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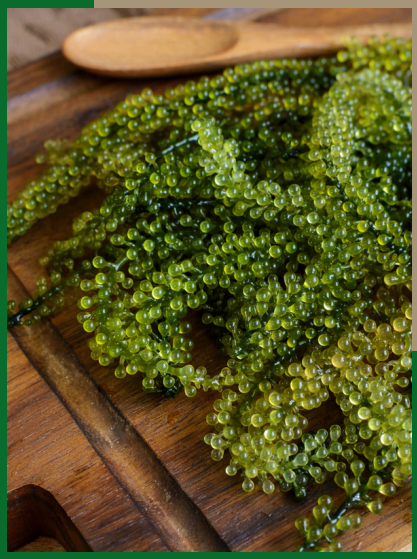

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It gives me immense pleasure to present the inaugural issue of Agri UptoDate (January 2026)—a humble yet determined step toward bridging the gap between agricultural research, innovation, and real-world practice. This first volume reflects our core vision: to make credible, research-backed agricultural knowledge accessible to students, researchers, entrepreneurs, and farming communities alike.

Editor's Note

The current issue brings together a diverse range of themes that are highly relevant in today's rapidly transforming agri-ecosystem. Articles such as "Climate Change Impacts on Vegetable Crops" highlight the pressing challenges faced by production systems, while "Impact of Digitalization on Agriculture and Agripreneurship: A Research-Oriented Perspective" showcases how technology, innovation, and entrepreneurship are reshaping the future of agriculture. Practical and emerging areas such as Mushroom Farming, Lawn Establishment, and Maintenance provide practical value for readers seeking enterprise and livelihood opportunities. The inclusion of Service-Based Startups further expands the discussion beyond conventional farming, reflecting the growing importance of agri-services and knowledge-driven enterprises.

This issue is the result of sincere contributions from researchers, academicians, and young professionals, and I extend my heartfelt gratitude to all authors for sharing their insights and expertise. I also thank our readers for placing their trust in this new initiative.

We hope Agri UptoDate will evolve into a reliable platform for knowledge exchange, critical thinking, and innovation in agriculture. Your feedback, suggestions, and continued support will be crucial in shaping future issues.
Happy reading and learning.

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Editor-in-Chief

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IMPACT OF CLIMATE CHANGE ON AGRICULTURE AND STRATEGIES FOR ADAPTATION

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Climate change has become one of the most serious global concerns for the 21st century. Climate change involves changes in temperature, rainfall patterns, and the occurrence of extreme weather conditions over a long period. These changes are caused by an increase in the concentration of greenhouse gases. Climate change is an important issue when viewed from an agricultural perspective. This is because agriculture is highly sensitive to climatic conditions. Changes in temperature, rainfall, and seasonal patterns will affect agriculture.

Agriculture has two-fold implications for climate change. It is highly vulnerable to climate change, and at the same time it contributes to greenhouse gas emissions. The use of chemical fertilizers, methane production from livestock, rice cultivation, and land use changes are major contributors to greenhouse gas emissions. According to the Intergovernmental Panel on Climate Change (IPCC), "the combined impact of agriculture, forestry, and land use changes contributes to a significant portion of the total global emissions of greenhouse gases." Hence, climate change in the context of agriculture is important for environmental sustainability and food security.

One of the impacts of climate change on agriculture is the effect of temperature changes. Changes in temperature may increase crop production by accelerating growth. However, it may also lead to reduced crop cycles, thereby affecting yields. High temperatures, especially during the flowering stage of crops such as wheat and rice, may reduce crop productivity. For instance, sterility of crops may occur as a result of heat stress, thereby affecting the level of yields. In regions such as northern India, changes in temperature have already started to affect the productivity of crops such as wheat and rabi crops.

Variability in rainfall is another important impact of climate change that affects agricultural activities. There are changes in the patterns of monsoon rains, which sometimes result in droughts in certain regions and floods in others. Inconsistent rainfall also affects sowing schedules, irrigation practices, and practices in general. Farmers who are entirely dependent on rainfall are at greater risk due to the unpredictable rainfall patterns. Besides, extreme weather conditions like cyclones, hailstorms, and floods are becoming more common, resulting in huge losses to agricultural activities.

Climate change may also impact the quality of the soil. Global warming may result in high rates of evaporation, which may decrease the moisture levels of the soil. Consequently, this may lead to the degradation of the soil. In addition, the change in the climate may impact the spread of diseases. Global warming may lead to high temperatures, which may result in the spread of some pests. Consequently, the use of more pesticides may be required, which may increase the cost of production.

