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Availability and Requirement of Millet Feed and Fodder for Ruminants in Andhra Pradesh: An Analysis

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ABSTRACT: Agriculture and animal husbandry are closely intertwined and mutually dependent on each for promoting food security, rural development, economic growth, building society, and incorporating cultural, religious believes. Mixed farming and livestock rearing play a crucial role in rural life. Livestock plays a significant role in the global agricultural sector, accounting for 40% of its total value. The availability of sufficient quantity of feed and fodder plays a crucial role in affecting the productivity and performance of animals. Availability and requirement of millets as feed and fodder to various livestock population in comparison with different crops of Andhra Pradesh was analysed in this study. The data pertaining to availability and requirement of millets as feed and fodder was collected from 1991 to 2020 by using various sources and availability of millets as feed was calculated by means of crop residues, concentrates and greens. Descriptive statistics and CAGR was conducted for analysing the feed and fodder availability. The dry matter requirement for livestock ruminants was not stable (increasing and then decreasing) but the availability of feed resources was in positive trend with CAGR value of 0.011. Among various feed resources the availability of crop residues showed high positive CAGR value of 0.015. Adoption of millets as fodder to ruminants will balance the feed requirement of livestock. Availability of data was the major challenge faced but with the help of Directorate of Economics & Statistics data was collected and analyzed.

Keywords: Livestock, Feed and Fodder, Millets, Availability, Requirement.

INTRODUCTION

Agriculture is the corner stone of Indian economy and life blood of our nation as 58 percent of the Indian population depends on agriculture & allied sectors including livestock, and associated industries. Over the years, the agriculture and allied sector has witnessed various significant advancements, transformations, technological innovations, scientific research, and sustainable practices that reshaped the crop cultivation and their availability as feed and fodder. The share of agriculture in India’s gross domestic product (GDP) during 2023 was 18.3 percent. Agriculture and animal husbandry are closely intertwined and mutually dependent on each for promoting food security, rural development, economic growth, building society, and incorporating cultural, religious believes. Mixed farming and livestock rearing play a crucial role in rural life (Dager, 2017). Livestock plays a significant role in the Indian economy with 30.5 million people dependent on cattle for their livelihood. Livestock rearing supports the well-being of two-thirds of rural population in India (Karthik *et al.*, 2021). Livestock plays a significant role in the global agricultural sector, accounting for 40% of its total value as reported by Food and Agriculture Organization. It also plays a crucial role in supporting the livelihoods of nearly 1.3 billion people, ensuring food security and nutrition worldwide. Around 70% of households rely on the livestock and agriculture sector for their livelihood (Ghosh *et al.*, 2016). Availability of feed resources plays a crucial role in optimizing the output of cattle and poultry (Ayele *et al.*, 2021). The availability of fodder from cultivated areas, forests, pastures, and grazing lands has a significant influence on the future development and growth of livestock. Cattle have been nourished with crop residues like straw (from rice, wheat, maize, millets), green fodder and pastures and grazing fields. The cattle's diet comprises a range of feeds, including dry fodder, green fodder, and concentrates such as oil cakes, grains, bran, and chuni. The availability of sufficient quantity of feed and fodder plays a crucial role in affecting the productivity and performance of animals.

Fodder, also known as hay, silage, or forage, is any crop or crop by-product used as feed for livestock, making it an essential source of protein and fat (Skibbe, 1992). Fodder is essential for meeting the nutritional needs of livestock, promoting animal health, enhancing productivity, reducing costs, and supporting sustainable agricultural practices. However, due to the growing human population and the resulting pressure on arable land, most of the land is already dedicated to food and cash crops. There is limited availability of high-quality arable land for fodder production. Heavy competition between commercial crops made farmers to cultivate them majorly by reducing acreage of fodder crops (Kumar *et al.*, 2012). Currently, the primary constraint hindering livestock production is the insufficient availability of feed and fodder resources followed by seasonal variations, lack of accessing to grazing land. Therefore, there is an urgent need to increase the productivity of cultivated fodder crops on the same piece of land in order to meet the fodder needs of ruminants. In addition to vertical expansion of arable lands the utilization of non- arable land area for pastures can be focused to balance the demand (Dahiya and Kharb 2003).

