



Estimating dry fodder availability and requirement for bovines*

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ABSTRACT

The availability and requirement of dry fodder for bovines in Tamil Nadu were estimated in the study. A survey was conducted to ascertain the grain-to-straw ratios in various cereals and pulses crops in 580 farms, randomly selected from across the 7 agro-climatic zones of the State. Secondary data on area and production of various agricultural commodities in the State (2007-08) were also collected from government and non-government agencies. Based on the ratios assessed and the data collected on production of cereals, pulses and oilseeds in the State, a methodology was framed for estimating dry fodder availability. The requirement of dry fodder for bovines was estimated (i) taking the dry matter requirement of 2.50% per Adult Cattle Unit (ACU) (350 kg body weight) and (ii) taking the requirement of dry fodder as 1 kg of dry fodder/100 kg of body weight. The dry fodder produced from cereals was estimated to be 5.08 million tonnes (66.84% to total dry fodder), with half of it coming from paddy. Dry fodder from pulses in the State was 0.38 million tonnes. Groundnut contributed 28.20% to dry fodder output in State. Total dry fodder requirement for bovines in the State, was 11.77 million tonnes as per procedure 1, and 9.36 million tonnes as per procedure 2, indicating a deficit of 4.17 million tonnes and 1.76 million tonnes, respectively. Total bovine population of the State was 7.33 million ACUs, of which 5.84 million ACUs (79.72%) were cattle and 1.49 million ACUs (20.28%) buffaloes. Dry fodder status also showed a deficit of 0.57 and 0.24 tonne/ACU in the State, in procedure 1 and procedure 2, respectively. All zones in the State showed only deficit status of dry fodder, in both the requirement situations.

Key words: Availability, Bovines, Dry fodder, Requirement

Indian crop and animal agriculture are supplementary to each other, with the output of one being the input for the other. With the Indian livestock depending mostly on crop residues and other low quality feed and fodder for their survival and production, feed scarcity is the major limiting factor in furthering livestock productivity in India (Birthal and Jha 2005). Although many attempts have been made earlier to estimate the livestock feed and fodder availability in the country (Pandey 1995, Singh *et al.* 1997 and Ramachandra *et al.* 2007), there is often less than adequate information available on how much of feed and fodder are really available for livestock, in relation to what is required.

Many studies aimed at estimating livestock feed and fodder availability assumed the availability of different feeds to their production and production to actual consumption by livestock (Dikshit and Birthal 2010), which is often less realistic, as availability gets affected by non-feed uses, carrying over feed from one year to another and destruction of fodder (Sidhu *et al.* 1998 and Gadde *et al.* 2009). With these facts in the background, a study was planned to develop a more reliable methodology for estimating dry fodder availability and requirement for bovines in different agroclimatic zones of Tamil Nadu.

MATERIALS AND METHODS

A survey was conducted to ascertain the grain-to-straw ratios in various cereals and pulses crops in all the 7 agro-climatic zones (Table 1) of the State. From the districts, 2 blocks were selected and from the selected blocks, 2 villages were selected randomly. From each of the chosen villages, 5 farmers were selected, thus forming the total sample of farmer respondents as 580 for primary data collection. The primary data collected included grain-to-straw ratios for paddy, maize, sorghum, bajra, ragi, other minor millets, black gram, green

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Table 1. Agro-climatic zones of Tamil Nadu

Zone	Constituent districts
North-eastern	Chennai, Kancheepuram, Thiruvallur, Cuddalore, Villupuram, Vellore and Thiruvannamalai
North-western	Salem, Namakkal, Dharmapuri, Krishnagiri and Perambalur
Western	Coimbatore, Erode, Karur and Dindigul
Cauvery delta	Tiruchirappalli, Thanjavur, Thiruvarur, and Nagapattinam
Southern	Pudukottai, Madurai, Theni, Ramanathapuram, Virudhunagar, Sivagangai, Tirunelveli and Thoothukudi
High altitude	The Nilgiris
High rainfall	Kanyakumari

gram, horse gram, bengal gram, red gram, groundnut and other oilseeds.

