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PEARL MILLET: A GLOBAL INITIATIVE FOR SUSTAINABLE FOOD SECURITY AND NUTRITION

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ABSTRACT:

Pearl Millets, known for their resilience and nutritional richness, have been recognized globally for their potential in enhancing food security and nutrition. Its highlights the significance of the Pearl Millets, a global initiative emphasizing the role of millets in sustainable agriculture, food security, and nutrition, their classification, nutritional profiles, and global distribution. Pearl Millets demonstrate remarkable adaptability to diverse and challenging climatic conditions, contributing to biodiversity and offering ecological benefits. This makes them a significant part of climate-smart agriculture. Pearl Millets enhance food availability and positively impact rural livelihoods and economies, contributing to food security. It's have been shed light on health benefits associated with Perl millet consumption, emphasizing their role in addressing hidden hunger and malnutrition. Despite these benefits, millets face barriers in cultural acceptance and require improved processing techniques. Technological innovations could help in improving processing, creating value-added Pearl millet products, and while effective marketing strategies could help in overcoming social and cultural barriers. Lastly it's discuss policy initiatives supporting millet cultivation and consumption, particularly reflecting on initiatives a Global Initiative for Sustainable Food Security and Nutrition. Future policy recommendations for sustained millet promotion are proposed, which include promoting millets as climate-smart crops, improving farmers' access to improved Pearl millet varieties and technologies, fostering an environment for Perl millet processing and marketing, and promoting international collaboration for Pearl millet research and development.

Keywords: The Perl Millet, Sustainability, Nutrition, Policies, Technology.

INTRODUCTION:

The United Nations (UN) also trying to recognizing the significant potential these grains have in offering sustainable solutions to global challenges such as food security, nutrition, and climate change. This declaration highlights the international community's concerted effort to promote millets' significance and integrate them into mainstream food systems. The initiative also aims to drive research and development and stimulate investment in millet-related activities, given its exceptional adaptability to harsh growing conditions and high nutritional content. However, these robust grains are traditionally grown in many parts of the world, especially in semi-arid tropical regions of Africa and Asia, playing a crucial role in the diet and economy of millions of smallholder farmers and consumers. These underutilized crops and their benefits. Global food security and nutrition remain major challenges, with an estimated 690 million people still suffering from hunger in 2019. With the ongoing climate crisis, population growth, and limited natural resources, the situation calls for a transformative approach to our food systems. Pearl Millets offer an opportunity in this respect as they are incredibly resilient, often thriving in conditions where other crops fail. They require little water, are resistant to pests and diseases, and can withstand high temperatures, making them an ideal crop under climate change scenarios. These characteristics enable pearl millets to provide a reliable source of food, particularly for populations living in vulnerable ecosystems. Nutritionally, millets are a powerhouse. They are high in dietary fiber, proteins, and essential minerals like iron, zinc, and magnesium. They are gluten-free and have a low glycemic index, making them suitable for people with celiac disease and diabetes. Thus, promoting millet consumption can help tackle malnutrition and diet-related non-communicable diseases. Its discuss the role of Pearl millets in sustainable agriculture, food security, and nutrition, the challenges associated with promoting their consumption, and the potential policy initiatives and international collaborations to enhance Pearl millet production and consumption. By doing so, it’s have been provide a comprehensive understanding of the potential of millets in shaping a sustainable and resilient global food system.

Analysis of the Nutritional comparison of pearl millet with sorghum, rice, and wheat (in 100 g grain) as below.

Contents	Crop			
	Pearl millet	Sorghum	Rice	Wheat
Carbohydrates (g)	61.8	67.7	78.2	64.7
Protein (g)	10.9	09.9	07.9	10.6
Fat (g)	5.43	1.73	0.52	1.47
Energy (Kcal)	347	334	356	321
Dietary fiber (g)	11.5	10.2	02.8	11.2
Calcium (mg)	27.4	27.6	07.5	39.4
Phosphorus (mg)	289	274	96	315
Magnesium (mg)	124	133	19	125
Zinc (mg)	2.7	1.9	1.2	2.8
Fe (mg)	6.4	3.9	0.6	3.9
Thiamine (mg)	0.25	0.35	0.05	0.46
Riboflavin (mg)	0.20	0.14	0.05	0.15
Niacin (mg)	0.9	2.1	1.7	2.7
Folic acid (μg)	36.1	39.4	9.32	30.1

ROLE OF MILLETS IN SUSTAINABLE AGRICULTURE:

