[P036] Anaerobic digestion of microalgae via closed-loop nutrient recycling: A sustainable integrated system to produce bioenergy for farms

Theme: 2. Solutions through Integrated Farming Systems

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Integrated farming systems are an excellent way to develop sustainable agriculture by increasing production while reducing costs and environmental damage. The development of an integrated system of biomass production is taking place in our algae demonstration farm at Pinjarra Hills, Queensland, Australia. The scope of the project is to develop an economical and eco-friendly system of biomass production by nutrient recycling and biogas production through anaerobic digestion of microalgae. In order to reduce production costs due to fertilizer demand, an anaerobic digester is being implemented in the farm which enables closed-loop nutrient recycling. The anaerobic digestion process not only produces biogas but also allows the production of a natural fertiliser to provide nutrients for repeat algae cultivation. In this project we evaluated the digestibility and biogas production potential of microalgae as well as the nutrient recovery of the process. The results show that microalgae are a highly efficient substrate for anaerobic digestion since they produce a high yield of bio-methane (220 L methane/kg dry biomass) compared to other biomass feedstocks used for anaerobic digestion. Nitrogen recovery was highly efficient and nitrogen conversion to ammonium occurred. However, phosphorous recovery still requires optimisation, as some of it becomes immobilised. Current research is underway to recover the remaining immobilised nutrients (precipitates and organic solids) by applying pH changes and in-pond aerobic digestion.

[P037] Intra-cultivar potential of Desmanthus spp. as a greenhouse gas mitigation strategy for tropical livestock pastoral systems

Theme: 2. Solutions through Integrated Farming Systems

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Improved agricultural efficiency and reduction in the impacts of tropical livestock farming on habitat degradation require global approaches that enhance ruminant farming functionality in terms of feed use efficiency, emissions and food security. This study evaluated the in vitro

mitigation potential of the prostrate to erect, herbaceous Desmanthus spp. pasture legume adapted to semiarid clay soil land types in northern Australia. D. bicornutus, D. leptophyllus and D. virgatus were seasonally harvested from commercial plots by Agrimix Pty. Ltd. Samples of the legumes and the control Rhodes grass (Chloris gayana) using ruminal fluid from grazing Brahman (Bos indicus) steers were incubated in vitro (Ankom RF1 Technology) for 24, 48 and 72 h. Overall, the in vitro organic matter degradability (OMD) and methane production between Desmanthus species differed ($P < 0.001$). Compared to the control (0.656 ± 0.027 proportion of total OM) at 48 h of incubation, D. leptophyllus showed lower OMD (0.479 ± 0.016), while D. bicornutus (0.688 ± 0.016) and D. virgatus (0.619 ± 0.015) were different from each other, but similar to the control. Methane production (ml/g OM) was 15.7 ± 1.54, 3.7 ± 0.89, 12.0 ± 0.95 and 11.7 ± 0.95, respectively. It is suggested that the impact of these attributes may benefit household farmers in developing economies to expand productivity, improve livelihoods and meet the growing food consumption. Further analyses of the intra-cultivar characteristics of Desmanthus spp. will complement the design of sustainable and efficient interventions across tropical pastoral feeding systems, with a particular emphasis on large-scale grazing operations.

[P038] Achacha - a fresh start for an exotic tropical fruit

Theme: 2. Solutions through Integrated Farming Systems

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A decade ago, the Achacha (achachairº, Garcinia humilis), was little known outside small areas of the Bolivian tropical lowlands where it was traditionally grown in small holdings. Since 2002, a plantation of 16,000 trees has been developed successfully on a 120ha former cane plantation in North Queensland, where it is the first and only known large-scale plantation of this fruit. While the trees successfully fruited, the quality of the fruit grown under conventional systems did not meet expectations. The chemical-based system was seen to have many negatives: not in line with management's approach to food; increasingly expensive inputs; trees becoming vulnerable to fungal diseases; and the plantation's proximity to a wetland of national significance. The conventional method was transitioned into an organic and biodynamic approach. This involved making fertilisers and other inputs on site, and creating a new farming philosophy based on sustainability. While suffering some initial decline in productivity, yield has returned to former levels with significantly lower waste, soil and fruit quality have improved significantly, costs have been reduced, staff are very happy with the new environment, and the paper-work required by overseas importers is minimal! This presentation will consider numerous innovative experiences. The Achacha will be presented as a viable crop for tropical areas, with an overview of its commercial development. Then the rationale for shifting to organic biodynamic methods will be explained, including financial, operational and ethical reasons for the change.

[P039] Soil Organic Matter inputs under tropical agricultural cropping systems: Where do they come from? What are they made of? Why does this matter?

Theme: 2. Solutions through Integrated Farming Systems

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