Secondary data on area and production of various agricultural commodities in the State (2007–08) were collected from government and non-government agencies. The sources of these data were Season and Crop Reports (various issues), Tamil Nadu - An Economic Appraisal (various issues) of the Department of Economics and Statistics, Government of Tamil Nadu and the website of Government of Tamil Nadu (www.tn.gov.in).

Dry fodder availability: Crop residues of various crops form a major (and possibly the only) portion of dry fodder consumed by livestock and the quantum of available crop residues is often unable to be estimated directly, as it is seldom quantified. Hence, the dry fodder was estimated based on the grain-to-straw ratios in this study too, but from the ratios obtained from the sample survey conducted specifically in the State. Grain-to-straw ratios of various crops were also used by many authors to estimate the crop residues available as dry fodder for bovines and the details of a few studies are shown in Table 2. Based on the ratios assessed and the data

Table 2. Grain-to-straw ratios in cereals and pulses used to estimate dry fodder

Crops	Nordblom (1998)	Ramachandra <i>et al.</i> (2007)	Prabu (2008)	Present experiment
Paddy	1: 1.60	1: 1.30	1: 1.36	1: 1.77
Maize	1: 2.00	1: 2.50	1: 1.83	1: 2.30
Sorghum	1: 3.00	1: 2.50	1: 2.00	1: 2.70
Bajra	1: 1.60	1: 2.50	1: 1.58	1: 2.40
Ragi	1: 1.60	1: 2.00	1: 1.86	1: 1.80
Other cereals	-	-	-	1: 2.50
Groundnut	-	-	-	1: 2.10
Pulses	-	-	1: 2.00	-
Black gram	-	-	-	1: 1.88
Green gram	-	-	-	1: 1.59
Other pulses	-	-	-	1: 1.70

collected on the total foodgrains (cereals and pulses) and oilseed production in the State, the methodology for estimating dry fodder availability was framed as below:

$$\sum_{i=1}^m \sum_{j=1}^n Q_{cij} = (Y_{ij} * GSR_{ij}) - NFW_{ij}$$

where Q_{cij} , quantity of crop residues (dry fodder) obtained of crop i in district j ; Y_{ij} , yield of crop i in district j ; GSR_{ij} , estimated conversion factor (grain-to-straw ratio) for crop i ; NFW_{ij} , quantity of i^{th} crop residues going for non-feed uses and wasted in district j . Besides, 70% of sorghum fodder output was included as dry fodder, as ascertained by the result of the survey.

Dry fodder requirement: The basis of Adult Cattle Unit (ACU) of 350 kg body weight (Sastry 1993) to homogenize the species (cattle and buffalo), breed (crossbred and indigenous), sex (male and female), age (calf, heifer and adult) and production (breeding, milch, dry, work) differences in bovines was considered in this study. For example, a male crossbred white cattle calf of less than one year weighing around 80 kg was considered equal to 0.22 ACU, a female indigenous white cattle heifer weighing 147 kg equal to 0.42 ACU, an adult crossbred milch cow weighing 326 kg equal to 0.93 ACU and adult Murrah buffalo male used for breeding weighing 513 kg equal to 1.46 ACU. McDonald *et al.* (1995) indicated that a grazing dairy cow of 600 kg would have an intake of 16 kg dry matter/day. Again, Banerjee (2000) recommended 2.75 kg of concentrates, 20 kg of green fodder and 6 kg of dry fodder/crossbred milch cattle/day. Although, not much of documented evidence, apart from these, could be traced to this aspect, interactions with the Scientists in the field of animal nutrition have yielded the fact that 8kg of green fodder and 1kg of dry fodder/100 kg of body weight and 500 g of concentrate feed for every kg of milk produced could be used to arrive at a more precise estimation of feed and fodder requirement. Thus, the requirement of dry fodder for bovines was estimated in this study using 2 different methods as detailed as below:

Procedure 1: The dry fodder requirement was estimated taking the dry matter requirement of 2.50% per ACU (350 kg body weight), i.e. 8.75 kg of dry matter per ACU, which would include 4.4 kg of dry fodder, assuming 10% moisture.

