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Reviving Kodo and Kutki: Nutritional Importance of Millet Consumption among Tribal Populations in Dindori, Madhya Pradesh

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Abstract

The two ancient Indian varieties Kodo and Kutki (Millets) were historically a key part of the food systems and traditional farming methods employed by the indigenous tribal populations residing within Dindori District, State of Madhya Pradesh. A comprehensive review article was conducted for this research to determine how these two varieties of indigenous millets provide nutrients to the Baiga and Gond tribes and contribute to food and nutrition security. The information presented in this review article is based upon an in-depth review of a large body of previously published research studies, federal publications, books, and relevant scholarly literature. Based on the reviewed data from the literature it appears that both Kodo and Kutki contain numerous beneficial elements such as; complex carbohydrates, dietary fiber, protein, essential minerals and vitamins. Therefore, these indigenous millets provide better nutritional value than many processed or refined cereal products. Additionally, the lower glycemic index and higher nutrient content of Kodo and Kutki contributes to reducing malnutrition, anemia, diabetes, and other health related problems. In addition to discussing the above-mentioned benefits of Kodo and Kutki the review discusses the loss of millet cultivation due to shifting consumer preferences toward westernized diets, market limitations, and changes in state and national policies supporting millet production. However, the review also presents evidence indicating the resurgence of millet production through state sponsored millet revitalization initiatives and millet promotional activities. Overall, the results of this review suggest that encouraging the development of Kodo and Kutki through millet production will lead to improved tribal nutrition, enhanced food security, support sustainable agriculture practices, protect traditional tribal knowledge systems.

Keywords: Kodo Millet, Kutki Millet, Tribal Nutrition, Food Security, Dindori District, Sustainable Agriculture.

1. Introduction

Millets were one of the first crop-based food sources grown in India (and therefore have been a mainstay of Indian agriculture for over thousands of years). In addition to being extremely small grain seeds, these include Kodo, Kutki, Ragi, Bajra, and Jowar; which have traditionally provided a source

of food for the large number of rural and tribal people due to its adaptability to various climates, and that it can be grown with less inputs. Prior to the mass introduction of high yielding varieties of rice and wheat through the Green Revolution, millets played a major role in India's food supply system, and made up a substantial portion of each family's diet. Millets are currently receiving increased recognition due to their very good nutritional characteristics and environmental sustainability. The government of India recognized their excellent nutritional composition by labeling them "Nutri-Cereals." It is believed that millet grains contain better quality nutrients than most other common grains, because they contain lower amounts of simple sugars (thus lower glycemic indexes), and they also have higher levels of trace elements, including iron, calcium, phosphorus, and zinc. Millets are now seen as key crops for addressing issues related to malnutrition, lifestyle-related disease, and climate change - all of which are increasingly becoming global issues. In addition, the fact that millets can grow well on poor quality land makes them even more valuable for promoting sustainable agricultural practices.

Dindori District and Its Tribal Population

The Dindori district can be described as being geographically situated within the eastern portion of Madhya Pradesh with its landscape composed of rolling hills and forests; with over ninety percent of this region's population consisting of members from tribal communities. Many tribal communities, including those who live in Dindori District rely upon either their agricultural or forestry-based occupations. In addition to other indigenous communities residing in Dindori there exist two major indigenous populations, namely the Baiga and Gond. Members of both these communities have traditionally possessed vast amounts of knowledge regarding sustainable agriculture, biodiversity preservation, and traditional food systems. Agricultural activities practiced by tribal communities throughout the Dindori District typically consist of using traditional agricultural techniques which include growing diverse types of crops (as opposed to monoculture), practicing mixed farming, and cultivating traditional crop species that are suitable to local environmental characteristics. For example, millet grains such as Kodo and Kutki have been grown and eaten by many families for centuries and continue to be a significant component of many people's diets.

Importance of Kodo and Kutki

Kodo millet (Paspalum scrobiculatum), and kutki or little millet (Panicum sumatrense) are some of the oldest traditional crop varieties in dindori which are very much robust against all types of adverse climate conditions. It has been used by the tribals of India for centuries as a staple food item and was eaten in several ways. As a food it is eaten as porridge, rotis etc. At this time of nutritionally poor diets kodo and kutki have become very popular because of their rich nutrient content that will help in fighting malnutrition. The two millets are also good sources of fibre, minerals and bio active

compounds; therefore, the two millets make an excellent addition to the diversified diet. The two millets provide sustenance to the people living in tribal areas who practice sustainable agriculture practices.

