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Research paper

Using the ecosystem service approach to determine whether jatropha projects were located in marginal lands in Ghana: Implications for site selection

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ABSTRACT

The concept of marginal land is often used to justify land availability and inform land allocation for biofuel projects. However, marginal lands can provide other valuable ecosystem services. Using interviews with multiple stakeholders and fieldwork in three collapsed biofuel projects in Ghana, this paper shares perspectives on how the ecosystem service approach (ESA) can offer a better basis for selecting land for biofuel projects. Expert interviews with key stakeholders (e.g. Lands Commission) in biofuel value chains in Ghana highlight the lack of consensus of what constitutes marginal land, with two dominant interpretations coming up; (i) land unsuitable for food production and (ii) land unsuitable for cost-effective agricultural production. Both interpretations however do not reflect the ecosystem services lands provide, as well as the significant cultural values attached to them. Our empirical work shows that many ecosystem services are obtained from the supposedly marginal lands that are neglected from both interpretations, as well as the standard project planning and Environmental Impact Assessment (EIA) processes. We make the case that when compared to the current marginal land narrative, the ESA offers a better lens for understanding local land uses, in managing emerging tradeoffs and providing information for locating biofuel projects. Our findings suggest that expanding the scope of EIAs by integrating elements of the ESA can go a long way towards informing site selection for biofuel investments.

1. Introduction

Numerous studies have raised concerns about the potential threat that biofuel expansion can pose to food production [1–6]. To this end, there has been a heated discussion whether it is ethically acceptable to promote commercial biofuel feedstock production, especially in the food insecure developing countries of Sub-Sahara Africa (SSA) [7]. These discussions have often been framed as the "fuel vs. food" debate [8,9].

The notion that biofuel feedstock production on marginal lands could circumvent the "food vs. fuel" dilemma has attracted an increasing attention in the academic literature [7,10–12]. Despite its long history as a term, marginal land became very popular in the biofuel literature only after the prominence of the "food vs. fuel" debate [11]. Early use of the concept of marginal land date back to Ricardo (1817) and the law of rent, which states that the marginal cost of land rent is a good reason for shifting capital and labour between high-quality land and 'marginal land' [13]. Peterson and Galbraith (1932) added some dynamism in the concept by introducing three terms: physically marginal (i.e. marginality based on location and environmental factors), productively marginal (i.e. marginality related to food suitability), and economically marginal (i.e. marginality related to cost-effectiveness of agricultural production) [14]. The cost-effective definition of marginal land was largely used in the economic theory of land and rent before the emergence of the biofuel debate [11]. The food suitability aspect of marginal land was largely promoted within the biofuel discourse as discussed below [15].

While a stringent definition of marginal land would preclude the production of biofuel feedstock in such areas, this is not the case in the biofuel literature. In reality several studies around the world (including SSA) have identified marginal lands as areas fit for sustainable biofuel feedstock production as a means of avoiding the food-fuel competition [15–17] (see below).

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Abbreviations

CSO	Civil Society Organisation
ESA	Ecosystem Service Approach
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
FDI	Foreign Direct Investment
MoFA	Ministry of Food and Agriculture
NTFP	Non-Timber Forest Product
SSA	Sub-Sahara Africa
TCPD	Town and Country Planning Department

There are however, many contested points regarding the current use of the term for biofuel feedstock production. These include: (i) what constitutes marginal land, (ii) where such lands are located, (iii) how much marginal land is available for biofuel feedstock production, and (iv) what are the differences between marginal land and abandoned and/or degraded land. In recent years discussions about the above have emerged both in academic [15,18,19] and policy/practice [16] domains.

Regarding the first point, two major definitions of marginal land can be found in the academic literature as they relate to biofuels. The first defines marginal land in relation to land suitability for food production, and particularly for growing food crops [16,17]. Proximate factors such as climate, erosion, soil quality, and other environmental risks are usually used to determine land suitability for food production [15–17]. However, studies about crop yields on marginal lands have generally generated mixed results, increasing the skepticism for using this criterion to determine what constitutes marginal land [15,20,21]. The second definition relates marginal land to the limited possibilities for cost-effective agricultural production, thus adopting a more economic viewpoint discussed above [11,22]. Whereas the first definition has normative undertones, the latter conveys practical considerations as to what constitutes a marginal land [11].