Procedure 2: This procedure involves estimation of feed and fodder requirement using the canon of 8.0 kg of green fodder and 1 kg of dry fodder / 100 kg of body weight and 500 g of concentrate feed for every kg of milk produced. Assuming that sufficient quantities of green fodder and concentrate feed are fed to bovines, the procedure 2 of 1kg of dry fodder/100 kg of body weight was used for calculating the requirement of dry fodder.

RESULTS AND DISCUSSION

As production of crops are influenced by the agro-climatic factors existed in the immediate preceeding year (s), besides

the current year, using the production data of only 1 year is likely to underestimate or overestimate the results, especially if the year chosen is not agro-climatically 'normal'. To overcome this problem, average of production of principal crops in the last 5 years ending 2007–08 (Table 3) was used in the study.

Cereals: Of the total cereal production of 61.01 lakh tonnes in the State, 19.32 lakh tonnes (31.67%) were produced in North-eastern zone alone. Southern and Cauvery delta zones produced an almost equal quantum of cereals (14.70 and 13.10 lakh tonnes; 24.10 and 21.48% respectively). Paddy, being the major cereal crop, was produced to the tune of 50.44 lakh tonnes (82.68%) out of the total of 61.01 lakh tonnes of cereals. North-eastern zone dominated in paddy production in the State with 18.11 lakh tonnes (35.90 %), followed by Cauvery delta (12.71 lakh tonnes – 25.21%) and Southern (12.44 lakh tonnes ; 24.67%) zones. Western zone produced 2.17 lakh tonnes (46.04%) of the maize produced in the State (4.71 lakh tonnes). An almost similar trend could be noticed with respect to sorghum crop also, with Western zone topping (0.95 lakh tonnes; 37.12%). It also needs to be emphasized that Southern and North-eastern zones were the only zones that produced bajra in any significant quantities. On the contrary, North-western zone

remained to be the only zone that produced almost all the ragi (1.32 lakh tonnes; 77.46%) of the State (1.71 lakh tonnes).

Pulses and groundnut: Of the total pulses produced (2.16 lakh tonnes) in the State, 0.57 (26.59%) and 0.50 (23.14%) lakh tonnes were produced in Southern and North-eastern zones, respectively. Black gram and green gram were the major pulse crops produced in the State (0.91 and 0.57 lakh tonnes; 41.97 and 26.39%, respectively). Horse gram and red gram were the other important pulses produced in the State, each in 0.24 lakh tonnes (a little over 11%). With the total production of 330.85 lakh tonnes of groundnut in the State, North-eastern zone alone produced 146.25 lakh tonnes (44.20%).

Estimated dry fodder availability from cereals: The total dry fodder produced from cereals was estimated to be 5.08 million tonnes (Table 4), about one-fourth of which was contributed each by Southern (23.22%) and North-eastern (23.21%) zones. North-western and Western zones offered one-fifth each to the total dry fodder availability of the State. About half of the total dry fodder from cereals came from paddy (2.50 million tonnes; 49.20%), while maize contributed 21.34% (1.08 million tonnes). Dry fodder from sorghum shared an extent of 13.57%, while bajra and ragi

Table 3. Zone-wise production of cereals, pulses and sugarcane (in tonnes) in Tamil Nadu

