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Detrashing Sugarcane Stalks: The 1st Critical Step to the Shift to Organic Farming in Sugarcane Production

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Abstract Cane detrashing minimizes the bulky trash to be managed at harvest time (about 12-20 t/ha);facilitates cutting stalks close to the ground; eliminates the need for stubble shaving ;facilitates piling the trash every other rows that improves ratoon cane establishment; and ultimately increases sugar yield . Cane detrashing is the 1st critical step to no burning and trash farming scheme and ultimately organic sugarcane production. Planters who had practiced detrashing-cum- trash farming had adjusted their cultivation equipment to do interrow cultivation .Detrashing-cum-trashing farming is cost savings, improves soil properties, increase yield especially in the ratoon and extend the ratoon cycle, dcrease the over all enrgy input, and carbon emission in sugarcane production. Detrashing is an added cost but the partial net return is positive for the planters while it provides jobs during non-milling months or non-harvesting months.It must be promoted to as many planters as possible. Government extension services must be planned to upscale its adoption. At least 420,000 ha are planted to sugarcane in the Philippines.

Keywords: Detrashing, sugarcane, organic farming, trash farming, ratoon canes, stubble shaving

Introduction

Burning sugarcane trashes is the common practice in sugarcane production. Sugarcane growers burn sugarcane fields in 2 stages, namely: the pre-harvest and post-harvest burn.Why burn ? On the average, the sugarcane plant produces 25-40 leaves, thus, it is trashy. Sugarcane "trash" include the tops, green and dry leaves. They constitute up to 25% of the entire sugar cane stalk . Some fields are weed-infested. If the field is too weedy, it is associated with the presence of snakes. The fear of snake bite plus the weeds obstructing the easy-cutting of stalks are all pointing out to the decision of burning the

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canes to facilitate harvesting. During peak harvest, January to March of any given year, the sugarcane growers tend to hurry up milling their canes. Burning is resorted to- the *pre-harvest burn*.

Without pre-harvest burning, abundant trashes remain after harvest . The trashes obstruct tillage in preparing the land for new cane establishment and in ratoon-crop establishment . Piling the trashes between cane rows to provide space for cultivation and fertilizer application is laborious. Coinciding this operation is harvesting where the priority is harvesting . To facilitate farm operation, burning is the easy option. The huge pile of trashes are difficult to manage in establishing the next crop, be it ratoon or new plant cane . Their quick and easy solution is to burn their canes- the *post harvest burning*.

The estimated amount of trash burned for the 420,000 ha of sugarcane harvested for crop year 2013-2014 is about 1.94 Mt trash (0.64 x 7.12 t/ha x 420,000 ha).

Burning canes, before or after harvesting, has many agricultural, environmental and health negative impacts .Burning canes liberate considerable amount of CO_2 and other GHGs .The estimated direct CO_2 emission from cane burning was 10,410 kg/ha. An additional 1,791 kg CO2/ha was estimated from the other gases (CH4 = 467 kg CO_2, CO = 1,241 kg CO_2, and N_2O=830 kg CO_2). This summed up to 12,204 kg CO_2/ha which translate to about 37% the total greenhouse gas emission in cane production in the farm (Mendoza, 2014).

Fig.2. Post- harvest burning of sugarcane trash .To quickly burn, a farm worker lights on the trashes from one end to the other end of the field. Photo taken at Negros Occidental Philippines, Feb.20,2015

On the agricultural side, there are so many nutrients lost through the biomass in sugarcane production. Sugar (sucrose) is only 10% of total tonnage yield. After evaporating moisture (50%), 10-15% of the trash + tops represent 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). Per hectare basis, the peso value of nutrients (N, P, K) of the 7.2 t/ha average trash produced per ha is PhP 5251/ha (US$119.36/ha). Converted into compost , the peso value of compost from sugarcane trash is about PhP6.65 billion (US$ 151.2 million) for the 420,000 ha harvested canes for CY 2013-2014 (Mendoza *et al*., 2015).

