

7. Millets: The Eco-Friendly Crops

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Abstract:

Millets are a group of small-seeded grasses that have been cultivated for thousands of years as food crops. Millets are classified into major and minor types. A few examples of commonly cultivated millets are pearl millet, finger millet, foxtail millet, proso millet, little millet, kodo millet, barnyard millet and sorghum. Millets, like sorghum, often use the C4 photosynthesis pathway, which is more efficient in utilizing water compared to the C3 pathway used by some other plants. This contributes to their water-use efficiency. These millets contribute to food security, especially in regions with challenging growing conditions, and they offer nutritional diversity in diets. Their cultivation supports sustainable and resilient agricultural practices. Millets are considered eco-friendly crops because of their certain characteristics, such as drought resistance, low resource input, biodiversity support, adaptability, reduced greenhouse gas emissions, nutrient-rich and health benefits, soil conservation, crop rotation and pest management and small farm-friendly. The adaptability of millets to diverse climatic conditions enhances the overall resilience of the farming system. Encouraging the cultivation and consumption of millets can contribute to more sustainable and eco-friendly agricultural systems, promoting environmental conservation and resilience in the face of changing climate conditions.

Keywords:

Millets, eco-friendly, drought resistance, water efficiency, biodiversity, carbon sequestration.

7.1 Introduction:

The United Nations General Assembly declared 2023 to be the International Year of Millets. Millets are a group of small-seeded grasses that have been cultivated for thousands of years as food crops.

Millets: Reservoir of Nutrients

The ability of millets to grow in poor, degraded soils can also provide land cover in arid areas, reducing soil degradation and supporting biodiversity. Millets are versatile, need 70% less water than rice to grow, take half as long to mature as wheat, and use 40% less energy to process.

They offer a comprehensive answer for sustained food security in the face of drought, water shortage, and climate change.

Millets are classified into major and minor types, and here are some examples:

**** Pearl Millet (*Pennisetum glaucum*):** - Also known as Bajra, it is a widely cultivated millet in Africa and the Indian subcontinent. It is rich in protein, fiber, and essential nutrients.

**** Finger Millet (*Eleusine coracana*):** - Commonly known as Ragi or Nachni, finger millet is a staple in parts of Africa and Asia. It is rich in calcium, iron, and amino acids.

**** Foxtail Millet (*Setaria italica*):** - Known as Kangni or Korra. Foxtail millet is cultivated in Asia and Africa. It is high in fiber and rich in minerals like iron and copper.

**** Proso Millet (*Panicum miliaceum*):** - Also called Common Millet or White Millet, it is grown in many parts of the world, including Asia, Europe, and North America. It has a short growing season and is used for both human consumption and animal feed.

**** Little Millet (*Panicum sumatrense*):** - Known as Kutki or Saame, little millet is cultivated in India and Southeast Asia. It is a good source of minerals like iron and phosphorus.

****Kodo Millet (*Paspalum scrobiculatum*):**- Commonly known as Kodra or Varagu, kodo millet, is cultivated in India. It is rich in fiber and has a low glycemic index.

**** Barnyard Millet (*Echinochloa crus-galli*):** - Also known as Sanwa or Jhangora, barnyard millet is grown in Asia. It is rich in iron and has a nutrient profile similar to rice.

**** Sorghum (Sorghum bicolor):** - Although sorghum is often considered separately, it is sometimes classified as a type of millet. It is a major cereal crop used for food, fodder, and biofuel. It comes in different varieties, including grain sorghum and sweet sorghum.

These millets contribute to food security, especially in regions with challenging growing conditions, and they offer nutritional diversity in diets. Their cultivation supports sustainable and resilient agricultural practices.

Millets are considered eco-friendly crops for several reasons:

7.2 Drought Resistance:

Millets are renowned for their exceptional drought resistance properties, making them well-suited for cultivation in arid and semi-arid regions. Here are key factors contributing to their drought resilience:

****Low Water Requirements: ****

- Millets generally require significantly less water compared to major cereal crops like rice and wheat. They can thrive in conditions with limited water availability.

****Adaptability to Harsh Environments: ****

- Millets have evolved to adapt to diverse climates, including regions with unpredictable rainfall patterns and extended periods of drought. Their hardiness allows them to withstand challenging environmental conditions.

****Deep Root Systems: ****

- Many millet varieties have deep root systems that enable them to access water stored deeper in the soil. This trait enhances their ability to endure dry spells and drought conditions.