Millets display exceptional adaptability to harsh environments and can grow in areas with poor soil fertility, high temperatures, and low rainfall, often where other cereals would fail. For example, pearl millet, native to the hot and arid Sahelian zone of Africa, can thrive under extreme heat up to 42°C. This resilience is due to a combination of physiological traits, including efficient water use, C4 photosynthesis, which allows for increased water-use efficiency, and a deep root system that enables plants to access moisture deep in the soil. Many pearl millet varieties mature quickly, which enables them to escape drought conditions. Pearl Millets also contribute to agrobiodiversity and have potential ecological benefits. Traditionally, a range of millet varieties has been cultivated, each with unique adaptations to local conditions, contributing to agroecosystem diversity. This diversity helps to maintain healthy soils, control pests and diseases, and enhance ecosystem resilience to stresses like climate change. Pearl Millets often require fewer inputs than other cereals, such as fertilizers and pesticides, leading to lower environmental impact. They also contribute to soil

health due to their deep root systems, which improve soil structure, enhance water infiltration, and prevent erosion. Climate smart agriculture (CSA) is a strategy for increasing sustainable agricultural productivity, enhancing resilience to climate change, and reducing greenhouse gas emissions where possible. Pearl Millets have a pivotal role in these context. Pearl millets can tolerate a wide range of climatic conditions and soils, are less reliant on synthetic inputs, and contribute to biodiversity and soil health. These attributes help to enhance both farm productivity and resilience in the face of climate change. The carbon footprint of pearl millet production is relatively low. Studies have shown that pearl millets have lower energy inputs and carbon emissions than rice and wheat, largely due to their lower need for synthetic fertilizers and irrigation.

PEARL MILLETS AND FOOD SECURITY:

Food availability, the first pillar of food security, refers to the physical availability of sufficient quantities of food of appropriate quality. Pearl Millets play a significant role in this aspect. Pearl Millets have the ability to grow in diverse and marginal conditions, including drought-prone, high-temperature, and low-fertility soils where other crops might fail. This robustness and adaptability contribute to maintaining food production under challenging conditions. The early maturity of many Pearl millet varieties ensures a fast return on investment and provides food and income early in the growing season, before other crops are ready for harvest. This feature can be crucial in contexts of food insecurity, providing a source of food during the 'hungry season'. Pearl Millets are often grown by smallholder farmers in developing countries, and their cultivation can have significant impacts on rural livelihoods and economies. Pearl Millets are used not only for human consumption but also as fodder for livestock, another key source of income and nutrition in many rural households. The cultivation of millets can also contribute to rural economic resilience.

NUTRITIONAL IMPORTANCE OF PEARL MILLETS:

Pearl Millets are nutritionally superior to many other commonly consumed cereals. They are rich in dietary fiber, protein, essential fatty acids, and vitamins, especially B vitamins, and are particularly high in essential minerals like iron, zinc, and calcium. For instance, pearl millet has a higher protein content and is richer in iron and zinc than rice, wheat, or maize. These comparisons illustrate that millets have a nutritionally well-rounded profile and can contribute significantly to a balanced diet, especially in regions where micronutrient deficiencies are prevalent. Consumption of Pearl millets has been associated with numerous health benefits. As a whole grain, the high fiber content in Perl millets helps in maintaining gut health, preventing constipation, and reducing the risk of diseases like colorectal cancer. Pearl Millet consumption may also contribute to the prevention and management of chronic diseases. For example, studies have shown that millets can help manage blood sugar levels, making them suitable for people with diabetes.

DISCUSSION:

Promoting Pearl Millet Consumption:

Despite their nutritional benefits, Pearl millets face certain cultural and social barriers. In some societies, millets are considered a "poor man's crop" or a famine food and are thus less preferred compared to other cereals like rice and wheat. The traditional knowledge and skills required for millet processing and cooking have been lost in many societies due to urbanization and the shift towards convenience foods. Overcoming these barriers requires reorienting public perceptions and reintroducing traditional food processing and cooking techniques. Technological innovations can play a critical role in improving the processing of Perl millets and adding value to millet-based products. Pearl Millet processing technologies, malting, and milling, have been developed to improve the quality and acceptability of millet foods. Scientific research has resulted in the development of value-added millet products like bread, cookies, pasta, and breakfast cereals that cater to modern tastes and preferences. These products can help promote the consumption of Perl millets among urban populations and

in societies where traditional millet foods are less preferred. Successful marketing strategies for millets have often combined promotional activities to raise awareness of the nutritional and environmental benefits of millets, with the development of attractive, value-added millet products. For example, the "Smart Food" initiative in India has successfully promoted the consumption of the Pearl millets through various strategies including TV cooking shows, school feeding programs, and partnerships with food companies to develop new Perl millet products.

