



# A Cross-Cultural Analysis of Traditional Knowledge of Pearl Millet Utilization between the Tonk District of Rajasthan and the Mainpuri District of Uttar Pradesh, India

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## Authors' contributions

This work was carried out in collaboration between both authors. Author DC designed the study. Author RY carried out the experiments and wrote the draft manuscript. Author DC supervised the study, and author RY analyzed the data and restructured the manuscript. Both the authors read and approved the final manuscript.

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## ABSTRACT

**Aims:** This study compares the use of pearl millet (*Pennisetum glaucum*) in Rajasthan and Uttar Pradesh, looking at cultural differences and potential future implications for genotype evolution in these areas.

**Study Design:** This study was based on semi-structured interviews.

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**Place and Duration of Study:** Bioscience and Biotechnology Department, Banasthali Vidyapith, Tonk, Niwai, Rajasthan, 2020–2023.

**Methodology:** To investigate the cultural and sociological elements promoting pearl millet adaptation, the study carried out a comparative ethnobotanical inquiry in the districts of Tonk, Rajasthan, and Mainpuri, Uttar Pradesh. From August 2020 to April 2023, 206 participants from each state participated in field surveys, semi-structured interviews, and focus groups. Data analysis was done to evaluate the applications, benefits, and growing practices of pearl millet.

**Results:** Pearl millet is an essential staple grain and livestock feed in Rajasthan and Uttar Pradesh. In both the districts nearly everyone consumes chapati made of millet flour. Pearl millet is a common livestock feed in both states, and people in Rajasthan use it specifically for feeding camels. Pearl millet has nutritional advantages, especially in heart disease and lowering cholesterol.

**Conclusion:** The study offers insightful information about the methods used in Rajasthan and Uttar Pradesh to grow pearl millet and its uses, and can be used to recommend policy changes and agricultural extension initiatives to improve productivity, food security, and farmers' livelihoods sustainably.

*Keywords:* Mainpuri; pearl millet; Rajasthan; survey; tonk; traditional use; Uttar Pradesh.

## 1. INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br] is cultivated for human consumption and animal fodder. Pearl millet is the third most dominant food grain in India after rice and wheat, grown both as a rainy season crop from June to October and as a summer crop from February to May. Pearl millet possesses the built-in capacity to survive under extremely high temperatures. For that reason, it is widely distributed in the arid zone and semi-arid tropics. The pearl millet growing states in India are Rajasthan, Uttar Pradesh, Maharashtra, Gujarat, Haryana, Karnataka, and Madhya Pradesh which together account for 98% of the total pearl millet area (8.69 million hectares) and 10.05 million ton average production in 2020-2022 (Sileshi et al., 2023).

It is believed that pearl millet originated in the Sahel area of Africa (Hanna et al., 2004). Depending on the area in which it is cultivated, this plant is either an obligatory or facultative upland species. Pearl millet grows best in sandy and acidic soils. Several studies on the ethnobotany of pearl millet have been conducted in Africa and India (Moussa et al., 2018, Verma et al., 2018, Naoura et al., 2019). The crops co-evolve with humans through a complex socio-cultural framework. Cross-cultural ethnobotany (Pieroniet al., 2005; Rexhepi et al., 2013) is very important for understanding crop evolution (Nyadanuet al., 2017). However, the cross-cultural traditional knowledge about pearl millet from different ethnic communities from Rajasthan and Uttar Pradesh is scarce.

Rajasthan, the northwestern region of India, consisting of 60% arid and 40 % semi-arid region, is the largest state of India. In the arid region, the average rainfall is below 400mm and in the semi-arid region, the average rainfall ranges from 500-800mm. The annual precipitation in Rajasthan is insufficient, causing regular agricultural droughts even when a meteorological drought is not declared. In Rajasthan, pearl millet is cultivated mainly as a rain-fed crop during the rainy season. The area under irrigated pearl millet cultivation is modest (6.1%, 2020-2021). In Rajasthan, the pearl millet production is 42.81 lakh tonnes from an area of 42.65 lakh Ha. (Anonymous, 2023).

