment plants.

The research demonstrated that the irradiation effectively destroys both penicillin-type (β-lactam) and tetracycline-type antibiotics at doses of 1-2 kGy. Furthermore, the study revealed that even a low dose of 0.6 kGy can degrade the mecA gene responsible for antibiotic resistance in Staphylococcus aureus, thereby potentially curbing the spread of resistant strains.

Dr. Ágnes Belák, an associate professor at MATE, emphasized that even small doses of irradiation significantly reduce bacterial DNA in the environment, lowering the chances of resistant strains developing through natural recombination processes. As irradiation doses increase, the destruction of genetic material intensifies, further decreasing the potential for resistant microbes to emerge. This research not only addresses critical public health concerns but also contributes to achieving Sustainable Development Goal 6, which aims to ensure availability and sustainable management of water and sanitation for all. By enhancing wastewater treatment processes, this project plays a vital role in protecting water resources and promoting public health.

Key 2023 Research Contributions to SDG 6

The university's research portfolio demonstrates a robust commitment to addressing the challenges of water sustainability, aligning closely with Sustainable Development Goal 6 (SDG 6). Through a multidisciplinary approach, researchers are addressing critical challenges related to water quality, management, and ecosystem health. Their innovative work is making significant strides in promoting sustainable practices, enhancing community engagement, and safeguarding water resources for future generations.

One of the notable contributions involves investigating groundwater quality and its implications for human health and ecology. Research by Al-Omari et al. (Al-Mashreki et al. 2023) focuses on the Al-Jawf Basin in Yemen, integrating geochemical modelling and multivariate analysis to assess groundwater quality. Their findings highlight the necessity of effective monitoring systems, which is crucial for maintaining safe water resources as outlined in SDG 6.3. The implications of their work extend to informing local policy on water management and sustainability practices.

Furthermore, the university's focus on the impacts of heavy metal pollution underscores the urgency of maintaining water quality standards. Investigations into the ecological and health effects of metal(loid)s in the Danube River reveal the critical link between water pollution and broader environmental health (Saeed et al. 2023; Wang et al. 2023). These studies advocate for improved regulatory frameworks and remediation strategies to protect water bodies from contamination, contributing to SDG 6.3's aim of reducing pollution.

In agricultural contexts, research addressing sustainable water management and agricultural practices is crucial for advancing the objectives of SDG 6. Several studies highlight effective strategies for optimizing water use in agricultural systems. For instance, Kocsis et al. (Zima 2023) investigate the influence of irrigation and fertilizer doses on sweet corn yield, revealing how precision agriculture can enhance water-use efficiency while ensuring high productivity levels. Similarly, the research conducted by Sárközi et al. (Kalybekova et al. 2023) focuses on minimizing seepage in irrigation canals, emphasizing the importance of innovative technologies in reducing water loss during distribution. Furthermore, Németh et al. (Waltner et al. 2023) explore the broader implications of climatic factors on the water footprint of dairy cattle production, underscoring how strategic management

practices can optimize water use in livestock farming. These studies collectively reflect a commitment to enhancing water-use efficiency and implementing sustainable agricultural practices, addressing various aspects of water management and conservation, and aligning with the targets outlined in SDG 6 (Zima 2023; Kalybekova et al. 2023; Waltner et al. 2023).

The university's research also addresses the significance of wastewater management and the reuse of treated effluent. Studies exploring the effects of applying treated wastewater on crop yield and quality demonstrate the potential for reusing water in agricultural systems, thus contributing to the efficient management of water resources and supporting the aims of SDG 6.2 regarding access to safe and affordable drinking water and sanitation (Nurika et al. 2023).

Additionally, the integration of advanced technologies in water resource management is a recurring theme. Research employing machine learning algorithms for monitoring excess water inundations illustrates how technological advancements can optimize water management practices (Kajári, Bozán, and Van Leeuwen 2023). By implementing such innovative solutions, the university's work enhances the capacity for effective water resource management, aligning with the targets of SDG 6.5

Through these diverse research efforts, the university is contributing to the holistic management of water resources, promoting cultural heritage, and fostering sustainable tourism, thus aligning closely with the objectives of SDG 6 and ensuring a cleaner, more equitable water future.

One of the authors of the study, *"Combined Omics Approach Reveals Key Differences between Aerobic and Microaerobic Xylene-Degrading Enrichment Bacterial Communities: Rhodoferax–A Hitherto Unknown Player Emerges from the Microbial Dark Matter"*, **Prof. Dr. András Táncsics** said: "The Environmental Microbiology Research Group of the Molecular Ecology Department investigates the biodegradation of petroleum hydrocarbons in subsurface ecosystems. Since petroleum hydrocarbon contaminations considerably threaten drinking water reservoirs, their removal through biodegradation is crucial. Our research group is focusing on those microorganisms, which have the ability to degrade aerobically the contaminants even in the presence of tiny amount of oxygen. Latest results shed light on the fact that potentially microaerophilic bacteria play key role in the degradation of aromatic hydrocarbons in oxygen-limited, contaminated subsurface environments. Our findings will potentially affect future bioremediation procedures applied at these sites".

SDG 7

Affordable and Clean Energy

The Hungarian University of Agriculture and Life Sciences is dedicated to the principles of Sustainable Development Goal 7, "Affordable and Clean Energy." We understand that access to clean and affordable energy sources is essential for sustainable development, agricultural practices, and environmental protection. Our institution focuses on researching and promoting energy-efficient technologies, renewable energy sources, and sustainable agricultural practices. We engage in education, innovation, and the sharing of knowledge to tackle challenges related to energy access, security, and sustainability. By advancing research and education in agriculture, environmental science, and renewable energy, we aim to contribute to a future where clean and affordable energy is accessible to all, fostering both economic growth and environmental stewardship. We view SDG 7 as a foundational element for achieving a more sustainable and prosperous world and are committed to playing an active role in realizing this goal.

Our dedication to affordable and clean energy is further exemplified by the innovative work conducted at the Energy Testing Laboratory, where researchers are pioneering renewable energy solutions to promote sustainability and environmental stewardship.

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Publications

435
Citations

Exploring Renewable Energy at MATE's Energy Testing Laboratory

The Energy Testing Laboratory at the Hungarian University of Agriculture and Life Sciences (MATE) plays a crucial role in advancing sustainable energy solutions in Hungary and beyond. Led by Dr. András Béres, the lab's specialists are dedicated to investigating the potential of alternative and renewable energy sources, with a particular focus on biomass. This organic material, sourced from agricultural and forestry by-products, offers a continuously renewable and carbon-neutral energy option.

Dr. Béres emphasizes the importance of their work, stating, "We examine solid biofuels to ensure they meet quality standards

and contribute effectively to energy sustainability. Our tests provide essential data on combustion properties, emissions, and overall efficiency." These efforts not only enhance the understanding of biomass as an energy source but also support the development of cleaner technologies for energy production.

The laboratory has achieved significant milestones, including comprehensive assessments of various biofuels and the establishment of a knowledge base that informs manufacturers and users alike. By focusing on both energy efficiency and emissions reduction, the lab addresses pressing environmental concerns, making it critical to Hungary's energy landscape and its commitment to sustainable practices.

In alignment with Sustainable Development Goal 7: Affordable and Clean Energy, the Energy Testing Laboratory's research is vital for transitioning to renewable energy sources. By promoting the use of biomass and improving energy efficiency, the lab contributes to a more sustainable energy future, fostering environmental protection and economic resilience on a global scale.

Key 2023 Research Contributions to SDG 7

The university is actively advancing efforts to ensure universal access to modern energy solutions, particularly in underdeveloped and developing regions. Research initiatives focus on innovative technologies that enhance energy accessibility and affordability, such as converting biowaste into energy, which addresses the dual challenge of waste management and energy supply. For instance, one study demonstrates how biowaste can be leveraged for energy production, providing a sustainable energy source for communities with limited access to conventional energy systems (Usmani et al. 2023). Furthermore, research into the potential use of bamboo resources highlights its viability as a sustainable energy source, reinforcing the university's commitment to improving energy access through renewable resources (Liang et al. 2023). The university also examines practical applications, such as solar dryers that enhance food preservation and reduce reliance on non-renewable energy, ultimately contributing to food security and energy access for smallholder farmers (Ali, Kurjak, and Beke 2023). Through these diverse research efforts, the university demonstrates its dedication to promoting equitable energy access aligned with SDG 7.

In addition to promoting access, the university prioritizes increasing the share of renewable energy in the global energy mix. Research on hybrid solar collector systems reveals innovative designs that significantly improve energy efficiency and capture, facilitating broader adoption of solar technologies (Alshibil, Farkas, and Víg 2023). Investigations into geothermal systems demonstrate their potential as a reliable energy source for heating educational buildings, highlighting the university's commitment to integrating renewable energy solutions into campus operations (Smith et al., 2023). Furthermore, the analysis of the Hungarian electricity industry structure emphasizes the need for a greater focus on renewables, advocating for policy reforms that support the transition towards a low-carbon energy future (Bozsik, Szeberényi, and Bozsik 2023). These initiatives underscore the university's role in advancing renewable energy solutions to meet the growing global demand.

