Promoting Sustainable Land Use Practices and Agricultural Resources Management for Biodiversity Conservation

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Abstract

Sustainable Land use practices as well as sustainable agriculture can arguably go a long way in promoting biodiversity conservation. However, a number of factors which include unsustainable agricultural practices and poor approaches to land use, among other social factors such as poverty and growing population pose a threat to not only biodiversity conservation but also guaranteeing human wellbeing for the sake of achieving sustainable development. This paper highlights the existing challenges in this area especially in the context of Kenya, and offers some recommendations on the way forward.

1. Introduction

While the threats to biodiversity conservation in Kenya are varied and acute, human population growth and the pressure on land and renewable natural resources have been identified as are the biggest threats.[1] Arguably, current land use practices reflect the economic priorities of powerful interested parties, including governments, development banks and companies, private land holders, farmers and others.[2] A combination of anthropogenic land-use practices and climate change have been attributed to massive biodiversity loss globally.[3] Most commentators have identified the major direct causes of human-induced biodiversity loss as the fragmentation, degradation or loss of habitats (land-use change); the over-exploitation of natural resources; pollution of air and water (by several activities such as agriculture); the introduction of non-native (alien, or exotic) species and climate change-induced biodiversity loss - these factors being

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[1] Wakhungu, J.W., Waruingi, L., Agwanda, B., Awori, P., Isiche, J., Itela, S. and Njumbi, S., 'Towards a National Biodiversity Conservation Framework: Policy Implications of Proceedings of the International Conference on Biodiversity, Land-Use and Climate Change', 5.

[2] Murray MG and Williamson D, 'Current Issues in Biodiversity Conservation' [2002] Wildlife Management Working Paper (FAO), 8.

[3] Smith, M.M., Gilbert, J.H., Olson, E.R., Scribner, K.T., Van Deelen, T.R., Van Stappen, J.F., Williams, B.W., Woodford, J.E. and Pauli, J.N., 'A Recovery Network Leads to the Natural Recolonization of an Archipelago and a Potential Trailing Edge Refuge' n/a Ecological Applications e02416.

inextricably linked with some or all of the other direct causes and in turn are driven by underlying causes.[4] In addition, studies have concluded that one major cause of future species loss will be land use change from agriculture. Further, infrastructure development and settlement expansion as well as the consequences of climate change will be significant contributors to future biodiversity loss if no new policy measures are being implemented.[5]

This paper critically discusses the biodiversity conservation issues that arise from land use and agricultural activities and makes some recommendations on how to promote sustainable land use practices as well as promoting sustainable agricultural practices to promote and protect biodiversity conservation.

2. Relationship between Agriculture and Biodiversity

It is generally agreed that the services provided by biodiversity cover a large spectrum of factors contributing to the generation of agricultural income: crop yield and quality, soil fertility, pest control and pollination. Other services, such as contributions to landscape quality are not directly beneficial to the farmer, but are beneficial to the community as a whole.[6] Agricultural environments and landscapes constitute a reservoir of diversity in terms of the number of species and the number of functions useful for agriculture (pollination, recycling of organic matter, amongst others). However, intensification of agricultural practices threatens this diversity.[7] Intensification of agricultural production is believed to have led to an increase in the productivity of cultivated areas, associated with the use of mineral fertilisers and synthetic pesticides and with the "simplification" of agricultural landscapes resulting from a reduction in the diversity of production systems.[8] Thus, while agricultural intensification has allowed mankind to feed the growing world population it has been cited as one of the main drivers of worldwide biodiversity decline.[9] The effect of biodiversity decline has been felt on broad ecosystems and environmental

