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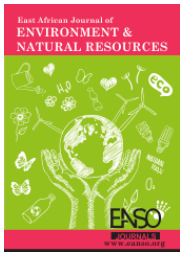

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Original Article

The Dynamics of Implementing Payment for Ecosystem Services Scheme in Lake Naivasha Basin Ecosystem, Kenya

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ABSTRACT

Lake Naivasha Basin is located in Nakuru and Nyandarua counties in the Republic of Kenya. It is an important ecosystem to the economy of Kenya, consistently contributing upwards of 1% of the national Gross Domestic Production. However, this landscape is continuously and rapidly degrading due to intensive land use practices and land fragmentation in spite of the existence of various natural resource management policies in Kenya. The promotion of Payment for Ecosystem Services (PES) as a policy option to foster ecosystems sustainability by increasing the capacity of government authorities and local communities in Kenya to conserve riparian and forest ecosystems so as to reduce the vulnerability of dependent communities and production enterprises to the observed and anticipated effects of climate change is implied in the key environmental and natural resources policies in Kenya. We examine whether the Lake Naivasha Basin Payment for Ecosystem Services (LNB-PES) scheme embodied the critical characteristics of an effective PES mechanism and if it achieved the desired ecological and livelihood results. A total of 1,191 heads of households and 11 key informants were interviewed for this study. The study results indicate that the LNB-PES scheme had some functional and conceptual inadequacies although it achieved remarkable adoption and compliance by participating farmers. Based on these results, we recommend that a new PES scheme with a conditionalities enforcement mechanism be initiated for the LNB with a view to informing the mainstreaming of the concept of enforceable PES in the existing policy framework, the development of a national or basin-level PES policy, and, support watershed restoration and climate change adaptation through the provision of forest technical extension services to land owners for the creation of woodlots and other watershed protection initiatives at farm level.

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INTRODUCTION

The Lake Naivasha Basin (LNB) in Kenya supplies critical ecosystem goods and services including supporting a thriving irrigated floriculture industry. The floriculture industry around Lake Naivasha accounted for slightly over 1% of Kenya's GDP (US $1.5b) annually and supported over 2 million Kenyans directly and indirectly between 2015 and 2019 (Kenya National Bureau of Statistics [KNBS], 2017; Kenya Flower Council, 2017). Other environmental goods and services provided by the basin include fish, subsistence agricultural produce (vegetables and milk), firewood, herbal medicine, construction materials and fodder, and regulatory services like climate change mitigation, water recharge and discharge, flood control and soil prevention provided by indigenous forests and riparian vegetation. However, the phenomenal growth in flower production, intensification of smallholder agriculture production units in the upper and middle catchment, geothermal power generation, and demand for domestic water use occasioned by human population growth and urban development have equally exerted pressure on water resources (Harper & Mavuti, 2004; GoK, 2012; KNBS, 2019a).

Despite the existence of natural resources management policies and regulations in Kenya, e.g., the National Environment Policy and the National Environment and Coordination Act, the LNB ecosystem continues to experience degradation, portending a serious ecological threat to the lake and the floriculture business (Harper & Mavuti, 2004). In an attempt to mitigate environmental degradation in the upper catchment of the LNB that was compromising the water supply, economic and ecological integrity of Lake Naivasha, the Kenyan Government, the floriculture industry in Naivasha, international environmental conservation and water governance organisations were galvanised into concerted action to develop a Payment for Ecosystem Services (PES) scheme aimed at protecting the upper catchment in order to assure a continuous flow of water to the lake (Boonstra, 2010).

Informed by experiences elsewhere and the complete drying of Lake Naivasha in the period 2008-2009, the Lake Naivasha Basin PES (LNB-PES) program was initiated in 2009 based on the premise that large-scale commercial farmers around the lake who depend on the waters of Lake Naivasha can ensure the sustainability of their agri-businesses

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by investing in the conservation of the upper-catchment, thus ensuring a continuous supply of water and a reduced risk to their business. Thus, these large-scale floriculture farmers contributed to the solely user-financed LNB-PES scheme that compensated over 3,000 small-scale farmers in the upper catchment with a token of US $17 per farmer per year for the opportunity cost of farming along the productive river banks and for employing value-added soil-saving and crop farming techniques (Boonstra, 2010).