Among the crops that are more sensitive to climatic changes are horticulture crops and fruit production. Climatic changes may affect the quality of fruits. Crops like kinnow, guava, and fruit crops may face problems like fruit drop, decrease in fruit size, and quality decline under extreme climatic conditions. For fruit cultivation farmers, climatic conditions may cause a decrease in their earnings and increase the risks of production.

Solutions to Climate Change in Agriculture

Climate change poses serious challenges to agriculture, but several solutions and strategies can help reduce its negative impacts and improve the resilience of farming systems.

1. Development of Climate-Resilient Crop Varieties

Scientists and agricultural institutions are developing crop varieties that can tolerate drought, heat, floods, and pests. These improved varieties help maintain productivity even under changing climatic conditions.

2. Efficient Water Management

Water conservation techniques such as drip irrigation, sprinkler irrigation, rainwater harvesting, and watershed management help farmers use water efficiently and reduce wastage. These practices are especially important in drought-prone areas.

3. Crop Diversification

Growing multiple crops instead of relying on a single crop reduces risk. Farmers can adopt mixed cropping, intercropping, and crop rotation to maintain soil fertility and reduce climate-related losses.

4. Conservation Agriculture

Practices like minimum tillage, crop residue management, and soil cover help conserve soil moisture, reduce soil erosion, and improve soil health. These practices also help store carbon in the soil.

5. Agroforestry

Integrating trees with crops and livestock systems helps improve biodiversity, enhance soil fertility, and reduce the impact of extreme weather conditions. Trees also help absorb carbon dioxide from the atmosphere.

6. Climate-Smart Agriculture

Organizations like the Food and Agriculture Organization promote climate-smart agriculture, which focuses on increasing agricultural productivity, adapting to climate change, and reducing greenhouse gas emissions.

7. Improved Pest and Disease Management

Using integrated pest management (IPM), biological control methods, and resistant crop varieties can reduce pest outbreaks that may increase due to climate change.

8. Strengthening Weather Forecasting and Early Warning Systems

Accurate weather forecasting helps farmers make better decisions about sowing, irrigation, and harvesting. Institutions like the Indian Meteorological Department provide weather information and advisories to farmers.

9. Government Policies and Support

Government programs such as crop insurance, subsidies for irrigation equipment, and climate-resilient agricultural programs help farmers cope with climate risks.

10. Farmer Awareness and Training

Providing education, training, and extension services to farmers helps them adopt sustainable farming practices and adapt to climate change effectively.

Conclusion

Climate change poses a major problem for agriculture by affecting crop production, water resources, soil conditions, and pests. Since agriculture forms the mainstay of the rural economy for many countries, including India, it is imperative that the problem of climate change be addressed to ensure the sustainability of agriculture. With advances in science, sustainable agriculture, and supportive policies, it is possible to mitigate the effects of climate change on agriculture to a considerable extent. By adopting climate-resilient agricultural practices and technologies, agriculture can become more sustainable and meet future food needs.

THE MUSHROOM REVOLUTION:
RETHINKING AGRICULTURE THROUGH

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- **Introduction**

Agriculture has traditionally relied on three major natural resources: arable land, sunlight, and water. However, with the rapidly growing global population and increasing climate variability, traditional farming systems are facing new challenges. Crop production in open fields is becoming increasingly unpredictable due to extreme weather, water scarcity, and soil degradation.

In this context, mushroom cultivation has emerged as a revolutionary agricultural enterprise. Once considered a niche horticultural activity, mushroom farming is now becoming a modern, efficient, and economically viable sector. It not only produces high-value food but also contributes to waste management, sustainable agriculture, and the circular bio-economy

- **Mushrooms: Nature's Biological Upcyclers**

One of the most remarkable advantages of mushroom farming is its ability to convert agricultural waste into nutritious food. Unlike conventional crops that depend heavily on chemical fertilizers and expensive inputs, mushrooms grow on organic residues known as substrates.

Common substrates used in mushroom cultivation include:

- Wheat straw
- Paddy straw or husk
- Sugarcane bagasse
- Sawdust from timber industries
- Other agricultural by-products

Through the biological activity of mycelium (the vegetative part of fungi), these low-value materials are transformed into high-value edible mushrooms. This process creates a unique economic advantage, allowing farmers to use inexpensive or waste materials to produce profitable crops.

