

Olayide, Olawale Emmanuel

Working Paper

Nigeria - land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for regional development, jobs, and food security

ZEF Working Paper Series, No. 201

Provided in Cooperation with:

Zentrum für Entwicklungsforschung / Center for Development Research (ZEF), University of Bonn

Suggested Citation: Olayide, Olawale Emmanuel (2021) : Nigeria - land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for regional development, jobs, and food security, ZEF Working Paper Series, No. 201, University of Bonn, Center for Development Research (ZEF), Bonn

This Version is available at:

<https://hdl.handle.net/10419/246470>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



zef

Center for
Development Research
University of Bonn

Working Paper 201

OLAWALE EMMANUEL OLAYIDE

Nigeria - Land, climate, energy, agriculture and development
A study in the Sudano-Sahel Initiative for Regional Development,
Jobs, and Food Security



ZEF Working Paper Series, ISSN 1864-6638
Center for Development Research, University of Bonn
Editors: Christian Borgemeister, Joachim von Braun, Manfred Denich, Till Stellmacher
and Eva Youkhana

Author's address

Olawale Emmanuel Olayide
Centre for Sustainable Development
Faculty of Multidisciplinary Studies
University of Ibadan, Ibadan, Nigeria
oe.olayide@ui.edu.ng, waleolayide@yahoo.com

Nigeria – Land, climate, energy, agriculture and development

A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security

Olawale Emmanuel Olayide

Abstract

This review report involves the analysis and synthesis of literatures on climate change, land use, energy, livelihoods and sustainable development in Nigeria. The methodology employed in the review involves searching keywords related to the study objectives on relevant literature search engines and platforms, including Google Scholar and Cross Referencing through triangulation of search results. The articles were screened and validated for inclusion or exclusion based on relevance, content and context. The review process follows the sustainable livelihoods framework. The search returns are complimented with published reports. The report provides information on the current status and guidance on appropriate interventions and innovative investments in Nigeria. Specifically, this report provides a systematic literature review on: 1) situation and trends in energy and land use changes, 2) observed and projected impacts of climate change, 3) technological, socioeconomic and policy actions for sustainable land management and climate change adaptation and mitigation, 4) evaluation of existing major policies and investments, and 5) conclusion and policy implications.

Based on the assessment of literature in this study, the key trends and problems include inadequate attention to the agricultural sector over the years, which has caused a major setback in food security and productivity. Climate change has further exacerbated the problem through desertification, drought and flooding across the country. The literature further revealed inadequate energy supply, distribution and low per capita consumption in Nigeria. The use of fuel wood for heating and cooking has significantly contributed to deforestation by worsening land degradation. Resulting implications are that food security is threatened and economic growth is hampered. Land degradation negatively impacts the environment and the rural poor whose livelihoods depend on it. Opportunities in agriculture and renewable energy should be further harnessed and forest and land use policies should be enforced to ensure sustainable livelihoods. In Nigeria, policies and investment plans on land use, energy/electricity and agricultural livelihoods are not coherent and lack consistency in implementation. Thus, lack of strong institutions has resulted in the weak performance witnessed in programme and policy implementation on climate change mitigation, land use, energy and sustainable development in Nigeria. Therefore, there is a need for productive, viable, sustainable policy and programmes that support climate change mitigation, land use, energy and sustainable development in Nigeria. Another important suggestion is the need for provision of renewable energy mix (off-grid) in forms that are easily accessible and affordable by households. Adequate attention should be paid to the provision of bio-energy and the wider bio-economy framework, including the transformation of solid waste, wood waste and agricultural waste into bio-gas and energy. Overall, the investment landscape in Nigeria is improving, and various opportunities for investment in agricultural livelihoods and value chains, renewable energy, carbon trading and green bonds should be harnessed through public-private partnerships.

Keywords: Sahel, energy, climate change, land degradation, innovation, policy

JEL codes: O30, Q24, Q25, Q42, Q54, Q55, Q58

Acknowledgements

The study was funded by the “Program of Accompanying Research for Agricultural Innovation” (PARI), which is funded by the German Federal Ministry of Economic Cooperation and Development (BMZ).

Contents

- 1 Introduction 1
- 2 Situation and trends in rural energy and land use change..... 3
 - 2.1 Energy use, associated challenges and opportunities 3
 - 2.2 Projected need and per capita energy consumption 4
 - 2.3 Opportunities for investment in the energy sector 5
 - 2.4 Land degradation and land cover/use 6
 - 2.5 Causes and impacts of land degradation 8
- 3 Observed and projected impacts of climate change in Nigeria 9
 - 3.1 Observed and projected trends in extreme weather events 9
 - 3.2 Climate change, agricultural productivity, livelihoods and food security..... 9
- 4 Technological, socio-economic and policy actions for sustainable land management and climate change adaption and mitigation..... 11
 - 4.1 Technological aspects of sustainable land management, climate change and mitigation
11
 - 4.2 Socioeconomic aspects of sustainable land management and livelihoods 11
 - 4.3 Policy actions for sustainable land management, climate change and mitigation 11
- 5 Evaluation of existing major policies and investments 13
 - 5.1 National renewable energy and energy efficiency policy..... 13
 - 5.2 Policies on drought, desertification, erosion, climate change and biodiversity 13
 - 5.3 Agriculture Transformation Agenda and Agriculture Promotion Policy 14
- 6 Conclusion and policy implications..... 16
- 7 References 17

