RESEARCH ARTICLE

Prioritization of Districts Based on Dairy Production

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Abstract

The study was carried out to prioritize the districts of Tamil Nadu state of India for identifying the dairy production potentials. Secondary data on veterinary institutional facilities and livestock production were collected from an integrated sample survey report, Government of Tamil Nadu, 2019-20. The data on rainfall, permanent pasture, gross cropped area, food grain production, cereal production, rural agricultural labor, rural marginal workers, number of co-operative banks, number of rural cultivators, surface road length, and landholding were based on Economic appraisal report, Government of Tamil Nadu, 2019-20. Factor analysis with principal component extraction was applied to detect the interrelationship among attributes of dairy progressiveness. The study identified components such as agriculture production, buffalo milk production, the component of veterinary infrastructure, and the component of cross-bred milk production. Based on the calculated factor scores of each factor component, the relative position of each district in the state has arrived. The districts of Namakkal, Salem, Thanjavur, Tiruvallur, and Cuddalore were ranked in top positions, and Dindigul, Ramanathapuram, Theni, Thoothukudi, and the Nilgiris were ranked in bottom positions in dairy production. The study advocates proper planning and prioritization of attributes among the districts to reduce variability for additional milk production.

Keywords: Dairy progressiveness, Factor analysis, Livestock production, Principal component approach, Regional disparity

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Introduction

Dairy farming, an integrated part of an agricultural system, complements each other and promotes the economic wellbeing of the rural population. It is an integral part of the rural economy. It supplements income to the economically weaker sections and generates gainful employment in the rural sector, particularly to the small, marginal farmers and landless agricultural laborers. In addition to income and employment generation, livestock provides manure, draught power, and quality animal source food(ASF).

In Tamil Nadu, the percent contribution of the livestock sector to the Gross State Value Added (GSVA) was 5.47, and that to the agriculture and allied activities was 45.62. During 2011-12, livestock's gross value-added estimate (at current prices) was Rs.26,179.44 crore. It increased to Rs.78,744.09 crore during 2018-19 (Policy note, Dept. of Animal Husbandry, Dairying, and Fisheries, Government of Tamil Nadu, 2019-20). This is achieved by dairy sector revolution and consequent to that structural change in cattle population happened. The dairy co-operatives increased their penetration and helped the farmers, particularly in input services, farm consultation services, and marketing services. Private dairying also came into picture and played a major role in milk procurement and marketing and increased its competitiveness. However, as milk production increased, the level of inequality in dairy development was witnessed but in varying magnitude (Kale *et al*., 2019). Further, India's estimated national demand for milk in 2030 is 266.5 million tonnes, whereas the current milk production is only 198.4 million tonnes in 2019(Economic survey, 2020-21).

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On the other hand, with the high income elasticities of demand, high-income growth rates, and high population growth rates, the demand for livestock products may be expected to rise rapidly. This excess demand can be fulfilled

by additional milk production, and it can only be achieved if inter-state disparities and inter-district disparities within the state are addressed. Hence,it is essential to determine the factors contributing to milk production and find out each district's relative position in dairy potentials. Such studies would allow planners and policy makers to carve out location-specific strategies and implement them effectively to increase dairy production.

Materials and Methods

The data related to rainfall, pasture land, gross cropped area, food grain production, cereal production, surface road length, number of co-operative banks, marginal workers, cultivators, rural agricultural labors, landholding, cattle population, buffalo population, breedable cross-bred female population, breedable indigenous female population, breedable buffaloes, number of veterinary hospitals, number of veterinary dispensaries and dairy indicators such as exotic milk production, cross-bred milk production, indigenous milk production, non-descript milk production, indigenous buffalo milk production and non-descript buffalo milk production were collected from the recently published Integrated sample survey Report, Government of Tamil Nadu in the year 2019-20, 20th Livestock census, (2019) recently published report of Economic appraisal of the Government of Tamil Nadu, 2019-20 and Dairying in Tamil Nadu, Statistical profile, National Dairy Development Board, 2014. To identify the relative position of districts in livestock progressiveness, resources, and infrastructure disparity among the districts, the data was analyzed by application of dimension reduction technique through factor analysis (Kathiravan *et al*., 2011). Based on the extracted components, the factor component score or the district versatility score arrived. The coefficient of each variable in the extracted components was multiplied by the variable's respective values for each district, and the total score for each district was calculated, and districts were ranked.

