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IMPLEMENTATION OF SUSTAINABLE AGRICULTURAL PRACTICES IN SCHOOL CURRICULUM

- BEST STUDENTS' PRACTICES -

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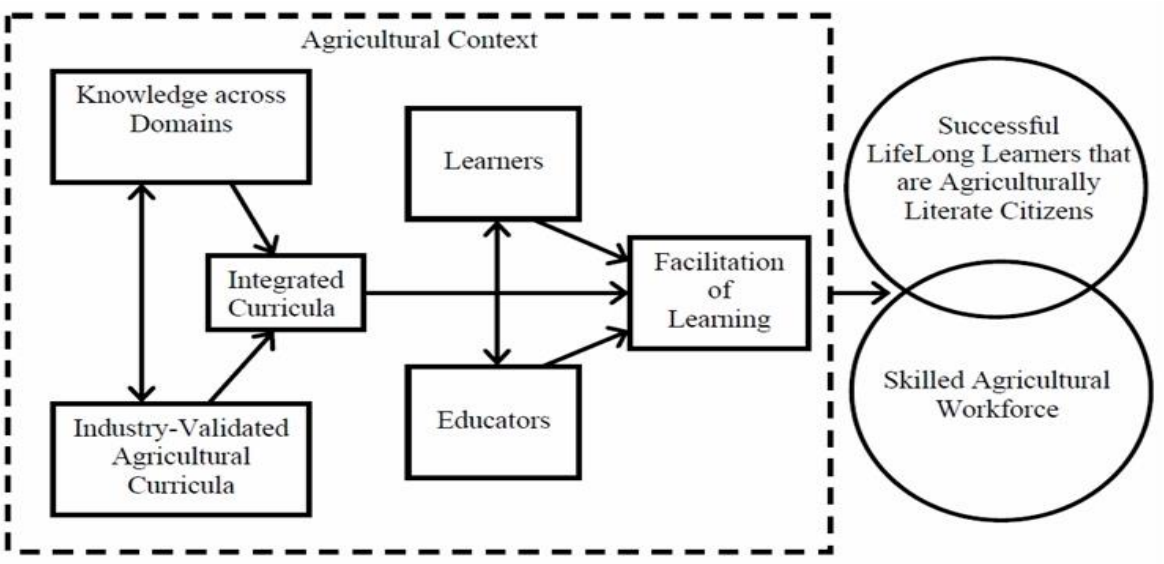
1.1. Introduction

With the rise of modern agricultural practices, formal education in agriculture has gained importance, leading to the establishment of specialized institutions, offering training in farming, livestock production, agricultural engineering, and agribusiness. These programs equip students with the necessary skills to tackle industry challenges.

The integration of technology in agricultural education has further transformed the field, incorporating digital tools, precision farming technologies, and remote sensing techniques into the curriculum. This fosters data-driven decision-making, precision agriculture, and sustainable farming practices to promote environmental stewardship and address food security concerns. Recently, the education sector in agricultural disciplines has experienced a significant transformation through the introduction of the new education policy, by advocating multidisciplinary and holistic learning approaches. It underscores the integration of practical skills, research-oriented education, and entrepreneurship development within agricultural curricula. The new education policy envisions agricultural education aligning with the evolving needs of the sector, fostering innovation, and encouraging research. It also emphasizes nurturing critical thinking, problem-solving abilities, and creativity among students. Additionally, the policy promotes collaboration between academic institutions, research organizations, and industry stakeholders to bridge the gap between theoretical knowledge and practical application.

This guidebook is aimed at giving answers to the most important questions related to the implementation of sustainable agricultural practices in the school curriculum.

1.2. Teaching and learning sustainable agriculture



Scheme 1.2. Teaching and learning agriculture

Sustainable agriculture is an approach to farming that balances the need for food production with environmental protection, economic viability, and social responsibility. It involves practices that maintain soil health, conserve water, reduce carbon emissions, protect biodiversity, and support rural communities. In the context of VET education, sustainable agriculture encompasses technical knowledge (e.g., organic farming, agroecology, precision agriculture), transversal skills (e.g., problem-solving, entrepreneurship, digital literacy), and attitudes promoting environmental stewardship.

Technical knowledge plays a crucial role in sustainable agriculture by combining traditional wisdom with modern scientific advancements to improve resource management, enhance productivity, and reduce environmental impact. This knowledge encompasses various aspects, including soil health, water management, pest control, and the use of innovative technologies.

Transversal skills, also known as soft skills, are not tied to a specific job or industry but are valuable across many situations and settings. They are personal attributes that help individuals thrive in diverse environments and can be developed and honed.

Environmental stewardship encompasses the responsible use and protection of the natural environment through conservation and sustainable practices. It's a shared responsibility to enhance ecosystem resilience and human well-being, involving individuals, communities, and organizations. This concept emphasizes a commitment to efficient resource use, preserving ecosystems, and complying with environmental regulations.

To implement sustainable agriculture effectively in schools, VET teachers must:

- Understand global and local sustainability challenges;
- Be familiar with relevant policies (e.g., the EU Green Deal). The EU Green Deal is a comprehensive action plan introduced by the European Union with the ambitious aim of making its 27 member states carbon-neutral by 2050. It was first presented in December 2019. This initiative represents a fundamental transformation of the EU's economy and society to ensure a sustainable future;
- Farm to Fork Strategy: The EU's Farm to Fork (F2F) strategy aims to create a more sustainable and environmentally friendly food system, while maintaining food security and affordability. It's a key element of the European Green Deal, focusing on transitioning the EU food chain from farm to consumer. This strategy encompasses initiatives across the entire food value chain, including food production, processing, distribution, and consumption, to reduce environmental impact and promote sustainable practice;
- Integrate sustainability principles into lesson plans, workshops, and farm practice;
- Foster student engagement through hands-on work, which means doing something with your hands or actively participating in a task rather than just learning about it or watching someone else do it. It emphasises practical experience and direct involvement, project-based, and experiential learning.

The main objectives of the VET teachers in the teaching and learning process in the applied agriculture discipline are:

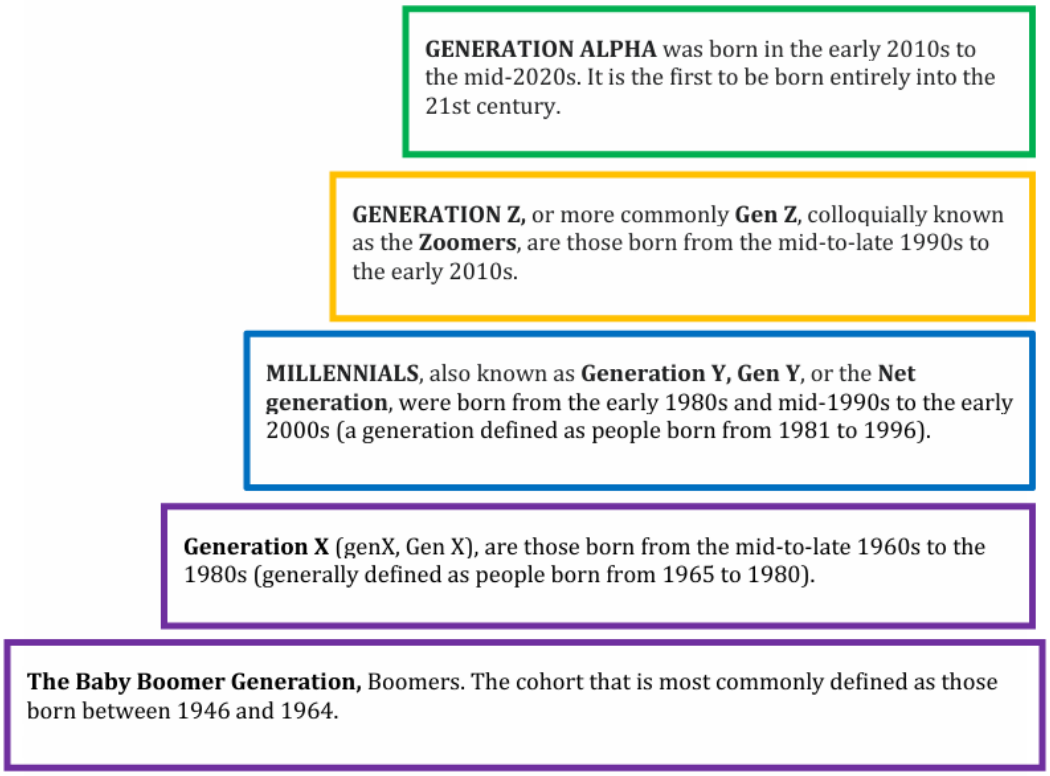
- ✓ The general goal is to provide students with quality education;
- ✓ Quality of learning requires students' higher independence in learning and work, skill of self-regulated learning, and better developed metacognitive abilities to manage their own learning process;
- ✓ To take all this into account when designing the teaching situation, knowledge and skills of creating a quality educational experience for students are needed;
- ✓ Applied disciplines in agricultural sciences have faced the challenge of how to develop the necessary practical professional knowledge, skills and values in the classroom environment;
- ✓ Their curricular content is more practical and requires the acquisition of skills parallel to theoretical knowledge.
- ✓ Two main problems are the problem of creating adequate activities for students in relation to the goals set and the problem of the poorer quality of teacher-student interaction;
- ✓ It means using high academic standards based on modern scientific knowledge to build dynamic combination of knowledge, skills, and values, and the 21st century competences in study programs of applied agriculture disciplines in undergraduate studies in online and hybrid environment;
- ✓ Expanding the understanding of active learning;
- ✓ Gaining insight into the possibilities and specifics of active learning when teaching topics related to sustainable agriculture;
- ✓ Understanding the characteristics, roles and activities of the main actors of the teaching process: teachers and students;
- ✓ Understanding and application of teaching/learning process analysis;
- ✓ Development of cooperation in the application of new LTA knowledge for revision of the syllabi

2. NEW GENERATIONS OF LEARNERS

Research on the characteristics of different generations and the differences between them is growing. Generations describe a group of individuals born during successive birth years who experience a similar cultural context. These individuals experience a common historical and cultural environment and also shape the culture in their way (Gentile, Campbell, & Twenge, 2013). For most psychological variables, investigations are a better dimensional approach (Haslam, Holland, & Kuppens, 2012). Thus, generational differences are more likely to follow a dimensional pattern with smooth, more gradual, and linear rather than discrete transitions between them. But as with other constructs such as age and race, this lack of clearly delineated categories does not preclude the existence of significant differences along the continuum. There are different social generations in the Western world. In the US, they are called as follows:

- The Lost Generation (born 1883 - 1900);
- The Greatest Generation (born 1901 - 1924);
- The Silent Generation (born 1925 - 1945);
- The Baby Boomer Generation (born 1946 – 1964);
- Generation X (born 1965 - 1979);

- Millennials (born 1980 – 1994);
- Generation Z (born 1995-2012);
- Gen Alpha (born 2013 – 2025).



Scheme 2.6. Categorization of generations

Generation Alpha is the group of students who should begin learning sustainable agriculture practices through an integrated curriculum.

Generation Alpha is a cohort of young people born in the early 2010s and mid-2020s (2013 – 2025). Named after the first letter of the Greek alphabet, Generation Alpha is the first to be born entirely into the 21st century. They are the first generation born to parents who grew up with the internet, mobile phones, tablets, and social networks. They also tend to be the most racially diverse and technologically capable. Generation Alpha are part of an unintentional global experiment where screens are placed in front of them from the youngest age as pacifiers, entertainers and educational aids. This great screen-age in which we are all living has a bigger impact on the generation exposed to such screen saturation during their formative years. They began being born in 2010, the year when iPad was launched, Instagram was created, and App was the word of the year, and so have been raised as screenagers to a greater extent than the fixed screens of the past could facilitate. For this reason we also call them **Generation Glass** because the glass that they interact on now and will wear on their wrist, as glasses on their face, that will be on the Head Up Display of the car they learn to drive on, or the interactive school desk

where they learn will transform how they work, shop, learn, connect and play. We were raised in a world where glass was something you looked through, but for them, it is something you look at. For us, it was "hands off the glass", but for this kinesthetic generation, glass is a hand-on medium.

We tend to assume that young generations are similar to earlier generations, with some specifics brought by the "zeitgeist" and lifestyle. But the differences between the new ones, from Millennials to Gen Z and the Alpha generation, are so many and so fundamental that we may wonder if we even know those we work with in education. In the simplest terms, the findings of significant multi-decade research show that on the one hand, the latest generations are "conceited", they believe in their uniqueness, their ability, that they are special and can do something great, and on the other hand, they are depressed, lost, lonely, incredibly vulnerable, and with significantly weaker cognitive performance than their peers in earlier generations.

The study of differences between generations is an old topic, but with such accelerated socio-cultural and technological changes, differences between generations have become one of the essential issues of quality and educational efficiency. If teaching is a complementary process involving partners in asymmetric interaction, then it is completely logical and necessary to know the characteristics of students as partners. Without it, nothing can be done to improve the quality of teaching/learning. Analyzing trends in self-assessment of the characteristics and attitudes of young people leads to a better understanding of modern culture and today's youth. And the better we understand them, the sooner we will be able to do something about their lives, not only to adapt education to them, but also to prevent "cognitive collapse", the evident cognitive decline of young generations but also to support their development.

iGen generation. Based on longitudinal meta-analyses, Twenge et al. (2019) conclude that the new generation suffers from more mental, personal, societal, social, educational, and relationship problems than any other generation in history. More comfortable online than at parties, post-millennials are more physically confident than teenagers ever were. But they are on the verge of a mental health crisis. Twenge (2017) noticed that around 2012 there were abrupt shifts in teen behaviours and emotional states that had never been seen before. The biggest difference between the Millennials and this new generation that Twenge calls **iGen** was in how they viewed the world and how they spent their time. The experiences they have every day are radically different from those of the generation that came of age just a few years before them. The "iGen" generation is growing up with smartphones, has an Instagram account before they start high school, and does not remember a time before the Internet. The Millennials grew up with the web as well, but it wasn't ever-present in their lives, at hand at all times, day and night. The advent of the smartphone and the tablet was quickly followed by hand-wringing about the deleterious effects of "screen time."

Recent students were more likely to see themselves as above average in agentic areas such as academic ability, drive to achieve, leadership ability, public speaking ability, self-confidence, and writing ability. Trends in positive self-views are correlated with grade inflation but are not explained by changes in objective performance or effort. The iGen results on the assessment test for students' readiness for college-level coursework by evaluating their skills in reading, writing, and math are lower, they have fallen compared

to the middle of the first decade of the 21st century, especially when it comes to writing and critical reading. More recent generations also have markedly higher expectations for future educational and professional attainments, even though the actual attainment of these goals has not changed. The researchers concluded that recent generations had become 'too ambitious' and that many of them were setting goals that might not be right for them. The iGen spent less time on homework than Gen X teens did in the early 1990s.

Combined with the decline in working for pay, this means iGen teenagers have more free time than Gen X teens, and they spend that time on their phones, in their room, alone, and often anxious. The academic skills of the iGen lag behind those of their predecessors, the Millennials. By 2015, every third high school student would admit that he/she had not read a single book for pleasure in the past year, which is three times less than in 1976. Students in higher education, who should read more, also read less. The number of those who read newspapers dropped from 70% at the beginning of the 1990s to only 10% in 2015, and that is when reading newspapers only once or more times a week is taken into account. That decline is significant, steady, and impressive. On average, younger generations score higher on intelligence tests, particularly on reasoning ability and maths; however, much of the gain has taken place at the lower rather than the higher end of the IQ range. At the same time, fewer and fewer young people read books, which suggests a decline in the skills involved in reading long passages of text. iGen students like doing things themselves better than sitting and listening to a lecture. When they must hear a lecture, these students respond to pictures, graphics, and short video segments like those found on YouTube. The downside of this is that the textbook may never be read, or may only be skimmed. Textbook publishers are beginning to respond to generational changes by shortening undergraduate textbooks and printing more material in easy-to-digest chunks. This trend is likely to continue; few young people today, even the high achievers, enjoy sitting quietly with a book and reading. Instead, they attempt to multi-task, doing homework while surfing the web and exchanging instant messages with friends.

There are several steps teachers can take to better teach this generation. The first step is to understand their perspectives and understand that they are a reflection of contemporary culture. iGen is doing exactly what his parents, teachers, and media taught him. The second step is breaking up lectures into short chunks, using videos, and promoting hands-on learning. However, teachers cannot compromise on the material and standards for content and learning that must be taught. As students feel more entitled, they will demand better grades for less work, just like they did in high school. In higher education, however, allowing students to earn good grades when they don't learn the material is not only unfair but dangerous. Today's students often need the purpose and meaning of the activities they are given. Previous generations had a sense of duty and would often do what they were told without asking why. Most young people no longer respond to calls to duty; instead, they want to know exactly why they are doing something and want to feel that they are having a personal impact. Perhaps this is an opportunity: if young people understand the deeper meaning of the task, they can bring their energy and passion to it.

2.1. Main requirements for learning/teaching sustainable agriculture

Learning and teaching sustainable agriculture are critical components for achieving long-term agricultural viability and sustainability within educational contexts. A robust framework for both learning and teaching involves a multi-faceted approach that integrates curriculum development, pedagogical strategies, community engagement, and entrepreneurial education, all aiming to nurture a culture of sustainability and innovation in agriculture.

Through literature, the key problems detected in the vocational schools are:

- ✓ Student motivation;
- ✓ Curriculum adequacy and curriculum alignment;
- ✓ Problems with realization of practical teaching and learning;
- ✓ Subject nature;
- ✓ Teacher role – pedagogical competencies of the teachers;
- ✓ Previous knowledge of students;
- ✓ Selection of students;
- ✓ Evaluation because of a lower level of knowledge;
- ✓ Teacher motivation;
- ✓ Losing control over students;
- ✓ Efficiency in learning;
- ✓ Availability of well-equipped teachers;
- ✓ Mental health of students;
- ✓ Socio-emotional isolation;
- ✓ Lower level of interactivity;

Curriculum development plays a crucial role in equipping students with the necessary knowledge and skills for sustainable agricultural practices. The incorporation of agricultural entrepreneurship into educational curricula has been highlighted as a means of linking practical skills with theoretical knowledge, thereby enhancing overall educational quality and contributing to the United Nations Sustainable Development Goal 4 (SDG-4), which aims for inclusive and equitable quality education (Rao et al., 2023). This approach fosters agricultural skills and emphasizes the importance of entrepreneurial thinking among students, aligning educational outcomes with the needs of modern agricultural practices (Phiri, 2019; Rao et al., 2023).

Moreover, addressing climate change within agricultural curricula is essential. Education that includes climate-smart agriculture focuses on innovation and responsiveness to environmental challenges, preparing students to engage with issues such as climate variability and resource management (Staden, 2020). This is especially urgent, as climate change impacts are already being observed in agricultural productivity and food security (Chhetri et al., 2023). Training educators with the competencies needed to deliver this kind of curriculum is also necessary (Staden, 2020).

A critical requirement for effective, sustainable agricultural education is the integration of sustainability practices within the educational framework. This integration ensures that students not only learn about sustainability but can also apply it practically in agricultural settings. For example, Yoshida and Yagi (2023) argue that social

sustainability practices enhance community support and involvement in urban agriculture. This highlights the need for educational programs to engage students with their communities, bridging theoretical knowledge and practical application.

Furthermore, collective action in educational settings enriches the learning environment and promotes a sense of community among learners. Evidence suggests that collective labour enhances food security and resilience among smallholder farmers (Owuor et al., 2024). Educational institutions can leverage this by forming community partnerships that provide hands-on, practical experiences in sustainable practices, thereby cultivating an ingrained understanding of sustainability through real-world application.

The overarching goal of sustainable agricultural education should focus on three essential pillars: knowledge acquisition, skill development, and community engagement. Knowledge acquisition involves comprehensive training covering a wide range of topics, including environmental impact, market dynamics, and innovative agricultural practices. Skill development includes hands-on experiences that allow students to apply their knowledge in practical settings, fostering a proactive approach to challenges faced in agriculture today. This is particularly important given the diverse disciplines integrated into agricultural education that require deep content knowledge (Tummons et al., 2020). Community engagement reinforces the importance of collaborative efforts in fostering sustainable agricultural practices and enhances social learning as part of the educational process.

Moreover, the role of technology and recent advancements in agricultural techniques underscores the necessity of an up-to-date curriculum that incorporates scientific innovations for sustainable agriculture. Educational programs should adapt to include such advancements, providing students with early exposure to cutting-edge practices that can elevate agricultural productivity and environmental stewardship (Guo et al., 2025).

Entrepreneurial education in agriculture is crucial for fostering a workforce equipped with the necessary skills and an innovative mindset that can adapt to the changing agricultural landscape. Policies promoting an entrepreneurial culture through agricultural education should focus on sufficient resources, qualified educators, and a curriculum designed to respond to market needs (Phiri, 2019). This establishes an environment where students are encouraged to innovate and create sustainable agricultural businesses and practices.

Diversity in learning methodologies can further enhance the teaching of sustainable agriculture. By adopting various pedagogical strategies, such as experiential learning, project-based tasks, and collaborative group work, educators can better engage students and cater to different learning styles. Such methodologies have been shown to improve comprehension and retention of complex agricultural concepts, leading to the development of more capable and responsible agricultural practitioners (Jenkins et al., 2010; Nicholls & Thorne, 2017).

Recognizing that agricultural education is a lifelong journey, it is vital to create pathways for continuous learning and professional development for both educators and students. This could include fostering partnerships with industry experts, promoting internships in sustainable agricultural practices, and encouraging participation in

agricultural research initiatives. By doing this, educational institutions not only expand their curricula but also create supportive networks that can assist students throughout their careers.

Understanding the local context and challenges faced by different communities in relation to sustainable agriculture is paramount. Tailoring educational programs to specific environmental, social, and economic contexts enables relevant and impactful education (Menon & Suresh, 2020). For instance, the unique agricultural challenges in regions like Zambia require specific policies and frameworks to address them effectively, ensuring that educational components remain relevant to the local agricultural economy (Phiri, 2019).

Assessment and evaluation of agricultural education programs should reflect the dynamic nature of sustainable practices. Continuous feedback loops from students, educators, and community stakeholders can inform necessary curricular adjustments, ensuring they remain effective in the face of changing agricultural demands. This holistic and responsive approach supports a culture of reflection and improvement within agricultural education.

Ultimately, learning and teaching sustainable agriculture requires comprehensive engagement with local agricultural ecosystems and a commitment to continuous adaptation and innovation in educational approaches. The integration of sustainable practices needs to be realized through collaborative efforts that involve educators, communities, and relevant stakeholders, ensuring that future agricultural leaders possess the skills and knowledge needed to navigate complex agricultural landscapes.

In conclusion, achieving effective, sustainable agricultural education necessitates a multidimensional approach that encompasses curriculum development, entrepreneurial education, community engagement, and continuous adaptation. By fostering an interconnected relationship among these components, educational institutions can better prepare students for the challenges of sustainable agriculture, thus contributing significantly to the overarching goal of creating resilient and sustainable agricultural practices globally.

3. DEVELOPMENT OF SKILLS AND COMPETENCIES (ENHANCING HUMAN CAPITAL)

Education, skills development and technical training are central to agricultural production and rural employment. It is widely recognized that there is an urgent need for faster and more sustainable agricultural growth to create jobs, generate income and guarantee food security, especially along agricultural value chains and sustainable growth targets. Sustaining this depends not only on direct factors that affect agricultural productivity, but also on institutional capacity to design and implement programmes and policies, and on human capacity building along entire value chains.

Agricultural education and training historically have facilitated growth in the sector, producing extension officers and hands-on technicians to support the production capacities of farmers and other value chain actors.

The development of skills and competencies for sustainable agriculture education is essential for cultivating a new generation of agricultural practitioners who are equipped to face the challenges posed by climate change, food security, and economic viability. Addressing these challenges requires a comprehensive educational framework that integrates theoretical knowledge with practical skills, emphasizes technological competencies, and fosters innovation in agricultural practices. Such a framework should also aim to empower teachers and students with sustainability-focused mindsets that can contribute positively to their communities.

The integration of climate-smart agriculture concepts into educational curricula can prepare future agricultural practitioners to adopt environmentally friendly practices that are central to sustainable food production (Piikki et al., 2017). Educational institutions should prioritize training programs that not only focus on theoretical foundations but also provide hands-on experience with emerging agricultural technologies. Use of digital tools and precision agriculture techniques can significantly enhance the efficiency of agricultural practices, leading to reduced waste and increased productivity (Gülmez, 2024). Skills in critical thinking, problem-solving, and collaboration are paramount for future agricultural professionals to address complex environmental and economic issues. Educational frameworks that emphasize these transversal skills can greatly enhance students' engagement with sustainability challenges (Karvonen et al., 2023). Programs aimed at building competencies for sustainable development should draw on both formal and informal educational activities to ensure comprehensive skill acquisition that is relevant in real-world contexts (Carrascal et al., 2019).

Furthermore, cultivating environmental awareness through education can empower students to make informed decisions that align with sustainability goals. This includes understanding the importance of biodiversity, ecosystem services, and efficient resource utilization in agricultural systems (Quinn et al., 2015). As research suggests, integrating sustainability education across different disciplines helps form a cohesive understanding of agricultural sustainability among future educators and professionals (Karvonen et al., 2023).

Entrepreneurial education also plays a vital role in developing competencies for sustainable agriculture. Trainers must focus on endowing students with the skills necessary to innovate and create sustainable businesses within the agricultural sector (Raof et al., 2021). Fostering an entrepreneurial mindset through educational programs

can enhance individuals' capabilities to address market demands, thereby linking education in agriculture with economic sustainability (Nuringsih, 2019). Moreover, it is essential to promote education programs specifically focused on sustainable entrepreneurship, guiding students in developing viable and environmentally friendly business models.

The integration of digital technologies and green entrepreneurship training is seen as vital for women in agriculture, as it can significantly enhance their participation and empowerment in the agricultural sector (Fertő & Bojnec, 2025). This aligns with the broader goal of ensuring gender equity and equality within sustainable agricultural practices.

Community engagement and collaborative learning are indispensable components of successful and sustainable agriculture education. Programs that involve collaboration with local communities, agricultural practitioners, and stakeholders facilitate practical experiences that allow students to apply their learning in meaningful contexts (Gnahoua et al., 2022). Engaging students in community-driven agricultural initiatives strengthens their problem-solving capacities and helps build adaptive management strategies tailored to local conditions.

Research demonstrates that community-based educational approaches can boost agricultural sustainability by promoting local knowledge and practices (Maligalig et al., 2019). These learning experiences not only provide practical skills but also enhance students' understanding of the socio-economic dynamics affecting agriculture in their communities.

The role of technology in enhancing capacities for sustainable agriculture cannot be overlooked. Appropriate technological interventions can significantly improve agricultural practices, promote efficiency, and reduce environmental impacts (Wood et al., 2015). Capacity-building programs must include training on new technologies and their applications in farming, such as data analytics for precision farming and sustainable resource management systems.

Moreover, equipping future agricultural professionals with computational thinking skills enables them to approach problem-solving through logical frameworks, thus promoting innovation within agricultural education (Chondrogiannis et al., 2021). Increasing digital literacy among agriculture students is imperative for their readiness to leverage advancements in technology for sustainable practices.

Despite the promising frameworks for developing skills and competencies in sustainable agriculture education, numerous barriers may hinder effective implementation. Low educational levels among farmers currently limit the effective use of modern agricultural technologies and practices (Gnahoua et al., 2022). Addressing these barriers requires a multi-faceted approach that includes strengthened vocational training, greater accessibility to educational resources, and enhanced involvement from educational and governance institutions.

Efforts must also focus on eliminating gender disparities in agricultural education and training. Empowering women in the agricultural sector through targeted educational programs is essential for maximizing their potential contributions to sustainable agriculture (Maligalig et al., 2019). A comprehensive approach that encompasses both education and opportunities can greatly facilitate women's empowerment and active participation in agricultural practices, ultimately advancing agricultural sustainability.