[4] Slingenberg, A., Braat, L., van der Windt, H., Rademaekers, K., Eichler, L. and Turner, K., "Study on understanding the causes of biodiversity loss and the policy assessment framework." (2009).
[5] *Ibid.*
[6] Le Roux, X., R. Barbault, J. Baudry, F. Burel, I. Doussan, E. Garnier, F. Herzog et al. "Agriculture and biodiversity: benefiting from synergies. Multidisciplinary Scientific Assessment." *Synthesis Report, INRA (France)* (2008), p.3.
[7] Ibid, p.1.
[8] Ibid, p.2.
[9] Kleijn, D., F. Kohler, A. Báldi, P. Batáry, E. D. Concepción, Y. Clough, M. Díaz et al. "On the relationship between farmland biodiversity and land-use intensity in Europe." *Proceedings of the Royal Society of London B: Biological Sciences* 276, no. 1658 (2009): 903-909, p.903.

aspects. For instance, freshwater ecosystems have suffered as excess nutrients from agricultural practices enter surface and ground waters and inefficient irrigation systems deplete water sources.[10] Furthermore, biological control of pests in arable fields is an important ecosystem service provided by high-diversity landscapes and species-rich enemy communities, but it can be affected by the intensification of agriculture.[11]

Inputs of mineral fertilizers and pesticides can lead to degradation of habitat quality at local-field scales, while transformation of perennial habitats (grassland) to arable fields and destructions of field boundaries and hedges leads to a loss of semi-natural habitats and simplification at landscape scales, including changes in the distribution and supply of resource for many species and the food webs building on them.[12]

It has been observed that since the world cannot stop producing food and, arguably, the world can little afford to lose more of its biological diversity, the challenge, therefore, is to find a system of agriculture that will produce food in a sustainable manner that enhances biodiversity rather than depleting it.[13]

Biodiversity is, therefore, considered important at all scales of the agricultural landscape, from the different soil microbes that help cycle nutrients and decompose organic matter, to wasps and bats that help reduce crop pests, and to birds and insects that pollinate high value crops, biodiversity helps farmers successfully grow food and maintain sustainable farm landscapes.[14] Thus, not only does the maintenance of biodiversity help ensure viable crop production, but many organisms and species have come to rely on particular agricultural landscapes for their very survival. That is, agriculture both supports, and is supported by, the maintenance of biodiversity.[15]

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[10] Geier, Bernward, Jeffrey A. McNeely, and Sue Stolton. "The relationship between nature conservation, biodiversity and organic agriculture." *Stimulating positive linkages between agriculture and biodiversity. Recommendations for building blocks for the EC-Agricultural Action Plan on Biodiversity. European Centre for Nature Conservation, ECNC Technical report series, Tilburg, The Netherlands* (2000): 101-105 at p. 102.

[11] Thies, Carsten, Sebastian Haenke, Christoph Scherber, Janne Bengtsson, Riccardo Bommarco, Lars W. Clement, Piotr Ceryngier et al., "The relationship between agricultural intensification and biological control: experimental tests across Europe." *Ecological Applications* 21, no. 6 (2011): 2187-2196, p. 2187.

[12] Ibid, p. 2187.

[13] Geier, Bernward, Jeffrey A. McNeely, and Sue Stolton. "The relationship between nature conservation, biodiversity and organic agriculture." *Stimulating positive linkages between agriculture and biodiversity. Recommendations for building blocks for the EC-Agricultural Action Plan on Biodiversity. European Centre for Nature Conservation, ECNC Technical report series, Tilburg, The Netherlands* (2000): 101-105 at p. 102.

[14] GRACE Communications Foundation, Biodiversity, available at http://www.sustainabletable.org/268/biodiversity.

[15] Ibid.

It is on this basis that this chapter discusses some viable options that can be useful in Kenya's efforts towards enhancing agricultural production through biodiversity conservation while eliminating the adverse agricultural practices and land use.

