

SUSTAINABLE PRACTICES ACROSS SECTORS: AN IN-DEPTH LOOK AT AGRICULTURE, BREEDING, AND AQUACULTURE



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Introduction: the Importance of preserving traditions: a reflection

Every country in the world, with its unique inhabitants, forms a beautiful, distinct, and characteristic mosaic that sets it apart from all others. Each culture, each community, possesses its own customs, traditions, values, and principles. In this context, traditions are of utmost importance for people because they define the soul and identity of that group. Without traditions, a people would lack a sense of identity and recognition; the beauty of the world lies precisely in its diversity of customs and practices (Ricci, 2019). Moreover, passed down from generation to generation, traditions serve as a living testament to a culture intertwined with nature, the seasons, the cycles of life, and religious devotion.

Nevertheless, in today's rapidly evolving world, the significance of cultural traditions can often be underestimated, and we rarely understand their true



essence. This is why this report aims to revive some local traditions by first explaining why it is important to keep traditions alive.

First of all, traditions act as a living memory, preserving the essence of our cultural practices, beliefs, and experiences. Unlike written records or stories, traditions engage our senses and emotions, creating a profound connection to the past. For example, experiencing a traditional festival or ritual firsthand offers a powerful way to connect with our history, allowing us to immerse ourselves in the sights, sounds, and emotions that our ancestors experienced.

Also, traditions often become the heart of tourism, providing visitors with a genuine taste of local life through unique customs, foods, dances, and rituals. These cultural experiences attract tourists seeking meaningful and memorable encounters, allowing them to connect with the heritage of the places they visit.



Figure 1. The event dedicated to Sardinian costumes and traditional clothing exemplifies how traditions can attract tourism. The event, called "Sestos," celebrates traditional Sardinian attire in Sassari. This tradition-rich festival attracts tourists, offering them an immersive experience in the local culture through its vibrant display of traditional clothing and festivities.



In conclusion, the world's wide array of traditions makes it a rich and diverse place. Each culture's unique customs, from food to dance to religious ceremonies, add to the global tapestry of human experience (Sardegna Polis, 2019). Appreciating and preserving our own traditions does not mean we cannot respect and value those of others. In fact, embracing our cultural heritage can enhance our appreciation for the myriad ways of life around the world.

However, it is important to note that **some traditions**, especially those related to food, agriculture, or livestock, can be **harmful** to the environment. For instance, certain traditional farming practices may involve the overuse of water resources or reliance on harmful pesticides.

To address these issues, we must strive to combine the importance of traditions with environmental sustainability. For example, while preserving traditional agricultural methods, we can integrate modern, sustainable practices such as organic farming, water conservation techniques, and the use of natural pest control. In traditional livestock rearing, adopting practices that minimize environmental impact, such as rotational grazing and improved waste management, can make a significant difference.

In this report, we aim to highlight traditions from various sectors that are both culturally significant and environmentally sustainable. By doing so, we honor and preserve our cultural heritage while ensuring these practices contribute positively to our environment and society.

1. From past to future: sustainable innovations in traditional agriculture

In recent years, there has been a growing recognition of the need for sustainable agricultural practices to address the environmental challenges posed by traditional farming methods. Sustainable agriculture seeks to balance the demand for food production with the need to preserve our natural resources and ecosystems. This approach involves practices that enhance soil health, reduce



water usage, and minimize the reliance on chemical inputs such as pesticides and fertilizers. By integrating sustainability into agricultural practices, we can ensure that farming remains productive and viable for future generations while protecting the environment. In this report, we will explore various sustainable agricultural practices that are **eco-friendly** but also respect and incorporate **traditional knowledge** and methods, demonstrating how **old and new can coexist harmoniously** for the betterment of our planet.

To provide examples of sustainable agriculture that remain deeply rooted in tradition, we interviewed experts from various agricultural subsectors. In this report, we will highlight the most significant insights from these interviews. Following this, we will dedicate a specific section to sustainable agricultural practices currently documented in scientific literature. This will offer practical guidance for those who wish to continue their traditional farming practices while integrating sustainability. Our aim is to provide concrete examples and suggestions to help maintain cultural heritage in a way that also benefits the environment.