On the health side, sugarcane workers have been observed to have significantly high rates of mortality due to illnesses attributed to burning canes. A study in the US suggests that people engaged in sugarcane farm-related occupations have significantly higher rates of lung cancer (Rothschild and Mulvey, 1983). Sugarcane workers have an increased risk of lung cancer and this may be related to the practice of burning foliage at the time of cane cutting. Burning of the sugar fields releases fly soot to the atmosphere which contains polycyclic aromatic hydrocarbons that have mutagenic and carcinogenic properties (Zamperlini *et al.,* 1997; Amre *et al.,* 1999; Cancanado *et al.,* 2006) also found an increased risk of lung cancer for workers employed in sugarcane farm in India. Work involving burning after harvesting and exposure to fibers of biogenic amorphous silica during fieldwork may account for the increased risks of lung cancer and possibly mesothelioma among sugarcane farmers (Poolchund, 1991).

Detrashing is always perceived as an added cost. Quantifying the monetary benefits of detrashing-cum-trash farming is not yet done. The merits of detrashing-cum-trash farming should be established so we can massively promote the practice in the 17 provinces (420,000 hectares) growing sugarcane in the Philippines.Hence, this study.

Methodology

In quantifying the over all benefits not only for the farmer, the soil, the environment of detrashing-cum-trash farming, we did key informant interviews for the primary data. There a lot of reviews and published data. We gathered and synthesize them. For the economic benefits, we simply adopted partial budgeting tool, that is quantifying the partial returns and partial costs to get the partial net benefits.

Discussion of Findings

There are many benefits that accrue with pre-harvest cane detrashing and they are listed as follows:

1. It minimizes the bulky trash to be managed at harvest time (about 12-20 t/ha). With detrashing, fewer trashes (60%) remain – after harvest. It is easier to pile the trashes in-between rows (Fig. 3). This could pave the way to a complete stop of burning the trashes;

Figure 3. Trashes and tops are placed in alternate rows .The trash-free row serves as the row for cultivation to apply fertilizer. The pictures above are 1st ratoon in a farm in Negros Occidental, Philippines (Photo taken Feb.28, 2015).

2) The detrashed leaves activates the microbes to start decomposition leading to enhanced decomposition of the remaining trash at harvest time if moisture is available. This reduced the need to apply chemical fertilizer (Mendoza 2015);

3) It improves air (CO2) circulation leading to sweeter canes at harvest (more sugar per ton cane). Detrashing improves cane stand and sugarcane stalks are sweeter (clean canes delivered to the mill are not exacted trash penalty (Dosayla 1994). There was improved sugar recovery and mill efficiency from cleaner and less trashycanes. Detrashed canes had 21.7% higher recoverable sugar per ton than trashy no-detrashed canes (Dosayla 1994). Thus, overall sugar recovery improves and sugar yield per ha increased. At about 5-10 kg sugar per tonne cane, this translated to about PhP15,000 – PhP 30,000 per ha (Table1).

4) Detrashing facilitate cutting stalks close to the ground, the base of the stalks is the sweetest part. The 2 to 3 inches of stalks left in the field were weighed. They weighed about 4 to 6 tonnes canes. At about 10% sugar recovery, this translate to about 400-600 kg sugar or about P12,000 – P18,000 worth of sugar. Cutting stalks close to the ground eliminates the need for stubble shaving worth P1,500 per ha.

5) Detrashing that paved the way to piling after trash every other rows had improved ratoon cane establishment. Trials are underway to prolong the ratoon up to 5. This is a considerable improvement over the plant and ratoon once, then plant again.

6) Dethrashing recycles nutrients absorbed, improves soil tilth, water infiltration and water retention and ultimately increases sugar yield (Mendoza et al 2003).

Moreover, the conventional practice of burning the trash-then-stubble shaving in the conventional ratoon cane establishment has a hidden cost. Burned tillers that emerge 2 or 3 days after cutting the stalks are the vigorous tillers. To flush tillers out, additional 2 to 3 bags of urea are necessary (PhP 2,200 – P3,300/ha at P1,100/bag of urea, 1US$ = P44). Table 1 shows the summary estimated partial return from detrashing cum trash farming in sugarcane .The partial net return ranged from PhP42,623 to PhP50,443 (USD907- 1073)
(1USD= PhP 47).Even if only 50% would be realized, the added return is enoprmous at PhP 21-25,000 (USD 450-535 per ha)

Table1 . Estimated partial return from ***detrashing*** cum trash farming in sugarcane.

