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Regional Trends and Pattern in Milk Production and Drivers for Future Growth in Gujarat State[§]

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Abstract

The state of Gujarat has historically been the front runner in milk production activities. The state's share in country's milk production as well as per capita availability of milk have been increasing consistently, ensuring not only food security but also employment and livelihood sustenance in the rural areas. A phenomenal growth in milk production of cross-bred cows has been witnessed in recent years, especially in the southern and northern regions of the state. Historically, among the various factors contributing to growth in milk production, incremental dairy animal population has been the important factor. However, henceforth it is the yield of lactating animals – a single-most significant factor that needs to be focused for augmenting and sustaining growth in milk across any type of dairy animal.

Introduction

Crop and livestock mixed farming is an essential characteristic of the Indian agriculture, pursued simultaneously with each complimenting the other. Structurally, both are pursued to maximize the resources of the farmer. The majority of the farmers, who are marginal and small, generally rear one or two milch animals, mainly using crop residues, by-products and family labour, especially of women and children (George, 1996).

In India, the state of Gujarat has historically been the front runner in milk production activities. One of the ways to assess the significance of agriculture and livestock in the state economy is through their contributions to the gross state domestic product. It is found that livestock contributed around 23 per cent to

the gross value of output of the combined agriculture and livestock sector in 2007-08. More significantly, the contribution of livestock to the state economy, which was 4.8 per cent in 1997-98, has remained almost constant over the past ten years, whereas at the national level, a shade decline of around one per cent has been witnessed in the contribution of livestock to the total gross domestic product during 1999-2000 to 2007-08 (GoI, 2009). In the state, within the spectrum of livestock, milk enjoys the absolute importance; as much as 89 per cent of the value of output in current prices is contributed by milk, the highest in India (GoI, 2008b). It may be noted that milk contributes around two-thirds of the total value of output from the livestock sector at the country level (GoI, 2009). Therefore, it would not be out of place if the discussion on the livestock in Gujarat is concentrated on dairy production or milk, in contrast to other components of livestock products (sheep, goat, camel, etc.).

Since the successful implementation of Operation Flood (OF) program – one of the world's largest and most successful dairy development programs – the country has been maintaining a secular growth of around 4 per cent per annum in milk production. From 1990-91 to 2008-09, the increase in contribution of the Gujarat

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state to national milk production has been noteworthy. Relative share of the state in country's milk production increased from 6.5 per cent in 1994 (GoI, 1994) to 7.7 per cent in 2008 (GoI, 2008a). Similar to the rise in absolute production of milk, the per capita availability of milk has been constantly increasing in the state as well as at the national level. In 2008-09, the state of Gujarat had third position in the country with per capita milk availability of 403 g/day; the top two states being Punjab (957 g/day) and Haryana (645 g/day). The domestic availability of milk on per capita basis has always been higher than the national average. Availability of milk and its ever increasing volumes have been contributing substantially to food security and sustenance of food production. The state of Gujarat has been historically contributing to ensuring food security not only in the state but elsewhere in the country too. It is significant that in 1990-91, the difference in availability of milk between the state and nation was 60 g (236 g for the state as against 176 g at the national level), and this difference continued to favour the state over the years, and stood at 145 g in 2008-09 (403 g for Gujarat as against 258 g at all-India level). It has been possible due to two factors: (i) higher growth in milk production compared to growth in human population, and (ii) the rate of growth in milk production in the state exceeding the national rate of growth. The finding therefore is that the consistency in increase in absolute growth in milk production is not only adding to food security but also ensuring employment and livelihood sustenance in the state.

The population of milch animals, their compositional characteristics and yields are important determinants of the strength of milk production. In India, the production attributes of milk have followed a diversified path. In some states, increase in milch animal population has been the most important reason for growth, some other states have gone in for technological intervention in breeding and attained growth, while in some states a judicious mix of population growth and improvement in quality of milch animals has been noticed. Therefore, a study of the state of Gujarat and characterization of their growth trajectory would be a subject of interest.

This paper has provided an in-sight on various facets of milk production system in the state of Gujarat. It has been conceptualized to highlight the important factors for the growth of milk production in different regions of Gujarat and examine the behaviour of the constituent

factors and possible direction for future. The regional characteristics become important as they help in linking different observations with the macro and regional features and thus facilitate a deeper understanding of the issues, their analyses from the perspective of different components that singularly or in conjunction with others shape the nature of the production systems.

