IFPRI Discussion Paper 02434

July 2026

Reviving Millets in India

Understanding Consumption Decline and Demand-Side Constraints

Anjani Kumar

Vanshika Pahwa

M L Jat

Development Strategies and Governance Unit
IFPRI South Asia Regional Office

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), a CGIAR Research Center established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Anjani Kumar (Anjani.Kumar@cgiar.org) is a Senior Research Fellow in the Development Strategies and Governance (DSG) Unit of the International Food Policy Research Institute (IFPRI), New Delhi, India.

Vanshika Pahwa (v.pahwa@cgiar.org) is a Research Analyst in IFPRI's DSG Unit, New Delhi, India.

M L Jat (dg.icar.nic.in) is Secretary, Department of Agricultural Research & Education and DG, Indian Council of Agricultural Research, New Delhi, India.

Contents

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Millets are increasingly promoted as climate-resilient and nutrient-dense crops in India's food systems transformation. Yet, despite rising policy support, their consumption continues to decline. This paper analyzes long-term trends and demand-side determinants of millet consumption using nationally representative data from Household Consumption Expenditure Surveys (2011–2012, 2022–2023, 2023–2024). Results show a steep decline in per capita millet consumption of more than 80 percent in rural areas since the late 1980s and a sharp reduction in the share of millets in total cereal consumption. Using a double hurdle model, we find that millet consumption remains concentrated among rural, lower-income, and less-educated households, with limited uptake among urban and higher-income groups. Participation in the Public Distribution System (PDS) increases the likelihood of consumption but reduces consumption intensity, indicating substitution with subsidized rice and wheat. We document a large production–consumption gap of nearly 14 million tons, suggesting increasing diversion of millets toward feed and processing uses. The findings highlight the need to rebalance cereal policies and strengthen demand-side incentives to integrate millets into modern food systems.

Keywords: Millets, Food Consumption, Demand Determinants, Economic Incentives, India

ACKNOWLEDGMENTS

This study was undertaken with support from the Indian Council of Agricultural Research (ICAR) under the ICAR–IFPRI Work Plan. The suggestions provided by the participants in the ICAR–IFPRI Annual Work Plan Review meeting are duly acknowledged.

1. INTRODUCTION

Global agrifood systems are facing increasing pressure to simultaneously address food and nutrition security, environmental sustainability, and climate resilience. Over the past several decades, agricultural development strategies have largely focused on increasing the productivity of a limited number of staple cereals, particularly rice, wheat, and maize. While these efforts have significantly improved food availability, they have also contributed to reduced crop diversity in both production systems and diets (Pingali 2012; FAO 2024). The resulting dependence on a narrow set of staple crops has raised concerns about nutritional imbalances, vulnerability to climate shocks, and the long-term sustainability of food systems (Willett et al. 2019). In this context, there is growing interest in promoting climate-resilient and nutrient-dense crops that can contribute to diversified and sustainable food systems.

Millets have gained renewed attention as crops that can simultaneously address these challenges. Often referred to as "nutri-cereals," millets possess several nutritional and agronomic advantages compared with major cereals such as rice and wheat. They are rich sources of micronutrients including iron, calcium, and zinc, and contain higher levels of dietary fiber and bioactive compounds that contribute to improved metabolic health (Anitha et al. 2021; Gowda et al. 2022; Rao et al. 2017). Millets also have relatively low glycemic indices and have been associated with reduced risks of noncommunicable diseases such as diabetes and cardiovascular disease (Saleh et al. 2013). From a production perspective, millets are well suited to dryland and rainfed agro-ecosystems due to their tolerance to drought, heat stress, and poor soil conditions. Their relatively low input requirements make them particularly suitable for smallholder farming systems and resource-constrained environments (Birthal et al. 2014; FAO 2023). Consequently, millets are increasingly viewed as important crops for climate-resilient agriculture and sustainable food systems.

India plays a pivotal role in the global millet economy. The country accounts for nearly 38 percent of global millet production and cultivates a wide range of millet crops, including pearl millet (bajra), sorghum (jowar), finger millet (ragi), and several small millets such as foxtail, barnyard, and kodo millets (FAO 2023). Historically, millets formed an integral component of traditional diets in many parts of India, particularly in semi-arid regions where they were well adapted to local agro-ecological conditions (Rao et al. 2017; Sreekala et al. 2023). However, both the production and consumption of millets have declined substantially over the past several decades.

The decline of millets in India is intricately linked to structural transformations in the country's agricultural and food systems. The Green Revolution period witnessed largescale investments in irrigation infrastructure, high-yielding varieties, input subsidies, and procurement systems that primarily benefited rice and wheat production (Pingali 2012; Gulati et al. 2021). These policy interventions significantly increased the availability and affordability of rice and wheat, leading to their widespread adoption in both production and consumption. The expansion of the PDS, which distributes subsidized rice and wheat to millions of households, further reinforced this shift in dietary patterns (Khera 2011; Drèze and Khera 2017). As a result, traditional coarse cereals such as millets gradually lost their prominence in both farming systems and household diets.

Beyond policy influences, broader socioeconomic changes have also contributed to the decline in millet consumption. Rapid urbanization, rising incomes, and evolving consumer preferences have led to increased demand for refined cereals, processed foods, and more diversified diets (Deaton and Drèze 2009; Pingali and Sunder 2017). These transitions have been accompanied by changing perceptions that often associate millets with traditional or "inferior" foods, particularly among urban consumers. The relatively limited development of millet value chains, including processing, marketing, and product diversification, has further constrained the availability and convenience of millet-based foods in modern food markets.

Recognizing the importance of millets for sustainable agriculture and nutrition security, the Government of India has recently undertaken several policy initiatives to revive millet production and consumption. These include the launch of national and state-level millet missions, support for millet-based value chains, increased investments in research and development, and efforts to incorporate millets into food-based safety net programs such as the PDS and school meal schemes. India also spearheaded a global initiative leading to the declaration of 2023 as the International Year of Millets by the United Nations, which has significantly enhanced global awareness and policy attention toward these crops (FAO 2023; Government of India 2023).

Despite renewed policy attention toward millets, evidence suggests that millet consumption in India remains low and continues to decline in many regions. Understanding the factors underlying this persistent decline is therefore critical for designing effective strategies to promote millet-based food systems. While existing studies have examined trends in millet production and agronomic performance, relatively little empirical research has analyzed the demand-side determinants of millet consumption using recent nationally representative household-level data. The paper seeks to address this gap by analyzing patterns and determinants of millet consumption in India using recent rounds of the Household Consumption Expenditure Survey (HCES). Specifically, the paper addresses three key questions. First, how has millet

consumption evolved over time across rural and urban India? Second, how does millet consumption vary across states and income groups? Third, what socioeconomic and institutional factors influence households' decisions to consume millets and the quantity consumed? To answer these questions, the study combines descriptive analysis of long-term consumption trends with econometric estimation using Cragg's double hurdle model. This framework allows us to examine the determinants of households' millet consumption and the intensity of their consumption.

The study makes three main contributions to the literature on food systems transformation and cereal consumption in India. First, it provides updated empirical evidence on millet consumption trends using the latest nationally representative household consumption surveys to document the sharp decline in millet consumption across both rural and urban areas over the past three decades. Second, the study identifies the socioeconomic and institutional determinants of millet consumption using a double hurdle framework that distinguishes between the decision to consume millets and the quantity consumed. Third, the analysis highlights the substantial gap between official estimates of millet production and measured household consumption, pointing to the need for better understanding of how millets are used within India's agrifood system. By providing new evidence on the demand-side dynamics of millet consumption, this paper also contributes to ongoing policy debates on how to revive millet-based food systems in India and strengthen the role of millets in promoting diversified, climate-resilient, and nutrition-sensitive food systems.

The remainder of this paper is structured as follows. Section 2 presents the conceptual framework showing the decline in millet consumption, Section 3 describes the data and methods used in the analysis. Sections 4 and 5 examine trends in millet consumption; long-term patterns in area, production, and yield; and the relative economics of millet production. Section 6 analyses the socioeconomic and institutional determinants of millet consumption. Section 7 addresses the production–consumption gap in millets, and Section 8 concludes with policy implications.

2. CONCEPTUAL FRAMEWORK

The decline in millet consumption in India is the result of policy incentives, structural transformation, and market constraints. As illustrated in Figure 1, this study conceptualizes millet consumption not only as a function of household preferences but also the result of a broader food system transition shaped by supply- and demand-side factors.

At the core of the framework are three sets of drivers. First, policy-induced distortions play a central role in shaping cereal consumption patterns. Since the Green Revolution, agricultural policies, including minimum support prices (MSP), input subsidies, irrigation investments, and public procurement, have disproportionately favored rice and wheat. The PDS reinforces this bias by supplying these cereals at highly subsidized prices. As shown in Figure 1, these interventions lower the effective consumer price and increase the availability of rice and wheat relative to millets, creating strong incentives for households to substitute millets with rice and wheat. Thus, millet consumption is influenced not only by intrinsic preferences but also by policy-driven distortions in relative prices and access.

Second, economic development contributes to dietary shifts. In line with Bennett's Law, rising incomes, urbanization, and occupational diversification lead households to move away from coarse cereals and toward refined grains, processed foods, and higher-value diets. As depicted in the framework, these changes alter consumption preferences and food environments. Millets, historically embedded in traditional diets, are increasingly perceived as inferior or less convenient, particularly among urban and higher-income households. Consequently, their role in the consumption basket diminishes unless they are repositioned within modern food systems.