Lastly, promoting a culture of continuous training and lifelong learning is crucial for equipping agricultural professionals with up-to-date knowledge and skills. The agricultural sector is continually evolving with new practices, technologies, and challenges; therefore, continuous professional development programs play an essential role in keeping educators and practitioners informed and adaptable (Karvonen et al., 2023). These training programs must be designed to address emerging issues and integrate best practices in sustainability to ensure ongoing relevance within the agricultural curriculum.

Through a combination of effective education methodologies, experiential learning, community engagement, and technology integration, the ability to develop skills and competencies for sustainable agriculture can be significantly enhanced. This holistic approach ensures that future agricultural professionals are knowledgeable and equipped with the practical skills necessary to drive innovation and sustainability in the agricultural sector.

3.1. VET Teachers' Skills and Competencies

The competencies and skills of vocational education teachers are crucial in effectively teaching sustainable agricultural practices.

Table 3.1. presents the key competencies and skills that VET teachers need to effectively organize the teaching and learning process for sustainable agriculture practices.

Table 3.1. VET teachers' skills and competencies, including both theoretical and practical knowledge in their field

Skill Category	Component	Description	Examples / Indicators
Subject Matter Expertise	Theoretical Knowledge	In-depth understanding of principles, processes, and standards in their vocational field	Understands and explains industry concepts, regulations, and procedures clearly
	Practical Skills	Ability to apply knowledge hands-on using industry tools, equipment, and methods	Demonstrates techniques, uses tools safely and efficiently, solves job-related tasks in real time
	Industry Currency	Up-to-date knowledge of industry trends, technologies, and standards	Engages with industry networks, attends workshops, integrates current practices into training
	Work-Based Learning Integration	Aligning training with workplace practices	Designs simulations, work placements, or live projects relevant to industry expectations
Pedagogical Skills	Curriculum Planning	Developing structured learning plans aligned with learning outcomes and industry standards	Prepares lesson plans, schemes of work, and competency-based assessments

	Instructional Methods	Applying diverse teaching methods to meet different learner needs	Uses demonstrations, group work, flipped classrooms, problem-based learning
	Assessment Design & Feedback	Designing valid assessments and providing constructive feedback	Develops practical tests, provides timely and formative feedback, assesses based on criteria
	Digital Pedagogy	Using technology to support and enhance vocational training	Employs LMS, virtual simulations, digital tools, online portfolios
Soft Skills	Communication	Clear, effective, and respectful interaction with learners and stakeholders	Gives clear instructions, active listening, non-verbal communication awareness
	Empathy & Emotional Intelligence	Understanding and supporting learners' emotional and social needs	Demonstrates patience, recognizes signs of disengagement or distress, provides encouragement
	Cultural Competence	Respect for diversity and inclusivity in the learning environment	Adapts language and materials, embraces learner diversity, prevents discrimination
	Motivation & Engagement	Inspires and encourages active learner participation	Uses relevant real-world examples, promotes learner autonomy and confidence
Other Important Skills	Adaptability & Flexibility	Responding to changing conditions, learners, and tools	Adjusts lesson pace, adapts to remote learning, updates content quickly
	Collaboration & Teamwork	Working with colleagues, industry, and education stakeholders	Participates in team planning, builds partnerships with industry/employers
	Lifelong Learning & CPD	Commitment to continuous improvement of vocational and teaching skills	Engages in professional learning communities, attends PD, self-assesses
	Green & Sustainable Practices	Promoting sustainability in technical and teaching practices	Embeds eco-conscious practices into training, reduces resource waste in practical tasks
	Digital Literacy	Competence in using and teaching digital tools relevant to the vocation	Teaches with CAD, simulations, e-learning platforms, digital portfolios depending on the field
	Problem Solving & Critical Thinking	Encouraging analytical thinking in learners and troubleshooting issues	Guides learners in resolving technical issues, evaluating

			alternatives, making decisions

Vocational education, especially in agriculture, necessitates that teachers not only possess substantive knowledge but also the capability to communicate effectively and utilize various instructional methodologies to impart sustainable practices.

This guidebook synthesizes relevant literature to elaborate on essential skills and competencies needed by these educators in promoting sustainable agriculture.

First and foremost, a strong understanding of sustainable agricultural practices is essential for vocational education instructors. Teachers should be equipped with comprehensive knowledge regarding various sustainable approaches, such as conservation agriculture, agroforestry, and organic farming. For instance, Karsinah et al. (2023), emphasize the role of organic mulch in improving soil resilience and reducing greenhouse gas emissions, which aligns with sustainable agricultural principles. Furthermore, Baptista et al. (2019a) highlight how educational programs can facilitate the sharing of best practices in sustainable farming. This indicates that vocational educators must stay updated with current and evolving sustainable practices to provide students with relevant and applicable knowledge.

Effective teaching in vocational settings requires the incorporation of adult learning principles and practical applications. The pedagogical approaches should facilitate active learning, where students can engage in hands-on experiences. Ji et al. (2022) discuss the positive correlation between farmers' age and the adoption of sustainable practices, suggesting that older farmers may benefit from experiential learning. This implies a need for teachers to design curricula that include practical components that align with the socio-demographic characteristics of the students.

Another crucial competency for educators is the ability to adapt their teaching strategies to include new technologies and methods supporting sustainable agriculture. As the agricultural landscape changes, the instructional strategies highlight the importance of continuous professional development for vocational educators in sustainable practices and technologies.

Teachers need to be capable of providing mentorship to students, encouraging them to adopt environmentally sustainable practices. This underscores that vocational teachers must not only impart knowledge but also inspire students to actively embrace sustainable methodologies.

With utmost importance are effective communication and collaboration skills that are vital for vocational teachers, particularly in working with industry stakeholders and facilitating community involvement in sustainable agricultural practices. Also, the importance of extension services in promoting sustainable agriculture is important, suggesting that educators should foster partnerships with agricultural communities to enhance their learning experience. This collaborative approach can facilitate a more profound impact on students and the broader agricultural ecosystem.

Table 3.2. Developing key competencies for VET teachers to enhance their role in sustainable agriculture education

Competency area	Description	Key skills & knowledge	Examples / Applications in teaching
Environmental and agroecological literacy	Understanding of ecological principles and sustainable agricultural systems	Soil health and biodiversity Water and energy conservation Circular farming practices Climate change impact	Integrates agroecology topics in curriculum; teaches composting, crop rotation, organic practices; leads field-based ecological activities
Pedagogical innovation	Ability to design and deliver learner-centered, inquiry-based, and context-relevant instruction	Active and experiential learning Project-based learning (PBL) Interdisciplinary approaches	Facilitates school gardens, problem-solving tasks, and real-world sustainability challenges
Digital competencies	Use of digital tools to teach and manage learning in sustainable agriculture	LMS and e-learning platforms Simulation software Data analysis and farm management tools (e.g., GIS, sensors)	Uses mobile apps for soil testing, introduces precision farming tools, and facilitates online agri-content
Entrepreneurial and social innovation skills	Capacity to foster innovation, value creation, and sustainable livelihoods	Agribusiness basics Green entrepreneurship Social enterprise models Value chain awareness	Guides students in starting green agri-projects, builds local produce marketing plans, and connects to local eco-entrepreneurs
International and intercultural competence	Ability to teach and collaborate across cultures and understand global sustainability perspectives	Global food systems Cross-cultural teaching strategies Multilingual content adaptation	Integrates case studies from other countries, uses FAO or UNEP content, and collaborates with international VET networks
Structured professional development opportunities	Engaging in systematic training and learning pathways to improve competencies	Attending sustainability-focused CPD Participating in teacher exchanges Earning micro-credentials in green skills	Completes online courses in sustainable agriculture, joins EU or FAO training programs, and reflects via teaching portfolios

If the VET teachers want to enhance their role in sustainable agriculture education, they need targeted upskilling across several key competencies:

a) Environmental and agroecological literacy: Teachers should have a deep understanding of ecological processes, sustainable land use, soil and water management, climate-smart agriculture, and circular bioeconomy principles. This requires continuous professional development through workshops, field visits, and access to scientific research translated into educational content.

b) Pedagogical innovation: Modern sustainable agriculture teaching demands learner-centred and inquiry-based methods. Teachers should be trained in:

- Project-Based Learning (PBL) that focuses on real-world sustainability issues;
- Problem-solving and design thinking to tackle agricultural challenges;
- Outdoor and experiential learning, including school gardens, composting projects, and local farm partnerships.

c) Digital competencies: Digitalization is transforming agriculture. Teachers must master:
   - Smart farming tools (drones, sensors, data analysis);
   - Online learning environments and digital content creation;
   - Collaboration tools (video conferencing, shared documents, learning platforms).

d) Entrepreneurial and social innovation skills: Sustainable agriculture includes new business models such as community-supported agriculture, eco-tourism, and farm-to-fork initiatives. VET teachers should promote:
   - Entrepreneurship education;
   - Sustainability-driven business planning;
   - Community engagement and social enterprise models.

e) International and intercultural competence: Global perspectives enhance sustainability learning. Teachers benefit from:
   - Exposure to international practices and innovations;
   - Intercultural communication training;
   - Participation in international projects and networks.

f) Structured Professional Development Opportunities: To facilitate skills development, schools, educational authorities, and VET providers should offer:
   - CPD Modules (CPD - Continuing Professional Development) modules are learning activities designed to help professionals enhance their skills, knowledge, and experience throughout their careers. They are a way to stay current in a field and improve performance. CPD modules can be formal or informal, and they can take many different forms, including online courses, workshops, conferences, and self-study and certification programs focused on sustainable agriculture.
   - Train-the-Trainer Programs enabling multiplier effects across institutions.
   - Summer schools, Bootcamps (A 'boot camp' refers to either a condensed and intensive timeframe where the focus is solely on the one topic, or it may refer to a sequenced program over a number of weeks – but where the focus is similarly highly intense and targeted on the development of a specific skill or understanding), and immersive learning (Immersive learning is a type of learning experience that engages learners deeply by placing them in simulated or virtual environments that mimic real-world scenarios. It uses technologies like virtual reality (VR), augmented reality (AR), and mixed reality (MR) to create a sense of presence and realism, making learning more interactive, engaging, and effective) in agroecology.
   - Peer Mentoring and learning circles (Peer mentoring and learning circles are collaborative formats where individuals, typically at similar levels within an organization or community, support each other's growth and

development through shared experiences, knowledge exchange, and peer-to-peer coaching) to promote reflective practice.

Teacher professional development must be accessible, flexible, and aligned with European frameworks such as the DigCompEdu (for digital skills) and GreenComp (for sustainability competences).

DigCompEdu refers to the European Framework for the Digital Competence of Educators. It is a framework designed to define and describe what it means for educators to be digitally competent. This framework is used to help educators self-assess their digital skills and competencies, and to guide their professional development in using digital technologies in education.

GreenComp refers to the European Commission's GreenComp reference framework for sustainability competences. It aims to equip learners with the knowledge, skills, and attitudes needed to live, work, and act sustainably, supporting lifelong learning across various educational settings.

In conclusion, vocational education teachers play a pivotal role in promoting sustainable agriculture through the teaching of critical skills and competencies, including comprehensive knowledge of sustainable practices, effective instructional strategies, integration of technology, mentorship, and communication skills. These competencies are fundamental to equipping students with the necessary tools to meet the demands of a sustainable agricultural future.

3.2. Students' Engagement and Activities

The basic requirements of student (learner)-oriented teaching are:

- ✓ Shifting the focus from the teacher to the student. This means shifting the focus from program delivery to creating learning environments and stimulating learning situations that align with subject objectives;
- ✓ Learning is understood as the active co-construction of student knowledge through the asymmetric interaction of students with the teacher/expert;
- ✓ The key concept of active learning is the student's activity in the learning process. It is characterized by the following:
  - It is an inner, thought activity;
  - Activities are diverse (verbal, manipulative, motor, etc.);
  - Activity is a continuum from less complex to highly complex activities;
  - The activities are relevant to the specific content, closely connected with the nature of the content being learned;
- ✓ Different teaching/learning methods encourage different student activities;
- ✓ There is no single solution for all teaching/learning situations, the teacher creates instruction depending on the content and goals, and the outcomes s/he wants to achieve, the characteristics of the students, and the conditions in which s/he works. If it is necessary to adopt professional terms, the main activity of the students will be memorization; if the goal is to develop skills, learning by doing is necessary; if the goal is to learn professional problem-solving competencies, activities that include complex, higher thought processes, but also emotional and social competencies are necessary;

- ✓ Active learning is effective because it implies that goals, methods, content, evaluation, and learning outcomes are aligned with each other (curriculum alignment)

The concept of student engagement is receiving much attention due to the shift toward constructivist, student-centered teaching methods, growing pressures to improve teaching and learning outcomes, and its association with a number of positive outcomes. Variously defined in the literature, student engagement refers to the student's contribution to their learning, in terms of time, commitment, and resources (Kahn, 2014); students' efforts to study the subject, practice, get feedback, analyze, and solve problems (Kuh, 2003); the "extent to which students are engaging in activities that higher education research has shown to be linked with high-quality learning outcomes" (Krause & Coates, 2008) or the "quality of effort and involvement in productive learning activities" (Kuh, 2009). Engagement in learning implies that the student takes an active role in their learning (Antić, 2008). The concept of student engagement is based on the constructivist assumption that learning is influenced by the way an individual participates in educational activities. Learning is seen as a 'joint enterprise' which also depends on institutions and staff providing the conditions, opportunities, and expectations for students to engage. Based on this, student engagement is understood not only as an activity of the students themselves but also of the institutions where they are educated: "the interaction between time, effort and other relevant resources invested by students and their institutions to optimize the student experience and improve learning outcomes and student development and performance, and the reputation of the institution' (Trowler, 2010). Interest in student engagement has expanded significantly, addressing how the quantity and quality of student effort affect learning and how environmental conditions and individual dispositions contribute to their engagement.

Student engagement in learning activities is a necessary part of learning because students learn what they do, so active engagement with the promotion of different mental activities can improve student learning. Students' engagement happens along a continuum and is a matter of degrees and complexity of their engagement. All students' activities are closely connected with the nature of the subject content and learning goals. Although it's the student's responsibility to engage in academic activities, the teacher's role is to create course designs that promote the development of mental activities, capability to think at different levels (memorization, comprehension, application, analysis, evaluation, and synthesis).

Students who are not engaged in schooling run the risk of inadequately acquiring the knowledge and skills needed to transfer and effectively function in future educational and work experiences. (Miller, Rycek, & Fritson, 2011). Because of these consequences, student engagement needs significant consideration by educators to better understand student behavior and address students' educational needs (Marx, Simonsen, & Kitchel, 2016). Student engagement is most often defined as a student's connection to learning and the learning environment that includes behavioral, emotional, and cognitive aspects of the student.

"Behavioural engagement" is the degree to which students are actively involved in learning activities. Indicators of behavioural engagement include time and effort spent participating in learning activities and interaction with peers, faculty, and staff. Indicators

of behavioural engagement reflect observable student actions and most closely follow the original conceptualizations of student engagement as quantity and quality of effort towards learning. Emotional engagement is students' affective reactions to learning. Indicators of emotional engagement include attitudes, interests, and values towards learning and a perceived sense of belonging within a learning community. Emotional engagement is often assessed using self-report measures and provides insight into how students feel about a particular topic, delivery method, or instructor. Finally, cognitive engagement is the degree to which students invest in learning and expend mental effort to comprehend and master content. Indicators of cognitive engagement include: motivation to learn; persistence to overcome academic challenges and meet/exceed requirements; and deep processing of information through critical thinking, self-regulation (e.g., set goals, plan, organize study effort, and monitor learning, and the active construction of knowledge). While cognitive engagement includes motivational aspects, much of the literature focuses on how students use active learning and higher-order thinking, in some form, to achieve content mastery" (Schindler, et al., 2017).

Many factors have been identified in literature as variables affecting student engagement in the classroom.

Research findings indicate that student engagement affects the following:

Students:

- ✓ Encourages a higher degree of information processing, thereby improving learning and positive perceptions of the learning environment;
- ✓ The behaviors associated with student engagement in the classroom are general attentiveness, eye contact, and raising hands to ask questions, all of which demonstrate an interest in the subject matter;
- ✓ More efficient use of class time, and participating in classroom activities that improve their learning;
- ✓ Interactions with peers through collaborative learning and discussions with diverse others are also important elements of student engagement;
- ✓ Academic behaviors, including the use of strategies for self-regulated learning, quantitative reasoning, activities that promote higher-order thinking, and reflective and integrative learning, can increase content knowledge as well as overall cognitive processing and are all linked to various aspects of achievement and success;
- ✓ Increased student satisfaction with their coursework and the overall schooling experience;
- ✓ Better multiple measures of academic performance including course grades, college GPA, and college retention;
- ✓ Improved career development focus;
- ✓ Students who have a higher level of engagement in university activities are better academically prepared when they graduate;
- ✓ But global engagement in broader college activities does not directly equate to academic and intellectual engagement.

The Classroom Environment surrounding the student

- ✓ Large classes, those with 30 or more students, can hinder the opportunity for students to participate, which in turn discourages them from engaging

fully in the first place. In large groups of students, engagement could be fostered by grouping students to facilitate discussion and enable teachers to approach students more directly and intimately.

- ✓ The time of day in which the class is scheduled also influences engagement. Some research reported students were least engaged, enjoyed the course the least, and negatively perceived teacher assistance during early morning sessions;
- ✓ The facilities and physical spaces in which these classes take place shaped students' on-task behaviors;
- ✓ Environmental features such as the quality of interactions with students, faculty, and other types of staff, as well as an overall perception of a supportive environment contribute to student engagement. Interpersonal interaction with faculty positively influenced student effort related to educationally purposeful learning activities and overall student perceptions of the learning environment.

The Teacher

- ✓ The teachers and their approaches to teaching in the classroom encourage or discourage student engagement;
- ✓ Teacher communication skills are positively associated with student affective learning and learning indicators. The interpersonal exchanges between students and teachers influence student engagement in the classroom;
- ✓ Being a more 'immediate teacher' who demonstrates energy and concern for student learning through being inclusive, encouraging, and ultimately realistic with communicating expectations can positively influence student engagement in the classroom;
- ✓ Small class sizes and verbally immediate teachers in combination work positively to encourage students to interact with classmates and teachers;
- ✓ Developing student-teacher relationships is essential to creating a positive classroom climate and encouraging students to become involved in their learning;
- ✓ Student apathy as perceived by teachers is a tangible phenomenon within college classrooms.

When considered together, influence from the teacher, influence from within the student, and environmental (contextual) influences are believed to interact to produce varied levels of an individual student's engagement in each and every course. Studying engagement and its effects is important to better prepare teachers to be more effective in the classroom and create better learning environments.

4. CONSTRUCTIVE ALIGNMENT OF OBJECTIVES AND LEARNING OUTCOMES, EVALUATION AND ASSESSMENT

The integration of constructive alignment into educational curricula is an important strategy that enhances the effectiveness of teaching and learning by ensuring that learning objectives, teaching methods, and assessment strategies are well-aligned. Constructive alignment is based on the principle that when the learning outcomes are clearly defined, they should guide the selection of teaching activities and assessment methods, thereby creating a cohesive learning experience that promotes deeper engagement and understanding among students (Boland et al., 2020; Bertoni et al., 2024; Hristov et al., 2023; Lith et al., 2025).

Aligning educational objectives with assessment strategies helps to create an environment where students can comprehend what is expected of them and how their learning will be evaluated. Research indicates that when students are aware of the learning outcomes, it alleviates anxiety and refines their focus, allowing them to navigate their academic tasks more efficiently (Field et al., 2022). For instance, a study suggested that students who feel confident in their understanding of course objectives can translate that understanding into a more structured learning experience, thereby enhancing the overall learning process (Iqbal et al., 2023).

Moreover, constructive alignment emphasizes the importance of educational assessment as a critical component of the curriculum. Assessments are not merely tools for measuring student knowledge; they are integral to shaping student learning experiences and outcomes. When assessments align closely with desired learning outcomes, students tend to be more motivated to engage with the curriculum, fostering a more profound understanding of the material (Tullo & Gordon, 2013; Boland et al., 2020; Byrne et al., 2021). This alignment underscores a broader pedagogical viewpoint, suggesting that assessments should reflect the taught content and the skills the course aims to develop, ensuring that students are adequately prepared for practical challenges.

The implementation of constructive alignment in educational settings necessitates a thoughtful approach to the design of learning activities. Effective instructional design requires the incorporation of various pedagogical techniques that support active learning and critical thinking, achievable through methods such as case studies, simulations, and problem-based learning approaches. Such methods not only align with realistic learning scenarios but also encourage the application of knowledge, bridging the gap between theoretical understanding and practical application.

Moreover, the effectiveness of blended learning environments, which combine traditional and digital learning methods, is increasingly recognized as an innovative approach to enhance constructive alignment. In a post-COVID educational context, many institutions are transitioning to hybrid models that integrate online assessments with conventional teaching practices, thereby facilitating a flexible learning experience (Cheng et al., 2023). This aligns with findings that students in blended learning environments tend to perform better when materials and assessments are cohesively designed to meet stipulated learning outcomes (Carvalho et al., 2022).

In addition, formative and summative assessments serve distinct yet complementary roles in the learning process. Formative assessments aim to provide feedback throughout the learning journey, helping educators gauge understanding and

adapt instructional strategies (Arrogante et al., 2021). Conversely, summative assessments measure accumulated knowledge at the end of a learning period, ensuring that the curriculum's learning outcomes are met (Arrogante et al., 2021). This dual approach affirms student learning and reinforces the necessity of maintaining robust alignments among learning objectives, instructional practices, and evaluative measures.

Ultimately, the reflection on educational practices through the lens of constructive alignment reveals significant implications for curriculum development and instructional effectiveness. Stakeholders in education, from curriculum designers to educators, must prioritize developing coherent frameworks that link learning outcomes, teaching activities, and assessments. This coherence enhances learning experiences and supports student achievement and promotes a culture of continuous improvement within educational institutions.

In conclusion, the alignment of objectives, learning outcomes, evaluation, and assessment in curricula is not a static model but a dynamic framework that evolves to meet the complexities of modern education. It is critical for educators to engage in ongoing dialogue and reflection regarding educational practices' alignment with learners' distinct needs and society's ever-changing demands. By cultivating constructive alignment in teaching, we can ensure that education continues to fulfil its vital role in personal development and professional readiness across disciplines.

4.1. Sustainable agriculture in the school curriculum

Sustainable agriculture is not just a vocational pathway; it is a comprehensive, interdisciplinary approach that connects environmental stewardship, food security, innovation, and community well-being.

Table 4.1. Structural framework for aligning learning outcomes and competencies

Component	Definition in the sustainable agriculture context
Learning Outcomes	What should students know, understand, and be able to do upon successful completion of the course?
Competencies	What combination of knowledge, skills, values and attitudes should students develop to perform sustainability-related tasks effectively?
Assessment Methods	What are the tools and techniques used to evaluate whether students have achieved the intended learning outcomes and acquired the necessary competencies?

Table 4.2. Learning outcomes for sustainable agricultural practices and their direct connection to competencies and assessment

Learning Outcome	Associated Competency	Assessment Method
Explain the principles of sustainable agriculture and its environmental benefits	Environmental and agroecological literacy	Written test, oral presentation, group discussion
Identify and apply soil conservation techniques (e.g., cover cropping, composting)	Practical vocational skills in agroecology	Fieldwork observation, practical demonstration, skills checklist
Design a basic crop rotation and integrated pest management (IPM) plan	Technical planning and agroecological design	Project report, planning sheet, peer evaluation

Use digital tools to monitor soil health or water usage	Digital competence in agriculture (precision farming tools)	Hands-on digital task, portfolio with screenshots, simulation assessment
Apply sustainable water management practices (e.g., drip irrigation, rainwater harvesting)	Resource management and environmental literacy	Practical demonstration, rubric-based performance task
Create a small-scale organic farming business plan	Entrepreneurial and innovation skills	Business model canvas, pitch presentation, feasibility report
Demonstrate collaborative work in a group farming project	Teamwork, communication, and project management	Group project rubric, peer assessment, instructor feedback
Evaluate the impact of agricultural practices on biodiversity and climate	Systems thinking, ecological awareness	Reflective essay, infographic or sustainability impact report
Engage with local farmers or agri-experts to gather and present sustainability insights	Community engagement and knowledge transfer	Interview report, multimedia presentation, oral Q&A
Reflect on personal practices and propose improvements for more sustainable farming	Lifelong learning and critical reflection	Reflective journal, self-assessment rubric, portfolio entry

Integrating sustainable agricultural education into school curricula requires engaging students through various types of subjects that serve different educational purposes: general educational, theoretically methodological, professionally applicable, and scientifically applicable.

Table 4.3. Sustainable agriculture school subjects

Subject Category	Focus Area	Example Course or Unit
General Educational Subjects	Ethical citizenship, literacy, and numeracy	Food and Society, Math in Agriculture, Eco-literature
Theoretically Methodological	Systems understanding, inquiry skills	Agroecosystems Analysis, Climate Change & Agriculture
Professionally Applicable	Vocational and entrepreneurial skills	Organic Crop Production, Sustainable Farm Management, Organic livestock production
Scientifically Applicable	Scientific principles and technical depth	Soil Chemistry, Plant Biology, "Agri-Energy Systems, Animal ecology

Below is a breakdown of how each category contributing to holistic learning.

General educational subjects are foundational subjects that develop essential literacies, such as reading, writing, numeracy, critical thinking, and global citizenship, that are applicable across all fields. When contextualized for sustainability, they provide the ethical, communicative, and cultural grounding students need to become responsible future farmers, consumers, and policymakers. The purpose of these subjects is to cultivate well-rounded, critical citizens who can comprehend sustainability issues through a socio-cultural, ethical, and civic lens.

Examples and Integration:

- Language Arts / Literature: Students analyze texts related to food systems, environmental justice, and indigenous agricultural knowledge. They also engage in persuasive writing to advocate for sustainable practices.
- Social Studies / History / Civics: Topics such as the history of agriculture, land use policies, colonialism and food systems, and the impact of globalization on farming are explored.
- Mathematics: Learners use data from gardens or farms to calculate crop yields, water usage, or financial planning for agri-projects.
- Ethics / Moral Education: Discussions revolve around food justice, animal welfare, and the environmental responsibilities of producers and consumers.

Theoretically, methodological subjects provide students with the academic and cognitive tools for planning, analyzing, researching, and designing systems essential for understanding and developing sustainable agricultural models. The purpose of these subjects is to endow students with frameworks for critical inquiry and problem-solving that can be applied to real-world agricultural scenarios and innovations.
Examples and Integration:

- Ecology and Environmental Science Theory: Students examine ecosystems, resource cycles, and biodiversity to understand the principles of agroecology.
- Systems Thinking / Geography: Learners explore agroecosystems, resource flows, and the relationships between local and global farming systems.
- Philosophy of Science / Scientific Methodology: Students reflect on the nature of agricultural knowledge, the ethical use of biotechnology, and the value of indigenous wisdom in sustainable agriculture.

Professionally applicable subjects focus on the vocational and hands-on aspects of agricultural education. They align closely with TVET (Technical and Vocational Education and Training) programs and prepare students for direct employment or entrepreneurial activities in the agricultural sector. The main objective of these subjects is to provide employable skills, promote innovation, and foster an entrepreneurial mindset centered on environmental and social responsibility.
Examples and Integration:

- Agrotechnics / Farm Management: Students learn how to manage crops, livestock, and farm resources using sustainable methods.
- Organic Farming / Permaculture Design: Practical modules teach soil care, crop rotation, pest control without chemicals, and designing regenerative systems.
- Agricultural Economics / Agribusiness: Learners develop small-scale business plans, calculate production costs, explore local markets, and pitch sustainability-focused agri-ventures.
- Green Technologies / Precision Agriculture: Use of drones, sensors, and GIS in farming is introduced, enhancing digital and green skills.