Nutricereals (Millets) are small-seeded grains that have been cultivated over years will be best fit to match fodder needs. Millets possess exceptional affordability as an energy source, containing abundant amounts of dietary fibre, proteins, vitamins, and minerals (Ashok Kumar *et al*., 2013). Millets are a valuable source of fodder for livestock due to their nutritional value, adaptability to harsh conditions, cost-effectiveness, and potential health benefits. Inclusion of millets in animal feed can contribute to the well-being and productivity of livestock, sustainable agriculture and best animal husbandry practices (Shashikala *et al*., 2013). Sorghum as a significant contributor to nutrient intake, constitutes approximately 35% of the overall consumption of calories, protein, iron, and zinc in the predominant production and consumption regions (Parthasarathy *et al.*, 2006). Green fodder of bajra is leafy, palatable and very nutritious feed stock for cattle ensuring good milk yield and it could fully replace maize in high supplement diets for confined cattle (Mugula *et al*., 2003). Sorghum acts as a valuable source of feed for livestock, especially during the dry season (Ashok Kumar *et al.*, 2011; Dendy 1995). Fodder sorghum can be grazed, cut fresh, made into hay or ensiled and has high nutritional value, making it an excellent choice for livestock feed (Pedersen and Fritz 2000; Dowling *et al*., 2022). In this background a study was conducted to understand millet as source of feed and fodder for livestock.

MATERIALS AND METHODS

Availability and requirement of millets as feed and fodder to various livestock population in comparison with different crops of Andhra Pradesh was analysed in this study. The data pertaining to availability and requirement of millets as feed and fodder was collected from 1991 to 2020 by using various sources like India stat, statistical abstracts &seasonal crop reports of Andhra Pradesh, livestock census and other sources. Availability of millets as feed was calculated by means of crop residues, concentrates and greens as shown in flow chart (Fig. 1).

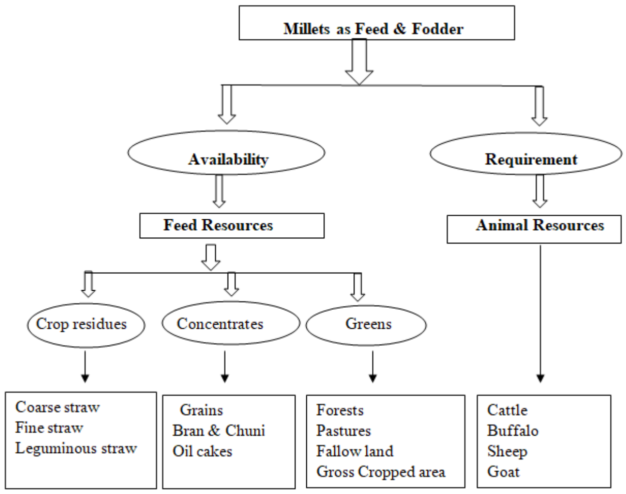

Fig. 1. Flow Chart of Feed and Fodder Availability and Requirement.

Crop production data and land utilisation data was used for calculating the dry matter availability by using standard conversion factors (Table 1 and 2). Livestock census data was used for calculating the dry matter requirement by using conversion factors as shown in Table 3**.**

Table 1: Conversion Factors for Various Crops.

Sr. No.	Crops	Crop Residues	Oil Cakes	Grains	Bran & Chunnies
1.	Paddy	1.30	-	0.02	0.08
2.	Wheat	1.00	-	0.02	0.08
3.	Jowar	2.50	-	0.05	-
4.	Bajra	2.50	-	0.05	-
5.	Barley	1.30	-	0.10	-
6.	Maize	2.50	-	0.10	-
7.	Ragi	2.00	-	0.05	-
8.	Small Millets	2.50	-	0.10	-
9.	Other Cereals	2.00	-	0.10	-
10.	Pulses	1.70	-	-	0.03
11.	Ground nut	2.00	0.7	-	-
12.	Sesamum	-	0.7	-	-
13.	Rape & Mustard	-	0.7	-	-
14.	Linseed	-	0.7	-	-
15.	Niger	-	0.7	-	-
16.	Sunflower	-	0.7	-	-
17.	Safflower	-	0.7	-	-
18.	Soyabean	-	0.7	-	-
19.	Sugarcane	0.25	-	-	-
20.	Coconut	-	0.0625	-	-
21.	Cotton	-	0.0499	-	-

Table 2: Green Fodder Yield for Land use Classification.

Sr. No.	Land use category	Green fodder (Tonnes/ha/year)
1.	Gross cropped area	1.6
2.	Forests	1.5
3.	Permanent pastures	5.0
4.	Cultivable wasteland	1.0
5.	Current fallows	1.0
6.	Other fallows	1.0
7.	Miscellaneous tree crops	1.0

Table 3: Conversion Factors for Calculation of Ruminant Livestock Units.