Figure 2. Professor Nello Biscotti

Starting with our first interview, we spoke with Professor **Nello Biscotti**, who introduced us to the concept of **ethnobotany** and its relationship with haute cuisine. Ethnobotany is closely linked to both sustainable agriculture and tradition because it is an interdisciplinary science that involves the use of plants within human societies, bridging botany and anthropology, and highlighting the cultural and practical significance of plants.

Recognizing the value of a plant involves understanding its properties and uses,



fostering respect and care for the environment where it grows. In this sense, ethnobotany serves as a crucial bridge between humans and nature, promoting sustainable land management and opening new perspectives for local development.

Professor Nello shared several interesting points. For instance, he emphasized how civilizations learned to use different parts of plants, such as roots, stems, leaves, and tops. For example, the **stems of wild asparagus** were traditionally harvested and consumed as a nutritious food source, providing essential vitamins and minerals. Moreover, certain wild *Asparagus* species have a long history of traditional medicinal use, with preparations ranging from medicinal infusions and decoctions to macerations, syrups, poultices, broths, or direct applications for the treatment of various health disorders (Hamdi et al., 2024).



Figure 3. *Wild asparagus*

Another example includes the leaves of **nettles**, that were used to make nutrient-rich soups (Bhusal et al., 2022), valued for their high iron and calcium content, which contributed to better overall health. Moreover, its leaves are abundant in fiber, minerals, vitamins, and antioxidant compounds. Stinging nettle has antiproliferative, anti-inflammatory, antioxidant, analgesic, anti-infectious, hypotensive, and antiulcer characteristics, as well as the ability to prevent



cardiovascular disease, in all parts of the plant (leaves, stems, roots, and seeds). The root of the stinging nettle is used to treat mictional difficulties associated with benign prostatic hyperplasia, while the leaves are used to treat arthritis, rheumatism, and allergic rhinitis (Bhusal et al., 2022). Finally, **stinging nettle** improves fish reproductive performance, making it a **cost-effective aquaculture plant**. Regarding **food**, leaves can be used to make curries, herb **soups**, and sour soups.



Figure 4. Nettles

Additionally, the tops of flowering herbs like **chamomile** were harvested for their medicinal properties and used to prepare **teas** (McKay & Blumberg, 2006) and remedies that aided in digestion and provided calming effects. Chamomile has moderate antioxidant and antimicrobial activities, and animal model studies indicate potent anti-inflammatory action, some antimutagenic and cholesterol-lowering activities, as well as anxiolytic effects (McKay & Blumberg, 2006).

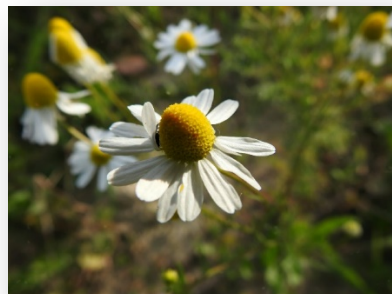


Figure 5. Chamomile



Professor Nello also noted the special role of wild herbs during periods of crisis, such as the Balkan War in Sarajevo when the city was besieged for over 50 days.

Following our interview with Professor Nello, we interviewed the chef **Domenico Cilenti**, who demonstrated how to use these sustainable herbs in cooking.



Figure 6. Chef Domenico Cilenti

Two standout preparations demonstrated how **traditional knowledge** can enhance modern culinary techniques, making a significant impact on both the palate and cultural heritage.

1. **Citrus-Marinated Fish with Wild Herbs:** the first dish was a citrus-marinated fish from Gargano (specific area of Apulia), incorporating an array of wild herbs with their unique flavors (such as bitterness and pungency) and their varying persistence on the palate.
2. **Sashimi with Vine Tendrils:** the second dish featured Puglia sashimi complemented by the use of vine tendrils (the climbing part of the



grapevine). The preparation involved an initial boiling of the tendrils followed by seasoning with ingredients such as oil, vinegar, and citrus. This method can also be applied to create a vine tendril salad, showcasing the versatility of this traditional ingredient.

Through these interviews, we understood that wild herbs can significantly enhance haute cuisine in several ways:

1. Some wild plants are rarely used, making dishes that incorporate them truly unique. For instance, a lot of people had never tasted vine tendrils before, highlighting their novelty and appeal.
2. Wild herbs were more commonly used in the past, thus incorporating them into modern dishes bridges contemporary cuisine with traditional practices. This connection enriches the dining experience with historical and cultural significance.