Zones	Cereals ^A						Pulses ^A						Sugarcane ^V
	Paddy	Sorghum	Bajra	Maize	Ragi	Total incl. others	Black	Green	Horse	Red	Bengal	Total incl. others	
North-eastern	1810862 (93.72) (35.90)	16605 (0.86) (6.50)	41942 (2.17) (36.35)	21917 (1.13) (4.65)	24216 (1.25) (14.17)	1932189 (100.00) (31.67)	27900 (55.85) (30.80)	6402 (12.82) (11.24)	2851 (5.71) (11.84)	10724 (21.47) (44.34)	39 (0.08) (0.94)	49953 (100.00) (23.14)	14624572 (44.20)
North-western	354454 (50.94) (7.03)	69697 (10.02) (27.30)	7518 (1.08) (6.51)	109971 (15.80) (23.33)	132396 (19.03) (77.46)	695847 (100.00) (11.41)	3719 (11.40) (4.11)	5323 (16.31) (9.34)	14403 (44.14) (59.81)	4962 (15.21) (20.51)	122 (0.37) (2.93)	32633 (100.00) (15.12)	6039751 (18.26)
Western	276813 (45.68) (5.49)	94770 (15.64) (37.12)	8091 (1.34) (7.01)	216972 (35.80) (46.04)	9131 (1.51) (5.34)	606043 (100.00) (9.93)	4335 (14.41) (4.79)	5806 (19.30) (10.19)	5960 (19.81) (24.75)	2917 (9.70) (12.06)	3794 (12.61) (91.11)	30081 (100.00) (13.94)	5951553 (17.99)
Cauvery delta	1271399 (97.02) (25.21)	17941 (1.37) (7.03)	1721 (0.13) (1.49)	18884 (1.44) (4.01)	199 (0.02) (0.12)	1310492 (100.00) (21.48)	29632 (65.59) (32.71)	14446 (31.97) (25.36)	337 (0.75) (1.40)	633 (1.40) (2.62)	41 (0.09) (0.98)	45181 (100.00) (20.93)	2774477 (8.39)
Southern	1244412 (84.65) (24.67)	56269 (3.83) (22.04)	56125 (3.82) (48.64)	103566 (7.04) (21.97)	4967 (0.34) (2.91)	1470094 (100.00) (24.10)	24446 (42.59) (26.99)	24988 (43.53) (43.86)	530 (0.92) (2.20)	4952 (8.63) (20.47)	168 (0.29) (4.03)	57403 (100.00) (26.59)	3693671 (11.16)
High altitude	4635 (98.66) (0.09)	0 (0.00) (0.00)	2 (0.04) (0.00)	0 (0.00) (0.00)	6 (0.13) (0.00)	4698 (100.00) (0.08)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	1 (100.00) (0.00)	1167 (0.00)
High rainfall	81249 (100.00) (1.61)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	81251 (100.00) (1.33)	559 (91.94) (0.62)	7 (1.15) (0.01)	2 (0.33) (0.01)	0 (0.00) (0.00)	0 (0.00) (0.00)	608 (100.00) (0.28)	0 (0.00)
State	5043824 (82.68) (100.00)	255282 (4.18) (100.00)	115399 (1.89) (100.00)	471310 (7.73) (100.00)	170915 (2.80) (100.00)	6100614 (100.00) (100.00)	90591 (41.97) (100.00)	56972 (26.39) (100.00)	24083 (11.16) (100.00)	24188 (11.21) (100.00)	4164 (1.93) (100.00)	215860 (100.00) (100.00)	33085191 (100.00)

Figures are average of 5 years ending 2007-08; II row in each zone shows % contribution of each source to total dry fodder produced in that zone and III row shows % contribution of each zone to the State total production of dry fodder under each source.