Data and Methodology

The data for the present study were collected from various issues of Integrated Sample Survey (ISS) published by Directorate of Animal Husbandry (GoG, 1990-91 to 2008-09). It has covered composition of milch animals, growth of milch animals, productivity of dairy animals and milk production. The inter-temporal analysis of the factors associated with milk production has also been carried out. Elasticity of milk production has been evaluated and analysis of factors contributing to milk production has been performed. Based on these analyses, policy level issues have been highlighted in the area of dairying in the state. The analyses have also been carried out at the regional level by aggregating the district level data of the state.

Regions of the State

As per the Agro Economic Research Centre, Vallabh Vidyanagar, there are five broad regions in the state — South Gujarat, Central Gujarat, North Gujarat, Kachchh and the Saurashtra (Dutta and Bhaiya, 2004). These regions were accepted as such for our study. However, the district of Kachchh itself constitutes a region, and therefore for ease of understanding and compilation of regional data, the Kachchh region was clubbed with the Saurashtra region. Various regions of the state along with the districts are depicted in Table 1.

Results and Discussions

Milch Animal Population

Numerically, buffaloes are the principal species in milk production. In 2008-09, the number was maximum of milch buffaloes (47 lakh), followed by local cows (22 lakh) and cross-bred cows (5.3 lakh). Over the past 18 years, there has been an appreciation of about 32 lakh milch animals in the state, which means addition of 1.8 lakh milch animals annually.

Table 1. Region-wise districts of Gujarat

Region	Districts
South Gujarat	Bharuch, Narmada, Navsari, Surat, Tapi, The Dangs, Valsad
Central Gujarat	Anand, Dohad, Kheda, Panchmahal, Vadodara
North Gujarat	Ahmedabad, Banaskantha, Gandhinagar, Mehsana, Patan, Sabarkantha
Kachchh	Kachchh
Saurashtra	Amreli, Bhavnagar, Jamnagar, Junagadh, Porbandar, Rajkot, Surendranagar

There has been a positive appreciation in all the categories of milch animals, but the rate of appreciation in the cross-bred cows and buffaloes has far outpaced that in the local cows. It is this differential rate of appreciation which has caused an intelligent shift in the composition of local cows from 39 per cent in 1990-91 to 29 per cent in 2008-09, while the share of buffaloes has improved from 59 per cent in 1990-91 to 63 per cent in 2008-09. The cross-bred cows accounted for only 2 per cent of milch animals in 1990-91 and increased to 7 per cent in 2008-09. It is apparent that the proportion of cross-bred cows has increased significantly during the period 2000-01 to 2008-09.

Another significant feature of this change was a gradual and consistent shift from the local cows to buffaloes. It may be mentioned that at the all-India level too, a similar trend is observed. Across different regions of the state, the Saurashtra region has depicted a significant contribution of local cows (43%), followed by the southern region (30%). The northern and central

regions have shown a lower proportion of local cows. A noticeable increase was witnessed in population of cross-bred cows in the northern and southern regions of the state.

Growth in Milch Animals

The growth in population of cross-bred cows has been remarkable, from 6 per cent per annum during 1990-91 to 2000-01 to 18 per cent per annum during 2000-01 to 2008-09. However, it was possible as the baseline population was at a low level. Between the populations of local cows and buffaloes, the growth rate in the former group has slowed down (0.14%) during the later period, compared to the previous period (2.59%). During 2000-01 to 2008-09, the growth in buffalo population has been tapered by one percentage point, as compared to that during 1990-91 to 2000-01. Therefore, it is postulated that there would be a further reorganization in the herd structure of the state, favouring buffaloes and the cross-bred cows (Table 3).

Table 2. Region-wise composition of milch animals in Gujarat

(in '00 No.)

