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How sustainable is bioenergy production in the Philippines? A conjoint analysis of knowledge and opinions of people with different typologies

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HIGHLIGHTS

- ▶ Three typologies differentiate knowledge and opinion on bioenergy in the Philippines.
- ▶ Ambivalent typology consists mostly of farmers who lack awareness on bioenergy.
- ▶ Realist typology is located in Mindanao who gives importance to social justice.
- ▶ Idealist typology has optimistic opinions on bioenergy impacts on sustainability.
- ▶ All typologies value sustainability determinants directly associated to daily living.

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ABSTRACT

We elicited people's preferences on policy issues related to bioenergy through survey and investigated the cluster typologies that influence these preferences using cluster and conjoint analysis. Three typologies (i.e. idealist, ambivalent, realist) were identified from clustering the respondents' familiarity on bioenergy and opinion on its effects on food security and economy in the Philippines. The "idealist" has optimistic opinions on bioenergy production, "realist" recognises the existing land use competition between bioenergy and food production, and "ambivalent" does not have clear opinion on the effects of bioenergy on food security and economy. Majority of realists are located in Mindanao and idealists in Luzon. The segmentation of the respondents aimed to identify the characteristics of people belonging to different typologies and to understand how the typologies influence the policy preferences for the different sustainability determinants of bioenergy. These determinants were based on the STRAP (sustainability trade-offs and pathways) framework for the integrated assessment of bioenergy sustainability. The results reveal that respondents with ambivalent typology, which are mostly farmers and farm workers, lack the necessary awareness to be able to play an active role in the bioenergy production chain. As main actors in the production of biomass feedstock for bioenergy, it is important that they gain not only general awareness but also practical knowledge on bioenergy production and its impacts on agricultural development. The respondents with realist typology in Mindanao give high importance to social justice due to unrests caused by religious conflicts and widespread poverty. Hence, unless these issues are resolved, it is hardly possible to make use of the huge bioenergy potential in this region. In general, respondents in all cluster typologies give more importance to sustainability determinants that are directly associated to their daily living. However, determinants relating to energy security and technology progress, which are not location-specific, are necessary to sustain domestic bioenergy production.

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1. Introduction

Opinions on the sustainability of bioenergy (or biofuels) are at odds because the institutional structure of its production is complex. Bioenergy production involves different products, different sectors and a range of actors interacting at and across different levels [9]. Thus it not only provides opportunities to generate multiple benefits apart from energy generation, but also causes conflict with many interests due to these inter-linkages [21]. Sustainability of bioenergy production is an immense challenge because of the need to balance economic, social and ecological well-being not only for the current but more so for the future generation. Moreover, sustainable production should result in an equal distribution of not only economic, social and ecological benefits but also costs among the different sectors and actors participating in the bioenergy production system. Understanding society's perception on these benefits and costs is essential for developing a stable bioenergy market. Policy should thus aim to collectively promote both modern technology (i.e. technical know-how) and improved awareness (i.e. social know-how) on bioenergy. Like in many other countries, the Philippines is implementing various bioenergy policies to reduce dependence on imported oil, enhance economic growth, increase energy efficiency and contribute to climate change mitigation [11]. It has joined the world in "biofuel fad", which Mendoza [34] describes as a wagon-like initiative to promote bioenergy production in a break-neck pace in response to the oil crisis. The Philippine government has thus pursued its bioenergy policies without delay. The most prominent policy is the Biofuels Act of 2006, which was not only signed and published, but also became effective already in 2007. In the same year the mandated minimum of 1% blend of biodiesel to gasoline was already implemented. The other mandates under the Biofuels Act include increasing the biodiesel blend to 2% in 2009, implementing 5% minimum bioethanol blend in 2009, and increasing the bioethanol blend to 10% in 2011 [45]. According to the Department of Agriculture (DA), the Biofuels Act is aimed at: (1) developing and utilising indigenous renewable and sustainably-sourced clean energy sources to reduce dependence on imported oil; (2) mitigating toxic and greenhouse gas (GHG) emissions; (3) increasing rural employment and income; and (4) ensuring the availability of alternative and renewable clean energy without the detriment to the natural ecosystem, biodiversity and food reserves of the country. The Act also allows oil companies to import biofuels until 2010 to meet these policy targets. Moreover, biomass for bioenergy production is exempted from value added tax and biofuel companies with 60% local ownership are provided financial assistance [62]. Whilst there were no reported obstacles during the transition to a higher biodiesel blend due to adequate local supply [10], the bioethanol situation was less stable. To comply with the bioethanol mandates, local companies have been importing bioethanol due to supply scarcity and price volatility.