This paper examines farmer perceptions and key outcomes of the LNB-PES scheme, specifically, whether the scheme embodied the critical characteristics of an effective PES mechanism or achieved the desired ecological and livelihood results by the targeted households.

METHODOLOGY

Study Area

The study area constituted the upper echelons of Lake Naivasha Basin in Nyandurua County in the Republic of Kenya, see *Figure 1*. However, the entire basin is much larger and comprises the Western slopes of the Aberdare Ranges rising up to 4,001 m above mean sea level (amsl), the undulating Kinangop Plateau and the Eburru Hills in Nakuru County (part of Mau Escarpment at 2,800 m amsl), covering an area of 3,400 km^2 (GoK, 2012).

The upper catchment of the LNB comprises a protected indigenous forest within the Aberdare Mountain ranges ecosystem and is the main source of rivers and streams that eventually form the greater Malewa river. River Malewa is the principal source of water for Lake Naivasha, contributing 80% of the inflows (Becht, 2007; GoK, 2012). In the middle catchment, extensive and intensive subsistence rain-fed agriculture and low-intensity irrigated commercial farming, dairy and sheep farming, agroforestry and small to medium size urban settlements exist. The middle catchment is also characterised by rapid land sub-division and urbanisation as well as extensive water abstraction from rivers and streams, damming, poor land use and high surface run-offs.

The most significant feature of the LNB is Lake Naivasha (0º45'S, 36º20'E), which is located in the lower catchment on the floor of the Gregorian Rift Valley. It is the second largest freshwater lake in Kenya, occupying an area of 145 km^2 at an altitude of 1,888 m amsl. Like most water bodies in the Gregorian Rift Valley, Lake Naivasha is shallow, with an average depth of 4.4 m (Adbullahi, 1999) and is internationally renowned for its biodiversity and natural beauty. Lake Naivasha is recognised as a wetland of international importance under the Ramsar Convention on Wetlands. However, unlike most Ramsar sites, Lake Naivasha supports a thriving floriculture and related agri-business industry that accounts for more than 70% of the country's cut flower exports, representing close to 40% of the European Union (EU) retail market (Hemel, 2013; KNBS, 2016). The exports generate 9% of Kenya's total foreign exchange revenue, which is slightly over 1% of Kenya's GDP (Hepworth et al., 2011; KNBS, 2019b; Kenya Flower Council, 2017).