3. Sustainable Land Use and Agricultural Practices and Biodiversity Resources in Kenya: The Challenges

The Food and Agriculture Organization of the United Nations defines 'sustainable land management (SLM)' as 'comprising measures and practices adapted to biophysical and socio-economic conditions aimed at the protection, conservation and sustainable use of resources (soil, water and biodiversity) and the restoration of degraded natural resources and their ecosystem functions'.[16] SLM is associated with activities that are meant to: prevent land conversion and protect vulnerable lands; prevent and mitigate land degradation and restore degraded soils; control soil erosion; improve soil-water storage; manage soil organic matter for soil carbon sequestration; manage and enhance soil fertility; promote integrated soil–crop–water management and integrated agroforestry and agrosilvopastoral systems; rehabilitate and sustainably manage dryland environments (e.g. managing grazing and livestock; rainwater harvesting; sand-dune reclamation; oasis management; drought management; and precision agriculture); and improve crop–water productivity and manage soil salinity in irrigated dryland agriculture.[17]

The agricultural sector in Kenya comprises the following subsectors: industrial crops, food crops, horticulture, livestock, fisheries and forestry—and employs such factors of production as land, water and farmer institutions (cooperatives, associations).[18] It is estimated that Kenya has an area of about 587,000 km^2 out of which 11,000 km^2 is water. Of the remaining 576,000 km^2 landmass, only about 16 per cent is of high and medium agricultural potential with adequate and reliable rainfall. This potentially arable land is dominated by commercial agriculture with cropland occupying 31 per cent, grazing land 30 per cent, and forests 22 per cent. The rest of the land is used for game parks, urban centres, markets, homesteads and infrastructure.[19]

[16] 'SLM Practices | Land & Water | Food and Agriculture Organization of the United Nations | Land & Water | Food and Agriculture Organization of the United Nations' <https://www.fao.org/land-water/land/sustainable-land-management/slm-practices/en/> accessed 17 November 2021.
[17] Ibid.
[18] Republic of Kenya, *Agricultural Sector Development Strategy 2010–2020*, p. 1.
[19] Republic of Kenya, Agricultural Sector Development Strategy, 2010-2020, p. 9. (Government Printer, Nairobi, 2010).

Arguably, the services provided by biodiversity cover a large spectrum of factors contributing to the generation of agricultural income: crop yield and quality, soil fertility, pest control and pollination.[20] It is also worth pointing out that agricultural environments and landscapes constitute a reservoir of diversity in terms of the number of species and the number of functions useful for agriculture (pollination, recycling of organic matter, amongst others).[21]

In 2008, Kenya launched *Vision 2030*, a long term development blue print for the country, with the goal of transforming Kenya into "a newly-industrialised, middle-income country providing a high quality of life to all its citizens in a clean and secure environment".[22] Agriculture is identified as a key sector to deliver the 10 per cent economic growth rate per annum envisaged under the economic pillar. As a result, the Development Blueprint leans heavily towards promotion of a commercially-oriented, and modern agricultural sector, which it plans to accomplish by institutional reforms in agriculture and livestock, increasing productivity of crops and livestock, introducing land use policies for better utilisation of high and medium potential lands, developing more irrigable areas in arid and semi-arid lands for both crops and livestock and improving market access for our smallholders through better supply chain management. This comes with its own fair share of challenges.

Agriculture has been termed as the largest contributor to biodiversity loss with expanding impacts due to changing consumption patterns and growing populations as it destroys biodiversity by converting natural habitats to intensely managed systems and by releasing pollutants, including greenhouses gases.[23] Historically in Kenya, the colonialists used the law to appropriate all land and land-based resources from Africans and to vest them in the colonial masters.[24] In addition, the law gave the colonial authorities powers to appropriate land held by indigenous people and allocate it to the settlers.[25] The colonial authorities were, therefore, able to grant land rights to settlers in the highlands, while Africans were being driven and restricted to the native reserves. In the natives'

[20] Le Roux, X., Barbault, R., Baudry, J., Burel, F., Doussan, I., Garnier, E., Herzog, F., Lavorel, S., Lifran, R., Roger-Estrade, J. and Sarthou, J.P., 'Agriculture and Biodiversity: Benefiting from Synergies' [2008] Multidisciplinary Scientific Assessment. INRA, Paris.

[21] *Ibid*, 1.