In addition to our insights from Professor Nello, we also interviewed **Carla** from Greccio, a small town near Rome. Carla shared her knowledge of local herbs and their use in traditional dishes. One notable example is the dish named "**Sette virtù**" (**Seven virtues**, in English). This dish is steeped in tradition and folklore.

According to some elderly residents of Teramo and Greccio, the original recipe for virtù required seven types of pasta, seven types of legumes, and seven types of vegetables and herbs, all cooked by seven housewives over seven hours. This clearly alludes to the seven virtues in Christian doctrine, which are gifts of the Holy Spirit: wisdom, understanding, counsel, fortitude, knowledge, piety, and fear of the Lord (Sorpasso MTS, 2018).

Traditionally, at the end of April, farmers and housewives would clear out their pantries in anticipation of spring. They would combine **leftovers** of various pastas, legumes, and vegetables with fresh seasonal produce, along with pork bones



and meat, to create a dish that has since become emblematic of the city. This dish symbolizes "*leaving winter behind and looking forward to spring.*"

Carla emphasizes the cultural significance of the dish, saying, "Le virtù... if you're not from here, maybe you'll never fully understand them, but you can totally appreciate it and its flavour."



Figure 7. Le sette virtù

This dish, deeply rooted in cultural heritage, showcases how **traditional practices can align with sustainable principles**. Indeed, as already mentioned, virtù is made by clearing out pantries at the end of April, using **leftovers** of various pastas, legumes, and vegetables, combined with fresh seasonal produce. This practice **minimizes food waste** and makes efficient use of available resources.

Moreover, the dish includes a variety of herbs, such as **wild fennel** and other spontaneous plants, which contribute to biodiversity. This practice supports the use of native plants and maintains traditional ecological knowledge.



1.1. Balancing heritage and environmental responsibility: evidence from scientific research

Integrating sustainable practices into traditional agricultural and culinary methods is a crucial step toward ensuring the longevity and health of our environment. Scientific research has increasingly highlighted the benefits of combining traditional knowledge with modern sustainability techniques. For example, studies have shown that practices such as the use of **organic fertilizers**—common in **many traditional farming systems**—not only significantly enhance soil health, increase biodiversity, and reduce the need for chemical inputs, but also promote the restoration of beneficial microorganisms following fumigation. Additionally, the application of organic fertilizers after fumigation has been found to strengthen the control effect on soil pathogens. For example, the use of **silicon fertilizer** and **potassium humate** has been shown to significantly increase strawberry yield, demonstrating the positive impact of these sustainable practices on crop production (Li et al., 2022). Moreover, the utilization of **wild and indigenous plants**, as emphasized in ethnobotanical studies, promotes the **conservation of local flora** and supports ecosystem stability (Khan et al., 2013).

To delve even deeper into **sustainable practices**, let us examine specific strategies that farmers can implement to enhance productivity while minimizing environmental impact:

1. **Crop Irrigation:** drip irrigation system, particularly in horticultural systems, has a high potential to **limit water inputs**, improve water use efficiency, and better match crop water demand both temporally and spatially (Wezel et al., 2014). This method significantly reduces the risk of soil salinization. However, it comes with high investment and management costs. Combining **drip irrigation** with **cover crops** can further enhance sustainability. Planting cover crops between main crops **reduces evaporation** from bare soil,



decreases soil erosion, increases soil organic matter, and enhances nitrogen concentration if legumes are used (Lopes et al., 2011; Wezel et al., 2014). Cover crops can also serve as mulch, providing additional benefits to soil health.

2. **Pest and Disease Management:** natural pesticides offer a promising agroecological alternative to synthetic pesticides, potentially mitigating the negative effects associated with chemical use (Wezel et al., 2014). Although not extensively studied for large-scale applications, natural pesticides, often referred to as botanical pesticides or botanicals, have significant potential. They include products derived from tree seeds, plant essential oils, pyrethrum from flowers, crude aqueous plant extracts, and tree extracts (Sinzogan et al., 2006). Despite their potential, the adoption of botanical pesticides faces challenges such as variable pest control efficiency, availability, regulatory constraints, and costs (Isman, 2008; Wezel et al., 2014). These pesticides are particularly relevant for the organic farming sector, where synthetic pesticides are prohibited, and for traditional agriculture in developing countries, where many of these botanicals are derived from tropical or subtropical plants native to those regions (Wezel et al., 2014; Regnault-Roger & Philogène, 2008).

