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RESEARCH ARTICLE

Experiences in Promoting Ensiling of Onion Crop Residue among Smallholder Dairy Farmers in Namakkal District of Tamil Nadu

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ABSTRACT

In mixed crop-livestock system country like India, frequent occurrence of drought limit animal feed resources such as green fodder and crop residues. Forage conservation technologies and Non-Conventional Feed Resources (NCFR) could mitigate dry season feed shortage but their adoption in smallholder systems has so far been low and varying across regions. In order to address and develop solution to the issues, this action research was attempted to introduce onion crop residue-based silage among small onion (Allium cepa) cultivating farmers of Namakkal district of Tamil Nadu. For the above purpose, ensiling of onion crop residue was standardised. Then attempts were made to popularise the standardised silage preparation using polypropylene bags and feeding of silage to dairy animals through farmers meetings, training, demonstration and field days. The adoption rate and perception on onion crop residue silage using bags were studied one year after intervention. This study found that 16.70 per cent had adoption of promoted technology and the remaining has not adopted. Added, majority of the farmers reported that silage making using fresh onion crop residue has less relative advantage over the existing practice, involves high complex procedures and has limited potential of experimenting in small scale. Furthermore, onion cropping area, herd size and perception(s) on the attributes of the technology differentiated adopters and non-adopters. The limited adoption of recommended technology demands bottom up / participatory approach for adoptable feed innovation.

Key words: *Adoption; Onion crop residue; Innovation; Silage; Smallholder dairy.*

Dairying in India continues to have a larger share in the livestock sector. This subsector dairy provides employment opportunities to 80 million households. Added, dairying contributes 21 to 26 per cent of the household's income (*Thirunavukkarasu, et al., 2019*) and livestock sector contributes 4.9 per cent of Gross Value Added (*GOI, 2018*). But the productivity of milk per animal is very low when compared to other developed countries. One of the reasons for the low productivity of dairy animals is due to malnutrition, under-nutrition or both, beside the low genetic potential. According to Planning Commission report (2007-12), there is a huge deficit of green fodder and dry fodder in India (Planning Commission report, 2012). The same scenario is noticed in Tamil Nadu state with the annual requirement of fodder is around 400 lakh MT against fodder availability of 300 MT (*GOTN, 2013*). This may be attributed by shrinkage of grazing areas, poor quality of dry fodder like paddy/sorghum straw, and changing cropping pattern in favour of cash crops and thus limiting crop residue for animal feeding (*Thirunavukkarasu, et al., 2014*). This scenario demands a focus towards better use of crop residues as animal feed resources. Namakkal district of Tamil Nadu have 2.2 lakh white cattle (*Livestock Census, 2012*) and one of the largest small onions (*Allium cepa*) producing district with more than 2000 hectares (*Department of Economics and Statistics, Namakkal, 2017*). This onion cultivation generates 5000 to 6250 tonnes of onion crop residue per annum. Onion cultivating farmers having a practice of disposing crop residue as such and / or limited feeding to animals without value addition. Thus, based on availability of crop residue, farmers

practice and to address feed shortage issues, Krishi Vigyan Kendra (KVK), Namakkal made attempts to include onion crop residue in dairy animal feeding. Internal deliberation with scientists (Horticulture, Agronomy, Animal Science, Extension and Animal Nutrition) suggested for ensiling onion crop residue through action research to promote optimal usage of easily available onion crop residue.

METHODOLOGY

Based on the technical inputs from Animal nutritionists and availability of crops at farmers field, various combinations of onion silage preparation were attempted viz., only fresh onion crop residue (100 kgs of onion crop residue + 2 kgs of jaggery + 1 kg of salt), fresh onion crop residue ensiled with green fodder maize (95 kgs of onion crop residue+ 5 kgs of maize + 2 kgs of jaggery + 1 kg of salt) and fresh onion crop residue ensiled with *Moringa oleifera* (90 kgs of onion crop residue+ 10 kgs of *Moringa* + 2 kgs of jaggery + 1 kg of salt). In all combinations, as per recommendation of nutritionists jiggery and salt were used to improve the palatability and nutritional value of the silage. The proximate analysis of pre and post ensiling was carried out. The results confirmed that onion crop residue ensiled with *Moringa oleifera* had marginal increase in crude protein and gross energy level. The details are as follows (Table.1).

Based on the laboratory results popularisation of silage preparation with 90 kgs onion crop residue and 10 kgs *Moringa oleifera* using High Density Poly Ethylene (HDEP) bags with 120 GSM was conducted during 2017-18 in Vadavathur village of Erumapatti Block of Namakkal district which accounts 21.28 per cent of total onion area in Namakkal *(Bharathi and Mohan, 2018*).

