

DEMAND AND SUPPLY PROJECTIONS OF PEARL MILLET IN RAJASTHAN

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ABSTRACT

The present study was conducted to estimate demand and supply pattern of pearl millet in Rajasthan. The study concluded that the demand of pearl millet for food will increase over time. In 2025, total demand of pearl millet (food) will be 2613 thousand tonnes. In 2015, it is likely to be 136 thousand tonnes in urban and 1926 thousand tonnes for rural Rajasthan. In 2020, it will be 154 thousand tonnes for urban and 2165 thousand tonnes for rural Rajasthan. In 2025, it will be 174 thousand tonnes for urban and 2439 thousand tonnes for rural Rajasthan. Demand projection for pearl millet (grain) for alternative uses indicated that demand for cattle feed (concentrates) is projected to be 2018 thousand tonnes (2020) and 2340 thousand tonnes in 2025. The demand for poultry feed industry is projected at 1406 thousand tonnes in 2025. The demand for alcohol industry is projected to be 815 thousand tonnes (2020) and 1091 thousand tonnes in 2025. The demand for seed is pegged at 24 thousand tonnes and 25 thousand tonnes in 2020 and 2025 respectively. The supply of pearl millet (grain) is projected at 5401 thousand tonnes (2015), 6469 thousand tonnes (2020) and 7759 thousand tonnes (2025). The gap between demand and supply (grain) is projected to be a surplus of 51 thousand tonnes (2015), 192 thousand tonnes (2020) and 284 thousand tonnes (2025).

Keywords: Pearl millet, food Demand, supply and Projection.

INTRODUCTION

India is a country of 1.21 billion people. More than 60 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. The millets are a group of small-seeded species of cereal crops, widely grown around the world for food and fodder. Pearl millet is one of the most important cereals for food security in the arid and semi-arid tropical regions. It is a significant source of dietary energy and nutritional security of poor farmer-consumers in several highly populated regions of Asia and Africa.. The crop has relatively high nutritional value and high amount of iron (8mg/100g). However, several anti-nutritional factors such as phytates, oxalates and polyphenols are present in pearl millet which may decrease the bioavailability of the iron. Indigenous knowledge in Northern India is that when consumed as chapati, it has a warming effect (the reason why pearl millet chapati is consumed mostly in the winter season). On the other hand, when consumed as 'Rabri' (a semi-liquid drink) in Haryana and Rajasthan, it has a cooling effect, (the reason why these products are most popular in the summer season in these states). Bajra is widely consumed in India especially in the rural areas in different recipes made locally. Some of the well known recipes made using bajra are bajra laddoo (sweet dish made using bajra and sugar/jaggery), bajra consumed with kadi (a besan and curd preparation), bajre ki roti/chappati and bajre ki khichdi. Pearl millet dry fodder is key to survival of livestock in Rajasthan especially during drought years. Livestock will be threatened if efforts are not made for enhancement of production of pearl millet grain and fodder. Pearl millet use is also increasing in distilleries as a cheaper source of starch. The demand projections of pearl millet for food, feed fodder and distilleries will give us an idea about the future domestic demand. As the economy is opening up, the price levels and income levels are changing. In this changing scenario, the expenditure elasticities will help us to work out future demand of pearl millet. In order to formulate an effective policy for the growth and development of pearl millet crop, it is crucial to know the demand and supply situation of pearl millet crop in the long run. Keeping these issues in view, an attempt is made in this study to analyze future demand and supply of pearl millet for food and alternative uses in Rajasthan.

ANALYTICAL TOOLS

In order to work out expenditure elasticity of demand for pearl millet in rural and urban Rajasthan using 61st round of NSSO data, various models were tried. The models tested were as follows:

$\log Y = \log a + b \log x + \log U$...Double logarithmic function.

$Y = a + bx + U$Linear function.

$Y = a + b_1x + b_2x^2 + U$Quadratic function.

$\log Y = a + b(1/x) + U$ Log Inverse function.

Where;

Y = Per capita expenditure on pearl millet (Rs/month) in rural/urban areas (NSSO data).