Uttar Pradesh is located in India's north-central region and shares its borders with Nepal and among the Indian states, Himachal Pradesh, Uttaranchal, Haryana, Rajasthan, and Delhi. The total area of Uttar Pradesh is 2, 40,928 km<sup>2</sup>, and the state consists of ~7.0% of land area of India. The State has a variety of environments, from rich, fertile Bhabar areas to arid and semi-arid, thorny scrub. In addition to an astonishing variety of habitats and ecosystems, Uttar Pradesh is home to a huge diversity of both domesticated and wild plants and animals. Traditionally, the people of Uttar Pradesh have utilized this abundant biodiversity resource to meet their requirements for food, medicine, clothing, shelter, spirituality, recreation, fuel, and a variety of other necessities for survival. In Uttar Pradesh, the pearl millet production is 21.95 lakh tonnes from an area of 10.10 lakh Ha. (Anonymous, 2023).

Pearl millet is very rich in protein and fiber and used as food and fodder. The desi pearl millet in Rajasthan and UP is utilized primarily for food because of its superior quality as compared to hybrid pearl millet.

The cross-cultural ethnobotanical studies were carried out with objective to identify similarities and differences between the two districts in Rajasthan and Uttar Pradesh with respect to traditional ethnobotanical knowledge on pearl millet and explore the possible role of culture and tradition in its uses.

## 2. MATERIALS AND METHODS

### 2.1 Data Source and Methodology

The current study is the comparative ethnobotany of the Tonk district of Rajasthan and the Mainpuri district of Uttar Pradesh to understand how the adaptation of pearl millet is facilitated by culture and people. For this work, the villagers were interviewed.

### 2.2 Study Area

The current study is a comparative study of the Tonk district of Rajasthan and the Mainpuri district of Uttar Pradesh to understand how the adaptation of pearl millet is facilitated by culture and people.

Tonk district (26.40° N, 75.87° E, elevation 264.32 m) and Mainpuri district of Uttar Pradesh (27.22° N, 79.025° E). Tonk district is located in the Northeastern part of Rajasthan. The Tonk district is surrounded by Ajmer and Bhilwara districts to the west, the Jaipur district to the north, and Bundi district to the south. The following villages were surveyed under this investigation from Tonk district (Rajasthan): Akodiya, Jugalpura Khurd, Banasthali, Niwai, Majdur Basti, Deopura, and Shora shown in (Fig. 1). In the Mainpuri district of Uttar Pradesh, eight villages (Nagla Udi, Nagla vade, Bharatpur, Kusmara, Lekhrajpur, Badagaw, Karhal, and Kuchela) were field surveyed (Fig.1).

#### 2.2.1 Data collection

A representative sample was obtained for the survey's data analysis by the selection of respondents. The data was collected in major millet-producing villages in Uttar Pradesh and Rajasthan through field visits individual semi-structured interviews and focus group

discussions conducted from August 2020–to April 2023. Around 206 respondents were surveyed and randomly selected from the Tonk district of Rajasthan and a similar number from the Mainpuri district of Uttar Pradesh. Interview questionnaires were prepared in English and then translated orally into local languages. Data regarding the plants used, the parts used, and the food and fodder preparation methods were collected during the interviews. Villagers of different ages were interviewed (Table 1). Two criteria were given importance for choosing a person with eligible qualifications for being respondents or not—whether the respondent is a permanent resident of the village and is associated with continued pearl millet production/ usage over the previous 10 years (Gangaiah et al., 2024).

#### 2.2.2 Data analysis

The ethnobotanical data were arranged in tabular form and the bar diagram and line diagram were drawn based on the percentage of each parameter.