1 Introduction

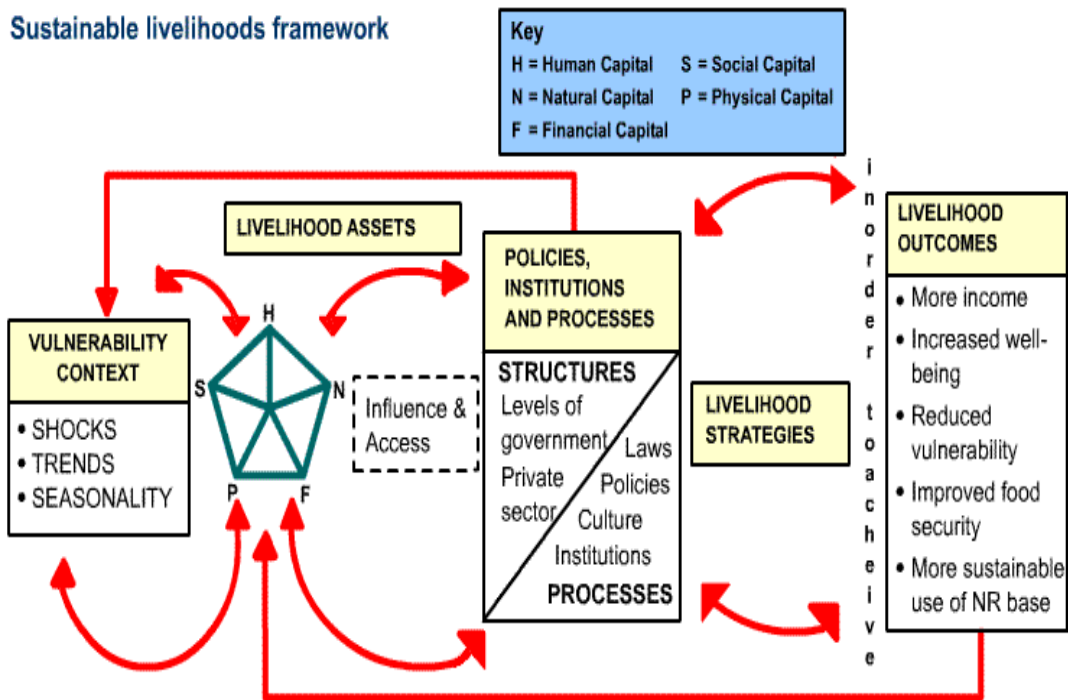
This research report provides a systematic literature review on: 1) situation and trends in energy and land use changes, 2) observed and projected impacts of climate change, 3) technological, socioeconomic and policy actions for sustainable land management and climate change adaptation and mitigation, 4) evaluation of existing major policies and investments, and 5) conclusion and policy implications for Nigeria.

Nigeria is the most populous nation in Africa. It has been governed by democratic rule since 1999. It has a growing population of about 186 million people and a GDP per capita of USD 2,178, a World Bank ease of doing business ranking of 169, and an improving corruption perception index (NBS, 2019; USAID, 2019). The mainstay of Nigeria's economy before the discovery of crude oil was agriculture. The agricultural sector provides employment for 56% of the population out of which 70% reside in the rural areas (FGN, 2012). Small-scale, resource-poor farmers dominate this population. They operate on 0.1 to 5 hectares of farmland, rely on low-level, traditional technologies and primitive production techniques, and focus on fisheries, animal husbandry and crop production (Idowu et al., 2011; Izuchukwu, 2011; Amaechi, 2018; Matemilola et al., 2017; Muhammad-Lawal et al., 2015). After independence in 1960, the country moved towards self-sufficiency and thrived in global markets as the world's largest producer of groundnuts, palm oil, cotton and cocoa. Up to the 1980s, the export of cash crops was responsible for 62.2% of foreign exchange and 66.4% of GDP (Olomola and Nwafor, 2018), with agricultural production largely practiced on subsistent and scattered plots (Matemilola et al., 2017; Muhammad-Lawal et al., 2015).

The population of Nigeria faces an energy deficit, while the natural resource (land) for the main livelihood (agriculture) is simultaneously being degraded by the impacts of climate change (Roche et al., 2019; FMP, 2020). Hence, this study assesses the nexus of climate change, energy, land use, livelihoods and sustainable development. It involves a systematic review of relevant literature to identify and triangulate key trends, problems, solutions and their implications for sustainable development in Nigeria. The methodology employed in the review involves searching keywords related to the study objectives on relevant literature search engines and platforms, including Google Scholar and Cross Referenced. The articles were screened and validated for inclusion or exclusion based on relevancy, content and context. The search returns are complimented with published reports. Further, the review study was conceptualized within the sustainable livelihoods framework (Figure 1), and underpins the various factors of vulnerability context (including climate change) which interacts with livelihood assets and policies to transform livelihood strategies into livelihood outcomes, such as reduced vulnerability and sustainable use of natural and land resource (DFID, 2001; Olayide and Ikpi, 2013).

The economy of Nigeria is undoubtedly agriculture-based (World Bank, 2008). The agriculture sector (including crops, forestry, fisheries and livestock) is practiced under interconnected systems based on natural resources (including water, land and energy). However, these resources are exposed to the impact of climate change and land degradation. Agriculture currently contributes about 22% to real GDP (NBS, 2019). The decline of the agriculture sector's contribution to Nigeria's GDP is largely attributed to the discovery of crude oil and fossil fuels in commercial quantities in Nigeria. Although the foreign exchange to the country is dominated by earnings from crude oil (NBS, 2019), agriculture is still the major driver of the economy in terms of employment and domestic food production. Thus, it is the largest non-oil contributor to the GDP (NBS, 2019). However, the country loses about USD 10 billion annually in export opportunity from crops of comparative advantage like groundnut, palm oil, cocoa and cotton due to a continuous decline in the production of these commodities (FAO, 2020). The decline in production is often attributed to climate change, lack of technological advancement, economic milieu and unfavourable policies (Olayide and Alabi, 2018).