X = Per capita total consumption expenditure on all commodities (Rs/month) in rural/urban area (NSSO data).

a= constant

b= Regression coefficient

u = Random/error term

The Quadratic function was found best fit because the value of R² (coefficient of multiple determination) was highest and regression coefficients were significant. The expenditure elasticity (ex) was worked out as follows:

$$ex = b_1 - b_2 / x$$

Where;

ex = expenditure elasticity of pearl millet in rural/urban areas

b₁, b₂ = regression coefficients and

x = mean value of total consumption expenditure on all Commodities in rural/urban areas (NSSO data)

Demand Projections

For projecting the demand for pearl millet (grain) for human consumption, rural/urban population in Rajasthan (millions) in time

period t , growth in per capita income (per cent) and expenditure elasticities of rural/urban Rajasthan were used in projecting pearl millet potential demand by 2015, 2020 and 2025. Demand projections for the pearl millet were obtained by using the following formula given by P. Kumar (1998);

$$Dit = di_0 * Nit (1+y * \eta_i)^t$$

Where;

Dit = Potential demand (kg) in rural/urban Rajasthan in time period t .

di₀ = Per capita consumption of pearl millet (Kg/month) in the base year (2004-05) using NSSO 61st round data.

Nit = Rural/urban human population in Rajasthan in time period ' t '.

y = Rate of growth in per capita income (in percent).

η_i = Expenditure elasticities for rural/urban population in Rajasthan.

Results and discussion

The population projections and consumption of pearl millet kg/capita/annum (NSSO) are presented in Table 1. According to National sample survey report of 61st Round (2004-05), the consumption of pearl millet/capita /annum was 6.90 kg and 33 kg for urban and rural people of Rajasthan respectively and the overall consumption of pearl millet was 26.50 kg/capita/annum. The table further reveals that population of Rajasthan is likely to be 85.30 million and 94.46 million in 2020 and 2025 respectively. The projected urban population is 19.64 million (2015) 22.21 million (2020) and 24.93 million (2025). The rural population is projected at 57.33 million (2015), 63.09 million (2020) and 69.53 million (2025). Table 2 and Table 3 show regression coefficients and R² using various regression models for rural and urban Rajasthan. Based on high R² values and significance of regression coefficients, the quadratic function was the best fit in both the areas. The expenditure elasticities were worked out from these regression coefficients and are presented in Table 4. The expenditure elasticities were found to be 0.09 for rural and 0.013 for urban Rajasthan.

Demand projections for pearl millet (Food)

Demand projections for pearl millet (food) in 2015, 2020 and 2025 were made on basis of certain assumptions; (a) Per capita consumption of pearl millet in 2004-05 (Table 1) using NSSO Data, (61st Round) will remain the same in 2011-12. (b) Per capita income growth in Rajasthan would be 5 per cent per annum over time. Using projected population and expenditure elasticities of rural/urban Rajasthan, the demand projections for pearl millet (food) were made and are presented in Table 5. The Table reveals that the demand of pearl millet for food will increase over time. In 2025, total demand of pearl millet (food) will be 2613 thousand tonnes. In 2015, it is likely to be 136 thousand tonnes in urban and 1926 thousand tonnes for rural Rajasthan. In 2020, it will be 154 thousand tonnes for urban and 2165 thousand tonnes for rural Rajasthan. In 2025, it will be 174 thousand tonnes for urban and 2439 thousand tonnes for rural Rajasthan. Table 6 shows consumption rates of different types of feed for different categories of livestock and total consumption of dry fodder and concentrates in Rajasthan based upon livestock population in 2007. (Dikshit and BIRTHAL, 2010)*. It reveals that per day consumption of dry fodder was 6.3 kg for a buffalo in milk, 5 kg for a dry buffalo, 7.5 kg for an adult male buffalo and 2.2 kg for young stock. Consumption rate of concentrate feed, which is essential for animal's growth and production, was estimated at 1.1 kg for a buffalo in milk, 0.5 kg for a dry buffalo, 0.4 kg for an adult male buffalo and 0.2 kg for a young one. Per day consumption of dry fodder was 5.5 kg for cow in milk, 4 kg for dry cow, 6 kg for an adult male and 2.1 kg for young stock. This was slightly lower than that of buffalo. There were hardly any differences in consumption of dry fodder and concentrates for goat and sheep. Total consumption of dry fodder and concentrates based on live stock census 2007 was 37188 thousand tonnes per annum and 4720 thousand tonnes per annum respectively.