[22] Sessional Paper 10 of 2012 on Kenya Vision 2030, Government of Kenya, Office of the Prime Minister Ministry of State for Planning, National Development and Vision 2030.

[23] Dudley N and Alexander S, 'Agriculture and Biodiversity: A Review' (2017) 18 Biodiversity 45, 31.

[24] Ogendo, HWO, *Tenants of the Crown: Evolution of Agrarian Law & Institutions in Kenya, (*ACTS Press, Nairobi, 1991), p.54.

[25] See generally the case of *Isaka Wainaina and Anor v Murito wa Indagara and others*, [1922-23] 9 E.A.L.R. 102.

reserves, there was overcrowding, soil erosion, and poor sanitation, amongst many other problems.[26] This colonial practice naturally led to massive loss of biodiversity in the country, with the Africans trying to maximize productivity in the small portions of land that they were allowed to control and cultivate for their own livelihoods.[27] Arguably, the African continent has never recovered from this and the negative effects on environment and biodiversity continue to manifest in present day land use and practices, especially in Kenya.[28] Arguably, conflicts between local groups and other more powerful actors, including both state agencies and private sector investors, remain widespread across the sub-continent and are often intensifying with strong political economic incentives for political elites and central bureaucracies to consolidate their control over natural resources.[29] In summary, some of the main challenges affecting efforts towards sustainable land management and land use are: land degradation, attributable to overgrazing; arable farming and conversion of arid and semi-arid lands to other uses; increasing population pressure; poverty; and climate change, among others.[30] There a need for conscious efforts by all stakeholders in addressing these challenges.

4. Legal and Policy Framework on Biodiversity Conservation in Land use and Agricultural Practices in Kenya

Article 60 of the Constitution of Kenya 2010 provides for the principles of land policy in Kenya and states that land in Kenya should be held, used and managed in a manner that is equitable, efficient, productive and sustainable, and in accordance with, *inter alia*, the principles of-- equitable access to land; security of land rights; sustainable and productive management of land resources; transparent and cost effective administration of land; sound conservation and protection of ecologically sensitive areas; elimination of gender discrimination in law, customs and practices

[26] See Ogendo, HWO, *Tenants of the Crown: Evolution of Agrarian Law & Institutions in Kenya*, *(*ACTS Press, Nairobi, 1991).
[27] Domínguez L and Luoma C, 'Decolonising Conservation Policy: How Colonial Land and Conservation Ideologies Persist and Perpetuate Indigenous Injustices at the Expense of the Environment' (2020) 9 Land 65; Le Billon P and Lujala P, 'Environmental and Land Defenders: Global Patterns and Determinants of Repression' (2020) 65 Global Environmental Change 102163.
[28] Domínguez L and Luoma C, 'Decolonising Conservation Policy: How Colonial Land and Conservation Ideologies Persist and Perpetuate Indigenous Injustices at the Expense of the Environment' (2020) 9 Land 65.
[29] Roe D, Nelson F and Sandbrook C, *Community Management of Natural Resources in Africa: Impacts, Experiences and Future Directions* (IIED 2009), ix.
[30] Waswa PF, 'Opportunities and Challenges for Sustainable Agricultural Land Management in Kenya' (2006) 1 environment and sustainable development: a guide for higher education in Kenya 1.

related to land and property in land; and encouragement of communities to settle land disputes through recognised local community initiatives consistent with this Constitution.[31]

The *Land Act 2012*[32] provides that-the National Land Commission should take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas. The Commission should also identify ecologically sensitive areas that are within public lands and demarcate or take any other justified action on those areas and act to prevent environmental degradation and climate change.[33] It also envisages a management body which should, on its own motion or at the request of the Commission, submit to the Commission for approval a plan for the development, management and use of the reserved public land vested in the management body. However, before submitting a plan to the Commission a management body should— (a) consider any conservation, environmental or heritage issues relevant to the development, management or use of the public land in its managed reserve for the purpose of that managed reserve; and (b) incorporate in the plan a statement that it has considered those issues in drawing up the plan; (c) submit an environmental impact assessment plan pursuant to existing law on environment; and (d) comply with the values and principles of the Constitution.[34]