Figure 1: The adapted sustainable livelihoods framework



Source: DFID (2001).

Climate change has had serious and unprecedented impacts in Nigeria as the most populous nation in the continent of Africa. The challenges of climate change range from economic impacts to social impacts with obvious environmental repercussions. These challenges are characterised by environmental pollution, floods, ocean surge and rapid decrease of forest resources, all of which have consequences for the environment. Literature finds that the agricultural sector is vulnerable to the impacts of climate change (Adeoti et al., 2010; Ebele and Emodi, 2016; Odunuga et al., 2014).

An adequate food production system is connected with functional energy systems. Unavailability and inaccessibility of energy/electricity has resulted into diverse constraints and complaints associated with the generation of power supply in rural Nigeria (Borok et al., 2013). This situation has led rural dwellers to improvise energy sources, including use of fuel wood as the main source for cooking and heating energy, which is predominant in the country, because only about 40% of the population has access to electricity supply with largely untapped sources of renewable energy. The national grid is also limited in reach (Energylopedia, 2019; FMP, 2015). The unbridled use of fuel wood for cooking and other domestic and construction activity is resulting in a loss of different species of forest trees to deforestation as felled trees are not replaced by new ones. This has led to an increase in the bare land (otherwise meant for trees and cultivation) and constructed lands in urban areas. Hence, the use of renewable resources such as biomass as sources of electricity has been advocated (Adaramola et al., 2011).

2 Situation and trends in rural energy and land use change

2.1 Energy use, associated challenges and opportunities

Energy is an important factor contributing to economic growth and development in Nigeria (Oyedepo et al., 2019). Biomass is used to produce bio-energy which can be used in rural and urban areas. Biomass can come in various forms such as solid waste, wood and wood waste and agricultural products and waste (Adaramola et al., 2011). Biomass and bio-fuels are potential innovative green energy sources capable of producing 2.01EJ (47.97MTOE) of energy from 168.49 million tons of agricultural residues and waste in Nigeria (Simonyan and Fasina, 2013). Furthermore, the current policy direction of the Nigerian government is to significantly increase the share of small hydro power sources as well as solar power generation to achieve energy sector goals of the sustainable development goals by 2030 (see Table 1). Hence, there is opportunity for investments in the energy sector in Nigeria.

Tab 1: Summary of renewable electricity sources and targets

Energy resource	Short-term (2015) in MW	Medium-term (2020) in MW	Long-term (2030) in MW
Hydro (LHP)	2,121.00	4,549.00	4,626.9
Hydro (SHP)	140.00	1,607.22	8,173.81
Solar	117.00	1,343.17	6,830.97
Biomass	55.00	631.41	3,211.14
Wind	50.00	57.40	291.92
% of RE plus LHP	10%	18%	20%
% of RE less LHP	1.3%	8%	16%

(FMP, 2015)

Nigeria plans to achieve energy security and to maintain its National Determined Contributions (NDC) by 2030 through the overhaul of current dysfunctional energy systems, including a transition into a low carbon energy system. Borok et al. (2013) opine that energy security could be achieved through diversification of energy supply and distribution. Thus, the policy of promoting an energy mix through renewable resources will ensure seamless transition into a low carbon energy economy while enhancing climate change mitigation, livelihood improvement, poverty reduction and sustainable development.

Due to Nigeria's over-dependence on hydro-electric power generation, the availability of sufficient water for the power plants affects power availability, especially in the dry season. Climatic variables of high temperatures coupled with low rainfall have been associated with a reduction in hydro-electric power generation and transmission (Idowu et al., 2011). Drought leads to evapotranspiration, which results in reduced water volume and reduction in hydroelectric power generating capacities. Hence, there is a need to explore alternative sources of renewable energies like solar and wind-powered energy systems. The different energy sources used in Nigeria include non-renewable resources such as coal and crude oil while renewable resources include hydro, wind, biomass, wave or tidal, geothermal and solar energy. However, inadequate legal and financing have hindered the progress in the energy sector in Nigeria (Elum and Momodu, 2017).

According to USAID (2019), the electricity capacity installed in Nigeria is 12,522MW which is divided into thermal (10,142MW) and hydro (2,380 MW). The current electricity access rate is 45% in rural and 55% in urban areas. In order to bridge the energy deficit in the country, the Federal Government of Nigeria has put some measures in place to promote investments in the energy sector. One of the

incentive schemes is the “pioneer project” which gives seven-year tax holidays to eligible industries e.g. solar energy powered equipment, cable and other electrical related equipment located in an economically disadvantaged local government area anywhere in the country (GIZ, 2015). Tariffs are developed by the Nigerian Energy Regulatory Commission (NERC) using appropriate methodology agreed upon by the project developers and consumers (FMP, 2015). The feed-in tariffs for the current medium-term Multi-Year Tariff Order (MYTO) reflect the cost and benefit of energy provision and investment in Nigeria (see Table 2). The tariffs are designed to ensure full cost recovery for investors as well as to bolster confidence in financing and investment opportunities in the energy/electricity sector.