Table 1. Strategies for promoting millet consumption

S.No.	Strategies	Expected Outcomes
1	Educate about the health benefits of millet	Increased knowledge and awareness about the nutritional benefits of millet
2	Include millet in school meal programs	Children develop taste and preference for millet from an early age
3	Organize cooking workshops using millet	Improved skills and knowledge on how to incorporate millet into daily meals
4	Collaborate with restaurants to offer millet-based dishes	Higher availability and visibility of millet in popular food outlets
5	Encourage farmers to cultivate millet through incentives	Increased production and availability of millet in the market
6	Government policies to subsidize millet prices	Millet becomes a more affordable choice for consumers
7	Social media campaigns promoting millet	Increased interest and curiosity about millet among digital-savvy consumers
8	Partner with health and fitness influencers	Increased endorsement of millet as part of a healthy lifestyle
9	Highlight millet in dietary guidelines	Official recognition of millet as a key part of a balanced diet
10	Retail partnerships for prominent shelf placement	Enhanced visibility of millet in supermarkets, making it a more likely purchase choice

Policy Initiatives And International Collaboration For Pearl Millet Promotion:

Government policies play a significant role in promoting Perl millet cultivation and consumption. In India, for example, the government included Pearl millets in the public distribution system and midday meal schemes to promote their consumption. Similarly, in Africa, Pearl millets have been included in school feeding programs in countries like Mali, Burkina Faso, and Ghana. Additionally, many countries have implemented policy measures to support Pearl millet farmers. These measures include subsidies for Pearl millet seeds and farming equipment, price supports, and improved access to credit.

There is a global initiative aimed at increasing awareness about the benefits of Pearl millets and promoting their cultivation and consumption. The initiative has involved various activities, such as global conferences, workshops, promotional campaigns, and research collaborations.

Challenges For Pearl Millet:

Despite the breeding efforts, most of breeding programs fail to deliver hybrids due to a vast variation in microclimate (day and night temperature and humidity) and soil apart from rainfall, which requires proper quantification. Further, narrow cultivar diversity in drought-prone ecology also is another factor for this. Thus, there is a high need to give higher priority to the below-mentioned areas to promote its production and utilization.

- Development of hybrids/varieties of pearl millet with better regenerative capacity on reversal of dry spell for harsh environment/drought-prone areas (for A1 zone in India).
- Development of hybrids/varieties resistant/tolerant to salt/high temperature.
- Shift in focus of breeding from productivity improvement to the identification of end product-specific traits.
- Mainstreaming of biofortification in pearl millet for iron and zinc.
- Enhancement of shelf life of pearl millet flour and overcome rancidity to promote its products.
- Development of screening protocols and control measures against different diseases such as downy mildew, blast, rust, ergot, smut.
- Generating authentic data on nutritional benefits of pearl millet and bioavailability studies.
- A study on demand survey for pearl millet.

Factors Governing Pearl Millet Production:

The demand-side factors governing Pear millet production include:

1. Increasing urbanisation and per capita incomes, which are changing consumer tastes and preferences.

2. Poor social status and lack of traditional knowledge in preparing millets.
3. Lower shelf-life of millet grains.
4. Larger share of rice and wheat in the public distribution system (PDS) compared to millets.

The Factors On The Supply Side Are:

1. The lack of industrial demand for value-added millet products, which discourages farmers from cultivating millets.
2. Low profitability and low remuneration.
3. The favoured production of rice and wheat during the Green Revolution.
4. Lack of access to quality seeds.
5. Inadequate infrastructure, such as processing technologies and milling equipment.