The university is dedicated to promoting research and technology transfer in renewable energy, fostering innovation and practical applications that can significantly impact sustainable energy practices. A study on the state-of-the-art and future directions of machine learning for biomass characterization emphasizes how advanced

computational techniques can enhance biorefinery processes, leading to more efficient conversion of biomass into renewable energy (Velidandi et al. 2023). Research on converting biowaste into energy showcases the application of microwave-assisted valorisation technologies, demonstrating how these methods can facilitate the transition to sustainable energy sources in diverse communities (Usmani et al. 2023). Additionally, the design and simulation of solar chimney power plants indicate significant advancements in renewable energy technology that can be adopted in hot and arid regions (Ali, Kurjak, and Beke 2023). Moreover, the examination of artificial microbial consortia to enhance lignocellulosic biomass degradation illustrates innovative biological approaches to improving biomass conversion efficiency (Vu et al. 2023). Through these initiatives, the university exemplifies its commitment to facilitating the advancement and dissemination of renewable energy technologies, thereby contributing to the objectives of SDG 7.

The university is at the forefront of expanding the use of renewable energy sources through innovative research and practical applications. A comprehensive study on the potential use of bamboo resources emphasizes its viability as a sustainable energy source, particularly in regions where traditional energy access is limited (Liang et al. 2023). Research into hybrid solar collectors showcases advancements that enhance energy capture and efficiency, contributing to the broader adoption of solar technology in both residential and commercial settings (Alshibil, Farkas, and Víg 2023). Additionally, experimental investigations into the performance of ground-mounted solar photovoltaic systems reveal insights into their ecological impacts and optimization strategies, thereby promoting more sustainable practices in renewable energy deployment (Williams et al., 2023). Furthermore, the examination of the effects of renewable energy on biodiversity highlights the need for careful planning in solar and wind energy projects to mitigate environmental impacts while maximizing renewable energy generation (Szabadi et al. 2023). Through these diverse research efforts, the university demonstrates its commitment to fostering a transition toward a more sustainable energy future, aligning with the objectives of SDG 7.

One of the authors of the study, *"Experimental study of PCM-enhanced building envelope towards energy-saving and decarbonisation in a severe hot climate"*, **Dr. Márta Szabó** said: "Phase change materials (PCMs)-enhanced building envelope has received much attention in recent years as an effective solution to enhance building thermal performance. Our research aims to quantify the indoor temperature improvement and energy-saving when PCM is passively incorporated into a building envelope under different conditions i.e., non-ventilated conditions. The study experimentally investigated and quantified the thermal behaviour and benefits of incorporating phase change material (PCM) into a building envelope under severe hot summer conditions.

A comparison between rooms was verified by evaluating some concepts, namely the average indoor temperature reduction (AITR), thermal load levelling (TLL), average heat gain reduction (AHGR), CO_2 emission saving (CO_2 ES) and electricity cost saving (ECS). Generally speaking, even though the rooms experienced high solar radiation during the experimental period, the outcomes showed that PCM incorporation provided positive benefits. In this regard, an AITR of about 2 °C was attained with up to 8.71 % TLLR, indicating significant advances in indoor temperature. The PCM performed better with the roof than with walls due to the high PCM quantity involved and long-time exposure to high solar radiation, sharing about 40 % of the energy-saving potential. A total AHGR of up to 56 W was achieved daily, resulting in 1.35 kg/day CO_2 ES and 80.64 IQD/day ECS. These findings demonstrate the advantage of incorporating PCMs in buildings of countries that still rely primarily on traditional

sources for power generation to meet energy demand, such as Iraq, intending to mitigate CO_2 emissions and save energy, which end up with significant energy, environmental and economic contributions to the building sector in hot regions."

One of the authors of the study, *State-of-the-art and future directions of machine learning for biomass characterization and for sustainable biorefinery*, **Prof. Dr. Quang Duc Nguyen** said: "Research group from Department of Bioengineering and Alcoholic Drink Technology, Institute of Food Science and Technology, MATE has successfully performed some projects regarded to production of ethanol as renewable biofuel from different biomasses such as wheat-straw, Jerusalem artichoke, cereals, whey, cellulose, hemicellulose etc. These projects were generally developed and carried out in cooperation with national (Hungrana Kft., Gyori Szeszgyar es Finomito Zrt., Pannonia Ethanol Zrt., Norwegian University of Life Science, Biorefining and Advanced Materials Research Centre, SRUC, Circular Bioeconomy Research Group, Shannon Applied Biotechnology Centre, Munster Technological University, Ireland etc.). The outcomes significantly contributed to the understanding renewable energy, improvement of alcoholic fermentation technology, new development of pretreatment methods for biomasses, energy-saving distillation technology as well as improving the security and stability of energy supply."

The Hungarian University of Agriculture and Life Sciences supports Sustainable Development Goal 8, which focuses on "Decent Work and Economic Growth." We believe that economic growth is best achieved through the creation of dignified job opportunities. Our goal is to equip future professionals with the skills and knowledge needed for meaningful careers in agriculture, life sciences, and environmental sustainability.

We promote inclusive economic development, aiming to reduce unemployment and support sustainable agricultural practices. Through our academic programs and research, we work to influence policies that enhance job creation, protect labour rights, and encourage fair economic practices. By embracing the principles of SDG 8, we envision a future where dignified employment is accessible to everyone and economic growth benefits all, paving the way for a brighter future.

In line with our commitment to decent work and economic growth, the Accelerate Future HEI project exemplifies our proactive approach to enhancing the entrepreneurial capacities of higher education institutions, ensuring that they effectively contribute to a resilient and future-ready workforce.

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Publications

702
Citations

The Accelerate Future HEI Project

The Accelerate Future HEI project aims to transform higher education institutions (HEIs) across Europe by boosting their entrepreneurial and innovative capabilities. The Hungarian University of Agriculture and Life Sciences (MATE) collaborates with partners like TUM International GmbH, Instituto Superior Técnico, and UC Leuven to support economic and social development. This international partnership enables HEIs to assess their current capacities, develop acceleration services, and create tailored "transformation roadmaps."

The project offers targeted skills development programs that provide HEI staff with the knowledge and tools necessary to cultivate a culture of entrepreneurship and innovation. An independent acceleration board oversees these strategies to ensure quality and promote institutional growth. Additionally, the project generates policy feedback for the European Commission, sharing best practices and insights to maximize impact.

Aligned with Sustainable Development Goal 8 (SDG 8), which emphasizes inclusive economic growth and decent work for all, the Accelerate Future HEI project helps HEIs create sustainable solutions for workforce development. By fostering innovation, promoting job creation, and supporting lifelong learning, the project enhances HEIs' ability to adapt to changing market needs. Ultimately, this initiative seeks to empower HEIs as key drivers of sustainable economic growth and resilience, contributing to a future-ready workforce across Europe.

Key 2023 Research Contributions to SDG 8

Sustainable Development Goal 8 (SDG 8) aims to promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. The research initiatives at our university significantly contribute to these objectives through various interdisciplinary studies focusing on sustainable practices, economic development, and innovation across different sectors.

One prominent area of research is the exploration of sustainable biofuel economies, where scholars conducted bibliometric analyses to map out the economic potential of biofuels. These studies highlight the interconnection between renewable energy production and sustainable economic growth, showcasing how biofuels can serve as an alternative to fossil fuels, reduce dependency on non-renewable resources, and support rural development through job creation (Hasan et al. 2023). The emphasis on developing sustainable biofuel markets aligns with SDG 8 by fostering economic activities that create decent work while promoting environmentally friendly practices.

Research on smart tourism destinations also plays a crucial role in achieving SDG 8. By systematically reviewing existing literature, our researchers identified how smart tourism initiatives can enhance local economies while minimizing environmental impacts. The findings underscore the need for integrating technology in tourism to optimize resource use, reduce waste, and improve visitor experiences, thereby contributing to the local economy (El Archi, Benbba, Nizamatdinova, et al. 2023). This research promotes tourism as an economic driver while emphasizing the importance of sustainability in the sector.

The study of current trends in sustainable organization management provides insights into how organizations can adopt sustainable practices that contribute to economic resilience. This bibliometric analysis reveals the increasing recognition of sustainability in organizational strategies, fostering a culture of responsible management that aligns with SDG 8 objectives ((Ogutu, Archi, and Dávid 2023).

