Environmental sustainability assessment of fruit cultivation and processing using fruit and cocoa residues for bioenergy and compost. Case study from Ghana - DTU Orbit (09/11/2017)

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Agro-industrial businesses often have easy access to agricultural and processing residues with whichthey may reduce costs and pollution by integrating their production with bioenergy production. In regionswith unreliable power supply, on-site electricity generation is a means to secure stable productionconditions. Furthermore, recycling of nutrients may help to reduce biomass suppliers' dependence on synthetic fertiliser. In this Environmental Sustainability Assessment (ESA) of fruit production in Ghanawe compare two technology options for the production of mixed, fresh, tropical fruit, including cultivation,transport and processing. The option 'Present practice' presents data from a case study where production is characterised by soil loss and synthetic fertiliser dependence in cultivation and grid supply of electricity in processing. The option 'Biogas' is hypothetical and characterised by biogas and electricity production using farming and processing residues and by recycling of nutrients and carbon to soil. Cocoa shells are used as a co-substrate in the biogas production. Estimating the environmental impact of cocoa shell residues exposes the multifunctionality issue, continuously debated in ESA, particularly concerning bioenergy production. We compare the use of allocation of cocoa production impacts and system expansion that includes cocoa production as possible methods to manage multifunctionality of inputs. Inassessments of residue-based production, we recommend using the latter method. Applying the system expansion method, we find that, in comparison with 'Present practice', the option 'Biogas' eliminates netsoil carbon loss and reduces synthetic fertiliser, diesel and external electricity requirements at the expense of a relatively small increase in human labour input. The ESA includes the following indicators and shows that the 'Biogas' option is superior to 'Present practice' with regard to Cumulative Energy Demand (-39%), Cumulative fossil Energy Demand (-34%), Food Energy Return On energy Investment (þ65%), Food Energy Return On fossil energy Investment (þ53) and Global Warming Potential (-29%) and similar to 'Present practice' in terms of the Emergy Assessment indicators Unit Emergy Value, Global Renewability Fraction, and Local Supply Fraction. Discarding the system expansion method, the same conclusion applies even if the emergy indicators are more ambiguous.

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