Objectives of the Review

1. To examine the nutritional composition and health benefits of Kodo and Kutki millets.
2. To assess the contribution of Kodo and Kutki consumption to food and nutritional security among the Baiga and Gond tribes of Dindori district.
3. To review the current status, challenges, and revival initiatives related to Kodo and Kutki cultivation and consumption in Dindori district.

Methodology of the Review

Nature of the Study

This study is a literature-based review that has as its purpose to summarize, critique and analyze the current state of knowledge about the nutritional significance of Kodo and Kutki millets by tribals in Dindori District, Madhya Pradesh. Because this is a review article, it depends on all secondary data which can be found from many publications and nonpublication's. It will try to understand the nutritional characteristics of the two millet types, their roles in tribal diets, how they contribute to food and nutritional security, and what barriers or opportunities exist for their resurgence. Relevant literature was carefully reviewed to identify the major themes, trends and research outcomes about millet production, usage practices and tribal nutrition.

Sources of Information

This review utilizes credible data obtained through multiple reliable sources. The list includes peer-reviewed articles in national/international journals, government reports/policy papers, ICAR/National Institute of Nutrition/Ministry of Agriculture and Farmers Welfare publications, books, dissertation, conference materials and online databases including Google Scholar, Scopus, Research Gate and Pubmed. Additionally, reports for tribal development/nutrition/millet promotion programs were accessed to have an overall understanding of this topic. All collected literature was systemically examined and placed into categories that support the purpose of the study.

Kodo and Kutki Millets: An Overview

Botanical and Agronomic Characteristics

Kodo millet (Paspalum scrobiculatum), and Kutki or little millet (panicum sumatrense) are two of the most important "small" millets that have been grown historically in central India, primarily in the tribal areas of Madhya Pradesh. They are preferred because they can be adapted to adverse environmental conditions and provide good nutrition. Kodo millet is an annual grain crop from the poaceae plant family. It has slender stalks, narrow leaves, and tight clusters of tiny grains on its

compact flower heads. Kodo millet is very drought tolerant and will do well in poorer and marginal soil which cannot sustain traditional cereals. Kodo millet takes longer than many of the other cereals to mature and requires very few inputs into farming, therefore it is suited for resource poor farmers. Kutki, commonly referred to as little millet is another hardy type of cereal from the same grass family as kodo. It produces small rounded seeds. It is distinguished from many other types of cereals by having a shorter maturity period and being adaptable to changing weather patterns. Kutki has natural resistance to some pestilence and disease compared with other common cereal plants; it thrives under rain fed production systems. In addition to both kodo and kutki possessing excellent ability to withstand extreme climates, this makes them extremely valuable in the current era of global warming and sustainable agriculture.

Cultivation Practices in Dindori

Dindori District (Madhya Pradesh) is an area that has traditionally grown Kodo and Kutki. Many members of the Baiga and Gond tribes have grown Kodo and Kutki as their primary crop. The majority of farmers utilize very little inputs in terms of chemicals and also employ farming practices that are both traditional and input-poor. These practices are based primarily upon traditional knowledge shared from generation to generation. The method of growing includes land preparation with simple hand tools; broadcasting and/or line sowing seed; limited application of chemical-based fertilizer and pesticide. Farmyard manure is commonly used by the local farmers as organic manure to improve the fertility of the land.

Climate-wise, Dindori has an ideal environment for growing millets. The district experiences medium to heavy precipitation in the summer months and has a wide range of soils which allow for the growth of these hardy crops. Kodo and Kutki can survive in drought type conditions and require much less water compared to rice and wheat, thus they are especially well suited for rain fed farming. Recently, there has been a resurgence of interest in millet cropping due to government policies aimed at promoting "nutri-cereals" and "climate resilient" farming. Millet cropping decreased significantly throughout India during the "Green Revolution," as rice and wheat became increasingly dominant. However, current data show evidence of a steady increase in the amount of Kodo and Kutki being cultivated in this area over time.