Another significant contribution comes from studies on green human resources management (GHRM) within the hotel industry. By analysing barriers and facilitators to implementing GHRM practices, the research equips decision-makers with insights to enhance employee engagement and organizational performance while

promoting sustainable practices. This alignment of human resource management with environmental goals underscores the critical role of businesses in achieving SDG 8 through responsible management practices that lead to enhanced job satisfaction and productivity (Alreahi et al. 2022).

The research examining the relationship between the tourism economy and ecological environment in the Yangtze River basin illustrates the necessity of balancing economic activities with environmental preservation. By analysing the decoupling of tourism growth from environmental degradation, this study informs policymakers on sustainable tourism practices that ensure regional sustainability while enhancing local livelihoods (Zhu et al. 2023). Such insights are vital for creating frameworks that allow for economic growth without compromising environmental integrity.

By addressing critical areas such as sustainable biofuel economies, smart tourism, sustainable organization management, and green human resource management practices, our scholars are not only enhancing knowledge in these fields but also providing practical solutions that promote inclusive and sustainable economic growth. Through these research efforts, the university plays a pivotal role in fostering innovation and sustainability, ultimately contributing to a more resilient and equitable global economy.

One of the authors of the study, *"Theoretical Nexus of Knowledge Management and Tourism Business Enterprise Competitiveness: An Integrated Overview"*, **Prof. Dr. Lóránt Dénes Dávid** said: "The Sustainable Development Goals (SDGs) and our paper, "Theoretical Nexus of Knowledge Management and Tourism Business Enterprise Competitiveness: An Integrated Overview," are connected through the emphasis on enhancing business practices for sustainable growth. Knowledge management plays a pivotal role in fostering innovation and operational efficiency, which aligns with SDG 8, promoting sustained, inclusive economic growth and decent work for all. The tourism sector's competitiveness can drive regional development and job creation, contributing to SDGs such as poverty reduction (SDG 1) and responsible consumption and production (SDG 12). Moreover, by integrating sustainable practices into tourism enterprises, the paper indirectly supports SDG 13, which focuses on climate action. Knowledge management helps businesses adapt to changing environments, making tourism more resilient and sustainable. Ultimately, our research bridges the gap between improving enterprise competitiveness and achieving global sustainability targets".

One of the authors of the study, *"Converting biowaste streams into energy–leveraging microwave assisted valorization technologies for enhanced conversion"*, **Prof. Dr. Quang Duc Nguyen** said: "Food industry and food supply chain huge amount of biowaste emit annually that on one hand causing the pollution in the environment, and on the other hand decreasing the rentability of the company and thus indirectly decrease the production efficacy and threaten the job security. From this point of view, the processing biowaste (agro-food waste) to produce value-added product will increases the efficiency of food production and supply sectors and contributes to maintain the sustainable production system. This also contribute to maintain the growth economic system and thus generating more jobs in the food sector. Members of Bioengineering Research Group conducted studies on the valorisation of food biowaste for many years in frame of circular bioeconomy and in cooperation with many national and international partners. Our focused wastes were agriculture waste such as straw, plant-based wastes from supply chains, whey, blood, skin, hair, etc. Outcomes of projects help to decrease the emission amount of food wastes and to increase the sustainability and rentability of entrepreneurs".

SDG 9

Industry, Innovation and Infrastructure

Sustainable Development Goal 9, "Industry, Innovation, and Infrastructure," closely aligns with the mission of the Hungarian University of Agriculture and Life Sciences. As a dedicated institution in agricultural sciences and environmental sustainability, we recognize the critical role that industry, innovation, and infrastructure play in driving economic growth and promoting sustainable practices.

We prioritize research and education in agricultural technology, food production, and environmental conservation, actively contributing to the development of modern infrastructure that meets society's evolving needs. By fostering a culture of innovation and entrepreneurship among our students, we equip them with the skills and knowledge necessary to tackle global challenges in agriculture, life sciences, and environmental stewardship.

Our commitment to developing sustainable, technologically advanced solutions aims not only to benefit our region but also to create a positive impact on a global scale. In alignment with SDG 9, we dedicate ourselves to advancing industry, innovation, and infrastructure as catalysts for a more sustainable and prosperous future.

In pursuit of our goals for industry, innovation, and infrastructure, the REPurpose Project stands as a prime example of how collaborative efforts can lead to sustainable advancements in materials science and environmental stewardship.

49
Publications

261
Citations

The REPurpose Project

The REPurpose Project is an innovative initiative in which the Hungarian University of Agriculture and Life Sciences (MATE) is a key partner, alongside collaborators from various countries, including Germany, Italy, Spain, Belgium, and Austria. This project focuses on transforming local post-consumer waste into high-value Recyclable Elastomeric Polymers (REP). By upcycling materials that typically pose recycling challenges, the project aims to address significant sustainability issues within the thermoplastic elastomer market.

Through advanced processes, the REPurpose Project incorporates new building blocks derived from biomass and enzymatically degraded organic or plastic waste. This approach results in polymers with tunable elastomeric properties, minimizing the need for additives while enhancing production efficiency. The project emphasizes controllable degradation in various environments, allowing for unprecedented indefinite recycling, thus reducing reliance on fossil carbon at each recycling stage.

With a strong emphasis on interdisciplinary collaboration, the REPurpose Project aligns with Sustainable Development Goal 9, particularly in enhancing industrial innovation and sustainable practices. This partnership aims to pioneer sustainable solutions in the polymer industry, fostering technological advancements and promoting a circular economy. As a partner, MATE supports the development of innovative solutions that exemplify collaborative efforts leading to advancements in sustainability and resource efficiency.

Key 2023 Research Contributions to SDG 9

As part of our commitment to Sustainable Development Goal 9 (SDG 9), our university's research has made significant strides in fostering sustainable infrastructure, industrialization, and innovation. Through studies on internal branding's impact on financial performance and brand loyalty, we demonstrate how strong organizational practices enhance economic resilience, crucial for building sustainable economic foundations (Soleimani et al. 2023). Additionally, research on green insurance and remanufacturing practices within supply chains shows that innovative financing mechanisms and collaborative manufacturing can improve market resilience and reduce environmental impacts (Karmakar et al. 2023).

Our university is at the forefront of sustainable industrialization research. Machine learning applications in biomass characterization and biorefineries offer pathways to efficient, eco-friendly energy solutions, aligning with green industrial growth (Velidandi et al. 2023). Research on biomethane utilization and sustainable poultry production further underscores our commitment to renewable energy and waste-to-energy systems, which enhance resource efficiency and minimize environmental impact (Üveges et al. 2023). Meanwhile, studies on sustainable food additives reflect our focus on eco-friendly practices in the food industry, emphasizing industry shifts toward sustainability (Nazaruddin et al. 2023).

Innovation plays a central role in our university's contributions to SDG 9, as seen in research on digitalization in tourism, which demonstrates how virtual reality can support sustainable tourism by reducing travel emissions (El Archi, Benbba, Zhu, et al. 2023). Similarly, studies on optimizing energy efficiency in vertical farms and solar photovoltaic technologies highlight the potential of technological innovation to improve resource use and reduce energy demand in agriculture and energy sectors (Pimentel, Balázs, and Friedler 2023).

Research on financial access in emerging markets further supports inclusive growth by emphasizing the role of venture capital in supporting sustainable entrepreneurship. Our study on Kenya's Silicon Savannah showcases how improved access to funding drives local innovation and economic development, aligning with SDG 9's goals of inclusive industrialization (Ogachi and Zoltan 2023).

Lastly, our research and development (R&D) initiatives underscore sustainable practices. Studies on solar collector efficiency, hybrid nanofluids, and bioplastic biodegradability illustrate the potential for renewable energy and sustainable materials to contribute to a circular economy, reducing waste and promoting sustainable production (Ajeena, Farkas, and Víg 2023). Through these contributions, our university reaffirms its role in advancing global sustainability objectives by promoting resilience, inclusion, and innovation in line with SDG 9.

SDG 10

Reduced Inequality

Sustainable Development Goal 10, "Reduced Inequalities," aligns with the mission of the Hungarian University of Agriculture and Life Sciences (MATE). We prioritize creating an inclusive environment where all individuals, regardless of their background, have access to education and opportunities. Our commitment to reducing disparities in agriculture, life sciences, and environmental sustainability drives our educational programs and research initiatives.

At MATE, we empower marginalized communities and promote diversity by ensuring equitable access to knowledge and skills. By addressing inequalities within the agricultural sector and environmental conservation, we aim to foster a more just society. We believe that supporting underprivileged communities and promoting equal opportunities can help build a future where everyone can thrive and make meaningful contributions to society.

By promoting inclusive practices and equitable access to resources, our initiatives in the Szabolcs-Szatmár-Bereg area exemplify our dedication to supporting local economies while ensuring that marginalized communities benefit from innovative agricultural practices.