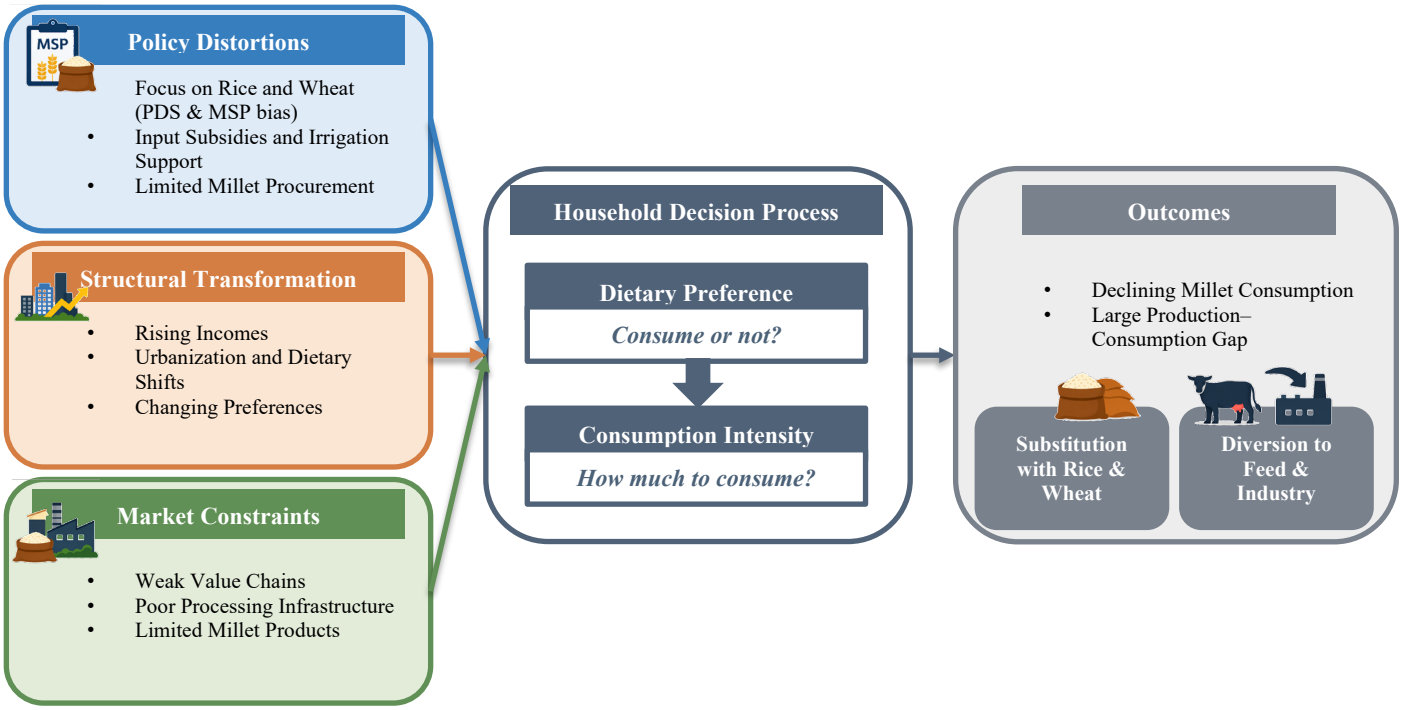
Third, market and value chain constraints further limit the competitiveness of millets. Compared to rice and wheat, millets are characterized by weak value chains, limited processing infrastructure, and inadequate product diversification. These constraints translate into higher retail prices, shorter shelf life, and longer preparation times, reducing their attractiveness to consumers. As highlighted in Figure 1, the lack of convenient and processed millet products restricts their integration into urban diets, even with increasing awareness of their nutritional benefits.

These three sets of drivers converge within household decision-making, which is modeled as a two-stage process. As illustrated in the central block of Figure 1, households first decide whether to consume millets at all (participation decision), which is influenced by access, cultural preferences, and exposure. Conditional

on participation, households then decide how much to consume (consumption intensity), which depends on income, prices, household characteristics, and substitution with other cereals. This two-stage structure provides the basis for the empirical strategy adopted in this study, namely the use of Cragg's double hurdle model.

The interaction of these drivers leads to observable outcomes, including declining millet consumption and a growing divergence between production and household consumption. As indicated in the framework, reduced demand not only reflects substitution toward rice and wheat but also contributes to a broader utilization shift, with millets increasingly diverted toward feed, processing, and other nonfood uses.

Figure 1. Drivers of declining millet consumption in India



Source: Authors' own illustration.

Note: MSP = minimum support prices; PDS = public distribution system.

Taken together, the conceptual framework highlights that the decline in millet consumption is not solely the result of changing preferences but also reflects a systemic transformation of the food economy, driven by policy biases, economic change, and market constraints. These forces interact to create a reinforcing cycle in which declining demand weakens production incentives, further limiting availability and consumption.

Understanding these interconnected drivers is essential for designing effective policy interventions. The framework suggests that supply-side promotion is unlikely to revive millet consumption unless it is accompanied by measures that address demand-side constraints embedded in India's food policy, market structure, and evolving food environments.

3. DATA AND METHODOLOGY

3.1 Data

The analysis primarily draws on two data sources. First, data on the area, production, and yield of major cereals, including millets for the period from 1985/86 to 2024/25, were compiled from the Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India. These data are used to examine long-term trends in millet production, area, and productivity. Second, the study uses unit-level data from three rounds of the HCES conducted by the National Statistics Office (NSO) in 2011–2012, 2022–2023, and 2023–2024. These nationally representative surveys cover more than 100,000 households across all states and union territories of India and collect detailed information on household consumption and expenditure for a wide range of food and nonfood items.

The HCES 2022–2023 and 2023–2024 surveys follow the Modified Mixed Reference Period approach, which uses a 7–day recall period for selected high-frequency food items and a 30–day recall period for other food items. Schedule Type II of the 2011–2012 Consumption Expenditure Survey adopts a similar recall structure, ensuring comparability across survey rounds. In addition to consumption data, the surveys provide detailed information on household socioeconomic characteristics, including religion, social group, occupation type, and participation in the PDS. Demographic information for individual household members, such as age, gender, marital status, and educational attainment is also recorded.

These datasets allow for an examination of long-term trends in millet production and consumption, as well as the socioeconomic determinants of millet consumption at the household level.

3.2 Methods

The empirical analysis combines descriptive and econometric approaches. The descriptive analysis examines trends and patterns in millet consumption across time, states, and consumption quintiles, as well as long-term trends in millet area, production, and yield. This analysis provides insights into the evolution of millet consumption and production within India's changing cereal consumption patterns.

To analyze the determinants of millet consumption at the household level, we employ Cragg's double hurdle model (Cragg 1971). Millet consumption is characterized by a large number of zero observations, as many households do not consume millets (82.7 percent of the sample). The prevalence of zero observations may be driven by distinct mechanisms. The decision to consume millets may be shaped by multiple factors affecting participation, including access to millet and millet products, familiarity with

millet-based foods, ease of cooking, shelf life, and dietary and cultural preferences (Sreekala et al. 2023; ICAR-IIMR 2015). Thus, we assumed that households' decision-making about whether to consume millets involves two stages. First, the household decides whether to consume millets (a dichotomous decision) and then decides on the intensity of consumption (a continuous variable). The ordinary least squares model is inappropriate because the dependent variable is censored at zero, potentially leading to biased estimates.

The double hurdle model addresses this issue by modeling the household decision process in two stages. In the first hurdle, we estimated the probit model to determine the probability of a household consuming millets and, in the second hurdle, we use a truncated regression model to determine the intensity of consumption. Each hurdle is conditioned by the household's socioeconomic and institutional characteristics.

The double-hurdle model can be represented as:

$y_{1i}^{*} = z'_i \alpha + v_i$ (Participation decision)

$y_{2i}^{*} = x'_1 \beta + u_i$ (Consumption intensity decision)

where:

- i represents households
- y_{1i}^{*} is a latent variable describing household's decision to consume or not and y_{2i}^{*} is a latent variable describing the desired level of consumption
- z_i and x_i are vectors of independent variables explaining the participation decision and consumption intensity, respectively
- α and β are vectors of coefficients associated with the respective independent variables z_i and x_i
- v_i and u_i are the respective independent and normally distributed error terms with zero mean and constant variance

The observed level of consumption y_i is therefore defined as:

$$y_i = \begin{cases} y_{2i}^{*} = x'_i \beta + u_i, & \text{if } y_{1i}^{*} > 0 \text{ and } y_{2i}^{*} > 0, \\ 0, & \text{otherwise} \end{cases}$$

The parameters of the model are estimated using maximum likelihood estimation, which jointly evaluates the likelihood contributions from both the participation and consumption equations. The parameters of the model are estimated using maximum likelihood estimation, which jointly evaluates the likelihood contributions from both the participation and consumption equations. The double hurdle specification is particularly appropriate in the context of this study because it allows the participation decision and the

consumption intensity decision to be determined by separate latent processes, while allowing the same explanatory variables to exert different effects across the two hurdles. In contrast, the Tobit model imposes the restriction that a single latent process governs both decisions, whereas the Heckman selection model assumes that zero observations arise solely from sample selection.

To evaluate the suitability of the double-hurdle framework, we compare it with the nested Tobit specification using a likelihood ratio test. The Tobit restriction is strongly rejected ($\chi^2(8) = 20{,}134.53$; $p < 0.001$), indicating that participation and consumption intensity are better modeled as separate decision processes.

3.3 Variables and model specification

We conduct our econometric analysis using the 2023–2024 round of the HCES to identify the socioeconomic and institutional drivers associated with millet consumption. The dependent variable in our analysis is household millet consumption. It is constructed as the aggregate quantity in kilograms of the four millet varieties (bajra, jowar, ragi, and small millets), consumed by a household during the reference period of 30 days. Two aspects of millet consumption are analyzed within the double hurdle framework: (1) the decision to consume millets, and (2) the quantity of millets consumed conditional on participation. The participation equation models whether a household consumes millets, while the outcome equation models the intensity of millet consumption among households that report positive consumption.

Millet consumption is highly right-skewed, characterized by a large proportion of non-consuming households (82.7 percent of the sample), reflecting the limited penetration of millets across Indian households. To address this, we transform the dependent variable using the natural logarithm of one plus consumption, $\ln(y + 1)$. This shifted logarithmic transformation retains zero observations, preserving the non-consumer classification required for the first hurdle of the double hurdle model. At the same time, it reduces skewness and the influence of extreme observations in the intensity equation, thereby improving conformity with the distributional assumptions underlying maximum likelihood estimation. We further examine the residuals from the truncated regression estimated on the consuming subsample, which exhibit near-normal characteristics (skewness = –0.024; kurtosis = 3.916), lending support to the normality assumption underlying the truncated regression component of the double hurdle model.

The explanatory variables included in the model capture household demographic characteristics, socioeconomic status, and institutional factors that may influence millet consumption. These variables include characteristics of the household head (gender, age, and education), household size, sector of

residence (rural or urban), social group, participation in the PDS, and monthly per capita consumption expenditure (MPCE), which serves as a proxy for household income. Household demographic variables capture differences in food preferences and consumption behavior across households. For example, larger households may consume greater quantities of staple foods, while older household heads may be more likely to maintain traditional dietary practices such as millet consumption. Education is expected to influence food choices through awareness of nutritional attributes as well as changing lifestyle preferences.

Institutional variables such as participation in the PDS are included to capture households' access to subsidized foodgrains through the public food distribution system. While the composition of cereals distributed through the PDS varies across states, participation in the PDS reflects households' access to subsidized cereals and may therefore influence their cereal consumption patterns.

MPCE is used as a proxy for household economic status and helps capture the role of income in shaping dietary choices. Higher-income households may diversify their diets away from traditional coarse cereals, while lower-income households may continue to rely on staple cereals, depending on price and availability. Table 1 summarizes the variables used in econometric analysis.

Table 1. Variables used in the econometric analysis

Variable	Description	Expected relationship with millet consumption
Millet consumption	Log of household monthly millet consumption, kg	Dependent variable
Participation in millet consumption	Dummy variable (1 = household consumes millets; 0 otherwise)	Dependent variable (participation equation)
Sex of household head	Dummy variable (1 = female-headed household; 0 otherwise)	Ambiguous
Age of household head	Age of the household head (years)	Positive (older households may maintain traditional diets)
Education of household head	Years of schooling of household head	Ambiguous / possibly negative
Household size	Number of members in the household	Positive
Rural residence	Dummy variable (1 = rural; 0 = urban)	Positive
Social category	Caste group (scheduled caste/scheduled tribe, Other backward class, others)	Varies by region
Participation in PDS	Dummy variable (1 = household receives PDS benefits; 0 otherwise)	Ambiguous / possibly negative due to rice–wheat substitution
MPCE	Monthly per capita consumption expenditure (Rs)	Ambiguous

Source: Authors' compilation based on HCES 2023–24.