****Short Growing Periods: ****

- Some millet varieties have relatively short growing seasons, allowing them to complete their life cycle and produce grains before the onset of severe drought. This adaptability helps in maximizing water-use efficiency.

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****C4 Photosynthesis Pathway: ****

- Millets, like sorghum, often use the C4 photosynthesis pathway, which is more efficient in utilizing water compared to the C3 pathway used by some other plants. This contributes to their water-use efficiency.

****Heat Tolerance: ****

- Millets exhibit good tolerance to high temperatures associated with arid climates. They can continue photosynthesizing even in conditions that might stress other crops.

****Resilience to Pests and Diseases: ****

- In certain cases, millets demonstrate resistance to pests and diseases, reducing the likelihood of crop losses during periods of water scarcity.

The combination of these traits makes millets a valuable crop for regions facing water challenges, contributing to sustainable agriculture and food production in the face of changing climate conditions.

7.3 Low Resource Input:

Millets are generally hardy and resilient, requiring fewer chemical inputs such as fertilizers and pesticides.

This leads to lower environmental impact compared to more resource-intensive crops. Here are some aspects of millet cultivation that demonstrate low resource requirements:

****Water Efficiency: ****

- Millets generally have lower water requirements compared to major cereal crops like rice and wheat. They can grow well in semi-arid and arid regions with limited water availability.

****Adaptability to Marginal Soils: ****

- Millets are well-suited for cultivation in soils that may be considered marginal for other crops. They can grow in less fertile soils and do not require high-quality land.

****Minimal Fertilizer Needs: ****

- Millets often have lower fertilizer requirements compared to some other crops. They can thrive with minimal chemical inputs, reducing the environmental impact associated with fertilizer use.

****Pest and Disease Resistance: ****

- Certain millet varieties exhibit natural resistance to pests and diseases, reducing the need for chemical pesticides. This contributes to lower input costs and promotes environmentally friendly farming practices.

****Short Growing Seasons: ****

- Many millet varieties have relatively short growing seasons, allowing for quicker crop cycles. This short duration reduces the overall resource inputs required for cultivation.

****Rainfed Agriculture: ****

- Millets are often grown in rainfed conditions, relying on natural rainfall rather than extensive irrigation systems. This characteristic contributes to their low resource input nature.

****Crop Diversity and Rotation: ****

- Introducing millets into crop rotations can enhance soil health and reduce the need for excessive external inputs. Their inclusion in diverse cropping systems promotes sustainable agricultural practices. The low resource input requirements of millet cultivation align with principles of sustainable agriculture, making them an attractive option for regions facing resource constraints or where sustainable farming practices are a priority

7.4 Biodiversity Support:

Growing millets contributes to agricultural biodiversity. The cultivation of diverse crops helps maintain a balanced ecosystem and can be beneficial for soil health. Millets contribute positively to biodiversity through various mechanisms associated with their cultivation. Here's how millets support biodiversity:

****Crop Diversity: ****

- The cultivation of millets adds diversity to cropping systems. Biodiversity is essential for maintaining healthy ecosystems and preventing the dominance of a single crop, which can lead to imbalances in the environment.

****Resilience to Pests and Diseases: ****

- Some millet varieties exhibit natural resistance to pests and diseases. By cultivating these varieties, farmers can reduce reliance on chemical pesticides, which helps maintain a more balanced and diverse population of insects and microorganisms in the ecosystem.

****Support for Pollinators: ****

- Millet crops, like other cereals, rely on pollinators such as bees and butterflies for fertilization. The cultivation of millets provides a food source for these pollinators, contributing to the overall health of pollinator populations.

****Soil Health Improvement: ****

- Introducing millets into crop rotations can improve soil health. Different crops have different nutrient requirements and contribute diverse organic matter to the soil, promoting a balanced microbial community and supporting overall soil biodiversity.

****Wildlife Habitat Preservation: ****

- Millet fields, especially when part of a diverse agricultural landscape, can serve as habitats for various wildlife species. This helps preserve biodiversity by providing suitable environments for birds, insects, and other organisms.

****Traditional Landraces and Local Varieties: ****

- Millet cultivation often involves the use of traditional landraces and locally adapted varieties.

The preservation and cultivation of these varieties contribute to the conservation of agricultural biodiversity.

****Climate Resilience: ****

- The adaptability of millets to diverse climates enhances overall ecosystem resilience to climate change. Maintaining a variety of crops that can thrive under different conditions supports biodiversity in the face of environmental challenges.