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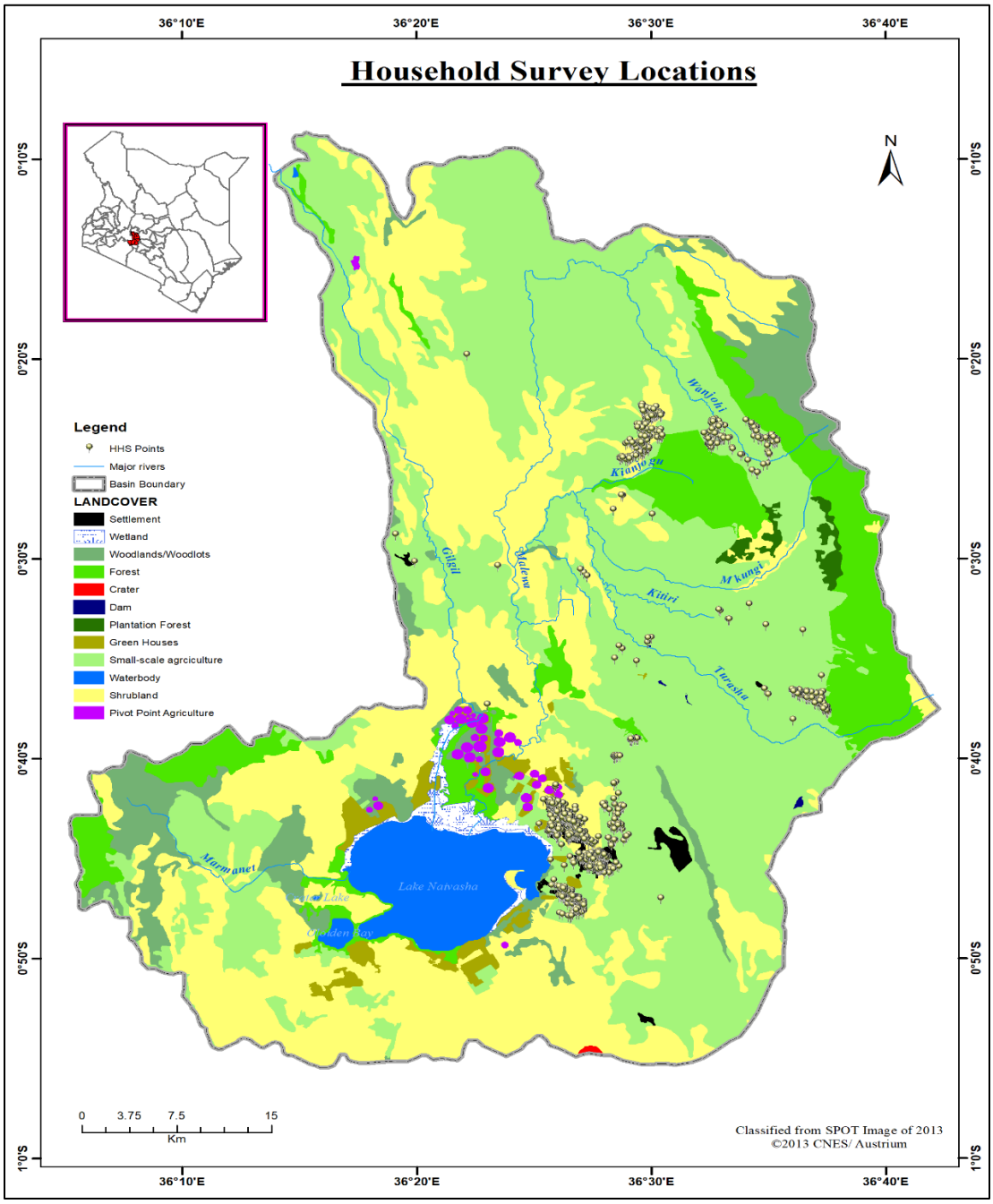
Figure 1: Map showing the study area/household survey locations



Source: (Researchers, 2018)

Data Collection and Analysis

Household surveys were undertaken by a team of enumerators with the respondent being the head of the household above 18 years of age. Household responses were fed directly into a smartphone loaded with Open Data Kit (ODK) software that would transmit the date and time of the interview, the GPS location of the respondent and the responses to an offsite digital repository. At the end of each day, all data would be downloaded and progressively added to an excel worksheet. A total of 1,191 households were interviewed in the upper (n = 868) and middle (n = 323) catchments, the

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majority (86.8%) of whom were below 60 years of age and 25% were below 30 years. The household sample size was determined using the Yamane formula as per the equation;

n = N/(1+N(e)2, where variables are:

n = the sample size, N = the population of the study, and, e = the margin error in the calculation (Iddon & Boyd, 2022).

Additionally, 11 key informants were interviewed using a structured questionnaire. The key informants comprised heads of private agribusinesses, government and non-government organisations operating within the Lake Naivasha Basin.

The resultant data were analysed using MS Excel software to determine the mode and mean age of respondents, level of education, the most significant land use, and if there were any significant changes in the production of the most dominant crops grown by targeted farmers in the LNB after involvement in the PES scheme.

RESULTS

The study sought to determine the land use types in the upper and middle catchments of the LNB, whether the farmers negotiated the payment under the PES scheme, and the conditions they had to fulfil once they joined the PES scheme.

It was observed that on average, 42% of the sampled population are literate, having acquired secondary-level education, which is considered the end of basic education in the current education framework in Kenya, see *Table 1*.

Table 1: Household Demographics in LNB

Parameter	Upper Catchment	Middle Catchment
Mean Age, Yrs	55	35
Mode H/Hold Size	4-6	4-6
No Education, %	7.0	6.5
Primary education, %	32.5	35.3
Secondary education, %	42.7	41.2
Tertiary education, %	17.7	17.0

As shown in *Figure 2*, intensive agriculture is the leading form of land use in the upper and middle catchments, whereas the built environment is the predominant land use in the lower catchment of the LNB.