This concept is often referred to as "substrate arbitrage," where low-cost inputs are converted into high-value commodities through biological processes.

- **Vertical Farming and High Yield Potential**

In conventional agriculture, land is considered one of the most limiting resources. Mushroom cultivation, however, overcomes this limitation through indoor and vertical farming techniques.

Since mushrooms do not require sunlight for photosynthesis, they can be cultivated inside climate-controlled rooms, warehouses, or sheds using stacked racks or hanging bags. This allows farmers to utilize vertical space efficiently.

Key advantages include:

- Multiple production cycles in a year
- High productivity in limited space
- Reduced dependency on weather conditions
- Efficient use of infrastructure

A well-managed mushroom production facility can generate extremely high yields even from a small area, making it ideal for urban and peri-urban agriculture.

- **Growing Global Market for Mushrooms**

The global mushroom industry has grown significantly in recent years and is currently valued at over 60 billion USD. The market is gradually shifting from basic commodity mushrooms toward specialty mushrooms and value-added products.

The commonly cultivated White Button Mushroom remains popular due to its high consumption worldwide. However, demand for specialty mushrooms is increasing rapidly.

Popular specialty mushrooms include:

- Oyster Mushroom (Pleurotus spp.)
- Shiitake Mushroom (Lentinula edodes)
- Lion's Mane Mushroom (Hericium erinaceus)

These mushrooms are gaining popularity due to their nutritional value, medicinal properties, and unique flavors. In many markets, specialty mushrooms can fetch three to five times higher prices than common varieties.

- **Waste to Wealth: The Circular Bioeconomy**

Mushroom farming also contributes to the concept of a circular bioeconomy, where waste materials are reused and recycled within the production system.

After harvesting mushrooms, the remaining material known as Spent Mushroom Substrate (SMS) still contains valuable nutrients. Instead of being discarded, it can be used as:

- Organic manure
- Soil conditioner
- Compost for agriculture
- Raw material for vermicomposting

Recent innovations are also exploring the use of mycelium-based materials to produce eco-friendly packaging, biodegradable materials, and leather substitutes.

These developments show how mushroom cultivation can contribute to sustainable industrial production and environmental protection.

- **Environmental Benefits of Mushroom Farming**

Mushroom cultivation has several environmental advantages:

- Utilization of agricultural waste
- Lower carbon footprint compared to many crops
- Reduced requirement of land and water
- Recycling of organic materials

With the increasing importance of carbon credits and climate-friendly agriculture, mushroom farming is becoming an attractive investment opportunity for green investors and sustainable agriculture initiatives.

Conclusion

Mushroom cultivation is transforming the economics of agriculture by offering a sustainable, land-efficient, and profitable farming system. By converting agricultural waste into nutritious food, mushrooms help bridge the gap between food production, environmental sustainability, and economic growth.

As the demand for specialty mushrooms, nutraceutical products, and eco-friendly biomaterials continues to rise, mushroom farming is emerging as one of the most promising sectors in modern agriculture.

For farmers, entrepreneurs, and policymakers, mushrooms represent a powerful opportunity to turn “waste into wealth” and build a resilient agricultural future.

MAIZE: PUNJAB'S SUSTAINABLE PATH TO AGRICULTURAL DIVERSIFICATION

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IPunjab's Agricultural Crossroads

Punjab has played an important role in mitigating food insecurity since the Green Revolution. The high productivity of paddy and wheat, and major procurement of the foodgrains in the central pool, also known as the grain bowl of India. The abundant availability of natural resources, such as rivers, canals, underground water, and high-quality soils, makes it an important state in India.

Once known as India's foodgrain bowl, Punjab is now at a critical stage. While delivering food security, decades of rice-wheat monoculture have come at a heavy cost: severe groundwater depletion, soil degradation, and increasing ecological stress. Paddy cultivation, in particular, consumes an unsustainable 2,500-3,000 litres of water per kilogram and contributes significantly to carbon emissions. A sustainable, climate-resilient, and economically viable cropping system is now more critical than ever.

Why Maize?

In Among the alternatives, maize stands out-not just as a water-efficient crop, but also as a lower carbon emitter crop and a high-demand crop due to high protein quantity and different type of maize based on endosperm characteristics. Requiring only 1,000 litres of water per kilogram, maize uses up to 70% less water than paddy and emits 63-75% less carbon.