Region	Local cow			Cross-bred cow			Buffalo		
	1990-91	2000-01	2008-09	1990-91	2000-01	2008-09	1990-91	2000-01	2008-09
Central	2886	4366	4525	292	522	981	7161	11465	12672
North	4033	4800	5524	257	485	2526	9198	12629	18270
Saurashtra	7374	9483	9249	55	93	289	6172	9900	12038
South	2496	3035	2593	175	289	1543	2842	3617	4407
Gujarat state	16788	21682	21922	778	1390	5338	25372	37612	47388
Composition (per cent)									
Central	27.91	26.70	24.89	2.82	3.19	5.40	69.26	70.11	69.71
North	29.90	26.79	21.08	1.90	2.71	9.59	68.20	70.50	69.34
Saurashtra	54.22	48.69	42.87	0.40	0.48	1.34	45.38	50.83	55.79
South	45.28	43.73	30.35	3.17	4.16	18.06	51.55	52.11	51.59
Gujarat state	39.10	35.73	29.37	1.81	2.29	7.15	59.09	61.98	63.48

Source: Deduced from GoG (1990-91; 2000-01; 2008-09)

Table 3. Region-wise compounded annual growth rate in milch animals in Gujarat

(per cent)

Region	Local cow		Cross-bred cow		Buffalo	
	1990-91 to 2000-01	2000-01 to 2008-09	1990-91 to 2000-01	2000-01 to 2008-09	1990-91 to 2000-01	2000-01 to 2008-09
Central	4.23	0.45	6.00	8.19	4.82	1.26
North	1.76	1.84	6.57	22.91	3.22	4.72
Saurashtra	2.55	-0.31	5.51	15.17	4.84	2.47
South	1.97	-1.95	5.15	23.31	2.44	2.50
Gujarat state	2.59	0.14	5.98	18.32	4.02	2.93

Source: Deduced from GoG (1990-91; 2000-01; 2008-09)

Milk Production

Consequent to the compositional changes in the characteristics of milch animals, it was but natural that the production features would follow an identical pattern as that of the animals, and the data presented in Table 4 confirm this proposition. During 1990-91 to 2008-09, milk production of local cows almost doubled, from 9.55 lakh tonnes to 18.51 lakh tonnes, of cross-bred cows registered almost a seven-fold increase, from 1.77 lakh tonnes to 11.92 lakh tonnes and of buffaloes rose from 22.26 lakh tonnes to 51.10 lakh tonnes. The share of buffaloes in total milk production remained constant at 66 per cent in 1990-91 and in 2000-01, but declined marginally in 2008-09. The share of cross-bred cows in milk production has increased more than proportionately at the cost of decline in the shares of local cows and buffaloes both. The change in the

proportionate share of cross-bred cows in the southern region was appreciable at 34 per cent in 2008-09, from a level of 10 per cent in 1990-91. Now if the findings relating to milch animal population, compositional changes and milk production are combined into some notable features, it is found that buffaloes and cross-bred cows are gaining ground and contributing to the growth in milk production and food security in the state. It would, however, be incorrect if the significance of the descript animals is undermined. They also have shown absolute growth in milk production over the different time points; however, it is the rate of growth that has marginally slowed down in the case of local cows.

Proportion of Milking to Total Milch Animals

Of the possible reasons often cited to explain the health of a milch herd is the proportion of milking

Table 4. Region-wise milk production across different species in Gujarat

(lakh tonnes per annum)

Region	Local cow			Cross-bred cow			Buffalo		
	1990-91	2000-01	2008-09	1990-91	2000-01	2008-09	1990-91	2000-01	2008-09
Central	1.22	2.01	2.98	0.71	0.73	2.07	5.26	8.86	11.28
North	2.37	3.76	5.05	0.63	1.11	5.79	9.27	13.17	21.42
Saurashtra	5.14	7.11	8.64	0.11	0.21	0.70	5.79	9.22	13.60
South	0.82	1.47	1.83	0.31	0.53	3.37	1.94	3.24	4.80
Gujarat state	9.55	14.35	18.51	1.77	2.58	11.92	22.26	34.49	51.10
Regional share (per cent)									
Central	16.94	17.31	18.27	9.89	6.28	12.66	73.17	76.41	69.07
North	19.33	20.84	15.65	5.17	6.13	17.94	75.49	73.03	66.41
Saurashtra	46.55	42.98	37.68	0.97	1.29	3.03	52.47	55.73	59.29
South	26.60	28.08	18.32	10.25	10.14	33.73	63.15	61.78	47.95
Gujarat state	28.44	28.19	22.70	5.27	5.06	14.62	66.30	66.75	62.68

Source: Deduced from GoG (1990-91; 2000-01; 2008-09)

Table 5. Region-wise compounded annual growth rate in milk production in Gujarat

(per cent)