## 3. RESULTS AND DISCUSSION

During the study, 206 farmers were interviewed in Rajasthan (Tonk district) as well as Uttar Pradesh (Mainpuri district). 206 farmers from Rajasthan and 206 farmers from Uttar Pradesh were randomly selected. A stratified random sampling technique was used to choose these farmers, guaranteeing a representative sample from different geographic areas within the two districts. Farmers were questioned about their agronomic practices, including the uses, advantages, food and livestock feed, good for health, plant part uses, and irrigation techniques of pearl millet.

Pearl millet serves as a crucial staple food, according to farmer interviews, and was the basis for traditional cuisines like "bajra roti" and "bajra khichdi," which are not only nourishing but also culturally significant (Verma et al., 2018). In Uttar Pradesh, khichdi of pearl millet is consumed majorly in breakfast (Kane-Potakaet al., 2021). Pearl millet used as a chapati by 97.78% of the respondents in Rajasthan and Uttar Pradesh followed by Mathri in Rajasthan at 54.37 % (Fig.2). Villagers from both states utilize pearl millet as livestock fodder, which includes cows, goats, buffalo, hens while in Rajasthan it is also used as camel feed.

The agricultural, dietary, and economic well-being of the population in the two districts under study is significantly impacted by its many advantages. A thorough study revealed use of pearl millet in Rajasthan and Uttar Pradesh in heart disease, cancer, cholesterol, acidity, chronic diseases, weight loss, indigestion, and blood pressure (Fig. 4). A maximum number of the respondents reported uses for heart disease (90.78% in Rajasthan, 90.29% in UP) and weight loss (65.53% in Rajasthan, 77.67% in UP). Pearl millet is also consumed to treat fluctuations in

blood pressure (68.93% in Rajasthan, 62.62% in UP).

As a nutrient-rich source, pearl millet makes a substantial contribution to enhance health security. Pearl millet grains are said to have a protein content of 11–15% and are high in dietary fiber. The native population in the studied districts of Rajasthan and Uttar Pradesh, where the native population relies heavily on pearl millet as a source of protein and energy (Krishnan et al., 2018).

**Table 1. Survey Questioner format**

S. No.	Questions	Yes /No, Remarks
1	Do you know what pearl millet is?	
2	If yes, how frequently do you use it in your diet?	
3	How do you use pearl millet in your diet?	
4	Do you include pearl millet in your diet?	
5	How can you use pearl millet in your diet? (In what form).	
6	What is the use of pearl millet in your district?	
7	Do you know the benefits of pearl millet?	
8	If yes then describe.	
9	Do you know if we can use pearl millet as cattle feed?	
10	Pearl millet is good for health or not? If yes then describe some points.	

**Table 2. Survey questions and draft answers of pearl millet farmers of Tonk district (Rajasthan) and Mainpuri district (Uttar Pradesh)**

S. No.	Questions	Explanation and uses	Yes	No
1	Do you know what pearl millet is?		✓	
2	Do you include pearl millet in your diet?		✓	
3	If yes, how frequently do you use it in your diet?		✓	
4	How do you use pearl millet in your diet?	Use it as flour to make flatbreads and for multigrain cookies		
5	How can you use pearl millet in your diet? (In your what form).	Chapati, khichdi, Dalia, kheer	✓	
6	Do you know the benefits of pearl millet?		✓	
7	If yes then describe.	Reduces cholesterol and assists with easing constipation		
8	Do you know if we can use pearl millet as cattle feed?		✓	
9	What is the main use of pearl millet in your district?	Use it to create flour for chapati and cattle food		
10	Pearl millet is good for health or not? If yes then describe some points.	Good for a diabetic diet Good for heart patients To reduce the acidity of the stomach	✓	