Scientifically applicable subjects delve into the scientific disciplines that underpin sustainable agriculture, fostering a deep understanding of biological, chemical, physical, and technological processes involved in food production and ecosystem management.

These subjects have aim to enable learners to understand and apply scientific knowledge and innovations to solve complex agricultural challenges responsibly.
Examples and Integration:

- Biology / Plant Science / Soil Science: Students investigate plant physiology, soil microbiomes, and sustainable nutrient cycles.
- Chemistry / Environmental Chemistry: Learners study the chemical composition of fertilizers, water testing, and pollution from pesticides or waste.
- Physics (Energy Systems in Agriculture): Topics such as solar energy for irrigation, wind turbines, and the mechanics of sustainable machinery are explored.
- Biotechnology / Genetics: Modern and ethical use of biotechnology in enhancing crop resilience or reducing environmental impact is discussed.

The integration of sustainable agriculture across these subject types ensures that students not only gain technical proficiency but also develop as informed, ethical, and critically engaged citizens. It prepares students to:

- Make informed decisions about environmental and food systems.
- Collaborate across disciplines and cultures.
- Innovate responsibly in farming practices.
- Contribute to the global shift toward a greener, fairer future.

Table 4.4. Curriculum Alignment Matrix

Curriculum Element	Learning Outcome	Assessment Type	Aligned Competency	Standards Reference (Optional)
Knowledge Acquisition	Define sustainable agriculture and its benefits	Written quiz / oral Q&A	Environmental literacy	National Curriculum Std. 2.1
Skill Application	Demonstrate composting and water-saving techniques	Practical demo/field task	Practical vocational skills	National Agriculture Std. 4.3
Systems Thinking & Design	Plan a diversified school garden	Project-based assessment	Agroecological planning	Curriculum Integration Project
Technological Literacy	Record and monitor plant growth using digital tools	Portfolio / data tracker	Digital agriculture competence	Digital Skills Framework
Social Innovation & Entrepreneurship	Pitch a sustainable farming solution	Business model + presentation	Innovation & entrepreneurial thinking	Entrepreneurship Education Standard 3.2
Reflection and Ethics	Write a sustainability reflection or behavior plan	Reflective essay	Responsible citizenship	Environmental Education Goals

Table 4.5: Structural framework for aligning learning outcomes and competencies in sustainable agricultural practices in the school curriculum

Curriculum Component	Learning Area/Topic	Learning Outcomes	Competencies	Suggested Activities

Knowledge (Cognitive)	Principles of Sustainability	Explain the concept and importance of sustainable agriculture	Identify core principles: resource efficiency, biodiversity, and soil health	Class discussions, posters, and presentations
	Soil and Water Conservation	Describe techniques for soil and water conservation	Analyze local farming methods and suggest improvements	Field visits, experiments, and video analysis
	Agroecological Practices	Understand agroecological systems and their benefits	Differentiate between conventional and sustainable farming	Case studies, comparative charts
Skills (Psychomotor)	Organic Farming Techniques	Demonstrate preparation of compost and natural pesticides	Apply basic composting, mulching, and natural pest control methods	School garden activities, compost pit building
	Crop Rotation & Cover Cropping	Design a basic crop rotation plan	Plan and implement rotational farming in school gardens	Seasonal planting plans, group projects
	Water Management	Build or simulate water-efficient irrigation systems	Construct small-scale drip irrigation or water collection models	STEM-integrated practical activities
Values (Affective)	Environmental Stewardship	Show care and responsibility for the environment	Develop a personal or group eco-agriculture action plan	Journaling, pledges, eco-club projects
	Community Engagement	Recognize the role of farmers and local food systems	Communicate with local farmers and report on best practices	Interviews, role plays, community farming days
	Food and Nutrition	Appreciate the link between farming and healthy diets	Advocate for school-grown food and sustainable eating habits	Cooking sessions, school lunch campaigns

Table 4.6. Learning outcomes for sustainable agricultural practices and their direct connection to competencies and assessment

Learning Outcome	Associated Competency	Assessment Method
Explain the principles of sustainable agriculture and its environmental benefits	Environmental and agroecological literacy	Written test, oral presentation, group discussion

Identify and apply soil conservation techniques (e.g., cover cropping, composting)	Practical vocational skills in agroecology	Fieldwork observation, practical demonstration, skills checklist
Design a basic crop rotation and integrated pest management (IPM) plan	Technical planning and agroecological design	Project report, planning sheet, peer evaluation
Use digital tools to monitor soil health or water usage	Digital competence in agriculture (precision farming tools)	Hands-on digital task, portfolio with screenshots, simulation assessment
Apply sustainable water management practices (e.g., drip irrigation, rainwater harvesting)	Resource management and environmental literacy	Practical demonstration, rubric-based performance task
Create a small-scale organic farming business plan	Entrepreneurial and innovation skills	Business model canvas, pitch presentation, feasibility report
Demonstrate collaborative work in a group farming project	Teamwork, communication, and project management	Group project rubric, peer assessment, instructor feedback
Evaluate the impact of agricultural practices on biodiversity and climate	Systems thinking, ecological awareness	Reflective essay, infographic or sustainability impact report
Engage with local farmers or agri-experts to gather and present sustainability insights	Community engagement and knowledge transfer	Interview report, multimedia presentation, oral Q&A
Reflect on personal practices and propose improvements for more sustainable farming	Lifelong learning and critical reflection	Reflective journal, self-assessment rubric, portfolio entry

4.2. Evaluation and assessment

Assessing sustainability learning should focus on both content knowledge and personal development. Methods include:

- Portfolios documenting growth, experiments, reflections
- Rubrics for projects assessing collaboration, problem-solving, innovation
- Journals capturing student observations and environmental ethics
- Community feedback on student-led initiatives
- Peer assessment during team projects
- Include opportunities for self-reflection and dialogue around ethical issues, global responsibility, and the student's role as an environmental steward.

Table 4.7. Assessment model for competency acquisition related to sustainable agricultural practices

Competency Area	Learning Outcomes	Assessment Type	Assessment Criteria	Assessment Tools	Frequency
Agroecological and Environmental Literacy	Explain core principles of sustainable agriculture	Written assessment Oral presentation	Accuracy of concepts Clarity	Quizzes, essays, concept	Mid & End of Term

	and environmental impact		Real-world relevance	maps, presentations	
Soil & Water Management Skills	Demonstrate soil conservation and efficient water use techniques	Practical demonstration Field observation	Proper technique Safety Effectiveness Resource efficiency	Performance rubric, instructor checklist, photos/videos	Ongoing, Project-based
Technical and Practical Farming Skills	Apply crop rotation, composting, and pest control methods	Project work Simulation-based task	Task accuracy Application of technique Compliance with sustainable practices	Field journal, task sheet, peer feedback, video evidence	Weekly/Project Milestone
Digital Competence in Agriculture	Use of digital tools for soil, crop, or water monitoring	Hands-on digital assessment Portfolio	Appropriate tool selection Data analysis Technical skill	Screenshots, app usage logs, LMS-based tests	Per module/task
Entrepreneurship & Innovation	Develop a green agri-business idea or community initiative	Business plan submission Presentation	Innovation Feasibility Sustainability impact Market awareness	Business model canvas, pitch rubric, feedback forms	Term project
Collaboration & Communication	Collaborate on a sustainable farming team project	Group project Peer evaluation	Contribution Teamwork Communication effectiveness	Peer rubric, group report, teacher observation	Per project cycle
Critical Thinking & Reflection	Analyze sustainability practices and propose improvements	Reflective journal Self-assessment	Insight depth Critical analysis Connection to practice	Reflection rubric, journal template	Weekly or Biweekly
Community & Cultural Engagement	Interview or engage with local farmers on sustainable practices	Field report Presentation	Respectful engagement Understanding of practices Reporting clarity	Interview guide, multimedia presentation, report form	Per field activity

Table 4.8. Role of formative and summative assessment in competency acquisition for sustainable agricultural practices in the school curriculum

Assessment Type	Purpose	Supports Acquisition of Competencies in	Assessment Examples	Role in Learning Process

Formative Assessment	Ongoing, low-stakes feedback to improve learning and skill development	Environmental literacy Practical farming skills Collaboration reflection and values	Observation checklists during composting Exit tickets on sustainability concepts Peer feedback in group projects	Identifies gaps early Encourages student reflection and adjustment Builds learner confidence
		Digital competence Entrepreneurial thinking	Digital logs of plant growth Prototype feedback for agri-business ideas	Promotes iterative learning Supports personalized learning pathways
Summative Assessment	Final evaluation of knowledge, skills, and values acquisition	Systems thinking Technical application Critical thinking	Practical test on soil conservation Design of sustainable garden Research essay on biodiversity impact	Validates learning outcomes Provides basis for grading and certification
		Communication & presentation skills Responsible citizenship	Reflective journal on personal sustainability actions Presentation on community farming practices	Measures depth of understanding Encourages synthesis and application of concepts
Combined Approach	Integration of both assessment types for holistic competency development	All key competencies in sustainable agriculture	Formative: Self-assessment logs → Sum	

Table 4.9. Formative assessment methods and learning alignment for sustainable agricultural practices in the school curriculum

Learning Objective	Aligned Competency	Formative Assessment Method	Purpose / Feedback Focus	Tools / Materials
Understand the concept and benefits of sustainable agriculture	Environmental and agroecological literacy	Concept mapping Think-pair-share	Check prior knowledge Clarify understanding of key principles	Whiteboard, markers, concept map templates
Identify soil and water conservation techniques	Practical and technical competence	Interactive demonstrations Exit tickets	Reinforce steps and processes Gauge student confidence	Hands-on tools, index cards, exit ticket prompts
Plan a basic crop rotation model or garden layout	Systems thinking and planning	Group sketching and peer feedback	Foster collaboration Refine planning skills	Graph paper, plant cards, peer rubric
Apply composting and organic farming practices in school garden	Practical vocational skills	Observation checklists Guided journaling	Monitor technique Encourage reflective practice	Observation rubric, student notebooks

Use basic digital tools (e.g., farm logs, water sensors) for monitoring	Digital literacy and environmental data handling	Digital skill log Student-led tech tutorials	Track engagement with tools Encourage peer teaching	Tablets, software tools, tech checklists
Work collaboratively in maintaining a sustainable school farm plot	Communication and teamwork	Collaborative task logs Peer evaluation	Strengthen group roles Promote accountability	Group work rubric, reflection sheets
Analyze the impact of farming methods on biodiversity and climate	Critical thinking and ecological awareness	KWL charts (Know–Want to know–Learned) Mini-reports	Scaffold inquiry process Support evidence-based reasoning	KWL templates, article excerpts, summary sheets
Engage with local farmers to learn sustainable techniques	Community engagement and cultural learning	Interview reflections Oral debriefs	Deepen real-world connections Encourage personal interpretation	Interview guides, voice recorders, group discussion guides
Reflect on personal habits and how to contribute to food sustainability	Values and responsible citizenship	Journals Exit slips	Promote self-awareness Track values and mindset shifts	Reflection journals, prompt cards

Table 4.10. Summative assessment methods and learning alignment for sustainable agricultural practices in the school curriculum

Learning Objective	Targeted Competency	Summative Assessment Method	Assessment Criteria	Tools / Artifacts
Describe key principles and benefits of sustainable agriculture	Conceptual understanding & ecological literacy	Written test / Multiple-choice quiz	Accuracy of definitions Clarity of explanationReal-world relevance	Test papers, digital quiz platform
Apply composting, crop rotation, or pest management techniques	Practical skills in organic farming	Practical exam / Hands-on demonstration	Correct process Tool use Safety Effectiveness	Field plot, tools, instructor checklist
Design a sustainable garden/farm layout with crop diversity	Planning & agroecological systems thinking	Project-based assessment Garden model design	Functionality Diversity Sustainability Creativity	Poster boards, 3D models, digital layouts
Analyze the environmental impact of traditional vs. sustainable farming methods	Critical thinking & environmental impact analysis	Research report / Comparative essay	Depth of analysis Use of evidence Structure & clarity	Essay rubric, reference materials

Create a digital logbook of plant growth, soil condition, or irrigation practices	Digital literacy & record keeping	Digital portfolio / e-journal submission	Completeness Use of tools Data accuracy	Spreadsheet, app-based tracker, screenshots
Present a green agri-business idea for local implementation	Entrepreneurial thinking & innovation	Pitch presentation / Business plan	Feasibility Innovation Sustainability impact	Slides, pitch deck, business model canvas
Collaborate on a team-based farming project in the school environment	Collaboration & teamwork	Group project outcome + individual role reflection	Team contribution Individual accountability Outcome success	Peer review forms, teacher rubric
Engage with local stakeholders to gather sustainability knowledge	Community & intercultural competence	Oral presentation / Visual storytelling	Communication Cultural sensitivity Content relevance	Posters, slide shows, audio-visual materials
Reflect on personal sustainable behaviors and future actions	Values education & responsible citizenship	Reflective essay / Personal sustainability plan	Self-awareness Depth of reflection Connection to learning	Essay prompt sheet, rubric

Table 4.11. Learning objectives and summative assessment tasks

Learning Objective	Summative Assessment Task	Skills Developed	Assessment Tool
Understand sustainability principles	Written test or digital quiz	Conceptual knowledge	Test paper / Online quiz
Apply soil and composting techniques	Practical exam / field demonstration	Technical skill, observation	Rubric, checklist
Plan sustainable garden layout	Project-based design task	Systems thinking, creativity	Presentation, peer feedback
Analyze environmental impacts	Essay / research report	Critical thinking, evidence-based writing	Rubric, draft-feedback loop
Create digital farm journal	Portfolio submission	Digital and organizational skills	Digital logs, rubric
Pitch sustainable agri-business idea	Group presentation / pitch	Innovation, communication	Rubric, peer review
Collaborate on school farming project	Group work + reflection	Teamwork, responsibility	Team rubric, reflection journal
Reflect on personal sustainability behavior	Reflective essay or action plan	Self-awareness, ethics	Journal, scoring rubric

Table 4.12. Linking learning outcomes, competencies and assessment methods for sustainable agricultural practices in the school curriculum

IMPLEMENTATION OF SUSTAINABLE AGRICULTURAL PRACTICES IN SCHOOL CURRICULUM
BEST STUDENTS' PRACTICES

Learning Outcome	Associated Competency	Assessment Method	Assessment Focus
Describe key principles of sustainable agriculture	Environmental and agroecological literacy	Written test / Concept map	Understanding of key concepts, environmental impact awareness
Apply composting, crop rotation, or soil conservation methods	Practical vocational skills in sustainable farming	Practical demonstration / Field observation	Application of farming techniques, safety, and sustainability practices
Design a simple farm layout using agroecological principles	Systems thinking and planning	Project-based assessment / Garden blueprint	Planning skills, logical thinking, integration of ecological concepts
Use digital tools to monitor soil or water levels	Digital competence in agricultural contexts	Digital portfolio / Skill log	Accurate use of digital tools, data recording, and interpretation
Analyze the impact of farming practices on biodiversity and climate	Critical thinking and environmental impact evaluation	Comparative essay / Research report	Ability to analyze, compare, and reason using evidence
Collaborate in a school gardening or farming project	Teamwork, communication, and collaboration	Group project / Peer and teacher evaluation	Group dynamics, role fulfillment, communication, problem-solving
Engage with local farmers to understand sustainable techniques	Community engagement and cultural awareness	Oral presentation / Interview report	Quality of engagement, communication skills, cultural sensitivity
Develop a small-scale sustainable agri-business plan	Entrepreneurial and innovation competencies	Business plan / Pitch presentation	Innovation, feasibility, sustainability alignment
Reflect on personal actions and suggest changes for sustainability	Self-awareness and responsible citizenship	Reflective essay / Journal entry	Depth of reflection, values, ability to connect learning to behavior
Communicate sustainability ideas through visual or oral means	Communication and advocacy skills	Poster, video, or oral presentation	Clarity of message, audience awareness, persuasive and visual impact

5. MODULE 2. BEST SUSTAINABLE AGRICULTURAL PRACTICES

5.1.1. The best student practices – case studies and examples

Sustainable agriculture education is crucial for equipping future generations with the necessary skills and knowledge to address contemporary environmental challenges.

This section highlights several exemplary case studies and practices adopted in various educational settings to promote sustainable agriculture among students. Here are some inspiring student-led practices from schools that have successfully implemented sustainable agriculture education:

Case Study 1: Eco Farm School

Students transformed their schoolyard into an organic farm with raised beds, compost bins, and a drip irrigation system. Over two semesters, they:

- Applied permaculture design principles
- Planted native species and heirloom vegetables
- Measured water efficiency and recorded biodiversity growth
- Sold their produce at a local farmers' market and reinvested the profit into the project

Key competencies developed:

- Soil science, ecology, entrepreneurship, digital data tracking.

Case Study 2: School Organic Gardens

Students created a school-based organic garden producing vegetables using compost from food waste and vermicomposting. Sustainability focus is on:

- Organic farming;
- Waste recycling;
- Community nutrition

The impact is on reduced food waste, supplying the school canteen with vegetables, and training students in organic certification practices

Case Study 3: Green Roof Garden

In an urban vocational school, students built a rooftop garden to explore sustainable urban agriculture. The project included:

- Using recycled containers and vertical planters
- Growing herbs and microgreens with LED grow lights
- Collecting rainwater and reusing greywater
- Using Arduino sensors to monitor plant growth and moisture
- Students produced video tutorials and manuals, which they shared on the school's online learning platform.

Key competencies developed:

- Engineering, technology, digital communication, climate literacy

Case Study 4: Soil Guardians

High school students engaged in a soil restoration and composting project. They:

- Collected cafeteria food waste for compost
- Built vermiculture boxes using recycled materials
- Conducted pH and nutrient testing on soil samples
- Hosted an "Eco Day" to educate the school and community

Key competencies developed:

- Laboratory science, teamwork, environmental advocacy, community outreach

Case Study 5: Crop Diversification and Intercropping

Students introduced intercropping of legumes with maize to improve soil fertility and food security in nearby communities. Sustainability focus is on:

- Soil health;
- Biodiversity;
- Resilience to climate change.

This case study has an impact on improved yields, reduced fertilizer use, and has been replicated by 30+ local farmers.

Case Study 6: Sustainable Poultry Farming

Students developed a low-cost poultry shed with natural ventilation, used herbal remedies for disease prevention, and fed birds with farm-grown feed. Sustainability focus is on:

- Animal welfare;
- Organic feed;
- Low GHG emissions.

This case can be model adopted in rural entrepreneurship training programs.

Case Study 7: Climate-Smart Farm Planning

Students conducted farm assessments for local smallholders, introducing climate-smart practices such as rainwater harvesting, mulching, and agroforestry. Sustainability focus is on:

- Water conservation;
- Carbon sequestration.

Helped 60+ farmers adopt water-saving techniques during drought years.

Case Study 8: Aquaponics and Closed-loop Systems

Students built a student-managed aquaponics unit, integrating fish tanks and vegetable beds. Sustainability focus is on:

- Resource efficiency;
- Nutrient recycling

Educational demo site, contributed to research, supplied local food co-op.

Case Study 9: Agroecology Learning Circles

Youth and student groups engaged in peer-to-peer learning with farmers using traditional ecological knowledge, permaculture, and seed-saving. Sustainability focus is on:

- Local knowledge;
- Agro-biodiversity;
- Food sovereignty

Empowered rural youth, preserved local seed varieties, and improved soil regeneration.

Case Study 10: Renewable Energy for Livestock
Students collaborated with local engineers to install biogas digesters using manure from the school's dairy farm. Sustainability focus is on:

- Circular economy;
- Renewable energy.

School powered partly by biogas, reduced energy costs, real-world skills in green tech.

Case Study 11: Field Trips and Hands-On Projects
Through field trips that expose students to local farming practices, conservation efforts, and sustainable resource management, students can observe and engage with practical applications of sustainable agriculture. This hands-on experience allows them to connect theoretical knowledge to real-world situations, reinforcing their understanding and commitment to sustainability.

Case Study 12: Learner-Centred Curriculum Transformation
By encouraging students to take ownership of their learning processes, schools can foster innovation and enthusiasm towards sustainable practices. For instance, student-led projects that focus on community gardens or greenhouse management can contribute directly to local food systems and create a tangible impact on student engagement and awareness regarding sustainable agriculture.

Case Study 13: Climate-Smart Innovations in Training
By training students and educators in innovative techniques for water conservation, soil health, and crop management, educational institutions can facilitate the adoption of more sustainable practices. Institutions focusing on these innovations empower students to lead agricultural advancements that mitigate climate change impacts.

Case Study 14: Academia-Industry Partnerships
By creating partnerships with local farmers and agricultural businesses, students gain exposure to current practices, challenges, and innovations in the field. This collaboration allows agriculture students to apply their academic knowledge in real-life situations, thereby enhancing their employability and fostering a deeper understanding of sustainable agriculture applications.

Case Study 15: Integration of Computational Thinking in Agriculture Education
This innovative approach helps students utilize technology to solve agricultural challenges through data analysis and smart farming techniques. By incorporating technology into agricultural education, students are encouraged to explore innovative solutions that contribute to sustainable agricultural practices.

Case Study 16: Responsive Curriculum Development
By actively soliciting students' opinions on incorporating real-world environmental and social issues into their coursework, curriculum developers can ensure the educational experience is relevant and empowering. Engaging students in conversations about sustainability can enhance their motivation and facilitate the adoption of sustainable practices in their future careers.

The integration of sustainable agriculture practices in school curricula through interdisciplinary approaches, experiential learning, collaboration with industry, and responsiveness to student needs is essential for fostering a workforce that values and implements sustainability. These case studies exemplify best practices that not only improve students' understanding of agricultural sustainability but also empower them to become proactive stewards of the environment.

The best student practices in sustainable agriculture share several key themes that contribute to their effectiveness and impact. First, hands-on and project-based learning play a central role, allowing students to apply theoretical knowledge in real-world settings and gain practical skills. These initiatives often emphasize the integration of traditional and scientific knowledge, combining ancestral practices with modern techniques to create more resilient and context-specific solutions.

A strong focus on local community impact ensures that student efforts are not only educational but also socially meaningful, addressing the real needs of farmers, families, and ecosystems. Many student-led projects prioritize low-cost, scalable innovations, making them accessible and adaptable for broader implementation in both rural and urban settings.

Additionally, these efforts are typically driven by multidisciplinary teamwork, bringing together students from various fields such as agriculture, veterinary science, engineering, and environmental studies. Most importantly, they highlight youth leadership in sustainability, empowering students to take active roles in shaping the future of food systems through innovation, advocacy, and responsible action.

5.1.2. Using artificial intelligence (AI) tools to support project-based learning (PBL)

Teachers can use an artificial intelligence framework when developing projects to provide well-rounded learning experiences. With the rise of artificial intelligence (AI) in education, more secondary school teachers are looking for creative and practical ways to integrate AI into student learning. Many educators have a common concern: How can students use AI without losing their creativity, authentic voice, and ownership over their work and the content they create?

Undoubtedly, AI will only get better, more powerful, and more deeply embedded in our everyday lives, how we work and create, as well as access and learn new information. That's why it's important to endow today's students with AI literacy and the ability to understand, evaluate, and use emerging technology confidently and with care for the greater good (helping others).

Now we're on the next step: using generative AI to create meaningful content as part of class projects. For this purpose, I appreciate and strongly recommend the AI Literacy Framework developed by Digital Promise, as it is firmly grounded in research. Furthermore, schools can leverage their components, understand, evaluate, and use, to provide students with the evolving fluency needed to make informed choices and use AI tools responsibly and creatively, no matter where technology goes next. When we integrate AI into teaching and learning with intention, it gives learners the technological literacy and know-how to use tools to express themselves as real-world digital creators

do (e.g., text, graphics, audio, and video for social media, websites, YouTube). Project-based learning (PBL) is a powerful vehicle for driving this digital transformation in learning and creating. PBL is a powerful instructional pedagogy because it's a student-centered approach that facilitates inquiry and creation processes. Additionally, teachers can coach students to intentionally connect their interests and passions to purpose and academic content to make projects more meaningful to them.

Projects designed with the student experience in mind engage them in authentic problems, enhance interdisciplinary connections, and lead to the development of high-quality products that are shared with authentic audiences, such as their communities. Furthermore, creating relevant, modern products through projects requires students to research, write, record, film, design, and edit. This is where AI tools and AI-empowered tools can help amplify their efforts, supporting content creation without automating the intended learning.

Teachers can align student projects with the Digital Promise AI Literacy Framework to help them better understand how AI works and evaluate its role in how it can help them learn and create ethically. ChatGPT, Gemini, Copilot, and Claude support the understanding and use of elements by assisting students with brainstorming ideas, outlining scripts, generating question prompts, and explaining complex concepts in kid-friendly language. For example, in science class, students use Gemini to simplify how renewable energy supports sustainable development. They then create a script and compile reliable data for a video reel explainer and data-driven infographic.

The evaluate element can be used by students in all content areas to analyze the accuracy and bias of AI-created content from AI platforms such as ChatGPT and Claude. For example, in history class, high school students use ChatGPT to create a summary of a well-known historical event. To implement AI ethics, they then fact-check it by referencing reliable primary sources and scholarly articles to assess the AI-generated summary for accuracy, missing perspectives, and potential bias.

Adobe Express for Education makes content creation safe for students with many intuitive AI features to empower students and make them think critically (including video and images). The platform even includes guardrails for generative AI prompts and results, which help ensure that content is appropriate for learners.

Descript is a powerful tool for demonstrating the *use of technology* elements by demystifying video and audio editing for learners. The tool allows audio to be transcribed and formatted like a typical document. The tool's ability to identify unnecessary text (e.g., filler words and repeated words) to enhance clarity in the final files is powerful. This supports media literacy and creative expression.

Quso.ai and Remini are great tools for refining content into well-polished images and videos for final digital products. These tools also support the *use of technology* elements by drastically improving video quality and converting long recordings into shorter, engaging clips.

These tools (and also others) are applicable in PBL to help students improve final products, improve their digital media production skills, and express their learning creatively.

As your students learn how to design and create with new tech tools, remind them that creating polished content isn't the final destination of their projects. The goal is to become better learners. Instil the value of productive struggle because creating and

achieving on their own builds knowledge and true confidence over time. Using AI tools with intention should sharpen their thinking and learning, and help them become wiser and more capable digital citizens.

5.1.3. Make the most of Google or Microsoft Forms

Many teachers already know how to use these time-tested tools, so getting even more out of them just makes sense. Great tech tools abound, but keeping up with all the options can be challenging for teachers and students alike. For teachers, the time it takes to test and set up new tools can be a deterrent from trying something new; for students, it means new things to master, which may impede content mastery.

Why use Forms?

Forms are ubiquitous. They're easy to access, set up, and share, taking as little as a few minutes to create. Forms integrate into nearly everything, allowing you to quickly link and embed them. And, most importantly, since students (and teachers) already know how to use Forms, technical know-how limits won't hamper content or skill assessment. Whether you're a Microsoft user or a Google user, Forms function similarly. Before sharing the Forms how-to, the teachers should take a beat to reflect on how they already use Forms, both as a creator or collector of responses and as a respondee.

5.1.4. 60-Second Strategy: Back Pocket Questions

With this simple activity, the final minutes before the bell rings can be an opportunity for review, not disarray. When the clock is ticking down before the bell rings, it's easy for a classroom to get a bit out of control. Students may get up, start talking, and even spill into the hallway. Witnessing this, middle school Spanish teacher Jamie Midyette wanted to find a solution to keep her students engaged until the very last second, so in her classes, she started implementing a strategy called *back pocket questions*.

Back pocket questions can be just that: questions a teacher has written on index cards that they can keep in their pocket. Midyette chooses to use her interactive whiteboard, often projecting sentences in Spanish with a blank for a missing word. The prompts may relate to the current unit, or they can be review, and they can be pulled from any subject area. In Midyette's class, a student volunteer flips through cards with students' names on them and randomly selects one. Midyette asks the students if they would like to respond. If they say yes, they read the full sentence out loud and fill in the blank on the fly. As a reward for participating, Midyette offers them a sticker and asks their fellow students to celebrate their work by snapping their fingers. Then the student volunteer selects the next name.