Added Return	**Low**	**High**	**Per ha (PhP)**	
1. Increased sugar recovery (5-10 kg/ton cane)	400	800	14800	29600
> as the canes are sweater(80TC/ha)				
2. Added sugar as cane stalks are cut close to the ground(kg sugar/ha)	400	600	14800	22200
Total (1+2)	800	1400	24000	42000
@ 65 % planter share			16800	29400
2016 composite price of sugar =PhP1850=PhP37/kg				
3. Stubble shaving to establish ratoon (savings as it is not done)			1500	1,500

4. Add saving on crop establishment due to more ratoon (2 ratoons)	11,250		22500	22,500
Total (1+2+3+4)			40800	53400
5. Savings on NPK fertilizer (Table2)			8863	8863
Total (1+2+3+4+5)			49663	62263
Added Costs				
1. Detrashing	1,500	3,000	1500	3000
2. Incentive pay for cutting canes close to the ground			2,500	3,500
3. Cane harvest & hauling due to added TC in NO.2	8 TC/ha	14TC/ha	3,040	5320
Total added costs			7,040	11820
Partial Net return		PhP	42,623	50443
1USD= PhP 47		USD	907	1073

Notes:

1.Increase sugar recovery (Dosayla data) @ 21.7% increase or 21kg/TC; we only used the moderate increase of 5-10% = 5-10 kg sugar/TC ;2.the added sugar used due to cutting canes close to the ground is based from the 4-6 TC/ha and at 10% recovery @70% share of planter;3.PhP45,000 cropestablishment costs. Conventional is 1 plant crop 1 ratoon, with detrashing cum trash farming , 3 ratoons = 4 crops/crop establishment(45/2=22.5 less 45/4= 11.25 =13.5);4.Added costs due to cane harvest and hauling to the mill = PhP380/TC.

The Philippines imports about 2.0 million tons of fertilizer (average for the last decade, Briones 2014) worth P40 billion pesos at PhP 20,000 per ton (910 million US dollars). Recycling them is saving precious dollar reserves used for importing fertilizers. The estimated savings on fertilizer is shown in Table 2. The estimated savings for nitrogen, phosphorus and potassium fertilizers amount to PhP5,763,PhP600,and PhP2,500 ;respectively or about PhP8,863 per ha. The reduced emission due to Nitrogen was also estimated PhP 3,229/ha (129.8 kg x 12.912 kg CO2/kgN x 0.041$/kg CO2 x PhP47/$). If the value of reduced emission due to N would be added, the total savings would be PhP12,092/ha.

Table 2. Estimated savings on nutrients / fertilizer (per ha) due to detrashing cum trash farming or without burning(pre-and post harvest)

Items	Unit	PhP/ha
1. Nitrogen saved in the trash without burning (note no.1) ;kg/ha	44	1954
2. Coupled N fixation (note no.2) ;kg/ha	85.8	3810
	129.8	**5763**
3. Phosphorus saved (note n.3),kg/ha	8	600
4. Potassium saved (note no.4), kg/ha	50	2500
Total (PhP) ***(PhP8,863 /7.15 ton trash= PhP1,239/ton trash)***		**8,863**
USD ***(1 USD = 47PhP)***		188.58
5.Reduced Emission due to Nitrogen in 1 & 2	129.8	1675.718
Peso value at $.041 / kg CO2 ;PhP/ha at 1USD=PhP47		**3,229.6**

Notes :

1. *Ross et al., 2000 estimated that about 44 kg is lost due to burning the trash ;N=PhP 44.4/kg*
2. *Patriquin found out that there is coupled N - fixation during trash decomposition in the field at 10-15 Kg N per ton trash(12 kg ave.) trash is about 10 - 15% of TC= 10-15 tons trash per ha, we used the average 11 tons;65% of these trash are burnt=7.15t/ha*
3. *Some of the P are also lost as they are blown by the wind in the ash @ 20% (40Kg/Ha) = 8kg/ha; PhP75/kg P in DAP*
4. *Potassium @ 70-73% loses (Mitchell et al., 2000)=50kg/ha; PhP50/kg K*
5. *Emission /kg N: 12.912 Kg CO2e (Mendoza; 2016)*

Many farmers are not into detrashing their canes. Shredding of the remaining trash after harvest appeared effective (Fig. 4) as done by conscientisized sugarcane planters in Eastern Batangas, Philippines. They fully recognize the multiple benefits of NBC (no burning of canes).

Figure 4.Tractor implement shredding the trash into finer pieces allows the tillers in the ratoon to emerge and grow faster. (Photo taken in a ratoon canes at Batangas , Philippines , Feb.17, 2014)

The era of cheap fertilizer is over. Philippine government is no longer subsidizing fertilizer (Briones, 2014). Yet, farmers do not treasure the fertilizing value of their residues. The calculated fertilizer values of burned trash are in CY 2013-2014 was PhP 5.2 billion for the 420,000 ha cane harvested for CY 2013-2014 (Php 1,239/ ton trash x 7.15 tons trash per ha (Table 2).