Region	Local cow		Cross-bred cow		Buffalo	
	1990-91 to 2000-01	2000-01 to 2008-09	1990-91 to 2000-01	2000-01 to 2008-09	1990-91 to 2000-01	2000-01 to 2008-09
Central	5.12	5.08	0.23	13.94	5.35	3.07
North	4.71	3.76	5.71	22.97	3.58	6.27
Saurashtra	3.30	2.47	7.09	15.91	4.75	4.98
South	6.07	2.78	5.38	25.99	5.26	5.04
Gujarat state	4.16	3.23	3.84	21.10	4.32	5.23

Source: Deduced from GoG (1990-91; 2000-01; 2008-09)

animals. A higher percentage of milking animals will positively influence milk production. But, a progressive increase in this percentage is biologically not possible, as milking and dry periods are the two unavoidable periods of the animal physiology. Nonetheless, a point of maximum level can only be achieved under the control conditions where all factors of production are regulated and provided in sufficient volume and quantity. Admittedly, under the field conditions, it is a difficult proposition. Given this situation, a brief analysis has been provided on the historical averages of the percentage in-milk animals for different regions of the state at different points of time (Table 6). The important observations are:

- A consistent improvement in percentage of milking animals of local cows,
- Buffalo herd seems to have improved, *albeit* marginally,
- Cross-bred cows have shown a slight fall in percentage of milking animals during 1990-91 to 2000-01, but have improved during 2000-01 to 2008-09,

- The fall in percentage of milking cross-bred cows in the northern region is noticeable.

Growth in Milk Output and Associated Factors

In the background of growth in milk output, it would be useful if the causes of growth are studied. BIRTHAL *et al.* (1999) have found that output index of milk had expanded at 3.98 per cent per annum over a period of 15 years, ending 1995-96, and the growth in input index had been 2.19 per cent per annum. The net result (output index minus input index) was a growth of 1.79 per cent per annum, which could be attributed to total factor productivity (TFP). The basket of input index in the formulation consisted of feed index, labour index and population stock index. Technically, it has been argued that the due to improvement in TFP, the growth in livestock sector has been positive and secular over a longer horizon. Similarly, an analysis was carried out to diagnose the factors that are directly responsible for the acceleration of milk output.

The facilitating or hindering factors of milk production are:

Table 6. Region-wise proportion of in-milk to milch animals in Gujarat

(per cent)

Region	Local cow			Cross-bred cow			Buffalo		
	1990-91	2000-01	2005-06	1990-91	2000-01	2005-06	1990-91	2000-01	2005-06
Central	52.53	53.89	61.39	85.52	60.17	71.69	62.84	59.84	64.58
North	53.76	60.35	60.97	69.18	73.82	68.72	64.60	64.58	64.72
Saurashtra	64.70	64.06	66.29	69.10	72.98	77.20	66.33	64.49	66.33
South	49.44	56.84	63.98	72.89	76.04	81.06	62.63	69.48	72.43
Gujarat state	57.68	60.20	63.64	76.14	69.11	73.29	64.31	63.59	65.81

Source: Deduced from GoG (1990-91; 2000-01; 2008-09)

Table 7. Region-wise annual growth in milk production and associated factors in Gujarat: Local cows

Particulars	Annual growth rate (%)				
	Central	North	Saurashtra	South	Gujarat state
In-milk animals	1.07	0.68	0.25	1.25	0.61
In-milk yield	1.30	1.56	1.49	3.30	1.59
Milch animals	3.22	2.21	1.10	0.87	1.74
Milk production	5.59	4.45	2.84	5.41	3.94

Table 8. Region-wise annual growth in milk production and associated factors in Gujarat: Cross-bred cows

Particulars	Annual growth rate (%)				
	Central	North	Saurashtra	South	Gujarat state
In-milk animals	-1.55	0.02	0.067	0.27	-0.37
In-milk yield	0.40	-0.10	0.31	-0.57	0.34
Milch animals	4.56	10.85	7.89	12.35	8.99
Milk production	3.40	10.77	8.88	12.05	8.97

Table 9. Region-wise annual growth in milk production and associated factors in Gujarat: Buffaloes

Particulars	Annual growth rate (%)				
	Central	North	Saurashtra	South	Gujarat state
In-milk animals	-0.18	0.01	-0.10	-0.37	0.01
In-milk yield	0.72	0.93	1.11	2.17	1.04
Milch animals	3.49	3.78	3.53	3.68	3.54
Milk production	4.03	4.73	4.54	5.49	4.59

- Percentage in-milk animals
- Yield of in- milk animals
- Number of milch animals

The region-wise and time series data for the years 1990-91 to 2008-09 have been fitted under a semi-logarithm regression equation for estimating region-wise as well as species-wise trend in growth rates. The results have been presented in Table 7, 8 and 9 for local cows, cross-bred cows and buffaloes, respectively. The growth in milk production for local cows at the state level has been found to be about 4 per cent per annum. This growth has been achieved through the positive contributions of all the three variables listed above. The most significant contributor to the growth in production has been the increase in number of milch animals (1.74%), followed by the yield (1.59%) of in-milk animals and the increase in proportion (0.61%) of milking animals.