A flexible closing activity can fill as much or as little time as you have with this one. In just a minute or two, several students will get the opportunity to practice their vocabulary, and many others will benefit by listening. Crucially, using back pocket questions contributes to a classroom environment in which everyone is seated and still learning until the bell signals that it's truly time to go.

5.1.5. When the Teacher-Student Relationship Breaks Down

These strategies will help teachers reset boundaries and repair relationships if classroom dynamics have become dysfunctional

"What do you do if the teacher–student relationship is dysfunctional?" This was the raw and honest question of parents, describing their child's classroom: a space filled with constant yelling, endless detentions, and escalating disrespect. Students felt unheard and resentful. Teachers, despite being highly experienced, were exhausted and at a loss. Parents were frustrated. No one was winning. Sadly, this scenario isn't rare. Many teachers will eventually encounter a class where the relationship fabric has worn thin or is completely torn apart. When the traditional tools of behaviour management fail, when both sides feel disrespected, what can a teacher do? The truth is: No amount of detentions, raised voices, or reward charts can fix a broken relationship. To move forward, we have to stop managing and start rebuilding.

In dysfunctional classrooms, the problem isn't just poor behaviour, but it's broken trust. When students feel chronically misunderstood or punished unfairly, they often stop trying. Their attitude becomes, "Why behave if I'm going to get in trouble no matter what?" Teachers, facing daily chaos, often become reactive, relying more on punishments, which deepens the disconnect. Before any strategy can work, we have to recognize that classroom management problems are often relationship problems in disguise.

It's human nature: When we feel out of control, we tend to tighten the reins. We raise our voices, increase punishments, and double down on structure. But in a broken classroom, more control often backfires. It tells students, "I don't trust you. You are a problem that needs to be fixed." The teachers must stop the cycle of escalation. Instead, teachers need to hit pause. Rather than trying to enforce compliance through power, the focus must shift to rebuilding a culture of respect and shared ownership.

When classrooms fall into cycles of conflict, it's important to understand the brain's role in behaviour. In high-stress environments, both students and teachers can become stuck in their reptilian brain, the part of the nervous system wired for survival responses: fight, flight, or freeze. When students are operating from this place, rational conversations, consequences, and even rewards won't work, because their brains are not in a state to receive or process complex information. If the reptile brain is activated, the thinking brain is offline. Before we can rebuild classroom culture, we must first create a sense of physical and emotional safety. This starts with the adults staying calm, predictable, and emotionally regulated themselves. It also means slowing down, lowering the volume, offering consistent routines, and intentionally modelling calm, nonthreatening interactions. Only when students feel safe can they access the parts of their brain needed for learning, empathy, and self-regulation.

One of the most powerful things a teacher can do is acknowledge the breakdown openly and professionally. This could sound like "I can see that the way we've been working together isn't helping anyone. I take responsibility for my part in that. I'd like us to have a fresh start." This simple act of honesty models accountability and maturity, two things we desperately want our students to learn. Resetting doesn't mean abandoning expectations. It means redefining them collaboratively.

Rather than imposing new rules from above, teachers can guide students through a re-norming process. Consider the following questions:

- What kind of classroom do we want to have?
- What helps you learn best?
- How should we treat each other when things get tough?
- What consequences make sense if agreements are broken?

When students help create the norms, they have a stronger sense of ownership and a greater investment in maintaining them. This is not about letting students "take over" the classroom. It's about leading in a way that invites participation, rather than enforcing compliance.

In a broken classroom, relationships are the curriculum, at least for a while. Teachers may need to temporarily scale back academic pressure to create space for healing.

- Start each lesson with a check-in question.
- Pair up students for low-pressure collaborative tasks.
- Share personal stories and experiences that humanize both students and teachers.

Trust grows in small moments, not grand gestures. A student who feels seen and respected will behave differently from one who feels judged and dismissed.

Traditional discipline often focuses on what rule was broken and what punishment is deserved. Restorative practices take a different approach. Instead of merely assigning consequences, they invite students to actively participate in repairing relationships and addressing the harm they've caused. Simple restorative conversations guided by these key questions can transform conflict into powerful learning experiences:

- What happened?
- Who was affected, and how?
- How can we repair the harm?

Research shows that this approach can significantly improve classroom culture, reduce behaviour issues, and build students' empathy and accountability.
Practically, this might look like the following:

- Holding short, structured conversations after incidents, rather than immediately assigning detentions.
- Facilitating class circles regularly to proactively build trust and discuss common issues.
- Using restorative reflection sheets, where students thoughtfully write about the incident, its impacts, and how they can make amends.

This shifts discipline from something done to students toward something done with them, helping rebuild relationships and empowering students to become part of the solution.

In high-conflict classrooms, parents and guardians often feel caught in the middle, unsure whether to defend their child or criticize the school. By bringing parents into the reset process, teachers can create a support network around the students:

- Communicate openly about the new approach.
- Share successes, not just problems.

- Ask parents for insights: "What helps your child stay motivated? What makes them shut down?"

Parents are much more likely to support classroom efforts when they feel informed and involved.

Resetting a broken classroom isn't a quick fix. It's not a matter of one powerful conversation or a few fun activities. Change will be messy. Some students will test the new boundaries. Some days will feel like progress; others will feel like relapses. That's normal. Consistency, compassion, and patience are the tools of real transformation.
When a classroom feels irreparably broken, it's tempting to fall into blame, blaming the students, the parents, the system, even ourselves. But the heart of teaching has always been about relationships. It's never too late to rebuild them. When they are led with humility, honesty, and humanity, even the most dysfunctional classes can find their way back to a place of respect, connection, and genuine learning. You've got this.

5.1.6. Student Engagement: A New Way to Think About Resilience

By starting with the idea that students already are resilient, teachers can nurture their ability to stick with things and not give up.

Most educators would agree that resilience is one of the most important skills for children to develop. It shows up in classrooms under many forms: growth mindset, grit, and persistence. Perhaps, if we take a step back, we'll find that our students already are resilient, and all they need is adults to help cultivate that quality.

I encourage educators who are passionate about building resilient kids to reflect on their practices and give some version of this approach a try. Great teaching is, I think, a lot like adjusting the dials on a control panel. Your students and the needs of everyone in the room will dictate what you turn up or down, day by day, student by student. The dials on my switchboard are observation, expectation, anticipation, and celebration.

As educators make the shift to this strengths-based approach, here are some ideas to focus on:

Lecturing less, observing more: Simply put, I step back, preach less, and observe more. Remember that this approach is about cultivating what already exists. It takes a lot less talking than many of us are used to or comfortable with. Focus on providing clear, concise, positive feedback when we see resilience rather than providing redirection and correction when we think we don't.

Setting realistic expectations and celebrating everything: Adults are often guilty of expecting kids to be mini-adults. You wouldn't shame a seedling for not having any flowers. In the same way, we often spend more time correcting kids for what they haven't yet achieved, even if it's not age or maturation-appropriate. Meet them where they are. Celebrate the small wins, and the wins will surely grow.

Anticipating barriers: Speaking of meeting them where they are, it's important for us as educators to anticipate barriers that students will face and create accessible pathways over those barriers. That's not to say we should remove obstacles from our students, resilience isn't built by never failing, but by building confidence through repeated success from challenges. For example, with my student who was struggling with assignment completion, inconsistent homework time and support at home was a barrier

to success. So, his family and I came up with a homework time and place, including attending extra help after school, where he could receive more guidance. We didn't say he shouldn't have to do homework: Instead, we created a pathway that helped increase his chances for success.

Praising specifically and abundantly: In the same way that I try to "catch" my students being good so I can capitalize on it, I tried to catch my students being resilient. Rather than telling them what to do, I gave clear and concise praise when they did it: "I noticed you were super-silly at the beginning of class, but you were so focused toward the end. Way to be resilient. "I know you were frustrated with me yesterday, but you came to class today with a smile, way to bounce back."

I often hear teachers express fear of overpraising. They're concerned that we're raising "everyone gets a trophy" kids and that if we praise them for skills that are still developing, we'll give them false confidence and discourage growth. People don't give up because they are experiencing success with a skill: They give up because they believe they never will. When praise is clear, concise, and authentic, we foster growth. We help kids recognize their abilities, celebrating small wins and opening doors for them to try again.

I am proud to say that the student in question is poised to finish the school year without a single missing assignment. I'm not crazy enough to take all the credit. In fact, I don't really want to take any. The resilience was already inside of my student; they just needed to know it too, just needed someone to show them. Educators have long known that strength-based pedagogy yields the best results, and I encourage all educators who want to cultivate their students' resilience to lean into this new approach.

Student Engagement

Nature Experiments to Spark Student Curiosity

Encourage your students to ask questions about and explore the world around them with these hands-on lessons.

6. Module 3: RECOMMENDATION ON HOW STUDENTS, KEY STAKEHOLDERS AND OTHER INDIVIDUALS CAN CONTRIBUTE AND ACTIVELY PARTICIPATE IN THE PROMOTION OF SUSTAINABLE AGRICULTURE

6.1. How can multi-stakeholder engagement be fostered through building partnerships and encouraging community involvement?

Stakeholders generally refer to any individual or group that, either positively or negatively, impacts or is impacted by the decisions, actions and products or services of an organization. Stakeholders can be either within or outside an organization. Based on whether the impact is direct or indirect, stakeholders can be grouped into either primary/economic stakeholders or secondary/external stakeholders. More loosely, a stakeholder can be defined as an actor who holds at least a stake in the changes to be brought about by a project. The material resources, social position and knowledge of these actors make them particularly potent, which enables them to wield significant influence over the design, planning and implementation of a project.

Sustainable agriculture thrives on collaboration. Engaging with local agriculture professionals, environmental organizations, and community members can enhance curriculum relevance and authenticity. Mulyana et al. (2016) emphasize the importance of aligning educational experiences with stakeholder expectations and community needs. This engagement can lead to internships, mentoring programs, and guest lectures that provide students with insights into the agricultural sector's real-world aspects and the applications of sustainable practices. There should be established strong partnerships with:

- Local farms and agricultural colleges;
- Environmental NGOs and cooperatives;
- Municipal sustainability programs;
- Parents and community volunteers.

Additionally, guest speakers may be invited, field trips organized, and students encouraged to take part in citizen science projects. Engaging the wider community increases relevance and creates a lasting impact.

The goal of contemporary education for sustainability is to apply the principles stated in the Sustainable Development Goals (UN DESA 2016). With the increasing complexity of socio-ecological and economic systems, students need new skills and capabilities to address the dynamics, interdependence and uncertainty of the modern world. Global problems (food security, climate change) are particularly relevant to the agri-food sector, so education for future agri-professionals must apply a holistic approach.

Multi-stakeholder partnership is critical for achieving the objectives of the 2030 Agenda for Sustainable Development (UN DESA 2019). Education that is learner-centred and based on real-life experiences, in partnership with stakeholders, is seen as an effective learning strategy for sustainability (UN DESA, 2019).

Stakeholder engagement is a win-win situation where organisations reach out and communicate with their stakeholders. In the education context, this requires 'interactions between education institutions and non-academic organisations involving educational activities (Kunttu, 2017). However, many recent studies on stakeholder engagement in the field of VET schools-industry collaboration focus mostly on collaboration for formal completion of the practical training period (Cricelli and Grimaldi, 2010; Ankrah et al., 2013), ignoring the educational work-based learning (Rybnicek and Königsgruber, 2019) and overlooking aspects of engagement such as contact initiation, communication strategies or outcomes of engagement (Philbin, 2008). Specific understanding of the contribution of VET schools-industry collaboration on education to the creation of joint knowledge and co-learning is very limited. This is surprising, as stakeholder engagement and knowledge creation have great potential for sustainable development of industry, VET school education and society.

Extending knowledge on stakeholder engagement in education requires considering the benefits and motivations that drive stakeholders to participate in VET school activities, as well as developing strategies to operationalize the engagement process.

Stakeholder participation can enhance the theoretical understanding and practical skills of students (Chang and Huang, 2022), but there is a mismatch between the theory taught in school courses and its applications in practice (Eksvard et al., 2014). Barriers include a lack of communication or a shared agenda on research priorities and current issues in real agriculture (Francis et al. 2014). The relationships between stakeholders and VET schools are two-directional links built on trust and commitment, established to transfer knowledge and disseminate ideas and skills in order to create value and improve education for sustainability. Transformation to sustainability can be achieved by multiple actors engaging in collaborations on pressing social, environmental and economic issues. Engagement can take the form of joint education activities, programme development, practice, training and student projects (Arvanitis, Kubli and Woerter 2008; Bruneel, D'Este and Salter 2010; Maietta, 2015), all within the space created by VET schools-stakeholder collaboration. Education, training and student projects represent opportunities to deepen relationships between the parties (Santoro and Saparito, 2003), co-create knowledge and improve learners' understanding of sustainability issues (Weckowska, 2015).

To effectively promote sustainable agriculture, students, teachers, key stakeholders, and other involved individuals can engage in a variety of activities that collectively contribute to the advancement of this crucial sector. These efforts encompass education, advocacy, collaboration, and the adoption of innovative agricultural practices.

5.1. Engagement of students in the promotion of sustainable agriculture

One of the primary avenues for contribution is education and awareness. Students can play a pivotal role by participating in educational programs that focus on sustainable agricultural practices. For example, VET programs can incorporate sustainable farming techniques and technologies into their curricula, thereby preparing future professionals to implement eco-friendly methods in their agricultural practices; this has been highlighted as integral for promoting communication among experts and facilitating knowledge transfer across sectors (Baptista et al., 2019b). Moreover, the inclusion of sustainable

agriculture topics in general education can foster a broader societal understanding of the significance of sustainable practices (Cao & Solangi, 2023).

Engaging students in sustainable agriculture programs is critical for fostering a generation of informed agricultural practitioners and environmentally conscious citizens. This involvement can take various forms, including practical experiences, curriculum development, peer education, and community outreach, each of which enhances students' understanding and commitment to sustainable practices.

One of the most effective methods for engaging students in sustainable agriculture is through experiential learning opportunities such as internships and hands-on projects. Programs that offer students the chance to work directly with sustainable farming practices enable them to apply theoretical knowledge in real-world settings. For instance, a collaborative internship program focused on organic farming allows high school students to engage in field production, attend educational workshops, and contribute to their community by distributing organic produce (Silva & Muller, 2013). This kind of engagement cultivates a deeper understanding of sustainability principles through direct involvement.

Moreover, student-run farms at educational institutions have shown remarkable success in promoting sustainable agriculture. These farms serve as practical laboratories where students can experiment with and implement sustainable farming techniques, such as crop rotation and permaculture practices (Parr & Trexler, 2011). Research indicates that students who participate in these environments report a stronger connection to their education and a commitment to sustainable practices (Carter et al., 2014).

Curricula that include sustainability topics and practical applications can significantly enhance student engagement. Programs designed around self-learning through hands-on experience, in-depth farm visits, and community activities foster an environment where students can explore sustainability (Kobayashi et al., 2010). Additionally, agricultural education programs that are inclusive and represent diverse perspectives, particularly those of underrepresented groups, can motivate and encourage broader participation in sustainable agriculture (Bullock et al., 2021; Schusler et al., 2021).

Mentorship also plays a crucial role in attracting students to agricultural programs. Studies highlight the impact of having role models within the agriculture field, particularly among minority students who may have limited representation in agricultural education spaces (Jones et al., 2021). Mentoring relationships not only help retain students in agricultural programs but also drive engagement, as mentors can guide students in understanding the complexities and benefits of sustainable practices.

Students can also engage with the community to promote sustainable agriculture beyond the classroom. Initiatives like organizing workshops for local farmers or participating in community gardens allow students to apply their knowledge while fostering community relationships (Lee et al., 2023). These outreach efforts help bridge the gap between academic study and actionable interventions in local agricultural practices, reinforcing the importance of collaborative efforts in fostering sustainability.

Engagement in research is another avenue for students to contribute to sustainable agriculture. By participating in research projects focused on sustainability issues, students can explore innovative solutions within their agricultural curriculum (Kunze & Büssing, 2022). This includes assessing the impact of various farming practices on the environment and local economies and advocating for policy changes that support

sustainable agriculture (Ankamah et al., 2021). Research opportunities encourage students to engage critically with the dynamics of agriculture and develop informed perspectives on sustainability.

Through these multifaceted approaches, like experiential learning, mentorship, community engagement, and research, students can actively participate in and promote sustainable agricultural practices. This engagement not only aids in their personal development but also contributes significantly to the promotion of sustainability within the broader agricultural sector.

Recommendations for students:

- ✓ Engage in practical learning: Participate in school gardens, on-campus organic farming plots, or livestock care programs;
- ✓ Adopt sustainable practices at home: Apply composting, waste reduction, and water conservation in personal spaces;
- ✓ Promote awareness: Organize peer-led workshops, debates, and sustainability campaigns in schools and communities;
- ✓ Use technology for innovation: Explore apps, data analysis tools, and precision farming technologies in projects;
- ✓ Volunteer in local farms: Work with farmers to learn firsthand about agroecology, organic production, and farm management;
- ✓ Research and document best practices: Conduct mini-research projects on local sustainable practices and share findings online or in local events.

5.2. Role of VET teachers in the promotion of sustainable agriculture programs

The role of VET teachers in promoting sustainable agriculture programs is critical and multi-dimensional. These educators not only impart knowledge and skills related to agricultural practices but also serve as mentors, advocates, and change agents who influence the attitudes and actions of their students towards sustainability in agriculture.

VET teachers are responsible for designing curricula that incorporate sustainable agricultural practices, emphasizing the integration of environmental stewardship and resource management within vocational training programs. Research indicates that VET educators are pivotal in shaping curricular content that aligns with sustainable development goals, fostering an awareness among students about the importance of eco-friendly farming techniques (McGrath & Powell, 2016). Such curricula often cover topics like organic farming, waste management, and biodiversity conservation, endowing students with practical skills that are directly applicable in the field (Handayani et al., 2020b).

VET teachers promote hands-on, experiential learning strategies that immerse students in sustainable agricultural practices. By facilitating projects that encourage students to engage directly with local farms or community gardens, teachers can create authentic learning experiences (Aggarwal et al., 2024). These programs often utilize local resources and case studies, reinforcing the practical application of sustainability concepts and helping students understand the complexities of agricultural ecosystems and the impact of their choices on those systems (Thunqvist et al., 2023).

Teachers in VET schools play a crucial mentoring role, guiding students through their educational journeys while fostering a supportive learning environment. Establishing trust and rapport with students is essential for encouraging their participation in sustainability initiatives (Roos et al., 2021). An environment where students feel comfortable discussing their ideas allows for a collaborative approach to problem-solving in sustainable agriculture, where students learn to work together on initiatives that promote environmental sustainability.

VET teachers often serve as a bridge between educational institutions and the agricultural industry. By fostering partnerships with local agricultural businesses, NGOs, and government agencies, teachers can provide students with opportunities to participate in fieldwork, internships, and community service projects (Kolho et al., 2022). Such collaborations enhance the practical relevance of the training provided and ensure that students are aware of current trends and needs within the agricultural sector. Furthermore, community-based projects allow students to practice sustainable techniques in real-world contexts, thus reinforcing their learning (Ryökkynen & Räty, 2022).

To effectively promote sustainable agriculture, VET teachers themselves must engage in ongoing professional development. Participating in training programs related to sustainable farming practices ensures that teachers remain current with innovations and trends in agriculture (Thunqvist et al., 2023). Enhanced knowledge and skills empower teachers to provide effective instruction and to model sustainable practices for their students, contributing to a culture of sustainability within the educational context.

VET teachers can also act as advocates for sustainable agricultural practices at various levels, including local, regional, and national policymaking. By promoting the value of sustainability in educational programs, teachers can influence education policy and curriculum standards that support sustainable development within the agricultural sector (McGrath & Powell, 2016). This advocacy can manifest in efforts to align VET programs with broader environmental objectives and policies, thereby ensuring that agricultural training contributes significantly to sustainable resource management (Choy et al., 2020).

VET teachers are ideally situated to encourage entrepreneurial thinking related to sustainable agriculture among their students. By introducing concepts of sustainable business practices and providing mentorship in business skills, teachers can help students develop innovative solutions to sustainability challenges within agriculture (Kolho et al., 2022). This entrepreneurial focus not only enhances students' employability but also encourages them to become proactive agents of change in their communities.

In conclusion, VET teachers play an essential role in the promotion of sustainable agriculture programs through curriculum development, experiential learning, mentorship, community collaboration, continuous professional development, policy advocacy, and entrepreneurship. By embracing these roles, VET educators can significantly influence the trajectory of sustainable agriculture, preparing students to meet the challenges of the future.

Recommendations for teachers and VET schools:

- ✓ Integrate sustainable agriculture into curricula at all levels;

- ✓ Enhance the competency and engagement of students through tailored educational programs;
- ✓ Facilitate hands-on training through field visits, model farms, and simulation labs;
- ✓ Encourage interdisciplinary projects involving agriculture, engineering, and environmental science;
- ✓ Raising awareness about the significance of agricultural landscapes and their sustainable management;
- ✓ Active engagement in community outreach to disseminate knowledge regarding sustainable agriculture practices;
- ✓ Be proactive in promoting an experiential learning approach;
- ✓ Continuous professional development of VET teachers is an essential need for effective teaching regarding sustainable agriculture.

5.3. Stakeholders' engagement in the promotion of sustainable agriculture programs

The promotion of sustainable agriculture programs necessitates the active engagement of various stakeholders, including farmers, agribusinesses, researchers, government bodies, non-governmental organizations (NGOs), and local communities. This multifaceted process is essential for ensuring that sustainable practices are understood, practiced, and effectively implemented across diverse agricultural contexts. Specifically, collaboration among stakeholders fosters a holistic approach to sustainable agriculture that incorporates ecological, social, and economic dimensions, ultimately enhancing food security and environmental resilience.

Collaboration among stakeholders is crucial for the successful implementation of sustainable agriculture initiatives. Public-private partnerships can be instrumental in fostering sustainable agricultural practices; such collaborations have proven essential in many regions, particularly where resources are limited (Hu et al., 2024). Students and other stakeholders can also engage in research initiatives that assess local agricultural practices and propose improvements that leverage modern technologies, such as precision agriculture and integrated farming systems, which enhance productivity while minimizing environmental impacts (Naglis-Liepa et al., 2021; Kayastha et al., 2024).

Engagement of stakeholders in sustainable agriculture initiatives can be likened to creating a cooperative framework where government, industry, academia, and civil society work collectively towards common goals. Such multi-stakeholder partnerships are pivotal for achieving sustainability and food security goals. Diverse participants can share knowledge, distribute resources, and develop innovative strategies for environmentally friendly farming practices, enhancing the resilience of food supply chains. Moreover, raising awareness among stakeholders about environmental impacts is crucial for the success of these initiatives. Rozaki et al. (2024) highlight the importance of increasing awareness among not only farmers but also the entire spectrum of stakeholders involved in sustainable agriculture, considering ecological and social alongside economic factors.

Furthermore, advocacy is necessary for creating a conducive policy environment that supports sustainable agricultural practices. Individuals and organizations can lobby for policies that prioritize conservation and sustainable land management, recognizing agriculture's dual role in food production and environmental stewardship (Khwidzhili,

2016). Stakeholders, including farmers, policymakers, and educators, can work together to formulate policies that incentivize sustainable practices, such as financial subsidies or technical support for adopting new technologies (Latruffe et al., 2016).

Another crucial contribution involves the practical adoption of sustainable practices at the community level. Students and local organizations can facilitate workshops and training sessions that empower farmers with the knowledge and skills needed to implement sustainable methods, such as crop rotation, biodiversity enhancement, and the use of biofertilizers, which significantly impact soil fertility and agricultural productivity (Nosheen et al., 2021; Mesfin, 2017).

In addition to awareness, leveraging modern communication tools plays a significant role in promoting sustainable agricultural practices. The findings underscore the influential role of social media platforms in disseminating information, shaping public perception, and engaging users in sustainability discussions. By harnessing platforms such as Facebook and Instagram, stakeholders can effectively share best practices, educational content, and success stories that inspire communal action towards sustainability. This digital engagement broadens the reach of sustainability initiatives and encourages a culture of shared responsibility. Such outreach is not solely limited to information dissemination; it also involves active participation in the decision-making process. Effective stakeholder engagement facilitates the co-creation of tailored solutions to address specific agricultural challenges. Actively involving stakeholders enables the formulation of practical, context-specific, innovative solutions, instilling a sense of ownership and responsibility towards sustainability goals.

Clarity in communication channels among stakeholders is vital, particularly in contexts where traditional agricultural systems face pressures from innovative agricultural technologies. Daum et al. (2021) discuss the implications of digitalization in agriculture, illustrating how stakeholder perceptions can influence the governance of agricultural value chains. Promoting dialogue between advocates of digital technology and traditional farming communities is crucial for better governance of agricultural practices that benefit smallholder farmers and enhance overall sustainability.

Furthermore, the effective integration of marginalized voices, such as those of displaced women or rural communities, into agricultural initiatives cannot be overlooked. Ouedraogo et al. (2024) indicate that engaging these groups not only improves food security but also builds local capacities for collective farming endeavours, thereby increasing overall sustainability and community cohesion. This approach empowers stakeholders by ensuring they have a say in resource management and agricultural practices, which is critical for fostering equitable development.

In summary, the combination of education, stakeholder collaboration, advocacy for supportive policies, and practical engagement at the community level forms a comprehensive approach to promoting sustainable agriculture. This multi-faceted strategy facilitates the transition towards more sustainable agricultural practices, ultimately benefiting both the economy and the environment.

Recommendations for key stakeholders:

- ✓ **Farmers**

- Adopt climate-smart practices (e.g., crop rotation, reduced chemical use, integrated pest management);
- Share traditional ecological knowledge with youth and research institutions;
- Participate in certification programs for organic or eco-friendly farming.

✓ **Private sector and agribusiness**

- Leverage technological advancements to enhance sustainability;
- Incorporate entrepreneurial education within the agribusiness framework;
- Adopt sustainable land management practices to improve soil health and ensure long-term productivity;
- Engagement with local communities and stakeholders in establishing sustainable practices;
- Integration of circular economy model into agribusiness strategies;
- Constant evaluation and adaptation of agribusiness practices based on research and technology;
- Invest in research and innovation for sustainable inputs (organic seeds, biofertilizers);
- Build fair-trade market chains that benefit smallholders;
- Sponsor student projects and competitions on sustainability.

✓ **Government and policymakers**

- Provide incentives, grants, and subsidies for sustainable farming;
- Support farmer education programs and sustainable agriculture extension services;
- Develop clear regulations to promote biodiversity, soil conservation, and water efficiency.

✓ **Other Individuals and communities**

- Consumers: Choose locally sourced, seasonal, and sustainably produced food.
- Community Leaders: Organize farmers' markets, eco-fairs, and community-supported agriculture programs.
- Nonprofits and NGOs: Offer training, awareness campaigns, and micro-funding for sustainable farming projects.
- Media Professionals: Highlight success stories and best practices to inspire public participation.

Cross-Cutting Actions for All Groups

- Collaboration: Foster multi-stakeholder platforms where students, farmers, researchers, and policymakers meet regularly.
- Capacity Building: Engage in continuous learning on sustainability trends and technologies.
- Advocacy: Actively support local and global initiatives for climate-smart and ethical farming.
- Monitoring and Sharing Results: Track the impact of sustainable practices and communicate outcomes to inspire adoption.