Various extension approaches (training, method demonstration, farmer–scientist interaction and farm visits) were used to propagate bag silage with onion crop residue. Further, a field day was organised at farmer's field for popularization of bag silage. In addition, the availability of polyethylene bags and other inputs were ensured for adoption.

Table 1. Laboratory results of Proximate analysis (Fresh and ensiled onion crop residue)

Nutritional characters	Fresh onion crop residue	Ensiled onion crop residue
Moisture	87.05%	84.85 %
Crude protein	1.90 %	1.93 %
Crude Fibre	2.23 %	3.67 %
Ether Extract	0.63 %	0.77 %
Total Ash	1.17 %	2.78 %
Gross Energy	537 kcal/kg	569 kcal/kg

After one year from the intervention the assessment on adoption, perception on technology attributes and factors differentiating adopters and non-adopters of ensiling of onion crop residue were studied through ex post facto research design with cross sectional data. In this study adoption status of bag silage was recorded as "adopters" and "non-adopters". The insight on technology attributes namely relative advantage over the existing in input and resource saving; compatible with farming situations and needs; simple to use; trialable at small scale; observability of results (*Rogers, 2003*) was captured through two-point continuum scale. The attribute score was arrived for each individual through summation of individual attribute scores. A well-structured pre tested interview schedule was used to collect data. The research was carried out among 30 randomly selected respondents in the adopted village from the sample frame of 198 dairy animal owning households. Based on the level of measurements the association between adoption and selected farm / farmers characters were examined through Mann-Whitney U test and chi-square analysis.

RESULTS AND DISCUSSION

The farmers possessed average herd size of 3.27± 1.26 number of dairy animals as similar to recent past study by *Thirunavukkarasu et al., 2014.* These farmers cultivated onion crop in 1.95± 0.95 acres. Majority of the farmers meet out the animal feed requirement through partial grazing. On an average the farmers allowed their animals for grazing for 2.53± 0.98 hours. They supplemented with weeds and mostly of Pearl Millet X Napier grass green fodder (*Pennisetum glaucum* X *Pennisetum purpurem*) and dry fodder (paddy and sorghum straw). Added majority (90 %) of the farmers used concentrates (commercial feed). Thus, dairying in the study village was more of smallholder nature with crop-residue feeding under semi-intensive system.

The study found that only 16.70 per cent farmers had adopted the preparation of onion crop residue silage and feeding it to their animals and the remaining has not adopted it. Furthermore, 53 per

Table 2. Association between adoption of bag silage and selected characteristics of dairy farm families (metric characters) (N=30)

Variables	Adoption status	Mean ranks	Sum of ranks	U -value
Herd size	Adopted (5)	14.00	350.00	25.00**
	Not adopted (25)	23.00	115.00	
Onion cropped area	Adopted (5)	14.22	355.50	30.50*
	Not adopted (25)	21.9	109.50	
Grazing time	Adopted (5)	14.98	374.50	49.50
	Not adopted (25)	18.10	90.50	
Knowledge on silage making	Adopted (5)	14.70	367.50	42.50
	Not adopted (25)	19.50	97.50	
Attribute score for Bag silage	Adopted (5)	13.22	330.50	5.50***
	Not adopted (25)	26.90	134.50	

Adopters and non-adopters differ at *** P<0.01, ** P<0.05 and * P<0.10

Table 3. Association between adoption of bag silage and selected characteristics of dairy farm families (non-metric characters) (N=30)

Category	Adoption status of silage		Chi-square value
	Adopted	Not Adopted	
Feeding of concentrates			
Yes	5 (16.70)	22 (73.30)	0.66
No	0 (0.00)	3 (10.00)	
Advantage of ensiling onion crop residue over existing practice(s)			
Advantageous	5 (16.70)	9 (30.00)	6.85**
Not advantageous	0 (0.00)	16 (53.30)	
Compatibility of ensiling onion crop residue with farming situation(s)			
Compatible	5 (16.70)	14 (46.70)	3.47*
Non compatible	0 (0.00)	11 (36.60)	
Complexity in ensiling onion crop residue			
Easiness	1 (3.33)	11 (36.67)	1.00
Complex	4 (13.33)	14 (46.67)	
Trialability of ensiling onion crop residue and feeding			
Trialable	4 (13.33)	1 (3.34)	17.33***
Not trialable	1 (3.33)	24 (80.00)	
Observability of benefits on ensiling onion crop residue			
Observable	5 (16.70)	11 (36.60)	5.25*
Not observable	0 (0.00)	14 (46.70)	

Adopters and non-adopters differ at *** P<0.01, ** P<0.05 and * P<0.10

cent of farmers alleged that the technology has less relative advantage over existing practice of disposal as such and / or feeding as such; 60 per cent felt silage making as highly complex procedure and 83 per cent perceived technology as non-trialable. While, 62 per cent felt this technology is suitable for their farming situations and 53 per cent felt benefits were observable on adoption of ensiling onion crop residue.