4. CONSUMPTION TRENDS

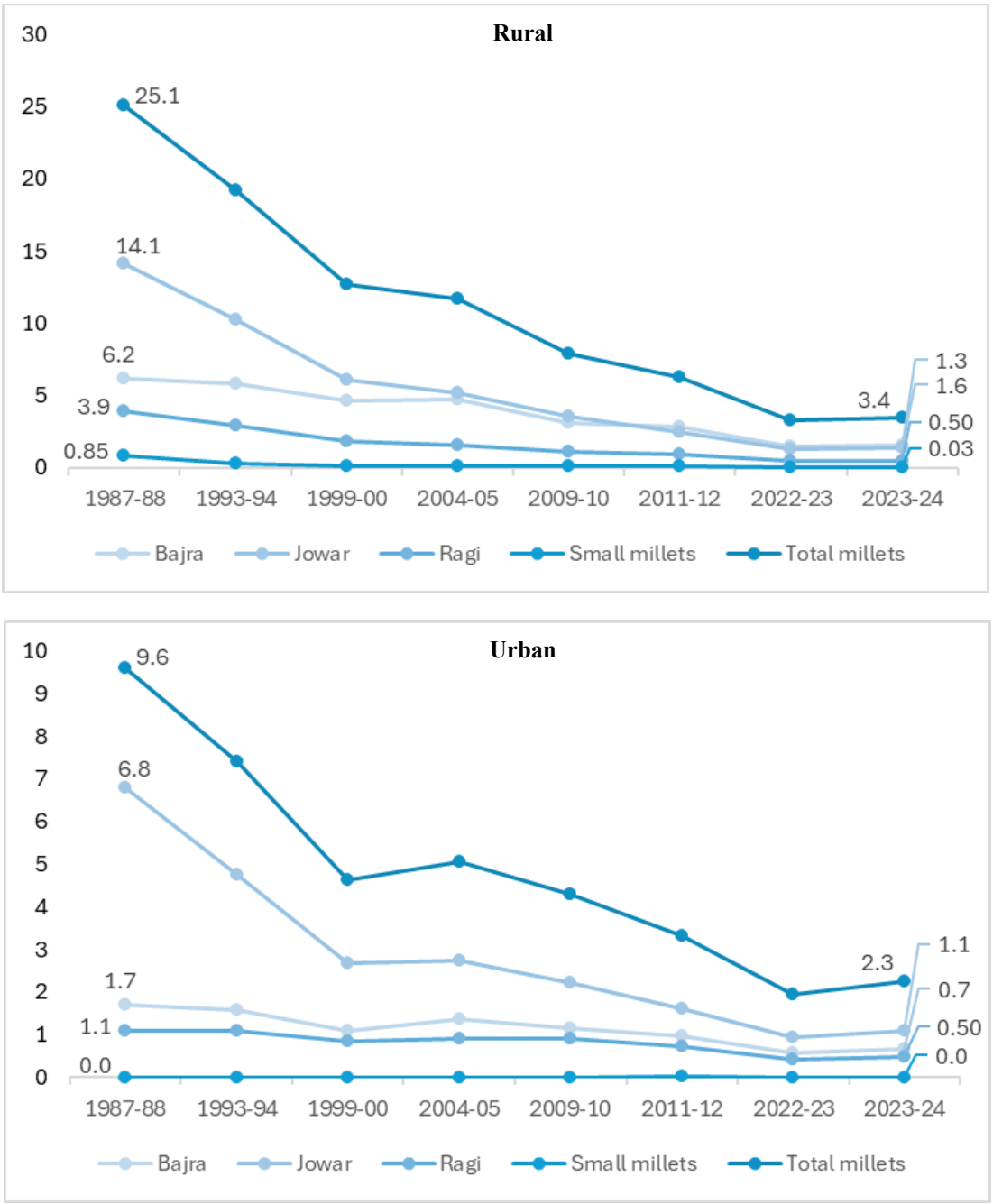
4.1 Long-term trends in millet consumption

Analysis of long-term trends in the consumption of millets in India indicate a pronounced decline in per capita millet consumption across both rural and urban areas over the past three decades (Figure 2). Between 1987/88 and 2023/24, annual per capita millet consumption in rural areas fell sharply from 25.1 kg to 3.4 kg, representing a decline of nearly 86 percent. Urban consumption also declined substantially during the same period, from 9.6 kg to 2.3 kg per capita per year.

This decline has been driven primarily by a sharp reduction in the consumption of jowar (sorghum), which historically constituted the largest share of millet consumption in India. In rural areas, annual per capita consumption of jowar declined from 14.1 kg in 1987/88 to 1.3 kg in 2023/2024, while in urban areas it fell from 6.8 kg to 1.1 kg. Consumption of bajra (pearl millet) also declined significantly, though less dramatically, from 6.2 kg to 1.6 kg in rural areas and from 1.7 kg to 0.7 kg in urban areas over the same period.

The magnitude of this decline coincided with major changes in India's food system over the past several decades. Increased availability and subsidized distribution of rice and wheat through the PDS, along with technological and policy support under the Green Revolution, significantly altered cereal consumption patterns and diminished the role of traditional coarse cereals in household diets.

Figure 2. Average annual per capita consumption (kg) of millets in India (1987/88–2023/24)



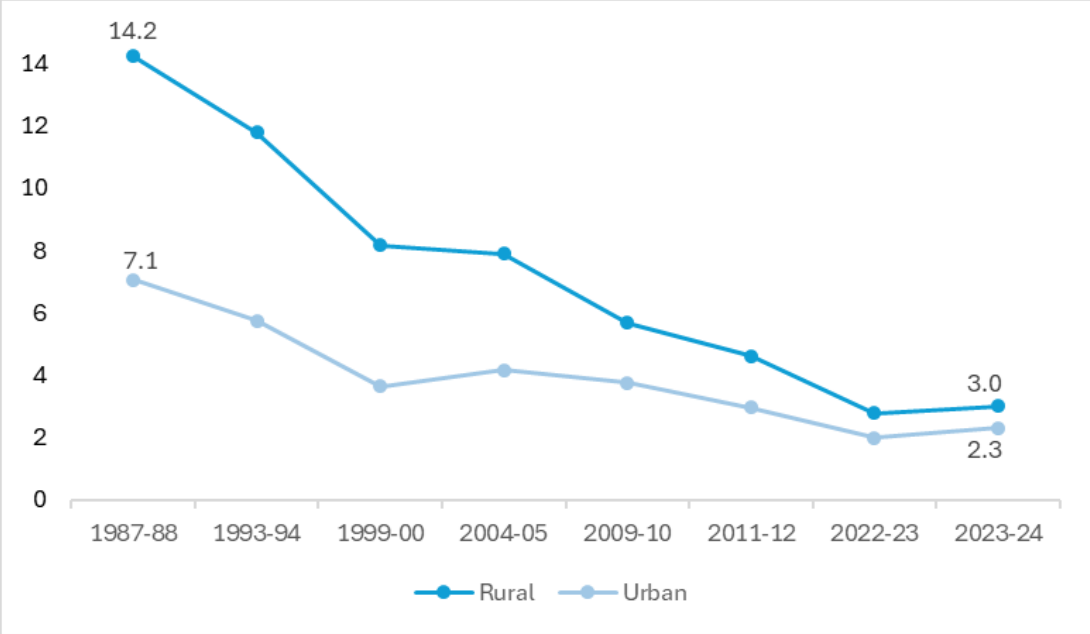
Source: NSO Consumption Expenditure Surveys (various rounds).

Note: *Bajra* (pearl millet), *Jowar* (sorghum), *Ragi* (finger millet). For 2022–2023 and 2023–2024, the all-India per capita millet consumption estimates reported by the NSO are based only on the population of states where millet consumption was recorded, rather than on the total national population. In contrast, our estimates use the total national population as the base.

4.2 Changes in millet share in cereal consumption

Findings on the share of millets in total cereal consumption reveal a steady and substantial decline in the relative importance of millets in the cereal basket (Figure 3). In rural areas, the share of millets in total cereal consumption declined from 14.2 percent in 1987/88 to just 3.0 percent in 2023/24. A similar trend is observed in urban areas, where the share declined from 7.1 percent to 2.3 percent over the same period. These findings are consistent with earlier literature which indicates that increased household incomes and expanded access to rice and wheat through the PDS has coincided with declining consumption of coarse cereals, including millets (Mittal 2007; Kumar et al. 2007).

Figure 3. Percentage share of millets in total cereal consumption (1987/88–2023/24)



Source: NSO Consumption Expenditure Surveys (various rounds).

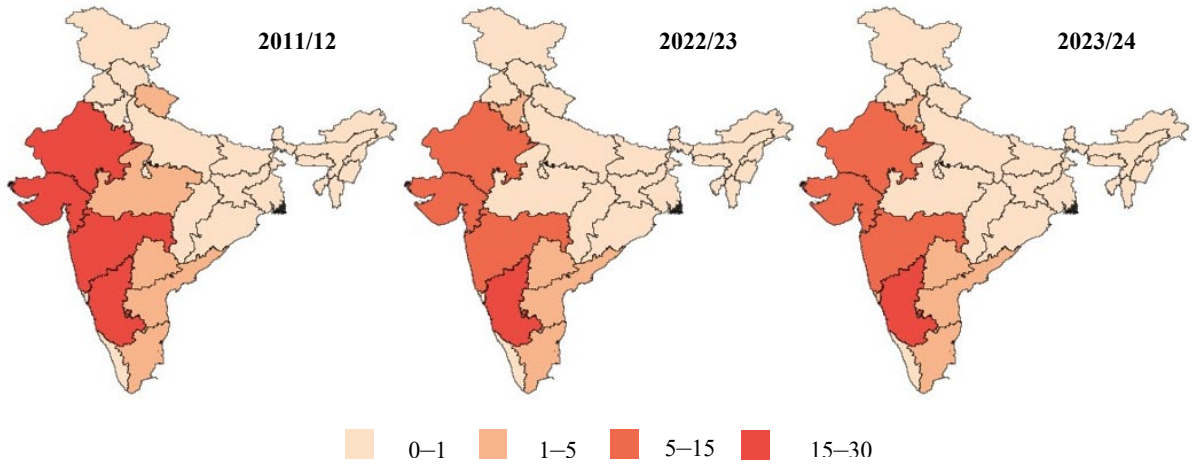
4.3 Regional patterns of millet consumption

Millet consumption in India exhibits strong regional variation, reflecting historical production patterns and local dietary traditions. Figure 4 illustrates state-level patterns of millet consumption between 2011/12 and 2023/24. The results show that millet consumption remains concentrated in a limited number of states, particularly Karnataka, Rajasthan, Maharashtra, and Gujarat. These states have historically been major producers of millets and continue to exhibit relatively higher consumption levels compared with the rest of the country.