3. **Conservation tillage:**

conservation tillage is a farming practice that **minimizes soil disturbance** and **maintains crop residue** on the **soil surface**. This practice contrasts with conventional tillage, where the soil is extensively turned over and crop residues are buried (EOS



Data Analytics, 2021). Here are some specific examples and detailed explanations of how conservation tillage works:



- a. No-Till Farming:** in no-till farming, seeds are directly planted into the soil without any prior soil cultivation. Specialized no-till seed drills cut a narrow slot or trench through the crop residue on the surface, place the seeds in the slot, and then close the slot back up. For example, a farmer growing soybeans can use a no-till planter to sow seeds directly into the remains of the previous corn crop. The corn stalks and leaves remain on the field, providing a protective cover. Naturally, this method reduces soil erosion by keeping the soil intact, enhances soil moisture retention by reducing evaporation, and improves soil health by maintaining organic matter and promoting earthworm activity.
- b. Strip-Till:** strip-till involves tilling narrow strips where seeds will be planted while leaving the areas between the rows undisturbed. This method combines the soil-warming benefits of conventional tillage with the erosion control benefits of no-till. For example, a corn farmer can use a strip-till machine to create 8-inch wide tilled strips while leaving the rest of the field covered with residue from the previous crop. Seeds are then planted in these strips.
- c. Mulch-Till:** in mulch-till, the entire soil surface is tilled, but crop residues are left on the surface to act as mulch. This practice involves using tools like chisel plows that do not completely invert the soil. For instance, a wheat farmer can till the soil after harvest, but instead of turning the soil over completely, a chisel plow is used to leave crop residue on the surface, which helps to reduce erosion and conserve moisture. This method reduces wind and water erosion, increases water infiltration and soil moisture retention, and enhances organic matter in the soil, improving soil structure and fertility.



4. **Agroecology:** recent agroecological practices emphasize integrating **natural or semi-natural landscape elements** such as **hedges** and **vegetation strips** within or around fields. These elements provide habitats for beneficial insects and pest predators, **reducing the need for pesticides**. They also enhance pollination, protect against erosion, and conserve biodiversity (Wezel et al., 2014). For instance, it is globally recognized that native **bee** species can enhance yield and production quality (Melathopoulos et al., 2015). Insect pollinators contribute to food production even for crops capable of self-pollination, as selfing can negatively affect yield and quality due to inbreeding (Kremen et al., 2002). Additionally, pollinators associated with hedgerow flora and wild plant patches, despite not visiting crops directly, also support agroecosystem functioning. Therefore, preserving these native species is crucial (Henríquez-Piskulich et al., 2021).



In this context, it is important to note that pesticides **reduce** the richness and abundance of pollinators and other beneficial native insects, leading to mid- and long-term declines and higher extinction rates, whether they forage in treated crops or not (Henríquez-Piskulich et al.,



2021). Pesticide residues have been detected in food items and substrates used by target and non-target insects (Botías et al., 2015). This impairs pollination services, reducing pollen collection efficiency and affecting crop yield. Native pollinators often respond differently to pesticide exposure



compared to managed pollinators like honeybees, sometimes showing greater susceptibility to **toxic effects**.

However, insects can also harbor pests, require management, and reduce cropped area. So, multi-stakeholder agreements are crucial for implementing these practices within territorial development.

5. **Cyanobacterial farming:** cyanobacteria have emerged as promising candidates for sustainable agriculture due to their ability to efficiently harvest solar energy and convert it into biomass using CO₂, water, and nutrients (Pathak et al., 2018).

Usually, scientists cultivate cyanobacteria in ponds or bioreactors. These setups involve maintaining optimal conditions like adequate light, temperature, and nutrient levels. The cyanobacteria then grow and multiply, creating biomass that can be harvested. This biomass is valuable because it enriches soil with nutrients, improving soil structure and fertility. It also helps in bioremediation, removing contaminants from soil and water. Additionally, cyanobacteria can form symbiotic relationships with other beneficial microorganisms, further enhancing soil health and crop growth.

In conclusion, cyanobacterial farming is environmentally friendly, helps reduce greenhouse gas levels, and can remove contaminants from wastewater and soil. However, its economic viability remains a **challenge** (Pathak et al., 2018).