Socio-economic Importance

Kodo and Kutki crop have a great deal of impact socially and economically on tribal community in Dindori. In addition to being a source of income for the majority of the small and marginal farmer's incomes; this crop is also a primary source of living. Millet cropping is less expensive than other types of crops and it can grow in poor soil therefore providing economic stability to those with limited resources. For generating income Kodo and Kutki are essential components of subsistence farming

systems. Food for tribal families in times of food shortages and uncertain climates are provided by grains that are made from Kodo and Kutki. Grains that are made from Kodo and Kutki are made into many different traditional foods and they help to ensure food security of tribal families all throughout the year. Therefore, these millets will ensure that the economic needs of the tribal population are met and their nutritional needs are met as well. This makes them vital to the rural economy of Dindori District as well as its rich traditional agricultural heritage.

Nutritional Composition and Health Benefits

Nutritional Profile

Paspalum scrobiculatum is known as kodo millet and Panicum sumatrense as kutki or little millet; both are nutricereals which are highly nutritious grain, traditionally used by tribal communities of India. This increasing awareness has led to recognition of these millets as “nutri-cereals” due to their high content of essential nutrients which are important for an individual’s overall health, and for prevention of deficiency diseases.

Carbohydrates

Carbohydrates make up the largest part of Kodo and Kutki millets, which provide a sustained amount of energy to support daily living. In contrast with the simple, refined grains available from other cereal sources, Kodo and Kutki millets have complex carbohydrate that can be digested at a slow pace by the body. The slow rate of digestion means there is a steady release of glucose to help stabilize blood glucose concentrations, while providing long lasting energy. Due to the large amount of complex carbohydrates they contain, Kodo and Kutki millets are especially well suited as an energy rich food for physically active populations, such as those from tribal communities who engage in agriculture and or forestry as their main forms of livlihood.

Proteins

Kodo and Kutki contain moderate amounts of protein, which are essential for growth, tissue repair, enzyme production, and immune function. Although their protein content is slightly lower than that of some pulses, it is generally higher than that of polished rice. The proteins present in these millets contribute significantly to the nutritional requirements of populations that have limited access to animal-based foods. When consumed along with pulses and legumes, these millets help provide a balanced amino acid profile and improve overall dietary quality.

Dietary Fiber

One of the most important nutritional attributes of Kodo and Kutki is their high dietary fiber content. Dietary fiber plays a vital role in maintaining digestive health, regulating bowel movements, and preventing constipation. The fiber present in these millets slows the absorption of glucose in the bloodstream, thereby helping regulate blood sugar levels. Additionally, dietary fiber promotes satiety,

reduces overeating, and contributes to healthy weight management. The fiber content of Kodo and Kutki is significantly higher than that of refined cereals such as polished rice.

Minerals and Vitamins

Kodo and Kutki are good source of many vital minerals and vitamins. They are a good source of the mineral content including phosphorus, calcium, magnesium, potassium, zinc and iron that help perform many physiological processes. Phosphorus and calcium are both very useful to maintain healthy bones and to develop bone. Iron is very helpful in the production of hemoglobin and to prevent anemia. Potassium and magnesium have important role in maintaining muscle function, nerve conduction and heart health. In addition to being a source of B-complex (Thiamine, Riboflavin, Niacin) vitamins, Kodo and kutki millets provide with a number of nutrients required for the metabolic process of energy and functioning of the nervous system.

Comparison with Rice and Wheat

Nutritional Superiority

Kodo and Kutki millets provide better nutritionally, when compared with rice and wheat, which are common cereals. Rice and wheat lose some of their fiber, vitamins, and minerals during the processing, especially for the refined products. Compared to rice and wheat, millets have more of the naturally occurring nutrients in them. Millets usually include greater percentages of dietary fiber, and essential minerals and bioactive compounds. Because of its superior nutrient density, it is more beneficial for areas that experience malnutrition and micronutrient deficiencies. The diverse nutrient profile of millets can be helpful to general health, as well as contribute to food diversification. As commercially purchased cereal options are limited for tribal populations who rely on local foods, Kodo and Kutki are nutritious and affordable alternatives.

Low Glycemic Index

A further significant benefit of Kodo and Kutki are the low glycemic indexes. The low GI foods produce a slower, steady increase in glucose released into your body. Most Indians consume polished rice as an everyday food. As polished rice has a high glycemic index it will cause a large spike in blood glucose level. Conversely, due to its high fibre content and complex carbohydrate structure, the digestion rate and subsequent absorption of glucose from millets are both slowed. These properties make Kodo and Kutki a good option for people with diabetes or those who are prone to metabolic syndrome.