Table 1: Factor analysis for milk production: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.519
Bartlett's Test of Sphericity	Approx. Chi-Square	957.280
	df	253
	Sig.	.000

Results and Discussion

The results of factor analysis are presented in Tables 1-3. The computed Kaiser–Meyer–Olkin (KMO) statistics was 0.519, indicating the model's acceptability. Barlett's test of sphericity tests the hypothesis of whether the population correlation matrix is an identity matrix. The chi-square statistics was 957.280 with 253 degrees of freedom at 0.01 significant levels. The results, *i.e.,* the KMO statistics and Barlett's test of sphericity, indicate the appropriate factor analysis model. Further, all the extracted communalities were acceptable, and all the variables were fit for the factor solution, as their extraction values range between 0.963 and 0.775. The results of eigenvalues and variability extraction indicate that the percentage of variance explained by each specific factor or component is presented in Table 2. All the six components extracted had initial eigenvalues greater than 1, accounting for about 84.687% of variations in the milk production attribute.

The results of the rotated component matrix (Table 3) indicate that factors like rural agricultural labor, cereal production, food grain production, number of rural marginal workers, gross cropped area, cattle population, and number of dispensaries had factor loadings of 0.887, 0.887, 0.842, 0.805, 0.789, 0.682 and 0.650, respectively on component - I, which suggested that the component - I was the combination of all these factors. It could be interpreted as a "component of agriculture production". Component -I individually contributed to 24.93% of the variation. The factor loadings of buffalo population (0.965), breedable age buffalo population (0.952), buffalo indigenous milk production (0.918), buffalo non-descript milk production (0.701) and availability of permanent pasture land (0.662) were greater than 0.4 and this component- II can be interpreted as "component for buffalo milk production". This component explained 16.527 percent of the variation. The eigenvalue for the first component (7.002) is almost twice that of the second component (4.094), which indicated that the "component of agriculture production" was the major factor that contributes to the milk production of the state. The eigenvalues for the third component for different

Table 2: Factor analysis for milk production: eigenvalues and extraction of variability

	Initial eigenvalues			*Rotation sums of squared loadings*		
Component	*Total*	*% of variance*	*Cum. %*	*Total*	*% of variance*	*Cum. %*
1	7.002	30.444	30.444	5.735	24.933	24.933
2	4.094	17.800	48.244	3.801	16.527	41.460
3	3.003	13.055	61.299	3.336	14.506	55.966
4	2.208	9.599	70.898	2.945	12.803	68.769
5	1.965	8.544	79.442	2.163	9.406	78.176
6	1.206	5.244	84.687	1.497	6.511	84.687

Extraction method: Principal component analysis.

Table 3: Factor analysis for milk production: Rotated component matrix

	Principal components					
Variables	*1*	*2*	*3*	*4*	*5*	*6*
Rural agricultural labor	0.887					
Cereal production	0.887					
Foodgrain production	0.842					
Rural marginal workers	0.805				0.413	
Gross cropped area	0.789					
Indigenous milk production	0.706					
Cattle population	0.682			0.548		
No. of dispensaries	0.650					0.458
Buffalo		0.965				
Breedable age buffaloes		0.952				
Buffalo indigenous milk production		0.918				
Buffalo non-descript milk production		0.701	0.401			
Permanent pasture		0.662				
Rainfall			0.926			
Number of veterinary hospitals			0.920			
Number of co-operative banks			0.919			
Cross-bred milk production				0.890		
Crossbred breedable female population	0.462			0.837		
Exotic milk production				0.678		
Number of rural cultivators				0.511		-0.440
Nondescript milk production					0.831	
Landholding					-0.827	
Surface road length						0.806

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalization.

a. Rotation converged in 7 iterations.

factors such as rainfall, number of veterinary hospitals and number of co-operative banks were greater than 0.4, and therefore, this can be considered as a separate component that contributes to dairy production. The third component could be named "veterinary infrastructure," which alone contributes 14.506% of the variation. Factors such as cross-bred milk production, cross-bred breedable female population, exotic milk production, and a number of rural cultivators with their factor loadings of 0.890, 0.837, 0.678, and 0.511 together explain 12.803% of the variation. These factors in component - IV can be named as a component for "cross-bred milk production".