The Land Act states that: - The National Land Commission shall make rules and regulations for the sustainable conservation of land based natural resources. The rules and regulations may contain—(a) *measures to protect critical ecosystems and habitats; (b) incentives for communities and individuals to invest in income generating natural resource conservation programmes; (c) measures to facilitate the access, use and co-management of forests, water and other resources by communities who have customary rights to these recourses; (d) procedures for the registration of natural resources in an appropriate register; (e) procedures on the involvement of stakeholders in the management and utilization of land-based natural resources; and (f) measures to ensure benefit sharing to the affected communities.*

The *Agriculture and Food Authority (AFA) 2016-2021 Strategic Plan*[35] also states the need to: - *Establish institutional capacity for data collection and collation on agricultural land use;*

[31] Article 60 (1), Constitution of Kenya 2010.
[32] Land Act, No. 6 of 2012, Laws of Kenya.
[33] Land Act, Section 11.
[34] Ibid, Section 17.
[35] Republic of Kenya, *Agriculture and Food Authority (AFA) 2016-2021 Strategic Plan*.

continuously monitor emerging environmental issues that affect the value chains; Enhance technical capabilities of the counties to increase agricultural production for food security and wealth creation. The overarching idea is to boost farmers' capacity to produce food crops *in more efficient, climate-resilient and ecologically responsible ways;* develop *and implement climate change adaptation and mitigation measures in agriculture responsible ways; Establish a Research Advisory Unit composed of AFA's Technical Team, and* Researchers *(KALRO, universities, other research institutions) to drive innovation in the Agricultural sub sectors; Create collaborative linkages with institutions such as KALRO, KEPHIS, Kenya Seed, universities and other research institutions on innovation and technology; Facilitate establishment of a collaborative arrangement between County Governments and KALRO on use of existing Agriculture Training Centres (ATCs) as technology transfer and innovation centres and provide technical assistance to the counties in promoting the concept of green growth economy as a way of ensuring environmental protection and sustainability through agricultural practices. AFA in conjunction with the Ministry of Environment and Natural Resources and other institutions should take on this task.*

The *National Land Policy 2009*[36] is also relevant to land-based biodiversity conservation. The overall objective of the National Land Policy 2009 is to secure rights over land and provide for sustainable growth, investment and the reduction of poverty in line with the Government's overall development objectives. The Policy also offers a framework of policies and laws designed to ensure the maintenance of a system of land administration and management that provides: All citizens with the opportunity to access and beneficially occupy and use land; economically viable, socially equitable and environmentally sustainable allocation and use of land; efficient, effective and economical operation of land markets; efficient and effective utilisation of land and land-based resources; and efficient and transparent land dispute resolution mechanisms.

The *National Spatial Plan 2015-2045* (NSP) aims at creating a spatial planning context that enhances economic efficiency and strengthens Kenya's global competitiveness, promoting balanced regional development for national integration and cohesion, optimizing utilization of land and natural resources for sustainable development, creating livable and functional human settlements in both urban and rural areas, securing the natural environment for a high quality of life and establishing an integrated national transportation network and infrastructure system.

[36] Republic of Kenya, *Sessional Paper No. 3 of 2009 on National Land Policy*, Laws of Kenya.

In order to boost agricultural productivity in Kenya, the *National Spatial Plan* seeks to develop policies and measures that will spur a positive shift in the sector such as: establishment of fertilizer factories to reduce the cost of agricultural inputs, increase investment in irrigation to reduce dependency on rain fed agriculture and increase amount of land under crop production and to ensure that each county has at least one agricultural value addition processing plant.[37]

The NSP provides strategies and policies to guide future growth of towns and assignment of roles to different urban areas.[38]

