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UTILIZATION OF SUGARCANE TRASH FOR LIVESTOCK FEEDING: AN ALTERNATIVE TO ON-FARM BURNING

An alternative to on-farm burning of sugarcane trash is critical for improving effective crop residue utilization as well as to reduce its contribution to various ill effects and to climate change. Drs Prakashkumar Rathod, Veeranna KC, Ramachandra B, and Mr Dattu Reddy share their experiences of sugarcane trash utilization for livestock feeding as an alternative to on-farm burning under Sujala-III Project implementation in Karnataka (India).

CONTEXT

Sugarcane is one of the important cash crops of India and plays a pivotal role in both the agricultural and industrial economy of the country. India is one of the largest producers of sugar, with sugarcane cultivation spread over 4 million hectares, and the production is estimated to be about 325 million tonnes with productivity of 70 tonnes per hectares (Mohan and Ponnusamy 2011). However, great attention is given only to improving sugarcane yield and not much to managing the cane trash. In India, approximately 6.5 million tonnes of sugarcane trash is being produced every year, with most of the residues usually burned in the field. About 5-8 tonnes of trash can be obtained from one hectare of sugarcane. But, when sugarcane trash is burnt, most of the organic matter and nutrients in the trash are lost, leading to dreadful environmental pollution (Mitchell et al. 2000). Farmers usually burn the trash under the impression that its management is laborious, will reduce germination, and hinder routine ratoon cultivation practices. Furthermore, burning is considered as the easiest and quickest way to get rid of large volumes of trash - and is less labour-intensive. It does not involve additional financial burden on farmers as it involves no transportation or disposal costs. Burning is believed to raise productivity, and shorten harvesting time by a couple of days (Box 1). On the other hand, farmers apply a huge quantity of fertilizers to meet the nutrient requirements of the crop.

Box 1. Issues of sugarcane trash burning

Burning trash after harvesting, has many negative agricultural, environmental, and health effects. Burning trash liberates a considerable amount of CO_2 and other GHGs. The estimated direct CO_2 emission from trash burning was 10,410 kg/ha. An additional emission of 1791 kg CO_2/ha was estimated from the other gases (CH_4 = 467 kg CO_2, CO = 1241 kg CO_2, and N_2O = 830 kg CO_2). This added up to 12,204 kg CO_2/ha, which translates into about 37% of the total greenhouse gas emissions in trash production on the farm (Mendoza 2014). On the agricultural side, there are many nutrients lost from the biomass in sugarcane production. Sugar (sucrose) is only 10% of the total tonnage yield. After vaporising the moisture (50%), 10-15% of the trash+tops represents the amount that can be recycled back in the farm. Bagasse (25%) is used as fuel in the mill. When trash is burned, the nitrogen is lost as nitrous oxides. Burned cane trash leads to near total loss of N at an average of 44 kg N/ha/yr. Some of the P and 70-73% of K are also lost through burning (Ross et al. 2000).

Table 1. Loss of nutrients due to burning of crop residues

Crop Residues	N loss	P loss	K loss	Total
	Mt/Yr			
Rice	0.236	0.009	0.200	0.45
Wheat	0.079	0.004	0.061	0.14
Sugarcane	0.079	0.001	0.033	0.84
Total	**0.394**	**0.014**	**0.295**	**1.43**

Source: Jain *et al.* (2014)

Table 2. Effect of burning of different crop residues on methane and nitrous oxide emissions in India, for the year 2010-11

Crop type	CH_4 emitted (Gg carbon equivalent)	N_2O emitted (Gg carbon equivalent)	Total emissions (Gg carbon equivalent)
Wheat	73.32	11.42	84.74
Rice	82.37	32.44	114.81
Maize	16.74	5.50	22.24
Sugarcane	115.12	26.48	141.60
Cotton	14.06	2.01	16.07
Total	301.60	77.85	379.45

Source: Lenka et al. (2014)

On the health side, sugarcane workers have been observed to have significantly high rates of mortality due to illnesses attributed to burning canes. Burning in the sugar fields releases fly soot into the atmosphere that contains polycyclic aromatic hydrocarbons that have mutagenic and carcinogenic properties (Allen et al. 2004). Further, Amre et al. (1999) found an increased risk of lung cancer in workers employed in sugarcane farms in India. However, it should be noted that not burning canes and utilising the trash in the field has many interrelated benefits for the soil, farmer, human health, society, and the environment as a whole.