It also boasts strong demand across diverse sectors- poultry feed, ethanol production, food processing, and snacks- making it a robust market commodity. Maize fits well into Punjab's existing cropping calendar, offering a practical and less disruptive shift from the paddy cropping pattern, with a similar time for cultivation and harvesting of the crop.

Profitability Gap: The Core Challenge

Despite these compelling advantages, the kharif maize crop has a lower adoption rate in Punjab. The biggest hurdle is the economic feasibility of the maize crop. With current yields averaging 37.5 quintals per hectare and market prices around ₹1,707 per quintal, maize gives an average profit of just ₹18,316 per hectare to farmers, which is far below the ₹83,613 earned from paddy.

Bridging this ₹65,000+ profitability gap is essential to drive large-scale farmer adoption. That profitability shows a comparative and absolute advantage of paddy crop over maize.

Short-Term Relief, Long-Term Questions

To incentivize maize cultivation, the Punjab government has introduced subsidies of ₹21,000 per hectare under a pilot project in Bathinda. However, the neighbouring state of Haryana, which also shares similar agronomic conditions in the upper Gangetic plains, provides a subsidy of ₹7,500 per hectare to encourage farmers to replace paddy with maize. Despite this, the initiative has not been successful. While such measures offer temporary relief, they are neither financially nor politically sustainable in the long run. Moreover, these direct subsidies fall under the WTO's "amber box" classification, potentially exposing India to trade disputes.

Yield and Market Reforms: The Long-Term Solution

For maize to truly replace paddy in Punjab's fields, structural reforms are needed, chief among them boosting yields and improving market access.

To match paddy's profitability under current MSP levels, maize yields must rise to 68.8 quintals per hectare. At prevailing market prices, they need to hit 81.4 quintals, a staggering 37.5 quintal jump from current productivity. This is achievable, but only with:

- **Investment in High-Yielding Varieties:** Punjab must urgently focus on R&D to develop high-yielding, drought-resistant, and early-maturing maize hybrids suited to its agro-climatic zones. Current yields in Punjab lag significantly behind states like Tamil Nadu, where maize yields average 75 quintals per hectare, peaking at over 80 quintals.
- **Market Reforms:** Stronger price discovery, fair procurement mechanisms, and the dismantling of entrenched cartel systems are critical. Expanding ethanol production infrastructure can also create stable demand and absorb surplus maize, insulating farmers from price crashes.

Broader Implications: Beyond Maize

Punjab's over-reliance on rice and wheat isn't accidental. These crops have long benefited from government-backed MSP procurement and sustained public investment in breeding and technology. Between 1966 and 2024, wheat yields surged from 8.87 to 35.59 quintals per hectare, and paddy from 8.63 to 28.82 quintals. This growth was fueled by targeted R&D into pest resistance, high yields, and climate resilience.

In stark contrast, maize and other crops, such as pulses and oilseeds, have suffered from chronic neglect in agricultural research. This disparity has led to a self-perpetuating cycle: farmers stick with rice and wheat not just because of price support, but because these crops deliver predictable yields and returns.

Breaking the Cycle

To promote genuine diversification, Punjab must replicate its rice-wheat strategy for maize: provide MSP assurance, but more importantly, invest in research to create high-yielding, resilient maize varieties. Only then can farmers confidently switch without compromising income or risking crop failure.

The Way Forward

For Punjab, maize is more than an alternative crop; it is a pathway to sustainability. Prioritizing innovation over subsidies and enabling market reform over short-term fixes is the only durable solution. By embracing maize, Punjab can safeguard its groundwater, reduce emissions, and ensure economic stability for its farmers.

The choice before Punjab is clear: continue down the unsustainable rice-wheat path or take a bold step toward a greener, more resilient future with maize at the helm.