The *Urban Areas and Cities Act*, 2011[39] calls for city and municipality established under its provisions to operate within the framework of an integrated urban areas and city development planning, whose objectives should be, *inter alia*: (d) be the basis for—(i) the preparation of environmental management plans; (ii) the preparation of valuation rolls for property taxation; (iii) provision of physical and social infrastructure and transportation; (iv) preparation of annual strategic plans for a city or municipality; (v) disaster preparedness and response; (vi) overall delivery of service including provision of water, electricity, health, telecommunications and solid waste management; and (vii) the preparation of a geographic information system for a city or municipality; (e) nurture and promote development of informal commercial activities in an orderly and sustainable manner; (f) provide a framework for regulated urban agriculture; and (g) be the basis for development control.[40]

A city or urban area integrated development plan should be aligned to the development plans and strategies of the county governments.[41]

The *Preparation and Implementation of County Spatial Plans, Draft Guidelines, February 2017* is an instrument to provide support to the County Governments to facilitate preparation of County Integrated Development Plans as required by law and also to realize coordinated and sustainable development planning in the counties. The manual guides: the process of plan preparation; Visioning; stakeholder engagement; presentation of the plan outputs; plan implementation; monitoring and Evaluation framework. The Manual also provides a reference frame to enable the realization of a unified understanding of the intention of the Integrated Planning framework among

[37] National Spatial Plan 2015-2045, p.65.
[38] Ibid, p.103.
[39] Urban Areas and Cities Act, No. 13 of 2011, Laws of Kenya.
[40] S. 36, Urban Areas and Cities Act, No. 13 of 2011.
[41] S. 37, Urban Areas and Cities Act, No. 13 of 2011.

the planners, the County Governments and other public and private agencies that have a stake in County Integrated Planning.

It advocates for a mainstreaming approach in order to ensure mainstreaming of cross cutting issues into the County Spatial Plans. Such issues include, *inter alia*, land, infrastructure, tourism, agriculture, livestock and fisheries, trade, manufacturing, education and training; health; environment, water and sanitation, Population, Urbanization and Housing, Gender, vulnerable Groups and Youth, sports and culture.

The *National Horticulture Policy, 2012*, mandates the Government to finalize the development and implementation of a land- use policy which shall guide agricultural land use including land subdivision.

The *National Environment Policy, 2013* was formulated to: provide a framework for an integrated approach to planning and sustainable management of Kenya's environment and natural resources; strengthen the legal and institutional framework for good governance, effective coordination and management of the environment and natural resources; ensure sustainable management of the environment and natural resources, such as unique terrestrial and aquatic ecosystems, for national economic growth and improved livelihoods; promote and support research and capacity development as well as use of innovative environmental management tools such as incentives, disincentives, total economic valuation, indicators of sustainable development, Strategic Environmental Assessments (SEAs); Environmental Impact Assessments (EIAs), Environmental Audits (EA) and Payment for Environmental Services (PES); promote and enhance cooperation, collaboration, synergy, partnerships and participation in the protection, conservation, sustainable management of the environment and natural resources; ensure inclusion of cross-cutting and emerging issues such as poverty reduction, gender, disability, HIV&AIDS and other diseases in the management of the environment and natural resources and promote domestication, coordination and maximisation of benefit from Strategic Multilateral Environmental Agreements (MEAs).

Some of the aims of the Environment Policy were to give the framework to guide the country's efforts in addressing the ever-growing environmental issues and challenges such as: *Loss of biodiversity:* Kenya continues to lose her biodiversity due to habitat destruction, overgrazing, deforestation, pollution, unsustainable harvesting of natural resources, biopiracy and introduction

of invasive and alien species, among others. Invasive and alien species are a major threat to the environment. They threaten indigenous species through the effects of predation, alteration of habitat or disruption of ecosystem processes. The challenge of dealing with loss of biodiversity becomes even more complicated when one is dealing with shared resources where laws and policies of respective countries are not harmonized;[42] *Rehabilitation and restoration of environmentally degraded areas*: There are several degraded areas in Kenya which require rehabilitation and restoration. These include wetlands, riverbanks, deforested areas, eroded shoreline, hilltops and disused quarries and mines;[43] *Climate change, energy, security and disaster management:* Climate change poses significant environmental challenges for Kenya as evidenced by the frequent droughts and water shortages that even affect power supplies. This is happening at a time when power demand is on the rise and utilisation of renewable energy sources exclusive of hydro remains relatively low. Other adverse impacts of climate change can be seen in the form of frequent and severe natural disasters such as floods, landslides and prolonged droughts. Increased frequency and intensity of extreme climatic conditions continue to undermine the country's sustainable development. Managing climate-related disasters remains a significant challenge.[44]