Sugarcane trash for livestock feeding

In India, crop residues are traditionally utilized as animal feed by itself or by supplementing with some additives. However, crop residues, being unpalatable and low in digestibility, cannot form the sole diet for livestock. Crop residues are low-density fibrous materials, low in nitrogen, soluble carbohydrates, minerals and vitamins with varying amounts of lignin which act as a physical barrier and impedes the process of microbial breakdown. To meet the nutritional requirements of animals, the residues need processing and enriching with urea and molasses, and supplementing with green fodders (leguminous/non-leguminous) and

legume (sun hemp, horse gram, cowpea, gram) straws. Table 3 depicts the chemical composition of sugarcane trash and urea ammoniated sugarcane trash.

Table 3. Chemical composition of sugarcane trash and urea ammoniated sugarcane trash

S. No	Chemical Composition (per cent dry matter basis)	Sugarcane trash	Urea ammoniated sugarcane trash (4%)
1	Dry matter	92.7	74.53
2	Organic matter	88.6	86.60
3	**Crude protein**	**3.0**	**11.98**
4	Ether extract	1.5	1.70
5	Crude fiber	34.7	34.17
6	Nitrogen-free extractives	49.4	38.74
7	Total ash	11.4	13.40
8	Neutral detergent fiber	79.1	78.80
9	Acid detergent fiber	50.3	52.65
10	Acid detergent lignin	20.8	17.27

Source: Jaishankar et al. (2017)

Considering the vitality of the above mentioned items, we lay emphasis on the utilization of sugarcane trash for livestock feeding as an alternative to on-farm burning. Enrichment of trash using urea was the practice followed in the study for improving trash utilization, especially in the summer months. Further, this project has also addressed the constraints faced by project staff and farmers in this project activity.

THE INITIATIVE

The project is implemented through the World Bank-funded Watershed Development Program of the Government of Karnataka, based on flow of water channels and socio-economic factors. These activities are undertaken in seven project districts of Karnataka. The experience shared here is from the project villages of the World Bank-funded, Karnataka Watershed Development Program-sponsored - Sujala III Project – implemented by Veterinary College, Bidar from December 2014 till date. The study involved individual farmers and member farmers of producer organizations (for example: Karnataka Milk Federation, private milk societies, etc.), State Dept. of AH&VS, State Dept. of Agriculture, etc.

Based on baseline survey results, conducted by the project team of Veterinary College, Bidar, in the project area, lack of green fodder and poor utilization of dry fodder and its wastage were identified as the critical gaps in animal husbandry sector of Bidar district. Further, it was also noted that sugarcane trash was burnt on the field without understanding its importance. To address this critical gap, technical interventions were introduced in consultation with technical experts, field functionaries, and the farming community.

Box 2. Methodology of the study

- Purposive sampling technique was used for selecting Bidar district since Sujala-III Project was implemented in this district by Veterinary College, Bidar.
- A baseline survey was carried out with about 790 farmers from 14 project villages, as identified by the Government of Karnataka (India).
- Awareness programmes, trainings, and demonstrations on the utilization of sugarcane trash for livestock feeding as an alternative to on-farm burning were conducted by multi-disciplinary teams for the beneficiaries. A 'before-after' research design was followed, along with participatory research, to demonstrate the impact of these programmes in the project villages.

- Pre-exposure and post-exposure knowledge tests and adoption studies were conducted in the project villages, focusing on the objectives of the scheme, both before and after conducting the awareness and demonstration programme.
- The study focused on urea enrichment methods (urea ammoniation and urea treatment) in the study for improving the nutritional composition of trash, especially in the summer months. Urea ammoniation method involves 4-6% urea with 30-40% moisture level stored for 21 days under anaerobic condition, while urea treatment method involves 2-3% urea with 20-25% moisture level and this is fed to animals immediately.

GOOD PRACTICES

- **Awareness programmes, trainings and demonstrations:** Multi-disciplinary teams conducted awareness programmes and demonstrations for beneficiaries on trash ammoniation and enrichment using urea for livestock feeding. The project team created awareness about the ill-effects of burning trash and its contribution to climate change. Moreover, during the process, farmers realized the importance of fodder chaffing, which most of them had not followed initially. The importance of chaffing was also highlighted for the benefit of the farming community so that fodder wastage could be minimized. About 850 farmers have participated in 21 demonstrations organized in different project villages for the last three years. The beneficiaries also participated in focus group discussions on different practices and issues under the guidance of experts or project staff.