Particulars	Maize (Current Situation)	Maize Yield Equivalent (Implicit Price)	Maize Yield Equivalent (MSP)
Yield (q/ha)	37.5	81.4	68.8
Yield Gap to Mitigate Paddy Profitability Gap (q/ha)	-	43.9	31.3
Profit (Rs./ha)	18316	83613	83613
Profitability Gap: Maize vs Paddy (Rs./ha)	65297	-	-

SEA VEGETABLES IN HUMAN NUTRITION:
NUTRITIONAL COMPOSITION, HEALTH BENEFITS AND SUSTAINABLE POTENTIAL

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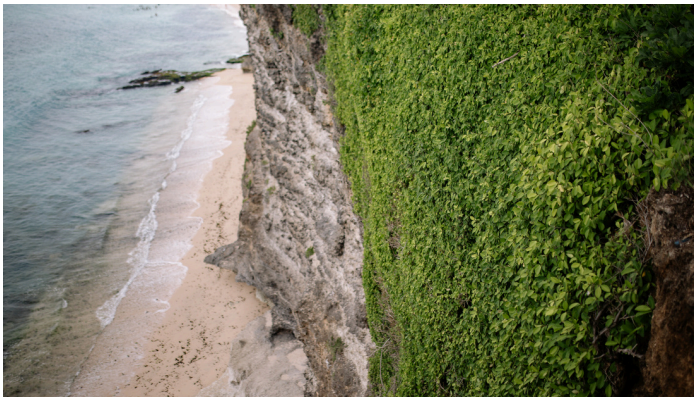
Introduction

Sea vegetables, commonly known as seaweeds, are edible marine algae that have been part of traditional diets for centuries, particularly in Asian countries. They are rich sources of essential nutrients, including vitamins, minerals, dietary fiber, proteins, and bioactive compounds. Sea vegetables also possess functional properties, including antioxidant, anti-inflammatory, and antimicrobial activities. In recent years, interest in sea vegetables has increased due to their potential health benefits and their role in sustainable nutrition. This article reviews the nutritional composition of sea vegetables, their health benefits, their role in disease prevention, and their potential as sustainable food resources.

Sea vegetables are categorized into three main groups based on their pigments and biochemical composition:

1. Brown algae: Bull Kelp, Hijiki, Arame, Wakame etc.
2. Red algae: Dulse, Ogonori, Carola, Irish moss, etc.
3. Green algae: Sea Lettuce, Green Laver, Sea Grapes, Gut weed, etc.



These marine plants absorb nutrients directly from seawater, which results in a high concentration of minerals and trace elements. Because of this characteristic, sea vegetables are considered *nutrient-dense foods*. In recent decades, research has highlighted the importance of sea vegetables as functional foods that contribute to human health and sustainable food systems.

Nutritional Composition of Sea Vegetables

Sea vegetables provide a wide range of essential nutrients for human health.

- **Protein**: Sea vegetables contain moderate levels of protein. Some species contain 10–30% protein on a dry-weight basis. These proteins include essential amino acids that are necessary for tissue growth and repair.

Wakame

Bull Kelp

Hijiki

Arame

Dulse

Carola

Ogonori

Irish Moss

Green Laver

Sea Grapes

Sea Lettuce

Gut Weed

- **Carbohydrates and Fiber:** Sea vegetables are rich in complex carbohydrates and soluble dietary fiber. Important polysaccharides like Alginate, Carrageenan, Agar and Laminarin are found in seaweeds. These dietary fibers support digestive health and help regulate cholesterol levels.
- **Lipids:** Sea vegetables contain low amounts of fat but may provide beneficial fatty acids such as Omega-3 fatty acids, which are important for cardiovascular health.
- **Vitamins:** Sea vegetables are excellent sources of several vitamins like Vitamin A, B-complex vitamins (including folate and vitamin B_{12} in certain species), Vitamin C, Vitamin E, and Vitamin K. These vitamins support immune function, vision, skin health, and energy metabolism.
- **Minerals:** One of the most important nutritional characteristics of sea vegetables is their high mineral content. Minerals like Iodine, Calcium, iron, magnesium, potassium, zinc, and Phosphorus are found in seaweeds. Sea vegetables are particularly known for their iodine content, which is essential for proper thyroid function and metabolism.
- **Bioactive Compounds:** Sea vegetables contain several biologically active compounds that contribute to their health benefits. Important bioactive compounds like Fucoxanthin, Fucoidan, Phlorotannins and Polyphenols are found in seaweeds. These compounds possess antioxidant and anti-inflammatory properties and may help reduce the risk of chronic diseases.