****Promotion of Agro ecological Practices: ****

- Millet cultivation is often associated with agroecological practices, which emphasize ecological principles in agriculture. These practices promote biodiversity by mimicking natural ecosystems and reducing reliance on external inputs.

In summary, the cultivation of millets supports biodiversity by promoting crop diversity, contributing to pollinator health, improving soil health, preserving wildlife habitats, and maintaining traditional agricultural practices.

Integrating millets into agricultural systems can contribute to more sustainable and biodiverse farming landscapes.

7.5 Adaptability:

Millets are versatile and can adapt to various agro-climatic conditions. Their adaptability makes them suitable for cultivation in diverse regions, contributing to agricultural sustainability.

Millets are renowned for their adaptability to diverse environmental conditions, and their cultivation is associated with several characteristics that contribute to this adaptability:

****Climate Resilience: ****

- Millets are well-suited for cultivation in a range of climates, including arid and semi-arid regions. They can withstand high temperatures and are adapted to regions with erratic rainfall patterns.

****Drought Tolerance: ****

- One of the key adaptability traits of millets is their ability to thrive in conditions of water scarcity. They have evolved mechanisms to cope with drought stress, making them valuable crops in regions prone to water shortages.

**** Low Water Requirements: ****

- Millets generally require less water compared to major cereal crops like rice. Their ability to perform well with limited irrigation makes them suitable for rainfed agriculture.

**** Short Growing Seasons: ****

- Many millet varieties have relatively short growing periods, allowing them to complete their life cycle quickly.

This adaptability enables farmers to adjust planting times based on the local climate and precipitation patterns.

****Soil Tolerance: ****

- Millets can grow in a variety of soil types, including soils that may be considered less fertile or marginal for other crops. This adaptability makes them suitable for cultivation in diverse agroecological zones.

****Pest and Disease Resistance: ****

- Some millet varieties exhibit natural resistance to pests and diseases. This resistance reduces the dependency on chemical inputs, contributing to the adaptability of millet cultivation to varying ecological conditions.

****C4 Photosynthesis Pathway: ****

- Many millets, including sorghum, use the C4 photosynthesis pathway. This pathway is more efficient in utilizing carbon dioxide, particularly in conditions of high temperature and water stress, contributing to the adaptability of millets in challenging climates.

****Local Varietal Diversity: ****

- The existence of diverse millet varieties and landraces adapted to specific local conditions enhances the overall adaptability of millet cultivation.

Farmers often select and cultivate varieties that perform well in their particular environment.

****Versatility in End Use: ****

- Millets have diverse end uses, ranging from staple food to fodder and from brewing to biofuel. This versatility allows for varied cultivation practices based on local needs and preferences.

The adaptability characteristics of millets make them valuable crops for regions facing climate variability, water scarcity, and other environmental challenges. They contribute to sustainable agriculture by providing a resilient and resource-efficient option for farmers in diverse agroecosystems.

7.6 Reduced Greenhouse Gas Emissions:

The cultivation of millets often involves lower greenhouse gas emissions compared to some conventional crops. Their lower reliance on synthetic inputs can contribute to mitigating climate change impacts.

Millet's cultivation can contribute to reduced greenhouse gas (GHG) effects and mitigate the environmental impact associated with traditional agriculture. Here's how millets play a role in this context:

****Low Methane Emissions: ****

Unlike rice cultivation, which is a significant source of methane emissions, millets generally produce lower methane levels. Reduced methane emissions contribute to lower overall greenhouse gas effects, as methane is a potent greenhouse gas.

****Water Use Efficiency: ****

Millets often have better water use efficiency compared to water-intensive crops like rice. The reduced need for irrigation in millet cultivation results in lower energy consumption and decreases the carbon footprint associated with pumping and distributing water.

****Limited Nitrous Oxide Emissions: ****

Millets generally require fewer nitrogen-based fertilizers compared to other major cereals. This helps limit nitrous oxide emissions, another potent greenhouse gas associated with the use of synthetic fertilizers.

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****Minimal Tillage Practices: ****

Some millet cultivation practices involve minimal or no tillage. Reduced tillage helps preserve soil structure and organic matter, contributing to carbon sequestration in the soil and mitigating the release of greenhouse gases associated with intensive tillage.

****Drought Resistance: ****

Millets' ability to thrive in water-stressed conditions reduces the need for irrigation and contributes to climate-resilient agriculture.

This resilience helps mitigate the environmental impact of water scarcity and its associated energy-intensive irrigation practices.

