Trash Management Practices in Sugarcane Cultivation : A Socio-economic Analysis

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Paper Received on August 19, 2020, Accepted on September 21, 2020 and Published Online on October 01, 2020

ABSTRACT

Sugarcane growers need to pay attention to nutrient management as few crops put such heavy demand on soil resources, as sugarcane. Though integrated nutrient management has been considered a broad based remedy against soil fertility decline, the management practices advocated by scientists, however, have been lot more ignored by the farmers when compared to control of insect pests and diseases. Hence, this study was purposively carried out in Salem cooperative sugar mill, Tamil Nadu as they have been advocating trash management practices and the mill had also been supplying micronutrients, compost and bio-fertilizers to the cane growers. The operational area of the mill comprises eight divisions from which 60 cane growers were selected at random from four villages in four selected Sections of two Divisions for conducting the study. The yield data were recorded from the individual farms and the sociological appraisal was done through personal interview. It was found that all the respondents adopted trash management practices in various forms like trash mulching, alternate furrow trash mulching, trash composting, trash incorporation using rotovator, trash decomposition using urea and cow dung mixture and trash burning. Yield analysis indicated that the farmers realized an increased yield of four to ten tonnes per acre depending on the practice adopted. Every farmer had some reason or other for adopting trash management practices viz., conservation of soil moisture, increased cane yield, improved soil aeration, smothering of weeds, overcoming drought situation to a greater extent and restoration of soil fertility. However, there are some restrictions in farmers adopting trash management practices and it includes high cost of labour, unavailability of labour when needed, lack of awareness about new technology, non-availability of microbial culture and lack of conviction about new technology. Nevertheless, it was seen that farmers had perceived trash management practice as a worthy practice to realize increased productivity with restoration of soil health and reduced toll on fertilizers.

Key words: *Farmers perception; Sugarcane; Trash management; Advantages; Economics;*

Nutrient management is one of the major issues of concern for the farmers throughout the world. Sugarcane growers in particular, need to pay attention to this issue as few crops put such heavy demand on soil resources, as sugarcane (*Hartemink and Wood, 2000*). The chemical, physical and biological status of soils is depleting undoubtedly due to continuous cultivation of land resulting in a more intensive and aggressive cane production system being adopted by the sugar industry (*Garside et al., 1997a*). Comparisons between old land (land under continuous sugarcane for >20 years) and new land (land previously never cultivated) demonstrate significant differences in many soil properties like bulk density, cation exchange capacity (CEC), pH, C, microbial biomass C and populations of soil organisms associated (*Yadav et al., 1994, Bramley et al., 1996; Garside et al., 1997b; Magarey et al., 1997* and *Skjemstad et al., 1999*).

A combination of factors has been responsible for physically, chemically and biologically degradation of soil and also including growth of the crop as a result of continuous monoculture, aggressive tillage prior to crop establishment, soil compaction caused by heavy machinery used to harvest and transport the cane and

the extensive use of inorganic fertilizers, insecticides and herbicides. Yield decline and the decline in soil health are indisputably linked (*Garside et al., 1997a* and *Pankhurst et al., 2003*). In order to overcome yield decline, farming practices which foster gradual improvements in soil health need to be either retained or implemented by the sugar industry. Such practices include the retention of crop residues, introduction of rotation breaks, a reduction in tillage and implementation of controlled traffic measures to reduce the amount of soil compacted during harvesting (*Garside et al., 2001; Bell et al., 2003* and *Pankhurst et al., 2003*).

Integrated nutrient management approach improves and sustains soil fertility and provides a sound basis for crop production systems to meet the changing needs through optimization of the benefits from all possible sources of plant nutrients in an integrated manner (*FAO, 2001*).

There are scientific studies conducted in research stations which state that adoption of INM practices leads to higher yield and net returns and reduced cost of cultivation. Though nutrient management is an issue of concern for cane growers as the crop puts a heavy demand on soil resources, adoption of trash management practices is still a reservation and the present study attempts to gain insights into this fast spreading technology. The primary objectives of the study are to study the profile of farmers adopting trash management practices, level of adoption of trash management practices, to study the advantages of trash management practices, to analyze the constraints in adoption, to work out quick economics involved and to get suggestions to increase the adoption of trash management practices.