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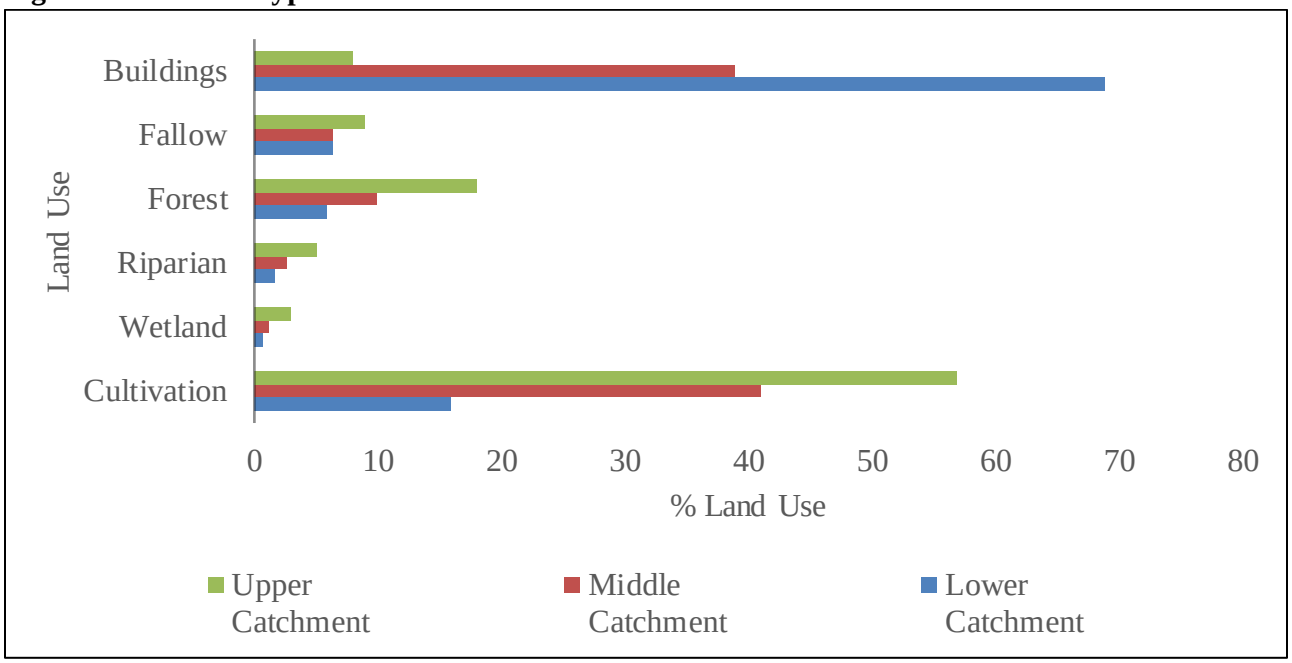
Figure 2: Land-Use types in Lake Naivasha Basin



Source: (Researchers, 2020)

As shown in *Table 2*, over 95% of the respondents were not involved in negotiations for the conditionalities that a majority (51%) indicated were asked to comply with. Although a majority of farmers (62%) did not sign any binding agreement or contract for the set conditionalities, there was a very high compliance rate of 92%, although close to 70% indicated there was some form of enforcement mechanism.

Table 2: Farmer Participation in Critical PES Attributes and Compliance in LNB

PES Attribute, % Response	Yes	No
Involved in negotiations	4.4	95.6
Given conditions	51.2	48.8
Signed binding contract/agreement	38.3	61.7
Compliance rate	92.1	7.9
Supervised Enforcement	69.8	31.2

Source: (Researchers, 2020)

Table 3 shows changes in the production of various crops grown by targeted farmers in the LNB after involvement in the PES scheme. The analysis uses a one-tailed T-Test to confidently (95%) test whether PES conditions improved farm productivity. The null hypothesis ($H_0 = 0$) and alternative hypothesis (H_a) are stated as follows;

H_0: There is no difference in farm productivity before and after the application of PES in LNB

H_a: There was an increase in farm productivity after the application of PES in LNB

Analyses show that there was a significant increase in tree cover, milk, cabbage, green peas, snow peas and maise production, whereas Irish potato and carrot production show no statistically significant difference.