****Promotion of Agro ecological Practices: ****

Millets are often well-suited to diverse agro ecosystems. Integrating millets into agro ecological farming systems promotes sustainable and environmentally friendly practices, reducing the reliance on synthetic inputs and minimizing environmental pollution.

While individual practices and conditions may vary, the overall characteristics of millet cultivation make them a potentially eco-friendly and climate-resilient choice, contributing to efforts to reduce greenhouse gas effects in agriculture.

7.7 Nutrient-Rich and Health Benefits:

Millets are rich in nutrients and have health benefits. Promoting their cultivation can lead to diverse and nutritious diets, reducing dependency on resource-intensive crops for food security.

Millets offer various nutritional and health benefits, making them a valuable addition to diets. Here are some key advantages:

****Rich in Nutrients: ****

- Millets are good sources of essential nutrients such as vitamins, minerals (iron, magnesium, phosphorus), and antioxidants. They contribute to overall nutritional well-being.

****High in Fiber: ****

- Millets, especially whole grains, are rich in dietary fiber. Fiber aids in digestion, helps maintain a healthy weight, and supports heart health by managing cholesterol levels.

****Gluten-Free: ****

- Most millets are naturally gluten-free, making them suitable for individuals with gluten sensitivity or celiac disease.

They provide a safe alternative to gluten-containing grains like wheat, barley, and rye.

****Low Glycemic Index: ****

- Millets generally have a lower glycemic index compared to some other grains.

This means they cause a slower and steadier increase in blood sugar levels, which can be beneficial for individuals with diabetes and for weight management.

****Protein Content: ****

- Millets contain proteins with a good balance of amino acids. While they may not provide complete proteins on their own, combining millets with other protein sources can contribute to a well-rounded protein intake.

****Heart Health: ****

- The fiber, antioxidants, and other nutrients in millets are associated with cardiovascular health. They can help lower cholesterol levels, regulate blood pressure, and reduce the risk of heart disease.

****Weight Management: ****

- The fiber content in millets promotes a feeling of fullness, aiding in weight management by reducing overall calorie intake. Additionally, the lower glycemic index can help control appetite.

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****Management of Diabetes: ****

- Millets' low glycemic index and fiber content contribute to better blood sugar control, making them suitable for individuals with diabetes.

****Antioxidant Properties: ****

- Millets contain antioxidants such as phenolic compounds, which help combat oxidative stress in the body.

Antioxidants play a role in reducing inflammation and lowering the risk of chronic diseases.

****Bone Health: ****

- Millets, particularly finger millet (ragi), are good sources of calcium and other minerals essential for bone health. Including millets in the diet can contribute to maintaining strong and healthy bones.

****Digestive Health: ****

- The fiber in millets supports digestive health by preventing constipation and promoting a healthy gut microbiome.

Incorporating a variety of millets into your diet can offer a range of nutritional benefits and contribute to a well-balanced and diverse eating pattern.

7.8 Soil Conservation:

Certain millet varieties have deep root systems, which can help prevent soil erosion and **contribute to soil conservation.**

Millet's cultivation can contribute to soil conservation through various mechanisms, promoting sustainable agricultural practices. Here's how millets benefit soil health and conservation:

****Erosion Control: ****

- The root systems of many millet varieties help bind soil particles together, reducing soil erosion. This is especially valuable in regions prone to wind or water erosion.

**** Water-Use Efficiency: ****

- Millets are known for their ability to thrive in semi-arid and arid conditions with limited water resources. Their efficient use of water helps in maintaining soil moisture and reduces the need for extensive irrigation, contributing to water conservation.

**** Drought Tolerance: ****

- Millets are adapted to withstand drought conditions. In areas facing water scarcity, cultivating millets can be a sustainable option, as they can survive with minimal water inputs.

****Biodiversity Support: ****

- Integrating millets into diverse cropping systems enhances overall agroecosystem biodiversity.

Different crops contribute to a more varied and resilient ecosystem, reducing the risk of pests and diseases and supporting beneficial organisms in the soil.

****Nutrient Cycling: ****

- Millet crops, particularly when grown in rotation with other crops, contribute to nutrient cycling. This helps maintain soil fertility and reduces the need for external inputs like synthetic fertilizers, promoting sustainable soil management.

****Cover Crop Benefits: ****

- In certain contexts, millets can be used as cover crops during fallow periods. Cover crops protect the soil from erosion, improve soil structure, and contribute organic matter when incorporated into the soil.

****Reduced Need for Agrochemicals: ****

- Millets often have lower susceptibility to pests and diseases compared to some other crops.

This reduces the need for chemical pesticides, minimizing the environmental impact on soil health.