METHODOLOGY

The study was conducted by using descriptive type of research design applying ex-post facto approach and the respondents were selected among cane growers adopting trash management practices. Salem Cooperative Sugar Mills Ltd. is a leading public sector sugar mill in Tamil Nadu state in South India and is a pioneer in introducing recent scientific technologies in cane cultivation. The study was purposively carried out in Salem Cooperative Sugar Mill as they have been advocating nutrient management practices to the cane growers. The study area, Salem Co-operative Sugar Mills Ltd is located at Pettappalayam in Namakkal Taluk of Namakkal District. The average cane yield recorded in the reserved area of the sugar mill hovers around 102 t/ha. The operational area of the mill comprises eight divisions from which two divisions *viz.*, Namakkal and Rasipuram were chosen. Sixty cane growers were selected from the Sections of Rasipuram (15), Namagripettai (15), Namakkal (15) and Erumappatty (15) at random for conducting the study. The yield data was recorded by purposive interview schedule from the individual farms and the sociological appraisal was done through personal interview. Their responses were tabulated and the data were analyzed using mean and percentage analysis as the statistical tools to analyze the collected data.

RESULTS AND DISCUSSION

The present study focused on the demographic profile of farmers adopting trash management practices, adoption of trash management practices, advantages of adoption, constraints faced by farmers, the economics involved and suggestions for increasing adoption.

Demographic profile of sugarcane growers adopting trash management practices : Demographic profile of the participants of the study indicated that they were mostly of old age group (>50 years: 62.00%) to middle age (35-50 years: 36.700%); Majority of them were educated up to secondary and graduate level (63.4%) and 8.3 per cent of illiterate growers also adopted trash management practices; As high as 96.60 per cent of the respondents were doing agriculture as their main occupation and a meager 3.40 per cent had agriculture as their secondary occupation. As majority of the respondents were full time engaged in agricultural activities, they had high economic motivation and managed their farm in a better way. Over one-third (38.4%) of them had a farming experience of more than 25 years and 33.4 per cent were in the category of 6-10 years of experience in sugarcane cultivation. The cane growers with more farming experience by virtue of their high exposure to the latest technologies could realize the importance of scientific technologies to improve the productivity of their farms. Majority of the respondents (46.7%) were possessing more than two hectares of farm land and hardly 13.4 per cent of them owned less than one hectare of land. Majority of the respondents (83.4%) cultivated sugarcane in an area of less than one hectare and one to two hectares. The cane growers

in this area follow mainly early season planting i.e. planting from October and it extends to April month. Crop rotation was followed by all the respondents with pulses, paddy, maize, turmeric, groundnut, cotton and Sorghum.

Over one-fourth (28.4%) of the farmers were self-sufficient of possessing implements and were having all the implements required for their farming activities and 20 per cent of farmers partially depended on hiring implements and partially having their own. More than half of the respondents (51.6%) did not possess any farm implements for their cultivation work and they fully depend on hiring (tractor, tiller, cultivator, disc plough and rotovator). The size of land holdings does not permit them to possess all the required implements. As high as 98.73 per cent of the respondents owned livestock such as cows, goats, buffaloes, draught animals and backyard poultry for additional source of income, apart from their own use and none of the growers own livestock for commercial purpose.

Mass media channels used by the respondents were radio, television and newspaper; all of them owned radio/ television and 83.40 per cent had the habit of regularly watching agricultural programs. Regarding newspapers, it was observed that 41.70 per cent were regular subscribers of newspapers; 91.70 per cent were found to be regular or occasional readers from the source of own and tea stall newspaper. Majority (66.70%) of them had medium level of social participation as they were more into agriculture and they found little time for active social participation. Less than one fifth of the respondents (15.0%) were able to manage high level of social participation. The source of information about various trash management practices as expressed by 93.40 per cent of the respondents was sugar factory officials followed by input dealers, friends and neighbours (6.60%).

Year of adoption of trash management practices : Due to continuous mono cropping, soil fertility decline is noticed in almost all the sugarcane growing areas. Farmers rely too much on chemical fertilizers due to non-availability of adequate amount of organic manure due to dwindling cattle population. Realizing this, the factory management has taken steps to popularize the various options for adding sugarcane wastes back into the same land since 2008. One among this is recycling trash, the dried sugarcane leaves through various management options. As early as 2008 itself, 10 per cent of the respondents have started adopting trash management practices and the percentage has been increasing over the years with 31.6 per cent of adoption during 2012 and it has stabilized over the years.

Trash management practices followed by farmers : Depending on the level of exposure to various trash management practices and the necessity realized to restore soil fertility, farmers have adopted the various trash management measures as listed in Table 1.