Despite their historically strong association with millet-based diets, these states also experienced substantial declines in consumption over time. For instance, in Gujarat, annual per capita millet consumption declined from 17.6 kg in 2011/12 to 7.6 kg in 2022/23, a reduction of more than 50 percent. Maharashtra recorded a similar decline of approximately 45 percent over the same period. Karnataka and Rajasthan also experienced notable reductions in consumption levels. The overall pattern suggests that millet consumption remains geographically concentrated and continues to decline, even in regions where these cereals were historically dominant.

The regional concentration of millet consumption highlights the persistence of agro-ecological and cultural influences on dietary patterns. In many states where rice and wheat dominate production and distribution systems, millet consumption remains extremely limited. This suggests that the revival of millet consumption may require region-specific policy strategies that account for historical dietary patterns and local production systems.

Figure 4. Trends in millet consumption across states in India (annual kg per capita)



Source: Authors' estimates using unit-level data from NSO surveys.

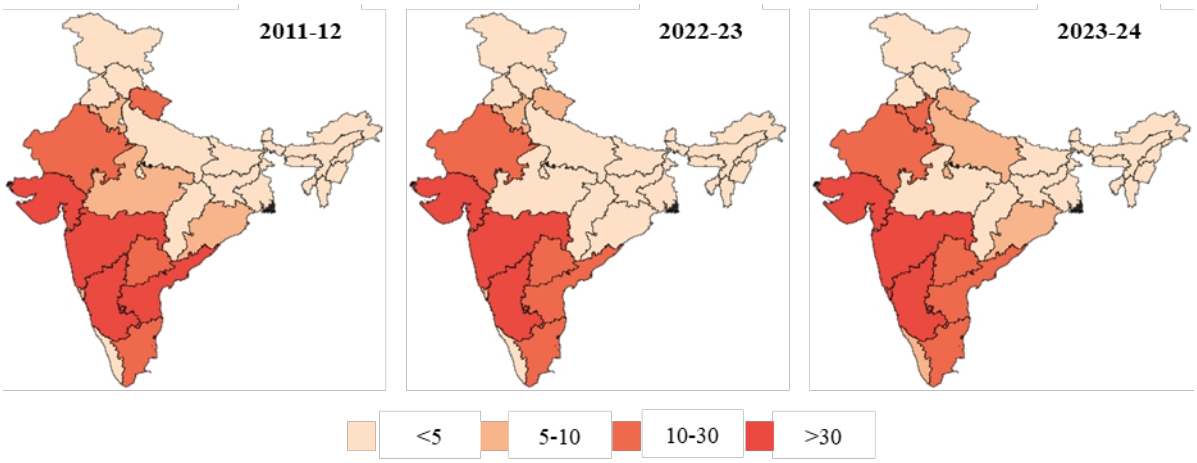
The broader literature emphasizes that the decline in millet consumption reflects the combined influence of multiple socioeconomic and institutional factors. Government policies such as the Green Revolution, the PDS, and substantial investments in research and development promoted the production, procurement, and distribution of fine cereals such as rice and wheat at the expense of coarse grains (Sreekala et al. 2023; ICAR-IIMR 2015). Rising incomes, urbanization, and changing consumer tastes and preferences further contributed to dietary shifts toward refined cereals (Mittal 2007; Kumar et al. 2007). As a result, rice and wheat became increasingly accessible and firmly integrated into national food systems, whereas millets

remained confined to specific regions, characterized by weak market integration, limited processing and value addition, and the continued perception of being a "poor man's" cereal (ICAR-IIMR 2015).

However, between 2022/23 and 2023/24, there was a slight uptick in the consumption of millets, especially in urban areas. This increase could be attributed to recent efforts by the government, such as declaring 2023 as the International Year of Millets, and growing awareness of the nutritional benefits of millets among the health-conscious urban population.

The state-level distribution of households consuming millets in 2011/12 and 2023/24 shows a similar pattern, with consumption concentrated in a few states, such as Karnataka, Gujarat, and Maharashtra, where more than 30 percent of households report consuming millets (Figure 5). However, the proportion of households consuming millets in these states has declined over time. In both Gujarat and Maharashtra, the share of millet-consuming households fell by more than 10 percent. In contrast, the proportion increased in some states, including Haryana, Tamil Nadu, and Telangana.

Figure 5. Trends in proportion of households consuming millets (% of total)



Source: Authors' estimates using unit-level data from NSO surveys.

4.4 Consumption across income groups

Table 2 presents millet consumption across consumption quintiles in rural and urban areas. The results indicate that millet consumption has declined across all income groups over time, although the magnitude of decline varies across consumption classes.

In rural areas, the largest reductions are observed among households in the lower-middle consumption quintiles (20–40 percent and 40–60 percent). For these groups, annual per capita millet consumption

declined by more than 50 percent between 2011/12 and 2023/24. Urban areas exhibit a similar pattern, with the most pronounced declines occurring among the middle consumption quintiles (40–60 percent and 60–80 percent). Among the highest consumption quintile (top 20 percent), the decline in millet consumption is relatively modest, although consumption levels remain low overall. This pattern reflects the already limited role of millets in the diets of higher-income households, who tend to consume more diversified diets that include refined cereals and processed foods.

The decline in millet consumption among lower-income households is particularly noteworthy. Historically, millets were an important staple for poorer rural households in dryland regions. However, the expansion of the PDS, which distributes subsidized rice and wheat, has likely contributed to the substitution of millets with these cereals in household diets. As a result, millets have gradually lost their traditional role as a staple cereal among lower-income households.

Table 2. Trends in millet consumption across consumption quintiles

Income quintile	Millet consumption (annual kg per capita)								
	2011/12			2022/23			2023/24		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
0–20%	6.3	4.1	6.0	3.5	2.1	3.3	3.7	2.7	3.5
20–40%	7.2	3.7	6.6	3.1	1.9	2.8	3.2	2.4	3.0
40–60%	7.0	3.8	6.3	3.0	1.9	2.7	3.2	2.2	2.9
60–80%	5.7	3.6	5.0	3.2	1.7	2.6	3.4	2.0	2.8
20–100%	4.3	2.7	3.4	3.4	2.0	2.5	3.2	2.0	2.4

Source: Authors' estimates using unit-level data from NSO surveys.

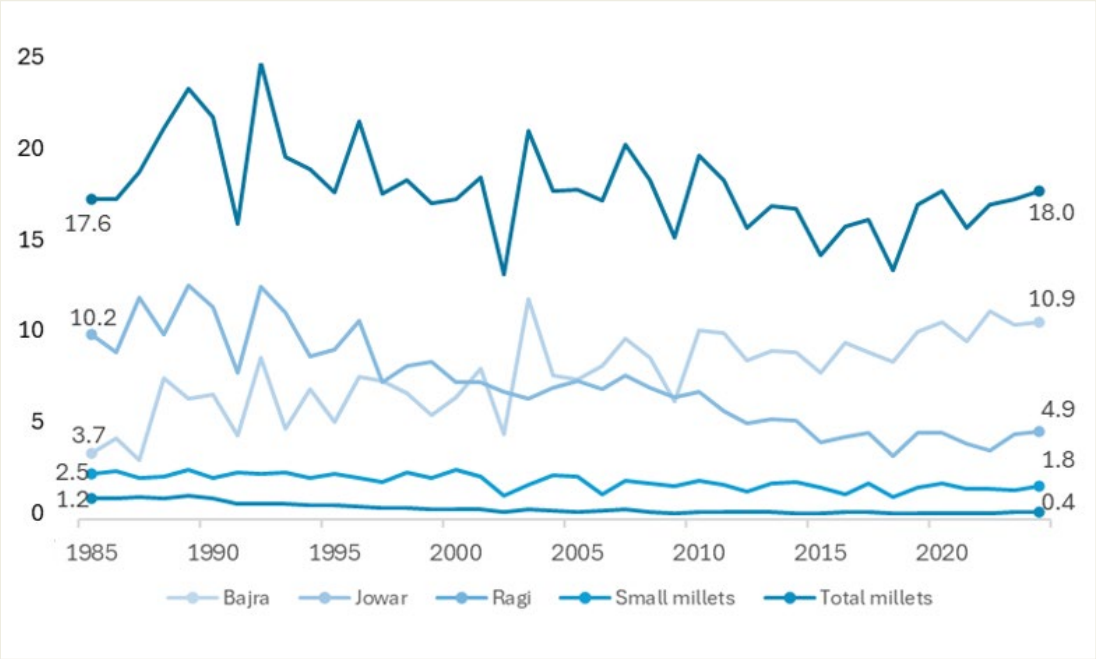
5. EVOLUTION OF MILLETS IN INDIA

5.1 Trends in millet production

Millets have historically played an important role in India's agricultural and dietary systems, particularly in semi-arid and rainfed regions where these crops are well adapted to harsh agro-climatic conditions. Prior to the Green Revolution, millets such as sorghum (jowar), pearl millet (bajra), and finger millet (ragi) formed a major component of cereal production and household consumption across large parts of the country. However, over the past several decades, both the production and consumption of millets have undergone significant structural changes.

Figure 6 presents long-term trends in millet production in India between 1985/86 and 2024/25. Over this period, total millet production has remained relatively stagnant with considerable year-to-year fluctuations. On average, total production declined slightly at an annual rate of about 0.5 percent. However, production trends differ substantially across individual millet crops. Among major millets, pearl millet (bajra) is the only crop that recorded positive production growth, increasing at an average annual rate of about 2 percent during this period. In contrast, production of sorghum (jowar), finger millet (ragi), and small millets declined steadily. The decline has been particularly pronounced for sorghum and small millets, reflecting substantial reductions in their cultivated area.

Figure 6. Production of millets in India (1985/86–2024/25)

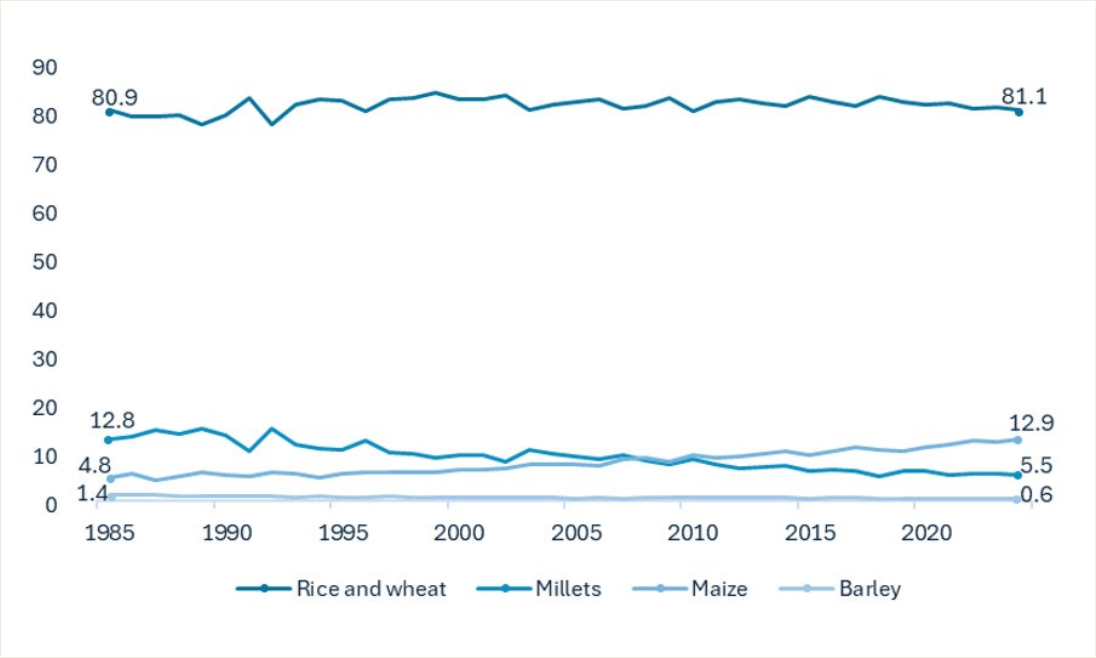


Source: Department of Agriculture & Farmers' Welfare, MoAFW.