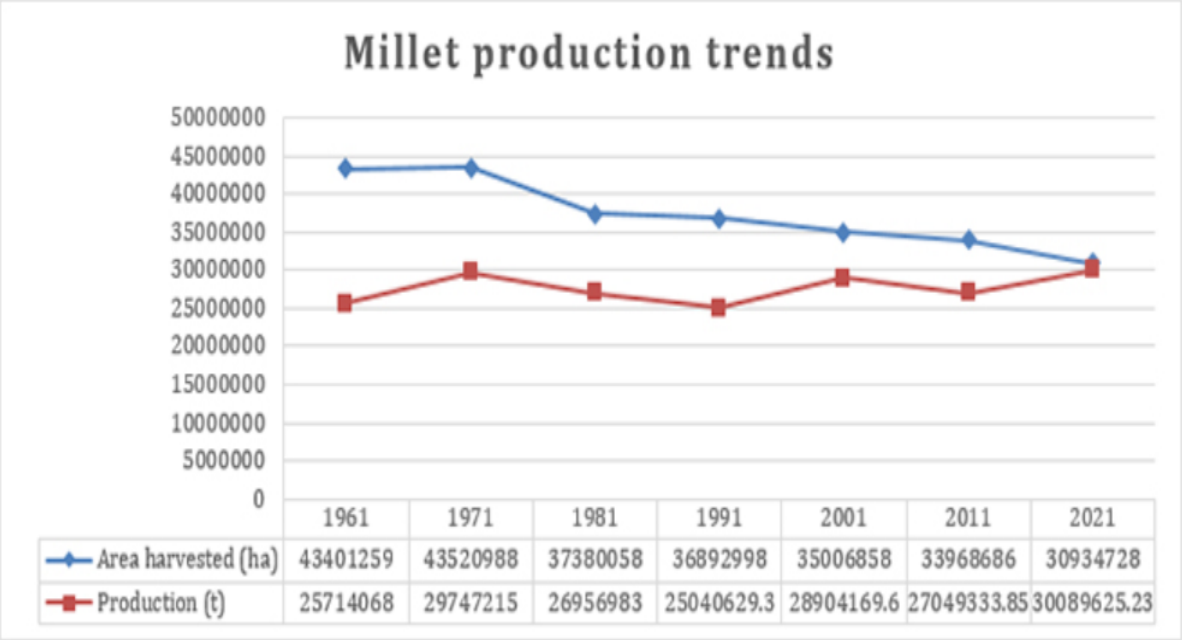
Factors influencing Pearl millet production and consumption may vary with cultural, social, and environmental conditions. While these factors are the root causes of the declining global millet production and consumption, they also provide solutions that can reverse declining global trends.

Pearl Millet Production And Consumption Patterns:

According to the Food and Agriculture Organization (FAO), the acreage of millet under cultivation in 2020 was 33 million hectares globally. This includes only a few countries that grow millets around the world. In 2021, the millet acreage in India was globally the highest (9.76 million hectares), followed by Niger (6.14 million hectares) and Sudan (2.8 million hectares).[16] The FAO estimates that global millet production was 28.33 million tonnes in 2019, which increased to 30.08 million tonnes in 2021. India is the largest producer, with a 43-percent global market share in 2021; the produce consists mainly of sorghum (jowar), pearl millet (bajra), finger millet (ragi), and other minor millets. As shown in Figure 2, while the area cultivated for millet has been on the decline globally since 1971, production quantity has remained near-equal to that in 1961, ranging from 25 million to 30 million tonnes. There has been a decline in the production trends since 1981, from 43.4 million to 37.4 million hectares,

which nearly steadied after 1991, despite a decrease in harvested area, which further declined to 30.93 million hectares..

Global Millet Production Trends as shown in below Fig.



CONCLUSION:

Highlights the potential of millets in addressing food security, nutrition, and sustainable agriculture. These resilient crops, rich in nutritional value, offer multiple benefits from promoting biodiversity to contributing to climate-smart agriculture. However, challenges in cultural acceptance, processing, and marketing of millets persist. Technology, effective marketing strategies, policy initiatives, and international collaboration can play pivotal roles in overcoming these barriers, creating supportive environments for processing and marketing, and fostering international collaboration in research and development. By doing so, Pearl millets can truly become a solution for sustainable food security and nutrition. The outcomes from model crops can be used in pearl millet to achieve added improvement and develop Zn- and Fe–enriched biofortified varieties. Synteny studies can prove useful for the identification of common genes linked with nutrition biosynthesis pathways, and these should be incorporated into pearl millet by traditional breeding or transgene techniques for further

nutritional improvements. In addition, nutritional as well as the economic security of small and marginal farmers, enhancing demand of pearl millet, value addition and market-led extension through food science and nutrition is vital to promote the cultivation and consumption of this crop. In conclusion, multidisciplinary approaches, including breeding, genomics, bioinformatics, biotechnology, nutrition and genetics etc. are required to exploit and harness the beneficial attributes of nutricereal pearl millet for combating changing climate and attaining nutritional security.

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