Health Benefits

Prevention of Malnutrition

Kodo and kutki have potential as nutrition sources that help address the nutritional challenges faced by India's indigenous populations. The rich composition of nutrients found within kodo and kutki

allows consumers to add essential vitamins and minerals to their diet, with regular intake providing improved dietary quality and supporting the body's need for optimal growth, development and function.

Diabetes Management

Low glycemic index and high fiber content in Kodo and Kutki support their use as diabetic diet aids. By slowing down carbohydrate absorption, they can also lower peak insulin response (the amount of insulin that is released after a meal) and decrease the amount of glucose in the blood after eating. Millet-based diets, which include both Kodo and Kutki, have been shown to improve glycemic control and reduce the incidence of type 2 diabetes. Because of this, many health professionals recommend these types of millets as an alternative to the consumption of refined grains.

Cardiovascular Health

Regular intake of Kodo and Kutki can improve overall cardiovascular health because they contain a lot of dietary fiber that reduces LDL (Low-Density Lipid), or bad cholesterol, in addition to having antioxidants and electrolytes such as potassium and magnesium which support blood pressure control by reducing oxidative stress. All of these characteristics will lower the occurrence of cardiovascular diseases like hypertension and coronary heart disease.

Digestive Health

The high dietary fiber content of kodo and kutki millets support an individual's ability to maintain good digestion. Both millets contain high amounts of soluble and insoluble fiber which promote the normal movement of the bowels, prevent constipation, and help create beneficial bacteria in the intestines. In addition to improving one's digestive health, this will improve the body's ability to digest nutrients. Also, due to the increased fiber content of these millets, they can aid individuals in weight loss by helping them eat less because of the fullness that fiber produces.

Role in Maternal and Child Nutrition

Maternal and Child Nutrition (MCN) is a vital area of Public Health in Tribal Regions. There has been very high Malnutrition Rates reported in Tribal Regions. Both Kodo Millet & Kutki Millet have a lot of potential to be used to improve the Nutritional Status of Women and Children. These two Millets contain Iron which will assist in preventing Anemia due to Iron Deficiency among Pregnant and Lactating Women. The Calcium and Phosphorus contained in both Millets assists with Bone Development and Maternal Health. Additionally, the Protein Content within both Millets will assist with Fetal Growth and Tissue Development. The Energy, Proteins, Vitamins and Minerals provided by Millet-Based Foods are important for Physical and Cognitive Development for Children. With the inclusion of Kodo Millet and/or Kutki Millet into Supplementary Nutrition Programs, School Meals, and Household Diets, there will be assistance in addressing Nutrient Deficiencies and assisting in

Healthy Growth. As such, Promoting the Consumption of Traditional Millets like Kodo Millet and Kutki Millet could prove to be a viable Strategy to Improve MCN and Overall Community Health for Populations in Tribal Regions.

Millet Consumption and Tribal Nutrition in Dindori

Traditional Dietary Practices

The Dindori District Tribal communities (Baiga and Gond) have historically utilized local natural resource bases and indigenous methods of agriculture to meet their basic nutritional/food needs. Millet is among the most common crops grown in this area and is part of the daily diet of many people. Historically, Kodo and Kutki millets were valued by many of the local communities not only because they are able to be grown under local climactic conditions, but also due to their historical and cultural value to local communities.

Local community members utilize millet in preparing a large number of traditional meals. Examples of millet based traditional meals that are prepared using Kodo and Kutki include: rotis; porridge; khichdis; gruel; and fermented millet foods. Many times, the millet is simply boiled and served as a staple meal; it can also be milled into flour to make breads and other food items. Millet is a very good choice for preparing meals for tribal families as it is a nutritious food item, easy to prepare, and fits well with tribal family's way of life/dietary preferences. The traditional preparation of millet has been passed down from generation to generation and clearly reflects the strong connection that exists between local communities and their agricultural heritage.

Seasonal food usage patterns also affect the diet of tribal populations. For example, during harvest time when millet grain is readily available to consume fresh, the amount of millet grain being consumed increases. Throughout the year millet grain provides food security. In addition to millet, tribal diets consist of forest products, wild fruit/vegetables/tubers/pulses, and less frequently animal products. The use of these products contributes to dietary variety and allows the communities to adapt to varying environmental conditions. Unfortunately, with increased access to markets and changes in consumer preference, the utilization of traditional millet is decreasing in some areas resulting in a greater reliance upon rice/wheat.