Tab 2: Electricity feed-in tariffs – wholesale contract prices (Nigeria Naira/MWh)

Energy infrastructure type	2014	2015	2016
Hydropower plants, small up to 30 MW	27,456 (173)	29,643 (154)	32,006 (126)
Land-mounted wind power plants	28,641 (181)	30,943 (161)	33,433 (132)
Solar PV plants, ground mounted, fixed	79,116 (499)	85,401 (444)	92,195 (364)
Biomass power plants	32,000 (202)	34,572 (180)	37,357 (147)

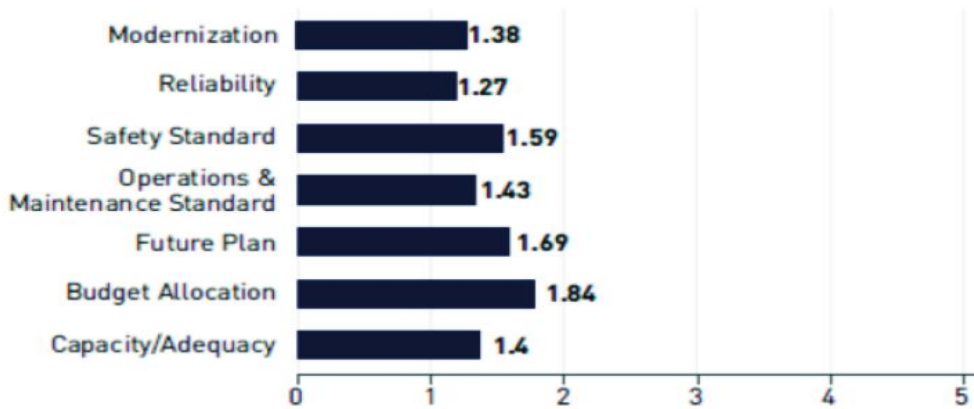
Note: Figures in parentheses are US dollar equivalent rates as adjusted by exchange rates. (GIZ, 2015)

Further, the United States Agency for International Development’s (USAID) Power Africa Project has invested in on-grid and off-grid projects in Nigeria (USAID, 2019). The project promotes energy mix systems including hydro and solar projects. For instance, the first independent power project (IPP), the Azura Project, reached financial close in 2015, and became operational in 2018. An additional USD 50 million investment was provided by the Overseas Private Investment Corporation (OPIC). The power project became operational in 2018. Rooftop solar panel kits are also being deployed to 70,000 residential and small commercial customers in Nigeria with a USD 15 million OPIC loan by Lumos Incorporated using a lease-to-own business model. General Electric, the U.S. African Development Foundation (USADF) and others under the auspices of the Power Africa initiative also awarded USD 900,000 grants to off-grid energy projects. However, the challenge of corruption often resulted in inefficiencies and unaccountability of government counterpart funds in the electricity sector (USAID, 2019).

2.2 Projected need and per capita energy consumption

The per capita electricity consumption for Nigeria in 2015 was 140 kWh, approximately 12 kWh per capita per month (World Bank and IEA, 2017; Olaniyan et al., 2018). With increasing population, the expected energy demand for lifestyle changes is also expected to increase. The low per capita electricity consumption in Nigeria is attributable to two processes – energy generation and distribution. Various factors are undermining development in energy generation and distribution in Nigeria (Okoye, 2019). For instance, on a scale of 1-5, Nigeria scored less than 2 on almost all the parameters of assessment (modernisation, reliability, safety standard, operation and maintenance standard, future plan, budget allocation, and capacity/adequacy) on power generation (see Figure 2). Hence, significant opportunities for investment would require institutional reform in the area of power generation in the energy sector in Nigeria.

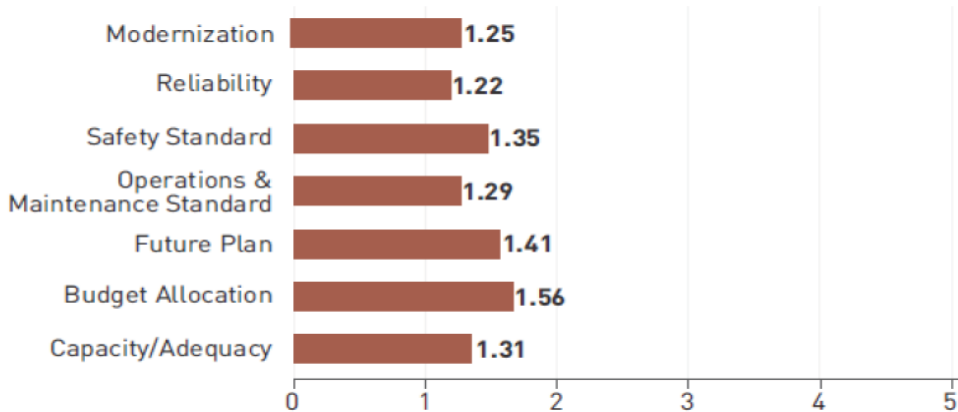
Figure 2: Electricity power generation infrastructure in Nigeria



Source: Okoye (2019).

Similarly, the parameters of modernisation, reliability, safety standard, operation and maintenance standard, future plan, budget allocation, and capacity/adequacy for power distribution in Nigeria are sub-optimal (see Figure 3). The low scores indicate specific areas for appropriate interventions and opportunities for investments and partnerships in Nigeria.

Figure 3: Electric power distribution infrastructure



Source: Okoye (2019).