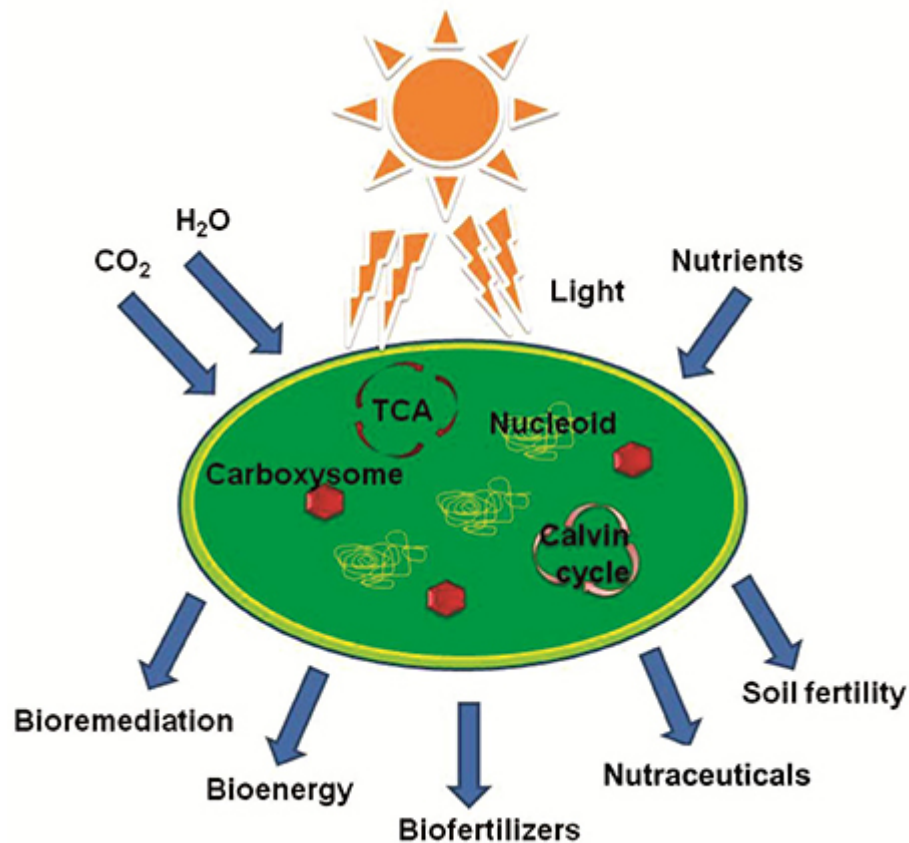
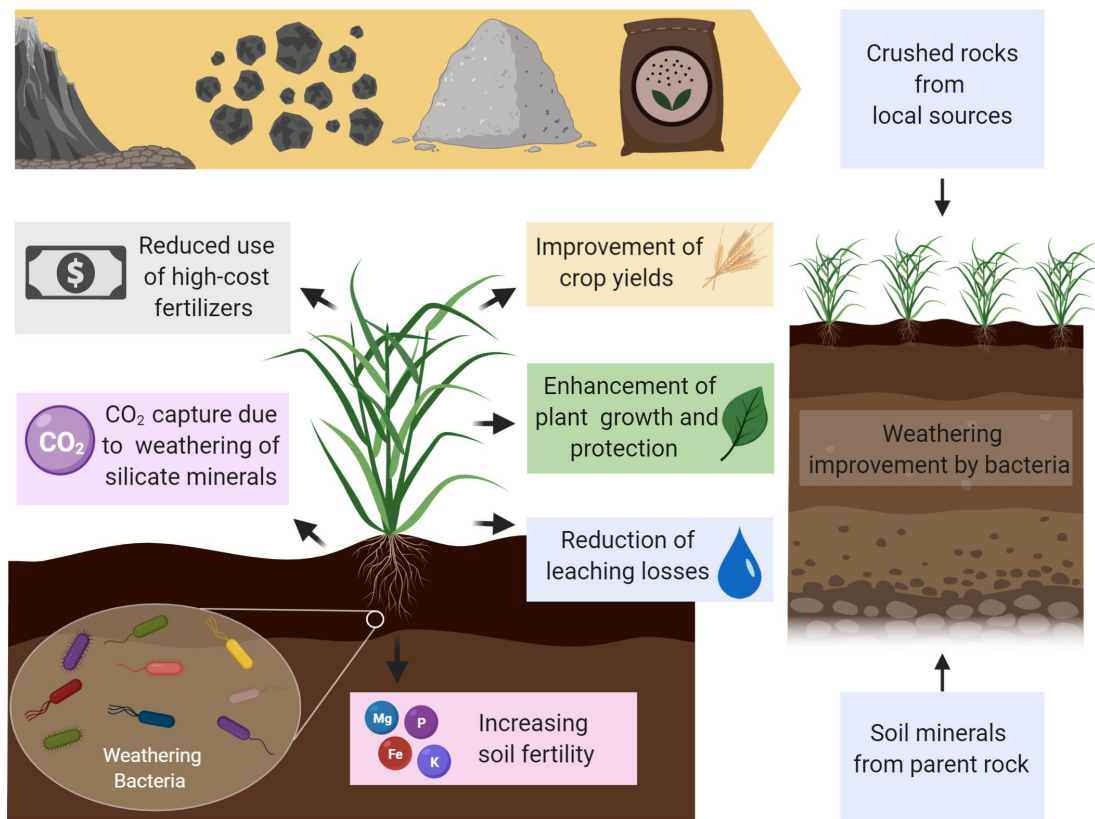