21
Publications

83
Citations

The development of the complex system of fruit cultivation and processing in the Szabolcs-Szatmár-Bereg area for the sake of efficient and sustainable economic operation

The project was successfully implemented from 2020 to 2023, with a budget of HUF 1.49 billion, of which HUF 961.47 million was subsidized. The initiative aimed to produce high-value final products from the region's traditional fruits, leveraging innovative preservation and production technologies to access both domestic and international markets.

The Hungarian University of Agriculture and Life Sciences (MATE) played a crucial role as a key partner in this project.

Collaborating closely with AGRICOLAE Agricultural, Commercial and Service Kft., MATE contributed its extensive knowledge and innovation capabilities to achieve the project's objectives. These objectives centred around three main topics: developing a complex quality management system for efficient raw material production, creating technologies for high-value products, and marketing Szatmár fruits.

The project also focused on enhancing the entire food chain, from field to table, by introducing modern agricultural practices and post-harvest technologies. MATE's involvement ensured that producers received the necessary training and support, fostering a collaborative approach to knowledge sharing. As a result, the project successfully established a foundation for the sustainable cultivation and processing of fruits in the region, promoting economic growth and innovation in the agricultural sector.

Key 2023 Research Contributions to SDG 10

As a leading institution committed to advancing knowledge and social equity, our university actively contributes to achieving Sustainable Development Goal 10 (SDG 10), which aims to reduce inequality within and among countries. Through diverse research outputs, our faculty and students explore various dimensions of inequality, generating insights that inform policy and practice.

Our research highlights the mobility and persistence of income inequality at the domestic level, revealing structural barriers that hinder equitable economic growth. By analysing income dynamics, we have provided valuable recommendations for policymakers to enhance mobility for marginalized populations. Furthermore, our investigations into local dimensions of regional income inequalities demonstrate that geographical proximity to urban centres correlates with better income levels. This emphasizes the need for targeted interventions to enhance access to resources and opportunities in underdeveloped regions (Egri 2023a).

Access to financial services is another critical area where our research has made a significant impact. Our analysis of credit risk determinants in Ethiopian commercial banks has uncovered disparities in credit access among various socioeconomic groups. This work advocates for inclusive financial policies that empower marginalized communities, promoting economic participation and reducing financial inequalities. Similarly, our examination of foreign direct investment (FDI) in Vietnam highlights how strategic investments in small-medium enterprises (SMEs) can create job opportunities and enhance local economic performance, further addressing inequalities (Bozsik, Ngo, and Vasa 2023).

In the context of global crises, our examination of the impacts of COVID-19 and the Russia-Ukraine war on financial asset volatility illustrates how such events exacerbate existing inequalities. By understanding the vulnerabilities that these crises introduce, we inform policies aimed at bolstering economic resilience, particularly for vulnerable communities disproportionately affected by economic disruptions (Taera et al. 2023).

Additionally, our research on sustainable project management for humanitarian disasters emphasizes the importance of effective management strategies in responding to crises that deepen inequalities. This research ensures that aid reaches the most affected populations, contributing to immediate relief efforts and addressing the root causes of inequality (Saadi, Gokce, and Dunay 2023).

Through these diverse initiatives, our university is making substantial contributions toward achieving SDG 10. By addressing income disparities, access to financial services, and the impacts of global crises, we are actively promoting inclusive and equitable growth in our communities and beyond.

One of the authors of the study, *"Credit Risk Determinants in Selected Ethiopian Commercial Banks: A Panel Data Analysis"*, **Prof. Dr. Mária Fekete-Farkas** said: "A research group of MATE focuses on contribution of financial institutions to sustainable development goals of UN. A recent study titled "Credit Risk Determinants in Selected Ethiopian Commercial Banks" (Muhammed et al. 2023) examines the factors influencing credit risk in Ethiopia, providing insights that contribute to the United Nations Sustainable Development Goal (SDG) 10, which seeks to reduce inequalities within and among countries. By analysing key variables such as inflation, capital adequacy, bank size, loan growth, and currency rates, this research highlights how these elements impact financial access for low-income and marginalized communities. Effective management of credit risk is crucial for promoting financial inclusivity by enabling banks to offer loans more equitably. The findings are particularly relevant for addressing disparities in access to financial resources. For example, the positive relationship between credit risk and inflation emphasizes the need for banks to adjust their strategies amid rising prices—an issue that disproportionately affects economically disadvantaged individuals seeking credit in developing nations like Ethiopia. Additionally, insights on capital adequacy emphasize maintaining sufficient reserves while scaling operations responsibly to ensure equitable service delivery across socioeconomic groups. Moreover, recommendations aimed at moderating lending policies alongside fostering sustainable loan growth further enhance economic participation by creating reliable pathways for low-income borrowers. The call for periodic evaluations of GDP trends relative to interest rates advocates adaptable banking policies capable of responding effectively during economic fluctuations—safeguarding vulnerable populations from potential adverse effects. In general, this study offers Ethiopian commercial banks to mitigate credit risks and expand fair lending practices across social groups. By enhancing banking resilience through responsible lending, it fosters financial inclusion and supports the UN's Sustainable Development Goal 10 to reduce inequalities locally and globally".

One of the authors of the study, *"Comparing the effect of climate change on agricultural competitiveness in developing and developed countries"* (Nugroho, Prasada, and Lakner 2023), **Prof. Dr. Zoltán Lakner** said: "The study investigated the relationship between climate change and agricultural competitiveness in developing and developed countries. We have examined data from 71 developing countries and 24 developed countries from 1990 to 2020 used the three-stage least squares method. This study proven, that the temperature change has the same effect in developing and developed countries, namely reducing the agricultural competitiveness. However, agricultural competitiveness in developed countries is more sensitive to temperature changes. Other explanatory variables have varying effects on temperature and agricultural competitiveness. We propose the use of technology in agricultural business management, as well as each country's commitment to increase agricultural competitiveness while manage rise in temperatures."

As one of the authors of the study, *"The impact of Covid-19 and Russia–Ukraine war on the financial asset volatility: Evidence from equity, cryptocurrency and alternative assets"* (Taera et al. 2023), **Prof. Dr. Zoltan Lakner** said: "Volatility and external shock persistence were investigated within the financial and alternative assets markets during times of crises triggered by Covid-19 and the war in Ukraine. The findings revealed that almost all financial and alternative assets experienced an increase in volatility, except Bitcoin, across all observation periods. Islamic stock

and ESG indexes exhibited high volatility before the Covid-19 outbreak. During the pandemic, all assets became more volatile. In addition, Islamic equities and ESG indexes showed relatively lower risk compared to conventional stocks and other alternative assets during the war. Multiple financial assets tend to be highly volatile during crises; however, global investors need to consider the advantages of incorporating Islamic stocks and ESG indexes as part of their investment portfolio innovation strategy, particularly in the presence of geopolitical risk".

Sustainable Development Goal 11: Sustainable Cities and Communities" is essential to the mission of the Hungarian University of Agriculture and Life Sciences. While our main focus is on agricultural and life sciences, we understand the important role that urban areas and communities play in promoting environmental sustainability. We are committed to addressing the connection between urban and rural areas, recognizing that the well-being of both populations is linked.

Our research and educational efforts focus on creating sustainable urban environments and supporting responsible land use. We work on developing eco-friendly cities with an emphasis on effective resource management and collaboration between urban and rural areas. By promoting sustainable urban development, we aim to build communities that are environmentally responsible and inclusive, improving the quality of life for everyone. As we work towards SDG 11, we tackle the specific challenges faced by urban and rural areas, striving to create a more sustainable and connected world.

Aligned with our commitment to Sustainable Development Goal 11, our focus extends beyond agricultural practices to address the critical interplay between urban and rural communities. Through initiatives like the LIFE Co-Clima project, we aim to promote sustainable development that not only fosters resilience in rural areas but also strengthens the interconnectedness of urban and rural environments.

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Publications

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Citations

LIFE Co-Clima Project

MATE is proud to participate in the LIFE Co-Clima project, a significant initiative funded by the European Union to enhance environmental sustainability and climate resilience in small rural settlements. This project responds to the urgent challenges highlighted by the historic drought of 2022, extreme temperature fluctuations, and rising food and energy prices, which have exposed the vulnerabilities of these communities in Hungary and across Europe.

In collaboration with key partners—including Püspökszilágy Municipality, Penc Municipality, MagosVölgy Ecological Economy, and the Association of Climate-Friendly Settlements—LIFE Co-Clima aims to develop a sustainable model that increases the adaptive capacity of small rural villages to climate change. The project focuses on improving community resilience, raising climate awareness, and promoting self-sufficiency in food security. By establishing small-scale eco farms and Community Adaptation and Demonstration Centres, it empowers residents with the knowledge and tools to implement nature-based solutions and develop autonomous livelihood strategies.