2.3 Opportunities for investment in the energy sector

There is undoubtedly a huge gap in energy generation and distribution in Nigeria. For instance, average peak in energy/electricity generated in the country in the last five years ranged from 2,687.2 MW – 5,074.7 MW (FMP, 2020). However, the peak electricity demand stood at 12,800 MW. This situation leaves the country with a huge demand gap of 7,000 MW to 10,000 MW. This huge insufficiency in energy portends significant opportunities for investment in renewable energy sources at all levels of value chains, and would provide the impetus for the achievement of universal access to electricity in Nigeria. Hence, this huge energy gap carries potentials for transformative strategies to accelerate electricity coverage through on-grid and off-grid systems (Scott and Miller, 2016).

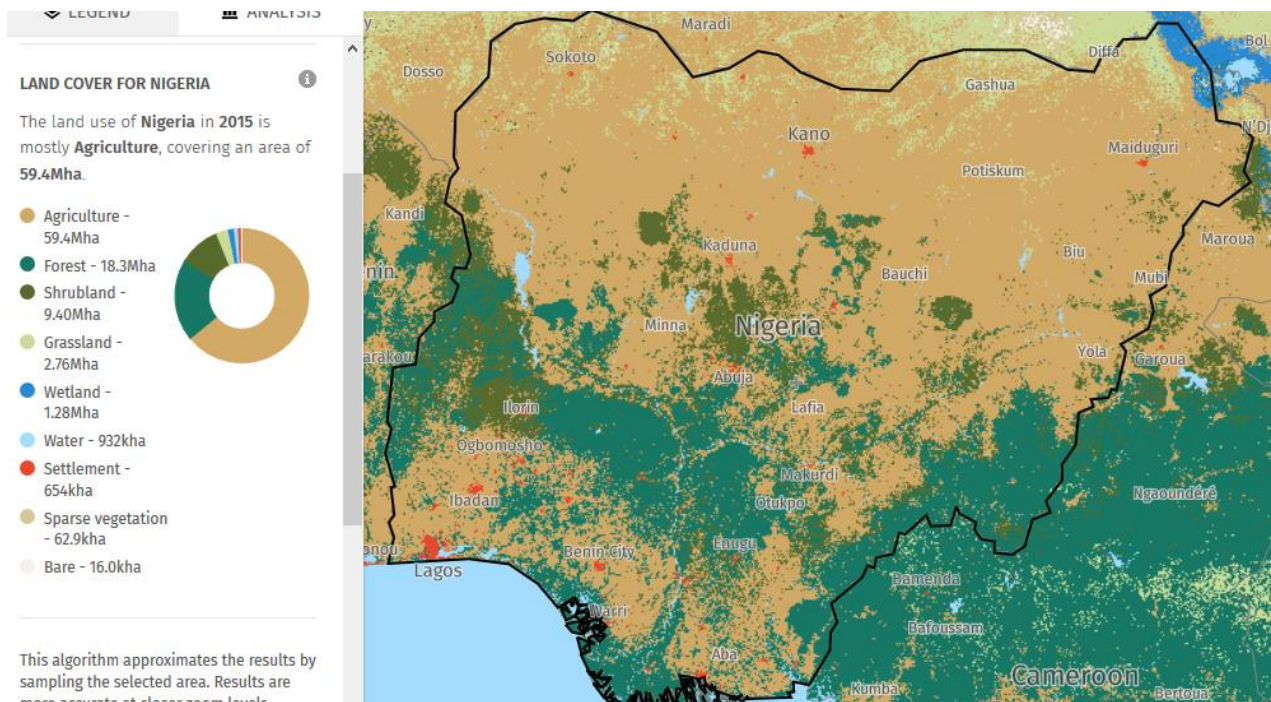
The potential for energy mix in Nigeria is waiting to be harnessed. There are opportunities to expand generation beyond the 30,000 MW from the various energy sources, including renewables and off-grid

supplies. Renewable sources include hydro, solar, wind and biomass. For instance, the country's potential to produce approximately 6.8 million m³ of biogas every day from an estimated 227,500 tons of fresh animal waste (GIZ, 2015) offers opportunities for investment. The country's potential for a renewable and sustainable energy mix should be vigorously harnessed for the multiple benefits of energy security, sustainable land use management, livelihood generation and sustainable development. Similarly, the Regional Off-Grid Electrification Project (ROGEP) supports Nigeria's acceleration of electricity access through the use of Standalone Solar Photovoltaic systems. ROGEP aims to provide Nigeria the opportunity to realize its universal electricity access goals, and is in tandem with the aspirations of the Federal Government as outlined in its 30:30:30 plan to achieve 30% renewable energy contribution to the country's energy mix by the year 2030. The 3050 MW Mambila Hydro Electric Power Project is also being executed by China Gezhouba Group Corporation and the Federal Government of Nigeria.

2.4 Land degradation and land cover/use

Land degradation is a damaging trend in land condition that is induced by human processes (ELD Initiative, 2013; Olsson et al., 2019). Land degradation has negative impacts on agricultural livelihoods and the food security of millions of Nigerians. A land cover/land use map of Nigeria (see Figure 4) reveals differential gradation from south to north in the country (Global Forest Watch, 2019). Generally, the southern part of Nigeria has a higher density of tree cover than the northern part of the country. The density of tree cover is noticeable along the River Niger and the River Benue to the Delta region. The northern part has a unimodal (one peak) rainfall regime while the southern part has a bi-modal (two peaks with a break in August) rainfall distribution. This pattern is predicted by the length of growing season which affects agricultural livelihood activities, with implications and impacts on agricultural value chains, food security and sustainable development in Nigeria (Olayide et al., 2009). The ecological challenges of the northern part of Nigeria (droughts, sand dunes and sand storms) would require greater investment in afforestation and reforestation programmes. The land cover map also correlates with the land productivity dynamics with the southern part of the country being denser and more productive than those in the northern part (LDNST, 2018). The northern part needs regular soil amendments (including fertilizer application) to enhance land productivity. The Dangote Group has recently invested two billion US dollars in fertilizer production in Lagos, Nigeria. The fertilizer firm has a production capacity of three million tons per annum of granular fertilizer.