Prioritization of Districts Based on Dairy Production Potential

District prioritization was done using the scores constructed using the values obtained in factor analysis through the principal component approach. The coefficient of each variable in the extracted components was multiplied by the variable's respective values for each district, and the total score for each district was calculated. The results of the versatility score for each district based on ranks are presented in Table 4.

Agricultural production, the presence of agriculture laborers, and cattle population are some of the resources that help dairying to perform in a particular district. Based on such agricultural production components, Kancheepuram district scored the highest position (1.884), followed by Villupuram (1.882) and Pudukkottai (1.82). This component supports the livestock by providing resources such as fodder, cereal and pasture land. Districts such as Nilgiris, Kanniyakumari, and Coimbatore had least agricultural production potentials.

For buffalo milk, based on the resource availability, the districts such as Namakkal (3.128), Thiruvallur (2.092), and Kancheepuram (1.655) had high production potentials, and districts such as Perambalur, Theni, and Ramanathapuram had the least production potentials. Enhancing the buffalo population through cross-breeding will help to increase milk production. Buffalo can digest completely and convert poor quality roughage into milk and meat(Dhanda, 2006). Further,

Table 4: District-wise versatility scores of milk production potentials

Districts	*Agricultural production (Component I)*	*Buffalo milk production (Component II)*	*Veterinary infrastructure (Component III)*	*Cross-bred milk production (Component IV)*
Kancheepuram	1.884 (01)	1.655 (03)	-1.637 (30)	0.684 (08)
Villupuram	1.882 (02)	-0.458 (20)	0.828 (06)	2.901 (01)
Pudukkottai	1.828 (03)	-0.081 (09)	-0.285 (19)	0.512 (09)
Cuddalore	1.420 (04)	-0.487 (22)	0.446 (11)	-0.218 (12)
Nagapattinam	0.996 (05)	-0.409 (17)	-0.001 (17)	-0.584 (23)
Thiruvallur	0.981 (06)	2.092 (02)	-1.085 (27)	-0.546 (21)
Sivagangai	0.927 (07)	-0.526 (23)	-0.981 (26)	-0.546 (20)
Thiruvannamalai	0.917 (08)	-0.587 (24)	0.890 (04)	2.453 (02)
Ariyalur	0.849 (09)	-0.344 (12)	0.103 (16)	-0.757 (28)
Thanjavur	0.773 (10)	-0.390 (15)	0.853 (05)	-0.081 (11)
Thiruvarur	0.349 (11)	-0.813 (27)	0.150 (14)	-0.473 (18)
Krishnagiri	0.272 (12)	-0.352 (13)	0.339 (12)	-0.990 (29)
Vellore	0.219 (13)	-0.487 (21)	0.470 (10)	1.682 (03)
Dharmapuri	-0.271 (14)	0.538 (07)	0.622 (09)	-0.223 (13)
Ramanathapuram	-0.350 (15)	-0.899 (31)	-0.784 (24)	-0.585 (24)
Madurai	-0.384 (16)	-0.693 (26)	0.104 (15)	-0.417 (17)
Perambalur	-0.385 (17)	-0.829 (29)	1.090 (02)	-0.309 (15)
Tiruchirappalli	-0.431 (18)	-0.432 (19)	1.019 (03)	-0.285 (14)
Tirunelveli	-0.442 (19)	-0.111 (10)	-0.423 (21)	0.024 (10)
Karur	-0.509 (20)	1.560 (05)	-0.372 (20)	-1.205 (30)
Virudhunagar	-0.612 (21)	-0.607 (25)	-0.437 (22)	-0.476 (19)
Dindigul	-0.641 (22)	-0.277 (11)	-0.809 (25)	-0.317 (16)
Theni	-0.697 (23)	-0.839 (30)	-0.642 (23)	-0.605 (25)
Salem	-0.732 (24)	0.895 (06)	3.218 (01)	0.887 (06)
Thoothukudi	-0.761 (25)	-0.417 (18)	-1.213 (28)	-0.755 (27)
Erode	-0.762 (26)	1.587 (04)	-0.052 (18)	0.953 (05)
Namakkal	-0.902 (27)	3.127 (01)	0.739 (07)	1.027 (04)
Tirupur	-1.184 (28)	0.182 (08)	0.229 (13)	-0.612 (26)
The Nilgiris	-1.328 (29)	-0.367 (14)	-1.730 (31)	-1.313 (31)
Kanniyakumari	-1.375 (30)	-0.401 (16)	-1.289 (29)	-0.579 (22)
Coimbatore	-1.531 (31)	-0.824 (28)	0.638 (08)	0.759 (07)