Demand Projections (Feed, Fodder, Seed and Distilleries)

Assumptions

Cattle feed: Pearl millet grain constitutes 30 per cent of total concentrates requirement of livestock (4720 thousand tonnes) given in

Table 6. This requirement is expected to increase @ 3 per cent/annum (ACGR of cattle population).

Dry fodder (cattle): Pearl millet dry fodder constitutes 40 per cent of total dry fodder requirement (37188 thousand/annum) given in Table 6. This requirement is expected to increase @ 3 per cent/annum (ACGR of Cattle population).

Poultry feed: 15 per cent of total production of pearl millet in 2008-2009 (4293.94 thousand tonnes) is consumed in the poultry feed industry. It is expected to increase @ 5 per cent per annum (ACGR of poultry population).

Distilleries: 10 per cent of total production of pearl millet in 2008-2009 (4293.94 thousand tonnes) is consumed in distilleries. It is expected to increase @ 6 per cent per annum.

Seed: Seed demand is estimated by multiplying the current seed rate of 4 kg/ha with the projected area under pearl millet in different years (Table 10).

All these assumption are based on interactions with farmers and poultry feed factories and distilleries.

Table 7 shows demand projection for pearl millet (grain) for alternative uses. Demand for cattle feed is projected to be 2018 thousand tonnes (2020) and 2340 thousand tonnes in 2025. The demand for poultry feed industry is projected at 1406 thousand tonnes in 2025. The demand for alcohol industry is projected to be 815 thousand tonnes (2020) and 1091 thousand tonnes in 2025. The demand for seed is pegged at 24 thousand tonnes and 25 thousand tonnes in 2020 and 2025 respectively. Total demand of pearl millet (grain) for food is projected at 3958 thousand tonnes and 4862 thousand tonnes in 2020 and 2025 respectively. Table 8 shows the total demand of pearl millet (grain) for food and alternative uses taken together. It reveals that total demand for pearl millet grain is projected to be 5350, 6277 and 7475 thousand tonnes in 2015, 2020 and 2025 respectively.

Supply Projections of pearl millet (grain)

Supply projections are made on basis of ACGR of area, production and productivity given in Table 9. The table reveals that annual compound growth rates (ACGR) of area, production and productivity are 1.16, 6.45 and 5.29 per cent per annum over a period of last fifteen years (1995-2009). Area under pearl millet is 5206.16 thousand hectares in the base year (2008-09) which is assumed to grow @ 1.16 per cent per annum (Table 9). Base year (2008-09) productivity was 825 kg/ha which is assumed to grow @ 2.5 per cent ACGR. The actual ACGR of productivity is 5.29 per cent (Table 9) which is not sustainable over a long period of time. Therefore, a moderate ACGR of 2.5 per cent is assumed. Table 10 shows supply projections of pearl millet over time. It reveals that the supply of pearl millet (grain) is projected at 5401 thousand tonnes (2015), 6469 thousand tonnes (2020) and 7759 thousand tonnes (2025). The projected supply is compared with the projected demand and the surplus/deficit is given in Table 11. The table reveals that gap between demand and supply is projected to be a surplus of 51 thousand tonnes (2015), 192 thousand tonnes (2020) and 284 thousand tonnes (2025).

Demand and Supply gap of Dry fodder (Pearl millet)

Dry fodder supply projection is assumed to be 2.5 times the grain supply projections given in Table 11. Demand projections of dry fodder of pearl millet are based on assumptions that 40 per cent of total consumption of dry fodder for livestock in Rajasthan (37188 thousand tonnes per annum given in Table 6) is met through pearl millet dry fodder. This is expected to grow 3 per cent per annum (ACGR of cattle population). Table 12 shows demand and supply gap of pearl millet (dry fodder) over the years. The table reveals a deficit projection of dry fodder of pearl millet -5315 thousand tonnes in 2015, -5631 thousand tonnes in 2020 and -5865 thousand tonnes in 2025.