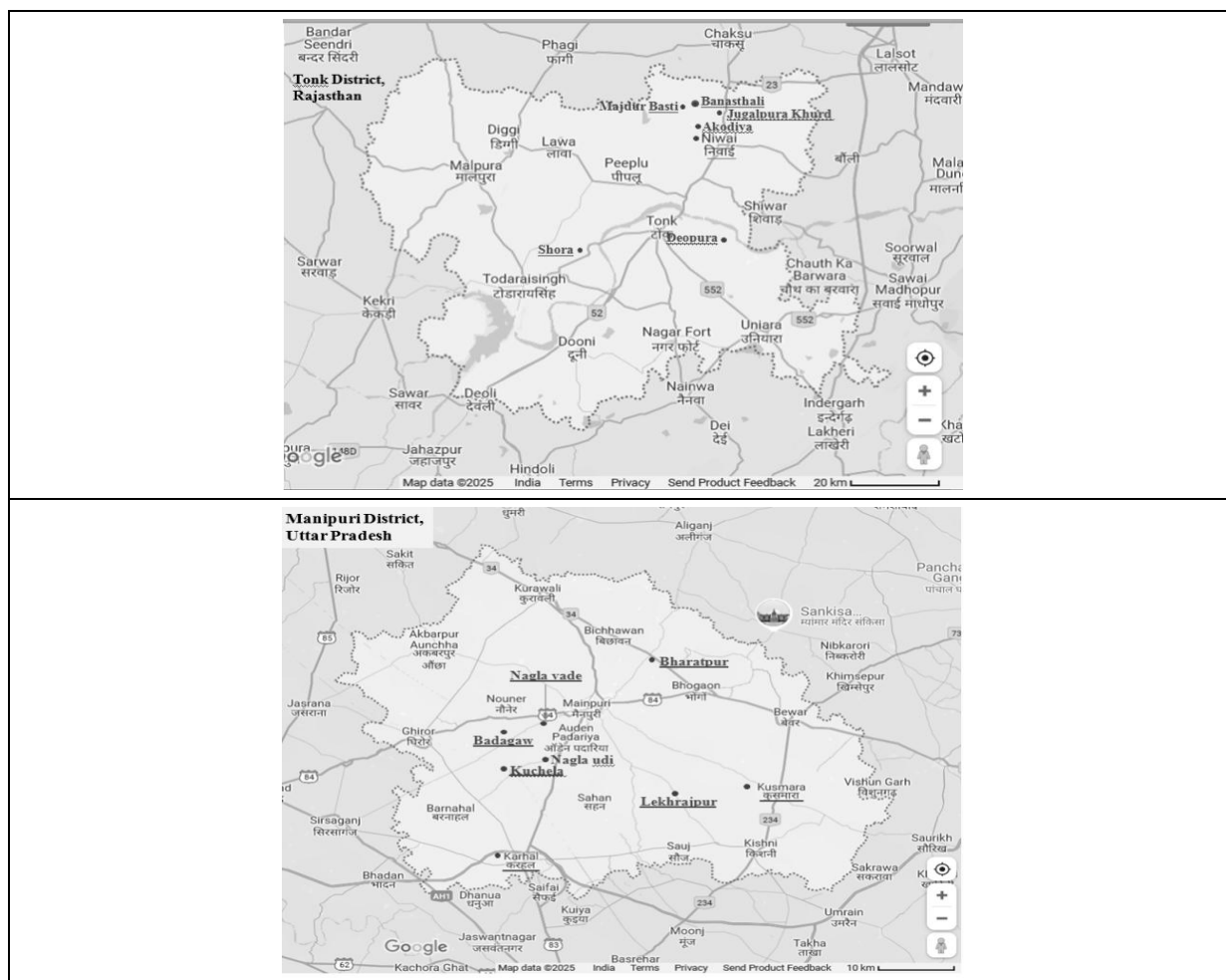


Fig. 1. Location of the study villages (underlined) in Tonk district (Rajasthan) and Mainpuri district (Uttar Pradesh). The image was produced using Google Maps.