Sr. No.	Species	Category	Conversion factor
1.	Buffalo	Above 3 years	1.00
		1-3 years	0.50
		Below 1 year	0.17
2.	Cattle	Above 3 years	0.80
		1-3 years	0.34
		Below 1 year	0.11
3.	Sheep	-	0.10
4.	Goats	-	0.10

The data was analysed by using statistical tools like Averages, Percentage Analysis, Cumulative frequencies, and conversion factors. Crop Annual Growth Rate (CAGR) was also used to determine the trend of millets as feed and fodder. The formulas used for the study was as follows

CF = CP * SV

where CF represents Conversion factors,

CP represents Crop production data of each crop

SV represents Standardized values of each crop.

CAGR: Compound Annual Growth Rate (CAGR) (%) = r =(AntilogB-1)×100

RESULTS AND DISCUSSION

The dry matter availability from 1991-2020 was estimated from the crop residues (coarse straw, fine straw and, leguminous straw), concentrates (Grains, Bran & Chuni and Oil cakes) and greens.

Crop residues: The dry matter availability of crop residues was estimated by calculating coarse straw, fine straw and leguminous straw of various crops. The coarse straw dry matter availability was calculated through major (jowar, bajra, ragi) and minor millets, maize and sugarcane crops. From Fig. 2, it could be concluded that sorghum have high dry matter availability among millets which is a key factor to be a major source of fodder crop along with maize and sugarcane. Maize and sugarcane are major fodder crops in India and millets can also be used as fodder cum grain purpose as sorghum has average dry matter availability of 0.56 million tonnes from 1991 to 2020.

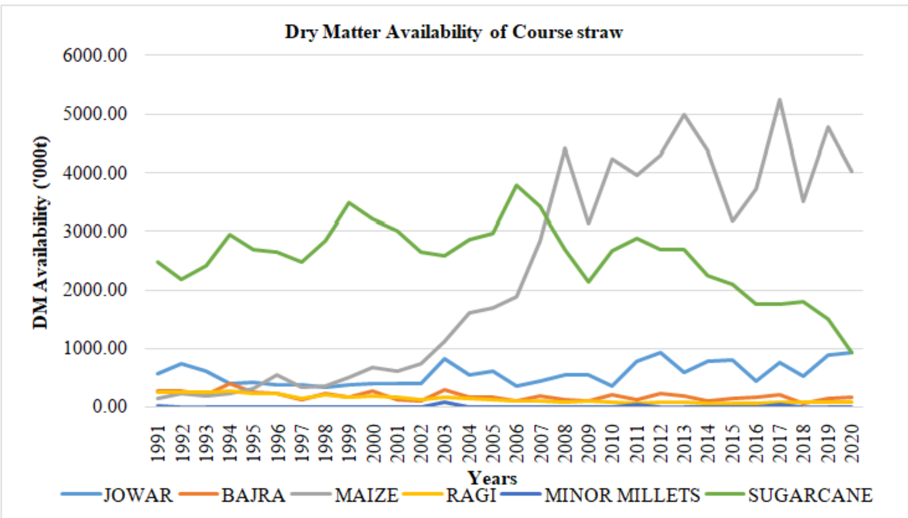

Fig. 2. Dry Matter Availability of Coarse Straw of Various Crops From 1991-2020.

The fine straw dry matter availability was calculated through paddy and wheat crops. From Fig. 3, it could be seen that paddy straw has high dry matter availability which primarily serves as bulk or filler to meet the dry matter requirement of ruminants. The average dry matter availability of paddy straw was 9.83 million tonnes from 1991 to 2020. Dry matter availability of leguminous straw was calculated by the pulses (horse gram, green gram, black gram, red gram, bengal gram, cowpea) and Groundnut crops as shown in Fig. 4. Among leguminous straw groundnut has high dry matter availability followed by bengal gram which commonly used as feed to livestock. The average dry matter availability of groundnut was 2.04 million tonnes followed by bengal gram (0.54 million tonnes) from 1991 to 2020.