Table 1. Trash management practices followed by farmers (N=60)

Trash Management practices	No.	%
Trash mulching	60	100.0
Alternate furrow trash mulching	48	80.00
Trash composting	12	20.00
Trash incorporation using rotovator	31	51.60
Trash decomposition using urea and cowdung mixture	7	11.70
Trash burning	14	23.30

Trash mulching: Trash mulching is a common practice followed invariably by all the sample farmers. Farmers detrash the crop at least once during the fifth month and few farmers detrash again during seventh month. The green leaves and semidried leaves are used as cattle fodder and the completely dried trash is placed on the furrows and trampled to compost. However, composting by this way takes a long time but labour is less compared to composting.

Alternate furrow trash mulching: This is practiced under furrow irrigation by 80 per cent of the sample farmers. Trash is removed from the crop after five months and is placed in alternate furrows; the other furrow with no trash placed is used for irrigation.

Trash composting : One-fifth of the respondents opted for trash composting; this was mainly noticed in farms where family labour was involved in sugarcane cultivation. Generally, up to 4 tonnes of trash is available from an acre of sugarcane crop (*Gopalasundaram, 2008*). The trash is collected from the field and brought out and put either in pits of 5-7 feet diameter or heaped in leveled surface. In either case, trash is placed in layers of up to two feet over which an inoculum of cowdung and bio-inoculum (*Trichoderma* or *Pleurotus*) is spread and the top layer is covered with soil and sealed. Pit is always preferred by the farmers as composting is done

faster. Water is sprinkled now and then to maintain sufficient moisture to hasten the decomposition process. Bioinoculum is procured from the agri-depots of the department of agriculture at the rate of 2 kg inoculum for the trash of one acre. The heap is raked up after three months twice at 15 days interval, thoroughly stirred and again heaped; in most of the times, the compost is ready by the end of 90 days or left for composting for another one month. This trash compost manure is used for sugarcane crop itself or stored for use in other crops. The practicing farmers have realized that this is a viable technology but for the availability of bio-inoculum and timely labour.

Trash incorporation using rotovator: Over half of the respondents (51.60%) adopted trash shredding using rotovator after the harvest of the previous crop. Using rotovator, trash is cut into small pieces and the cut trash is left as such in the field and allowed to act as mulch.

Trash decomposition with urea and cowdung mixture: Hardly 12 per cent of the respondents adopted trash composting using a mixture of cowdung and urea. After the trash is spread on the field, a slurry of cowdung and urea is sprinkled over trash to hasten the process of decomposition.

Trash burning: Nearly one-fourth of the respondents (23.30%) go in for trash burning, though not a common practice in this area. Trash burning is generally done when the plant crop or the previous crop is infested by sucking pests like woolly aphid, pyrilla, mealy bugs or rarely scales. For very few farmers it is a regular practice to burn the trash in situ in the field after harvest as it reduces labour cost. They also feel that trash burning induce better sprouting of the subsequent crop.

The recent practices like, the use of trash shredder and trash decomposition using microbial consortium were not used by the respondents due to lack of awareness about these practices.

Level of adoption of trash management practices : The level of adoption of the various trash management practices along with the cost involved is given in Table 2.

Table 2 indicates that the trash management practice of trash composting gives the maximum advantage in terms of increased cane yield of 8-10 tons per acre, with an additional cost of Rs.5000 to Rs.7300. This was followed by trash decomposition using cowdung slurry and urea with an increased cane yield of 6-7 tonnes per acre investing Rs 1500-2200 per acre. The amount incurred towards trash management was very meager compared to the cost of cultivation.

Quick Economics

Cost of cultivation	237682 (Plant crop)	172707 (Ratoon)
Average yield (tons/ha)	113 (Plant crop)	100 (Ratoon)
Total income	286875	255000
Net Income	49193	82293

The average cost of cultivation for the 60 respondents was Rs.95073 per acre or Rs.237682 per hectare in plant crop and Rs.69083 per acre or Rs.172707 per hectare in ratoon crop. With a cane yield of 113 t/ha in plant crop and 100 t/ha in ratoon crop, the net income realized by the sample farmers amount to Rs.49193 and Rs. 82293 in plant and ratoon crop respectively.

Relationship between socio-economic profile of respondents and adoption of trash management practices : Correlation analysis was done to find out the relationship between the socio-economic characteristics of the respondent farmers with their level of adoption of trash management practices was worked out using correlation analysis as given in Table 3.

Out of 12 independent variables selected for the study, except crop rotation followed by the respondents, all the other eleven variables had positive correlation with the level of adoption of sugarcane technologies. Crop rotation followed generally depends on the water availability and marketability of the produce. The respondents had a wide choice of crops, however, a negative relation was seen.

