



# Awareness and perceptions of ecosystem services in relation to land use types: Evidence from rural communities in Nigeria



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## ABSTRACT

For the ecosystem service (ES) paradigm to be relevant to policy and decision-making, it is important to integrate local residents' awareness and perceptions of ES into ES assessment. Using data collected from 102 villages in Nigeria, we assessed communities' awareness and perceptions of a broad range of ES in relation to land use types. We also examined the factors that affected awareness levels across communities. While provisioning services were generally recognized, a majority of the villages also appreciated spiritual values as a cultural service. Awareness of regulating and supporting services, including those that were important for maintaining the stability and productivity of agroecosystems, was generally low. Exposure to forest, unused land, and lowland floodplain was positively correlated with respondents' awareness. In addition, socio-economic and cultural factors such as ethnicity and food intake status had important influence on the awareness levels, whereas adult literacy and government extension programs had limited influence. These results underscore the importance of direct experience and local context in shaping people's awareness about ES. While communities demonstrated diverse ways of using land and deriving ES, much remains to be done to increase awareness and knowledge among communities about the benefits and provision of ES in Nigeria.

## 1. Introduction

Ecosystem services (ES) are benefits humankind receives from ecosystems, categorically broken down by the Millennium Ecosystem Report (MEA, 2005) into provisioning, regulating and supporting, and cultural. Local residents' awareness and perceptions of ES, as well as the value they place on these services, are increasingly important given the alarming rates of degradation in terrestrial ecosystems (Nkonya et al., 2016). Further, changes in land use can profoundly alter landscape patterns and ecosystem functions, ultimately compromising the provision of ES (Lawler et al., 2014). This is particularly true in developing countries given that ES and biodiversity are the wealth of the poor who heavily depend on natural resources (Daily et al., 2011; Dasgupta, 2010). For example, over 80% of the population in sub-Saharan Africa depend on traditional medicines (WHO, 2013), while fuelwood, charcoal, crop residues and cow-dung provide 90% of cooking energy (WHO, 2015). Sustainable management of ES is therefore a vital global interest, particularly in developing countries where such services are often associated with poverty alleviation.

Human interactions with ecosystems, as well as values, beliefs, and socioeconomics, shape people's appreciation of what nature has to offer (Cowling et al., 2008; Willock et al., 1999; Hein et al., 2006; Vermeulen and Koziell, 2002). Ecological features of local landscapes also affect cognitive awareness and appreciation of nature's benefits (Urgenson et al., 2013). For example, Muhamad et al. (2014) found that people living closer to forests perceived more ES in West Java, Indonesia. Abram et al. (2014) observed marked spatial variations in rural local people's values and perceptions of ES in the forested regions of Borneo.

People's awareness and perceptions of ES, if held with conviction and strength, may also shape specific attitudes and behaviors (Willock et al., 1999). For example, farmers who have relevant knowledge about pest regulation and pollination services provided by beneficial insects may refrain from spraying broad-spectrum chemical insecticides that can damage beneficial insect populations, thus minimizing the negative effects associated with indiscriminate use of agrochemicals. Environmental knowledge is also predictive of the level of adoption of conservation practices (Poppenborg and Koellner, 2013; also see review in Willock et al., 1999). Nkonya et al. (2008) showed that

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awareness positively influences compliance with community regulations related to tree planting and protection in Uganda.

The characterization of ES are increasingly popular precursors for the development of sustainable natural resource management and land use policies (Sagie et al., 2013). For example, the *Economics of Ecosystems and Biodiversity (TEEB)* approach requires the identification of vital ES necessary for meeting country policy priorities and making recommendations on how decision makers can integrate these services into policies (TEEB, 2013). Recent studies have highlighted the importance of translating ES and landscape considerations into policy actions that support the United Nations Sustainable Development Goals (e.g., Costanza et al., 2016; *The Landscapes for People, Food and Nature Initiative*, 2015; Wood and DeClerck, 2015). Although ES assessments are increasing in number around the globe (Martinez-Harms et al., 2015; Seppelt et al., 2011; Abson et al., 2014), there is little evidence decision makers are integrating this knowledge into policy (Förster et al., 2015). This is partly because ES assessments fall short in strategic targeting information needed for effective decision making (Honey-Rosés and Pendleton, 2013; Laurans et al., 2013; Martinez-Harms et al., 2015). To be socially relevant to policymakers (Orenstein, 2013), assessments should encompass local people's diverse views, knowledge, and preferences with respect to how ES can contribute to human well-being and livelihoods (Hauck et al., 2013).

While a number of studies have analyzed stakeholder perceptions of ES, the geographic focus has primarily leaned towards developed countries, often addressing limited land use systems or a narrow range of ES. For example, Lugnot and Martin (2013) looked at knowledge about services provided by plant biodiversity in livestock production systems in France. Martín-López et al. (2012) found that formal studies, environmental behavior, and gender variables influenced the probability of people recognizing the ecosystem's capacity to provide services in Spain. Hauck et al. (2013) and Lamarque et al. (2011) conducted similar studies in Europe. Looking at the Israeli-Jordanian border in the Southern Arava Valley Desert, Sagie et al. (2013) found that although they shared a nearly identical ecosystem, local residents from two sides of the border showed distinct differences, as well as some similarities, in how they use and value ES. Such studies underscore the role of culture, ethnicity, nationality, and economics in formulating perceptions about ES and appreciation of what nature has to offer.