Table 5.1. Roles of different groups of stakeholders involved in sustainable agriculture practices

Group	Key Actions	Example Activities
Students	Learn, practice, and promote sustainable farming methods	- School gardens & model farms- Peer workshops on composting, water saving- Digital farming projects & mobile apps for agriculture
Educators / Institutions	Integrate sustainability into curricula	- Field visits to eco-farms- Interdisciplinary sustainability projects- Lab simulations of soil and water conservation
Farmers	Implement and share sustainable practices	- Crop rotation & integrated pest management- Organic certification programs- Mentoring student interns
Government / Policymakers	Support through policy and funding	- Subsidies for organic inputs- Farmer training programs- Laws promoting biodiversity and soil health
Private Sector / Agribusiness	Invest in sustainable innovations	- Organic seeds & biofertilizers R&D- Fair-trade supply chains- Sponsoring sustainability competitions
Communities / NGOs	Mobilize local participation	- Farmers' markets & CSA programs- Public eco-awareness campaigns- Micro-grants for small sustainable projects
Consumers	Choose sustainable food options	- Buy local & seasonal produce- Reduce food waste- Support ethical brands

Nonetheless, challenges persist in achieving genuine stakeholder engagement. Many existing frameworks for sustainable agriculture fail to effectively address the genuine needs and concerns of diverse stakeholders, often due to the prevalent technocratic attitudes in agricultural policymaking (Velten et al., 2015). It is essential to recognize that merely presenting agricultural solutions is insufficient; policymakers must be attuned to the social and cultural dynamics that influence stakeholders' perceptions of sustainability.

Assessing the efficacy of sustainable practices involves continuous evaluation and feedback loops among stakeholders. Developing methodologies that embrace stakeholder feedback in sustainability assessments can lead to more integrated and innovative agricultural policies (Huang et al., 2014). The necessity for stakeholder collaboration is further underlined by the existence of voluntary sustainability standards, which rely on stakeholder input to shape agricultural practices and promote accountability in sustainability initiatives.

Transformative shifts in agricultural practices often necessitate cultural changes among stakeholders regarding the interconnectedness of economic and environmental

impacts. Understanding these relationships fosters a self-aware society inclined to support sustainable practices. The interplay between environmental advocates and economic stakeholders forms the basis for inspiring collective action towards sustainability.

In essence, stakeholder engagement in sustainable agriculture programs is a multidirectional process where knowledge sharing, capacity building, and joint initiative development are paramount. Evidence suggests a strong correlation between comprehensive stakeholder engagement and successful sustainability outcomes. Cultivating trust and understanding among diverse agricultural stakeholders allows for a more cohesive and resilient approach to agricultural sustainability.

Conclusively, the promotion of sustainable agriculture programs necessitates a robust framework of stakeholder engagement that prioritizes education, communication, and collaboration. The blend of traditional agricultural practices with modern sustainability approaches will be vital in realizing the full potential of agricultural innovation. Sustaining this momentum will require concerted efforts from all involved parties, recognizing that the future of agriculture hinges not just on technological advances but also on the collaborative strength and commitment of its many stakeholders.

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of the European Union

Implementation of sustainable Agricultural practices in school curriculum

-Best students practices-

(annex)

Lesson Plan

1.Subject:	*Sustainable Agriculture*	***4. Teacher:***	*Karavas Zisis*
2. Topic:	*Fertilization*	***5. Class/Year:***	*2rd/2025*
3. Lesson:	*Organic Fertilizers and Soil Health in Sustainable Agriculture*	***6.School Year:***	*2025/26*

Learning Objectives:

- Define organic fertilizers and distinguish them from chemical fertilizers.
- Explain the benefits of organic fertilizers for soil health and sustainability.
- Identify different types of organic fertilizers (compost, manure, biofertilizers).
- Analyze the impact of organic fertilization on crop yield and environmental protection.
- Solve simple problems related to soil degradation and propose organic solutions.

Teaching methods:	***Tools/Equipment:***
• Presentation (overview of organic fertilizers) • Team discussion (pros and cons of organic vs. chemical fertilizers) • Demonstration (showing compost samples or videos of organic fertilizer application) • "Problem Tree" (mapping soil health issues caused by chemical fertilizers) • Case study analysis (examining farms that transitioned to organic fertilization)	• Computer • Projector • Smart board • Flipcharts/markers • Samples of compost/manure (optional)

Introduction activities:

- Teacher introduces the lesson: **Organic Fertilizers and Soil Health**.
- Present the learning objectives clearly.
- Short brainstorming: "What comes to mind when you hear the word *organic*?"
- Explain how soil health is the foundation of sustainable agriculture.

Implementation/Main Activities

Activity 1:

Presentation & Discussion (20 min)

- Teacher explains types of organic fertilizers and their role in soil fertility.

- Students discuss: “Why might farmers prefer chemical fertilizers despite environmental risks?”

Activity 2: Demonstration (20 min)

- Show compost/manure samples or a short video of organic fertilizer preparation.
- Students observe and note differences compared to chemical fertilizers.

Activity 3: Problem Tree (25 min)

- Groups create a “problem tree” showing soil degradation causes (overuse of chemicals, erosion) and solutions (organic fertilization, crop rotation).
- Each group presents their tree.

Activity 4: Case Study (20 min)

- Teacher presents a case study of a farm that switched to organic fertilization.
- Students analyze outcomes: improved soil health, reduced costs, better market positioning.

Conclusion/Ending Activities:

- Summarize key takeaways:
  - Organic fertilizers improve soil health and sustainability.
  - They reduce environmental damage compared to chemicals.
  - Farmers can use them to meet consumer demand for sustainable products.
- Reflection: Each student writes one benefit of organic fertilizers on a sticky note and shares with the class.

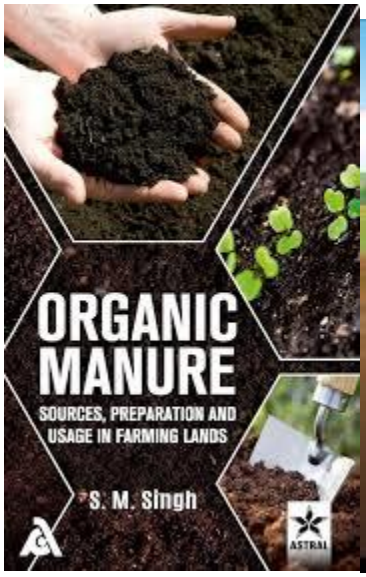
Next tasks:

- St Students prepare a short report comparing **organic vs. chemical fertilizers** in terms of cost, yield, and sustainability.
- Collect photos of local composting or organic farming practices.
- Watch a video on soil health and organic farming (teacher provides link).

Suggested video links:

- FAO: Organic Fertilizers and Soil Health : https://www.youtube.com/watch?v=7-YMheTIPJo

- YouTube: Composting for Sustainable Agriculture : https://www.youtube.com/results?search_query=composting+sustainable+agriculture



Lesson Plan

1.Subject:	Sustainable Agriculture	***4. Teacher:***	*Karavas Zisis*
2. Topic:	Crop Rotation and Biodiversity	***5. Class/Year:***	*2rd/2025*
3. Lesson:	"Crop Rotation and Biodiversity: Practical Tools for Sustainable Agriculture"	***6.School Year:***	*2025/26*

Learning Objectives:

By the end of the lesson, students will be able to:

- Explain the importance of crop rotation and biodiversity for soil health and pest control.
- Identify at least three crop rotation patterns suitable for vocational farming contexts.
- Design a simple farm plan incorporating biodiversity practice.
- Reflect on how these practices contribute to long-term sustainability.

Teaching methods:	***Tools/Equipment:***
• Mini-lecture with visuals • Group discussion and brainstorming • Hands-on farm plan design activity • Video-based learning • Reflection and peer feedback	• Projector/interactive whiteboard • Printed worksheets and markers • Internet-enabled device for video playback • Photos of crop rotation and biodiversity practices (see below)

Introduction activities: (10 minutes)

- icebreaker: "Why do farmers rotate crops?"
- Show a photo of **monoculture vs. crop** rotation to spark discussion.
- Outline lesson objectives clearly.

Implementation/Main Activities

1. **Mini-Lecture (20 min)**
    - Explain crop rotation cycles (e.g., cereals → legumes → root crops).
    - Discuss biodiversity practices: hedgerows, cover crops, mixed cropping.
    - Use diagrams and photos to illustrate.
2. **Video Learning (10 min)** Play a short video introducing crop rotation and biodiversity in practice:
    - Suggested: *"Crop Rotation Explained"* (YouTube educational video).
3. **Group Activity (25 min)**
    - Students design a **farm plan** with 3-year crop rotation and biodiversity features.
    - Each group presents one sustainable practice they included.

4. **Discussion (10 min)**
    - Compare conventional vs. sustainable approaches.
    - Highlight vocational opportunities in sustainable farming.

Conclusion/Ending Activities:

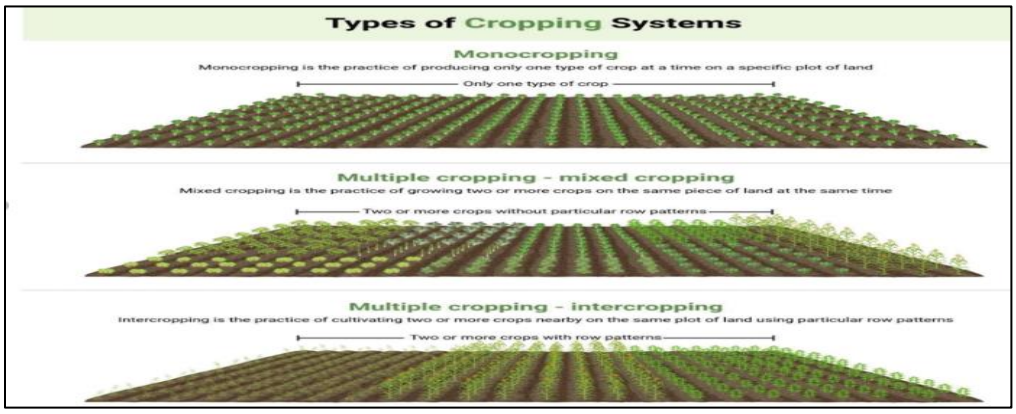
- Recap: “Rotation builds soil, biodiversity builds resilience.”
- Each student shares one practice they would apply in real life.
- Teacher summarizes and connects to next lesson (Agroforestry).

Next tasks:

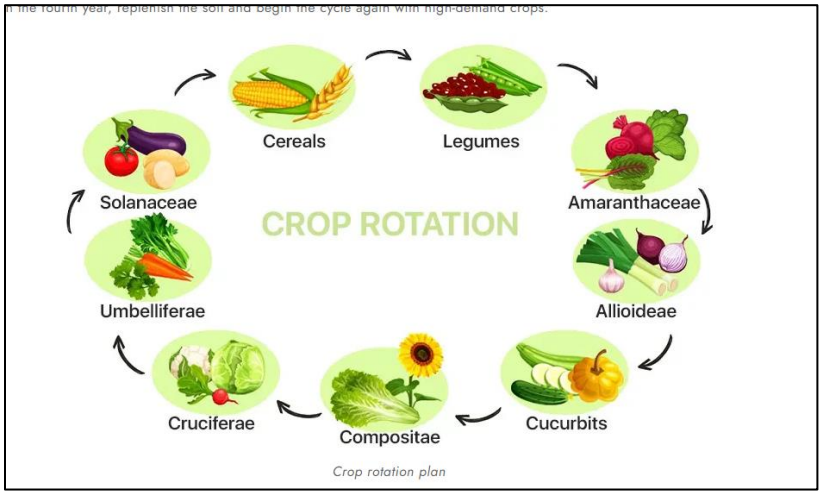
- Homework: Research one local farm using crop rotation or biodiversity and prepare a short report.
- Prepare for next lesson: “Agroforestry and Biodiversity in Farming.

Suggested photos

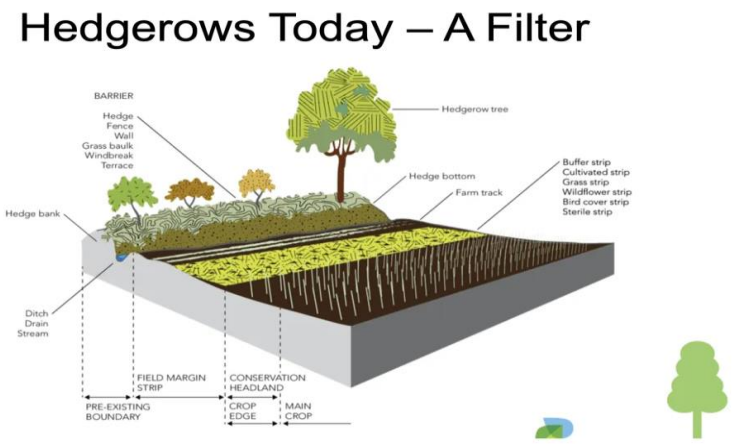
1.Monocropping vs multicropping



2.Crop rotation diagram (cereals □ legumes □ root crops).



- Hedgerows supporting biodiversity on farmland.



Suggested Video

1.Crop rotation:

https://www.youtube.com/watch?v=XeNA6XdMoF8

2.Why do farmers rotate crops:

https://www.youtube.com/watch?v=3QLYFg4NIN8

Lesson Plan

1.Subject:	*Sustainable Agriculture*	***4. Teacher:***	*Papadimitriou Lampros*
2. Topic:	Agricultural Science – Sustainable Farming Practices	***5. Class/Year:***	*2rd/2025*
3. Lesson:	*Fertilization*	***6.School Year:***	*2025/26*

Learning Objectives:

- Students will understand the importance of fertilization in sustainable agriculture.
- Students will distinguish between organic and inorganic fertilizers.
- Students will recognize modern technologies (e.g., climate-smart, precision fertilization).
- Students will develop critical thinking skills in choosing appropriate fertilization methods

Teaching methods:	***Tools/Equipment:***
• Lecture with audiovisual material. • Discussion – questions and answers. • Group work (designing a sustainable fertilization plan). • Case study.	• Projector/Computer. • Photos & diagrams. • YouTube video. • Worksheets for group activity.

Introduction activities: (10 minutes)

- Teacher asks: "What do you know about fertilizers?"
- Show photos of organic & inorganic fertilizers.
- Short introduction to sustainable agriculture.

Suggested images:

- Diagram of sustainable fertilization strategies
- Climate-smart fertilizers
- Integrated soil fertility management
- Biofertilizers – role in sustainable agriculture

***Implementation/Main Activities*: (60 minutes)**

- **Lecture (20'):** Nutrients (N, P, K), organic vs. inorganic fertilizers.
- **Case study (15'):** Example of a farm that reduced chemical fertilizers and increased yield with compost**.**
- **Group activity (20'):** Students design a fertilization plan for a crop (e.g., wheat or maize) with sustainability goals.

- **Discussion (5'):** Advantages and disadvantages of organic fertilization.

Suggested video: **Video**: https://www.youtube.com/watch?v=md2RBgr0vSY

Conclusion/Ending Activities: (10 minutes)

- Recap of key points.
- Short discussion: "How can sustainable fertilization help the future of agriculture?"
- Students write one action they would adopt as farmers.

Next tasks: (5 minutes)

- Homework: Research one example of sustainable fertilization in a Greek farm.
- Prepare a 5-minute presentation for the next class.

Suggested images

1. **Diagram of sustainable fertilization strategies**

2.**Integrated soil fertility management**

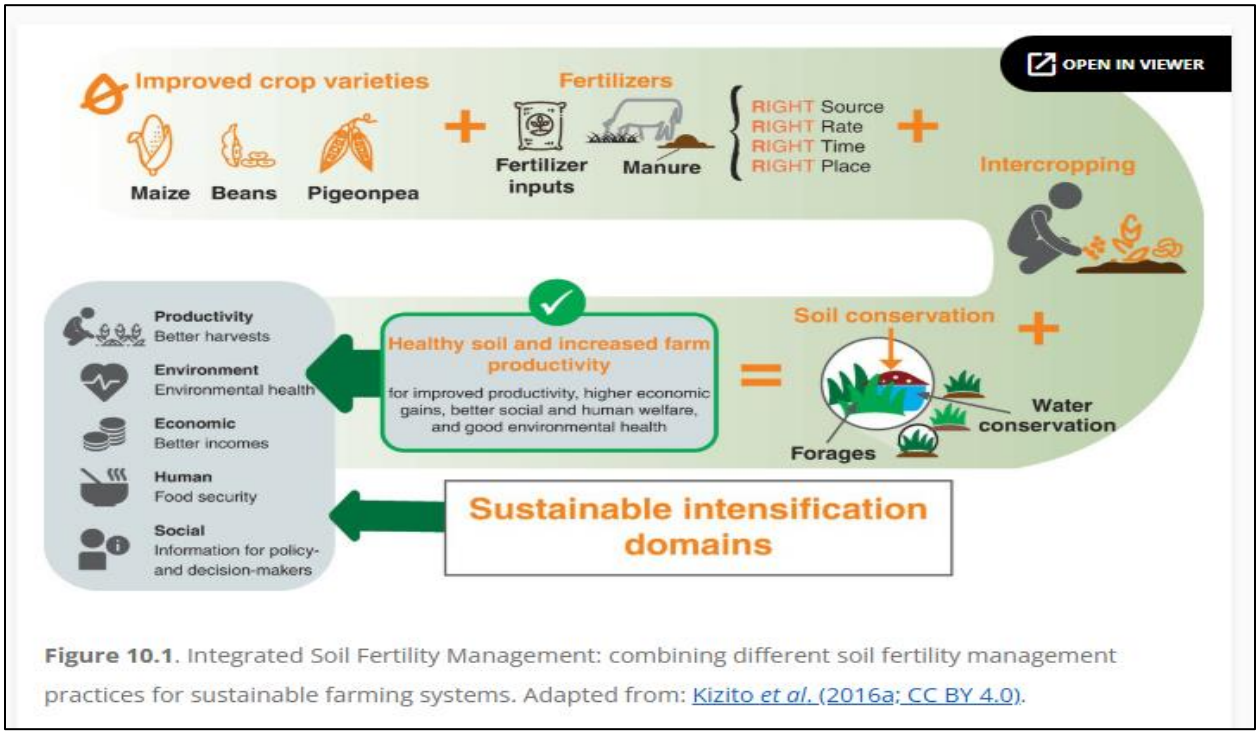
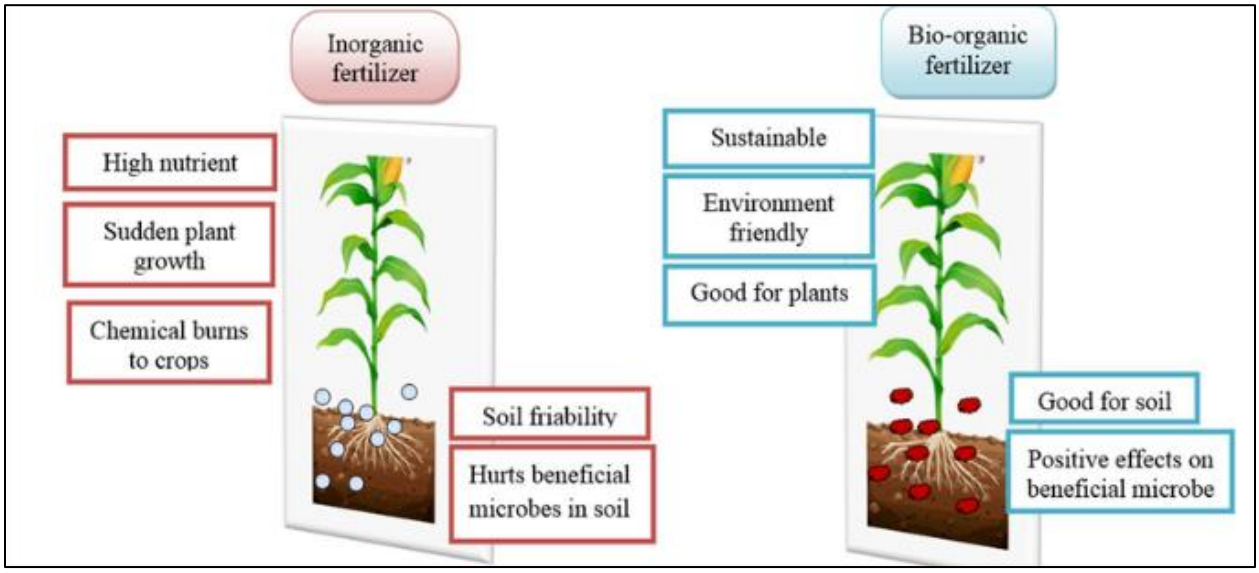


Figure 10.1. Integrated Soil Fertility Management: combining different soil fertility management practices for sustainable farming systems. Adapted from: Kizito *et al.* (2016a; CC BY 4.0).

3.Biofetrilizers

4.organic Vs inorganic fertilizers



Useful links:

1.More Sustainable Fertilization with COMPO EXPERT : https://www.youtube.com/watch?v=w5UbJ5pYqcc

2. Fertilize Your Crops with Advanced Fertilizing Machines To Increase Crop Yields | Smart Farming :

https://www.youtube.com/watch?v=md2RBgr0vSY

Lesson Plan

1.Subject:	Sustainable Agriculture	***4. Teacher:***	*Papadimitriou Lambros*
2. Topic:	*Water Irrigation*	***5. Class/Year:***	*2rd/2025*
3. Lesson:	Water-Smart Farming & Irrigation Efficiency	***6.School Year:***	*2025/26*

Learning Objectives:

- Describe why water conservation is essential in sustainable agriculture.
- Compare traditional and modern irrigation systems.
- Identify water-saving technologies used in Mediterranean/European farms.
- Evaluate irrigation efficiency using simple observations and demonstrations.
- Propose a water-smart irrigation plan for a small farm scenario.

Teaching methods:	***Tools/Equipment:***
• Interactive discussion • Mini-lecture with visuals • Hands-on group activities (stations) • Case study analysis • Collaborative problem-solving • Short formative assessment (exit quiz)	• Projector or slides with irrigation diagrams • Soil samples (sand, loam, clay) • Simple irrigation models (bottles, perforated cups, trays) • Water containers • Worksheets (comparison table + case study sheet) • Markers, paper, or digital devices • Optional: real drip tape, emitters, or irrigation components

Introduction activities: (10 minutes)

Warm-Up: "Water Footprint Guessing Game"

- Show images of common crops (tomato, lettuce, olive).
- Students guess which crop uses the most water.
- Brief discussion on why water use matters in agriculture.

Purpose: Activate prior knowledge and introduce the concept of water scarcity.

Implementation/Main Activities

A. Mini-Lecture with Visuals (15 minutes)

Topics covered:

- Water scarcity in Mediterranean agriculture
- Traditional irrigation: flood, furrow
- Modern irrigation: drip, micro-sprinklers, subsurface drip
- Key concepts: evapotranspiration, soil moisture, runoff, infiltration

B. Hands-On Group Activity: "Irrigation Efficiency Lab" (25 minutes)

Students rotate through **three stations**:

1. **Drip vs. Sprinkler Simulation**
    - Compare water distribution and loss.

2. **Soil Moisture & Texture Test**
    - Observe water retention in different soil types.
3. **Runoff & Infiltration Demo**
    - Tilted tray experiment to show water movement.

Student Task: Complete a worksheet comparing efficiency, water loss, and suitability for crops.

C. Case Study Analysis (15 minutes)

Students receive a scenario of a small vegetable farm with limited water.

Group Task: Propose a water-smart irrigation plan including:

- Recommended irrigation system
- Water-saving technologies
- Expected benefits

Groups briefly present their solutions.

D. Teacher Consolidation (10 minutes)

Key takeaways:

- Why drip irrigation is widely used
- Importance of irrigation scheduling
- Role of sensors and weather data
- Water conservation as part of sustainable farm management

Conclusion/Ending Activities:

Exit Quiz (5 questions)

- Name one traditional and one modern irrigation method.
- Why is drip irrigation more efficient?
- What is evapotranspiration?
- Give one example of a water-saving technology.
- How does soil type affect irrigation needs?
- Students submit answers before leaving.

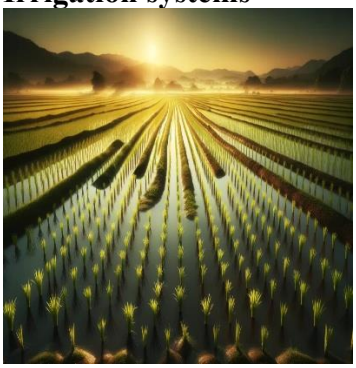
Next tasks:

- **Option A:** Students design a simple irrigation layout for a 200 m² vegetable plot.
- **Option B:** Short reflection: “Three ways my family farm (or a local farm) could save water.”
- **Option C:** Research task: Find one innovative irrigation technology used in Europe and describe how it works.

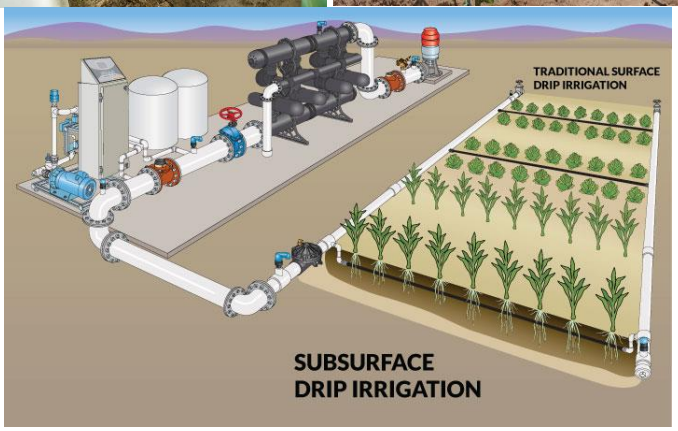
WARM UP IMAGES



Irrigation systems







Related videos:

1. **Efficient Irrigation & Water Conservation** https://www.youtube.com/watch?v=XV-Hqke9cZM
2. **Water Conservation – Study.com** https://study.com/academy/lesson/video/water-conservation-how-water-management-can-lead-to-sustainable-use.html
3. **Irrigation Scheduling ("Watch the Weather, Wait to Water")** https://www.sjrwmd.com/water-conservation/videos

Lesson Plan

1.Subject:	**Mechanical Engineering**	***4. Teacher:***	***Karkalis Nikolaos***
2. Topic:	**Machines in agriculture**	***5. Class/Year:***	***B/2025***
3. Lesson:	**Smart Machines in Sustainable Agriculture**	***6.School Year:***	***2025/26***

Learning Objectives:

Students will be able to:

- Explain what makes a machine "smart" in agriculture.
- Identify key smart machines (GPS tractors, drones, sensors, robots).
- Compare traditional vs. smart machinery.
- Describe how smart machines support sustainability.
- Analyze a farm scenario and propose smart-machine solutions.

Teaching methods:	***Tools/Equipment:***

- Interactive discussion
- Mini-lecture with visuals
- Hands-on demonstration (videos + images)
- Group analysis
- Worksheet completion
- Comparison table activity
	• Projector
	• Internet access
	• Printed worksheets
	• Comparison table
	• Images from search results:
	  o Smart agriculture machinery (Farmonaut)
	  o GPS-guided tractor interior (Kingstec)
	  o Bonirob robot (Engineering.com)
	• Video links

Introduction activities:

Warm-Up: "Old vs. Smart"(10 minutes)

Show students two images:

- Traditional tractor
- Smart GPS-guided tractor (Kingstec)

Ask:

- "What differences do you notice?"
- "Which one is more sustainable? Why?