Additionally, LIFE Co-Clima contributes to SDG 11: Sustainable Cities and Communities by fostering community cohesion and strengthening existing networks of mutual support, enhancing the overall quality of life for residents. The project also aligns with SDG 13: Climate Action by addressing the impacts of climate change through innovative adaptation strategies and promoting sustainable practices that mitigate vulnerability. By creating a model that can be widely adopted, LIFE Co-Clima not only addresses immediate climate challenges but also lays the groundwork for a more resilient and sustainable future for small rural settlements.

Key 2023 Research Contributions to SDG 11

At our university, we are dedicated to advancing research that aligns with Sustainable Development Goal 11 which focuses on sustainable cities and communities. Our interdisciplinary studies emphasize the importance of sustainable transport systems in promoting urban mobility and reducing carbon emissions. For instance, research on energy-saving traffic-regulated street lighting demonstrates significant potential for optimizing energy use in urban transport, enhancing safety and accessibility. Additionally, our investigations into tourism competitiveness in Eastern Africa highlight the critical role of sustainable transport infrastructure in boosting local economies and facilitating eco-friendly options for both residents and visitors (Bacsi, Yasin, and Bánhegyi 2023).

Inclusive urban planning is another focus area, where our research emphasizes community involvement as essential for sustainability and heritage protection. Studies on forest adventures in UNESCO-listed sites reveal how engaging local populations fosters better environmental stewardship (Ghorbani, Zhu, et al. 2023). Furthermore, analyses of urban master plans underscore the necessity of participatory approaches that consider the diverse needs of urban residents. Our research on UNESCO heritage sites and tourism development advocates for strategies that enhance visitor experiences while safeguarding cultural and natural resources, promoting both community well-being and heritage preservation (Khadour, Fekete, and Sárospataki 2023).

Resilience is a key theme in our research, as evidenced by studies addressing the connections between environmental protection and disaster risk reduction. Investigating heavy metal contamination and climate change responses provides vital insights for developing policies that minimize risks and enhance community preparedness (Saeed et al. 2023). Protecting cultural and natural heritage sites is intrinsically linked to safeguarding them from disasters, reinforcing the idea that heritage preservation enhances community resilience against climate-related impacts.

SDG 11

Sustainable Cities and Communities

Our commitment to sustainable urban environments extends to innovative waste management strategies aligned with circular economy principles. Research on zero waste concepts and waste generation forecasting offers valuable insights for urban planners (Edza Aria Wikurendra*, n.d.). Furthermore, studies on alternative fuels derived from plastic waste highlight the potential for sustainable energy solutions in urban settings.

Lastly, we emphasize the importance of universal access to safe green spaces, which serve as vital ecological resources and promote biodiversity. Our research into the role of trees in urban landscapes and green infrastructure underscores their significance in creating liveable urban environments (Nádasy, Valánszki, and Sárospataki 2023). Through these diverse initiatives, our university is actively contributing to achieving SDG 11, striving to create sustainable, resilient, and inclusive urban environments.

One of the authors of the study, "Plant Responses to Global Climate Change and Urbanization: Implications for Sustainable Urban Landscapes", Dr. László Orlóci said: "Our study, published in 2023, focuses on the study and promotion of sustainable adaptation of urban environments, especially metropolitan ones, in the light of climate change and urbanization. As ornamental plants are the most widely used plant group in urban areas and are becoming of particular importance due to increasing urbanization, we attach particular importance to our work in this area. We need to make cities suitable for their inhabitants and for animals and plants, which need to form a living community. Our research group's task is to facilitate this process from the plant point of view, and to demonstrate the impact of urban plants on the community and vice versa. By doing so, we believe we can make a significant contribution to mitigating the negative impacts of increasing urbanization and the use of appropriate plants can help to create environmentally friendly, sustainable urban communities - making our research topic closely aligned with the MATE strategy and the UN SDG 11 target".

One of the authors of the study, *"Sustainability contribution of hybrid solar collector towards net-zero energy buildings concerning solar cells wasted heat"*, **Dr. Piroska Víg** said: "In Solar Laboratory of MATE, many people deal with increasing the efficiency of solar energy utilization from different aspects. Alshibil developed a water-air-based PV/T unit. It has implemented such a combi cooling that has proven to be extremely effective both in terms of increasing the efficiency of the solar panel and in terms of the utilization of waste heat, so his PV/T collector is well suited to the objectives of sustainability. Further related research is the applicability of nanofluids, phase change materials and the investigation of nanotechnological thin layers for active solar energy surfaces in order to increase the efficiency of solar systems".

SDG 12

Responsible Consumption and Production

The Hungarian University of Agriculture and Life Sciences' is deeply committed to addressing the critical issues of responsible consumption and production, especially within agriculture, life sciences, and environmental sustainability. We actively pursue education and innovation to promote and enhance sustainable and environmentally conscientious practices. Our academic programs are dedicated to equipping our students and stakeholders with the knowledge and competencies necessary to foster more sustainable and efficient patterns of consumption and production. Our academic programs focus on equipping students and stakeholders with the knowledge and skills needed to encourage more sustainable and efficient consumption and production patterns. We emphasize the importance of reducing waste, conserving resources, and mitigating the ecological impacts of agriculture and related sectors. Through efforts like minimizing food waste, advocating for sustainable farming techniques, and adopting environmentally friendly technologies, we strive to significantly contribute to the achievement of responsible consumption and production in line with SDG 12. Our commitment extends to raising awareness and actively participating in the shift towards a more sustainable and circular economy.

To put these principles into practice, MATE has launched several transformative initiatives that exemplify our commitment to fostering a circular economy.

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Publications

638
Citations

Cultivating Sustainability: MATE's Circular Economy Initiative

MATE led a transformative project aimed at fostering a circular economy on the Szent István Campus in Gödöllő. Funded under project number KEHOP-3.2.1-15-2021-00037, this initiative focused on the sustainable management of agricultural and green waste, aligning with the European Union's Circular Economy Action Plan.

At the heart of the project was the establishment of the Biological Circular Economy Analysis and Knowledge Centre, finalized

at the end of 2023. This centre served as a hub for research and innovation, supporting initiatives that promoted biomass-based agriculture. Through interdisciplinary collaboration, it aggregated scientific knowledge to develop effective strategies for reducing food waste and enhancing waste treatment technologies.

Students played a vital role in this initiative, engaging in community composting efforts. Kitchen waste collected on campus was processed in community composters, while animal manure and green waste were treated in a larger pilot composter using advanced technologies. The project also included compost master training, empowering students to promote composting in their communities.

By creating a closed-loop system for organic waste, MATE not only improved local soil health but also exemplified sustainable practices, making significant strides toward responsible consumption and production.

Key 2023 Research Contributions to SDG 12

MATE University's research advances the achievement of Sustainable Development Goal 12 (SDG 12) by driving sustainable practices across multiple sectors. A significant body of research highlights the need for sustainable management and efficient use of natural resources. For instance, optimizing agricultural practices has shown potential to reduce environmental impacts while enhancing productivity. Research by Ajibade et al. (2023) provides insights into sustainable agricultural practices that balance productivity with ecological integrity. Such practices are critical for minimizing resource depletion and ensuring food security.

Innovations in food production systems, such as plant-based proteins, also offer sustainable alternatives to conventional animal agriculture. A study by Akter et al. (2023) highlights the environmental benefits of adopting plant-based protein sources, emphasizing reduced greenhouse gas emissions and land use compared to traditional livestock farming.

The application of circular economy principles in research is further contributing to responsible production. The transition to a circular economy can minimize waste and maximize resource efficiency. Research conducted by Singh et al. (2023) analyses how circular practices in the food supply chain can reduce food waste, a critical step towards achieving sustainability in production systems.

Reducing food waste remains a major focus, with "Consumer Food Waste Reduction Programs in Europe | Food Inspection Notices" presenting innovative strategies for food recovery and redistribution, providing practical frameworks for stakeholders to minimize waste at various stages of the food supply chain. Additionally, research on renewable energy solutions, such as that by Velidandi et al. (2023) supports sustainable production by reducing reliance on carbon-intensive energy sources.

Through a strong commitment to education and capacity-building, MATE University is also embedding sustainability into the curriculum, as shown in studies like Khademi-Vidra and Bakos (2023). These efforts are equipping future leaders with the skills needed to advance responsible consumption and production.

SDG 12

Responsible Consumption and Production

MATE University's research interdisciplinary collaborations and innovative research are laying the groundwork for a more sustainable future and substantially contributing to SDG 12.

One of the authors of the study, *"Green Human Resources Management in the Hotel Industry: A Systematic Review"*, **Prof. Dr. Zoltán Bujdosó** said: "The hotel industry high-resource-consumption industry (e.g., energy and water), it also produces a large amount of waste. Applying green human resources management practices reflects an organization's environmental awareness and responsibilities. This study revealed that the importance of green human resources management goes beyond environmental objectives; and there are significant barriers that should be taken into consideration when applying GHRM practices in the hotel industry".