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****Carbon Sequestration: ****

- Practices such as intercropping or incorporating millets into agroforestry systems can contribute to carbon sequestration. This helps mitigate climate change by capturing and storing carbon in the soil.

****Resilience to Climate Change: ****

- The adaptability of millets to diverse climatic conditions, including heat and drought, enhances soil resilience to the impacts of climate change. Millets can continue to provide yields in conditions that may be challenging for other crops.

****Preservation of Indigenous Agro ecosystems: ****

- Traditional millet cultivation practices, including mixed cropping and agroforestry, have often been part of indigenous agricultural systems. Preserving and promoting these practices contribute to sustainable soil management. By incorporating millets into farming systems, adopting agroecological practices, and promoting sustainable soil management, farmers can contribute to soil conservation and long-term agricultural sustainability.

7.9 Crop Rotation and Pest Management:

Including millets in crop rotation can disrupt pest cycles, reducing the need for chemical pesticides and promoting natural pest control methods. Millet's cultivation plays a significant role in crop rotation strategies, contributing to effective pest management and sustainable agricultural practices. Here's how crop rotation involving millets can benefit pest management:

****Disruption of Pest Cycles: ****

- Crop rotation, which involves planting different crops in sequential seasons, disrupts the life cycles of pests. Millets, being part of a diverse rotation, can break the cycle of pests that specifically target certain crops.

****Reduction in Pest Buildup: ****

- Planting millets after other crops in the rotation helps reduce the buildup of pests that may have developed a preference for those crops. This can lower the overall pest pressure on the farm.

****Species-Specific Pest Control: ****

- Different crops attract different pests. By rotating crops, farmers can discourage the proliferation of pests that are specific to a particular crop. Millets, with their distinct characteristics, may not be as susceptible to certain pests as other crops.

****Beneficial Insect Promotion: ****

- Crop rotation supports the presence of beneficial insects, such as natural predators and parasites of pests.

A diverse cropping system, including millets, provides a more balanced ecosystem that can naturally regulate pest populations.

****Weed Control: ****

- Crop rotation can also help in managing weed populations. Millets, with their competitive growth and ability to suppress weeds, contribute to effective weed control when included in the rotation.

****Disease Management: ****

- Some diseases are specific to certain crops.

By rotating crops, especially with disease-resistant crops like millets, farmers can reduce the risk of disease buildup in the soil.

****Nutrient Cycling and Soil Health: ****

- Crop rotation, including millets, contributes to nutrient cycling and improved soil health. Healthy soils support strong and resilient crops that are better equipped to withstand pest and disease pressures.

****Reduced Dependency on Chemical Pesticides: ****

- By integrating millets into crop rotations, farmers can reduce the reliance on chemical pesticides.

This aligns with sustainable farming practices, minimizing the environmental impact of pest control methods.

****Resilience to Climate Variability: ****

- The adaptability of millets to diverse climatic conditions enhances the overall resilience of the farming system. This resilience can contribute to effective pest management in the face of climate variability.

Crop rotation strategies, which often involve the cultivation of millets, are essential components of integrated pest management (IPM) systems. These practices contribute to more sustainable and environmentally friendly agricultural systems by reducing the need for chemical inputs and promoting a balanced ecosystem.

7.10 Small Farm-Friendly:

Millets are often suitable for small-scale farming, empowering local communities and supporting sustainable agricultural practices. Indeed, millets cultivation is well-suited for small farms. Millets are hardy, drought-resistant, and adaptable to various soil types. They typically require fewer inputs like water and fertilizers compared to major crops, making them a sustainable choice for small-scale agriculture. Additionally, millets are nutritious and contribute to crop diversity, enhancing the resilience of small farm systems.

7.11 Conclusion:

Millets are hardy, drought-resistant, and adaptable to various soil types. They typically require fewer inputs like water and fertilizers compared to major crops, making them a sustainable choice for small-scale agriculture.

Integrating millets into agricultural systems can contribute to more sustainable and biodiverse farming landscapes. Millet's cultivation can contribute to reduced greenhouse gas (GHG) effects and mitigate the environmental impact associated with traditional agriculture.

Unlike rice cultivation, which is a significant source of methane emissions, millets generally produce lower methane levels. Reduced methane emissions contribute to lower overall greenhouse gas effects, as methane is a potent greenhouse gas.

Encouraging the cultivation and consumption of millets can contribute to more sustainable and eco-friendly agricultural systems, promoting environmental conservation and resilience in the face of changing climate conditions.

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