Note: *Bajra* (pearl millet), *Jowar* (sorghum), *Ragi* (finger millet), and *Small millets* (include various millets, such as Barnyard millet, Proso millet, Kodo millet, Kutki millet, and Foxtail millet). Production is reported per agricultural year (June–July).

At the same time, the overall importance of millets within India's cereal economy has diminished considerably. As illustrated in Figure 7, the share of millets in total cereal production declined from about 12.8 percent in 1985/86 to only 5.5 percent in 2024/25. During the same period, the production shares of rice, wheat, and maize increased, reflecting the changing structure of cereal production in India.

Figure 7. Percentage share of millets in total cereal production (1985/86–2024/25)



Source: Department of Agriculture & Farmers' Welfare, MoAFW.

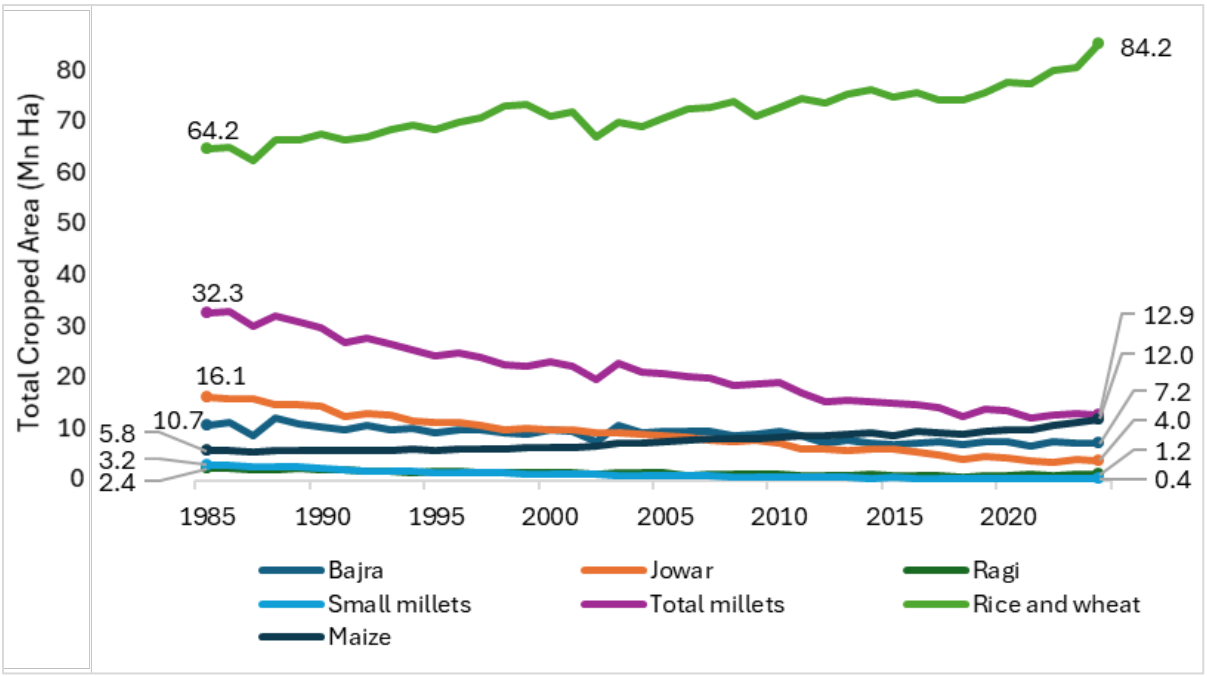
5.2 Changes in area and yield

The decline in millet production has been driven primarily by a contraction in the area under millet cultivation. As shown in Figure 8, the total area under millets declined sharply from 32.3 million hectares in 1985/86 to about 12.9 million hectares in 2024/25, representing a reduction of nearly 60 percent. This decline was observed across most millet crops. The area under small millets experienced the sharpest contraction, declining by nearly 86 percent during this period. Sorghum area declined by about 75 percent, while finger millet and pearl millet recorded reductions of roughly 50 percent and 30 percent, respectively.

While the area under millet cultivation declined consistently, the area under cereals, such as rice, wheat, and maize experienced steady growth. For rice and wheat, the cultivated area increased by 30 percent from

64.2 m/ha in 1985/86 to 84.2 m ha in 2024/25. The area under maize cultivation more than doubled during this period, rising from 5.8 m ha to 12 m ha.

Figure 8. Total cropped area for cereals in India (1985/86–2024/25)



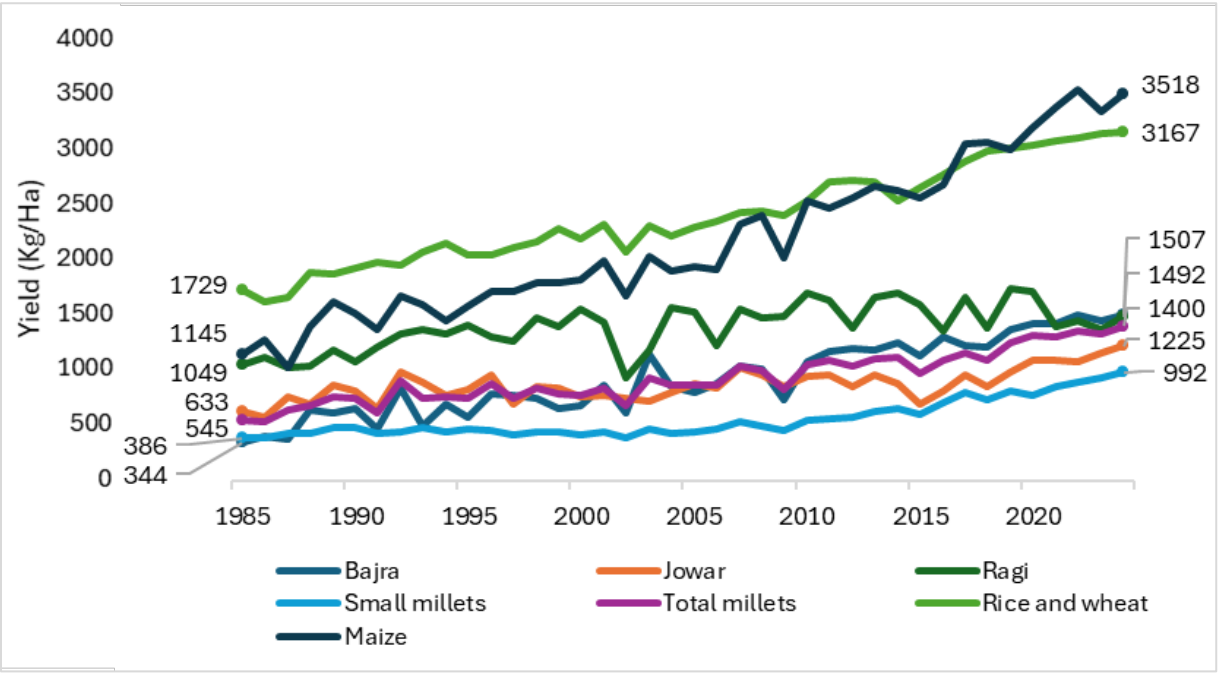
Source: Department of Agriculture & Farmers' Welfare, MoAFW.
Note: *Bajra* (pearl millet), *Jowar* (sorghum), *Ragi* (finger millet), and *Small millets* (include various millets, such as Barnyard millet, Proso millet, Kodo millet, Kutki millet, and Foxtail millet). Area is reported per agricultural year (June–July).

Changes in Millet Yield

In contrast to the decline in production area, yields of millets have improved over time. As shown in Figure 9, average yields increased across all millet varieties due to technological improvements in crop breeding, improved seed varieties, and better agronomic practices. The most pronounced increase was observed for bajra, explaining its production growth, despite the reduction in area. For other millets, yields improved, but the gains could not offset the steep fall in cultivated area, thereby reducing overall production. As a result, total millet production has either stagnated or declined over time.

This decline may be because cultivating millets is less economically favorable than cultivating rice and wheat (Chandra et al. 2024).

Figure 9. Average yield (kg/hectare) for cereals in India (1985/86–2024/25)



Source: Department of Agriculture & Farmers' Welfare, MoAFW.
Note: *Bajra* (pearl millet), *Jowar* (sorghum), *Ragi* (finger millet), and *Small millets* (include various millets, such as Barnyard millet, Proso millet, Kodo millet, Kutki millet, and Foxtail millet). Yield is reported per agricultural year (June–July).

Table 3 presents the compound annual growth rates of area, production, and yield for major cereals in India between 1985/86 and 2024/25. Among millets, all varieties experienced a substantial decline in cultivated area during this period. The contraction was particularly pronounced for small millets and jowar, whose cultivated areas declined at annual rates of 5.2 percent and 3.7 percent, respectively. Despite improvements in yields across most millet crops, these gains were insufficient to offset the sharp reduction in area, resulting in declining production for all millets except bajra. Bajra recorded the highest yield growth of 3.2 percent annually, allowing it to maintain positive production growth despite a decline in cultivated area.

In contrast, major cereals such as rice, wheat, and maize experienced simultaneous increases in both cultivated area and productivity, leading to a significant expansion in production. Growth was particularly notable for maize, where area and yield increased by 1.9 percent and 2.7 percent per year, respectively, resulting in annual production growth of 4.6 percent. These contrasting trends highlight the structural shift in India's cereal economy, where millets have gradually lost importance relative to other cereals.

Table 3. Growth in area, production, and yield of cereals in India (1985/86–2024/25)

Cereal name	CAGR (%)		
	Area	Production	Yield
Bajra	-1.1	2.1	3.2
Jowar	-3.7	-2.8	1.0
Ragi	-2.2	-1.3	0.9
Small millets	-5.2	-3.2	2.1
Millets	-2.5	-0.5	2.0
Rice and wheat	0.5	2.1	1.6
Maize	1.9	4.6	2.7
Barley	-1.8	0.1	1.9

Source: Department of Agriculture & Farmers Welfare, MoAFW.

Note: CAGR = compound annual growth rate.