SDG 13

Climate Action

Climate Action, as defined by Sustainable Development Goal 13, is central to our mission. While we specialize in agricultural and life sciences, we understand the urgent challenges posed by climate change. Our institution is committed to research, education, and practices that support climate mitigation and adaptation. We focus on developing sustainable, climate-resilient agricultural methods and promoting responsible land management. Through our academic programs and research initiatives, we equip students and stakeholders with the knowledge and tools to tackle climate-related issues effectively. By engaging in climate action, we aim to reduce greenhouse gas emissions, enhance environmental sustainability, and protect ecosystems, aligning with SDG 13. Our efforts also include advocating for sustainable agriculture, fostering climate resilience in both rural and urban areas, and supporting global initiatives to combat climate change. Ultimately, we strive to promote a sustainable and climate-resilient future, ensuring our actions today contribute to a healthier planet for generations to come.

To translate our commitment into impactful action, the Hungarian University of Agriculture and Life Sciences (MATE) actively participates in various initiatives that embody our dedication to climate action.

69
Publications

432
Citations

Food4CE Project

The Hungarian University of Agriculture and Life Sciences (MATE) is a vital partner in the Food4CE project, a European initiative dedicated to strengthening Alternative Food Networks (AFNs) and fostering sustainable, resilient food supply systems. This project aims to tackle the challenges faced by AFNs by enhancing logistics efficiency and promoting environmentally friendly practices. It establishes two key platforms: the Knowledge Transfer Platform (KTP), designed for sharing knowledge and best practices among stakeholders, and the Matchmaking Platform, a digital marketplace that connects farmers, consumers, and logistics providers.

MATE brings invaluable expertise in agriculture, life sciences, and sustainability to the project, driving innovation and research within AFNs. The university plays a crucial role in equipping stakeholders with the tools and strategies needed to implement sustainable practices, thereby bolstering the resilience of food supply systems in the face of climate change.

The Food4CE project significantly contributes to SDG 13: Climate Action by emphasizing the reduction of greenhouse gas emissions associated with food logistics and promoting sustainable practices that mitigate the impacts of climate change. By fostering collaboration among diverse stakeholders, the project helps create a more interconnected and resilient food network across Europe. This initiative not only addresses immediate logistical challenges but also supports broader climate goals, ensuring a sustainable future for food systems and paving the way for a more sustainable food landscape.

Key 2023 Research Contributions to SDG 13

Sustainable Development Goal 13 (SDG 13) emphasizes the urgent need to combat climate change and its impacts. At MATE University, researchers are committed to exploring innovative solutions and strategies that contribute to this goal. Through their dedicated efforts, they are not only addressing climate challenges but also fostering sustainable practices that can significantly mitigate climate-related risks.

MATE University is at the forefront of developing sustainable practices and innovative technologies. Research has demonstrated the effectiveness of phase change materials (PCMs) in building designs, which enhance energy efficiency and reduce greenhouse gas emissions. The experimental study on PCM-enhanced building envelopes highlights the potential for these materials to play a crucial role in decarbonization efforts in extreme climates (Hwang et al., 2022). Additionally, innovative approaches to converting biowaste into energy illustrate the university's commitment to circular economy principles, emphasizing the value of waste as a resource (Usmani et al. 2023).

Recognizing the significance of climate resilience, MATE University's research also focuses on adaptation strategies to combat climate change impacts. Studies on advanced mycotoxin control techniques are particularly pertinent in light of climate-related risks to food safety. These studies aim to enhance soil health and ensure the integrity of agricultural products in the face of increasing challenges (Loi et al. 2023). Moreover, research into the impacts of climate change on agricultural competitiveness emphasizes the need for adaptive strategies that can safeguard food security while promoting sustainable practices (Nugroho, Prasada, and Lakner 2023).

The university advocates for the integration of climate considerations into policy frameworks that govern various sectors. Research highlights the need for a multi-stakeholder approach to achieve a net-zero economy, which involves collaboration between industries, governments, and communities (Singh et al. 2023). This integrative approach not only aids in developing effective climate policies but also addresses the challenges faced by vulnerable agricultural sectors affected by climate fluctuations.

MATE University's commitment to promoting biodiversity alongside renewable energy initiatives is a key aspect of its research agenda. Studies examining the ecological impacts of ground-mounted solar photovoltaic sites reveal the necessity of balancing energy development with biodiversity conservation. This research underlines the

importance of conducting thorough ecological assessments to minimize negative impacts on local wildlife (Tinsley et al. 2023). By integrating environmental considerations into renewable energy projects, the university aims to foster sustainable development while protecting biodiversity.

Understanding consumer behaviour in relation to sustainability is also a critical focus for MATE University researchers. Investigations into the factors influencing organic food purchasing decisions highlight the role of consumer awareness in promoting sustainable agricultural practices (Akter et al. 2023). By exploring the motivations behind consumer choices, the university contributes to broader discussions on how public awareness and behaviour can support climate action and sustainable food systems.

Through these diverse research themes, MATE University demonstrates its commitment to addressing climate change and promoting sustainability. The university's interdisciplinary approach fosters collaboration and innovation, reinforcing its role as a leader in contributing to SDG 13. As researchers continue to explore and implement solutions, MATE University remains dedicated to advancing knowledge and practices that combat climate change and its effects.

One of the authors of the study, *"Advanced mycotoxin control and decontamination techniques in view of an increased aflatoxin risk in Europe due to climate change"*, **Prof. Dr. László Hornok** said: "During the last 25 years, research activity of prof. L. Hornok and his group was focused on mycotoxin producing fungi that infect cereals and pose serious health hazards to humans and animals. In national and international cooperation, they (i) developed new diagnostic methods to manage early detection of these fungi and help control decisions, (ii) deciphered the reproduction strategies of several representatives of toxigenic fungi, (iii) identified common genetic regulatory elements of stress response and toxin production, and (iv) evaluated/improved mycotoxin control measures. This research activity helps to produce healthy food raw materials with reduced use of pesticides".

SDG 14

Life Below Water

At the Hungarian University of Agriculture and Life Sciences (MATE), our commitment to Sustainable Development Goal 14—Life Below Water—drives our efforts to support healthy aquatic ecosystems and promote sustainable practices in fisheries and marine environments. We understand the vital role oceans, seas, and freshwater resources play in biodiversity and food security. Our focus includes research that addresses challenges like overfishing, pollution, and climate change. By integrating education with practical solutions, we prepare students and researchers to tackle these issues effectively. We also engage with local communities and organizations to raise awareness about protecting aquatic life. Through workshops and outreach initiatives, we advocate for responsible fishing practices and sustainable management of aquatic resources. Our dedication to SDG 14 is part of our mission to ensure that marine and freshwater ecosystems thrive for future generations.

As part of our commitment to Life Below Water sustainability, we have initiated transformative projects that address both the ecological and economic aspects of fisheries. By integrating scientific research with community involvement, we aim to foster responsible fishing practices that ensure the health of aquatic ecosystems while supporting the livelihoods of those who depend on them.

24
Publications

43
Citations

Market-oriented fishing innovation in the field of the production technology of certain fish species and the development of environmentally conscious fishing tackle and fish baits

The "Market-oriented Fishing Innovation" project, which commenced on February 1, 2020, and concluded in August 2023, is a is a transformative initiative focused on enhancing sustainable practices within the fishing industry. Led by ENERGOFISH Kft. in partnership with the Hungarian University of Agriculture and Life Sciences (MATE) and Czikkhalas Halastavai Kft., the project aims to innovate production technology for crucian carp and broad crucian carp while developing environmentally friendly fishing tackle and fish baits. The project received a grant of HUF 480,028,117.

This initiative addresses the growing demand in Hungary's dynamic fishing sector while mitigating environmental impacts. One of its primary goals is to develop safe, small, and semi-scale breeding technologies for crucian carp and broad crucian carp, employing both monoculture and innovative polyculture methods in typical Hungarian valley-closing dams.

A key innovation is the creation of two environmentally conscious products. The first aims to replace toxic lead weights with safer alternatives like zinc or tungsten, significantly reducing ecological harm. The second product is a biodegradable gummy corn fish bait that decomposes quickly, promoting both environmental safety and fish health.

Through the collaboration of the consortium partners, this project not only fosters responsible fishing practices but also supports Sustainable Development Goal 14, which focuses on the conservation and sustainable use of aquatic resources. By setting new standards in environmentally friendly fishing practices, the initiative exemplifies a commitment to ecological stewardship and sustainable resource management, ensuring the future of Hungary's fishing industry.

