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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).

Key Words: Pearl millet, food Demand, supply and Projection. **JEL Classification:** Q21, Q31

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

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(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:

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

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

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

$\log Y = a + b(1/x) + U \dots$ 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 the highest and regression coefficients were significant. The expenditure elasticity (e_x) was worked out as follows:

$$e_x = \frac{\bar{x}}{\bar{y}} (b_1 - 2b_2\bar{x})$$

Where;

e_x = 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):

$$D_{it} = d_{i0} * N_{it}^{1+y} \eta_i$$

Where;

D_{it} = Potential demand (kg) in rural/urban Rajasthan in time period t.

d_{i0} = Per capita consumption of pearl millet (Kg/month) in the base year (2004-05) using NSSO 61st round data.

N_{it} = 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 1 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).

The results presented in Table 2 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 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

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

Area	Population (million)			*Consumption (kg/capita/annum) (2004-05)
	2015	2020	2025	
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 Rajasthan

Model	b ₀		b ₁		b ₂		F		R ²	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Linear	-9.55	-1.87	0.28 ^{NS}	0.05 ^{NS}	-	-	2.61	4.17	0.20	0.27
Log-Linear	-90.81	-16.02	23.88 ^{NS}	4.17 ^{NS}	-	-	3.44	5.39	0.25	0.32
Log-Inverse	37.87	6.41	-1903.9 ^{NS}	-327.9 ^{NS}	-	-	4.42	6.80	0.30	0.38
Quadratic	-253.49	-37.66	6.87*	1.01*	-0.04*	-0.006*	13.33	16.87	0.74	0.77

*Significant at 5per cent level of significance

NS: Non-significant

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 3.

The perusal of Table 3 reveals that the demand of pearl millet for food will increase over time. In 2025, total demand of pearl millet

Table 3: Demand projections for Pearl Millet (Food)

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

(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. The perusal of Table 4 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)*.

The results revealed 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

Table 4: Feed consumption rates of cattle feed, green fodder, dry fodder and concentrates in Rajasthan based on Livestock population census

Type of milch animals	Type of milch animals	Livestock population census 2007			(000 tonnes)		
		(million)			Total consumption of green fodder	Total consumption of dry fodder	Total consumption of concentrates
		Green fodder	Dry fodder	Concentrates			
Cattle							
In-milk	3.22	5.9	5.5	0.6	6934	6464	705
Dry	2.3	4.7	4	0.4	3946	3358	336
Adult male	2.08	7.1	6	0.3	5390	4555	228
Young	4.53	4	2.1	0.2	6614	3472	331
Buffalo							
In-milk	3.93	8.9	6.3	1.1	12767	9037	1578
Dry	1.89	9.7	5	0.5	6692	3449	345
Adult male	0.1	7.1	7.5	0.4	259	274	15
Young	5.17	6.1	2.2	0.2	11511	4152	377
Goats	21.5	1.5	0.2	0.1	11771	1570	785
Sheep	11.19	1.7	0.2	0	6943	817	0
Others	0.55	1.5	0.2	0.1	301	40	20
Poultry	14.4	-	-	-	-	-	0
Total	70.86	58.2	39.2	3.9	73128	37188	4720

*Feed consumption rates given by Dikshit and BIRTHAL. (2010)

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 5. 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 5. 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 9).

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

The perusal of Table 6 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

Table 5: Total demand for Food and Alternative uses

Particulars	(000' Tonnes)		
	2015	2020	2025
Demand for Food	2062	2319	2613
Demand for cattle feed (Concentrate)	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

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 5 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 6. The results revealed 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. 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 which is not sustainable over a long period of time. Therefore, a moderate ACGR of

Table 6: Supply projections of pearl millet (Grain)

Year	Projected Area (000' ha)	Projected Productivity* (Kg/ha)	Supply projections** (000'tonnes)
2015	5644	957	5401
2020	5979	1082	6469
2025	6334	1225	7759
ACGR (%) 1995-2009	1.16	6.45	5.29

2.5 per cent is assumed. Table 6 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 7. The perusal of Table 7 revealed 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 7. 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 4) is met through pearl millet dry fodder. This is expected to grow 3 per cent per annum (ACGR of cattle population).

The results presented in Table 7 show 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.

Table 7: Demand and supply gap of pearl millet(Grain and Dry fodder)

Year	(000'tonnes)					
	Supply projections		Demand		Surplus/Deficit	
	Grain	Dry Fodder	Grain	Dry Fodder	Grain	Dry Fodder
2015	5401	13502	5350	18817	51	-5315
2020	6469	16172	6277	21803	192	-5631
2025	7759	19397	7475	25262	284	-5865

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.

REFERENCES

- 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.
- Farooq Umar, Trevor Young, and Muhammad Iqbal (1999) An Investigation into the Farm Households Consumption Patterns in Punjab, Pakistan. *The Pakistan Development Review* 293-305.
- Musebe, O. R. and Kumar, P. (2006) Food expenditure pattern of rural household in Andhra Pradesh. *Indian Journal of Agricultural Marketing*. 20:1 131-139.
- Paroda, R.S., Kumar, P. and Kumar, P. (2000) Food production and demand in South Asia. *Agril. Econ. Res. Rev.*, 13:1 1-24.
- Praduman Kumar, Madan, Dey, M., Ferdinand and Paraguas, J. (2005) Demand for Fish by Species in India: Three stage Budgeting Framework. *Agricultural Economics Research Review* Vol.18 July-December 2005 167-186.

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