The growth analysis of cross-bred cows and buffaloes, however, did not follow the growth pattern of the local cows. In both these cases, the impact of proportion of milking animals has been found either negative or constant, while the other two factors have positively influenced milk production. Significantly, increase in the number of milch animals has been a far stronger factor compared to increase in the yield of in-milk animals.

If the growth enhancing factors are carefully studied, it is found that it is the local cows that have consistently improved their performance, across the regions as well as the state. The cross-bred cows and the buffaloes though improved on two counts (in-milk yield and increase in number), stumbled in percentage of in-milk animals. It is therefore important that yield rates have constantly aided improvement in milk production, which could be ascribed to technological innovations in milk production. As there could be a

Table 10. Elasticity co-efficient of milk production in Gujarat

Region	Local cow			Cross-bred cow			Buffalo		
	Ratio of in-milk to milch	In-milk yield	Milch population	Ratio of in-milk to milch	In-milk yield	Milch population	Ratio of in-milk to milch	In-milk yield	Milch population
Central	3.546***	2.595***	1.557***	-0.134	3.162***	0.944***	-1.117	2.681***	1.034***
North	3.510***	2.750***	1.928***	-1.374	-2.726	0.982***	1.839	4.581***	1.241***
Saurashtra	6.350***	1.853***	2.098***	6.014***	8.011**	1.111***	-0.366	3.090***	1.241**
South	1.158**	1.629***	0.854*	5.405	0.078	0.414**	-0.098	2.078***	0.385**
Gujarat state	5.500***	2.390***	2.124***	-6.748*	9.890***	1.006***	0.971	4.058***	1.271***

Notes: ***, ** and * depict significance at 0.5 per cent, 5 per cent and 10 per cent levels, respectively

biological limit to improvement in percentage of milking animal, it is possible that a limit in this regard has already set in. Nonetheless, the two other factors that seemed to be driving the production growth are quite redeeming in the context of the state and therefore, much of the efforts need to be crystallized for their sustenance.

Elasticity of Milk Production

The elasticity of milk production with respect to ratio of in-milk to milch animal, yield of in-milk animal, milch animal population were computed and are presented in Table 10. Improvement in yield of milking animals appears to be most commonly and uniformly significant factor which could improve milk production across any type of animal. However, improvement in the ratio of milking to total animals under the given situation of the state cannot influence milk production, especially in the case of cross-bred cows and buffaloes. In analysis in the previous section also, a similar trend has been observed in ascertaining the growth rates in milk production. It is therefore established that for a healthy development and growth of the milch herd it is necessary that yield stimulating factors are properly cared, which by itself would fuel growth in milk production.

Conclusions

The study has revealed that milk production in Gujarat has grown at a higher rate than that of the nation and hence the contribution of state to national milk production has increased from 6.5 per cent to 7.7 per cent during the past 18 years. In the state, milk enjoys absolute importance within the livestock spectrum as 89 per cent of the total value of output from livestock comes from milk. Across species, buffaloes have been found to dominate in the central

and northern regions of the state, while cows are in majority in the Saurashtra and southern regions. In recent years, in addition to buffaloes, cross-bred cows have been gaining importance in milk production, especially in the southern and northern regions of the state. The main driver of the growth in milk production in the state has largely been incremental number of animals, distantly followed by in-milk yield. It may also be noted that beyond a point, the incremental numbers would not be favourable. Due to increase in animal population, not only the pressure on land would increase, but it will also call for the sustainability of feed-fodder requirements to fulfill the nutritional requirements of the dairy animals. Yet, there are regional variations in this pattern across the species. From a futuristic point of view, the results of elasticity of milk production have indicated that yield of lactating animals is the common important factor across all species that needs to be paid attention for the sustenance of milk production growth in the state.

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