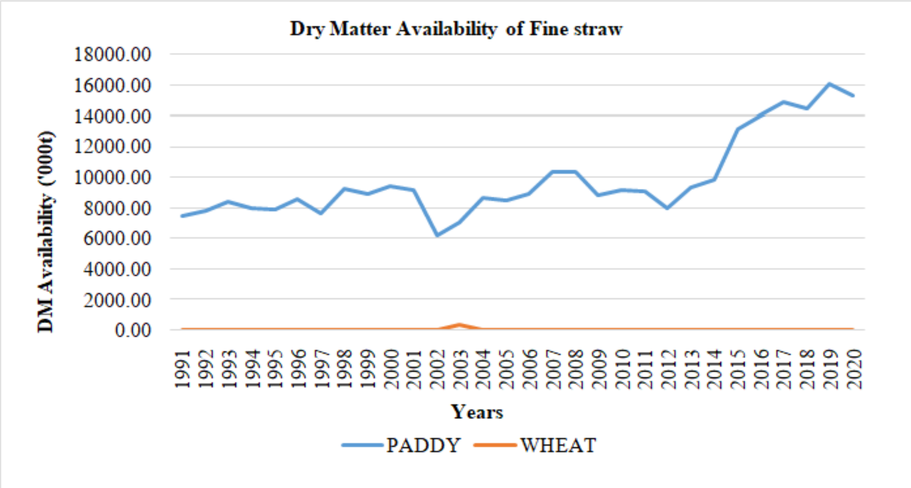

Fig. 3. Dry Matter Availability of Fine Straw from 1991-2020.

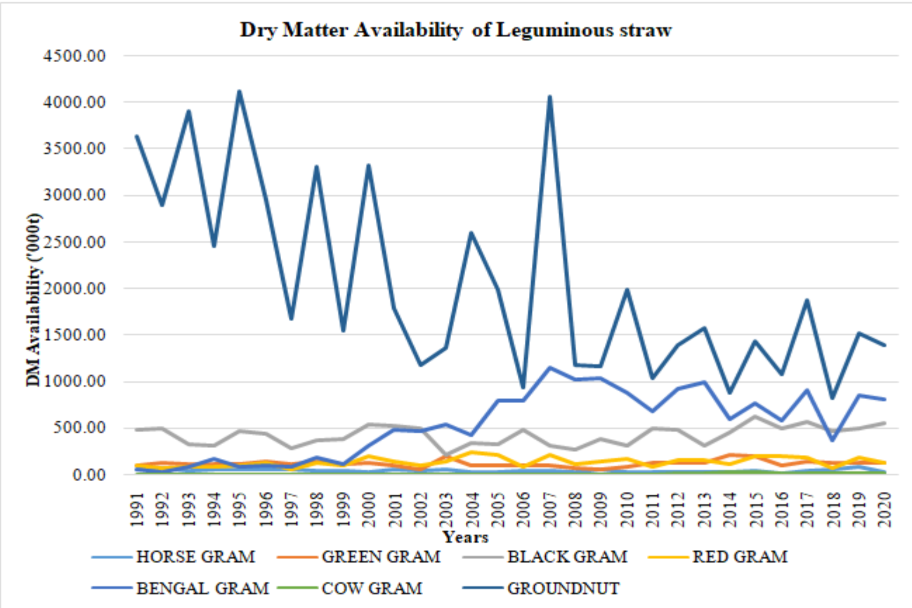

Fig. 4. Dry Matter Availability of Leguminous Straw from 1991-2020.

Total Dry Matter Availability of Crop Residues. Total dry matter availability of crop residues from 1991-2020 was 565.71 million tonnes with the average of 18.85 million tonnes as shown in Table 4. Dry matter availability of fine straw has major share of (52.2%) followed by course straw (30.8%) and leguminous straw (17%). The average dry matter availability from the coarse straw is 5.69 million tonnes, fine straw is 9.84 million tones and leguminous straw is 3.31 million tonnes. Though fine straw contributed major percent but CAGR states that dry matter availability of total crop residues, fine straw and coarse straw contributed to 0.02 percent i.e., coarse straw availability of millets to fodder is moving in a positive trend which is a boosting factor to livestock. The crop annual growth rate of coarse straw and fine straw is positive whereas the leguminous straw is negative from 1991-2020.

Table 4: Dry Matter Availability of Crop Residues from 1991-2020.