Policy Implications

Distilleries use pearl millet grain for alcohol purpose. But pearl millet has low starch content (52 per cent) as compared to broken rice (68 per cent) and jowar (58 per cent). Therefore, pearl millet breeders should initiate research efforts to increase starch content in pearl millet. The study also projects a deficit fodder production scenario in coming years. Therefore, research efforts should be made to evolve hybrid varieties with thick stem to ensure regular and enhanced fodder supply for sustenance of livestock in Rajasthan.

Table 1: Population projections and per capita consumption of pearl millet

| State | Area | Population (million) | | | *Consumption (kg/capita/annum) (2004-05) |
|-----------|-------|----------------------|-------|-------|--|
| | | 2015 | 2020 | 2025 | |
| Rajasthan | Urban | 19.64 | 22.21 | 24.93 | 6.90 |
| | Rural | 57.33 | 63.09 | 69.53 | 33.00 |
| | Total | 76.97 | 85.30 | 94.46 | 26.50 |

*Source: National sample survey Report of 61st Round (2004-05)

Table 2: Regression coefficients and R2 using various regression models for Rural Rajasthan

| Model | b0 | b1 | b2 | F | R2 |
|-------------|---------|-----------|--------|-------|------|
| Linear | -9.55 | 0.28NS | - | 2.61 | 0.20 |
| Log-Linear | -90.81 | 23.88NS | - | 3.44 | 0.25 |
| Log-Inverse | 37.87 | -1903.9NS | - | 4.42 | 0.30 |
| Quadratic | -253.49 | 6.87* | -0.04* | 13.33 | 0.74 |

*Significant at 5per cent level of significance NS- non significant

Table 3: Regression coefficients and R2 using various regression models for Urban Rajasthan

| Model | b0 | b1 | b2 | F | R2 |
|-------------|---------|-----------|--------|-------|------|
| Linear | -9.55 | 0.28NS | - | 2.61 | 0.20 |
| Log-Linear | -90.81 | 23.88NS | - | 3.44 | 0.25 |
| Log-Inverse | 37.87 | -1903.9NS | - | 4.42 | 0.30 |
| Quadratic | -253.49 | 6.87* | -0.04* | 13.33 | 0.74 |

*Significant at 5per cent level of significance NS- non significant

| Model | b0 | b1 | b2 | F | R2 | |
|-------------|--------|--------|----------|---|-------|-------|
| Linear | - | 1.8769 | 0.0515NS | - | 4.17 | 0.275 |
| Log-Linear | - | 16.023 | 4.1776NS | - | 5.39 | 0.329 |
| Log-Inverse | 6.4186 | - | 327.94NS | - | 6.80 | 0.382 |
| Quadratic | - | 37.668 | 1.0181* | - | 16.87 | 0.771 |

*Significant at 5per cent level of significance NS- non significant

Table 4: Estimated expenditure elasticities of Pearl millet in rural and urban Rajasthan

| Region | Expenditure elasticities |
|--------|--------------------------|
| Rural | 0.090 |
| Urban | 0.013 |

Table 5: Demand projections for Pearl Millet (Food)

| (000' Tonnes) | | | |
|---------------|------|------|------|
| Rajasthan | 2015 | 2020 | 2025 |
| Urban | 136 | 154 | 174 |
| Rural | 1926 | 2165 | 2439 |
| Total | 2062 | 2319 | 2613 |

Table 6: Feed consumption rates of cattle feed, green fodder, dry fodder and concentrates in Rajasthan based on Livestock population census (2007)