Nutritional Challenges among Tribal Communities

Tribal communities in Dindori suffer from a multitude of nutritional issues despite being knowledgeable about and having access to a vast variety of nutrient-rich traditional foods. Malnutrition is one of the leading public health concerns that exist within tribal communities and is predominantly experienced by women and children. The aforementioned factors are all contributors to poor nutrition; these include (1) socioeconomic status or poverty, (2) lack of access to medical care, (3) inadequate nutrition through diet, and (4) marginalization due to economic status. Protein

energy malnutrition occurs at high levels in specific demographics, i.e., children less than five years old and pregnant women. The above-mentioned demographic will be affected with under-nutrition if they do not consume sufficient quantities of well-balanced diets resulting in stunted growth and decreased immune functions. In addition to protein energy malnutrition, there are also significant amounts of micronutrient deficiencies, specifically for iron, calcium, zinc, and vitamins A and C. Anemic conditions occur primarily amongst women and young girls, causing them to have numerous adverse effects on both their physical and reproductive health. Nutritional deficiencies caused by food insecurity complicate existing nutritional issues. Because so many tribal families rely upon rain-fed agriculture, which has low yields when subjected to climate variability, droughts, etc., and therefore crop failure(s), the availability of adequate nutrients for food security is severely limited. As a result of this limited availability, the majority of tribal members have no choice but to eat less-than-ideal forms of nutrition during times of drought. For example, since rice is consumed primarily for caloric purposes, and because it lacks some very important vitamins and minerals found in millet and other grains, eating rice regularly contributes to an increase in the likelihood of experiencing a deficiency in a particular nutrient.

Contribution of Kodo and Kutki to Nutritional Security

Kodo and Kutki millets represent considerable potential to enhance tribal nutrition. They are high in starches, protein, fibre, minerals, vitamins and antioxidants. Therefore, they should be considered as part of a healthy diet. In comparison with the refined cereal products (that have been shown to cause nutritional deficiency), Kodo and Kutki millets may help to correct some of the nutritional deficiencies seen in many tribal diets. Cultivating or consuming Kodo and Kutki millets at the household level contributes to both food and nutrition security. Because they can thrive using low input and rain-fed conditions, they will always provide food when there is climatic stress. As well as providing reliable access to nutrient dense grain, their longer shelf life ensures access to these nutritious foods at all times during the year. Millet use allows tribal families to rely less upon outside food sources and increase family self-sufficiency.

Millet based foods added to pulse, vegetable, and forest product-based meals create a more balanced and nutritious meal. This diversity is especially important for those such as; children, pregnant women, and the elderly who have higher nutritional needs. While the benefits of millet consumption are experienced by individual households, it has a positive effect on broader community health. Regular intake of Kodo and Kutki millets may assist in preventing malnutrition, anemia, diabetes, etc. They support digestive health due to their high fibre content and support glucose regulation through their low glycaemic indices. Better nutritional status improves body growth and development, cognitive abilities, working capacity and general lifestyle.

While growing concerns exist about food security and climate changes, the use of traditional millet foods represents a sustainable option for tribal nutrition. Nutrition program, public distribution system and community education opportunities can contribute to tribal food security and improved health results from tribal members of the Dindori district.

Revival of Kodo and Kutki: Opportunities and Challenges

Kodo and Kutki millets have historically contributed to the farming and diet of tribal peoples in Dindori District, Madhya Pradesh. They are very nutritious, environmentally friendly and suitable for local climatic conditions. Although they offer a multitude of positive qualities, many people have stopped cultivating and consuming them in recent years. Increased interest on the part of consumers and producers for the healthiness and environmental advantages of these millets is leading to increased support to cultivate and consume them again. Reviving Kodo and Kutki provides possibilities as well as obstacles to produce sustainable agriculture, food security and better diets for tribal peoples.

Factors Responsible for Decline

Shift toward Rice and Wheat

The increased preference for rice and wheat is another significant reason that led to the reduction in Kodo and Kutki production. After the Green Revolution, the Indian Government promoted rice and wheat using subsidy programs, irrigation systems, and other means to increase their yields. This ultimately resulted in them becoming a staple crop in much of India including tribal areas at the expense of millets. In addition to the growing popularity of rice, the PDS program made it possible for most households to purchase cheap rice through the distribution system which provided an incentive for many families to cease consuming millet. Food preferences and attitudes toward food changed over time; rice and wheat are now perceived as indicators of modernity and social standing, while millets are seen as "the poor man's food." Thus, younger generations have become disinterested in cultivating and eating millet-based foods and therefore the food culture surrounding millet has diminished.