Figure 8. Various outcomes of cyanobacterial growth that can be utilized for the development of sustainable agricultural practices (Pathak et al., 2018).

6. **Bacterial fertilizers:** bacterial fertilizers are transforming traditional agriculture by leveraging specific microorganisms' ability to convert minerals into plant-available compounds, thus significantly enhancing soil fertility. These fertilizers naturally provide **nutrients** and boost soil microbial biodiversity, essential for soil health and vitality. They help create a rich, balanced environment that promotes plant growth and reduces chemical intervention needs. Additionally, bacterial fertilizers combat soil erosion and increase water retention, crucial in drought-prone or heavily farmed areas.





7. **Vermicomposting in agricultural waste management:** vermicomposting is an eco-friendly and economical technique that utilizes **earthworms**, such as *Eisenia foetida*, to manage agricultural waste by converting it into nutrient-rich compost. This process involves the decomposition of organic matter through the combined activity of earthworms and aerobic microorganisms. Agricultural wastes, including livestock residues, crop byproducts, and food processing wastes, are biodegraded efficiently, reducing their environmental impact. But let us see how vermicomposting works:



- a. Agricultural wastes such as livestock residues, crop byproducts, and food processing wastes are collected. These materials serve as the **feedstock** for the vermicomposting process.
- b. Earthworms, particularly species like *Eisenia foetida*, consume the organic waste. As they digest the material, it is broken down by both the earthworms and the aerobic microorganisms present in the waste. The earthworms' digestive process and the microbial activity transform the waste into vermicast, a nutrient-rich compost.
- c. For optimal decomposition, the temperature of the feed should be maintained between 20–35 °C, with relative humidity between 60–80%. These conditions ensure that the earthworms remain active and effective in breaking down the organic material.
- d. During decomposition, the total organic carbon (TOC) and the carbon-nitrogen (C/N) ratio of the waste decrease, while the nitrogen-phosphorus-potassium (NPK) content increases. This transformation enhances the nutritional value of the resulting compost.

The vermicast, or worm castings, produced is an excellent bio-fertilizer that improves soil fertility, structure, and water-holding capacity. It also promotes the growth of plant-growth-promoting rhizobacteria (PGPR), which further supports plant health and crop yields.

8. **Improved rice cultivation to reduce methane emissions:** rice is the nutritious staple crop for more than half of the world's people, but growing rice produces **methane**, a greenhouse gas more than 30 times as potent as carbon dioxide. Methane from rice contributes around 1.5 percent of total global greenhouse gas emissions, and could grow substantially.



So, reducing methane emissions from rice paddies is crucial for mitigating climate change. One of the most effective strategies is **Alternate Wetting and Drying (AWD)**, which involves intermittent flooding and drying of rice fields (Yagi et al., 1997). This method alters the water management practices to reduce methane emissions by introducing periods of soil aeration. Now, let us see how AWD Works:

- A. The rice field is initially flooded to support the early stages of rice growth.
- B. During the growing season, the water is periodically drained from the fields for short periods, allowing the soil to dry out and oxygen to penetrate.
- C. After a brief drying period, the field is re-flooded. This cycle is repeated several times during the growing season.