Key 2023 Research Contributions to SDG 14

MATE University is committed to advancing research and practices that align with Sustainable Development Goal 14 (SDG 14), which aims to conserve and sustainably use oceans, seas, and marine resources. The university's research addresses various aspects of marine ecosystems and fisheries sustainability, highlighting contributions to each sub-goal outlined in SDG 14.

University researchers assess the environmental impacts of aquaculture practices and evaluate the consequences of invasive species on native ecosystems, alongside water quality management practices to mitigate adverse effects on marine habitats. These efforts contribute to developing sustainable management strategies that protect marine ecosystems from degradation (Svigruha et al. 2023). Researchers implement sustainable fish farming practices, enhance fish health, and improve nutritional quality while advocating for responsible harvesting techniques to prevent overfishing, ensuring the sustainability of fish stocks and enhancing food security through responsible aquaculture practices (Bartucz et al. 2023).

The investigation of nutritional benefits of aquatic foods and the examination of welfare implications of various fish farming practices also take place, addressing environmental stressors that contribute to ocean acidification. By promoting practices that alleviate acidification impacts, university researchers foster healthier aquatic ecosystems (Péter et al. 2023). MATE University also investigates the integration of ecosystem services into aquaculture management frameworks and develops innovative, sustainable feed options. These initiatives establish regulatory practices that prevent overfishing and promote responsible resource management in fisheries (Fazekas et al. 2023).

SDG 14

Life Below Water

University researchers focus on sustainable aquaculture practices as integral to conservation efforts, supporting the protection of critical marine habitats. Through this research, MATE University contributes to establishing protected marine areas, enhancing biodiversity and ecosystem resilience. The analysis of fish behaviour and nutritional content in aquaculture systems aims to develop sustainable practices that reduce dependence on harmful fisheries subsidies. Findings support informed policy decisions that mitigate adverse effects of subsidies on marine ecosystems and fisheries sustainability (Tóth et al. 2023).

MATE University conducts extensive studies on fish behaviour, handling practices, and impacts of nutrient runoff on aquatic ecosystems. This research enhances scientific understanding and informs best management practices, ultimately benefiting marine biodiversity and sustainability. Through diverse research efforts, MATE University significantly contributes to achieving SDG 14 by promoting sustainable practices in aquaculture and fisheries management. The university remains dedicated to advancing scientific knowledge and fostering conservation efforts to protect and sustainably use marine resources, ensuring the health and resilience of ocean ecosystems for future generations.

One of the authors of the study, *"Nursing of Pike-Perch (Sander lucioperca) in Recirculating Aquaculture System (RAS) Provides Growth Advantage in Juvenile Growth Phase"*, **Dr. Uroš Ljubobratović** said: "Pikeperch (Sander lucioperca) is well well-accepted and highly valued fish species among consumers all over Europe, which is why its yearly trade in the old continent counts tens of thousands of tons. Nevertheless, the vast majority of this trade comes from the captive fisheries, out of which again the vast majority already led (Europe) or is still leading (Asia) to overfishing. Therefore, to target goal 14.4, farming conditions for this species should be optimized, ensuring economic viability and minimizing resource use and environmental impacts, with more than two-decade-long research on this topic focusing on pikeperch-intensive culture as the most feasible mode of pikeperch rearing. Corroborating these efforts, a recent MATE study tested the two methods of juvenile production – intensive larviculture in closed controlled conditions and extensive nursing in ponds, for the first time showcasing the advantage of nursing pikeperch indoors for juvenile on-grow. This evidence might facilitate the transition from fishery to farming, strengthening the role of aquaculture as the roadmap for sustainable exploitation of marine resources".

SDG 15

Life on Land

Sustainable Development Goal 15, "Life on Land," is at the heart of our mission at the Hungarian University of Agriculture and Life Sciences. We are dedicated to protecting and sustainably managing terrestrial ecosystems, closely aligning our efforts with the goals of SDG 15. Our research, educational programs, and initiatives focus on conserving biodiversity, addressing deforestation, and restoring degraded lands.

Through our academic offerings and research projects, we tackle critical issues such as sustainable land use, reforestation, and wildlife conservation. We emphasize responsible agricultural practices and effective land management to foster the health and resilience of ecosystems. By promoting sustainable methods, we aim to protect terrestrial life in accordance with SDG 15.

Our commitment goes beyond academic pursuits; we strive to raise awareness, implement conservation strategies, and support international collaborations to safeguard life on land. Together, we work towards a future where terrestrial ecosystems are preserved and thrive for generations to come.

77
Publications

210
Citations

Our dedication to SDG 15 encompasses a range of initiatives aimed at promoting the sustainable management of terrestrial ecosystems. One notable example is the SOURCE Project, which highlights our approach to integrating social and organic farming practices for a more resilient agricultural landscape.

The SOURCE Project

The SOURCE project, implemented from early 2022 to 2023, was a collaborative effort led by AGRIFORM from Italy, in partnership with the Hungarian University of Agriculture and Life Sciences (MATE) and New Agriculture New Generation (NEAGEN) from Greece. Its primary goal was to strengthen the connection between social farming (SF) and organic farming (OF) by upskilling farmers and aspiring individuals, ultimately promoting sustainable and inclusive ecosystems.

Throughout the project, the consortium conducted in-depth studies to identify the key competencies of the "social organic farmer." This process involved developing a vocational training curriculum tailored to the specific needs of this emerging role. Stakeholders from the three partner countries actively participated in a co-creation process, ensuring diverse perspectives were integrated into the training framework.

One of the project's key achievements was the formulation of a comprehensive policy recommendation plan to support social organic farming practices. The policy paper, available in Italian, Hungarian, and Greek, provides guidelines for government policies that promote a more equitable, sustainable, and resilient food system. It emphasizes the need for well-founded training programs aligned with the EU Strategy 2020 and highlights best practices in social organic farming.

By enhancing farmers' skills and knowledge, the project made significant contributions to Sustainable Development Goal 15, which focuses on protecting and promoting the sustainable use of terrestrial ecosystems. This initiative has laid the groundwork for a more resilient agricultural landscape in Europe, benefiting both producers and consumers.

Key 2023 Research Contributions to SDG 15

At MATE University, our researchers are dedicated to advancing Sustainable Development Goal 15 (SDG 15). We focus on protecting and restoring terrestrial ecosystems, managing forests sustainably, and tackling land degradation and biodiversity loss. Through innovative research and collaboration, we promote sustainable practices that enhance environmental stewardship and build ecological resilience.

Our research emphasizes sustainable agricultural practices, particularly the use of bio-based fertilizers. Studies show these fertilizers improve soil health and biodiversity, which are crucial for maintaining ecosystem services like nutrient cycling and water retention (Kovács et al. 2023). Additionally, our investigations into phytoremediation demonstrate effective methods for restoring contaminated lands, especially through heavy metal uptake by various plant species (Tőzsér 2023). These findings are vital for promoting healthy ecosystems and conserving natural resources.

In forest management, our research evaluates grazing practices on wetland and grassland habitats, revealing strategies that enhance biodiversity while supporting agricultural productivity (Fűrész et al. 2023). Analysing alien vascular plant species in Hungary provides insights into managing native vegetation, contributing to efforts aimed at halting deforestation and promoting biodiversity conservation (Csiky et al. 2023). By focusing on these aspects, we contribute to the sustainable management of forests and other terrestrial ecosystems.

Addressing desertification and land degradation, our studies on conservation tillage demonstrate improvements in soil quality and crop yields, promoting sustainable agricultural practices (Kovács et al. 2023). The application of biochar for soil remediation highlights effective methods for restoring degraded lands contaminated with rare earth elements, improving soil health and contributing to carbon sequestration (Chen et al. 2023).

SDG 15

Life on Land

Through these diverse research efforts, our scholars at MATE University contribute significantly to achieving the sub-goals of SDG 15. We promote innovative solutions, emphasize conservation, and foster a sustainable future for terrestrial ecosystems. By combining research excellence with a commitment to environmental sustainability, we aim to protect and restore our planet's ecosystems for generations to come.

One of the authors of the study, *"Conservation Tillage Improves Soil Quality and Crop Yield in Hungary"*, Prof. **Dr. Márta Birkás** said: "In line with international trends, this research undertakes to agreement to sustainable development, included improving the soil and the environment quality. The university provides an effective background for the fulfilment of this task and the realization of the common goal. This publication was realised in a teamwork, and the data based on a twenty-year long-term experiment. The results confirm the progress of national soil tillage with an international reflection."

Dr. Gábor Markó, one of the authors of the study, *"Innovative research will support the early detection of biodiversity loss in urban ecosystems"*, is an associate professor participating in an international research team that focuses on the taxonomic and behavioural responses of birds to the challenges presented by urban ecosystems. Urbanization is a significant cause of species loss, making it essential to develop effective methods for monitoring biodiversity patterns. Consequently, new methodological approaches are necessary for large-scale habitat monitoring. Remote sensing emerges as a cost-effective solution for monitoring extensive biological communities.

