ABSTRACT

Algal biofuel has been shown to have great potential to solve the World's sustainable energy crisis but technologies for large-scale cultivation are still elusive. While photobioreactors meet very high value algal products there is still no technology for producing algae by the millions of tons. Flooded paddy lands of India offer excellent opportunities for co-cultivation of algae with paddy crop provided it meets various sustainability criteria, not to mention very low cost options. This research examines sustainability, technology and climate change challenges to this above concept termed "Algiculture". The potential of naturally emerging algal consortia to overcome travails of pure-culture, the ability to scavenge 'lost' plant nutrients in flooded paddy, overcome threats by grazers and predators, evolving naturally mediated techniques to harvest algae, impact on methane emissions, etc. were examined critically under laboratory and flooded paddy conditions. Experimental results indicate that many of the sustainability criteria can be met by growing algae simultaneously with a paddy crop for the first 60-75d which doubles the overall biomass yield from such lands. Algae raised can scavenge ammoniacal-N that generally occurs as unavoidable losses in flooded paddy system and can thus be raised without additional fertilizer inputs. This simultaneously ameliorates the N-pollution from paddy runoff to water bodies. Algal cultivation with paddy (Algiculture) alters micro-environmental conditions e.g. oxygen supersaturation, to make methane emissions unfavourable and by contrast algae even take up the C hitherto wasted away as methane and thereby converting an environmental liability to conservation. Consortia dominated by *Chlorella* and *Chlorococcum sp.* along with a small number of *Cyanophycaeans* facilitate simple low energy algal harvest techniques employing clumping and floc-formation that enables maintaining appropriate stocking density of algae and allowing continuous operation. The pattern of grazer /predator occurrence in such systems, techniques to minimize their influence by merely altering the cultivation conditions have been worked out and tested successful. The causes of reduction in methane emissions and C-source identification have

been assessed with ^{13}C discrimination studies. The research creates a new potential reducing GHG on the one hand for also raising sustainable bioenergy options in India as well as in all flooded paddy lands of the world