Earlier studies also documented a substantial contraction in the area under millet cultivation. For instance, Sreekala and colleagues (2023) report that the area under millets declined significantly between 1970/71 and 2018/19, particularly for jowar and small millets, which fell by 64 percent and 85 percent, respectively. Although technological advancements contributed to improvements in millet productivity, these gains were not sufficient to compensate for the sharp decline in cultivated area. Much of the land previously under millets was diverted to more remunerative crops such as cotton, maize, and sugarcane, which benefit from stronger value chains and market demand (ICAR-IIMR 2015).

The decline in millet cultivation can be attributed to a combination of demand- and supply-side factors. On the demand side, dietary diversification and changing food preferences have contributed to a gradual shift away from millet consumption. In rural areas, millets have largely been replaced by rice and wheat, which are widely available at subsidized prices through the PDS. In urban areas, millet products are often sold at relatively higher retail prices due to limited processing infrastructure, shorter shelf life, and irregular demand, which reduces their affordability and consumption.

On the supply side, several factors have reduced the economic viability of millet cultivation. These include relatively low-price realization, and limited policy support for input subsidies, irrigation, and procurement,

as well as inadequate investment in seed development, research and development, and processing infrastructure. In addition, weak market linkages and underdeveloped value chains have constrained the commercialization of millet crops (ICAR-IIMR 2015; Kumar et al. 2011).

5.3 Policy and market drivers of millet decline

The declining importance of millets in India's agricultural system reflects a combination of policy-induced distortions, changing economic incentives, and evolving market structures. Since the Green Revolution, agricultural policies have disproportionately supported rice and wheat through irrigation expansion, input subsidies, MSP, and assured procurement under the PDS (Pingali 2012; Gulati et al. 2021). These interventions significantly enhanced the profitability and stability of rice and wheat cultivation relative to millets, thereby altering cropping patterns over time.

Simultaneously, rising incomes, urbanization, and dietary transitions have reduced demand for traditional coarse cereals. The expansion of the PDS, largely centered on subsidized rice and wheat, has further reinforced this shift by lowering their effective consumer prices and crowding out millets from household consumption baskets (Khera 2011; Drèze and Khera 2017). As a result, millets have progressively lost their role in both production systems and diets, with farmers increasingly reallocating land toward more remunerative crops such as maize, cotton, and sugarcane, which benefit from stronger market integration and value chains.

Profitability and Risk in Millet Cultivation

A key driver of this shift is the relatively low and volatile returns associated with millet cultivation. Evidence from Table 4 shows that returns from millet crops are not only lower but also more volatile compared to major cereals. For instance, during the 2021–2024 period, average returns from bajra (8,657 Indian rupees [INR]/ha) and jowar (9,007 INR/ha) were substantially lower than those from paddy (30,216 INR/ha) and wheat (50,456 INR/ha), while ragi even recorded negative returns in some periods. In contrast, maize has emerged as a more attractive alternative, with returns increasing sharply to more than 30,000 INR/ha in recent years, reflecting stronger demand from feed and industrial sectors.

These patterns suggest that millet cultivation is characterized by both lower profitability and higher risk, which weakens farmer incentives, particularly in the absence of effective procurement and price support mechanisms.

Table 4. Profits from cereals across states in India (in nominal prices)

Year	Profit* (GVO – (A2 + FL))					
	Bajra	Jowar	Maize	Ragi	Wheat	Paddy
2007–2010	5,080	4,893	8,016	1,861	24,332*	15,492
2010–2013	4,684	7,869	12,867	-309	24,322	16,727
2013–2016	6,091	6,091	10,053	3,456	29,066	18,428
2018–2021	10,195	9,422	15,978	6,411	43,549	24,468
2021–2024	8,657	9,007	30,156	-6,596	50,456	30,216

Source: CACP data published in various annual reports.

Note: *Estimated in Indian rupees (INR) per hectare, GVO (gross value of output), A2 + FL (actual paid-out cost plus imputed value of family labor). Data point is for the period 2008/09 to 2010/11.

Further insights are provided by Table 5, which reports the ratio of returns to variable costs across states. The results indicate that millets consistently generate lower returns relative to wheat and paddy, with considerable interstate variation reflecting differences in agro-climatic conditions and market access. While some regions exhibit moderate profitability for crops such as bajra and jowar, these gains are neither widespread nor stable over time. The persistent gap in returns underscores the structural disadvantage faced by millet producers within India's cereal economy.

Table 5. Ratio of returns to variable costs for cereals across states in India

State		AP	GJ	HY	KT	MP	MH	RJ	TN	UP	OD	PJ	WB	AI
Bajra	1981–83	-	2.06	1.75	-	-	-	2.5	-	1.8	-	-	-	1.93
	1991–93	-	1.99	1.81	1.6	-	-	1.98	-	-	-	-	-	1.89
	2001–03	-	1.57	1.17	-	-	1.26	1.8	-	1.41	-	-	-	1.44
	2013–15	-	2.16	1.32	1.68	1.22	1.41	3.19	1.89	-	-	-	-	1.8
	2023–24	-	2.27	2.00	-	-	1.43	2.11	-	2.11	-	-	-	2.02
Jowar	1981–83	-	-	-	2.59	2.13	1.96	-	-	-	-	-	-	2.19
	1991–93	1.88	-	-	2.87	1.63	-	1.76	-	-	-	-	-	1.93
	2001–03	1.46	-	-	1.19	1.25	1.65	1.61	1.83	-	-	-	-	1.57

State		AP	GJ	HY	KT	MP	MH	RJ	TN	UP	OD	PJ	WB	AI
	2013–15	2.41	-	-	2.18	1.88	1.6	1.85	2.79	-	-	-	-	2.12
	2023–24	2.59	-	-	1.70	-	1.37	2.39	1.72	-	-	-	-	1.63
	2001–03	-	-	-	1.19	2.26	-	2.01	-	-	-	-	-	2.46
Ragi	2013–15	-	-	-	1.24	1.8	-	1.16	1.31	-	-	-	-	1.4
	2023–24	-	-	-	1.20	-	-	-	-	-	2.16	-	-	1.22
	1981–83	1.58	-	-	1.59	1.22	-	1.21	1.05	-	-	-	-	1.51
	1991–93	2.38	1.18	-	1.94	1.49	1.24	1.25	1.77	1.35	-	-	-	1.58
Maize	2001–03	2.24	-	-	1.25	-	-	-	-	-	-	-	-	1.74
	2013–15	1.71	-	-	1.45	-	1.1	2.6	-	-	-	-	-	1.59
	2023–24	2.15	-	-	1.91	1.96	2.04	2.38	1.8	1.59	-	1.44	-	1.99
	1981–83	-	-	2.51	-	1.5	-	2.2	-	1.83	-	3.09	-	2.18
	1991–93	-	-	-	-	-	-	-	-	-	-	-	-	2.44
Wheat	2001–03	-	1.83	3.72	-	1.23	-	2.75	-	2.15	-	3.63	-	2.44
	2013–15	-	2.22	4.36	-	2.58	0.67	3.25	-	1.88	-	4.48	1.2	2.61
	2023–24	-	2.57	3.22	-	3.00	1.60	2.82	-	2.43	-	3.01	1.61	2.65
	1981–83	-	-	2.51	-	1.5	-	2.2	-	1.83	-	3.09	-	2.18
	1991–93	-	-	-	-	-	-	-	-	-	-	-	-	2.44
Paddy	2001–03	-	1.83	3.72	-	1.23	-	2.75	-	2.15	-	3.63	-	2.44
	2013–15	-	2.22	4.36	-	2.58	0.67	3.25	-	1.88	-	4.48	1.2	2.61
	2023–24	1.84	1.76	2.84	1.85	2.55	0.92	-	1.60	1.54	1.73	2.80	1.73	1.90

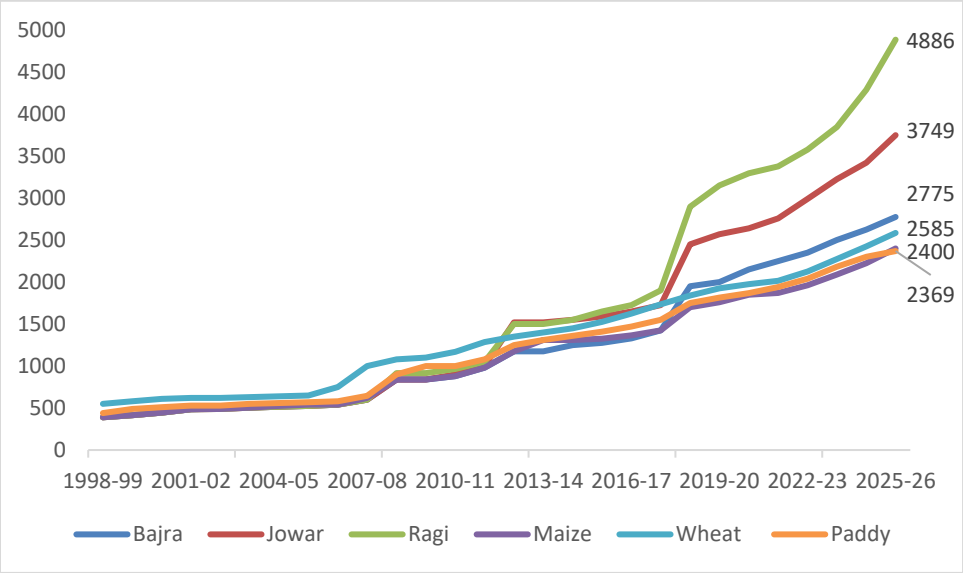
Source: Calculated using CACP data published in various annual reports.

Policy Signals and Economic Outcomes

Despite this relative disadvantage, recent policy efforts have sought to promote millets through higher MSP growth. As shown in Figure 10 and Table 6, MSPs for millets increased at a faster rate than for rice and wheat over the past two decades, with compound annual growth rates of 10.6 percent for ragi, 9.6 percent for jowar, and 8.2 percent for bajra. This reflects a clear policy intent to incentivize millet production.

However, the evidence suggests a disconnect between policy signals and farm-level outcomes. Despite higher MSP growth, millet cultivation remains less remunerative due to several structural constraints. First, procurement of millets remains limited and geographically concentrated, reducing the effectiveness of MSP as a price guarantee. Second, millets receive relatively lower input support compared to rice and wheat, particularly in terms of irrigation, fertilizers, and extension services. Third, weak value chains and limited processing infrastructure constrain market demand and price realization.

Figure 10. Trends in MSP for cereals in India (1998/99–2025/26)



Source: Department of Agriculture & Farmers Welfare, MoAFW.

Table 6. MSP for cereals in India (1998/99–2025/26)

Crop/Year	Bajra	Jowar	Ragi	Maize	Wheat	Paddy
1999	390	390	390	390	550	440
2005	515	515	515	525	640	560
2010	840	840	915	840	1100	1000
2015	1250	1550	1550	1310	1450	1360
2020	2000	2570	3150	1760	1925	1815
2026	2775	3749	4886	2400	2585	2369
CAGR (%)	8.2	9.6	10.6	7.4	6.3	7.0

Source: Department of Agriculture & Farmers Welfare, MoAFW.