| | Cattle | Buffalo | | | | Other | | | | Total | | | | |
|--|--------------|---------|------|------------|-------|---------|------|------------|-------|-------|-------|-------|--------|---------|
| | | in-milk | dry | adult male | young | in-milk | Dry | adult male | young | | Goats | sheep | others | Poultry |
| Livestock population census 2007 (million) | Rajasthan | 3.22 | 2.3 | 2.08 | 4.53 | 3.93 | 1.89 | 0.1 | 5.17 | 21.5 | 11.19 | 0.55 | 14.4 | 70.86 |
| *feed consumption rates including intake through grazing (kg/animal/day) | Green fodder | 5.9 | 4.7 | 7.1 | 4 | 8.9 | 9.7 | 7.1 | 6.1 | 1.5 | 1.7 | 1.5 | - | 58.2 |
| | Dry fodder | 5.5 | 4 | 6 | 2.1 | 6.3 | 5 | 7.5 | 2.2 | 0.2 | 0.2 | 0.2 | - | 39.2 |
| | Concentrates | 0.6 | 0.4 | 0.3 | 0.2 | 1.1 | 0.5 | 0.4 | 0.2 | 0.1 | 0 | 0.1 | - | 3.9 |
| Total consumption of green fodder (in 000' t/annum) | Rajasthan | 6934 | 3946 | 5390 | 6614 | 12767 | 6692 | 259 | 11511 | 11771 | 6943 | 301 | - | 73128 |
| Total consumption of dry fodder (in 000' t/annum) | Rajasthan | 6464 | 3358 | 4555 | 3472 | 9037 | 3449 | 274 | 4152 | 1570 | 817 | 40 | - | 37188 |
| Total consumption of concentrates (in 000' t/annum) | Rajasthan | 705 | 336 | 228 | 331 | 1578 | 345 | 15 | 377 | 785 | 0.00 | 20 | 0 | 4720 |

Feed consumption rates given by *Dikshit A.K. and BIRTHAL, P.S. (2010) "India's Livestock Feed Demand: Estimates and Projections" Agricultural Economics Research Review, Vol. 23 January-June 2010 15-28.

Table 7: Demand projections for pearl millet (Grain) for alternative uses (000'tonnes)

| Rajasthan | Demand for cattle feed (Concentrates) | Demand for Distillery | Demand for Seed | Demand for Poultry feed | Total Demand |
|-----------|---------------------------------------|-----------------------|-----------------|-------------------------|--------------|
| 2015 | 1793 | 609 | 23 | 863 | 3288 |
| 2020 | 2018 | 815 | 24 | 1101 | 3958 |
| 2025 | 2340 | 1091 | 25 | 1406 | 4862 |

Table 8: Total demand for Food and Alternative uses

| (000'tonnes) | | | |
|-----------------------------|------|------|------|
| | 2015 | 2020 | 2025 |
| Demand for Food | 2062 | 2319 | 2613 |
| Demand for cattle feed | 1793 | 2018 | 2340 |
| Demand for distillery | 609 | 815 | 1091 |
| Demand for seed requirement | 23 | 24 | 25 |
| Demand for poultry feed | 863 | 1101 | 1406 |
| Total demand (Grain) | 5350 | 6277 | 7475 |

Table 9: Annual compound growth rates (ACGR) of area, production and productivity of Pearl millet in Rajasthan

| Per cent | |
|------------|------------------|
| Rajasthan | |
| Item | ACGR (1995-2009) |
| Area | 1.16 |
| Production | 6.45 |
| Yield | 5.29 |

Table 10: Supply projections of pearl millet (Grain)

| Year | Projected Area (000' ha) | Projected Productivity (Kg/ha) assuming ACGR of 2.5per cent (If slow down in productivity) | Supply projections (000'tonnes) at 2.5per cent ACGR |
|------|--------------------------|--|---|
| 2015 | 5644 | 957 | 5401 |

Table 11: Demand and supply gap of pearl millet (Grain)

| (000'tonnes) | | | |
|--------------|--------------------|--------|-------------------|
| Year | Supply projections | Demand | Surplus / Deficit |
| 2015 | 5401 | 5350 | 51 |
| 2020 | 6469 | 6277 | 192 |
| 2025 | 7759 | 7475 | 284 |

| | | | |
|------|------|------|------|
| 2020 | 5979 | 1082 | 6469 |
| 2025 | 6334 | 1225 | 7759 |

Table 12: Demand and supply gap of pearl millet (Dry fodder)

| (000'tonnes) | | | | |
|---|------|--------|--------|-------------------|
| | Year | Supply | Demand | Surplus / Deficit |
| Demand and supply gap in dry fodder (000't) | 2015 | 13502 | 18817 | -5315 |
| | 2020 | 16172 | 21803 | -5631 |
| | 2025 | 19397 | 25262 | -5865 |

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