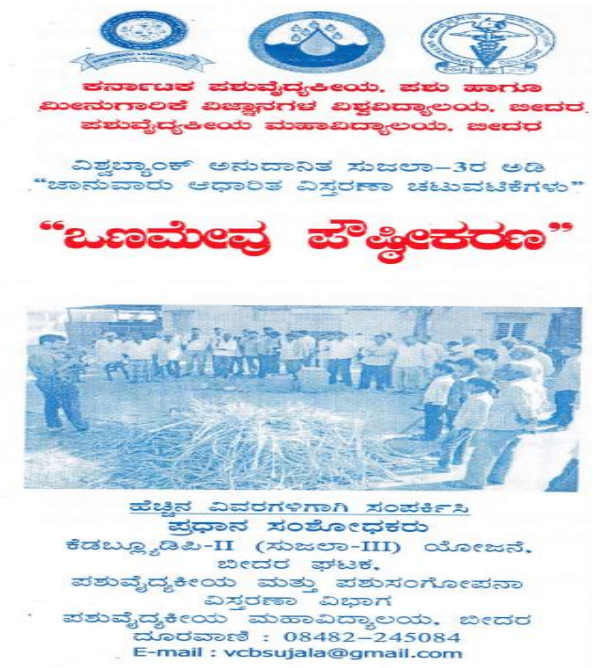
- **Promoting Urea enrichment methods:** The study focused on urea enrichment methods (urea ammoniation and urea treatment) for improving the nutritional composition of trash, especially in the summer months. However, urea ammoniation method was preferred by the project team over urea treatment since the ammoniation method improves palatability and fibre digestibility, as well as supplies valuable protein in the form of nitrogen, and this is considered to be highly beneficial compared to the other method.

- **Advisory services by technical staff:** The project got technical staff involved for creating awareness about project activities and importance of dry fodder utilization in livestock feeding. Advisory services, provided on a timely basis by the technical staff, have helped beneficiaries to a great extent.

- **Enhanced access to inputs:** Even though this practice does not involve much costly inputs, interested farmers were provided small sachets of urea for easy use of urea with trash. This was planned so as to reduce the confusion of farmers about the exact combination of urea, trash and water in the enrichment method. A few interested farmers also learnt about the distribution of chaff cutter through the offices of the State Department of Agriculture and State Department of Animal Husbandry & Veterinary Services, and

could procure them successfully. Interested farmers who came forward to adopt this practice also received bags, water troughs (barrel), and plastic sheets through the project.

- **Farm literature and video:** Farm literature and reading materials were distributed to all the beneficiaries. Furthermore, a video was developed in the vernacular language and was displayed for the benefit of farmers. This video is available at https://www.youtube.com/watch?v=0MflERGSBtk



- **Convergence of multi-stakeholders/actors:** Diverse agencies viz., World Bank, Karnataka Watershed Development Department, Veterinary College-Bidar, Livestock Research and Information Centre (Deoni), Bidar, state departments of Agriculture and Animal Husbandry & Veterinary Services, individual farmers and member farmers of producer organizations (Karnataka Milk Federation) were all involved in the project.

BENEFITS AND IMPACT

- **Increase in dry fodder utilization and farmers' interest:** There is an increase in the number of farmers who are interested in utilizing sugarcane trash as fodder for livestock. Farmers were initially of the impression that sugarcane trash was non-palatable and that animals could not consume the trash properly. Further, most farmers burnt the trash on the farm itself. However, through the intervention of project activities, farmers in the project villages initiated enrichment of trash using urea under the supervision of the project team. Gradually, over a period of time, farmers have come to realize the importance of trash utilization and have adopted this practice under field conditions. This enriched matter acts as fodder during the summer season when no other sources of fodder are available for livestock.

- **Improved knowledge level of dairy farmers:** The overall knowledge level of beneficiaries about dry fodder enrichment and utilization of sugarcane trash and its importance has increased after participating in demonstrations and various programmes through the project. Further, the knowledge retention level has also improved due to hands-on project activities.

- **Improved quantity and quality of milk:** Field level observations have confirmed that the problem of less milk yield, and low fat and 'solids not fat' (SNF) content was solved to a great extent due to feeding of enriched trash to their dairy animals during the summer months. The experiences of farmers during summer

(almost four months) for last two years indicated that enriched trash feeding has improved the overall health status of dairy animals, especially because this trash was palatable and nutritious compared to non-ammoniated trash (as seen in Table 3).