Implementation/Main Activities

A. Mini-Lecture with Visuals (15 minutes)

Topics:

- What makes a machine “smart”?
- Sensors, GPS, automation, AI
- Sustainability benefits: less fuel, fewer chemicals, precision

Use images:

- Smart machinery overview (Farmonaut)
- Bonirob robot (Engineering.com)

B. Video Demonstration (10 minutes)

Play selected clips:

1. **Smart Farming Explained (AI, Drones & Data)** https://www.youtube.com/watch?v=SS1YdUFYV28
2. **Smart Farming: Tech for Sustainable Food** https://www.dw.com/en/smart-farming-tech-for-sustainable-food/video-68640143

Students take notes on:

- What machines they saw
- How they improve sustainability

C. Group Activity: “Smart Machine Stations” (20 minutes)

Create 3 stations:

Station 1 — GPS & Precision

Show GPS tractor image (Kingstec) Students identify:

- How GPS reduces fuel
- How it prevents overlapping passes

Station 2 — Robots

Show Bonirob robot (Engineering.com) Students discuss:

- How robots reduce herbicide use
- How automation helps sustainability

Station 3 — Drones

Show smart farming drone image (Freepik) Students analyze:

- How drones detect crop stress
- How drones reduce pesticide use

D. Case Study (20 minutes)

Scenario: *A 20-hectare vegetable farm wants to reduce water use, fuel consumption, and pesticide application.*

Groups propose:

- Which smart machines to use
- Why they improve sustainability
- Expected benefits

Groups present in 1–2 minutes.

Conclusion/Ending Activities:

- Review key concepts
- Students complete exit quiz (in worksheet)
- Teacher highlights real-world adoption of smart machines

Next tasks:

- Short report: "Three smart machines that could improve a Greek farm."
- Optional: Find a real smart machine used in Thessaly.

WARM UP PHOTOS




COMPARISON TABLE

TRADITIONAL vs SMART MACHINERY		
Feature	**Traditional Machinery**	**Smart Machinery**
Fuel Use	High	Reduced via GPS precision
Chemical Use	High (blanket spraying)	Low (targeted spraying, robots)
Soil Impact	High compaction	Controlled traffic, lighter robots
Labor	Manual	Automated / assisted
Data Use	None	Sensors, AI, analytics
Sustainability	Moderate	High

Source:

USEFUL VIDEOS

1. **Smart Farming Explained (AI, Drones & Data)** : https://www.youtube.com/watch?v=SS1YdUFYV28
2. **Smart Farming: Tech for Sustainable Food** : https://www.dw.com/en/smart-farming-tech-for-sustainable-food/video-68640143

USEFUL WEBSITES

1. https://farmonaut.com/
2. https://kingstec.com/
3. https://www.engineering.com/robotic-automation-meets-agriculture/
4. https://www.freepik.com/free-photos-vectors/smart-farm-drone

Lesson Plan

1.Subject:	**Plant Production**	***4. Teacher:***	***Karkalis Nikolaos***
2. Topic:	**Machines in agriculture**	***5. Class/Year:***	***B/2025***
3. Lesson:	**Use of sensors in Sustainable Agriculture**	***6.School Year:***	***2025/26***

Learning Objectives:

Students will be able to:

- Explain what agricultural sensors are and how they work.
- Identify major types of sensors used in sustainable agriculture.
- Describe how sensors reduce water, fertilizer, and pesticide use.
- Interpret basic sensor data (soil moisture, temperature, NDVI).
- Propose sensor-based solutions for a real farm scenario.

Teaching methods:	***Tools/Equipment:***
- Interactive discussion - Mini-lecture with visuals - Video demonstrations - Group station activities - Case study analysis - Worksheet completion -	- Projector - Internet access - Printed worksheets - Images (soil moisture sensor, weather station, drone NDVI map, greenhouse sensors) or real objects if it's possible. - Video links (see at the end of lesson plan)

Introduction activities:

Warm-Up: "Guess the Sensor" (10 minutes)

Show 3 images:

- Soil moisture probe
- Weather station
- Drone NDVI map

Ask:

- "What do you think each device measures?"
- "How could this help a farmer save resources?"

A. Mini-Lecture with Visuals (15 minutes)

Topics:

- What is a sensor?
- Types of agricultural sensors:
  - Soil moisture sensors
  - Temperature & humidity sensors
  - Weather stations

    - Leaf wetness sensors
    - Nutrient sensors
    - Drone-based imaging sensors (NDVI)
- How sensors support sustainability:
    - Reduce water waste
    - Reduce fertilizer runoff
    - Reduce pesticide use
    - Improve yields

B. Video Demonstration (10 minutes)

Play selected clips:

1. **Soil Moisture Sensors Explained:** `https://www.youtube.com/watch?v=Jm2xZ4n9i1E` (youtube.com in Bing)
2. **Smart Farming with IoT Sensors :** `https://www.youtube.com/watch?v=SS1YdUFYV28` (youtube.com in Bing)

Students write down:

- What sensors they saw
- How each one improves sustainability

C. Group Activity: "Sensor Stations" (20 minutes)

Create 3 stations:

Station 1 — Soil Moisture Sensors

Students examine images of probes and discuss:

- How they prevent over-irrigation
- How they support drip irrigation scheduling

Station 2 — Weather & Climate Sensors

Show weather station images. Students identify:

- How weather data reduces pesticide spraying
- How temperature/humidity data prevents disease

Station 3 — Drone & Imaging Sensors

Show NDVI map images. Students discuss:

- How drones detect crop stress early
- How this reduces chemical use

D. Case Study (20 minutes)

Scenario: A 10-hectare tomato and lettuce farm struggles with water waste and uneven crop growth.

Groups propose:

- Which sensors to install
- Where to place them
- Expected sustainability benefits

Groups present briefly.

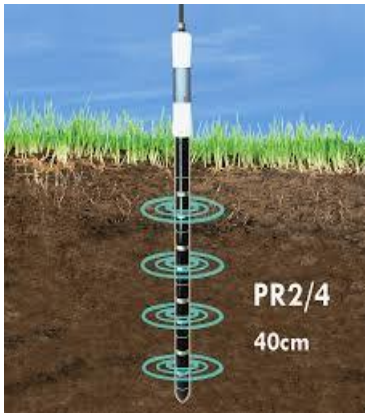
Conclusion/Ending Activities:

- Review key concepts
- Students complete exit quiz (worksheet)

Next tasks:

- Short report: “How sensors could improve a Greek greenhouse.”
- Optional: Sketch a sensor layout for a 1-hectare field

WARM UP PHOTOS



COMPARISON TABLE

TRADITIONAL vs SENSOR-BASED FARMING		
Feature	**Traditional Machinery**	**Smart Machinery**
Water Use	Based on guesswork	Based on real-time soil data
Fertilizer Use	Uniform application	Variable-rate based on nutrient sensors
Pest Control	Calendar spraying	Weather + leaf wetness data
Crop Monitoring	Visual inspection	Drone imaging + analytics
Sustainability	Moderate	High

Source:

USEFUL VIDEOS

1. Soil Moisture Sensors Explained from: **https://www.youtube.com/watch?v=Jm2xZ4n9i1E**
2. Smart Farming with IoT Sensors from **:** **https://www.youtube.com/watch?v=SS1YdUFYV28**
3. NDVI & Drone Crop Monitoring **from :** **https://www.youtube.com/watch?v=0P6lG9x2W0E**

USEFUL WEBSITES

1. https://aai-drones.com/drone-ndvi-photography-a-guide-to-enhanced-crop-monitoring/
2. https://www.nature.com/articles/s12276-023-01006-z

Lesson Plan

1.Subject:	Plant Production	***4. Teacher:***	***Michalakis Kostantinos***
2. Topic:	Composting and Agricultural Farm Systems	***5. Class/Year:***	***B/2025***
3. Lesson:	Composting and Agricultural Farm Systems: Turning Organic Waste into Soil Fertility	***6.School Year:***	***2025/26***

Learning Objectives:

Students will be able to:

- Explain what composting is and how it supports sustainable farm systems.
- Identify key materials and conditions required for effective composting.
- Describe how composting contributes to soil fertility, nutrient cycling, and circular farm systems.
- Compare different composting methods used in agricultural settings.
- Apply composting principles to design a simple composting plan for a vocational-level farm.

Teaching methods:	***Tools/Equipment:***
- Mini-lecture with visuals - Guided discussion - Video-based learning - Group problem-solving activity - Hands-on demonstration (if materials available) - Reflection and peer feedback	- Projector or interactive whiteboard - Printed worksheets - Compost samples (optional) - Photos of composting systems - Internet access for video - Flipchart or markers

Introduction activities (10 minutes):

- Ask students: “What happens to organic waste on a farm?”
- Show a photo of a compost pile and ask students to identify visible materials.
- Briefly explain that composting is a controlled decomposition process that transforms organic matter into humus, improving soil fertility and reducing waste.
- Present lesson objectives.

Implementation / Main Activities (65 minutes)

1. Mini-Lecture: Composting in Sustainable Farm Systems (20 minutes)

Key points (supported by search results):

- Composting reduces pollution, recycles nutrients, and lowers fertilizer costs.
- Compost is produced by mixing organic materials such as crop residues, manure, and green waste, which decompose through microbial activity.
- Composting is central to circular farm systems, closing nutrient loops and improving soil health.
- Basic requirements: carbon-rich materials, nitrogen-rich materials, oxygen, moisture, and time.
- Benefits: improved soil structure, increased water retention, reduced chemical inputs.

2. Video Learning (10 minutes)

Recommended videos:

- "How Composting Works – Sustainable Farming Basics" : https://www.youtube.com/watch?v=n9OhxKlrWwc
- "Farm-Scale Composting Explained" (aligned with agricultural systems) https://www.youtube.com/watch?v=QFhG2v3WkXo

Students watch and note:

- What materials are used
- How the compost pile is managed
- Benefits for the farm system

3. Group Activity: Designing a Farm Composting System (25 minutes)

Students work in groups of 3–4 to design a composting system for a small vocational-level farm. They must include:

- Source of organic materials (crop residues, manure, kitchen waste)
- Composting method (windrow, static pile, bin system, or vermicomposting)
- Space requirements
- Management plan (turning schedule, moisture control)
- Expected benefits for soil and crops

Groups present their design in 2–3 minutes.

4. Discussion: Composting in Circular Agricultural Systems (10 minutes)

Prompt questions:

- How does composting reduce farm waste?
- How does composting support soil fertility and crop productivity?
- What challenges might farmers face when implementing composting? Use insights from sources showing composting as a key part of circular, sustainable systems.

Conclusion/Ending Activities (10 minutes):

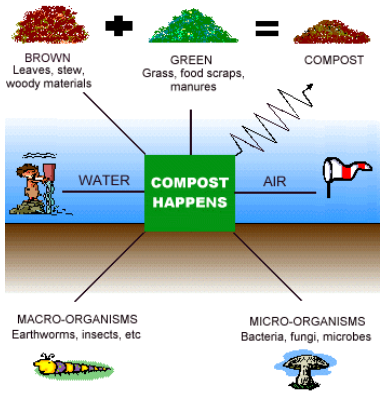
- Recap the key steps of composting and its role in sustainable agriculture.
- Students share one new insight they gained.
- Teacher highlights how composting supports long-term soil health and reduces reliance on chemical fertilizers

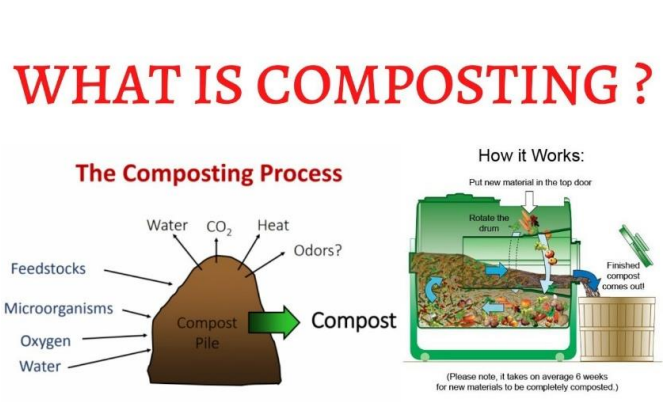
Next tasks (5 minutes):

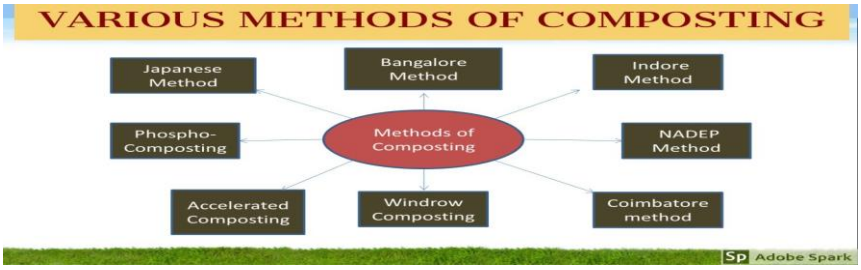
- Homework: Students research one composting method (e.g., windrow, Bokashi, vermicomposting) and write a short summary.
- Next lesson: Soil fertility management and organic amendments.

PHOTOS (compost piles)









USEFUL VIDEOS

- https://www.youtube.com/watch?v=n9OhxKlrWwc
- https://www.youtube.com/watch?v=QFhG2v3WkXo

USEFUL WEBSITES

1. https://www.marshall.edu/sustainability/composting/what-compost/
2. https://directcompostsolutions.com/8-methods-composting/

Lesson Plan

1.Subject:	Sustainable Agriculture	***4. Teacher:***	***Michalakis Kostantinos***
2. Topic:	Agroecology and Integrated Farm Systems	***5. Class/Year:***	***C/2025***
3. Lesson:	Agroecology in Action: Integrating Plants, Animals, and Soil	***6.School Year:***	***2025/26***

Learning Objectives:

Students will be able to:

-Explain the core principles of agroecology and how plants, animals, and soil interact within a farm ecosystem.
-Identify examples of integrated farming systems (e.g., crop–livestock systems, agroforestry, compost-based nutrient cycling).
-Analyze ecological relationships (nutrient flows, pest–predator interactions, soil fertility processes).
-Collaborate in groups to design a simple integrated farm model.
-Evaluate how integration reduces external inputs and improves sustainability.
-Appreciate the value of ecological thinking in farm management.
-Demonstrate teamwork, communication, and problem-solving in practical tasks.
-Recognize the importance of biodiversity and circular resource use.

Teaching methods:	***Tools/Equipment:***
- **Interactive mini-lecture** (short bursts with student questioning) - **Think-pair-share** discussions - **Ecosystem puzzle activity** (movement-based) - **Video-based guided observation** - **Case-study rotation** (students move between stations) - **Group design challenge** (students create an integrated farm system) - **Whole-class ecosystem web** (string activity showing connections) - **Reflection circle** and exit tickets	-Projector or interactive whiteboard -Flipchart paper or large sheets -Markers, colored pencils -Sticky notes (for exit tickets) -Printed worksheets or station cards -Cards for the ecosystem puzzle (plants, animals, soil organisms, water, sun, compost, pests, predators) -String or yarn for the ecosystem web -Case-study station sheets (3 stations) -Example photos of integrated farm systems (agroforestry, mixed crop–livestock, composting)

Introduction activities (10 minutes):
1. "Farm Ecosystem Puzzle" (3–4 min)

Give each student a card:
-Plant
-Animal
-Soil organism
-Water
-Sun
-Compost
-Pest
-Predator
Students must find their "connections" (e.g., chicken → manure → soil → plants). This immediately gets them moving and thinking in systems.

2. Quick Pair-Share (2 min)

Ask: "What happens when one part of the farm ecosystem is missing?" Pairs discuss, then 2–3 share aloud.

Implementation / Main Activities (65 minutes)

1. Mini-Lecture + Interactive Questions (10 minutes)

Keep the lecture short and break it with prompts like:

- "Who can give me an example of a plant–animal interaction?"
- "What happens to soil if animals overgraze?"

2. Video + Guided Observation (10 minutes)

Play the agroecology video. Give students a **viewing checklist**:

- Where do plants support animals?
- Where do animals support soil?
- Where does soil support plants?

After the video, students compare answers in pairs.

3. Case-Study Rotation (10 minutes)

Set up **3 stations** around the room:

- **Station A:** Vegetable garden + chickens
- **Station B:** Orchard + sheep
- **Station C:** Agroforestry strip + compost

At each station, students answer:

- What are the inputs?
- What are the outputs?
- How do the components support each other?

Groups rotate every 3–4 minutes.

4. Group Design Challenge (25 minutes)

Students work in groups of 3–4 to design an **integrated agroecological farm**.

They must include:

- 2–3 plant species
- 1–2 animal species
- Soil fertility strategy (compost, manure, cover crops)
- Biodiversity features
- Water management
- A simple map

Active twist:

Each group must **justify** one design choice by explaining the ecological interaction (e.g., "We placed chickens in the orchard because they eat pests and fertilize the soil").

Groups present for 1 minute each.

5. Whole-Class "Ecosystem Web" (5 minutes)

Use string or yarn. Students stand in a circle holding cards (plants, animals, soil, water, insects). They pass the string to show connections. You end up with a **web** that visually demonstrates agroecology.

- If one student drops their string, the web collapses — a powerful metaphor..

Conclusion/Ending Activities (10 minutes):
Exit Ticket (5 minutes)

Students write on a sticky note: **"One integration I would apply on a real farm is…"** They place it on the board.

Reflection Circle (5 minutes)

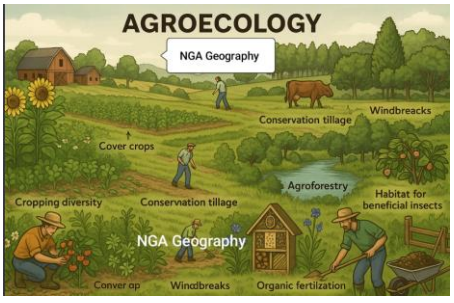
Ask 3–4 students to share:

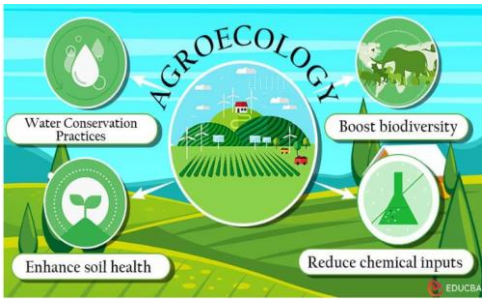
- What surprised them?
- What connection was most interesting?

Next tasks (5 minutes):

- Homework: Visit a local farm (or research online) and identify **three plant–animal–soil interactions**.
- Next lesson: Agroforestry and perennial systems

PHOTOS





USEFUL VIDEOS

- https://www.youtube.com/watch?v=IGVZOLV9SPo
- https://www.youtube.com/watch?v=7gZkzj8V1nM

Lesson Plan

1.Subject:	Agricultural tourism	***4. Teacher:***	*Petar Milosavljevic*
2. Topic:	Landscapes of exceptional quality	***5. Class/Year:***	*III year*
3. Lesson:	National parks in Serbia-Kopaonik	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:
Define the concept of national parks and their importance in the development of agrarian tourism in Serbia
They understand the cultural, economic and ecological importance of the creation and sustainability of national parks in Serbia
To present all the positive aspects of national parks in Serbia
To propose measures that will raise the national parks to a higher level of organization, maintenance and visits

Teaching methods:	***Tools/Equipment:***
Presentation *Team discussion* *Demonstration* *https://youtu.be/_pSHSUwCo78?si=pn7EaDp0GXU_iKOw* *https://share.google/ttufvhvIsA8xVL9Kg*	- *Computer* - *Projector* - *Smart board* *Smartphone*

Implementation/Main Activities

The students visited the Kopaonik National Park. It was first protected in 1981.
The national park begins at an altitude of about 800 m and ends with mountain ridges interconnected by high passes.
They are dominated by the highest peak, Pančićev vrh (2,017 m above sea level). The largest area of the park encompasses the central and most forested part of the Kopaonik massif, a vast, relatively flat area with an altitude of approximately 1,700 m. Kopaonik is characterized by a high level of biological diversity.
The high mountain flora alone is made up of 825 species, of which 91 species are endemic and 82 species are subendemic. Touring all the natural beauties of Kopaonik, the students openly expressed their enthusiasm for our region. In addition, they also noticed phenomena or events that negatively affect the presentation of this national park.

During the tour of the national park, I gave the students the task to write down in their notebooks or mobile phones everything that would improve or facilitate the movement and stay of tourists on the mountain.

In order to better argue the observed things, students can take pictures or record everything they have observed.

After returning to school, I will divide them into two groups and make a small competition.

1. What are the bad things they noticed on the tour of the park.

2. The easiest way to solve that problem.

3. What did they like and can it be improved?

At the end of the class, we will write a letter to the administration of the Kopaonik National Park and forward it to them as suggestions for better management of the park.

Conclusion/Ending Activities

At the end of the lesson, we start a joint discussion about everything we saw, noticed, talked about.

Students use their notebooks in which they recorded their observations, use pictures or videos from their mobile phones.

We give one of the students the task of finding phone numbers or websites where we can report everything we have seen, give some advice or a suggestion for solving it.

What students should do for the next class

Students will find the addresses of competent institutions responsible for the work of national parks and send them some of their observations, suggestions for better compliance with ecological norms and the sustainability of such eco systems.

The students will talk about some of their personal visits to certain natural locations and whether those destinations deserve and have the possibility to be designated as "areas of exceptional natural features".

Lesson Plan

1.Subject:	Agricultural tourism	***4. Teacher:***	*Petar Milosavljevic*
2. Topic:	Agricultural tourism in Serbia	***5. Class/Year:***	*III year*
3. Lesson:	Ethnic village (houses) in Serbia	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:
To define the term ethnic village and its importance in the development of tourism in Serbia.
- To understand their cultural and economic importance.
- To present all the positive aspects of agricultural tourism in Serbia .
- To propose new innovative methods in the creation and operation of ethnic villages in Serbia.

Teaching methods:	***Tools/Equipment:***
Presentation *Team discussion* *Short films on you tube about ethnic villages/ ethnic houses in Serbia* *Official websites of certain ethnic villages/houses* *https://youtu.be/7slTNB7VqT8?si=Q_cE8UTFvbAwTLap* *https://share.google/Zx3Vo6Arc1BLOU0vS*	*Computer* *Projector* *Smart board* *Smartphone*

Implementation/Main Activities

Serbia is rich in authentic ethnic villages that offer a unique insight into traditional village life, customs and cuisine, ideal for a holiday in nature. Accommodation in these villages varies from simple rooms to complexes with additional facilities such as swimming pools and spa centers,

Tour of an ethnic village with project students near our city. Ethno houses Grebac are located on the regional road Prokuplje Krusevac over the mountain pass Grebac on Jastrebac at almost 1000 meters above sea level. Ethno house Grebac offers accommodation, 24 beds in comfortable double rooms. The restaurant and dining room are furnished in ethnic style and decorated with ethnic motifs that characterize the atmosphere of the ethnic house itself.

After returning to school, we analyze the tour of the ethnic house.

I will divide the students of the class into two groups.

The first group will have the task of showing, after analyzing the housing units in the ethnic house, whether they have noticed any shortcomings or shortcomings of the space and how they would improve that housing space.
For the sake of easier and better analysis, I give the students the recorded material from the ethnic village.

The second group is doing an analysis of the restaurant and the kitchen in the given facility.
The group will highlight all the good sides of the restaurant and the kitchen, and will also give their suggestions to improve the quality of the food, the variety or the efficiency of the service in the kitchen and the restaurant.

Groups have 15 minutes each for work and analysis. I will visit both groups for a few minutes and give them guidelines and some of my suggestions.

The groups will use the photographs of the object and write their observations, proposals, suggestions on the green and red papers.

At the end of the class, the groups will have five minutes each to give an analysis of the data.

After the analysis, we will discuss the task together and present clear and precise conclusions about the ethnic village Grebac and the way to improve the work of the ethnic house Grebac itself.

Conclusion/Ending Activities:

Describe the key messages from the lesson: The students visited all the facilities and rooms in the ethnic house. They saw the conditions under which the devices are stored, prepared and put into circulation. They learned how such a facility functions and what possible problems can be encountered in further work.

Next tasks:

What students should do for the next classThe students will try to virtually design their own ethnic house project and give some of their new ideas in order to realize such a project.

Lesson Plan

1.Subject:	*English language*	***4. Teacher:***	*Smiljana Radulovic*
2. Topic:	*Agribusiness associated with English Language*	***5. Class/Year:***	*III year*
3. Lesson:	*English is key for "Green Agripreneurs"*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To define the importance of English language in every segment of agriculture,*
- *To understand the purpose of the language itself,*
- *To present criteria of importance of English language through some examples,*
- *To solve simple problems using English language and purpose solutions,*
- *To show how knowing English language encourages young people to engage in agriculture,*
- *To communicate internationally to secure financing and market their green products worldwide.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Demonstration* - *"Problem tree"* - *Customer journey* - *Conclusion*	- *Computer* - *Projector* - *Smart board* - *Magazines, books...*

Introduction activities:

Introduction to the topic and activities:

English is a key for "Green Agripreneurs", is the lesson. Present to the students the importance of English language knowledge. Explain them how is very important to think, communicate, write etc. on English language.

Agriculture is very important for our country, and Green Agripreneurs is a program, often associated with youth and agribusiness initiatives that encourages young people to engage in agriculture. English language is the key, because it opens doors to global knowledge, innovation, investment and markets, allowing to apply modern, sustainable techniques and also to communicate on international level.

Also most of the latest research, online courses and any example of innovation: Agriteach sustainability, organic production are available on English language.

Implementation/Main Activiti

1. ***Teacher divide students into groups****.*
2. ***Part A: Giving a product***
   - *Each group must have to take a product, in front of them.*
   - *The product is different and it is bought in some market.*
3. ***Part B: Translation what is written on the products***
   - *Guide students what to do with the product: take the product, look all the sides of it.*

- Guide the students to translate all what is written and to say what the product is for.

4. ***Part C: Analyses of the importance of the English language***

-The given examples of the product to each group are intended to indicate how easier people can find what they are looking for in the market if they have a knowledge of the English language.

-Explain how the English language has an essential role.

-Also students are guided to communicate in front of each group about their product and compare their products.

Conclusion/Ending Activities:

Describe the key "English language is the key in Agripreneurs" from the lesson.

We can communicate on every language, but in short English languages is the tool that turns a local, green agricultural ideas into global, profitable and innovative business.

Next tasks:

Make an investigation:

Go to some supermarket and buy any product you like. Look on the back of the product and try to translate, understand all what is written.

What you can notice? Is it important to know English language? Some products don't have translation on your language, only English language is used.

Lesson Plan

1.Subject:	*English language*	***4. Teacher:***	*Smiljana Radulovic*
2. Topic:	*Sustainable agriculture and market*	***5. Class/Year:***	*III year*
3. Lesson:	*Positive influence of sustainable agriculture, supported by English language*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *What is sustainable agriculture,*
- *The role of the market in sustainable agriculture,*
- *Positive influence of sustainable agriculture,*
- *How the market can support sustainable agriculture?*
- *Innovation, digitalization in agriculture,*
- *English language as support to market, innovation, digitalization.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion*	- *Computer* - *Projector* - *Smart board*

Introduction activities:

Sustainable agriculture is an approach to raising and raising animals that meets today's needs for food and fiber without compromising the ability of future generations to meet their own needs, focusing on three pillars: ecological health, economic profitability and social and economic equity. The goal is to integrate agricultural practices with natural cycles, reduce dependence on synthetic inputs, such as artificial fertilizers and pesticides and preserve the natural resource base.

The market affects: what is produced, how much is produced, how it is produced, methods and technology, innovation and for what price the products are sold. Supply and demand have a big impact on farmer decisions today.

Implementation/Main Activities

1. ***Teacher divide students into groups***
2. ***Part A: Giving an example***

   -Each group must to have an example of the same vegetable, but differently produced. One treated by pesticides and the other one don't treated by pesticides.

   -each group must to look properly on the example, having enough time for finding good explanation for good and bad of the given vegetables.
3. **Part B: Calculation**

   -Give the students instructions what to look and to write on the paper what they see, what they think which product is good or less good for consuming.

   -Guide the students how easier is to find the differences and how is important to make a difference.
4. **Part C: Analysis**

-The written items show the differences between the same two, but differently threatened in other side.
-Explain the students the importance of approximation where ever you are and how specific it can be.
-Also the students are guided to give in each group explanation of the vegetables: specifics, etc., which vegetable they will consume it. On English language the students must to explain.