Sr. No.	Year	Dry matter Availability of Course straw ('000t)	Dry matter Availability of Fine straw ('000t)	Dry matter Availability of Leguminous straw ('000t)	Total Dry matter Availability of crop residues ('000t)
1.	1991	3701.95	7516.78	4453.60	15672.33
2.	1992	3656.14	7833.54	3693.20	15182.88
3.	1993	3679.40	8421.20	4568.60	16669.20
4.	1994	4231.21	7985.10	3193.11	15409.42
5.	1995	3899.49	7892.88	4932.60	16724.98
6.	1996	4001.49	8602.43	3843.51	16447.43
7.	1997	3439.25	7675.06	2263.45	13377.75
8.	1998	3953.94	9288.95	4180.86	17423.75
9.	1999	4684.80	8898.20	2321.83	15904.83
10.	2000	4745.62	9408.35	4525.67	18679.64
11.	2001	4299.82	9154.73	3110.42	16564.98
12.	2002	3976.98	6220.20	2356.94	12554.12
13.	2003	5039.10	7415.69	2507.75	14962.54
14.	2004	5310.46	8649.59	3742.14	17702.18
15.	2005	5537.75	8528.38	3459.06	17525.18
16.	2006	6220.82	8911.39	2439.58	17571.79
17.	2007	6993.40	10390.38	5862.56	23246.35
18.	2008	7820.05	10390.92	2685.42	20896.39
19.	2009	6026.30	8856.20	2835.67	17718.18
20.	2010	7547.32	9224.16	3461.46	20232.93
21.	2011	7875.00	9060.48	2470.50	19405.98
22.	2012	8222.43	8029.93	3126.99	19379.35
23.	2013	8542.29	9352.53	3214.32	21109.14
24.	2014	7534.94	9893.26	2317.50	19745.70
25.	2015	6293.12	13142.63	3304.04	22739.79
26.	2016	6151.12	14044.17	2493.33	22688.62
27.	2017	8057.91	14849.08	3728.97	26635.96
28.	2018	5975.49	14451.63	1948.49	22375.61
29.	2019	7369.84	16040.87	3296.08	26706.79
30.	2020	6095.71	15313.64	3054.26	24463.62
TOTAL		170883.14	295442.35	99391.92	565717.41
MEAN		5696.10	9848.08	3313.06	18857.25
SD		1638.06	2620.49	918.84	3644.31
CAGR		0.02	0.02	-0.01	0.02

Concentrates. The dry matter availability of concentrates was calculated by grains, bran, chuni and oil cakes. Dry matter availability of grains was calculated through millets, paddy, wheat and maize as shown in Fig. 5. Among all the grains paddy has major contribution with average dry matter availability of about 0.15 million tonnes from 1991-2020. The average dry matter availability of millet crops was 0.018 million tones of which sorghum had high dry matter availability with an average of 0.011 million tonnes from last three decades.

The bran & chuni dry matter availability was calculated by paddy, wheat and pulse crops. Fig. 6 states that paddy have high dry matter availability among wheat and pulses. The average dry matter availability of paddy was 0.60 million tones with a major share among the bran & chuni from 1991 to 2020.

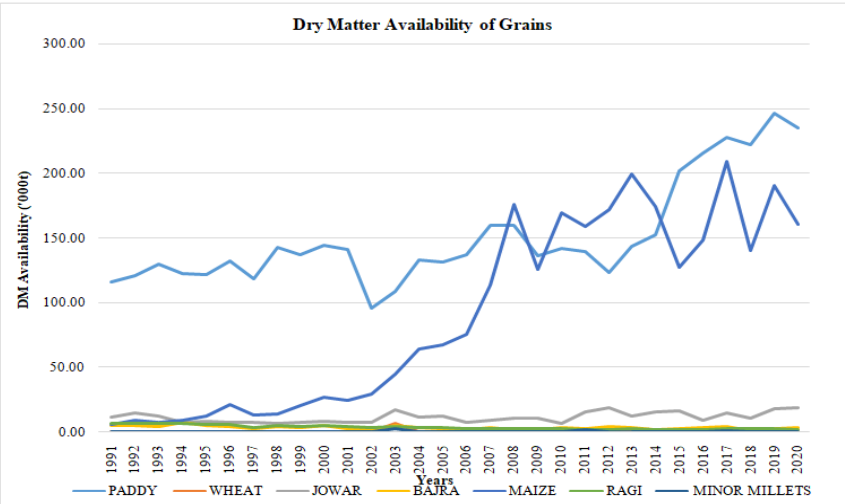

Fig. 5. Dry Matter Availability of Grains from 1991-2020.

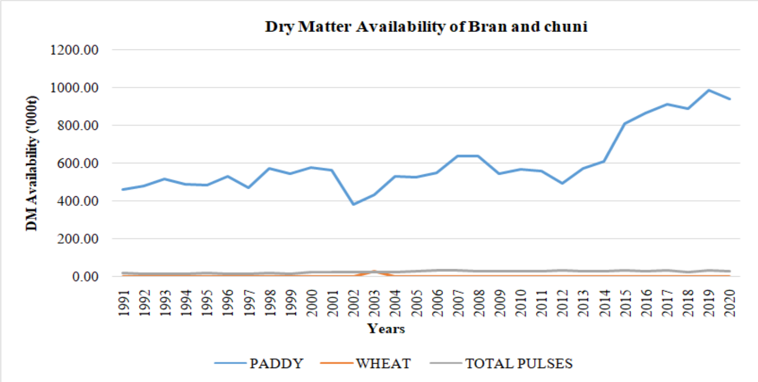

Fig. 6. Dry Matter Availability of Bran & Chuni from 1991-2020.

