Costa Rica pineapple field residue valorisation

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Introduction

Costa Rica is the largest pineapple exporter in the world, with approximately 60,000 hectares (Figure 1) under cultivation, employing more than 30,000 people and generating exports of almost 1 billion dollars per year. In a typical 30 to 36 month cycle, 2 pineapples harvests are made, producing a total of 155,000 kg/ha of pineapples. In addition to the fruit, an estimated 220-250 ton fresh FM per/ha field residue (30 tons of DM/ha) are produced. Overall more than 500.000 tons DM residue are produced each year in Costa Rica. Currently these crop residues are incorporated into the soil. Incorporating up to 250 (FW) tons of biomass into the soil is costly, takes time and leads to loss of pesticides and nutrients into the environment. In the residue larvae of the blood-sucking stable fly (*Stomoxys calcitrans*) can develop, severely affecting cattle.

Objective

The objective of the study was to identify solutions for dealing with pineapple residues in Costa Rica

Current residue management

Current residue management (Figures 2, 3, 4) includes use of herbicides to desiccate, followed by burning of residue and soil incorporation and also includes insecticide application to prevent larvae development. If stable fly infestation levels are high the residues are sometimes landfilled. Removal of residue may solve the problems. Harvesting methods are being developed (Pari et al. 2018). Profitable applications of the residue have to be identified.

Figure 1. Typical pineapple plantation in Costa Rica

Figure 2. Paraquat to **desiccate** followed by burning and incorporation into the soil

Figure 3. Shredding, pesticides and soil incorporation

Figure 4. Landfill is an option if fly infestation is high

Requirements for pineapple residues applications:

- Local processing: 85% moisture content makes transport expensive
- Nutrient recycling: nutrients in crop residues have a potential fertilizer value
- Profitability: current cost for residue management is $US/ha 1500 to 2500 (inputs, wearing, fuel)
- Provide a total solution for the residues: No additional waste and solve fly problem

New application options in the field

- Field fermentation under plastic (like “Bokashi”)

New application options after removal

- Biogas for electricity and transport fuel: No market access now, only for own use allowed
- Biorefinery: research is mostly on pineapple tops and peel – less on plant/leaves. It is not a total solution - combination with biogas needed
- Paper/fibers: variant of biorefinery, no local interest?
- Thermal conversion: First drying needed – nutrients can be problem
- Composting: limited market outside organic farming – effect on fly?
- Animal feed: little information, residue may have low suitability

Table 1. Assessment of pineapple field residue disposal and added value options based on expert judgement

	Current methods				Removal and added value methods			
Assessment criteria	Herbicides / fire / shredding	shredding / incorporation	Green burying	Field fermentation	biogas for electricity	biogas for transport	thermal conversion	biorefinery + biogas
1. Control fly								
Effectiveness of control	1	1	2	2	2	2	2	2
Use of insecticides	-2	-1	2	2	2	2	2	2
Use of herbicides	-2	2	2	2	2	2	2	2
2 Disease control	1	-2	2	2	2	2	2	2
3. Soil effects								
nutrient recycling	-1	2	-2	2	2	2	-2	2
nutrient runoff/leaching	-1	-1	0	0	2	2	2	2
organic matter	-1	2	-2	2	2	2	-2	2
4. land use efficiency								
Cycle length	0	0	1	0	2	2	2	2
Biomass use	-2	-2	-2	0	2	2	2	2
5. Potential GHG saving								
Fossil fuel mitigation	-2	-1	-1	0	1	2	2	2
methane emission	0	0	-2	?	1	1	2	2
6. Costs and potential added value								
agro-chemical costs	-2	-1	2	2	2	2	2	2
fertilizer costs	-1	1	-2	2	0	0	-2	0
machinery costs	-1	-1	-1	-1	-1	-1	-1	-1
investment costs	2	2	2	1	-2	-2	-1	-2
Costs/benefits for farmer	-2	0	-2	1	1	1	0	1
7. Policy/legal interventions								
In line with regulations?	-1	-1	0	0	-2	-2	0	-2
In line with policy wishes?	-2	-2	-2	-2	2	2	1	2
Policy adaptation needed	2	2	2	2	-2	-2	0	-1
Added value for society	-2	-2	-2	-2	1	1	1	2
8. Employment effects	0	0	0	0	0	1	1	2
9. Research & Development								
State of development	2	2	2	-1	0	0	0	-1
Research investment need	2	2	2	0	0	-1	0	-2
Total score	-12	2	1	14	19	20	15	22

Conclusions

- In-field solutions to residues are limited
- Removal and applications of residues have multiple benefits
- Biogas production seems to be key in any solution
- Favourable regulations and market development (access) are required. Such as feed in tariffs for electricity and use of biogas as transport fuel

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