Methane (CH_4) is produced in rice paddies under anaerobic conditions by methanogenic bacteria. By periodically **draining the fields**, **AWD** introduces **aerobic conditions**, which inhibit the activity of these bacteria and thus reduce methane production (Yagi et al., 1997). Additionally, aerobic conditions favor methane oxidation by methanotrophic bacteria, further reducing methane emissions. Indeed, research by Yagi et al. (1996) demonstrated that midseason drainage could reduce methane emissions by up to 50%. Moreover, AWD uses **less water** compared to continuous flooding, which is beneficial in regions facing water scarcity. Properly managed AWD does **not** compromise rice yields and can even enhance productivity due to improved root oxygenation.



However, effective implementation of AWD requires well-prepared irrigation systems, which may not be available in all rice-growing regions. Also, there may be increased labor and costs associated with the management of intermittent irrigation practices. Finally, farmers may need training and support to adopt AWD practices effectively and they should collaborate with agricultural extension services to optimize irrigation schedules and monitor soil moisture levels. The use of simple tools like perforated field water tubes can help farmers determine the appropriate times to drain and re-flood their fields.

9. **Rewetting wetlands and peatlands: Paludiculture:** peatlands, covering about 3% of the global land area, hold approximately 500 gigatons of carbon, making them crucial for addressing environmental issues (). These ecosystems can either be carbon sinks or sources, depending on their management. Currently, about 10% of peatlands globally are **drained**, contributing significantly to greenhouse gas emissions. Rewetting these areas can substantially reduce emissions—up to **20-30 tons of CO₂** equivalents per hectare annually in temperate regions. In this context, **paludiculture** refers to the cultivation of crops or trees in wet conditions, maintaining the peatland's natural hydrology.

More specifically, paludiculture represents a sustainable and productive use of wet peatlands, effectively preventing subsidence and reducing greenhouse gas emissions. This practice involves the utilization of biomass from both naturally occurring and artificially established vegetation on rewetted peatlands (Wichtmann et al., 2016; Tanneberger et al., 2022; Lupascu et al., 2021). It sustains peat body integrity, promotes peat accumulation, and provides ecosystem services akin to those of natural peatlands. As a form of carbon farming on organic soils, paludiculture enables the harvest of above-ground biomass, particularly in temperate, subtropical, and tropical regions, without significantly impairing peat formation (Lupascu et al., 2021).



The harvested biomass has diverse applications, including food, fodder, construction materials, biofuels, industrial biochemistry, pharmaceuticals, and cosmetics (Tanneberger et al., 2022). A comprehensive list of suitable plant species for paludiculture is available in the **Database of Potential Paludiculture Plants** (DPPP) (Abel et al., 2013).

Nevertheless, implementing paludiculture necessitates interdisciplinary cooperation and practical feedback. It involves developing or adapting crops for permanently wet conditions and understanding the complex interactions under varying management practices. Pilot projects are essential for refining techniques, assessing environmental impacts, and creating product markets (Tanneberger et al., 2022). In this sense, future research should focus on both the novel use of paludiculture and the unique characteristics of rewetted lands compared to pre-drainage conditions (Kreyling et al., 2021).

10. **Seed residues in agriculture:**

agricultural residues from major crops like barley, maize, rice, soybean, sugar cane, and wheat hold significant potential as resources for energy and material production. The global production of residues from



these six crops is substantial, with North and South America, Asia, and Eastern Europe being major contributors. The theoretical energy potential of these residues is estimated at 65 EJ per year, equivalent to 15% of global primary energy consumption. The use of these residues is promoted by international policies and could play a crucial role in meeting future energy demands and reducing reliance on fossil fuels, especially as global population and energy needs rise (Bentsen et al., 2014). Moreover, utilizing agricultural residues for



energy and material production is sustainable for several reasons. First of all, instead of burning or discarding residues, they are repurposed, reducing waste. Also, agricultural residues are continuously generated with each crop cycle, providing a steady supply of biomass. Finally, when residues are returned to the soil as compost, they improve soil fertility and structure (Fu et al., 2021).

By integrating these scientifically-backed sustainable practices, we can maintain the cultural significance of traditional methods while addressing contemporary environmental challenges. Moreover, this approach also ensures food security and promotes healthier ecosystems for future generations.

2. Sustainable... (choose a title) -> TURKEY

2.1. Sustainable...

3. Sustainable... (choose a title) -> DENMARK

3.1. Sustainable...



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