



Assessment of Paddy straw availability in Andhra Pradesh

Lakshmi et al.

Assessment of Paddy Straw Availability as a Feed Source for Sustainability of Livestock Farming in Guntur, Bapatla and Palnadu Districts of Andhra Pradesh

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ABSTRACT

This study focuses on the availability of paddy straw, a critical fiber source for dairy animals in Andhra Pradesh (AP), with a particular emphasis on the Guntur, Bapatla, and Palnadu districts. These districts represent three distinct irrigation scenarios in paddy cultivation: highly irrigated (Bapatla), rain-fed (Palnadu), and bore well-based (Guntur). Data on paddy straw usage and availability were collected from 84 dairy farmers directly or indirectly involved in paddy cultivation, spanning nine villages (three from each district). The questionnaire data indicated that the main reasons for mechanical harvesting and straw burning were a shortage of labour and high labour costs. The average yield of paddy straw was estimated at 8.75 tonnes/ha for manual harvesting and 3.74 tonnes/ha for mechanical harvesting. On average, dairy farmers feed 6 kg of paddy straw per animal per day, depending on the availability of green fodder and grazing grass. This data was applied to assess paddy straw requirements and availability in three districts and also in Andhra Pradesh based on the data reported by Agriculture and Animal Husbandry Departments. The study found that machine harvesting of paddy results in deficiencies of 53.62%, 60.82%, and 94.83%, while manual harvesting results in deficiencies of -8.23%, 8.58%, and 87.93% in Guntur, Bapatla, and Palnadu districts, respectively. Compared to Guntur and Bapatla, Palnadu faces a more severe paddy straw shortage due to its higher cattle and buffalo population and lack of canal irrigation. Overall, the study estimated that machine harvesting results in an 87.59% deficiency, while manual harvesting leads to a 71.04% deficiency in Andhra Pradesh for the year 2023-24. Given the livestock population in Andhra Pradesh, the current paddy straw shortage and disposal issues necessitate the urgent adoption of alternative strategies to ensure the sustainability of dairy farming.

KEYWORDS: Area of cultivation, Dairy farming, Feed resources, Paddy harvesting, Paddy straw

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INTRODUCTION

Livestock sector has been the primary source of energy for agriculture operations and also is a major source of animal protein for the masses. Sustainability of dairy farming in developing countries like India majorly depends on availability of feed and the economics of feeding, as feed alone accounts for 60-70% of production cost (Reddy et al., 2018). Paddy/rice straw is natural crop residue, which is easily available to most farmers worldwide (Dobermann and Fairhurst 2002). Often considered as an agricultural waste, it is the world's third-largest residue from agriculture after sugarcane bagasse and maize straw (McLaughlin et al., 2016). Rice straw holds immense potential as a feed source for cattle

and buffaloes of south and south east Asian countries. In India 70% livestock feed is being contributed from paddy and wheat straw only due to their practical, abundant and economic availability. In India, 43.95 million hectares of land are under paddy cultivation, which produced nearly 106.54 million tonnes of rice and 160 million tonnes of straw in the last few years (Trivedi et al., 2017) With contribution of 12.6 % of total India's total rice production Andhra Pradesh ranks 3rd and produces 12.89 million tonnes of rice. Paddy straw is abundantly available after the harvest season. The ratio of rice grain to straw produced ranged from 56.29–100.03t / ha, straw yield 92.19–135.43t / ha 1:1.5 and availability of paddy straw was expected to be 20 million metric tonnes (MMT) (Akay, 2022)

However, the actual availability of paddy straw reduced drastically due to rapid mechanization of harvesting and field burning of crop residues. According recent study (Bhattacharyya et al., 2022) around 60% of paddy straw is being burnt in fields. Shortage of labour for harvesting, short crop window period, uncertainty of weather conditions and many other factors are contributing towards the field burning of crop residues. It has been observed that from the past 5 years the paddy farmers in Andhra Pradesh are resorting to mechanical harvesting with tyre and chain seed pickers of paddy instead of manual cutting resulting in greater biomass losses. These practices along with the annual inflation lead to increase of paddy straw price from Rs. 1400 per ton in the year 2010 to Rs. 8000 per ton in 2024 as per the information by the paddy farmers of AP.