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Table 3: Comparison of Ecosystem Value in Terms of Farm Productivity Before and After the LNB-PES Scheme

Ecosystem Value/Attribute	Before PES	After PES	*p*-value
Indigenous trees per acre	152.46	262.01	0.0115
Milk Production, Lt/day	18.17	32.21	0.0250
Irish Potato, bags/year	22.30	30.92	0.1869
Cabbage, heads/year	338.93	812.41	0.0329
Carrot Production, bags/year	11.10	19.03	0.0599
Green Peas, Kg/year	117.59	265.13	0.0046
Snow-peas, Kg/year	54.13	147.42	0.0222
Maize Production, bags/year	5.29	7.17	0.0006

Overall, a majority of targeted PES farmers indicated that there was an increase in crop production, land cover and household income. Farmers overwhelmingly attributed the positive changes to PES, as shown in *Table 4*.

Table 4: Changes in crop production, land cover and household income among LNB-PES participants

Change in variable	Crop Production	Land Cover	Income
Increased, %	63.7	90.9	71.7
Reduced, %	15.3	2.9	6.7
No Change, %	21.0	6.2	21.7
Attribute to PES, %	76.5	81.1	79.4

DISCUSSION

In the 20th and 21st Centuries, ecosystems experienced unprecedented changes resulting in extensive and largely irreversible loss of biodiversity, with over 60% of ecosystem goods and services being degraded, thus representing one of the most challenging global risks in modern times (Greiber, 2009; Millenium Ecosystem Assessment, 2005a; Millenium Ecosystem Assessment 2005b; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018; World Economic Forum, 2022). Water is critical to the survival of the LNB ecosystem and local economy; hence the accelerated degradation of water catchment areas heralds a grim and unsustainable future. Provision of adequate water remains a key challenge for the 21st century, where the major issues relating to the management of water remain centred around catchment degradation as well as inadequate enforcement and compliance with policy and regulatory requirements (Chepyegon & Kamiya, 2018; GoK, 2012; Marshall, 2011).

The concept of PES has worked in varying degrees elsewhere in addressing environmental conservation issues where a business enterprise thrives on the use of environmental goods and services. For example, Vittel (Nestlé Waters) works with farmers, local authorities and the general citizenry to make commitments, which reconcile human activity and environmental protection, including financing farmers in north-eastern France catchment areas to adopt certain farming practices and technology in order to address the risk of nitrate contamination caused by agricultural intensification in the aquifer, thus guaranteeing high-quality drinking water (https://www.vittel.com/committed-preserve-biodiversity accessed 3rd October 2022,

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Perrot-Maître 2006). In Brazil, PES is one of the mechanisms used in a policy mix to slow down the rate of Brazilian Amazon Forest loss, which reduced from 27,000 Km^2 in 2004 to 5,000 Km^2 in 2012 (Börner et al. 2015). In Kenya, Van de Sand et al. (2014) draw upon the results of a participatory vulnerability assessment among potential ecosystem service providers in the Sasumua watershed (also part of the Aberdares Range in Nyandarua County) to show that PES can play a role in enhancing adaptation to climate change if complemented with the right institutional framework. Further, a study by Mugenya (2012) in the Kasigau area of Taita Taveta County, Kenya, concluded that PES programs could be used to promote environmental conservation as well as contribute to poverty alleviation.

In the LNB, intensive agriculture is the leading form of land use in the upper and middle catchments of the LNB. However, this practice has become a major driver for land use changes and poor land use practices. Harper & Mavuti (2004), Becht (2007), GoK (2012), Kissinger (2014), Nordvander (2014) and Nature Kenya (Midrift Hurinet, 2022) have all documented destructive and degrading land use changes from natural/indigenous forests to agriculture and the attendant unregulated water abstraction in the LNB catchment. The application of PES instruments in several developed and developing countries has proven essential to changing environmentally harmful behaviour and for accruing benefits to rural livelihoods (Khanal & Paudel 2012, https://www.vittel.com/committed-preserve-biodiversity, accessed 3rd October 2022; Perrot-Maître 2006).