Figures in parenthesis indicate ranks

buffalo calf can achieve an 800 gm/day weight gain without any supplementary feed, resulting in low-cost production (Cruz, 2007). Such economic advantages of buffalo rearing should be tapped to increase its contribution to the state.

Protecting livestock against diseases is crucial to increase dairy potential. Strengthening existing veterinary hospitals and dispensaries, including running mobile veterinary ambulances, will help deliver livestock services better and minimize disease losses, reduced mortality, and increased milk production. The results indicate that districts such as Salem, Perambalur, Tiruchirapalli, Thiruvannamalai, and Thanjavur were found better in infrastructural facilities to counter diseases against animals compared to with least resource potential districts.

The cross-bred population with increased productivity contributes to milk production potential. Low milk production may be due to low genetic potential, poor nutrition, inefficient farm management, unfavorable agro-climatic conditions, poor veterinary and extension services (Dhara *et al*., 2006). Based on the cross-bred milk production component, districts such as Villupuram, Thiruvannamalai, Vellore, Namakkal, and Erode were highly progressive (Table 3), and districts such as Thoothukudi, Ariyalur, Krishnagiri, and Karurwere least progressive.

Conclusion

Based on the factor scores obtained through factor analysis, the study classified the progressive nature of the districts and identified vast differences in dairy potentials across the studied districts of Tamil Nadu. The study identified four major factor components: agricultural production, buffalo milk production, veterinary infrastructure, and cross-bred milk production contributing to the dairy production potential of a district. Policy interventions that improve the dairy value chain and the development of an organized marketing network would help the dairy farmers and further reduce the milk handled by informal market traders. Improved veterinary intervention through an effective livestock service delivery system would reduce disease losses; improve the artificial insemination coverage, and enhance milk production potential in least progressive districts. Evolving a feed and fodder strategy such as creating fodder co-operatives, utilizing the existing grazing land effectively, and increasing production of fodder crops by utilizing barren lands will increase its availability and pave the way for holistic livestock growth and development.

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References

Cruz L, C. (2007). Trends in buffalo production in Asia. *Italian Journal of Animal Science*, *6* (2): 9- 24.

Dairying in Tamil Nadu, A Statistical profile (2014). National Dairy Development Board, Anand, Gujarat, India

Dhanda, O.P. (2006). Development of Indian buffalo as dairy animal. Proc. 5th Asian Buffalo Association Congress, Nanning, China, pp: 112-119.

Dhara, K. C., Ray, N. & Sinha, R. (2006). Factors affecting production of F1 cross-bred dairy cattle in West Bengal. *Livestock Research for Rural Development, 18* (4).

Economic appraisal (2019-20). Department of Evaluation and Applied Research, Government of Tamil Nadu.

Economic survey (2020-21). Department of Economic affairs, Economic division, Ministry of Finance, Government of India.

Integrated sample survey (2019-20).Department of Animal Husbandry, Dairying and Fisheries, Government of Tamil Nadu.

Kale, R.B., Ponnusamy, K, Sendhil, R, Maiti, S, Chandel, B.S., Jha, S.K., Mohanty, T.K. and Lal, S.P. (2019). Determinants of inequality in diary development of India. *National Academy science letters, 42* (3): 195-198.

Kathiravan, G. & Selvam, S. (2011). Crafting livestock production zones: A principal components approach. *Indian Journal of Animal Research, 45* (1): 1–9.

Livestock census (2019). Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

Policy note (2019-20).Department of Animal Husbandry, Dairying and Fisheries, Government of Tamil Nadu.