Table 4. Estimated dry fodder availability from cereals in tonnes in Tamil Nadu

Zone	Paddy	Maize	Sorghum	Bajra	Ragi	Foddersorghum	Others*	Total
North-eastern	897463 (76.10) (35.90)	50409 (4.27) (4.65)	44834 (3.80) (6.50)	100661 (8.54) (36.35)	43589 (3.70) (14.17)	705 (0.06) (0.62)	41618 (3.53) (37.94)	1179279 (100.00) (23.21)
North-western	175667 (18.08) (7.03)	252933 (26.03) (23.33)	188182 (19.37) (27.30)	18043 (1.86) (6.51)	238313 (24.53) (77.46)	43911 (4.52) (38.87)	54528 (5.61) (49.70)	971577 (100.00) (19.12)
Western	137189 (14.04) (5.49)	499036 (51.08) (46.04)	255879 (26.19) (37.12)	19418 (1.99) (7.01)	16436 (1.68) (5.34)	48257 (4.94) (42.72)	665 (0.07) (0.61)	976880 (100.00) (19.23)
Cauvery delta	630105 (86.30) (25.21)	43433 (5.95) (4.01)	48441 (6.63) (7.03)	4130 (0.57) (1.49)	358 (0.05) (0.12)	2809 (0.38) (2.49)	870 (0.12) (0.79)	730146 (100.00) (14.37)
Southern	616731 (52.28) (24.67)	238202 (20.19) (21.97)	151926 (12.88) (22.04)	134700 (11.42) (48.64)	8941 (0.76) (2.91)	17287 (1.47) (15.30)	11888 (1.01) (10.84)	1179675 (100.00) (23.22)
High altitude	2297 (93.76) (0.09)	0 (0.00) (0.00)	0 (0.00) (0.00)	5 (0.20) (0.00)	11 (0.45) (0.00)	0 (0.00) (0.00)	138 (5.63) (0.01)	2450 (100.00) (0.10)
High rainfall	40267 (100.00) (1.61)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	40267 (100.00) (1.61)
Tamil Nadu	2499719 (49.20) (100.00)	1084013 (21.34) (100.00)	689261 (13.57) (100.00)	276958 (5.45) (100.00)	307647 (6.06) (100.00)	112968 (2.22) (100.00)	109705 (2.16) (100.00)	5080271 (100.00) (100.00)

*includes *varagu*, *samai*, *korra*, etc.

contributed around 6%. The higher dry fodder availability of 1.18 million tonnes in Southern and North-eastern zones was because of the significant production of fine cereal straw in these zones. More than half (52.28%) of the total dry fodder produced in Southern zone was from paddy, aptly supported by maize (20.19%). More than three-fourths of the total dry fodder in North-eastern zone was from paddy, with dry fodder from bajra also being significant (36.35 %) to the State total.

While North-eastern zone contributed significantly to the State production of dry fodder from paddy (35.90%) and bajra (36.35%), Western zone did so for maize (46.04%) and sorghum (37.12%). As North-western zone shared 77.46% to the State's total dry fodder from ragi, its contribution through maize (27.30%) and sorghum (23.33%) was also substantial. When Cauvery delta's contribution of dry fodder from paddy (25.21%) needs mention, the unequivocal role of Southern zone to the State's total dry fodder by almost all the cereals (from 22 to 49%) merits attention. The highest quantum of dry fodder from fodder sorghum crop was produced in Western zone (0.05 million tonnes; 42.72% to State's total).

Estimated dry fodder availability from pulses: Of the total production of 0.38 million tonnes of dry fodder from pulses (Table 5), Southern zone contributed the highest share of 26.32%, followed by North-eastern (23.67%) and Cauvery delta (21.37%) zones. While the massive output of dry fodder

from black gram, green gram and red gram had led the Southern and Cauvery delta zones to top in total production of dry fodder in the State, the higher contribution of black gram and red gram had done so for North-eastern zone. However, the relative higher output of dry fodder from horse gram in North-western and Western zones and that of bengal gram in Western zone could not place their respective zones anywhere near the top of total dry fodder production, owing to their dismal production with respect to the major pulses such as black gram and green gram. Among various pulses, black gram bestowed 45.18% (0.17 million tonnes) to the total dry fodder production from pulses of the State, followed by green gram with 24.03% (0.09 million tonnes). Horse gram and red gram each offered a little above one-tenth of the total dry fodder production from pulses in the State. Bengal gram accounted only a meager portion.