Figure 4: Land cover in Nigeria



Source: Global Forest Watch (2019).

Further, in 2015, land use in Nigeria was mostly agriculture, which covered an area of 59.4 million ha (see Table 3). Agriculture had the largest share of the total land cover with 64% in 2019 (FAO, 2020; Global Forest Watch, 2019). Hence, this attests to the dominance of agriculture as a major livelihood enterprise in Nigeria. The share of forest cover was 19.7% in the same period. Shrub and grass land have a total share of 13%. However, recent data (LDNTS, 2018) reports that the share of forest has declined to 11% of the total land cover of the country. This decline further aggravates the level of productivity with attendant implications for climate change, energy, poverty, food insecurity and sustainable development in the country.

Tab 3: Status of land cover type in Nigeria

Land cover type	Area (Million ha)	Share (%)
Agriculture	59.40	64.1
Forest	18.30	19.7
Shrub land	9.40	10.1
Grass land	2.76	3.0
Wetland	1.28	1.4
Water body	0.93	1.0
Settlement	0.65	0.7
Bare land	0.001	0.001

(computed based on Global Forest Watch, 2019)

Furthermore, from 2001 to 2018, Nigeria lost 858,000 ha of tree cover, equivalent to an 8.5% decrease in tree cover since 2000, and 201 million tons of CO₂ emissions (Global Forest Watch, 2019). Generally, the rate of loss in tree cover is faster than the rate of recovery of tree cover on annual basis. Similarly, a total soil organic carbon loss of 1,307,187 tons is the estimated result of changes from forest land to other land use, representing 0.04% of the national soil carbon stock (LDNST, 2018; UNCCD, 2016).

Considering the multi-faceted nature of climate change impacts, halting and reversing land degradation is imperative, as is transforming land from being a source of greenhouse gas emissions to a sink by increasing carbon stocks in soils and vegetation through reforestation and afforestation programmes.

2.5 Causes and impacts of land degradation

Land degradation is a multi-impact phenomenon in Nigeria. The impact of land degradation affects the entire country, both the northern and southern parts. Sand dunes and storms, droughts, and desertification are prominent impacts of land degradation in the northern parts while soil erosion is a recurrent experience in the southern part. Flash flooding occurs in the whole country while coastal flooding occurs mostly near the coastlines in the southern part of the country (Adeoti et al., 2010; LDNTSP, 2018). According to LDNTSP (2018), land degradation results in loss of forest lands, and conversion of forest lands into shrubs and grasslands as well as an increase in bare lands. In the last decade, 463,360 ha of forestland has been lost, including, 344,710 ha that has been converted to shrubs, grasslands and sparsely vegetated areas, and 118,570 ha that has been converted to cropland. Similarly, bare lands and other areas increased by 80 ha in the same period. It was also reported that 360,340 ha of forestland was already showing declining productivity while 178,620 ha of forestland showed early signs of declining productivity.

The causes of land degradation are both direct and indirect (Geist and Lambin, 2001; Kissinger et al., 2012; LDNTSP, 2018; Millennium Ecosystem Assessment, 2005). Livelihood activities, including agriculture expansion, infrastructure development and wood extraction are the direct causes of land degradation in Nigeria. The indirect causes include changes in political governance and commodity price changes (Geist and Lambin, 2002; Obersteiner et al., 2009). Population increases, unemployment, inconsistent agricultural practices, mining, quarrying, infrastructure, transportation and energy have also aggravated land degradation in Nigeria. The resultant effects of land degradation in Nigeria include unemployment, conflict over resources (crop farmers-herdsmen conflict), food insecurity, desertification, drought, flood and erosion (LDNTSP, 2018). Most of the rural poverty experienced in Nigeria is as a result of land degradation induced by human activities. Examples of this are bush burning, deforestation and over-grazing which have led to soil erosion in the south and desert encroachment in the north. Low productivity from subsistence farming has been associated with degradation of farmland; this has also brought about the conversions of lands to marginal agricultural lands with fragile soils (Ogunlela and Ogunbile, 2006). Increasing marginal lands and soils have great tendency to increase poverty, especially in rural area. A study conducted by Ezeaku and Davidson (2008) found that land degradation has generally reduced food, water, fuel, and climate regulation with consequences such as food insecurity, increase in poverty and slow economic development. Thus, the importance of the challenge of land degradation to the nexus of food, energy and water cannot be over-emphasized. Access to energy is important for sustainable livelihoods in Nigeria. This is critical for social, economic and environmental development. Oyedepo (2012) stressed the promotion of renewable energy resources in meeting the energy needs of Nigeria. This is because energy demand is already high and is increasing without adequate and regular supply. Hence, access to clean and renewable energy would promote employment, female empowerment, economic growth, environmental sustainability and the general wellbeing of Nigerians.