Harnessing this resource effectively not only addresses waste management concerns but also offers a sustainable solution to meet the nutritional needs of dairy animals. Assessment of availability plays crucial role before planning and adaptation of different strategies to improve the straw availability (Chaudhary et al., 2019). Hence the present study was conducted to estimate the availability of paddy straw for livestock feeding in the year 2024-25 in the state of Andhra Pradesh with special reference to Guntur, Bapatla and Palnadu districts of Andhra Pradesh.

MATERIALS AND METHODS

This study was conducted based on data collected from 84 dairy farmers directly or indirectly involved in paddy cultivation, spanning nine villages (three from each district) and Livestock population statistics provided by the Andhra Pradesh Animal Husbandry (APAH) department, alongside paddy cultivation data sourced from the Andhra Pradesh Agriculture Commissionerate for the years 2022-23 and 2023-24.

The location of study represents Guntur, Bapatla and Palnadu districts of Andhra Pradesh with reported with average rain fall (mm) of 812.2, 837.5 and 697.7 respectively from June 2023 to April 2024 (Andhra Pradesh Water Resource Information Management System). To assess the availability of paddy straw of Andhra Pradesh the area of paddy cultivated during rabi season of 2022-23 and kharif season of 2023-24 was considered. This step was followed by collection of information from Guntur, Bapatla and Palnadu districts considering the paddy

cultivation area for the year 2023-24. While Guntur district represents bore well and mixed irrigation facilities, in Bapatla district majority of cultivation land is covered under Krishna western main canal with continuous availability of canal water for irrigation. In Palnadu district the cultivation land is primarily rain fed and largely depends on availability of Nagarjuna sagar right bank canal (NSRBC) water. Due to reduced rain fall in the year 2023-24 resulting in absence of canal irrigation most of the Palnadu farmers opted for rain fed and commercial crops over paddy cultivation. The three districts were considered as representative of Andhra Pradesh agriculture scenario with three different crop irrigation methods i.e. rain fed, canal and borewell irrigations.

Regional differences may exist for the variables of interest, surveys were conducted in multiple locations in the three districts to collect data from farmers on yield of straw in manual/mechanical harvest and quantity of straw offered to dairy animals.

The survey questionnaire was developed by distributing questionnaire forms consisting of 10 questions to 84 dairy farmers engaged directly or indirectly in paddy straw cultivation. A pre-tested and semi structured questionnaire was designed to collect data on cultivation area of farmer, Irrigation source, major crops (Area of fodder cultivation), method of harvesting paddy, Yield per hectare, number of dairy animals (Cattle/buffalo), quantity of straw offered/animal, seasonal availability and utilization of green and dry fodders, major constraints in paddy harvesting and in animal feeding.

For calculation of paddy straw availability from these three districts kharif and rabi crop data of 2023-24 was considered. The yield of paddy straw in manual harvesting was considered as 8,750 kg/ha based on the information collected from paddy farmers practicing manual harvesting and paddy straw sellers who sold the straw to dairy farmers. Due to mechanical harvesting where the seed pickers harvesting with tyre/chain harvesters the yield of straw reduced drastically, and the paddy straw yield was calculated based on bales number. Farmers are opting for 30 and 50 kg bales based on the baler capacity. There is an average yield of 120-130 bales/ha weighing around 30 kg each and 70-80 bales/ha of 50 kg each. Based on interview data mechanical harvest yield of paddy straw was considered as 3750 kg/Ha to assess the paddy straw yield.

Paddy straw requirement of cattle and buffaloes

For estimating the paddy straw requirement of cattle and buffaloes, the cattle and buffalo population data of APAH statistics 2022 were considered. Irrespective of animal type the body weight of cattle and buffalo was taken as 400 kg to calculate feed requirement from dry roughage. The paddy straw was assumed to be supplied @6 kg per day per animal representing 1.5% of body weight. For 365 days supply of paddy straw to one cattle/buffalo there is a requirement of 2,190 kg paddy straw. These figures may vary depending on availability of green fodder, which increase during lean seasons due to reduced green fodder availability. The requirements were calculated district wise and also state wise to check the areas of severe feed shortage.

Paddy straw requirement versus availability

The dry fodder deficiency assessment was done by calculating the yield of straw from reported areas of paddy cultivation. The data on area of paddy that were subjected to manual and mechanical harvesting was not recorded anywhere hence separate calculation was done considering total area under manual harvesting and mechanical harvesting to derive the fodder deficiency percentage under manual and mechanical harvesting scenarios. The paddy straw requirements of AP large ruminants and three districts and the availability of paddy straw calculated were considered to estimate the paddy straw deficiency percentage.