With respect to dry fodder from black gram, Cauvery delta, North-eastern and Southern zones shared the first three ranks in the State by producing 0.06 million tonnes (32.71%), 0.05 million tonnes (30.80%) and 0.05 million tonnes (26.98%), respectively. Southern zone produced a greater amount of dry fodder from green gram (0.04 million tonnes; 43.86%) in the State. Cauvery delta (0.02 million ton; 25.36%) fared well in the State with respect to dry fodder from green gram. North-western zone excelled in dry fodder production from horse gram in the State by producing 59.81% of the State

Table 5. Estimated dry fodder availability from pulses in tonnes

Zone	Blackgram	GreenGram	Horsegram	Redgram	Bengalgram	Others	Total
North-eastern	52452 (58.78) (30.80)	10179 (11.41) (11.24)	4847 (5.43) (11.84)	18231 (20.43) (44.34)	66 (0.07) (0.93)	3463 (3.88) (12.84)	89238 (100.00) (23.67)
North-western	6992 (12.58) (4.11)	8464 (15.23) (9.34)	24485 (44.07) (59.81)	8435 (15.18) (20.51)	207 (0.37) (2.92)	6977 (12.56) (25.87)	55560 (100.00) (14.74)
Western	8150 (15.89) (4.79)	9232 (18.00) (10.19)	10132 (19.76) (24.75)	4959 (9.67) (12.06)	6450 (12.58) (91.11)	12357 (24.10) (45.83)	51279 (100.00) (13.60)
Cauvery delta	55708 (69.16) (32.71)	22969 (28.51) (25.36)	573 (0.71) (1.40)	1076 (1.34) (2.62)	70 (0.09) (0.99)	156 (0.19) (0.58)	80552 (100.00) (21.37)
Southern	45958 (46.31) (26.98)	39731 (40.04) (43.86)	901 (0.91) (2.20)	8418 (8.48) (20.47)	286 (0.29) (4.04)	3942 (3.97) (14.62)	99237 (100.00) (26.32)
High altitude	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	2 (100.00) (0.01)	2 (100.00) (0.00)
High rainfall	1051 (92.76) (0.62)	11 (0.97) (0.01)	3 (0.26) (0.00)	0 (0.00) (0.00)	0 (0.00) (0.00)	68 (6.00) (0.04)	1133 (100.00) (0.67)
Tamil Nadu	170311 (45.18) (100.00)	90585 (24.03) (100.00)	40941 (10.86) (100.00)	41120 (10.91) (100.00)	7079 (1.88) (100.00)	26965 (7.15) (100.00)	377001 (100.00) (100.00)

II row in each zone shows% contribution of each source to total dry fodder produced in that zone and III row shows% contribution of each zone to the State total production of dry fodder under each source.

total of 0.04 million ton. Western zone was the notable contributor to the State level horse gram crop residue. North-eastern zone (44.34% to the State) was the prime producer of red gram crop residue in the State.

Estimated total dry fodder availability: Cereals alone contributed 66.84% to the total dry fodder production of 7.60 million tonnes in the State (Table 6). While groundnut could contribute to the extent of 28.20%, the dry fodder from pulses formed only less than 5% to the total dry fodder production. Among various zones, North-eastern zone performed well in dry fodder by producing 2.41 million tonnes (31.73%), followed by Southern (1.46 million tonnes; 19.26%), North-western (1.44 million tonnes; 18.94%) and Western (1.31 million tonnes; 17.19%) zones.

Bovine population in adult cattle units (ACUs) in Tamil Nadu: The total bovine population of the State was 7.33 million ACUs (Table 7), of which 5.84 million ACUs (79.72%) were cattle and 1.49 million ACUs (20.28%) were buffaloes. While North-eastern zone led in total bovines in the State with 2.15 million ACUs (29.29%), North-western and Southern zones each had one-fifths of State's total bovines. Western and Cauvery delta zones had around 15% of the total bovines each.