3 Observed and projected impacts of climate change in Nigeria

3.1 Observed and projected trends in extreme weather events

About two-thirds of Nigeria's land mass in the northern parts of the country is prone to drought and desertification which puts its energy resources, fishing and farming culture at risk. Evidence from Lake Chad, the largest lake in the Chad Basin and an economically important water source that provides water to over 30 million people in four countries (including Nigeria), shows that the lake has shrunk by over 90% due to climate change and water withdrawals (UNEP, 2013). In 1960, Lake Chad was the fourth largest lake in Africa and the second largest endorheic lake in the world. In 1950, it covered over 37,000 km², by 1960 it dropped to cover 26,000 km², and by the mid-1990s it was further depleted, covering only 15,000 km². By the turn of the century, the lake had lost about 96% of its waters, shrinking to about 1,350 km². In fact, the lake has completely receded beyond the Nigerian border (Onuoha 2008).

The persistence of drought in the northern part of Nigeria is caused by low rainfall, which in turn led to the low water levels in streams and rivers witnessed in some communities, and ultimately lead to water scarcity that brought about economic and environmental hardships (Ozor, 2009). Olayemi (2016) noted that this situation worsened the living conditions of many people as drought affects the quantity of water available, which triggers distributional conflicts and poses major challenge of water handling and management. Anyadike (2009) reported that drought-related conflicts have resulted in the death of over 200,000 and displacement of more than two million people in Nigeria.

Similarly, the southern part of Nigeria is also confronted with the challenge of climate change. This is specifically linked to its expansive 800 km coastline, which is prone to ocean surges, heavy storms and floods (Kunlere et al., 2018). Over the period of 1985 to 2014, the country has been exposed to floods that have negatively impacted over 11 million people, causing 1,100 deaths alongside property damaged amounting to USD 17 billion (Nkwunonwo et al., 2015). The country has suffered degrees of flooding (coastal and flash flooding) and climate related disasters with extremely high externalities due to diverse factors (Adeoti et al., 2010; Ajayi et al., 2012). The frequency and intensity of flooding has been increasing in the country. For instance, 32 of the 36 states in Nigeria experienced flooding incidences with catastrophic outcomes in 2018 (Ikpefan and Okeke, 2018) along with increased inundation (Odunuga et al., 2014).

3.2 Climate change, agricultural productivity, livelihoods and food security

There is increasing evidence of the impacts of climate change on agricultural productivity, agricultural livelihoods and food security. Idowu et al. (2011) and Olayide et al. (2016a) noted that due to the over-dependence of the Nigerian cropping system on rainfall, agricultural productivity and livelihoods have been significantly impacted. As a response to changing climatic variables, farmers from the southern parts of the country are now adapting to the change in weather through cultivation of crops that require heavy rains. Farmers in the northern part of the country consider rain scarcity before crops are planted, and seasonal migration of herders has been more frequent. Moreover, decline in cereal crop (including millet and maize) yields is linked to variability in rainfall and drought conditions (Adejuwon, 2005, 2006; El-Tantanwi et al., 2018; Lebel and Ali, 2009; Odekunle, 2004).

Further, Mereu et al. (2018) showed through a simulation model that a 70% decrease in crop yields is expected by 2050 due to climate change under a business as usual scenario. The study substantiated

the case for rice as the most affected crop with a yield decline of 7% in 2020 and 25% in 2050. Rainfall variability and increased temperature has reduced the quantity of pastoral lands, resulting in annual variability of livestock flocks caused by diseases and pests (e.g. foot rot and mange), thereby impacting accruable profits and necessitating cuts to investment by over 20% per annum (Idowu et al., 2009).

Climate change impacts food security, however food insecurity implies unavailability, inaccessibility and poor utilisation of food (Dutse and Ibrahim, 2013). Food insecurity results from increased crop failure and loss of livestock. In some areas diminishing returns are already setting in with a loss in the length of growing days of 20%. Growth rates of major staples like maize, guinea corn, millet and rice are suppressed by a rise in temperature. In addition, infestation by pests and diseases is affected by variability in climate, thus hampering food storage. Further, Onyia et al. (2015) identified the link between change in climate and conflict in the country. According to the report, the migration of herdsmen and their animals to the southern part of the country in search for water and greener pastures has resulted in conflicts. Rural-urban migration has been said to be the main cause of conflict in northern Nigeria. These are the new realities induced by climate change. Drought, desertification and deforestation are recurrent and now occur at alarming rates in northern Nigeria as a result of water scarcity and pasture inadequacy. This situation has made cattle herders begin their annual migration to the south earlier and forces them to stay in the southern fields for longer periods in the hope that the fields in the north would have had enough time to be fully regenerated.

4 Technological, socio-economic and policy actions for sustainable land management and climate change adaption and mitigation

4.1 Technological aspects of sustainable land management, climate change and mitigation

Nigeria has a low level of agro-technological advancement in land management and climate change response, including irrigation systems for adapting to climate change and enhancing climate smart agriculture since only 1% of irrigated arable lands are under irrigation (Olayide et al. 2016a). The National Adaptation Strategy and Plan of Action policy underscores climate-specific and climate-sensitive variables (Olayide et al., 2016b). The strategies promoted for climate change adaption and mitigation in Nigeria include the expansion of irrigated area, flood plain agriculture (Fadama), water harvesting, crop diversification, adoption of drought tolerant crop and planting materials, organic farming, agro-forestry, afforestation and reforestation as well as development of water catchments, rangeland and cattle ranges (Ruga settlements). The impact of climate change is also considered in technologies' electrical infrastructure. For instance, solar-powered irrigation systems are advocated for as a form of renewable energy mix. Although agricultural and energy policies are often not in tandem with environmental policy in terms of how specific numbers and projections are made (FMARD, 2015; FMP, 2015, 2020), it is noteworthy that renewable sources of energy are specified as a source of energy for promoting climate-smart agriculture in Nigeria (Olayide et al., 2016b).