The concept of PES entails voluntarily negotiating on and agreeing to certain conditions that must be met by the parties involved in a PES Scheme, usually over a well-defined land use presumed to produce a service (Wunder, 2006; Wunder, 2007; Wunder et al., 2008; Muradian et al., 2010; Khanal & Paudel, 2012). For it to be effective, though, the agreed land use must benefit and sustain the land owner or user, who is the key producer of the ecosystem service.

The LNB-PES Scheme was not based on negotiated and agreed-upon conditionalities; neither was a trustee engaged or established to source and manage the funds. The conditions were imposed on farmers, who nevertheless adopted them overwhelmingly, as shown by the very high compliance. Noting that respondents attributed the overall increase in crop production, land cover and household income to the LNB-PES scheme, the detailed statistical analysis also indicated there was a significant increase in milk production but no significant increase in potato production in an area renowned for its propensity for milk and potato production. PES initiatives target long-term changes in land use, whereas potatoes have a short 3-months growth cycle and are usually integrated with other crops in small farm sizes. However, milk production benefits from increased land cover as well as increased availability of feeds from other crops, like cabbage, which showed a significant increase in production.

CONCLUSION

Despite the notable positive on-farm changes, the LNB-PES scheme shows conceptual inadequacies for a functional PES initiative due to the highly evident lack of voluntary and direct negotiations with farmers in setting conditions, which is the most critical element of PES schemes. Further, this study established that there was neither a law enacted nor a corporate body or trustee established to regulate and manage the scheme; hence commercial farmers (users) contributed on the basis of willingness and the upper catchment farmers (producers) were paid on an 'ad hoc" basis.

Recommendations

The concept of Payment for Environmental Services has been touted as an important, flexible, and beneficial economic incentives-based instrument for safeguarding and enhancing land use and the sustainable provision of environmental goods and

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services that humanity relies on for sustenance (Wunder, 2007; The & Ngoc, 2008; Wunder et al., 2008; Sommerville et al., 2009; Mauerhofer, 2013; Van de Sand et al., 2014). The incentives are postulated to entice landowners to implement land-use practices that safeguard rather than degrade their land while at the same time optimising production (Coase, 1960; Muradian et al., 2010; Moros et al., 2020). However, for it to be effective, the practical application of PES must espouse certain conceptual parameters, the key of which are negotiated conditionality and a supportive institutional and policy framework (The Katoomba Group, 2008; Bac et al., 2014; Wunder, 2015). Our study indicates that the LNB-PES Scheme had weak voluntary negotiation and condition-setting mechanisms. It is therefore recommended that a reinvigorated PES regime that embodies voluntary and direct negotiations between users and producers in the setting of certain measurable environmental conditions and parameters be set up in the entire LNB as a case study for guiding the application of PES in Kenya.

The Katoomba Group (2008) acknowledges that there is limited information on whether economic incentives like PES have been successful in safeguarding and enhancing access to and affordability of quality environmental goods and services without compromising the rights of the services user and the landowner/provider. Further, most PES scholars have avoided researching the policy and enforcement perspective, leading to insufficient knowledge of the policy and institutional framework within which PES must be anchored in order to secure sustainability and equity of benefits (Greiber, 2009; Namirembe & Bernard, 2015; Moros et al., 2020). It is therefore recommended that to avoid a deviation in the practical application of PES in Kenya from its definitive conceptual attributes, a science-based policy process and conditionalities enforcement mechanism be initiated for the LNB with a view to informing the mainstreaming of the concept of PES in existing policy and institutional framework, or, the development of a national or basin-level PES policy, institutional and legislative framework.

The National Government of the Republic of Kenya through the departments responsible for environment, water and agriculture, and related institutions, as well as respective County Governments of Nakuru and Nyandarua, should provide technical extension services to land owners for the creation of woodlots and other watershed protection initiatives at farm level. This targeted land use should be part of the reinvigorated LNB Payment for Environmental Services scheme aimed at achieving watershed restoration targets, improvements in water quality and quantity as well as food security. Notably, these on-farm woodlot initiatives will also support climate change adaptation and soil erosion control functions and also represent a wider policy application of PES in Kenya.

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