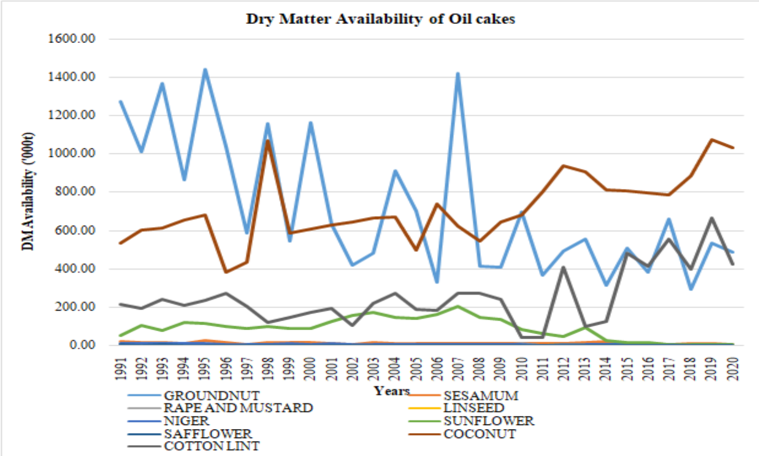

Fig. 7. Dry Matter Availability of Oil Cakes from 1991-2020.

The dry matter availability of total concentrates from 1991-2020 was 80.17million tonnes with the average of 2.67 million tonnes as shown in the Table 5. The by-products like oil cakes (66.7%), brans, and chunies (23.53%) constituted the major portion, while grains (9.74%) constituted a small fraction of the concentrates. The average dry matter availability from the oil cakes is 1.78 million tonnes, Bran & chuni (0.62 million tonnes) and grains (0.26 million tonnes). According to CAGR dry matter availability of grains is 0.04 percent, bran & chuni is 0.02 percent and dry matter availability of total concentrates is 0.01 percent showing a positive trend from 1990-2020.

Greens. Greens dry matter availability was estimated by calculating the forest area, total cropped area, permanent pastures, grazing lands and fodder from other sources. Fig. 8 depicts that total cropped area was more among the greens. The total cropped area has average dry matter availability of 12.45 million tonnes during 1991 to 2020.

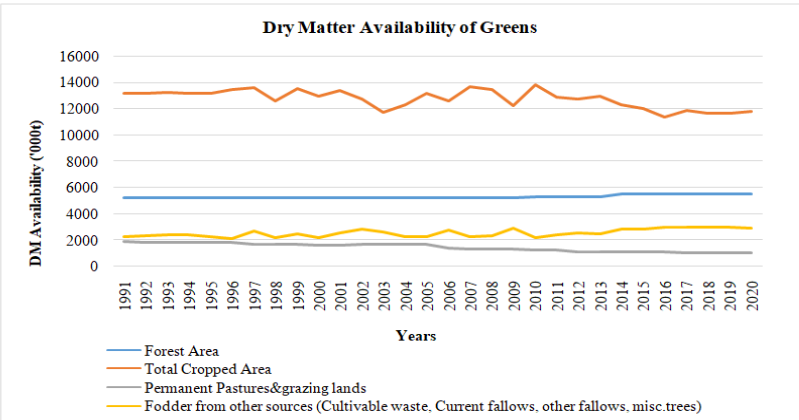

Fig. 8. Dry Matter Availability of Greens from 1991-2020.

From Table 6 it could be concluded that, contribution of total dry matter availability from the greens was 162.70 million tonnes with an average of 5.42 million tonnes from 1991-2020. Major contribution of 373.55 million tonnes was from the total cropped area with an average of about 12.76 million tonnes. According to CAGR the total dry matter availability from the greens was -0.02 percent which shows a negative trend and these results were in line with results of Dagar *et al*. (2017).

Table 5: Dry matter Availability of Concentrates from 1991-2020.