Note: CAGR = compound annual growth rate.

Shifts in India's Cereal Economy

Taken together, these factors point to broader shifts in India's cereal economy, characterized by the declining role of millets and the increasing dominance of rice, wheat, and maize. While rice and wheat are supported by strong policy backing and stable demand through public procurement systems, maize has benefited from rapidly expanding demand in feed and industrial uses. In contrast, millets remain largely confined to rainfed regions with weak market integration and limited commercial demand.

This shift is further reinforced by demand-side changes. As consumer preferences move toward more convenient and processed foods, millets face additional disadvantages due to longer cooking times, limited product diversity, and persistent perceptions as "inferior" or traditional foods. These demand-side constraints interact with supply-side disincentives, creating a reinforcing cycle of declining production and consumption.

Overall, the evidence suggests that the decline of millets is not merely a consequence of changing consumer preferences, but rather the outcome of systematic policy and market biases that favor alternative cereals. While recent policy initiatives have attempted to reverse this trend, the persistence of economic disincentives and weak value chains continues to limit their effectiveness. Addressing these structural

constraints will require moving beyond price support toward a more integrated approach that simultaneously strengthens production incentives, market development, and consumer demand.

6. DETERMINANTS OF MILLET CONSUMPTION

6.1 Descriptive statistics

This section presents summary statistics for key household characteristics used in our econometric analysis. Table 7 reports the mean values of selected variables for households that consume millets and those that do not, along with the differences in means between the two groups. The results provide preliminary insights into the socioeconomic characteristics associated with millet consumption.

The statistics indicate several significant differences between millet-consuming and non-consuming households. Households that consume millets are more likely to be in rural areas and have larger household sizes. In addition, millet-consuming households exhibit higher participation in the PDS, suggesting a possible association between PDS access and cereal consumption patterns. The demographic characteristics of household heads also differ between the two groups. On average, household heads in millet-consuming households are older than those in non-consuming households, indicating that millet consumption may be more prevalent among households that maintain traditional dietary preferences. At the same time, household heads in millet-consuming households tend to have lower levels of formal education compared with those in non-consuming households.

There are also notable differences in economic characteristics. The average MPCE is lower among millet-consuming households than among non-consuming households, suggesting that millet consumption remains more prevalent among relatively lower-income households. This pattern is consistent with the historical role of millets as staple foods in traditional rural diets. Overall, the descriptive statistics suggest that millet consumption in India remains closely associated with rural households, larger family sizes, and lower levels of education and income. These preliminary patterns provide useful context for the subsequent econometric analysis, which examines the determinants of both the likelihood of millet consumption and the quantity consumed at the household level.

Table 7. Descriptive statistics of key household characteristics by millet consumption status

Variables	Type	Not consuming	Consuming	Mean difference
Sex of the HH head	Dummy (1 = female, 0 otherwise)	0.154	.143	.012
Age	Years	48.380	50.953	-2.574***
Education	In years	7.099	6.264	.836***
Household size	Number of members in household	4.173	4.434	-.262***
Sector	Dummy (1 = rural, 0 otherwise)	0.572	.671	-.099***
Social category:	Dummy (Base: Others)			
Scheduled Caste/ Scheduled Tribe		0.320	.274	.046
Other backward class		0.397	.474	-.077***
Others		0.283	.253	.03
Participation in PDS	Dummy (1 = yes, 0 otherwise)	0.673	.738	-.065***
Monthly per-capita consumption expenditure	Rupees	6102	5883	218.637

Source: Authors' estimates using unit-level data from HCES 2023/24.

Note: ***, **, and * represent statistical significance at 1, 5, and 10 percent.

6.2 Estimates from double hurdle model

To examine these relationships more systematically, we estimate Cragg's double hurdle model to analyze both the decision to consume millets and the quantity consumed, conditional on participation. All estimates are computed using survey weights to account for the stratified sampling design of HCES and to ensure population-representative results. The results are reported in Table 8.

In the selection equation, several household characteristics significantly influence the probability of millet consumption. Household size, rural residence, and participation in the PDS are positively associated with the likelihood of millet consumption, indicating that millet consumption remains concentrated in rural households and in regions where traditional cereal consumption patterns persist. Older household heads are also more likely to consume millets, suggesting that generational dietary preferences continue to influence consumption decisions.

In contrast, female-headed households and households with more educated heads are less likely to consume millets. This finding suggests that higher levels of education and socioeconomic mobility have not yet translated into increased millet consumption despite growing awareness of their nutritional benefits. Instead, these households may be more likely to adopt diets that include refined cereals and processed foods.

In the outcome equation, which captures the intensity of millet consumption among participating households, household size and rural residence again emerge as significant determinants, indicating that larger rural households consume greater quantities of millets. In contrast, female-headed households and households with more educated heads consume smaller quantities of millets.

Participation in the PDS is negatively associated with the quantity of millets consumed. This may be because households with access to subsidized foodgrains rely less on millets and therefore consume smaller quantities of them. The coefficient on MPCE is statistically significant but negligible, while that for scheduled caste/scheduled tribe (SC/ST) households is statistically insignificant. The results are largely consistent with those obtained after including state fixed effects. The only notable changes are that the coefficient on MPCE becomes statistically insignificant, and SC/ST and other backward class households are less likely to consume millets compared to other households.

Table 8. Estimates of double-hurdle model for determinants of millet consumption

Variables	Outcome equation		Selection equation	
Sex of the HH head (1 = female, 0 otherwise)	-0.080***	-0.131***	-0.047***	-0.114***
	(0.018)	(0.011)	(0.013)	(0.016)
Age	0.000	-0.002***	0.008***	0.005***
	(0.001)	(0.000)	(0.000)	(0.001)
Education (Number of years)	-0.004**	-0.010***	-0.003***	-0.006***
	(0.002)	(0.001)	(0.001)	(0.001)
Household size	0.133***	0.121***	0.035***	0.077***
	(0.004)	(0.003)	(0.003)	(0.003)
Sector (1 = rural, 0 otherwise)	0.248***	0.246***	0.105***	0.334***
	(0.035)	(0.021)	(0.028)	(0.032)
Social Category (Base: Others)				
Scheduled Caste/ Scheduled Tribe	-0.138***	-0.045**	-0.002	-0.070***
	(0.030)	(0.018)	(0.022)	(0.024)
Other backward class	-0.032	0.004	0.100***	-0.058***
	(0.027)	(0.016)	(0.020)	(0.021)
Participation in PDS (1 = yes, 0 otherwise)	-0.206***	0.011	0.123***	0.256***
	(0.023)	(0.014)	(0.018)	(0.021)
Monthly per-capita consumption expenditure	-0.0000365***	-0.000***	0.0000234***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	1.143***	-5.428***	-1.703***	-1.876***
	(0.062)	(0.567)	(0.043)	(0.115)
Sigma	-0.182***	-0.574***		
	(0.014)	(0.012)		
State FE		Yes		Yes
Observations	260,967	260,967	260,967	260,967

Source: Authors' estimates using unit-level data from HCES 2023/24.

Note: Figures in parentheses present standard errors; ***, **, and * represent statistical significance at 1, 5, and 10 percent.

The marginal effects reported in Table 9 reinforce these findings. Household size, rural residence, and PDS participation exert the largest influence on the quantity of millet consumption, highlighting the continued importance of traditional dietary patterns and public food distribution systems in shaping cereal consumption choices.

Overall, the results suggest that millet consumption in India remains strongly rooted in traditional rural diets and has not yet become integrated into the broader dietary transition occurring across the country. Despite increasing policy attention and awareness campaigns, millets continue to be consumed primarily by rural households in historically millet-producing regions.

Table 9. Marginal effects of determinants of millet consumption

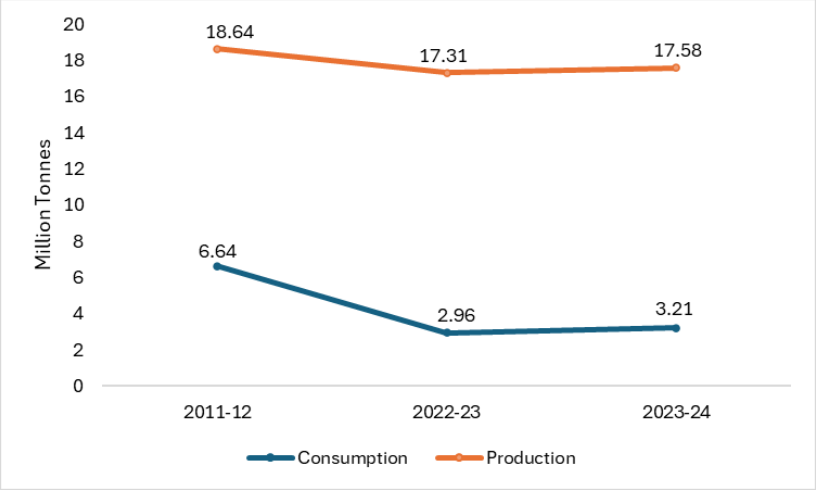
Variables	dy/dx	Standard error	p-value
Sex of the HH head (1 = female, 0 otherwise)	-0.031	0.006	0.000
Age	0.003	0.000	0.000
Education (Number of years)	-0.002	0.001	0.001
Household size	0.035	0.001	0.000
Sector (1 = rural, 0 otherwise)	0.079	0.013	0.000
Social Category (Base: Others)			
Scheduled Caste/ Scheduled Tribe	-0.021	0.010	0.042
Other backward class	0.037	0.010	0.000
Participation in PDS (1 = yes, 0 otherwise)	0.020	0.008	0.015
Monthly per-capita consumption expenditure	0.000	0.000	0.001

Source: Authors' estimates using unit-level data from HCES 2023/24.

7. PRODUCTION–CONSUMPTION GAP IN MILLETS

An important observation emerging from the analysis is the substantial gap between official estimates of millet production and household consumption. According to government statistics, millet production in India was approximately 17.6 million tonnes in 2023/24 (Figure 11). In contrast, estimates derived from household consumption survey data and population projections suggest that total millet consumption was approximately 3.2 million tonnes during the same period. This implies a production–consumption gap of nearly 14 million tonnes. Even after accounting for international trade, the magnitude of this gap remains largely unexplained. Similar discrepancies between production and household consumption of coarse cereals were documented in earlier studies examining structural changes in India's cereal economy (Kumar et al. 2007; Birthal et al. 2014; Joshi and Birthal 2016). These studies show that the decline in direct human consumption of coarse cereals has not necessarily been matched by a proportional reduction in their production, suggesting that a growing share of output may be diverted toward nonfood uses.

Figure 11. Production–consumption gap in millets



Source: Consumption was estimated using unit-level data from NSO surveys and population projections published by the National Commission on Population, Ministry of Health & Family Welfare. Production data came from Agricultural Statistics at a Glance, 2023 and UPAg, Department of Agriculture & Farmers Welfare.