Conclusion/Ending Activities

In short, sustainable agriculture is a holistic approach that strives for harmony between nature, economy and society, providing healthy food and resources for all, now and in the future. In the sea of all this English language is only one small contribution to support sustainable agriculture in a way to better presentation to the world.

Next tasks:

Imagine that you are a farmer who produced fruit.
Answer:
-Would you rather take conventional or sustainable production?
-How would the market works: prices, customers, demands which influence on your decision?
-What would be the advantages and disadvantages of your decision?
Make a research for one sustainable agricultural product from the domestic market and write: the name of the product, does the product have a certificate, why is more expensive or cheaper than the regular product, what is dominant language (English, or some other foreign languages) on the back of the product?

Lesson Plan

1.Subject:	*Mathematics*	***4. Teacher:***	*Ivan Veljković*
2. Topic:	*Sustainable agriculture and mathematics*	***5. Class/Year:***	*II year*
3. Lesson:	*Mathematic in Modern Veterinary Medicine*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To understand the role of Mathematics in Modern Veterinary Medicine*
- *To apply the acquired knowledge in Mathematics in solving various problems in Modern Veterinary Medicine*
- *To see that Mathematics is a tool that helps solve various problems in a modern veterinary medicine*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Demonstration* - *"Problem tree"* - *Customer journey*	- *Computer* - *Projector*

Introduction activities:

The teacher explains to the students the role of Mathematics in Modern Veterinary Medicine.
Which is why Mathematics is important in Modern Veterinary Medicine?
Nowadays, it is hard to imagine that the one science can function independently. Generally, in certain solutions, the help of some other science is needed. So, it is with Modern Veterinary Medicine. Mathematics plays an important role in Modern Veterinary Medicine because it enables accurate measurement, data analysis, decision-making and improvement of animal health.
Mathematics helps veterinarians to:
-correctly calculate the dose of the drug
-monitor the health condition of the animals
-plan nutrition and breeding
-prevent the spread of infectious diseases
-they spent time and money rationally.

Implementation/Main Activities

The teacher indicates to the students where Mathematics is most often used in Modern Veterinary Medicine and that he will explain the application of Mathematics in Modern Veterinary Medicine through tasks. The tasks solved by the students, with additional explanations from the teacher.

DOSING OF DRUGS

The most common application of Mathematics in Modern Veterinary Medicine is the calculation of the dose of drug according to the body weight of the animal. A formula is used for this
$D = m * p_d$, where is D the dose of drug, m the mass of the animal, p_d dose per kilogram of animal weight
Task 1. *What dose of the drug should be given to a cow weighing 420kg, if the drug is given in a dose of 2 mg/kg?*

*D = m * p_d*
m = 420 kg, p_d = 2 mg/kg
*D = 420 *2 = 840 mg*
Here we must take into account the body weight of the animal, the concentration of the drug and the duration of the therapy, because without accurate calculations the therapy can be ineffective or even dangerous.

DILUTION AND PRECENTAGES
Drugs are often diluted.
***Task 2**. How many ml of active substance are there in 200 ml of 15 % concentration solution?*
1 % = 1 / 100 = 0,01 15 % = 15 / 100 = 0,15
*15 % of 200 ml = 0,15 * 200 = 30 ml*

ANIMAL NUTRITION
Here Mathematics is used to make proper meals:
-percentage of protein, fat and carbohydrates
-daily energy needs.
Proper nutrition affects health, growth and production (milk, meat, eggs …).
***Task 3.** If a 2,5 kg meal should contain 18 % protein, how many kg of protein is in that meal?*
18 % = 0,18
*P_r = 0,18 * 2,5 = 0,45 kg*

STATISTICS AND HEALTH MONITORING
Veterinarians use:
-the mean value (average)
-tables and graphs for monitoring the results of analyses (body mass, body temperature …).
***Task 3.** The body temperatures of three cows are: 38,5 ^{o} C, 38,9 ^{o} C, 39,1 ^{o} C. Calculate the average temperature.*
T_{av} = (T_1 + T_2 + T_3) / 3, T_1 = 38,5 ^{o} C, T_2 = 38,9 ^{o} C, T_3 = 39,1 ^{o} C
T_{av} = (38,5 +38,9 + 39,1) / 3
T_{av} ≈ 38,83 ^{o} C

SPREAD OF DISEASE
In infectious diseases it is monitored:
-number of infected animals
-percentage of disease animals in the herd
***Task 5.** In a flock of 120 sheep, 18 got sick. What is the percentage of sick sheep in the flock?*
U-in total, n-number of sick sheep in the flock
p = n / U
p = 18 / 120 = 15 %

Conclusion/Ending Activities:
-Mathematics is the everyday tool of the veterinarian
-Miscalculations can endanger health
-Correct calculations mean safe and successful treatment.

Next tasks:

Students are given several more similar problems (as in class), which they should do as homework and show then in the next class.

Lesson Plan

1.Subject:	*Mathematics*	***4. Teacher:***	*Ivan Veljkovic*
2. Topic:	*Sustainable agriculture and mathematics*	***5. Class/Year:***	*II year*
3. Lesson:	*Mathematics in sustainable agriculture*	***6.School Year:***	*2025/2026*

Learning Objectives:

Students to be able:
-to define sustainable agriculture
-to notice the difference between sustainable and conventional agriculture
-to understand the role of mathematics in sustainable agriculture
-to use mathematics and its methods to predict and increase yields, reduce costs and protect the environment

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Demonstration* - *"Problem tree"* - *Customer journey*	- *Computer* - *Projector*

Introduction activities:

Introduction to the topic and activities:
Present to the students the importance of Mathematics knowledge.
Mathematics has a very important role in many sciences including agriculture. What is sustainable agriculture?
Sustainable agriculture is an approach to food production and other agricultural goods that ensures long-term soil fertility, economic profitability and conservation of natural resources, while taking into account the health of people, animals and the entire environment. The concept of sustainable agriculture was developed as a response to the negative consequences produces by intensive production systems in the second half of the 20. century: soil degradation, water pollution, reduction of biodiversity and increased emission of greenhouse gases. Conventional agriculture implies highly mechanized and specialized systems, with often excessive use of mineral fertilizers and pesticides. In it, one culture is most often grown, which leads to the exhaustion of the soil and the appearance of disease and harmful organisms.
Sustainable agriculture strives
-optimal use of locally available resources
-reducing external chemical intervention
-diversity of crops and animals
-preserving the natural balance
-inclusion of local community and knowledge
-long-term economic survival of the farm
Where is the role of mathematics?
-Area and yield
-Percentage
-Water consumption
-Linear function and costs
-Ecological aspect -reducing the use of pesticides

Implementation/Main Activities

The teacher sets students problems that they have to solve

Problem 1. *The field has an area 4 ha. That wheat yield is 6t/ha. What is the total yield?*

P=4 ha, p=6 t/ha

P_t*=P*p=4 ha*6 t/ha=24 t*

Problem 2. *The corn yield increased by 15% compared to last year. If the yield last year was 8 t, how much is it now?*

1%=1/100=0,01 15%=15/100=0,15

P=100% + 15%=115%=1+0,15=1,15

P_t*=1,15*8 t=9,2 t*

Another way 8:P_t*= 100:115*

P_t**100 = 8*115*

P_t*=8*115/100*

P_t*=9,2 t*

Problem 3. *1 ha of corn requires 3000* m^3 *of water. How much water is needed for 2,5 ha?*

P_1*=1 ha,* P_2*=2,5 ha,* V_1*=3000* m^3*,* V_2*=?*

P_1*:*P_2*=*V_1*:*V_2

1: 2,5 = 3000: V_2

V_2**1 = 2,5*3000*

V_2 *= 7500* m^3

Problem 4. *How much are the costs processing a field of 3,5 ha, if the price of processing 1,5 ha is 1800 dinars?*

P_1 *= 3,5 ha,* P_2 *= 1,5 ha,* C_2*= 1800 dinars*

P_1*:* P_2 *=* C_1*:* C_2

3,5 : 1,5 =C_1 *: 1800*

C_1**1,5 = 3,5 *1800*

C_1 *= 6300 /1,5 =4200 dinars*

Problem 5. *The farmer reduced the use of pesticides from 15 kg to 12 kg. By what percentage has the consumption of pesticides been reduced?*

M_1*=15 kg,* M_2*=12 kg*

M_1 *:* M_2 *= 100 : (100-p)*

15 : 12 = 100 : (100-p)

*15 * (100-p) =12 *100*

100-p = 1200 / 15 = 80

P = 100-80 = 20%

Conclusion/Ending Activities:

Mathematics helps the farmers to

-properly plan production

-reduce costs

- protect the environment

Sustainable agriculture without mathematics is not possible.

Next tasks:

Students are given several more similar problems (as in class), which they should do as homework and show then in the next class.

Lesson Plan

1.Subject:	*English Language*	***4. Teacher:***	*Biljana Nikolovska-Prlja*
2. Topic:	*Module 6: No Planet B*	***5. Class/Year:***	*II year*
3. Lesson:	*Sustainable Agriculture - Vocabulary practice*	***6.School Year:***	*2025/26*

Learning Objectives:

Students will be able to:

- identify and understand key vocabulary related to sustainable agriculture;
- use new vocabulary in short spoken and written contexts;
- explain basic concepts of sustainable agriculture using target words;
- cooperate in teams to analyze problems and propose simple solutions using English

Teaching methods:	***Tools/Equipment:***
- *Demonstrative Method* - *Communicative / Audio-Lingual Method* - *Cooperative Learning* - *Oral Presentation* - *Eclectic (Mixed) Approach* - *Total Physical Response (TPR)*	- *Computer* - *Projector* - *Smart board* - *Worksheets with vocabulary tasks*

Introduction activities (5 minutes):

The teacher asks the students a warm-up question:
- *"What problems can agriculture cause to the environment?"*
Students answer freely and the teacher writes key words on the board. Teacher presents the learning objectives and explains that students will learn new words related to Sustainable Agriculture and use them in real agricultural situations. Students say any English words they already know connected to sustainability (recycle, nature, water, soil, organic, etc.).

Implementation/Main Activities (30 minutes):

The teacher presents a list of 25 key vocabulary items with short definitions. Then briefly explains meaning and gives one simple example sentence. Students receive a worksheet with exercises where they complete the sentences using the correct word. The teacher monitors their work and offers help if needed. After finishing, students read their answers and correct if there are mistakes.

Problem Tree Exercise:
Students work in small groups to analyze one environmental problem related to agriculture (e.g., soil pollution). The teacher explains the exercise. The problem is written in the center of the "tree." Students identify the **causes** of the problem (roots) and the **effects/consequences** (branches), using the newly learned vocabulary.

Groups create a simple problem tree: **"Soil pollution".**

- Roots = causes (pesticides, waste, overuse of chemicals)
- Trunk = problem
- Branches = consequences (poor crops, unhealthy food, damaged environment)

Students must use at least 3 new vocabulary words. Each group briefly presents their tree and explains their ideas in simple English.

https://docs.google.com/document/d/1NI7BLP5dh5_RfQCCeTpLkt0CPRoeGAv-bm6qssTudbI/edit?usp=sharing
https://docs.google.com/document/d/1gCNwZO-o42-RVGTPZS5-0IfTpZ-ZY_w8sRGj14k5wCo/edit?usp=sharing

Conclusion/Ending Activities (10 minutes):

Each group briefly presents their tree and explains their ideas in simple English. Students say one new word they learned and its meaning. The teacher encourages students to summarize: Sustainable agriculture protects nature, soil, water and human health.

Next tasks:

Students create a mini-glossary with 10 new words:
word – definition – translation – example sentence.

Lesson Plan

1.Subject:	*English Language*	***4. Teacher:***	*Biljana Nikolovska-Prlja*
2. Topic:	*Module 3: The Wonders of Nature*	***5. Class/Year:***	*I year*
3. Lesson:	*Sustainable Agriculture - Speaking*	***6.School Year:***	*2025/26*

Learning Objectives:

Students will be able to:

- understand and use 10–12 basic words about sustainable farming (soil, water, organic, pesticide, irrigation, biodiversity, etc.);
- speak in short, clear sentences using linking words (*first, then, next, finally*);
- describe a simple process (a farmer starting sustainable farming) using the target vocabulary;
- ask and answer simple questions in pairs (e.g., *Why? How? What should he do?*);
- work in pairs/groups and share one short oral answer with the class.

Teaching methods:	***Tools/Equipment:***
- *Demonstrative Method* - *Communicative / Audio-Lingual Method* - *Cooperative Learning* - *Oral Presentation* - *Eclectic (Mixed) Approach* - *Total Physical Response (TPR)* - *Pair work and guided speaking* - *Role play*	- *Computer* - *Projector* - *Smart board* - *Slides with pictures (soil, irrigation, insects/bees, compost, farm)* - *Role cards (Farmer / Advisor)*

Introduction activities (5 minutes):

Teacher asks: *"What problems can farming cause to the environment?"* Students answer (e.g., *pollution, waste, dirty water…*). The teacher writes the key words on the board. Then the teacher asks: *"What is 'sustainable'?"* Students try a simple definition: *"Good for nature / for the future."*

Implementation/Main Activities (30 minutes):

Teacher presents 10–12 words with pictures and short definitions and example sentence for each (soil, protect, organic, pesticide, irrigation, water, save water, compost, waste, biodiversity, insects/bees, healthy food)

The teacher checks understanding with quick concept questions (either/or, yes/no):

- "Organic: chemicals or no chemicals?"
- "Irrigation: water plants or sell food?"

Teacher encourages students to give simple explanations:

- Soil is the ground for plants.
- We protect the soil.
- Organic = no chemical pesticides.

The teacher sets the context and explains: *A farmer wants to start sustainable farming.* Students are encouraged to use linking words and describe the farmer's journey using the given vocabulary:

- First, he protects the soil.
- Then, he chooses organic methods.
- Next, he uses irrigation wisely. He saves water.
- Finally, he improves biodiversity. He helps insects and plants.

The teacher monitors for correct linking words (*first/then/next/finally*) and correct use of key vocabulary and writes the sentences on the board.

Students work in pairs and get role cards.

Role A: Farmer (asks for help)

- "My soil is weak." "What should I do?"
- "The water near my farm is dirty."
- "I have a lot of waste from plants and food."

Role B: Advisor (gives tips using the vocabulary)

- "You should use compost. Compost helps the soil."
- "You should use organic methods."
- "You should make compost from waste."

Students swap roles and present in front of the class.

https://docs.google.com/document/d/1P8Q85skPE0OIGUaqtfKL91ZXD1OSrSUAuJHkY90ZBAU/edit?usp=sharing
https://docs.google.com/document/d/1HsIUg8IfGh8UgWWMy0iq70iwSMxidn4ZiVmIFdXN24c/edit?usp=sharing
https://commons.wikimedia.org/wiki/File:Mulch_shredded_yard_waste.JPG
https://commons.wikimedia.org/wiki/File:CompostBinTube_wb.jpg
https://commons.wikimedia.org/wiki/File:Drip_tubes-GAP.jpg
https://commons.wikimedia.org/wiki/File:European_honey_bee_extracts_nectar.jpg

Conclusion/Ending Activities (10 minutes):

Each student chooses a word from the list and gives short explanation and an example: (e.g., *"Irrigation—We save water."*) The teacher encourages students to summarize: *"Sustainable agriculture protects soil, water, nature, and our health."*

Next tasks:
Students write a short paragraph (80–100 words):
"Why sustainable agriculture is important for our future."

Lesson Plan

1.Subject:	Animal Hygiene and Welfare of Domestic Animals	***4. Teacher:***	*Ivica Marinkovic*
2. Topic:	Hygiene and Environmental Factors in Animal Husbandry	***5. Class/Year:***	*II year*
3. Lesson:	Utilization of Atmospheric (Rain) Water	***6.School Year:***	*2025/26*

Learning Objectives:

Students will be able to:

- Recognize the importance of water for almost all natural processes on Earth.
- Describe the significance of water for all living organisms.
- Explain whether life processes can occur without water.
- Understand the limited potential of water resources.
- Identify the main sources of water.
- Propose ways to reuse water for sustainable agriculture.
- Recognize the consequences of poor water management.
- Develop a responsible attitude toward water use and conservation.

Teaching methods:	***Tools/Equipment:***
- Guided discussion - Demonstration of good and poor practices - Direct instruction - Group work focused on proposing positive solutions	- Computer - Projector - Multimedia presentation - Images or videos showing positive and negative practices

Introduction activities:

The teacher asks the following questions:

- How much water is there on planet Earth?
- Is all water suitable for use?
- What are the main sources of water?
- Is there any biological process in the body that does not require water?

Through these questions, the teacher introduces the topic and emphasizes the essential role of water.

Implementation/Main Activities

- Explanation of key biochemical processes in living organisms and the role of water in them.
- Presentation of water supply sources and their limited availability.
- Discussion of possibilities for water reuse in different agricultural technological processes.
- Special focus on the origin, collection, and reuse of atmospheric (rain) water.
- Viewing video materials demonstrating the collection and purification of atmospheric water.

- https://www.youtube.com/watch?v=1PYj8eJZtII
- Discussion on possible uses of purified atmospheric water.
- Discussion on how these measures contribute to sustainable and environmentally friendly agricultural production.

Student Activities

- Presentation of group ideas.
- Students propose examples of where atmospheric water can be collected.
- Students suggest possible applications for reused atmospheric water.

Conclusion/Ending Activities:

Review of learned content through questions:

- How much water is there on planet Earth?
- Can all water be used?
- What sources of atmospheric water exist?
- For what purposes can atmospheric water be used?
- What are the methods of collecting atmospheric water?

The teacher and students jointly summarize the key points of the discussion.

Next tasks:

The teacher divides students into two groups:

Group 1: Research how ancient civilizations collected and purified atmospheric water and how they used it.

Group 2: Research modern innovative methods for collecting and filtering atmospheric water.

Lesson Plan

1.Subject:	Livestock Production and Nutrition of Domestic Animals	***4. Teacher:***	*Ivica Marinkovic*
2. Topic:	Construction and Interior Design of Facilities for Housing Different Categories of Cattle	***5. Class/Year:***	*II year*
3. Lesson:	Site Selection for Building Dairy Cows Housing Facilities	***6.School Year:***	*2025/26*

Learning Objectives:

Students will be able to:

- Describe the importance of site selection when building facilities for housing dairy cows.
- Identify where facilities for dairy cows can and cannot be constructed.
- Recognize the consequences of incorrect site selection on animal production.
- Identify the positive aspects of an appropriate location for building facilities.
- Identify the negative aspects of an unsuitable location and how it affects milk production.
- Explain the key criteria for site selection and the minimum requirements that must not be compromised when location options are limited.

Teaching methods:	***Tools/Equipment:***
- Guided discussion - Demonstration of good and poor practices - Direct instruction - Group work focused on proposing positive solutions	- Computer - Projector - Multimedia presentation - Images or videos showing positive and negative practices

Introduction activities:

The teacher asks the following questions:

- What factors influence milk production in dairy cows?
- Does milk production depend only on genetic inheritance, or are there other factors?
- Besides genetics and nutrition, is there a third important influence?
- Does housing have a role in milk production?
- Do polluted air, groundwater and noise affect milk quality and quantity?

The teacher introduces the topic and emphasizes that factors such as location, groundwater level, noise and air pollution are crucial in determining the suitability of a site.

Implementation/Main Activities

- Presentation of positive examples of suitable site selection.
- Special focus on the long-term consequences of incorrect site selection.
- Discussion of positive and negative effects of location on milk production in dairy cows.

Student Activities

1. Based on prior knowledge from Anatomy and Physiology of Domestic Animals, students explain the biochemical processes involved in milk production and the role of external factors in lactation.
2. Based on prior knowledge from Animal Hygiene and Welfare of Domestic Animals, students explain negative external influences on milk production, such as groundwater, air pollution, noise, and proximity to major roads, airports, and factories.

Conclusion/Ending Activities:

Review of key points through questions:

- How does improper site selection affect the environment?
- What additional investments are required to adapt facilities built at unsuitable locations?
- How is animal welfare compromised by poor site selection?
- How does it affect milk production?

The class jointly summarizes the discussion. Students propose ideas and examples of suitable locations for building dairy farms.

Next tasks:

The teacher divides students into two groups:

Group 1: Research and select images of **suitable** locations for building dairy cow facilities (positive examples).

Group 2: Research and select images of **unsuitable** locations for building dairy cow facilities (negative examples).

Lesson Plan

1.Subject	Floriculture	4.Teacher	Kristina Jovanova
2.Topic	Technologies for growing and producing flowers in protected areas/greenhouses	5.Class/ Year	III year
3.Lesson	Systems in protected areas/greenhouses	6.School year	2025/2026

Learning Objectives:
Students will be able to:

- Identify and list the main systems used in protected areas (greenhouses).
- Explain the importance of these systems for the rational use of water, energy, and soil.
- Describe the function and operation of each system.
- Explain how automated systems and digital technologies contribute to higher efficiency and lower production costs.
- Compare traditional agricultural production with precision agricultural production in protected areas, emphasizing the advantages of sustainable systems.
- Develop interest in innovative agricultural solutions and new business opportunities as part of green entrepreneurship.

Teaching methods	Tools/ Equipment
conversation and guided discussion demonstration explanation use of pictures/video/ multimedia presentation problem-based learning	PowerPoint presentation pictures/posters of greenhouses and systems Smart board/ videos of smart greenhouse systems

Introduction (5 minutes):

The teacher asks students questions about the types of protected areas in which flowering plants are grown and how these spaces are classified according to their construction and level of equipment. Students are guided to explain the meaning of elementary protected spaces and fully equipped (cultivation) protected spaces.

The teacher asks: *"What do we mean by fully equipped protected spaces?"* and introduces the new lesson unit: **Systems in Protected Areas**.

The teacher states:
"Today we will learn about systems in protected areas and their role in modern and sustainable floriculture production."

Students are encouraged to share their prior knowledge and any experiences related to systems that enable plants to grow and develop normally throughout the year.

Implementation / Main Activities (25 minutes):

The teacher reviews the concept of fully equipped protected spaces and explains why they are described as such.

A PowerPoint presentation is shown to illustrate the layout and positioning of systems within a protected space. Using the presentation, the teacher explains the systems required in a modern greenhouse for flower production:

Systems in Protected Areas:

- Irrigation system (drip irrigation)
- System for maintaining relative air humidity
- Ventilation system
- Heating system
- Shading system
- CO_2 enrichment system

Sustainable Practices in Floriculture:

- Rational use of water
- Biological pest control
- Use of organic fertilizers
- Use of solar energy

Digital and Precision Agriculture:

- Temperature and humidity sensors
- Automatic activation of irrigation
- Digital control of greenhouse ventilation systems
- Smart greenhouses

The students follow the teacher's presentation and actively participate through questions and answers. The teacher asks them to share their personal experiences.

Conclusion/ Ending Activities (10 minuts):

The teacher the following questions:

- What did we learn today?
- Why are greenhouse systems important?
- How does technology help in floriculture?

The teacher initiates a short discussion or conducts a mini quiz about the application of digital technology in agriculture. Through these activities the teacher summarizes the key concepts of the lesson.

Next tasks:

The teacher divides students into two groups:

Group 1:
Prepare a plan for establishing a fully equipped protected space within the school farm. Design the layout, internal organization, and the necessary systems for growing flowering plants.

Group 2:
Visit a company or nursery that grows flowering plants in modern greenhouses using contemporary technology. Conduct an interview with the greenhouse owner using previously prepared questions (there are numerous nurseries engaged in the production of flowering plants a In our local area). Prepare a presentation using photographs and interview responses.

Lesson Plan

1.Subject	Gardening	4.Teacher	Kristina Jovanova
2.Topic	Technologies of vegetable production in protected areas	5.Class/ Year	IV year
3.Lesson	Salad production technologies in a vertical garden	6.School year	2025/2026

Learning Objectives:
Students will be able to:

- Describe the morphological and biological characteristics of lettuce (*Lactuca sativa*).
- Explain agrotechnical measures for lettuce production.
- Explain what a vertical garden is and why it is used in lettuce production.
- Identify and describe lettuce-growing technologies (hydroponics, aquaponics, aeroponics, NFT systems).
- Explain the advantages of applying these salad production technologies in vertical gardens.
- Compare traditional agricultural production with modern precision farming systems in protected areas, emphasizing the advantages of sustainable systems.
- Develop interest in innovative agricultural solutions and new business opportunities as part of green entrepreneurship.

Teaching methods	Tools/ Equipment
- Conversation and guided discussion - Explanation and presentation - Demonstration (pictures, videos, models) - Group work - Questions and answers	- PowerPoint presentation - Video on vertical gardens and aquaponics - Images of aquaponic systems (fish + lettuce) from the school farm - Whiteboard / flipchart

Introduction (5 minutes):

The teacher asks students about their prior knowledge of lettuce production, for example:

- How is lettuce produced?
- In which period of the year is lettuce usually grown?
- What problems occur during lettuce production?
- How does water shortage affect product quality?
- How do climate changes influence the production process?
- How does lettuce production contribute to healthy nutrition?

The teacher also asks about challenges faced by vegetable producers and whether students have ideas on how these problems could be overcome, how production could be simplified, quality improved, and costs reduced.

Students are encouraged to think about new technologies and production methods that could address these challenges. The teacher then introduces the lesson topic:

"Today we will discuss salad production technologies in vertical gardens, using modern technology and sustainable practices."

Implementation / Main Activities (25 minutes):

Using a PowerPoint presentation, students learn about the morphological and biological characteristics of lettuce (*Lactuca sativa*) and agrotechnical measures applied in traditional production. The teacher then introduces modern methods of lettuce production, focusing on growing plants in vertical gardens.

Advantages of Growing Plants in Vertical Gardens:

- Efficient use of space (especially important in urban areas) and compensation for limited soil availability
- Suitable for lettuce due to its short vegetation period and shallow root system

Modern Lettuce Production Technologies:

- Hydroponics
- NFT system (Nutrient Film Technique)
- Aeroponics
- Aquaponics

When lettuce is grown in vertical gardens using these technologies, sustainable agricultural practices are applied, enabling:

- Rational water use (up to 70–90% lower consumption)
- Reduced use of pesticides
- Use of renewable energy sources (e.g., solar panels for pumps)
- Integration of plant and animal production
- Application of circular economy principles and sustainability

Digital and Precision Agriculture in Vertical Gardens:

- Sensors for moisture, pH, temperature, and light
- Automatic irrigation and nutrient dosing
- Applications for monitoring plant growth
- Cameras and software for monitoring plant health

https://www.youtube.com/watch?v=WiwHQPJ3FF4
https://www.youtube.com/shorts/ul7e72qbUFY
https://www.youtube.com/shorts/29Q7S216_-U
https://www.youtube.com/shorts/8AUaJOR0ffQ
https://www.youtube.com/watch?v=uNiSjzAgi1M

The students follow the teacher's presentation. They actively participate through questions and answers and share their personal experiences.

Conclusion/ Ending Activities (10 minutes):

The teacher asks the following questions:

- What did we learn today about the morphological and biological characteristics of lettuce?
- What are the advantages of modern lettuce production systems compared to traditional methods?
- What are the benefits of growing lettuce in vertical gardens?
- How does the aquaponics system function?

The students answer the questions and summarize the key concepts.

Next tasks:

The teacher divides students into groups and assigns tasks:

Group 1: What are the advantages of growing lettuce in a vertical garden?
Group 2: Which lettuce production technologies are applied without soil?
Group 3: What is the role of technology and sensors in lettuce production in vertical gardens?
Group 4: Research an example of vegetable production using a modern soilless system and describe the digital technologies used.

Lesson Plan

1.Subject:	Pedology	***4. Teacher:***	Rosana Mladenovska
2. Topic:	Organic part of the soil	***5. Class/Year:***	II year
3. Lesson:	Creation of Organic Matter through Composting of Agricultural Plant Residues	***6.School Year:***	2025/26

Learning Objectives:
-Students will be able to:
- Define the concept of organic matter.
- Explain the concept of composting plant residues.
- Explain how organic matter is created through composting.
- Understand the role of organic matter in soil fertility.
- Provide examples of agricultural plant residues for composting.
- Apply basic steps for proper composting.
- Evaluate the contribution of composting to sustainable agriculture and environmental protection.