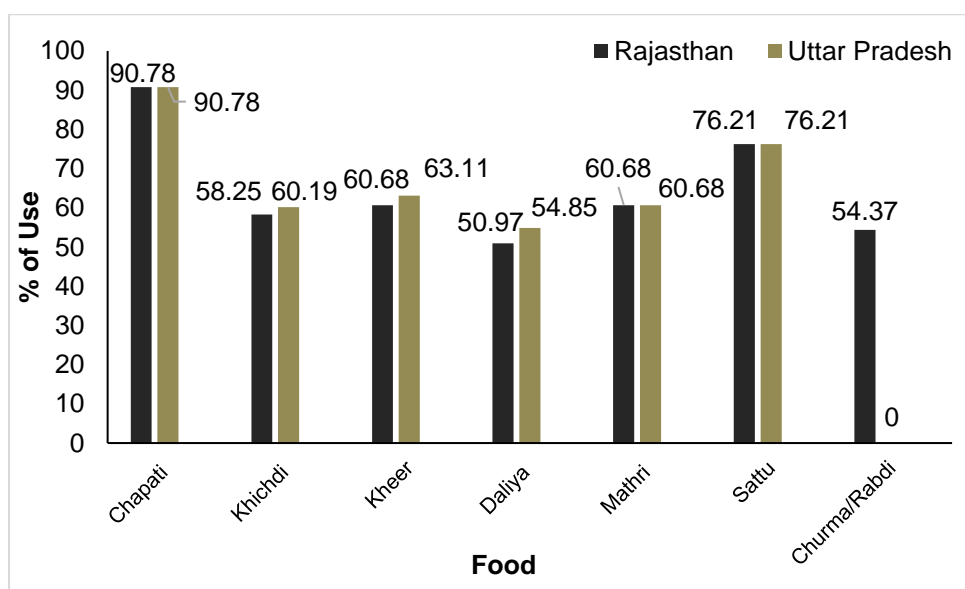


Fig. 2. Use of pearl millet as food in Tonk, Rajasthan and Mainpuri, UP

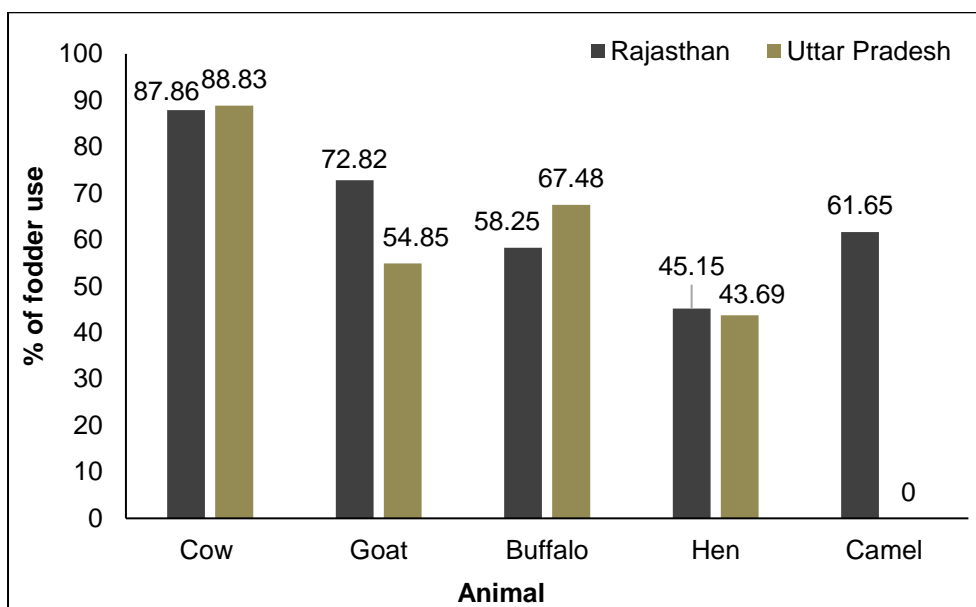


Fig. 3. Use of pearl millet as fodder in Tonk, Rajasthan and Mainpuri, UP

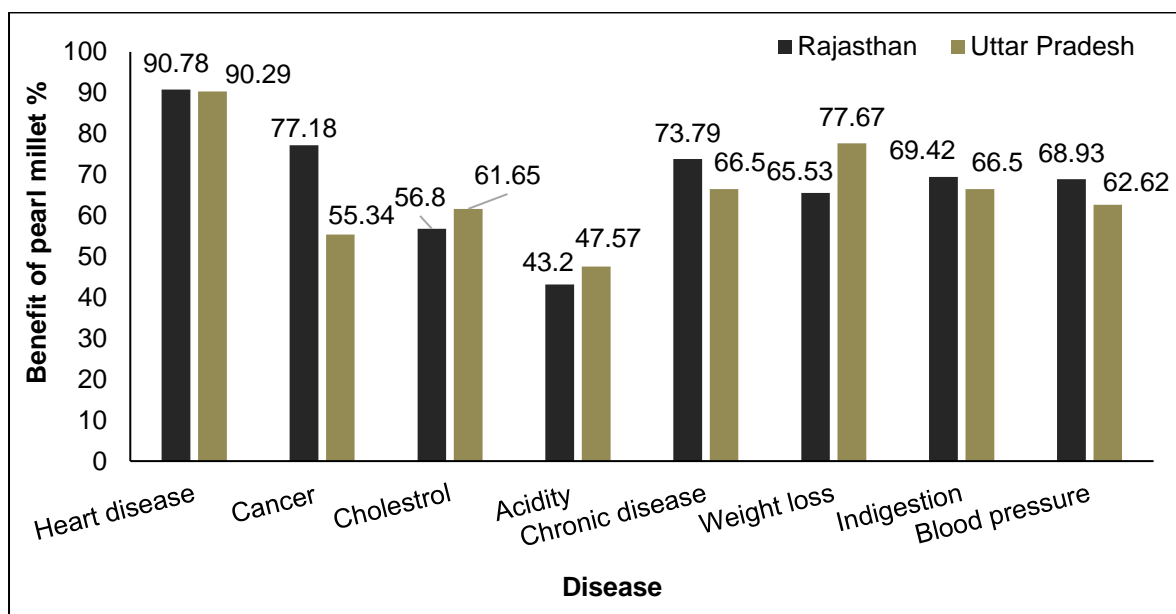


Fig. 4. Pearl millet health benefits as responded in Rajasthan and Uttar Pradesh

India's Rajasthan and Uttar Pradesh are the states where pearl millet is most often consumed as a staple crop especially in the winter season. There is a consistent trend of pearl millet consumption throughout both states. To maintain its use as a staple in farming areas and other locations, sustainability should be the primary objective in addition to aiming for higher yields. The food sector should be given incentives to use pearl millet in both innovative and classic processed food items (such as bread and

biscuits etc.) (Rao et al., 2024). Both the pearl millet crop producer and the consumer would gain by taking advantage of the specialty markets that are emerging in urban India. The prospects for pearl millet utilization and production are encouraging. Therefore, research into customer preferences and the needs of pearl millet utilization profiles will aid in identifying the target categories for increased market share.

#### 4. CONCLUSION

The research on pearl millet in Rajasthan and Uttar Pradesh gave useful scientific information on the development of the pearl millet industry in these two states. 412 farmers were interviewed, and the results showed a wide range of agriculture practices, difficulties, and opportunities. Based on this information, policy suggestions and agricultural extension programs may be created that will increase the production of pearl millet, increase food security, and enhance the lives of local farmers. These results can serve as a foundation for future studies and activities aimed at promoting sustainable pearl millet farming methods and ensuring the adaptability of this crucial crop to changing economic and environmental situations.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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