The scenario of cattle dominating with more than 80% of bovines was common with most agro-climatic zones of the

State, with an exception of Western and North-western zones, whereas it was only 66.87 and 71.10%, respectively, for the reason that these 2 zones had relatively more buffaloes, i.e. 33.13 and 28.90%, respectively. It is also worth mentioning that North-eastern and Southern zones together had more than half (51.73%) of the State's cattle, while North-western and Cauvery delta zones shared the next 34.23%. Buffaloes were heavily concentrated in Northern and Western parts of Tamil Nadu, with North-eastern (22.92%), North-western (29.96%) and Western (23.92%) zones together having more than three-fourths (76.80%) of the State buffaloes.

Estimated dry fodder requirement for bovines: The total dry fodder required for the bovines in the State, as per procedure 1, was 11.77 million tonnes (Table 8), of which, 29.29% (3.44 million tonnes) was required for the bovines of North-eastern zone alone. While around 20% of dry fodder was estimated to be required for the bovines of North-western and Southern zones each (2.47 and 2.26 million tonnes, respectively), a little over 14% was required for that of Western and Cauvery delta zones each (1.72 and 1.68 million tonnes, respectively). However, the other 2 smaller zones needed only less than 1% of the dry fodder for their bovines. However, the total dry fodder required for the bovines in the State, as per procedure 2, was 9.36 million tonnes. Again, 29.29% of dry fodder was required for the bovines of North-

Table 6. Estimated total dry fodder availability in tonnes in Tamil Nadu

Zone	Cereals	Pulses	Groundnut	Total
North-eastern	1179279 (48.89) (23.21)	89238 (3.70) (23.67)	1143358 (47.41) (53.35)	2411875 (100.00) (31.73)
North-western	971577 (67.51) (19.12)	55560 (3.86) (14.74)	412115 (28.63) (19.23)	1439252 (100.00) (18.94)
Western	976880 (74.76) (19.23)	51279 (3.92) (13.60)	278548 (21.32) (13.00)	1306707 (100.00) (17.19)
Cauvery delta	730146 (78.10) (14.37)	80552 (8.62) (21.37)	124238 (13.29) (5.80)	934936 (100.00) (12.30)
Southern	1179675 (80.60) (23.22)	99237 (6.78) (26.32)	184794 (12.63) (8.62)	1463706 (100.00) (19.26)
High altitude	2450 (99.59) (0.05)	2 (0.08) (0.00)	8 (0.33) (0.00)	2460 (100.00) (0.03)
High rainfall	40267 (97.00) (0.79)	1133 (2.73) (0.30)	113 (0.27) (0.01)	41513 (100.00) (0.55)
Tamil Nadu	5080271 (66.84) (100.00)	377001 (4.96) (100.00)	2143174 (28.20) (100.00)	7600446 (100.00) (100.00)

II row in each zone shows% contribution of each source to total dry fodder produced in that zone and III row in each zone shows% contribution of each zone to the State total production of dry fodder under each source.

eastern zone, while around 20% was required for North-western and Southern zones each and a little over 14% for Western and Cauvery delta zones each, as the number of bovines remained same here too.

Status (surplus/deficit) of dry fodder in Tamil Nadu: The availability and requirement of dry fodder in the State indicated the fact that there was a deficit of 4.17 million tonnes (Table 8), as per procedure 1 and all the zones in the State showed only deficit status. However, there was a decline in the deficit level from 4.17 million tonnes to 1.76 million tonnes of dry fodder in the State in the estimation procedure 2. Here again, all the zones in the State showed deficit status. Although this study considered only the bovines for calculating the dry fodder requirement, the small ruminants too require certain amount of dry fodder which only further escalates the deficit of dry fodder to 5.48 and 2.80 million tonnes, as per procedures 1 and 2, respectively.

