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A Systems Approach to Biodigester Evaluation: Analyzing Bioresources to Assess Farm Integration in the Arsi Zone, Ethiopia

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Abstract

Smallholder farms in the Arsi zone, Ethiopia, have an average size of 3.3 ha, are situated at an altitude of around 2200 m with annual rainfall between 800–1300 mm and temperatures between 10–25 °C. Agriculture in this region has a high potential, but is limited by water logging, surface runoff, high soil erosion and decreasing soil fertility. Traditionally, livestock manure on smallholder farms is primarily used as a fuel and the remainder as fertiliser on fields. Competition between these two applications can be eliminated by biodigesters, in which manure is transformed to biogas utilised for light and cooking, and bioslurry, a nutritious organic fertiliser. In this study we analyze, how far biodigesters as part of the farming system can cover farm own energy demand and increase nutrients and organic matter supply in the form of bioslurry/compost to the crops to increase farm income and the sustainment of soil and future crop productivity. Bioresource management of 47 farms have been analyzed, and mainly qualitative data collected to identify opportunities and constraints of biodigester use.

Results show that bioslurry partly contributes to cover fertiliser demand, as bioslurry production is limited by biodigester size, labour and manure due to relatively short stable periods. The quantity of biogas produced is also able to partly cover household energy demand. Manure is still - to some extent - used as a fuel, since the biogas stove does not support cooking the locally favoured “injera”.

Since the share of animal manure is limited for bioslurry production, and already available cooking facilities for injera is not integrated, recirculation of nutrients and organic matter stays insufficient. Recommendations include forage legumes and shrubs, and grasses into the farm system, which provide quality feed, increasing milk and cow dung production, and carbon and nitrogen stored in below-ground biomass. Improved bioslurry storage facilities and provision of a stove supporting the cooking of injera will increase biodigester efficiency and contribute to an overall increase of farm income.

Keywords: Arsi zone, Ethiopia, bioresources, household biodigester, integrated smallholder farm