To support and comply with the provisions of the Biofuels Act, the DA has been pursuing the Biofuel Feedstock Program, which provides (1) production support services, (2) extension support, education and training services, (3) credit facilitation, (4) research and development, (5) irrigation support services, other infrastructure and post harvest & development services, and (6) marketing development to promote the use of coconut and jathropa for biodiesel and sugarcane, cassava, and sweet sorghum for bioethanol [11]. As a result, ethanol accounted for 0.30% of the total indigenous energy supply and 0.10% of the total domestic energy supply in 2009 [16]. At present, however, the local supply of biodiesel and bioethanol is largely produced from coconut and sugarcane; both are traditional crops in the Philippines. In 1990 coconut and sugarcane plantations accounted for 3.1 million hectares (or 24%) and 235,000 ha (or 2%) of the 12 million hectares of agricultural lands in the Philippines [5]. The areas cultivated for these crops increased to 3.6 million hectares and 355,000 ha in 2010. In terms of volume of production, coconut increased from 12 to 15 million metric tons and sugarcane increased from 21 to 23 million metric tons during the period 1990–2000 and 2001–2010. In the Philippines, however, the potential fuel yield per hectare from other crops is higher than coconut and sugarcane. For example, the ethanol yields per hectare per year are 6000 L from sweet sorghum and only 4550 L for sugarcane (for cassava it is as low as 1395 L) [56]. The biodiesel yields per hectare are as high as 1892 L from jatropha and as low as 630 L from coconut [15]. However, the use of cassava, sweet sorghum and cassava as biofuel feedstock is considered to be in the research and development (R&D) stage [11]. The areas planted to cassava increased only slightly from 214,000 ha in 1990 to 218,000 ha in 2010 and the volume of production was around 2 million metric tons throughout these periods [5]. The areas planted to and volumes of production for sweet sorghum were rather negligible in the Philippines as compared to the other bioenergy crops. But this is expected to increase considering the ongoing research and pilot projects on using sweet sorghum for bioethanol production [46]. The cultivation of jathropa for bioenergy production is still on a pilot testing phase. The Philippine National Oil Company–Alternative Fuels Corporation (PNOC–AFC), the government agency responsible for promoting and coordinating biofuels project on jathropa, aims to establish 1500-hectare jatropha mega-nurseries cum pilot plantations, 700,000-hectare biofuel crop plantations, and 1-million metric tons biodiesel refineries in 2012 [44]. The government supports the cultivation of jatropha, a second generation bioenergy crop, for the production of biodiesel because it grows on marginal lands. Thus, the Philippines have the potential to develop a sustainable bioenergy sector using bioenergy crops that does not compete with food crops and agricultural lands.

This paper aims to assess this potential by understanding the policy preferences of the people towards sustainable bioenergy production. Specifically, it assesses preferences for both first generation (i.e. sugar-rich crops, starch-rich crops and oil-rich crops) and second generation (i.e. agriculture/forest residues, fast-growing trees, and perennial grasses) bioenergy crops, which are or can be used for the production of biodiesel (e.g. coconut, jathropa, etc.) and bioethanol (e.g. sugarcane, cassava, sweet sorghum, switchgrass, etc.). Such an assessment is critical for many developing countries including the Philippines due to its impact on food security, specifically as a result of the negative effects of bioenergy feedstock production and processing on increasing water scarcity and agricultural land pressure [34]. In the Philippines the land pressures from large-scale monoculture plantations will reverse many benefits achieved from agrarian reform [34,52]. The expansion of bioenergy production has been recently impeding the Philippine Agrarian Reform Programme, which is implemented since the 1990s to distribute large sugarcane and coconut plantations to poor farm tenants [8]. Moreover, recent evidence shows that whilst the coconut farm gate prices were higher after the implementation of Biofuels Act, coconut farm workers real wage decreased and coconut farmers experienced increased price volatility [25]. The framework for assessing the sustainability of bioenergy production in this paper is based on the STRAP (sustainability trade-offs and pathways) ap-