From Table 2 and 3, it can be inferred that herd size, onion cropped area and perceived attributes of technology had an association with adoption status of bag silage. Farmers with larger herd size and onion crop area had an association with adoption of ensiling of onion crop residue in bags. While the feeding practices (Grazing time and concentrate feeding) and knowledge of the farmers does not have the association with adoption of bag silage. The average knowledge score on bag silage preparation was 6.03 (max. score 7) and does not differentiate adopters and non- adopters. This may be due to uniform extension

approaches adopted to transfer principle knowledge and technical know-how to dairy farmers during the research intervention in the village. On examining individual attributes as well as overall attributes of ensiling of onion crop residue in bags had association with adoption status. The relative advantage, trialability, observability of benefits and compatibility had association with adoption. In specific, the association between adoption and trialability was significant at 1 per cent level. Added relative advantage had significant association with adoption at 5 per cent level. It should be noted that around half of the farmers felt that ensiling has less relative advantage and poor observable benefits. Added majority of the farmers felt this technology as not trialable.

The result is in line with *Rogers (2003)* who reported that 49-87 per cent of the variance in the rate of adoption of innovations is explained by attributes and also with *Pannell, et al., (2006)* who reported that farmers are more likely to try out a new innovation with less risky and have higher expected benefits relative to the superseding technology. The farmers felt there is not much of relative advantage of ensiling onion crop residue over disposing as such / feeding to animals. This may be due to opportunity cost involved for labour usage for silage making, not appreciable reduction in feed cost or visible increase in milk production. Added, around half of the farmers reported poor observability of benefits (in terms of milk yield or quality or cost savings) on feeding silage as against feeding concentrates where farmers observe advantage (feeding vs non-feeding) and gross visibility of benefits (increased milk and quality). Further, the cost (labour costs for collecting, filling and stamping- (₹ 125 to 250 and Bag cost ₹ 400) limits trialability of making silage and its feeding to animals. Further farmers felt that the procedure involved from collection of crop residue, *Moringa oleifera* and mixing it with jiggery and salt, stamping for air tight packing and keeping it for 21 days for ensiling as complex and cumbersome. Thus, silage making in bags at farmer's field is less advantageous, highly complex and less trialable. The results are in line with *Roling (2002)* who reported lack of resources, perceived benefits and benefit costs / profitability limits the adoption. Added, *Rangenekar (2014)* and *Rathod and Chander (2015)* also stated that improving the attributes of technology may pave for better acceptance of technology among end users.

The result further gives limelight over the silage technology adoption. Since 1970, Indian scientists and extensionists promoted silage making both to preserve excess fodder in flush season and to improve the feeding quality of crop residues. Since its inception, silage making technique was transformed from pit / bunk method to bag silage appropriate for smallholder dairy farmers for easier adoption in 2010 and also State Department of Animal Husbandry, Tamil Nadu was distributed 40,000 silage bags of 250 kg capacity to dairy farmers in the financial year 2016-17 (*GOTN, 2016*). But even after refinement of silage making technology and its availability, the uptake among farming community at farm gate is limited. Thus, technology generators need to focus on improvement of attributes of innovation (*Thirunavukkarasu and Narmatha, 2016*).

In recent past, silage making, away from farm gate of farmers and distribution of the same through distributors / retailers as entrepreneurial business models are gaining momentum. The silage packaging design (50 to 80 kg packs) has also improved the access of silage for smallholder farmers. These entrepreneurs use maize green fodder for silage making and this may result in increased cost of maize grains. This will ultimately increase the milk production cost (through silage and concentrate feeding) at farm gate. To keep the milk production cost under control, the potential of silage making using crop residues in silage business models needs to be explored. *Yadav, 2019* and *Yadav and Naagar, 2021* also reported that income had significant relationship with adoption of improved dairy practices.

CONCLUSION

To sum up, this study found that extension approaches have appreciable role until the creation of awareness and knowledge (To understand and to have idea). After the knowledge function, the attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) plays a major role in determining technological adoption decision function (Adoption of bag silage). This scenario demands bottom-up approach through engaging primary stakeholders (dairy farmers) and potential partners (Research institutions, Extension agents and Silage making companies etc.) for development of better adoptable silage-based products for small holder dairy farmers.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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