Teaching methods:	***Tools/Equipment:***
-Direct instruction -Guided discussion and questioning -Team discussion -Demonstration -Group work -	-Computer -Projector -Presentation -Images or videos of composters and organic fertilizer

Introduction activities:

The teacher initiates the lesson by asking the following questions:

- What happens to plant residues after harvesting or picking?
- Can waste become a useful resource?

The teacher introduces the topic and emphasizes that composting represents one of the key principles of sustainable agriculture and the circular economy**.**

Implementation/Main Activities

- Explanation of the terms: plant residues, organic matter, compost.
- Presentation of the composting process (conditions, phases, materials).

- Demonstration / images showing proper composting of agricultural residues.

- Group work: students discuss:

- which plant residues are suitable for composting;
- how compost improves soil structure and fertility;
- how reusing waste reduces environmental pollution.
- The groups present their conclusions to the class.

- Watching videos showing examples of composting practices:
- https://www.youtube.com/watch?v=aKlauRA7ugI&list=PLJL4KbiCSQmH-DUP7ggbAVXmny16X6vUi&index=7
- https://www.youtube.com/watch?v=XOu60D6VGqc

Conclusion/Ending Activities:

- Brief review of the content covered in the lesson.
- Each student states one benefit of composting.
- The teacher summarizes by emphasizing the connection between organic matter, healthy soil, and sustainable food production.

Next tasks:

- Prepare a short list of agricultural plant residues that can be composted.
- Describe a simple composter.

Lesson plan

1. Subject :	Food hygiene and safety	***4. Teacher :***	Rosana Mladenovska
2. Topic :	Hygiene in plant production	***5. Grade/ Year:***	I year
3. Lesson :	Maintaining hygiene in greenhouses and plastic tunnels	***6. Academic year:***	2025/26

Learning objectives:
Students will be able to:
• explain the importance of hygiene in greenhouses and plastic tunnels;
• list basic hygiene measures when working in protected spaces;
• understand how good hygiene contributes to sustainable agriculture;
• identify the consequences of poor hygiene maintenance (diseases, pests, reduced yield);
• develop a responsible attitude towards the environment and safe food production.

Teaching methods:	***Tools/Equipment:***
• direct instruction • guided discussion and questioning • team discussion • demonstration • group work	• computer • projector • multimedia presentation • pictures or videos of greenhouses / plastic tunnels

Introductory activities:
The teacher initiates the lesson by asking the following questions:
• What can happen if hygiene is not maintained in a plastic tunnel?
• Why do diseases spread faster in protected spaces?
• What is the easiest way to clean a plastic tunnel?

The teacher introduces the topic and emphasizes that hygiene is a preventive measure and the foundation of sustainable agriculture.

Implementation/Main activities

Explanation of the concept of hygiene and its role in protected spaces.

Presentation of basic hygiene practices:
• cleaning and disinfection of tools;
• removal of infected plant residues;
• maintaining clean pathways and working surfaces;

• entry control (footwear, clothing);
• proper management of plant waste (composting);
• disinfection of greenhouses and plastic tunnels.

• The students actively follow the teacher's explanations, express their own opinions, provide examples, share personal experiences, and respond to the questions posed by the teacher.

Video materials:

- https://www.youtube.com/watch?v=0NNTkI_7l7E
- https://www.youtube.com/watch?v=LpDbnTnx-yA

A discussion on how these measures contribute to sustainable and environmentally friendly production, with students expressing their own opinions.

Conclusion/Final activities:

- Understanding the importance of maintaining hygiene in greenhouses and glasshouses .
- The students state one reason why hygiene is important for sustainable agriculture.
- The teacher highlights that prevention is the foundation of sustainable production.

Next tasks:

Students prepare a short list of at least 5 hygiene measures for maintaining hygiene in a greenhouse or plastic tunnel.

Lesson Plan

1.Subject:	*Sustainable development*	***4. Teacher:***	*Barbara Turk*
2. Topic:	*Eco remediation methods*	***5. Class/Year:***	*IV year*
3. Lesson:	*Hedgerows*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To define the meaning of hedgerows,*
- *To understand the benefits of hedgerows,*
- *To present the composition of hedgerows,*
- *To solve simple problems and propose solutions.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Practical work* - *"Problem tree"*	- *Computer* - *Projector* - *Plant and wild animal atlas*

Introduction activities:

In the past, hedgerows (tree barriers) were maintained between fields, which helped prevent valuable soil from being washed away. Hedgerows also have many other important ecological functions, such as retaining moisture and nutrients in the soil, preventing soil erosion, self-cleaning, and preserving biodiversity. In this regard, we must not forget that hedgerows are one of the most important habitats for many endangered and protected birds. Today, hedgerows are no longer found between fields, as farmers are subsidized based on the size of their cultivated land. Hedgerows also make it difficult for farmers to cultivate agricultural land with machinery.

Vegetation barriers consist of several types of planted plants (trees, shrubs, grasses) that require large amounts of water. With their root systems, the plants prevent pollution, e.g. from agricultural use of land or traffic, from spreading towards watercourses or water sources. Regularly growing wood biomass can serve as a source of local energy self-sufficiency, which is highly recommended in the fight against climate change due to its renewability and CO2 neutrality.

Implementation/Main Activities

Investigate hedgerow life:
Use plant and wild animal atlas to investigate plant and animal life found in hedgerows.
Teacher provides the plant and wild animal atlas and leads students to identify as many different species as they can.
Students make a note which species they found.

Scientific hedgerow study:
Compare two or more hedges. Estimate their height and width, count the number of different types of trees and shrubs in them. How many are native species? Is the hedge on an old boundary? What shape is the hedge? Tall hedges with a wide base and plenty of plant cover are best for wildlife. Narrow hedges with lots of gaps are not as good for wildlife.
While identifying the species students also observe the hedgerow and define role of it in the nature and for farming.

Conclusion/Ending Activities:

Key takeaways:
Biodiversity of hedgerows
Importance of hedgerows
Balance between farming and nature

Next tasks:

Prepare the plan for preventing damage, caused by farming, of water sources.

Lesson Plan

1.Subject:	*Sustainable development*	***4. Teacher:***	*Barbara Turk*
2. Topic:	*Invasive species*	***5. Class/Year:***	*IV year*
3. Lesson:	*Invasive species*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To define invasive species,*
- *To name three examples of invasive species that affect their local and/or regional ecology,*
- *To explain one example how invasive species cause damage to existing native ecosystems,*
- *To name two ways they can help reduce the negative impact of invasive species and prevent the introduction of native species into our ecosystems.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Practical work*	- *Computer* - *Projector* - *Atlas of invasive species*

Introduction activities:

Native Species: A species that naturally exists in an area. A native plant, for example, is a plant that has lived and evolved in a certain place for a long time (i.e. thousands of years) and is part of the natural ecosystem. Native species are adapted to local conditions, and have coevolved with other competing species, predators, diseases, climate factors and other aspects of a region, and are part of a natural, balanced system.

Non-Native but Non-Invasive Species: Not all foreign / introduced species are invasive – many ornamental plants such as roses and tulips won't survive outside of gardens. Other introduced species such as tomatoes and wheat are beneficial food resources. However, others, such as the Asian long-horned beetle and the gypsy moth, have destroyed countless hectares of forest.

Invasive Species: Invasive species are non-native species that cause economic or environmental harm, and can spread rapidly to new areas. Many people are surprised to learn that some of the plants they have in their gardens or see along roadsides or in parks are invasive. Invasive plants can move into a habitat and completely take over from the original vegetation, as they don't have the competition, predators and diseases to keep them under control. Without these controls to slow them down, these plants grow faster and bigger than the native plants they are competing with.

Invasive Plant Characteristics:
There are four main distinguishing features of invasive plants:
- ***they are usually prolific seed producers,***
- ***their seeds spread easily and effectively,***
- ***they establish and spread quickly,***
- ***they lack natural predators and diseases that keep them under control in their native locations.***

Implementation/Main Activities

Instructions:
1. Discuss the difference between native, introduced and invasive plants as a class.
2. Go on a short walk or field trip to explore native and invasive plants in your area: visit the school grounds or a nearby park or natural area. Have students work in pairs to list the number and types of plants they find, and draw or take pictures of them.
3. Have each student select one or two invasive plants from your region and make pages for a Local Invasive Plant Field Guide.
4. For each species page, have the students draw a picture of the plant and include its:
• colour
• size and shape,
• where it came from,
• where it is found,
• how it spreads around,
• how many seeds it produces a year,
• if it has any predators or pests that feed on it, and
• what native species and environments it impacts.
Also include any safety hazards that the plant might possess: e.g. if it has spines or burrs, if its sap is toxic or dangerous to touch.
5. In the field guide, include examples of what to do if you find the invasive plant species.
6. When everyone has completed their two pages, compile all the pages together into a booklet and make a Field Guide for your area.

Conclusion/Ending Activities:

Key takeaways:
Invasive species in the area
Health hazards of the invasive species

Next tasks:

Make a herbarium of invasive species



Lesson Plan

1.Subject:	*Sustainable development*	***4. Teacher:***	*Jana Goršin Fabjan*
2. Topic:	*Pollution*	***5. Class/Year:***	*IV year*
3. Lesson:	*Water pollution*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:
- *To discuss pollution,*
- *To practice using water quality tests.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Practical work*	- *Computer* - *Projector* - *Water quality tests* - *Water samples*

Introduction activities:

This lesson is a hands-on inquiry activity examining physical and chemical water quality indicators. In the first period, students will focus on substances found in water and design a table to record water quality test data. The second period will be field trip to local stream or pond to do the physical and chemical water quality testing on water in their watershed. This lesson covers quantitative testing for temperature, pH, dissolved oxygen, free chlorine, phosphates and nitrates. As well, qualitative testing for clarity/turbidity and odor is covered. The last period will have students calculate the means of their results. Students will then examine their data, dray conclusions and determine some of the human and natural processes that could have contaminated water.

Students will use a range of resources, communication skills and technologies in addressing environmental questions. Students will learn about water as a resource and the impact of different human actions and technologies on the quality of water.

Implementation/Main Activities

Procedure
1. Show students the 5 water samples and ask them some questions:
a. What can you observe by looking at these samples?
b. Which sample(s) do you think is drinkable?
c. Which sample(s) do you think would be good water for fish?
d. How could you get more information about the water samples?

2. Looking at water samples to see how clear they are is one test that scientists use to determine the health of a river habitat. But not everything that affects water can be seen with the human eye, so there are different tests that scientists perform to learn about water in a river. One of those is pH testing, which lets a scientist know how acidic or alkaline a liquid is on a scale of 0-14. Scientists have done many tests over the years and learned that in general a healthy river is around 7.4 or nearly neutral – not too acidic or alkaline. Today you will test the water samples with your tablemates and figure out which samples you would recommend as safe for fish that live in rivers.
3. Show students how to use water quality kits and record their answers.
4. Have students conduct their experiments at their table.

5. Discuss the conclusions from the experiment.
a. Explain to the students what made the different water samples more alkaline or acidic.
b. Discuss what chemical pollutants can change the pH of water in a watershed.

Conclusion/Ending Activities:

Key takeaways:
Importance of water quality
Use of water quality kits

Next tasks:

Prepare a plan to improve water quality.

Lesson Plan

1.Subject:	*Sustainable development*	***4. Teacher:***	*Jana Goršin Fabjan*
2. Topic:	*Soil health*	***5. Class/Year:***	*IV year*
3. Lesson:	*Microorganisms in soil*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To identify the role of bacteria in soil,*
- *To identify interaction between organisms in soil*
- *To grow soil bacteria on petri dish.*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion* - *Practical work*	- *Computer* - *Projector* - *Petri dish* - *Soil samples*

Introduction activities:

Soil bacteria are the most numerous (though not the largest by mass) component of the soil microbe community. They are typically 3 µm in size. Bacteria are often found adhering to soil particles via chemical bonds, and many are aquatic in that they survive in thin films of water adhering to soil particles. Some are capable of movement using one or more flagella that extend from their cell membrane. They reproduce asexually by budding or binary fission. Some bacteria only survive in aerobic conditions, some prefer aerobic conditions but can tolerate anaerobic ones, and some can only survive in anerobic conditions.

There is a wide variety of bacteria in the soil. When compared to bacteria grown in a lab culture, soil bacteria in their natural habitat are enveloped by a thick mucilaginous shell that is thought to protect them from changes in moisture, pH, and other conditions. Bacteria must be able to adapt to periods of severe lack of food or water by shifts in metabolic activity and structures such as mucilaginous shell. Some species form spores under extremely dry conditions and will return to their normal shape when moisture returns.

The type of bacteria in the soil depends on the conditions of the soil. Oxygen-deprived soils are likely to be dominated by members of the genus Clostridium. Bacteria are also more common in smaller soil pore spaces where they are protected from predation by protozoa and nematodes.

Besides their important role in decomposition, bacteria are also key to nitrogen cycling, as they are the most important soil microbe involved in fixing atmospheric nitrogen into an organic form and also, in some groups such as those in the genus Nitrosomonas, mineralizing it to an inorganic form.

Actinomycetes are a type of bacteria that are often discussed separately because of their unique shape. Rather than being rod or sphere shaped as other bacteria are, actinomycetes form long stringy, hair-like networks called hypha that reproduce asexually via spores. Their growth is similar to that of fungi but their hypha are considerably smaller. Actinomycetes decompose a wide variety of substances, many of which are difficult to break down and include chitin and cellulose. They are far more common in high pH soils and tend to be replaced by bacteria and fungi in lower pH soils. They are also more common in soils located in drier and hotter regions.

These microbes also have life history traits of wide interest to people. They are responsible for secreting many antibiotics now used in medicinal applications – such as streptomycin – which were discovered in the 1950s to be able to combat bacterial infections in humans such as strep throat. In their natural habitat, it is thought that these compounds play a role in protecting actinomycetes from predation by other soil microbes. A second interesting fact is that actinomycetes secrete an organic compound, geosmins, that contribute to the earthy smell of soil most easily noticed after a rainfall.

Implementation/Main Activities

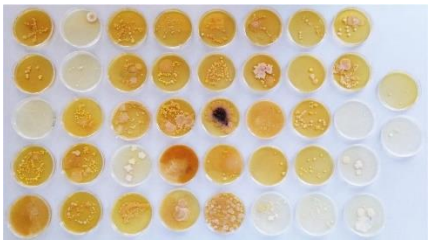
Procedure
1. Ask students where they think they will find the most microbes in the soil. Student pairs should work together to determine and record their hypothesis for the experiment.
2. Each pair of students should choose a different soil sample.
3. Review proper sterile technique and safety considerations with the students, and have them take a sample from their chosen soil and inoculate a sterile petri dish.
4. After the sterile dishes have been inoculated, they should be sealed with tape and labelled appropriately.
5. Discuss the importance of having a control sample, and have each pair of students set up a control dish for comparison using sterile water.
6. Incubate the dishes at room temperature for several days or in an incubator at 37˚ C for 1–2 days, depending on the class schedule. Do not open the dishes.
7. Have the students record their observations of the growth. They should include a drawing and descriptive information about size of colony, color, shape, etc.

Conclusion/Ending Activities:

Key takeaways:
Sterile work
Importance of microorganisms in soil

Next tasks:

Identify the microorganisms on petri dishes.



Lesson Plan

1.Subject:	*Entrepreneurship and marketing*	***4. Teacher:***	*Ana Marjanović*
2. Topic:	*Product marketing*	***5. Class/Year:***	*IV year*
3. Lesson:	*Trademarks*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able:

- *To understand Intellectual Property and its role in protecting: designs, trademarks, inventions and creative works*
-

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion*	- *Computer* - *Projector*

Introduction activities:

Teacher gives an explanation about intellectual property – patent, design, trade mark and copyright. S/he focuses on the trademark and asks the students to think of a famous trademark of different brands that they like. Teacher provides examples of past inventions as inspiration. S/he reminds the students those inventors always refine and improve their ideas as they work, and explains a patent in more detail describing how it can be used to protect new inventions from being copied. S/he explains ow its unique appearance could be protected y a registered design and how its name could be protected by a trademark.

Implementation/Main Activities

Activity Overview

In this activity, students apply their understanding of trademark law by creating an original trademark for a fictional product or business. They will design a brand identity and then ***defend its trademark strength and legality*** *using key trademark principles such as distinctiveness, consumer perception, and likelihood of confusion. This activity encourages creativity while reinforcing legal reasoning and real-world application.*

Step 1: Choose a Product or Business (5–10 minutes)

Students may work individually or in small groups. Each group selects or is assigned a fictional business or product category, such as:

- *A clothing or shoe brand*
- *A food or beverage product*
- *A tech app or digital service*
- *A sports team or entertainment brand*

Students briefly describe:

- *What the product or service is*

- *Who the target consumers are*
- *Where and how the product will be sold (local, national, online)*

Instructional Focus:
Emphasize that trademarks exist to help consumers identify the source of goods or services, so understanding the target market is essential.

Step 2: Create the Trademark (15–20 minutes)

*Each group creates at least **one primary trademark**, which may include:*

- *A brand name (word mark)*
- *A logo or symbol*
- *A slogan or tagline*

*Students sketch their trademark or describe it clearly in words. They should be reminded **not to copy or closely imitate existing brands**.*

Required Elements:

- *Brand name*
- *Visual or descriptive representation*
- *Short explanation of what the trademark communicates to consumers*

Step 3: Classify the Trademark's Strength

*Students analyze their trademark using the **distinctiveness spectrum**:*

- *Generic*
- *Descriptive*
- *Suggestive*
- *Arbitrary*
- *Fanciful*

*They must identify where their trademark falls and explain why. If it is descriptive, students should consider whether it might need **secondary meaning** to gain protection.*

Guiding Questions:

- *Does the trademark describe the product directly?*
- *Does it require imagination to understand the product?*
- *Is the word unrelated to the product's function?*

Step 4: Likelihood of Confusion Analysis

Students evaluate whether their trademark could cause confusion with existing brands.

They must explain:

- *Whether similar trademarks already exist*
- *How their trademark avoids confusing consumers*
- *Differences in name, logo, color, font, or market*

Instructor Prompt:
"What would a reasonable consumer think when seeing this trademark for the first time?"

Step 5: Defend the Trademark (Presentation or Written Defense)

Each group presents a short defense (2–3 minutes) or submits a written explanation addressing:

- *Why the trademark is distinctive*
- *Why it deserves legal protection*
- *How it helps consumers identify the source of the product*
- *How it avoids infringement*

Other students may ask questions or challenge the trademark's strength, simulating a basic legal or business review process.

Conclusion/Ending Activities:

Key takeaways:

- *Trademarks protect **brand identity**, not the product itself*
- *Strong trademarks are **distinctive and unique***
- *The main legal issue in trademark disputes is **consumer confusion***
- *Trademarks help consumers make informed choices and help businesses protect their reputation*
- *Not everything can be trademarked — generic terms belong to everyone*

Next tasks:

Prepare marketing plan.

Lesson Plan

1.Subject:	*Entrepreneurship and marketing*	***4. Teacher:***	*Ana Marjanović*
2. Topic:	*Product marketing*	***5. Class/Year:***	*IV year*
3. Lesson:	*Marketing*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able to:

- *Define marketing and explain its purpose in business*
- *Identify the core elements of marketing (needs, wants, value, exchange)*
- *Explain and apply the **4 Ps of Marketing** (Product, Price, Place, Promotion)*
- *Analyze how businesses use marketing to influence consumer behavior*
- *Create and justify a basic marketing strategy for a product or service*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion*	- *Computer* - *Projector*

Introduction activities:

1. Warm-Up: "Why Did You Buy It?"

Activity:
Ask students to think of the last product they purchased (food, clothing, app, or service).

Discussion Prompts:

- *Why did you choose that product over others?*
- *Did an ad, social media post, packaging, or recommendation influence you?*
- *Was price, brand, or convenience the main factor?*

Purpose:
Helps students realize marketing affects everyday decisions, often subconsciously.

2. Hook: Marketing Everywhere

Activity:
Show quick examples (images or descriptions) of:

- *A social media ad*
- *Product packaging*
- *Influencer endorsement*

- *Store layout*

Key Question:
"Which of these is marketing — and why?"
(Answer: All of them.)

Purpose:
Expands students' understanding of marketing beyond advertising.

Implementation/Main Activities

1. Mini-Lesson: What Is Marketing?

Instructor Input:
Explain that marketing is ***the process of identifying customer needs and delivering value*** *through products and services.*

Cover key concepts:

- *Needs vs. wants*
- *Target market*
- *Customer value*
- *Exchange*

Check for Understanding:
Ask students to give one example of a need and one want.

2. The 4 Ps in Action

Activity:
Divide students into small groups and assign each group a product (e.g., sneakers, energy drink, mobile app, fast-food restaurant).

Group Task:
Students identify:

- ***Product:*** *What is being sold?*
- ***Price:*** *Is it cheap, premium, or competitive?*
- ***Place:*** *Where is it sold?*
- ***Promotion:*** *How is it advertised?*

Purpose:
Shows how marketing decisions work together rather than in isolation.

3. Create a Simple Marketing Strategy

Activity:
Groups create a basic marketing plan for a new or imaginary product.

Required Elements:

- *Product description*
- *Target customer*
- *One decision for each of the 4 Ps*
- *Explanation of why their strategy would appeal to customers*

Presentation:
Groups briefly present their strategy to the class.

Purpose:
Encourages creativity while reinforcing strategic thinking.

Conclusion/Ending Activities:

Key takeaways:

- *Marketing is more than advertising — it's about **creating value for customers***
- *Understanding the customer is the foundation of all marketing decisions*
- *The **4 Ps** help businesses design effective marketing strategies*
- *Marketing influences what people buy, how they buy, and why they buy*
- *Successful marketing balances business goals with consumer needs*

Next tasks:

Prepare advert.

Lesson Plan

1.Subject:	*Crop production*	***4. Teacher:***	*Boštjan Punčuh*
2. Topic:	*Plant protection*	***5. Class/Year:***	*III year*
3. Lesson:	*Pest management*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able to:

- *Define plant protection and explain why it is important*
- *Identify common threats to plants (pests, diseases, weeds, environmental stress)*
- *Describe different plant protection methods (cultural, biological, mechanical, chemical)*
- *Explain the concept of **Integrated Pest Management (IPM)***
- *Apply basic plant protection strategies to real-world situations*

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion*	- *Computer* - *Projector*

Introduction activities:

1. Warm-Up: "What's Wrong With the Plant?"

Activity:
Show images (or describe scenarios) of plants with:

- *Yellowing leaves*
- *Holes in leaves*
- *Wilting or stunted growth*

Discussion Questions:

- *What do you think is happening to this plant?*
- *What could be causing the damage?*

Purpose:
Activates prior knowledge and introduces the idea that plants face many threats.

2. Hook: Why Plant Protection Matters

Activity:
Ask students:

- *What would happen if farmers couldn't protect crops?*
- *How would plant damage affect food prices, food supply, and the environment?*

Purpose:
Connects plant protection to food security, economy, and daily life.

Implementation/Main Activities

1. Mini-Lesson: What Is Plant Protection?

Instructor Input:
*Explain that plant protection involves **preventing, managing, and controlling threats** to plants to ensure healthy growth and food production.*

Cover key threats:

- *Insect pests*
- *Plant diseases (fungal, bacterial, viral)*
- *Weeds*
- *Environmental stress (drought, heat, frost)*

Check for Understanding:
Ask students to name one threat and its effect on plants.

2. Types of Plant Protection Methods

Activity:
Introduce the four main methods:

- ***Cultural:** crop rotation, proper spacing, healthy soil*
- ***Biological:** beneficial insects, natural predators*
- ***Mechanical/Physical:** traps, nets, hand removal*
- ***Chemical:** pesticides (used responsibly)*

Group Task:
Each group is given a plant problem (e.g., aphids on vegetables, weeds in a field, fungal disease on leaves).

Students decide:

- *Which protection method(s) would work best*
- *Why that method is appropriate and safe*

Purpose:
Builds problem-solving skills and awareness of sustainable practices.

3. Integrated Plant Protection Plan

Activity:
Groups design a simple plant protection plan for a garden, farm, or school greenhouse.

Required Elements:

- *The plant or crop being protected*
- *Main threats*
- *At least two protection methods*
- *Explanation of how their plan protects plants and the environment*

Presentation:
Groups briefly share their plan with the class.

Purpose:
Encourages holistic thinking and real-world application.

Conclusion/Ending Activities:

Key takeaways:

- *Plant protection helps ensure **healthy plants and a stable food supply***
- *Plants face many threats, including pests, diseases, weeds, and climate stress*
- *There are multiple plant protection methods, and not all involve chemicals*
- *Responsible plant protection balances productivity with environmental safety*
- *Everyone plays a role in protecting plants, from farmers to home gardeners*

Next tasks:

Identify possible pest / disease on the plant

Lesson Plan

1.Subject:	*Crop production*	***4. Teacher:***	*Boštjan Punčuh*
2. Topic:	*Sowing*	***5. Class/Year:***	*III year*
3. Lesson:	*Sowing*	***6.School Year:***	*2025/26*

Learning Objectives:

Students to be able to:

- Define sowing and explain its importance in plant growth
- Identify different methods of sowing seeds
- Describe the conditions needed for successful sowing
- Explain the steps involved in proper sowing
- Demonstrate correct sowing practices for seeds

Teaching methods:	***Tools/Equipment:***
- *Presentation* - *Team discussion*	- *Computer* - *Projector* - *Soil* - *Pot* - *Seeds*

Introduction activities:

1. Warm-Up: Where Do Plants Come From?

Activity:
Show students seeds of different plants (beans, corn, rice, sunflower, etc.).

Discussion Prompts:

- *What do you think this will grow into?*
- *What does a seed need to start growing?*
- *Have you ever planted a seed before?*

Purpose:
Activates curiosity and connects learning to students' experiences.

2. Hook: From Seed to Plant

Activity:
Show a simple diagram or short explanation of the plant life cycle, focusing on the seed stage.

Key Question:
"Why is sowing an important first step in growing plants?"

Purpose:
Helps students understand the role of sowing in agriculture and gardening.

Implementation/Main Activities

1. Mini-Lesson: What Is Sowing?

Instructor Input:
*Explain that sowing is **the process of planting seeds in soil so they can grow into healthy plants**.*

Cover key points:

- *Seeds must be planted at the right **depth***
- *Proper **spacing** helps plants grow well*
- *Soil should be **loose and fertile***
- *Water is needed, but not too much*

Check for Understanding:
Ask students to name one thing seeds need to grow.

2. Methods of Sowing

Activity:
Introduce common sowing methods:

- ***Broadcasting:** scattering seeds over soil*
- ***Line sowing (drilling):** seeds planted in rows*
- ***Dibbling:** placing seeds in holes*
- ***Transplanting:** moving seedlings to the field*

Group Task:
Each group matches a crop (e.g., rice, wheat, maize, vegetables) to the best sowing method and explains why.

Purpose:
Helps students understand that different plants need different sowing techniques.

3. Hands-On Sowing Activity

Activity:
Students practice sowing seeds in pots, trays, or a garden bed.

Steps:

1. *Prepare the soil*
2. *Place seeds at the correct depth*
3. *Cover lightly with soil*
4. *Water gently*

5. *Label the plant*

Safety Note:
Emphasize gentle handling of seeds and proper use of tools.

Purpose:
Builds practical skills and reinforces theoretical knowledge.

Conclusion/Ending Activities:

Key takeaways:

- *Sowing is the **first and most important step** in growing plants*
- *Different crops require different sowing methods*
- *Proper depth, spacing, soil, and water help seeds germinate*
- *Careful sowing leads to healthy plant growth and better yield*
- *Everyone can practice sowing at home or at school*

Next tasks:

Smart sowing