It was found out that trash farming could be done more effectively if canes are detrashed. It provides many socio-economic benefits as well. Sugarcane planters doing detrashing found the practice beneficial as it providing off season labor to their workers as detrashing is done between July to September, the non-harvesting/crop establishment period for sugar production. The arrangement between the planter and the workers is that those who detrash the sugarcane (hence easier to harvest) will also be the one to harvest the canes. Cutting is easier and faster as the base of the stool is cleared already. Loading the cut cane stalks to the hauling truck is also facilitated since the stalks are not trashy. Other incentive attached to detrashing is if the stalks are cut close to the ground there is no longer need for stubble shaving. The cost of stubble is P1,500/ha (US$ 34 , 1US$=PhP 44). This is automatically given to the group of workers who performed detrashing . There must is incentive in cutting canes close to the ground.

The estimated /quantified socio-economic benefits of detrashing cum trash farming are shown in Table 3.The total employment generation (35 md x 420,000 ha = 14.7 million mandays valued at 3.675 billion pesos (USD 78.19 million). This is considerable money inflow to the workers who do not have

any work during non-harvesting months. Piling of trash could be done by women as cutting and loading is done by men. Trash farming provides jobs to rural women; it is gender sensitive.

Table 3. Quantifying the socio-economic benefits of Detrashing cum trash farming

ITEMS	
LABOR	
1. Additional labor due to detrashing and piling of trash(md/ha)	20
2. Guarding the canes (roving guard)(md/ha)	15
Total per ha- additional manday(md)	35
@PhP 250/md ; PhP/ha	8750
For the 420,000 ha sugarcane in the country (PhP billion)	**3.675**
@ 60% compliance (PHP250/md)	2.205
MONETARY VALUE (Billion PhP)	**8.82**
USD (million)	**187.66**

Trash farming generates on-farm employment so necessary in rural areas to arrest out migration to congested urban areas. There should be incentives or award to the farmers for not burning crop residues so they will be motivated to stop. It should be treated as payment for their added labor in recycling or composting crop residues. Recycling crop residues will not only benefit them but the world as a whole. Paying the farmers for the equivalent CO_2 sequestered benefits the farm, the community, society, and the environment. It is simply recognizing as well as cost sharing on the part of the farmers who grow sugar .The Philippine government (starting from the previous one) had been implementing Conditional Cash Transfer (CCT) for the poor. This program could be improved by having conditionality of helping farmers to stop sugarcane trash burning . Detrash sugarcane stalks.

The Philippines has an Organic Agriculture Act of 2010 (R.A. 10068). Organic farming starts from non-burning-cum-crop residue recycling. The National Organic Agriculture Board (NOAB) should consider formulating the detailed guidelines for promoting crop residue recycling. The principle that *the farm is a food and fertilizer factory at the same time* should be promoted.

As early as the 1950s, it was already recognized that trash mulching improves the yield of sugarcane (Pineda 1956) .Sugarcane trash serving as a soil amendment, increases both tonnage and sugar quality (Abrigo 1981). High sugar yields are desirable as they increase mill efficiency and returns to the farmer. Moreover, higher quality canes delivered to the mill reduce the cost per unit of sugar manufactured.

Not burning canes and utilizing the trashes in the field has many interrelated benefits to the soil, farmer, and the environment (Figure 5).