Market and Policy Influences

Market-based elements have also been a major contributor to millet production reduction. When compared with rice and wheat, Kodo and Kutki are usually supported by fewer institutional efforts (i.e., purchase, store, process, and sell) than those other two grains. Millet farmers experience difficulty receiving good prices for their product because there is little or no access to markets, as well as less consumption. Without organized supply chains, and with even less government focus on it, most farmers would grow different crops that provided them better economic stability.

Government and Institutional Initiatives

National Millet Mission

India's government has implemented various programs to increase millet cultivation due to its nutritional and climate resiliency capabilities. The National Millet Mission will be working to grow millet as well as to provide better quality, a stronger supply chain, and an opportunity for the farmer selling millet. The national millet mission is also planning on promoting knowledge about how nutritious millets are and to try to get people to add millet into their diet.

International Year of Millets (2023)

The U.N.'s designation of 2023 as the "International Year of Millets" was an important step toward increasing global awareness about these ancient grains. By highlighting their nutritional, environmental, and economic value, the yearlong campaign also prompted national governments, researchers and research centers, and other organizations in civil society to promote millet-based food systems. Through various initiatives including awareness-building campaigns; exhibition displays; training sessions for farmers, consumers, and policymakers; and changes to policies regarding millet production and consumption, India's efforts brought greater attention to sustainable agricultural practices and nutrition through the use of Kodo (Paspalum scrobiculatum) and Kutki (Echinochloa frumentacea).

State-Level Programs in Madhya Pradesh

The State Government of Madhya Pradesh has taken a number of steps to stimulate millet production. Especially in tribal districts (for example Dindori), these actions included giving farmers high-quality seed, conducting training courses for farmers, providing technical support, and offering financial aid to millet growers. Millet was also incorporated into existing nutrition/livelihood projects. In cooperation with agricultural universities/research centers and tribal development organizations, the state government encouraged the renewal of traditional millet cultivation methods and strengthened marketing connections for millet grower communities.

Challenges in Revival

Limited Awareness

Despite growing recognition of the benefits of millets, awareness regarding their nutritional value remains limited among many consumers. Younger generations are often unfamiliar with traditional millet-based foods and may prefer processed and refined cereals. This lack of awareness reduces consumer demand and affects the profitability of millet cultivation.

Processing and Marketing Issues

Traditional processing is still an area of significant difficulty in regards to Kodo and Kutki revivals. In addition to being very labor intensive and time consuming; traditional processing techniques (i.e., removing millet grain husk) have contributed significantly to the high cost of producing these crops.

Millet producers also face many marketing challenges as well, such as branding issues, limited market access and limited distribution channels that will impede the growth of millet-based products.

Loss of Traditional Knowledge

Millet farming is slowly disappearing; it takes a vast amount of knowledge that was passed down through generations about seeds, growing the crop, how to prepare the crop, and how to store it. As many young people leave rural areas to seek education or employment elsewhere, they are no longer interested in learning how to farm as their ancestors did. Therefore, documenting these forms of knowledge will be vital to bringing back Kodo and Kutki.

Future Prospects

Value Addition

Addition to value of millet has a great scope for improving the economic viability of Kodo & Kutki cultivation. Millet based products like flour, biscuits, noodles, snacks, breakfast cereal, health mix, ready to cook food etc. are becoming popular among health-conscious people. Developing millet based diversified products will be able to increase consumer demand, improve farmer income & generate employment opportunity in rural area.

Market Development

Strengthening market structures is essential in order to ensure that millet revitalization activities are sustainable over time. The establishment of an effective system of procurement will assist in increasing the profit from millet production. Promoting FPOs, developing branding and packaging options, and creating opportunities for millet producers to sell into urban areas and internationally, as well as supporting public awareness programs that illustrate the health and nutrition advantages of millets, can create additional incentives to grow millet.

Nutrition-Sensitive Agriculture

The Kodo and Kutki promotion also fits well within the framework of nutrition-sensitive agriculture as it aims to achieve higher levels of agricultural production while at the same time producing better (i.e., more nutritious) foods for consumption. In addition to being integrated into government nutrition programs, school feeding programs, and community health projects, the inclusion of these two varieties of millets could assist in decreasing malnutrition rates and increasing the overall availability of diverse diets for tribal populations in Dindori District. Due to their ability to be resilient in a changing climate and high nutrient density, Kodo and Kutki offer the opportunity to develop long-term sustainable food systems and enhance the quality of life and livelihoods of tribal communities in Dindori District. In doing so, the revitalization of these two crop varieties will represent an important step toward attaining food security, environmental sustainability and equitable rural development.