In a recent scientific paper titled "EVI and NDVI as Proxies for Multifaceted Avian Diversity in Urban Areas," the research team demonstrated strong links between two satellite-derived vegetation indices. These indices can serve as reliable measures for assessing bird diversity and specialization across various urban settings. The study enhances our ability to monitor biodiversity patterns effectively and consistently over large regions, which is crucial for tracking the health of urban ecosystems. It also supports the goal of conserving biodiversity. This information is valuable for policymakers as it encourages the expansion of green spaces and biodiversity, contributing to the restoration of urban ecosystems.

Gábor Markó emphasized that changes in population patterns result from long-term environmental effects. Our team aims to highlight the importance of monitoring animal behaviour, which can be rapid and flexible, providing early feedback on environmental impacts within ecosystems. Birds are excellent sentinels for this purpose".

SDG 16

Peace, Justice and Strong Institutions

Sustainable Development Goal 16, “Peace, Justice, and Strong Institutions,” is essential to the Hungarian University of Agriculture and Life Sciences. Our focus on agricultural and life sciences goes hand in hand with the need for peace and strong institutions for sustainability. We promote good governance, ethical practices, accountability, and transparency in our academic and research activities. By encouraging integrity within our community, we aim to contribute to peaceful and just societies. Our commitment to SDG 16 includes advocating for ethical governance and collaborating with stakeholders to foster a more equitable world.

Key 2023 Research Contributions to SDG 16

At MATE University, our research significantly contributes to Sustainable Development Goal 16 (SDG 16), which promotes peaceful and inclusive societies, access to justice, and the establishment of effective, accountable institutions. Our studies emphasize key themes essential for achieving these objectives.

7
Publications

22
Citations

Accountability and transparency within organizations are crucial. Implementing green human resource management (HRM) practices encourages environmental responsibility among employees, fostering a culture of ethical behaviour. This commitment to transparency is vital for driving responsible investments and ensuring effective resource allocation. For instance, research on green insurance highlights how these financial products enhance accountability by supporting sustainable projects (Ahmad et al. 2023).

Community engagement is another important theme. Involving local communities in environmental initiatives not only nurtures a sense of ownership but also strengthens governance. Studies on pollinator-promoting interventions demonstrate the

positive impact of community participation in sustainability efforts, showcasing how collaborative approaches can improve decision-making processes in humanitarian contexts (Süle et al. 2023).

Additionally, examining ethics and corruption within organizational structures reveals the detrimental effects these issues have on governance. Addressing clientelism and promoting integrity are essential for achieving accountability. Research into legal gaps in refugee protection advocates for reforms to ensure justice for vulnerable populations, underscoring the importance of ethical practices as a foundation for effective governance (Nekmahmud and Patwary 2023).

Effective governance is key to realizing the objectives of SDG 16. Research on waste generation forecasting illustrates the significance of data-driven decision-making in enhancing institutional efficiency. This evidence-based approach is crucial for improving responses to environmental and humanitarian challenges, as it facilitates better resource allocation and strategic planning (Saadi, Gokce, and Dunay 2023).

We are indeed committed to accountability, community engagement, ethical practices, and governance as means of fostering peaceful and inclusive societies to advance sustainable development. Our researchers strive to make a positive impact, ensuring their work resonates within academia and beyond.

SDGs through the eyes of the MATE Teacher and Impact Award winners

This year, the *MATE 2030 Strategy* has launched the *Teacher Awards* and *Impact Awards* scheme. One of the key objectives of the *MATE 2030 strategy* is to improve the quality and efficiency of education, which is key to the development and long-term success of our University. To recognise and motivate the teaching community, our University has established six new teaching awards (*Most Popular Educator of The Year, Innovative Educator of the Year, Talent Manager of the Year, Young Teacher of the Year, Educator of the Year, Lifetime Achievement Award for Teachers*).
Another key objective of the MATE 2030 strategy is to take social responsibility through a range of high-impact activities that address specific problems and promote the vision of a knowledge-based society. To recognise and motivate university employees, the Impact Awards scheme has been established, consisting of four categories (*Innovations Impact Award, Impact Award for Sustainability, Agora Impact Award, MATE Media Ambassador Impact Award*). It is open to any university employee working on solutions to a wide range of social and/or environmental problems, in the fields of innovation, research and development, community building or communication.
In the next section, you can read about how the award winners surveyed think about their achievements and the Sustainable Development Goals:

Prof. Dr. Előd Kondorosy - *Most Popular Educator of the Year Award*
"My activities on the field of education and research are well compatible with SDG goals, namely: I am teaching zoology and different courses on nature conservation; all of them are excellent for SDG goals 14 and 15. With my colleagues we regularly organize field trips for our students; on which we in vivo familiarize the students with the fauna (and flora) of terrestrial and water habitats. This activity is important for SDG goals 4 (Quality education), 14 and 15 as well. During our lectures I regularly draw the attention of our students for the consequences of climatic changes (SDG goal 13) through invasions of adventive species which strongly affect the natural ecosystems."

Kornélia Éva Dékány - *Innovative Educator of the Year Award*
The candidate's commitment to fostering inclusive, high-quality education aligns directly with the United Nations Sustainable Development Goal of ensuring equitable education and promoting lifelong learning opportunities. By actively employing cooperative learning, retrieval practice, and gamification, they create an engaging and supportive environment where all students can thrive. These methods not only enhance mathematical understanding but also encourage continuous learning and personal growth, equipping students with skills essential for lifelong learning in a rapidly changing world.

Dr. Judit Podráczky - *Educator of the Year Award*
"As a teacher, I am dedicated to preparing the next generation of teachers by setting an example of equitable, inclusive teaching that is sensitive to socio-cultural changes and recognizes the value of diversity (SDG 4). As a researcher, I focus on a public education development project aimed at enhancing competency in health and environmental education. It contributes to the research-based advancement in early childhood health education (SDG 3). Promoting good health habits early in life is crucial, as these habits form the foundation for desired health behaviours in adulthood. To this end, my colleagues and I have adapted a measurement tool of health education standards for preschoolers to assess their health literacy in line with these standards. We involve students in various phases of the research and actively incorporate our results into curricula (SDG 4)."

Dr. András Koris - *Innovations Impact Award*
SDG 3: Good Health and Well-being
The digestion of native proteins (e.g. from bovine milk or soy) in their original form are not optimal for human consumption, as well many positive health effect of the peptides are hidden in the natural form (e.g. high blood pressure regulation, obesity reduction, anti-carcinogenic effects, lowering methabolic sydrome), further they can cause allergenic reaction in 5-10% of the population. In our research we are transforming the proteins into a tasty product with easier digestibility, increased bioactivity and reduced allergenicity which could definitely help to maintain or improve the human health conditions (Abdisa et al. 2024; Nath et al. 2021; 2022).

SDG 12: Responsible Consumption and Production
The high energy requirement of food plants is known (e.g. UHT treatments, evaporation, distillation, drying) but in practice, despite some efforts, not too many actions has been performed in order to reduce this fact mainly due to economic reasons. In our research we are always focusing on the reduction of energy utilization via application and development of sustainable technologies to give alternative processes for the industry. For example, beside many other technologies, membrane techniques can ensure promising solution for these issues. Additionally, energy efficient drying, and development of environment-friendly extraction methods are also in the centre of our laboratory research (K. Albert et al. 2016; Krisztina Albert, Vatai, and Koris 2017; Chaabane et al. 2023; Tolnay, Nath, and Koris 2020; Varga et al. 2023).

Dr. Ákos Malatinszky - *Impact Award for Sustainability*
Dr. Ákos Malatinszky shapes the minds of children, young people and students through real-world-learning. He is the head of the BSc in Nature Conservation Engineering and course leader of a number of courses on nature conservation integrating sustainability knowledge at BSc, MSc and PhD level. He co-ordinated the writing of the Higher Education chapter of the National Environmental Education Strategy 2020. Member of the National Council for the Environment since 2007, previously its chair and vice-chair, commenting on government proposals on climate change and biodiversity and helping to build partnerships between different, often opposing sectors. His research focuses on the conservation management of terrestrial habitats.

Prof. Dr. Károly Penksza - *MATE Media Ambassador Impact Award*
In education, modern platforms significantly enhance the effectiveness of knowledge dissemination. The YouTube channel of professor Dr. Károly Penksza, Botanist in the Kitchen delivers insights in an accessible and engaging manner. As part of university instruction, it presents up-to-date knowledge and recent research findings through brief (3–10 minutes) or extended (45–90 minutes) lectures. With 353 videos, the channel has had a broad impact, accumulating a total of 13,200 viewing hours, 245,200 views, and amassing a following of 3,500 subscribers.

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