The foregoing policy and statutory instruments are some of the legal tools used to lay a foundation for protection and conservation of land-based biodiversity resources.

5. Adoption of Sustainable Agricultural Production Methods and Diversification of Livelihoods

It has been argued that Agricultural land serves many purposes beyond food production and mechanisms are needed to pay farmers for wider stewardship of land resources and thus a multifunctional landscape approach balances different needs at a landscape scale while incorporating site-level specificity on land use, demand, and condition.[45] In addition, consumers are believed to play a critical role in reducing unsustainable food waste and many of the techniques and strategies for biodiversity-friendly farming systems exist; the challenge is to bring them to scale.[46]

[42] National Environment Policy, p.5.
[43] Ibid.
[44] Ibid, p.6.
[45] Dudley N and Alexander S, 'Agriculture and Biodiversity: A Review' (2017) 18 Biodiversity 45.
[46] Ibid.

Notably, under Kenya's Vision 2030, agriculture is identified as a key sector to deliver the 10 per cent economic growth rate per annum envisaged under the economic pillar. As a result, the Development Blueprint leans heavily towards promotion of a commercially-oriented, and modern agricultural sector, which it plans to accomplish through institutional reforms in agriculture and livestock, increasing productivity of crops and livestock, introducing land use policies for better utilisation of high and medium potential lands, developing more irrigable areas in arid and semi-arid lands for both crops and livestock and improving market access for our smallholders through better supply chain management.[47]

While intensification of agricultural production has the potential to lead to an increase in the productivity of cultivated areas, associated with the use of mineral fertilizers and synthetic pesticides and with the "simplification" of agricultural landscapes resulting from a reduction in the diversity of production systems in order to feed the growing world population,[48] the same has also been cited as one of the main drivers of worldwide biodiversity decline.[49] The adverse effect has been on broad ecosystems and environmental aspects such as freshwater ecosystems which have suffered as excess nutrients from agricultural practices enter surface and ground waters and inefficient irrigation systems deplete water sources,[50] while biological control of pests in arable fields which is an important ecosystem service provided by high-diversity landscapes and species-rich enemy communities can be affected by the intensification of agriculture.[51]

In addition, use of mineral fertilizers and pesticides can lead to degradation of habitat quality at local-field scales, while transformation of perennial habitats (grassland) to arable fields and destructions of field boundaries and hedges can lead to a loss of semi-natural habitats and

[47] Sessional Paper 10 of 2012 on Kenya Vision 2030, para. 3.3.

[48] Le Roux, X., Barbault, R., Baudry, J., Burel, F., Doussan, I., Garnier, E., Herzog, F., Lavorel, S., Lifran, R., Roger-Estrade, J. and Sarthou, J.P., 'Agriculture and Biodiversity: Benefiting from Synergies', p.2.

[49] Kleijn, D., F. Kohler, A. Báldi, P. Batáry, E. D. Concepción, Y. Clough, M. Díaz et al. "On the relationship between farmland biodiversity and land-use intensity in Europe." *Proceedings of the Royal Society of London B: Biological Sciences* 276, no. 1658 (2009): 903-909, p.903; Poisson, M.C., Garrett, D.R., Sigouin, A., Bélisle, M., Garant, D., Haroune, L., Bellenger, J.P. and Pelletier, F., 'Assessing Pesticides Exposure Effects on the Reproductive Performance of a Declining Aerial Insectivore' n/a Ecological Applications e02415.