RESULTS AND DISCUSSION

Dietary fiber is vital component in the diets of dairy animals that regulates rumen function and major contributor of rumen bulk. Slow digesting fiber from paddy straw helps in synthesis of acetic acid a major volatile fatty acid in the rumen that plays key role in milk fat synthesis (Woodford et al., 1986). The fiber requirements of dairy animals in Andhra Pradesh are majorly met from paddy straw. Assessing the requirement and availability of paddy straw is crucial

for devising strategies to mitigate field burning and conserve straw for animal feeding purposes Paddy straw holds significant importance as a feed resource for large ruminants in Andhra Pradesh. However, the rapid mechanization of paddy harvesting, coupled with the traditional practice of field burning paddy harvest residues, has led to a substantial increase in the price of paddy straw. From the survey report collected from 84 dairy farmers it was understood that surge in prices has prompted the farmers with livestock to opt for baling (mechanical harvest) the long fiber residues of paddy straw instead of burning them in the fields. While this shift in practice conserves paddy straw for animal feeding, it exacerbates the dry fodder deficit in Andhra Pradesh. The survey analysis from 74% of paddy farmers depicted that the high wages for labour as the main driving force for burning of straws in the fields and 28 % farmers reported longer inter cropping interval in decomposition of residue in mechanical harvesting led them to field burning of paddy straw (Table 1).

The yield of paddy straw was considered as 8.75 and 3.75 tonnes/ha in manual and mechanical harvesting respectively, on the basis of data provided by farmers and dairy farmers who purchase paddy straw for feeding the dairy animals on hectare basis. The response from 87% of interviewed farmers indicated that the major cause of higher prices of paddy straw was due to shortage of green fodder, faced by dairy farmers of KVK jurisdiction. Similar to current study a survey conducted (Debela et al., 2017) reported that more than 98.9% of the livestock owners response indicated that feed shortage is a seasonal problem and 82.2% of the respondents reported that feed shortage is a serious problem during dry season. From the information provided by farmers it was inferred that the livestock of Palnadu region largely depended on grazing and paddy straw as compared to Guntur and Bapatla districts.

Table 1. Survey analysis of dairy farmers and average yield of paddy straw in Guntur, Bapatla and Palnadu districts

	No. Of dairy farmers surveyed	% Farmers holding paddy fields	% Farmers adopted different disposal methods			Yield of straw in manual harvest ton/ha	Yield of straw in mechanical harvest ton/Ha	Quantity of paddy straw/animal/day In kg*
			Manual harvest	Mechanical harvest	Field burning			
Guntur	18	61.1 (12)	27.3 (3)	36.4 (4)	45.5 (5)	9.0	3.8	6.17
Bapatla	27	100 (27)	25.9 (7)	40.7 (11)	33.3 (9)	8.8	3.5	5.04
Palnadu	39	33.3 (13)	15.4 (2)	76.9 (10)	7.7 (1)	8.5	3.3	8.89

*The values varied depending on seasonal availability of green fodder and the values were taken as average of values provided by farmers

In Bapatla district the number of farmers cultivating fodder crops during kharif and rabi season were higher than Guntur and Palnadu districts and the dairy animals of this district were fed with paddy straw from March to August months. On an average, farmers of Guntur Bapatla and Palnadu regions were feeding 6.17, 5.04 and 8.89 kg of paddy straw/animal/day (Table 1). These values vary with season, rainfall and grazing grass availability.

In Andhra Pradesh, the capacity for paddy cultivation spans 2,343,473 hectares, encompassing both Kharif and Rabi seasons. However, due to reduced rainfall and the unavailability of canal water for irrigation, there has been a significant decline of 66.54% in paddy cultivation area. Particularly, the Rabi season suffered a severe 87.63% reduction in cultivated land compared to the expected area. The paddy straw assessment was calculated considering average yield of 8.75 ton/ha in manual harvesting and 3.75 ton/ha or 125 bales of 30 kg in machine harvesting. The anticipated yield from manual and mechanical harvesting was projected at 6.86 and 2.94 million metric tonnes (MMT) of straw, respectively (Table 2). With a livestock population of 10,819,586 cattle and buffalo in Andhra Pradesh, the annual requirement for paddy straw is estimated at 23.69 MMT (Table 3) for the year 2024-25. This indicates an expected deficiency of 71.04% and 87.59% in manual and mechanical harvesting, respectively (Table 4). The deficit percentage may further escalate as many farmers resort to burning straw after mechanical harvesting rather than baling it for livestock feed.