Several factors may contribute to this divergence between production and measured household consumption. First, a portion of millet output is used as livestock feed, particularly in mixed crop-livestock production systems prevalent in dryland regions of India. Sorghum and pearl millet are widely used as fodder crops, and in some cases, the grains themselves are incorporated into livestock feed rations (Birthal

et al. 2014; Parthasarathy Rao and Hall 2003). With the rapid expansion of the livestock sector in India, demand for coarse cereals as feed ingredients may have increased over time.

Second, millets are increasingly being utilized as raw materials in food processing industries. In recent years, there has been growing interest in millet-based value-added products such as breakfast cereals, snacks, bakery products, and ready-to-cook foods. The expansion of these value chains, supported by government initiatives and rising consumer awareness of the nutritional benefits of millets, may have contributed to increased industrial demand for millets (NITI Aayog 2024; Government of India 2023; Gulati and Juneja 2022).

Third, part of the discrepancy may arise from seed retention and postharvest losses, which are typically not captured in household consumption surveys. In traditional millet production systems, farmers often retain a portion of their harvest for seed and other on-farm uses. In addition, postharvest losses during storage, handling, and processing can account for a nontrivial share of cereal output in developing country contexts (FAO 2019).

Finally, the gap may also reflect measurement limitations in both production statistics and consumption surveys. Household consumption surveys capture only direct household consumption and may underestimate the use of millets in processed foods or meals consumed outside the home. Conversely, production statistics may be subject to estimation challenges, particularly in rainfed regions where millet cultivation is characterized by smallholder production and significant interannual variability.

Overall, the presence of a large production–consumption gap underscores the need for improved data systems to better understand the utilization pathways of millets in India's agrifood system. More precise estimates of feed use, industrial demand, and postharvest losses would help clarify the true demand structure for millets and provide valuable insights for designing policies aimed at revitalizing millet value chains and expanding millet consumption.

8. CONCLUSION

This paper examines long-term trends and determinants of millet consumption in India using nationally representative household consumption surveys and an econometric analysis. The results reveal a significant transformation in India's cereal consumption patterns over the past several decades, characterized by a sharp decline in millet consumption and increasing dominance of rice and wheat in household diets.

The descriptive analysis shows that per capita millet consumption has declined dramatically across both rural and urban areas since the late 1980s. Rural consumption fell from more than 25 kg per capita annually in 1987/88 to about 3–4 kg in 2023/24, while urban consumption declined from nearly 10 kg to around 2 kg during the same period. This decline reflects broader structural changes in India's food system, including the expansion of rice and wheat production during the Green Revolution, largescale public procurement and distribution of these cereals, and evolving dietary preferences associated with rising incomes and urbanization. The analysis also highlights strong regional concentration in millet consumption. Despite the overall decline, millet intake remains relatively higher in states such as Karnataka, Rajasthan, Maharashtra, and Gujarat, which historically formed part of India's millet-growing regions. However, even in these states, consumption levels have declined substantially over time, suggesting that traditional millet-based dietary systems are gradually eroding.

Another notable finding is the substantial gap between millet production and measured household consumption. While official statistics report millet production of approximately 17–18 million tonnes in recent years, estimates derived from household consumption surveys suggest much lower levels of direct household consumption. This discrepancy indicates that a considerable share of millet output may be diverted to nonfood uses such as livestock feed, industrial processing, seed retention, and postharvest losses. The presence of such a large gap highlights the need for improved data systems to better capture the multiple utilization pathways of millets in India's agrifood system.

The econometric results further reveal that millet consumption remains strongly associated with traditional rural households. Rural residence, larger household size, and older household heads are associated with a higher likelihood and intensity of millet consumption, indicating that millets continue to be embedded in traditional dietary patterns. In contrast, households with more educated heads and higher levels of economic mobility are less likely to consume millets, suggesting that increasing awareness of the nutritional benefits of millets has not yet translated into broader adoption across socioeconomic groups.

Taken together, these findings suggest that the recent policy emphasis on promoting millets has not yet translated into a significant revival of millet consumption in India. Revitalizing millet-based food systems will therefore require a combination of production, market, and demand-side interventions.

Several policy implications emerge from the analysis.

First, strengthening demand for millets should become a principal component of millet promotion strategies. While current policy initiatives have largely focused on increasing production and awareness, sustained growth in millet cultivation will require stronger and more stable consumer demand. Public awareness campaigns highlighting the nutritional and health benefits of millets can help reshape consumer perceptions, particularly among urban and middle-income populations.

Second, food-based safety net programs can play a key role in expanding millet consumption. Systematically integrating millets into the PDS, midday meals, and other nutrition programs can create stable demand while improving dietary diversity and nutrition, especially in millet-consuming states.

Third, strengthening millet value chains is critical for improving accessibility and convenience for consumers. Investments in processing technologies, storage infrastructure, and product innovation can help overcome barriers related to preparation time, shelf life, and consumer preferences. The development of ready-to-cook and ready-to-eat millet-based foods could help expand millet consumption in urban markets.

Fourth, price and procurement policies may need to be better aligned with millet promotion goals. Expanding public procurement of millets and ensuring remunerative prices could provide stronger incentives for farmers to maintain or expand millet cultivation, particularly in rainfed regions with agro-ecologically optimal conditions for these crops.

Finally, policy strategies should recognize the regional diversity of millet production and consumption patterns. In historically millet-consuming regions, efforts should focus on preserving and revitalizing traditional millet-based food systems. In other regions, promotion strategies may need to emphasize the nutritional and environmental benefits of millets to encourage new consumer adoption.

Overall, millets have the potential to play a significant role in promoting climate-resilient agriculture, improving dietary diversity, and supporting sustainable food systems in India. Realizing this potential will require coordinated policy efforts that simultaneously address production incentives, market development, and consumer demand. By aligning agricultural, nutrition, and food system policies, millets can contribute to building more diversified, resilient, and nutrition-sensitive agrifood systems in India.

REFERENCES

Anitha, S., Kane-Potaka, J., Botha, R., Givens, D. I., Sulaiman, N. L. B., Upadhyay, S., & Bhandari, R. K. (2021). Millets can have a major impact on improving iron status, hemoglobin level, and in reducing iron deficiency anemia: A systematic review and meta-analysis. *Frontiers in Nutrition, 8*, 725529.

Birthal, P. S., Khan, M. T., Negi, D. S., & Agarwal, S. (2014). Impact of climate change on yields of major food crops in India: Implications for food security. *Agricultural Economics Research Review, 27*(2), 145–155.

Birthal, P. S., Joshi, P. K., Negi, D. S., & Agarwal, S. (2016). *Sources of growth in Indian agriculture: Implications for food security and poverty*. New Delhi: ICAR.

Chandra, T., Jaiswal, S., Tomar, R. S., Iquebal, M. A., & Kumar, D. (2024). Realizing visionary goals for the International Year of Millet (IYoM): accelerating interventions through advances in molecular breeding and multiomics resources. *Planta*, *260*(4), 103.

Cragg, J. G. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica, 39*(5), 829–844.

Dayakar Rao, B., Bhaskarachary, K., Arlene Christina, G. D., Sudha Devi, G., Vilas, A. T., & Tonapi, A. (2017). Nutritional and health benefits of millets. Hyderabad: ICAR–Indian Institute of Millets Research.

Deaton, A., & Drèze, J. (2009). Food and nutrition in India: Facts and interpretations. *Economic and Political Weekly, 44*(7), 42–65.

Drèze, J., & Khera, R. (2017). Recent social security initiatives in India. *World Development, 98*, 555–572.

FAO. (2019). *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome: Food and Agriculture Organization.

FAO. (2023). *International Year of Millets 2023*. Rome: Food and Agriculture Organization.

FAO. (2024). *International Year of Millets 2023: Final report*. Rome: Food and Agriculture Organization.

Government of India. (2023). *Shree Anna: The International Year of Millets 2023 and India's millet mission initiatives*. Ministry of Agriculture & Farmers Welfare, New Delhi.

Gowda, N. N., Siliveru, K., Prasad, P. V., Bhatt, Y., Netravati, B. P., & Gurikar, C. (2022). Modern processing of Indian millets: A perspective on changes in nutritional properties. *Foods, 11*(4), 499.

Gulati, A., Roy, R., & Saini, S. (2021). *Revitalizing Indian agriculture and boosting farmer incomes*. Singapore: Springer.

Gulati, A., & Juneja, R. (2022). Transforming Indian agriculture. In *Indian agriculture towards 2030: Pathways for enhancing farmers' income, nutritional security and sustainable food and farm systems* (pp. 9–37). Singapore: Springer.

Joshi, P. K., & Birthal, P. S. (2016). Changing consumption patterns and implications for food demand in India. *Agricultural Economics Research Review, 29*(1), 1–12.

Khera, R. (2011). India's public distribution system: Utilisation and impact. *Journal of Development Studies, 47*(7), 1038–1060.

Kumar, P., Kumar, A., Parappurathu, S., & Raju, S. S. (2011). Estimation of demand elasticity for food commodities in India. *Agricultural Economics Research Review*, *24*(1), 1–14.

Kumar, P., Mruthyunjaya, Dey, M. M., & Birthal, P. S. (2007). Long-term changes in Indian food basket and nutrition. *Economic and Political Weekly, 46*(26–27), 43–52.

Mittal, S. (2007). What affects changes in cereal consumption?. *Economic and Political weekly*, 444–447.

NITI Aayog. (2024). *Working group report on crop husbandry, agriculture inputs, demand and supply*. Government of India, New Delhi.

Parthasarathy Rao, P., & Hall, A. J. (2003). Importance of crop residues in crop–livestock systems in India and farmers' perceptions of fodder quality in coarse cereals. *Field Crops Research, 84*(1–2), 189–198.

Pingali, P. L. (2012). Green revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences, 109*(31), 12302–12308.

Pingali, P., & Sunder, N. (2017). Transitioning toward nutrition-sensitive food systems in developing countries. *Annual Review of Resource Economics, 9*, 439–459.

Saleh, A. S., Zhang, Q., Chen, J., & Shen, Q. (2013). Millet grains: Nutritional quality, processing, and potential health benefits. *Comprehensive Reviews in Food Science and Food Safety, 12*(3), 281–295.

Sreekala, A. D., Anbukkani, P., Singh, A., Dayakar Rao, B., & Jha, G. K. (2023). Millet production and consumption in India: Where do we stand and where do we go? *National Academy Science Letters, 46*(1), 65–70.

ICAR–Indian Institute of Millets Research (IIMR). (2015). *Vision 2050*. Hyderabad.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al. (2019). Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet, 393*(10170), 447–492.

ALL IFPRI DISCUSSION PAPERS

All discussion papers are available **here**

They can be downloaded free of charge

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
www.ifpri.org

IFPRI HEADQUARTERS
1201 Eye Street, NW
Washington, DC 20005 USA
Tel.: +1-202-862-5600
Fax: +1-202-862-5606
Email: ifpri@cgiar.org

IFPRI SOUTH ASIA OFFICE
NASC Complex, CG Block
Dev Prakash Shastri Road
(Opp. Todapur)
Pusa, New Delhi 110012 India
Phone: +91.11.42244545
Fax: +91.11.42244549
Email: ifpri-NewDelhi@cgiar.org