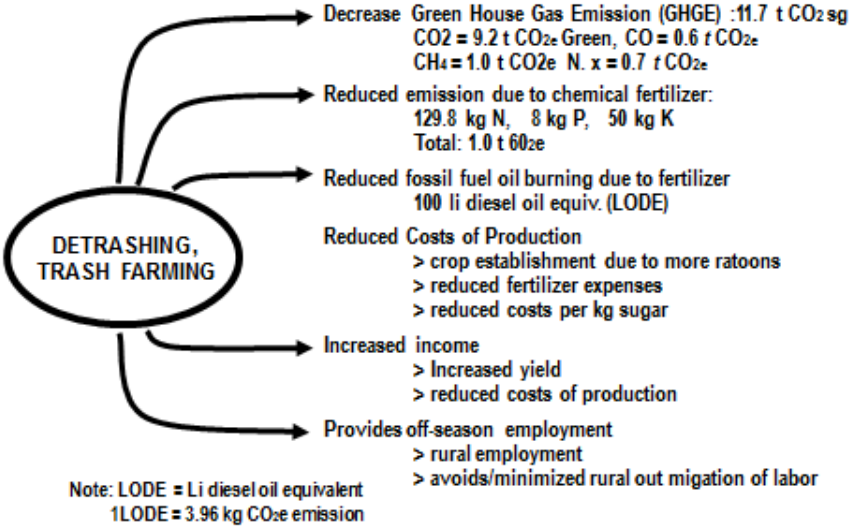

Fig. 5. Multiple benefits of detrashing cum trashfarming in sugarcane production (Mendoza 2016)

Foremost, utilizing the trashes as in mulch farming increase sugar content at 11.6% (Mui *et al*., 199) . Mulching was shown to significantly improve the sugar level of ratoon crops. Long-term fertility improvement of degraded soils through trash farming could lead to an overall increase in sugar levels and boost economic returns. Yields in the ratoon were 33% higher in the trashed field than the non-trashed fields. There was an increase in both tonnage and sugar quality .A 50% increase in sugar yields in trash-mulched canes compared with non-trashed farms in small farms was recorded by Delos Santos and Mendoza (2002). Also, trash farming extends the ratooning cycle. A sugarcane planter in Negros had recorded yield increases in their ratoon and they had learned how to adapt their cultivation equipment as shown in picture below.

A sugarcane planter in Cadiz, Negros Occidental had adjusted their cultivating equipment to suit No burning canes after harvest to re-establish their ratoon canes. Other planters are afraid to this due to accidental or intentional burning

The cost of fertilizer usage (material + application) accounts for about 21% of the total variable costs of production (average for plant and ratoon cane). Trash farming improves the economics of sugarcane production. Where trash farming was implemented, net returns increased by 43% in the first ratoon crop .The trash-farmed ratoon crop achieved the lowest cost. It was 31% below the cost of the conventional plant crop and 10.0% below the ratooned conventional crop. The trash farmed crop had 20% higher ratoon tonnage yield (78 t/ha) than conventional cane (65 t/ha).

The increased yield in the trash farmed cane also reduced the overall energy input of sugar produced. Fertilizer reduction was estimated to be 99 kg N/ha to 110 kg N/ha. The total fossil energy requirement for the fertilizer in the ratoon crop is thereby reduced to 9.1 GJ/ha (Mendoza *et al*., 2003).Trash farming reduces direct fossil fuel energy inputs.

Why trash farming or organic farming in sugarcane farms could not be easily done was analysed . We did a sondeo approach in interviewing the farmers (Hildebrand,1981).As revealed by practitioners, the adoption of trash farming is not simply the non-burning of cane. During seminars we are presenting the idea but they mention many reasons as cited above why they cannot do it . We then scanned who are the practitioners of trash farming. Many if not all of them are doing detrashing . They start detrashing the stalks when the cane had formed 5-7 internodes (5-7 leaves could be removed).

There are 2 groups of sugarcane planters where detrashing-cum-trashing farming (or no burning canes) is implemented at the farm level. The first group are the conscientisized and environment conscious planters (in fact some of these have started doing it). The second group are the beneficiaries of agrarian reform program of the government. About 120,0000 ha sugar lands are now be distributed to former workers of sugarlands. Trash farming is a cost saving option for these group of sugarcane growers. It extends the ratoon (crop establishment costs P25,000 – P35,000/ha). Also, it could reduce the application of fertilizer (P20,000 – P25,000/ha) and still provide modest yield of about 70 tonnes cane per ha (Delos Santos and Mendoza, 2002).

Conclusions

Detrashing-cum-trashing farming is cost savings, improves soil properties, increase yield especially in the ratoon and extend the ratoon cycle, dcrease the over all energy input, and carbon emission in sugarcane production.

Detrashing provides jobs during non-milling months or harvesting months. The net return is still positive for the planters while it gives work for the farm workers.

It must be promoted to as many planters as possible. Government extension services must be planned to upscale its adoption .

Acknowledgement

The author would like to thank the sugarcane planters we interviewed on the pros-and-cons of detrashing-cum-trash farming. To those who had trail blaized the practice, we salute them. May their numbers increase and soon become the majority not unlike now , they are the minority.

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