Table 2. Trash management practices: area adopted, yield increase and cost of labour

Trash management practices	Area adopted (acres)	Yield increase (tons/acre)	Labour cost/ acre
Trash mulching	94.70	6-7	4500-5500
Alternate furrow trash mulching	88.40	5-7	4000-5000
Trash composting	16.00	8-10	5000-7300
Trash incorporation using rotovator	21.50	4-6	2500-3000
Trash decomposition using urea and cowdung slurry	44.40	6-7	1500-2000

Table 3. Relationship between profile of sugarcane farmers with level of adoption of technologies (N=60)

Independent variable	Correlation coefficient ('r' value)
Age	0.119^{NS}
Educational status	0.211^{NS}
Occupational status	0.459*
Size of land holding	0.418*
Experience in farming	0.135^{NS}
Experience in sugarcane cultivation	0.369*
Economic motivation	0.256^{NS}
Crop rotation followed	-0.017^{NS}
Farm implement possession	0.431*
Income level	0.079^{NS}
Mass media exposure	0.542*
Social participation	0.415*

*Significant at 0.01 percent level; ^{NS} Non-Significant

Independent variables *viz.*, occupational status, size of land holding, experience in sugarcane cultivation, farm implement possession, mass media exposure and social participation showed positive significant relation with adoption of trash management practices. Farmers with more than 10 years of experience in sugarcane farming were widely prevalent in the sample and they tried to improve cane productivity by following latest technologies in trash management. Few respondents had owned almost all the farm implements needed for sugarcane cultivation and others had hired on lease from neighbours. Messages gained through radio, television channels, social media and farm magazines help to create awareness on new technologies as reflected in the analysis. Most of the respondents in this study were members, if not office bearers in at least one social organization in the village leading to exchange of information and thereby increased adoption of new technologies.

Advantages in adoption of trash management practices : Selection of an appropriate sugarcane variety suited to the location is the first step towards reaping a good crop. Added to this, adoption of recent technologies recommended by research institutes also help to boost the productivity of sugarcane crop. The farmers in the study area were found to be medium to high in their level of adoption of various trash management practices. The advantages as reported by the respondents are given in Table 4.

The advantages of trash management practices as perceived by the farmers in their order of importance include conservation of soil moisture, increased cane yield, improves soil aeration, smothering of weeds, overcome drought situation to a greater extent, restoration of soil fertility, improvement in humus content of the soil, better soil structure, reduces the soil ec, improvement in soil pH, helps to maintain microclimate in the fields and enhances soil micro flora and fauna. Trash management by any means make the left out of the plant produce in the same field from where it is produced. This in turn helps to restore soil fertility. More than the immediate benefits, long term effect on the soil is pronounced in the soil and this practice also helps to sustain the microbial flora and fauna in the soil which are beneficial.

Table 4. Perception of advantages of adopting trash management practices (N=60)

Advantage	No.	%
Conservation of soil moisture	60	100
Overcome drought situation to a greater extent	55	91.60
Restoration of soil fertility	53	88.30
Improvement in humus content of the soil	49	81.60
Increased cane yield	59	98.30
Smothering of weeds	56	93.30
Improvement in soil pH	34	56.60
Reduces the soil EC	39	65.00
Improves soil aeration	57	95.00
Better soil structure	48	80.00
Helps to maintain microclimate in the fields	29	48.30
Enhances soil micro flora and fauna	26	43.30

A typical trash blanket from a 100t/ha crop will contain (approximately) 64 kg N (*Mitchell and Larsen, 2000*). A substantial proportion of these nutrients are lost if the trash is burnt. Incorporation of trash into the top 10 cm of soil has been shown to increase both labile C and microbial biomass (*Stirling et al., 2005*).

Sugarcane varieties grown in India are subjected to a large array of pests and diseases. However, there have been few reports of the impact of trash mulching on these pests and diseases. Damage to tillers by early shoot borer was decreased with GCTB (*Chapman et al., 2001*).Populations of the greyback canegrub *(Dermolepida albohirtum* (Waterhouse) were reduced in ratoon crops under GCTB compared to burnt trash in a replicated trial at Tully (*Robertson and Walker, 1996*).

Noble et al., (2003) found a significant decrease

in soil pH in the 0-5 cm soil layer after six years of cropping under a trash retained system compared to a trash burnt system. Accompanying the decrease in pH, was an overall enhancement of the cation exchange capacity (CEC) of the soil associated with an increase in organic carbon levels in the 0-5 cm soil layer.

The application of '*insitu'* green mulch *(Sesbania aculeate)* and sugarcane trash mulch increased the availability of N to 11.9 per cent as compared to those un mulched plots (*Dahiya, 2001)*.