The details of availability and requirement of dry fodder for bovines across the State presented so far did specify only the absolute deficit across the zones, without providing information on per livestock unit basis. As the density of bovine population differed across zones, annual deficit status of dry fodder was worked out per ACU to throw more light

Table 7. Bovine population in ACUs in Tamil Nadu

Zone	Cattle	Buffaloes	Total
North-eastern	1805673 (84.13) (30.90)	340650 (15.87) (22.92)	2146323 (100.00) (29.29)
North-western	1095582 (71.10) (18.75)	445263 (28.90) (29.96)	1540845 (100.00) (21.02)
Western	717463 (66.87) (12.28)	355486 (33.13) (23.92)	1072949 (100.00) (14.64)
Cauvery delta	904660 (86.48) (15.48)	141459 (13.52) (9.52)	1046119 (100.00) (14.27)
Southern	1217062 (86.21) (20.83)	194651 (13.79) (13.10)	1411713 (100.00) (19.26)
High altitude	36166 (91.97) (0.62)	3159 (8.03) (0.21)	39325 (100.00) (0.54)
High rainfall	66081 (92.20) (1.13)	5591 (7.80) (0.38)	71672 (100.00) (0.98)
Tamil Nadu	5842687 (79.72) (100.00)	1486258 (20.28) (100.00)	7328945 (100.00) (100.00)

II row in each zone shows% contribution of each species to the total bovine population in that zone and III row in each zone shows% contribution of each zone to the respective State total population of each species.

on the real dry fodder status in each zone. Dry fodder status showed a deficit of 0.57 and 0.24 tonne per ACU in the State, when the notions of 2.5% of dry matter (procedure 1) and 1 kg of dry fodder/100 kg body weight (procedure 2) requirement were considered, respectively. It needs emphasis that all the individual zones in the State also showed only deficit status of dry fodder, in both the situations. Except the Western and North-eastern zones where the deficit of dry fodder is better than the State average, all the other zones extensively lacked in dry fodder availability. This less fortunate scenario of alarming deficit of dry fodder is a matter of serious concern in the efforts to facilitate milk production.

There needs to be greater dependence on the data on area and production of crops to work out dry fodder availability and hence, when there are changes in land use pattern and cropping pattern, the estimated dry fodder availability in the State is likely to vary. Again, the grain-to-straw ratios of different crops may also show spatial and temporal variations and varietal differences in the future. Hence, the possibility of these differences needs to be reviewed, whenever needed, to generalize the results of this study. Although necessary allowances were given to exclude the non-feed uses of fodder produced, there could still be a possibility of variations due

Table 8. Annual requirement and deficit of dry fodder for bovines in Tamil Nadu

Zones	Requirement in tonnes		Deficit in tonnes			
	Procedure 1	Procedure 2	Procedure 1		Procedure 2	
			Per annum	Per annum per ACU	Per annum	Per annum per ACU
North-eastern	3446994 29.29	2741927	-1035119	-0.48	-330052	-0.15
North-western	2474597 21.02	1968430	-1035345	-0.67	-529178	-0.34
Western	1723155 14.64	1370692	-416448	-0.39	-63985	-0.06
Cauvery delta	1680066 14.27	1336417	-745130	-0.71	-401481	-0.38
Southern	2267212 19.26	1803464	-803506	-0.57	-339758	-0.24
High altitude	63156 0.54	50238	-60696	-1.54	-47778	-1.21
High rainfall	115105 0.98	91561	-73592	-1.03	-50048	-0.70
Tamil Nadu	11770286 100.00	9362728	-4169840	-0.57	-1762282	-0.24

Figures in parentheses indicate percentages to State total.

to expansion of these alternative uses, which should be taken care of in future estimation procedures. Besides the changing cropping pattern, introduction of new short term crop varieties and increasing use of mechanical harvesters could bring down drastically the potential dry fodder availability, which is already under short supply.

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