According to Chandrasekhar et al. (2019), there are four primary methods for disposing of mechanically harvested paddy straw: removing loose straw and burning stubbles, burning both loose straw and stubbles, removing straw and incorporating stubbles into the soil, and incorporating both loose straw and stubbles into the soil. Depending on feasibility, farmers in Andhra Pradesh are adopting one of these methods for straw disposal, leading to a substantial shortage of fodder for livestock feeding.

Table 2. Paddy straw availability assessment for Guntur, Bapatla and Palnadu districts and Andhra Pradesh state

District	Area sown in Ha	Expected availability in tonnes	
		Manual harvest	Mechanical harvest
Guntur	55,776	4,88,040	2,09,160
Bapatla	92,373	8,08,264	3,46,399
Palnadu	15,949	1,39,554	59,809
Andhra Pradesh [#]	7,84,119	68,61,041	29,40,446

Table 3. Cattle and buffalo population and paddy straw requirement Andhra Pradesh and Guntur, Bapatla and Palnadu districts

District	Cattle	Buffalo	Total	Paddy straw requirement in tonnes*
Guntur	16,899	1,89,009	2,05,908	4,50,938.5
Bapatla	21,930	3,81,764	4,03,694	8,84,089.9
Palnadu	64,240	4,63,921	5,28,161	11,56,673
Andhra Pradesh	46,00,087	62,19,499	1,08,19,586	23,694,893 (23.7 MMT)

Data courtesy: Department of Andhra Pradesh Animal Husbandry statistics on livestock population 2022-23

* Straw requirement calculated considering average data provided by farmers of three districts as 6 kg straw per animal) per day for 365 days

Despite being characterized by a low nutritive value primarily constituted of cellulose and lignin, paddy straw remains a crucial component in livestock feeding. It accounts for over 70% of the fiber requirements for Indian large ruminants (Mahesh and Mohini, 2013). Extensive research has been taken up to improve the nutritive value of these residues (physical chemical and biological treatments) at

national agricultural institutes and state agriculture universities (Dhanda et al., 1994; Nagalakshmi and Reddy, 2012). However, the nutritive value of paddy straw bales can be improved by addition of fermentation medium at the time of baling process and was found 11.15% profitable over conventional baling practice (Singh and Rani, 2024).

Table 4. Paddy straw requirement and expected availability to livestock in Andhra Pradesh

District	Paddy straw requirement (tonnes)	Manual harvesting		Machine harvesting	
		Expected yield (tonnes)	Deficiency %	Expected yield (tonnes)	Deficiency %
Guntur	4,50,939	4,88,040	8.23	2,09,160	53.62
Bapatla	8,84,090	8,08,264	8.58	3,46,399	60.82
Palnadu	11,56,673	1,39,554	87.93	59,809	94.83
KVK, Guntur jurisdiction	24,91,701	14,35,858	42.37	6,15,368	75.30
Andhra Pradesh	2,36,94,893	68,61,041	71.04	29,40,446	87.59

The once esteemed straw, now relegated to waste destined for burning, faces a host of challenges including technical, structural, socioeconomic, and institutional barriers (Bhattacharya et al., 2021). Aside from contributing to air pollution, the field burning of paddy straw leads to the depletion of soil organic matter and essential nutrients, reduces microbial activity, and heightens the land's susceptibility to erosion (Kumar et al., 2023). Apart from livestock feeding in order to reduce field burning many alternative and sustainable bio energy models have also been proposed to prevent the field burning of paddy straw (Trivedi et al., 2015). Urgent measures are required to tackle the practice of field burning rice straw, ensuring its availability for feeding large ruminants in India to sustain the dairy sector amidst severe forage shortages

CONCLUSION

Paddy straw, often overlooked as a by product of rice cultivation holds potential as a valuable feed source for livestock. However, factors like a reduction in cultivation area due to decreased rainfall in Andhra Pradesh during 2023-24 and the rapid mechanization of harvesting have caused a decline in the availability of paddy straw for livestock feed. Practices such as field burning and field decomposition of post-harvest paddy waste have worsened the situation, leading to a sharp rise in the price of paddy straw, which challenges the sustainability of dairy farming. This pressing scenario necessitates urgent strategies to augment the availability of paddy straw for viable dairy farming.

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