The management practices leading to an increase in earthworm numbers in sugarcane soils include a pasture fallow (*Pankhurst et al., 1999*) and strategic tillage practices which involve minimum soil disturbance during removal and re-planting of the sugarcane crop (*Braunack and Magarey, 2002*). The increase in earthworms in this cropping system was associated with increased sugarcane yields and improved soil water infiltration compared to a cultivated treatment. *Bell et al. (1999)* found that trash management and soil moisture status during ratoon establishment significantly affected shoot numbers and crop growth in early harvested crops.

From the above review, it is clear that use of sugarcane trash as mulch or shredding is very effective. The beneficial effect of sugarcane trash mulch or shredding on soil pH, EC, organic carbon, available nutrients and microbes has been well elucidated and its effect on sugarcane growth, yield, quality and plant protection measures have been improved.

Constraints in adoption of trash management practices : Though many new technologies are made available to the sugarcane growers, farmers face specific constraints in adopting the same. To introduce any new technology into a social system, the technology must perform well than the already existing technology in the system. The system members must observe its performance directly in their own situation and evaluate them in terms of their own reference. If the members of the system are convinced with the performance of new technology, and also if the calculated negative factor percentage (constraints) is less than the positive factor percentage (advantages), then the technology can be easily diffused among the members of a social system.

The constraints faced by the respondents in adopting trash management practices are enumerated in Table 5.

Table 5. Constraints in adoption oftrash management practices (N=60)

Constraints	No.	%	Rank
High cost of labour	59	98.30	I
Non-availability of labour	55	91.70	II
Lack of awareness about new tech.	45	75.00	III
Non-availability of microbial culture	40	66.70	IV
Lack of conviction about new tech.	35	58.30	V
Poor extension support	25	41.70	VI

Among the constraints expressed by the respondents, high cost of labour was of major concern as expressed by 98.30 per cent of the respondents.

Labour has become a scarce commodity especially during peak seasons and this is perceived as a major hindrance for adoption by 91.70 per cent of the respondents. The other constraints in their order of importance were lack of awareness about new technology (75%), non-availability of microbial culture in time (66.70%), and lack of conviction about new technology (58.30%) and poor extension support (41.70%).

Suggestions to increase the adoption of trash management practices : Due to the advancement in scientific approach towards agriculture, many new technologies are available for adoption. It is not the dearth of technology that haunts Indian agriculture today, but the non availability of adequate knowledge about the technologies to the intended clients. Adequate technical support is needed to increase the rate of adoption. The suggestions as indicated by cane growers at varied levels are enumerated below.

At farmers level :

- Creation of awareness about the importance of trash management and the availability of trash management practices.
- Motivating the farmers to adopt trash management.
- Making the inputs like microbial inoculum available to farmers.
- Make farmers realize the usefulness of trash management.
- Supply of adequate literature to farmers on trash management practices.
- Give need based on-farm training to farmers.

At factory level :

- Conducting frequent / periodical village meeting to popularize trash management practices.
- Providing incentives by sugar mills to farmers adopting trash management practices to motivate them.

- Cane harvesting priority should be given for those adopting trash management practices.
- To supply implements for easy detrashing.
- Having model farms depicting trash management practices and its effects.
- Short video films on success stories in the village.

At government level :

- Arrangements for training and demonstration to cane growers.
- Total subsidy for trash management.
- Providing trash incorporation implements / trash management implements on subsidy basis.

At research level :

- Identifying microbial culture to easily decompose trash.
- Releasing of self detaching sugarcane varieties.
- Invention of small scale machineries for trash management.
- Quick trash decomposing techniques.

CONCLUSION

The importance of retaining cane trash from the soil health perspective is that it is a resource that assists in the maintenance of soil biological functioning (*Thomas and Varughese, 2008*). Without these inputs, the capacity of the soil biota to maintain its functioning will decline resulting in multiple problems associated with such things as yield decline and increased dependence of the cropping system on chemical inputs and their potential off-site impact. Trash management was seen as a major component in organic recycling in ancient times which slowly got replaced by chemical fertilizers. With increased nutrient demands of the subsistence agriculture, integrated nutrient management including trash incorporation is advocated as a broad based remedy against soil fertility decline by scientists; however, it has been lot more ignored by the farmers when compared to biotic stress management. In an extension perspective, such differences in perception between the users of the soil and the experts are generally common. Nevertheless, in the present study, it was seen that adoption of trash management practices resulted in increased productivity and thereby additional income to the practicing farmers.

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