Regarding the second and third point, a recent meta-analysis indicates that marginal land accounts for 9 910 000 km^2 globally [23]. In SSA, the extent of marginal lands has been estimated at 1 320 000 km^2 [23,24]. While these studies use proxies [19] or provide contradictory results in terms of production, land availability, and the ability to target these areas [15,21,25], they nonetheless have offered a foundation to propagate the idea that marginal lands are abundant in SSA and can be used for biofuel production.

Across SSA, the notion that such marginal lands fit for biofuel production do exist has been used to build national support and attract foreign direct investments (FDIs) [7,15]. However, studies on the prospects and challenges of using marginal lands for biofuel development in SSA can be contentious [15] and offer limited advice for informed policy-making [7].

It has been argued that the current framing, quantification, and classification of marginal lands are not actually helpful in SSA contexts as many local uses of the land are ignored [26]. Indeed, classifying marginal lands as outlined above can overlook many of the other uses of land, including the benefits derived from ecosystems (i.e. ecosystem services). In other words, the fact that land is unsuitable or uneconomic for food production does not necessarily mean that it does not cater for multiple other human needs by providing ecosystem services that contribute to human well-being [27–29].

Research in SSA, has suggested that there are indeed many ecosystem service impacts related to biofuel-driven large-scale land conversion [1,15,30,31]. Understanding the ecosystem service trade-offs during the life-cycle of biofuel investments (and particularly for the feedstock production stage) can have important ramifications for biofuel project planning including the selection of site, feedstock and agricultural, management practices.

From this starting point, the aim of the paper is to identify some of the misconceptions that arise when using the marginal land narrative as a basis to choose the location of biofuel feedstock production, as well as how the ecosystem services approach (ESA) can offer a complementary lens for biofuel project planning. We use examples from jatropha production in Ghana that offers an ideal context for this study as it experienced some of the most significant biofuel expansion in SSA [32] on supposedly marginal land, which was followed by a widespread collapse of the sector [33].

After outlining the methodology of this study (Section 2), we identify the critical lack of consensus between key stakeholders in Ghana on what constitutes marginal land appropriate for biofuel feedstock production (Section 3.1). Then we use the ESA approach to report the actual uses/benefits derived from supposedly marginal lands in three jatropha projects in Ghana before the land conversion to jatropha monocultures, and after project collapse (Section 3.2–3.3). Following this, we then identify the important mismatches between these uses/benefits and the actual impacts considered in the official EIA reports (Section 3.4). Finally, we put these findings into perspective and address some fundamental issues related to the use of the ESA for biofuel project planning (Section 4).

2. Methodology

2.1. Data collection and analysis

For the purpose of this study we employ the definition and classification of ecosystem services adopted by the major ecosystem services initiatives of the last decade [28,28,29] as applied in ecosystem services settings [56]. Based on these, ecosystem services are the benefits that humans derive directly and indirectly from nature, including:

- Provisioning services: e.g. food, fuelwood, clean water, medicinal plants
- Regulating services: e.g. climate regulation, water purification, erosion regulation
- Cultural services: e.g. recreation, aesthetic and religious values
- Supporting services: e.g. habitat provision, soil formation, nutrient cycles

Primary data was collected during two rounds of fieldwork (Table 1). During the first fieldwork (September 2015) we undertook (a) expert interviews to interpret the diverse meaning of the term marginal land among key stakeholders in Ghana, and (b) household surveys around three jatropha projects to understand changes in provisioning ecosystem services following landscape conversion (Table 1) (see Section 2.2). During the second fieldwork (February–March 2016) we undertook (a) participatory mapping to understand better the landscape modifications, and (b) focus group discussions (FGDs) to understand changes in regulating and cultural ecosystem services and substantiate the changes in provisioning ecosystem services identified during the household survey.

The expert interviews were conducted with key representatives of major stakeholders in the land and biofuel sector of Ghana. In total we undertook 14 interviews with different stakeholders that represented the main organisations involved in biofuel value chains in Ghana as identified in a previous review of the literature [33]

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