Health Benefits of Sea Vegetables:

- **Support for Thyroid Function:** Sea vegetables are one of the richest natural sources of iodine. Iodine is required for the production of thyroid hormones, which regulate metabolism, growth, and energy balance. Adequate iodine intake helps prevent iodine deficiency disorders such as goiter.
- **Improve Cardiovascular Health:** Sea vegetables may support heart health by reducing blood cholesterol levels and lowering blood pressure. These factors may reduce the risk of cardiovascular diseases such as hypertension and heart disease.
- **Enhance Antioxidant Activity:** Sea vegetables contain antioxidants, including carotenoids, flavonoids, and vitamins, that help neutralize harmful free radicals. These antioxidants protect cells from oxidative damage and may reduce the risk of diseases such as cancer, diabetes, and cardiovascular disorders.
- **Weight Management:** Due to their low-calorie content and high fiber levels, sea vegetables can support weight management. The fiber content promotes a feeling of fullness and helps regulate appetite.
- **Improve Digestive Health:** Sea vegetables serve as prebiotics, supporting the growth of beneficial gut bacteria. The soluble fibers found in seaweeds improve digestion and help maintain a healthy gut microbiome.
- **Immune System Support:** Bioactive compounds such as fucoidan have been shown to possess antimicrobial and immune-modulating properties. These compounds may help enhance immune function and protect the body from infections.

Conclusion:

Sea vegetables are highly nutritious marine foods that provide a wide range of essential nutrients, including vitamins, minerals, proteins, dietary fiber, and bioactive compounds. Their consumption offers numerous health benefits, including improved thyroid function, cardiovascular protection, digestive health, and immune support. In addition to their nutritional value, sea vegetables contribute to environmental sustainability and may play an important role in future global food systems. Incorporating sea vegetables into the human diet can therefore support both health and sustainable nutrition.

WOMEN'S EMPOWERMENT THROUGH DAIRY FARMING

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Introduction

India is the world's largest producer of milk, contributing nearly 23% of global milk production. The dairy sector plays an important role in strengthening rural livelihoods and contributes significantly to the Indian economy.

Dairy farming also serves as a powerful tool for women empowerment, providing income opportunities, improving decision-making power, and enhancing social status in rural communities.

Women's Role in the Dairy Sector

Women constitute nearly 70% of the workforce in dairy farming and are actively involved in many activities such as:

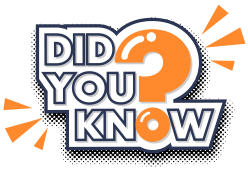
- Feeding livestock
- Milking animals
- Cleaning sheds
- Processing milk products
- Managing household nutrition

While men often handle marketing and transportation, women perform the core daily management tasks in dairy farming.

Why Dairy Farming Empowers Women

Dairy farming empowers women because:

✓ It can be practiced near home
✓ Provides regular income
✓ Requires relatively small land holdings
✓ Encourages participation in Self Help Groups (SHGs)



- India supports more than 80 million dairy farmers.
- Nearly 75 million women are engaged in dairy-related activities.
- Dairy farming provides a daily income compared to seasonal crop income.

Dairy Sector and Sustainable Development

The dairy sector contributes to several United Nations Sustainable Development Goals (SDGs) including:

- SDG 1 – No Poverty
- SDG 2 – Zero Hunger
- SDG 5 – Gender Equality
- SDG 8 – Decent Work and Economic Growth

By strengthening women's role in dairy farming, rural communities can achieve better nutrition, income security, and social development.

Measuring Women Empowerment in Agriculture

Researchers use different indexes to measure empowerment levels in agriculture.

Major Indexes Include

Women's Empowerment in Agriculture Index (WEAI)

Measures decision-making power, access to resources, income control, leadership, and time allocation.

Women's Empowerment in Livestock Index (WELI)

Focuses specifically on empowerment through livestock and dairy activities.

Emerging Opportunities for Women in Dairy

Women can expand their role through:

- Dairy cooperatives
- Milk processing enterprises
- Value-added dairy products (paneer, ghee, yogurt)
- Digital dairy marketing platforms
- Agri-entrepreneurship

These opportunities can significantly increase women's income and leadership in rural economies.

Key Indicators of Women's Empowerment in Dairy

Domain	Indicators
Economic Empowerment	Income generation, access to credit
Social Empowerment	Participation in cooperatives
Decision Making	Control over livestock management
Psychological Empowerment	Confidence and self-reliance
Health & Nutrition	Improved household nutrition
Access to Resources	Land, livestock ownership
Constraints	Cultural and financial barriers

Conclusion

Dairy farming has emerged as a powerful pathway for women empowerment in rural India. With supportive policies, access to finance, and improved training opportunities, women can transform dairy farming into a sustainable livelihood.

Strengthening women's participation in dairy farming will not only improve family incomes and food security but also contribute to inclusive agricultural development.

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