Sr. No.	Year	Dry Matter Availability of Grains ('000t)	Dry Matter Availability of Bran & Chuni ('000t)	Dry Matter Availability of Oil cakes ('000t)	Dry Matter Availability of Total concentrates ('000t)
1.	1991	144.25	476.96	2102.86	2724.07
2.	1992	155.74	496.20	1931.89	2583.82
3.	1993	159.56	529.87	2322.97	3012.40
4.	1994	154.22	504.28	1862.14	2520.64
5.	1995	152.73	500.12	2500.82	3153.67
6.	1996	171.08	542.88	1806.51	2520.47
7.	1997	144.37	485.62	1321.48	1951.48
8.	1998	172.86	587.05	2460.65	3220.55
9.	1999	172.00	561.13	1382.84	2115.97
10.	2000	189.88	600.24	2054.40	2844.52
11.	2001	179.68	586.55	1589.22	2355.44
12.	2002	137.50	403.42	1329.02	1869.93
13.	2003	189.12	482.56	1551.96	2223.63
14.	2004	214.88	552.55	2008.88	2776.31
15.	2005	216.66	550.68	1533.60	2300.94
16.	2006	224.02	581.12	1427.63	2232.78
17.	2007	288.76	671.30	2532.22	3492.28
18.	2008	351.09	666.06	1386.92	2404.07
19.	2009	277.00	574.55	1434.51	2286.06
20.	2010	324.64	593.74	1522.39	2440.78
21.	2011	319.66	582.75	1278.25	2180.67
22.	2012	320.39	524.74	1897.42	2742.54
23.	2013	360.69	604.68	1671.09	2636.46
24.	2014	345.41	634.45	1295.19	2275.05
25.	2015	349.80	841.96	1819.01	3010.78
26.	2016	378.54	889.40	1616.42	2884.36
27.	2017	460.37	946.69	2015.56	3422.62
28.	2018	376.32	909.30	1585.51	2871.13
29.	2019	459.82	1018.64	2290.17	3768.62
30.	2020	419.53	971.93	1957.25	3348.71
TOTAL		7810.57	18871.42	53488.78	80170.75
MEAN		260.35	629.05	1782.96	2672.36
SD		103.34	164.99	381.30	477.96
CAGR		0.04	0.02	0.00	0.01

Table 6: Dry mater Availability of Greens from 1991-2020.

Sr. No.	Year	Forest Area	Total cropped area	Permanent pastures & Grazing lands	Fodder from other sources (Cultivable waste, Current fallows, other fallows, misc. trees)	Total green fodder yield	Dry Matter Availability from greens
1.	1991	5187.42	13193.24	1921.85	2266.68	22569.19	5642.30
2.	1992	5187.42	13193.24	1872.82	2327.71	22581.19	5645.30
3.	1993	5180.98	13274.7	1856.97	2377.47	22690.12	5672.53
4.	1994	5180.98	13199.76	1825.53	2391.21	22597.48	5649.37
5.	1995	5180.98	13220.11	1852.53	2222.43	22476.05	519.01
6.	1996	5180.98	13451.52	1852.53	2096.6	22581.63	5645.41
7.	1997	5180.98	13643.22	1702.35	2641.33	23167.88	5791.97
8.	1998	5180.98	12641.17	1686.8	2190.68	21699.63	5424.91
9.	1999	5180.98	13520.89	1666.45	2448.63	22816.95	5704.24
10.	2000	5180.98	12952.37	1649.92	2164.74	21948.01	5487.00
11.	2001	5180.98	13378.58	1651.19	2491.11	22701.86	5675.47
12.	2002	5180.98	12728.33	1694.53	2816.58	22420.42	5605.11
13.	2003	5180.98	2327.71	1694.53	2624.29	21215.71	5303.93
14.	2004	5180.98	12319.31	1694.53	2239.79	21434.61	5385.65
15.	2005	5181	13188.8	1695	2236	22300.8	5575.20
16.	2006	5200.5	12590.4	1375	2752	21917.9	5479.48
17.	2007	5200.5	13675.2	1305	2253	22433.7	5608.43
18.	2008	5200.5	13492.8	1305	2305	22303.3	5575.83
19.	2009	5200.5	12259.2	1295	2896	21650.7	5412.68
20.	2010	5230.5	13832	1260	2178	22500.5	5625.13
21.	2011	5230.5	12892.8	1260	2394	21777.3	5444.33
22.	2012	5226	12734.4	1065	2531	21556.4	5389.10
23.	2013	5239.5	13004.8	1060	2431	21735.3	5433.83
24.	2014	5494.5	12304	1070	2811	21679.5	5419.88
25.	2015	5532	12051.2	1060	2810	21453.2	5363.30
26.	2016	5532	11388.8	1055	2927	20902.8	5225.70
27.	2017	5532	11912	1045	2952	21441	5360.25
28.	2018	5532	11675.2	1040	2949	21196.2	5299.05
29.	2019	5532	11659.2	1030	2944	21165.2	5291.30
30.	2020	5532	11851.2	1015	2903	21301.2	5325.30
Total		158142.6	373556.15	43557.53	75571.25	650827.53	162706.88
MEAN		5271.42	12764.81	1451.91	2519.04	21694.25	5423.56
SD		144.34	2026.42	327.63	287.94	1953.46	488.36
CAGR		0.002	-0.004	-0.022	0.009	-0.002	-0.002

Total Dry Matter Requirement of Livestock. The total dry matter requirement for ruminant livestock units from 1991 to 2020 was represented in the Table 7. The total dry matter requirement has been increased from 1993(21.23 million tonnes) to 2007 (27.87 million tonnes) and then decrease from 2012- 2019 this is due to increase in the number of ruminants over the years.