[50] Geier, Bernward, Jeffrey A. McNeely, and Sue Stolton. "The relationship between nature conservation, biodiversity and organic agriculture." *Stimulating positive linkages between agriculture and biodiversity. Recommendations for building blocks for the EC-Agricultural Action Plan on Biodiversity. European Centre for Nature Conservation, ECNC Technical report series, Tilburg, The Netherlands* (2000): 101-105 at p. 102.

[51] Thies, Carsten, Sebastian Haenke, Christoph Scherber, Janne Bengtsson, Riccardo Bommarco, Lars W. Clement, Piotr Ceryngier et al., "The relationship between agricultural intensification and biological control: experimental tests across Europe." *Ecological Applications* 21, no. 6 (2011): 2187-2196, p. 2187.

simplification at landscape scales, including changes in the distribution and supply of resource for many species and the food webs building on them.[52] Soils may also deteriorate as a result of erosion, compaction, loss of organic matter and contamination with pesticides, and in some areas, heavy metals.[53]

It has rightly been argued that where the connection between producers and consumers is weak or costly, farmers' earnings are reduced, creating disincentives to adopt agricultural productivity enhancing technologies. This is because, certain types of technologies or innovations are only profitable when farmers are integrated into market.[54] Furthermore, the understanding of the structure and function of markets and value chains; farmers' output market participation level and participation of various actors and constraints along the value chain is essential for accelerating technology adoption and increasing growth of agricultural production and the competitiveness of smallholder farmers.[55]

The National Horticulture Policy, 2012 ascribes to the Government the mandate to: - e*nhance environmental conservation and measures to mitigate the effects of climate change and global warming; Encourage and offer incentives for green and conservation farming; Establish a clear framework to enhance inter-institutional coordination; Partner with the private sector to enable the country participate in carbon trading, sustainably protect fragile ecosystems like riparian areas and the country's major water towers, promote water use efficiency and adopt green energy; Introduce incentives for investment on green energy and other alternative sources of energy; Support initiatives on carbon and water trading, and green water credit; Enhance horticultural production, the Government will strengthen and harmonize public extension services to offer specialized extension services.*

The Crops Act, 2013, in Section 4 sets out that*: - the national government and county governments shall be guided by the principles in the management and administration of agricultural land that land owners and lessees of agricultural land, being stewards, have the obligation to cultivate the*

[52] *Ibid*, p. 2187.
[53] Chris Stoate and others, 'Ecological Impacts of Arable Intensification in Europe' (2002) 63 Journal of Environmental Management 337.
[54] International Centre of Insect Physiology and Ecology *(icipe),* 'Markets and Value Chains Research,' available at http://www.icipe.org/research/social-science-and-impact-assessment/markets-and-value-chains-research [Accessed on 11/07/2017].
[55] Ibid.

lands they own or lease and make the land economically productive on a sustainable and environmentally friendly manner.

Biodiversity is important at all levels of the agricultural landscape, from the different soil microbes that help cycle nutrients and decompose organic matter, to wasps and bats that help reduce crop pests, and to birds and insects that pollinate high value crops, biodiversity helps farmers successfully grow food and maintain sustainable farm landscapes.[56] Thus, not only does the maintenance of biodiversity help ensure viable crop production, but many organisms and species have come to rely on particular agricultural landscapes for their very survival. That is, agriculture both supports, and is supported by, the maintenance of biodiversity.[57]

6. Conclusion

Arguably, while secure rights, such as tenure and access to resources, can also contribute to biodiversity conservation by providing the incentives and legal frameworks for careful stewardship of resources, conservation can also impact negatively on people's rights, for example by denying access to resources, and weak rights can undermine conservation efforts.[58] There is thus a need to strike a balance between achieving conservation and ensuring that communities exploit natural resources sustainably to meet their basic needs and also improve their lives. A sustainable land management approach should ensure active participation of affected communities especially those engaged in agricultural practices, if the same is to be achieved for the sake of conservation of biological resources in the country.

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