- **Improved economic returns:** Interventions carried out in this project for increased availability and utilization of crop residues in general, and sugarcane trash in particular, were aimed at increasing milk production and reducing the cost of milk production, which in turn resulted in increased economic returns for livestock producers. Most important characteristics were the low cost of its practice, relatively short wait for benefits, and observable benefits. The farmers have a varying range of income benefits depending on the quantity of sugarcane trash. Furthermore, farmers have saved money which they normally would have spent on purchasing fodder from other sources in summer season. The farmers were able to save an average of Rs 4500 to Rs 5000 for one ton of trash, indicating that 'money saved is money earned'.

- **Improved yield in next harvest:** The trash which earlier was burnt in the field has been utilized as fodder, keeping the soil's micronutrients intact, leading to better maintenance of soil fertility and improved crop

yield in the next sowing. Further, farmers have reduced contributing towards soil and air pollution and overall climate change in the project area.

LESSONS LEARNT AND CHALLENGES FACED

The project clearly revealed that an integrated approach of extension activities viz., training, on-farm demonstration, farm literature, etc., can promote adoption of scientific practices by sensitizing and improving the knowledge level of farmers. There is improvement in availability of fodder for livestock during summer, as well as in quality and quantity of milk yield. However, during the process of implementation, this activity did face various problems and challenges, which are given below.

- Project beneficiaries were not aware of the importance and effective utilization of crop residues and sugarcane trash. Hence, addressing farmers on sugarcane trash ammoniation and enrichment and creating this as a felt need was a challenging task in the initial period for the project team. The project team made efforts to motivate and strengthen the scientific knowledge of the beneficiaries.
- It was very difficult for the project team to convince the beneficiaries about the project objectives in general, and sugarcane trash as fodder, in particular. Hence, the farmers required regular follow-up and field level observation.
- The project faced these problems: low commitment from farmers, lack of labour, and negative attitude of farmers about urea feeding. Furthermore, farmers also had to be convinced about the right combination of urea, trash and water in this practice. The neem-coated urea, which is presently available in the market, was also assured to be useful for this particular practice.
- Another major problem faced by the farmers was the non-availability of chaff cutters. Although a few farmers procured chaff cutters through different sources and subsidies, majority of the farmers lacked chaff cutters in the project villages due to their poor economic status, and very small scale of livestock farming. Moreover, efforts to initiate community-based chaff cutters in the project villages didn't work due to various issues among the project beneficiaries.

Interestingly, Prakashkumar Rathod the first author, of this good practice recalls the AESA blog, *Are we generating need based and field relevant livestock technologies?*, written with Dr Mahesh Chander, and reiterates the fact that scientific technologies or practices can be well adopted with the right combination of knowledge and input service delivery. Although this project has achieved the target to some extent, large scale adoption and diffusion of this practice is essential for effective utilization of crop residues in general, and sugarcane trash in particular.

POLICY IMPLICATIONS

- A policy shift emphasising delivery of major inputs, like chaff cutter and regular follow-up for carrying out an integrated extension approach, is very critical for adoption of this particular practice. In the existing scenario, the authors realized that the practice could be adopted easily if the farmers get access to major inputs, knowledge about the practice of trash utilization and its enrichment, and its contribution to livestock production.
- Further, as the generation demand, quality, feasibility and economics of crop residues and sugarcane trash management vary from region to region, a region-specific and need-based crop residues management plan should be set up.
- The options, in terms of incentives or awards to the farmers who protect environment and effectively utilize the crop residues or trash and develop relevant technologies and practices, is the urgent need for improving productivity and protecting the environment.
- All stakeholders, viz., farmers, supply and value chain service providers, researchers, extension agents, policymakers, civil servants and consumers need to be engaged in understanding and harnessing the full potential of these valuable resources for sustainability and resilience of Indian agriculture. Through

departmental linkages an effective strategy may be planned for effective utilization of trash using relevant scientific and technological applications.

- Commercialisation or entrepreneurship in trash utilization, fodder block preparation, densified trash preparation, trash-based pellets, etc., can be newer options to meet the fodder requirements of livestock. The trash bales or densified trash can be easily transported, stored, and would be highly economical.
- This study had considered only initial trial of neem-coated urea with reference to odour, palatability, solubility, absorption, etc., under laboratory conditions. However, with the changing government policy, a large scale study on the utilization of neem-coated urea, which is presently available in market for enrichment of trash, is very necessary.
- In the long run, this method of trash utilization may be adopted for other crop residues since India suffers from the issue of crop residue burning, causing ill effects on environment. This can also be one of the solutions for fodder scarcity problems in the livestock sector.

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