Table 7: Total Dry Matter Requirement.

Sr. No.	Year	Total Dry matter Requirement in ('000t)
1.	1993	21233.58
2.	1999	22355.04
3.	2003	23783.82
4.	2007	27871.53
5.	2012	23653.10
6.	2019	23611.20

Total Dry Matter Availability of Feed Resources. The total dry matter availability of feed resources from 1991-2020 was 810.94 million tonnes with an average of 27.03 million tonnes as shown in the Table 8. Among all feed resources crop residues have high share (69.7%) followed by greens (20.3%) and concentrates (9.8%). Crop residues have high share and CAGR showed the positive trend (0.015 %).The dry matter requirement of livestock has increased from 1993 to 2007 and then decreased again. There may be a general trend of decreasing dry matter requirements in livestock, specific factors can vary depending on the species, management practices, and regional contexts.

Table 8: Total Dry Matter Availability of Feed Resources from 1991-2020.

Sr. No.	Year	Dry matter Availability of Total crop residues ('000t)	Dry matter Availability of Concentrates ('000t)	Dry matter Availability of Greens ('000t)	Total Dry matter Availability of Feed resources ('000t)
1.	1991	15672.33	2724.07	5642.30	24038.70
2.	1992	15182.88	2583.82	5645.30	23412.00
3.	1993	16669.20	3012.40	5672.53	25354.14
4.	1994	15409.42	2520.64	5649.37	23579.43
5.	1995	16724.98	3153.67	5619.01	25497.66
6.	1996	16447.43	2520.47	5645.41	24613.31
7.	1997	13377.75	1951.48	5791.97	21121.20
8.	1998	17423.75	3220.55	5424.91	26069.21
9.	1999	15904.83	2115.97	5704.24	23725.03
10.	2000	18679.64	2844.52	5487.00	27011.16
11.	2001	16564.98	2355.44	5675.47	24595.89
12.	2002	12554.12	1869.93	5605.11	20029.16
13.	2003	14962.54	2223.63	5303.93	22490.10
14.	2004	17702.18	2776.31	5358.65	25837.14
15.	2005	17525.18	2300.94	5575.20	25401.33
16.	2006	17571.79	2232.78	5479.48	25284.04
17.	2007	23246.35	3492.28	5608.43	32347.05
18.	2008	20896.39	2404.07	5575.83	28876.29
19.	2009	17718.18	2286.06	5412.68	25416.91
20.	2010	20232.93	2440.78	5625.13	28298.83
21.	2011	19405.98	2180.67	5444.33	27030.97
22.	2012	19379.35	2742.54	5389.10	27510.99
23.	2013	21109.14	2636.46	5433.83	29179.42
24.	2014	19745.70	2275.05	5419.88	27440.62
25.	2015	22739.79	3010.78	5363.30	31113.86
26.	2016	22688.62	2884.36	5225.70	30798.68
27.	2017	26635.96	3422.62	5360.25	35418.82
28.	2018	22375.61	2871.13	5299.05	30545.78
29.	2019	26706.79	3768.62	5291.30	35766.71
30.	2020	24463.62	3348.71	5325.30	33137.63
TOTAL		565717.41	80170.75	165053.93	810942.09
MEAN		18857.25	2672.36	5501.80	27031.40
SD		3644.31	477.96	151.16	3906.37
CAGR		0.015	0.007	-0.002	0.011

CONCLUSIONS

Livestock plays a significant role in the Indian economy with 30.5 million people dependent on cattle for their livelihood. Livestock rearing supports the well-being of two-thirds of rural population in India. From the study it could be concluded that crop residues showed the positive trend over last three decades. There is a considerable increase in dry matter availability over the three decades when compared to the dry matter requirement. The dry matter requirement of livestock has increased from 1993 to 2007 and then decreased again due to improper feed efficiency, lack of best alternative feed resources, change in genetic selection and changing environmental considerations. Through best fodder-based millet cultivars, technology dissemination on millets will further increase crop residues availability with the same positive trend and acts as best alternative for feed and fodder for livestock.

FUTURE SCOPE

This paper forms the basis for understanding millets as source of feed and fodder for ruminants. The future studies will focus on the impact of millet consumption on ruminants.

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