Conclusion

Agricultural systems & food culture millet use in tribal communities Baiga and gond people have lived in the area for thousands of years. They live in the Dindori district, Madhya Pradesh. Kodo and Kutki millets were used historically in their farming systems and diets. Traditionally, they grow and eat this type of grain.

Review Kodo and Kutki are climate-resistant grains that provide nutrition and improve health outcomes.

Kodo and Kutki millets have higher levels of nutrients than common cereal grains like rice and wheat. Examples include: complex carbs, dietary fibers, proteins, minerals, vitamins, and bioactives. Because they have a lower gi and contain more fiber than most grains; they may help prevent or manage disease such as diabetes and heart disease. Kodo and Kutki are also rich in the same types of micro-nutrients that are missing from diets of tribal people; such as iron, calcium, phosphorus, etc. Many of which are critical for the health and wellbeing of tribal women and children.

Study reasons why farmers stopped growing and eating millets.

Farmers stopped growing millets because of various reasons; i.e., growing preference towards rice and wheat, changes in diet, lack of market access for millets, government policies favoring large cereal producers. Since there was less millet grown/used in diets; many tribal families lost some level of protection against malnutrition/micronutrient deficiency/food insecurity. Also, when tribal families started replacing millet-based foods with cereal based foods; it decreased their ability to maintain a varied diet and negatively impacted overall nutritional quality of their diet.

Study efforts to promote millet revival.

Recently there have been efforts to promote the revival of millet cultivation. Some examples of these efforts include; government funded projects like the National Millet Mission, international events such as the International Year of Millets (2023), and regional programs within Madhya Pradesh. These activities have helped increase awareness about the nutritional and environmental benefits of millets. Increased awareness has led to an increased number of farmers returning to millet cultivation. It has also provided tribal farmers with additional opportunities for adding value to their products; developing markets for those products; and increasing income.

Reviving millet is important for climate change, sustainable agriculture and public health.

Millets use fewer inputs and will continue to thrive even under dry/drought conditions. This makes them suitable for the poor tribal farmer who typically uses small plots of land. If we incorporate millets into our nutrition sensitive agricultural programming; food assistance programs; school meal programs; and community nutrition programs; we can reduce malnutrition while at the same time provide a variety of healthy food options.

Nutritional Importance of Kodo and Kutki

Kodo and Kutki millets are extremely nutrient-rich food grains that help improve the diets of many Tribal communities. Rich in complex carbohydrates, dietary fiber, proteins, vitamins and minerals, they provide a well-rounded diet. The high fiber in both Kodo and Kutki provides good digestive health and also keeps you full longer and helps with your blood glucose control. Iron, Calcium, Phosphorus and Zinc are all found in these millets and can assist with building strong bones, helping prevent infections and preventing a lack of nutrients (malnutrition) and therefore have the potential to be used as great weapons against malnutrition and to aid in improving the over-all health of the entire community.

Significance for Tribal Food Security

Kodo and Kutki make significant contributions to food and nutritional security for tribal communities within Dindori district. Both crops have been demonstrated as being adaptable to the climate in that region. Additionally, both crops can be grown by farmers with rain-fed or very low input systems. Both crops can provide food at all times due to the ability to survive under drought and adverse climate. In addition, the long shelf-life of the two crops allow families to store food throughout the year. The provision of nutritious food as well as support to dietary variety has strengthened household food security and reduced reliance on outside food.

Recommendations for Policy and Future Research

Future research will have a number of areas to investigate; the long-term health effects of millet-based diets, consumers' acceptance of value-added millet products, and the social and economic effects of millet revitalization efforts. Documentation of local knowledge systems, along with development of sustainable conservation strategies, is required to promote and protect the traditional millet-based food systems used by tribal communities. (Policy Measures) Millet's cultivation may be promoted using policy measures such as financial incentives, high-quality seeds, agricultural extension services, and better market access. Inclusion of Kodo and Kutki into public nutrition programs, school meal programs, and food security schemes would increase the amount of Kodo and Kutki that people consume and therefore its potential health benefits.

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