Fewer studies have assessed levels of ES awareness and perceptions in developing countries, particularly in sub-Saharan Africa where the need for sustainable ecosystem management and poverty alleviation is most profound. Muhamad et al. (2014) found that rural people in a forest-agricultural landscape of West Java, Indonesia were greatly aware of ES, although they identified provisioning more than other services. Place of origin, residential location, area of agricultural lands and agroforests, and number of livestock were the most influential socioeconomic factors determining the number of ES an individual respondent perceived. Focusing on pollination services provided by bees in coffee farming systems in central Uganda, Munyuli (2011) found that more than 90% of the surveyed farmers were unaware of how pollination could increase coffee yields. Awareness of pollination services was associated with coffee farming experience, contact with extension services, and mode of acquisition of the coffee field, although land tenure was not considered. The study also indicated that farmers were unwilling to manage their lands to protect pollination services, primarily because they considered such services to be an unsolicited “free service” or “public good.” Kasina et al. (2009) found that most farmers in western Kenya were similarly unaware of the importance of pollination in crop production. As such, they recommended incorporating bee pollination management into local extension programs. In forest ecosystems of Jordan, access to markets, income, gender, and level of education affected ES awareness (Al-Assaf et al., 2014), whereas residential characteristics were influential in the Arabah

Valley of Jordan and Israel (Orenstein and Groner, 2014).

An emerging body of evidence suggests that natural habitat and diverse land use in agrarian landscapes help foster biodiversity (Newbold et al., 2014) and provide potential ES such as natural pest suppression (Landis et al., 2000; Bianchi et al., 2006; Karp et al., 2013; Shackelford et al., 2013; Milligan et al., 2016), soil conservation (Mäder et al., 2002), nutrient retention (Raudsepp-Hearne et al., 2010), crop pollination (Klein et al., 2003; Carvalheiro et al., 2010), and cultural services (van Zanten et al., 2014; Riechers et al., 2016), that are essential to farming and human wellbeing (Tscharntke et al., unpublished manuscript). In most world regions, agronomic intensification has transformed many agricultural landscapes into expansive monocultures with little natural habitat, resulting a pervasive concern that such landscape simplification may compromise the provision of ES (Meehan et al., 2011; Larsen, 2013). Further, economic development and urban spatial expansion in developing countries has led to dramatic land use changes, threatening the remaining forest and other natural or semi-natural land cover. To our knowledge, there has been few, if any, prior studies that have examined how rural residents' awareness of ES are related to the relative distributions of different land use types in the landscape they reside in. This study will fill in this void.

In the present study, we explore potentially influential factors and apply socio-economic methods, including in-depth interviews with rural residents and multivariate regressions, to understand local people's awareness and perceptions of ES concerning land use across rural communities in Nigeria. Nigeria has diverse biophysical characteristics, ethnicities, agroecological zones (AEZs), and socio-economic and cultural conditions (Aregheore, 2009). To our knowledge, there has been little, if any, empirical evidence from Nigeria or western Africa on rural communities' awareness and perceptions of ES. Results can help guide strategies that foster awareness and positive perceptions about the benefits of ES and how they are connected to land use. This study also provides valuable insight into potential opportunities and constraints facing rural communities in terms of enhancing environmental stewardship and sustainable management of ecosystems.

## 2. Material and methods

### 2.1. Study area

Nigeria's ecosystems encompass semi-arid savanna ecosystems in the north and tropical forest ecosystems in the south (Aregheore, 2009). Amidst diverse agroecological conditions there is also heterogeneity in ethnicity and cultures (Aregheore, 2009; Metz, 1991), as well as vast economic disparities between different regions of the country (Oxford Poverty and Human Development Initiative, 2015). Land degradation has been recognized as one of the most important natural resource management problems in Nigeria, constraining agricultural and rural development (FAO, 2002; Odemerho, 1992; Titilola, 2008). Despite robust economic growth for the past decade (AfDB, OECD, and UNDP, 2015), the proportion of the population that is multidimensionally poor is 53.3% nationally and 70% in rural areas, with remarkable regional variation (Oxford Poverty & Human Development Initiative, 2015).<sup>1</sup> Such drastic differences in the types of resource constraints across regions potentially contribute to particular views and needs related to services derived from ecosystems.

<sup>1</sup> The global Multidimensional Poverty Index (MPI), developed by the Oxford Poverty & Human Development Initiative (OPHI), is an international measure of acute poverty covering over 100 developing countries. It complements traditional income-based poverty measures by capturing the severe deprivations that each person faces at the same time with respect to education, health and living standards (Alkire et al., 2016; OPHI, 2007–2016).

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