4.2 Socioeconomic aspects of sustainable land management and livelihoods

Various sustainable land management (SLM) and livelihood strategies are practiced at the farm and community levels in Nigeria. Farmers diversify into various production systems, including cereal-legume systems, crop-livestock systems, agroforestry, planting of indigenous climate-resilient crops, seasonal migration from drought-affected or flood-affected areas and off-farm activities (Adeoti et al., 2010; Olayide et al., 2009; Olayide et al., 2019; Sanz et al., 2017). These sustainable land management and livelihood strategies reduce uncertainties and risk associated with agricultural livelihood activities in the face of climate change (Pender et al., 2009). The strategies also reveal underlying social and economic responses to climate change impacts in Nigeria. The sustainable livelihoods framework adapted for this study incorporates social and financial capitals for enhancing livelihood outcomes, including more sustainable management of the natural (land) resource base, as well as social justice and principles of equity, especially among people who are economically and environmentally vulnerable (Odunze, 2019).

4.3 Policy actions for sustainable land management, climate change and mitigation

Climate smart agriculture is gaining momentum as a strategy for handling climate impacts while at the same time promoting climate change mitigation, climate change adaptation, climate resilience, and increasing productivity of livelihoods (Olayide et al., 2016a). Specifically, climate smart agriculture enhances and equips farmers and others with agricultural livelihoods with the strategies, trainings and

tools necessary for enhancing food systems. A general summary of the Nigerian government’s National Adaption Strategy and Plan of Action on Climate Change (NASPA-CCN) envisions integrating climate adaptation with sustainable development while also seeking to reduce vulnerability and enhance resilience and capacity of all economic sectors and people, especially women, children, the resource-poor and people with disabilities. It also seeks to reduce or minimize risks by improving adaptive capacities to deal with land degradation, drought, flooding and erosion (Olayide et al., 2016a).

Land degradation and drought are strongly correlated (Reichhuber et al., 2019), and sustainable land management has been proven to be a holistic approach for achieving land restoration and regeneration (Sanz et al., 2017; Pender et al., 2009). Nigeria’s strategies for promoting sustainable land management are focused on combating desertification, land degradation, drought and erosion while promoting climate change mitigation, climate change adaptation and renewable energy (see Table 4). The proportional allocation of the investment needs of the strategies and technological responses/practices reveal that the use of agroforestry practices and animal waste management to improve cropland productivity has the highest financial need. The investment outlay reveals that the use of agroforestry practices to improve cropland productivity receives the largest share. The use of agroforestry practices and animal waste management are consistent with sustainable land management and resource conservation with high potential for bio-gas generation for electricity, livelihood activities, green enterprises, and climate change mitigation. Similarly, the investment plans include the introduction of financially viable alternative options for the prevention of bush/forest encroachment. The strategies have the potential to enhance carbon trading, secure land tenure and land rights and empower women in forest-based and non-forest-based product utilisation.

Tab 4: Strategies and investment plan for reversing land degradation in Nigeria (to be achieved by 2030)

Strategies and technological responses/practices^a	Area (Ha)	Investments required (USD)^b	*Share (%) of total investment required
Reforestation with local species, expanding irrigation, rainwater harvesting, conservation agriculture, agroforestry	528,000	47,520,000	0.02
Community-based forest management, livelihood diversification	3,776,000	339,840,000	0.18
Avoiding further decline of forest through economic incentives (rehabilitation), conservation agriculture, agroforestry	214,654,000	19,318,860,000	9.96
SLM practices to avoid overgrazing, SLM practices to avoid soil erosion, rotational grazing, addressing invasive bush encroachment, afforestation and enforcing compensation	188,240,000	16,941,600,000	8.73
Use of agroforestry practices to improve cropland productivity, animal waste management	1,228,770,000	110,589,300,000	56.99
Introduce financially viable alternative options for the prevention of bush encroachment	5,202,640	46,823,760,000	24.13
Total		194,060,880,000	100

Note: *Computed. a Sustainable land management practices based on Sanz et al., 2017; b Cost estimations: Reforestation to USD 9,000/ha or USD 900,000/sq km, 1 sq km = 100 ha). Based on Summers et al. (2015). (LDNST, 2018)

5 Evaluation of existing major policies and investments

There are various policies and strategic plans that are related to land degradation, climate change, energy, livelihoods, and sustainable development in Nigeria. However, of the specific policies that directly focus on land degradation, climate change, energy, livelihoods, and sustainable development, the National Economic Recovery Growth Plan (NERGP) and the National Policy on Environment are overarching. The National Economic Recovery Growth Plan (2017-2020) specifies the path for economic growth and recovery after the 2016 recession while the National Policy on Environment covers most areas of the environment, including agriculture, energy, natural resources, and climate change. For empirical review purposes, the National Renewable Energy and Energy Efficiency Policy; Policies on Drought, Desertification, Erosion, Climate Change and Biodiversity; Agriculture Transformation Agenda; and Agriculture Promotion Policy are presented in this report. The identified policies and programmes have direct implications on the themes of land degradation, climate change, energy, livelihoods, and sustainable development.

5.1 National renewable energy and energy efficiency policy

The National Renewable Energy and Energy Efficiency Policy (NREEEP) is consistent with the adoption and ratification of the United Nations Sustainable Development Goals (SDGs), especially the goals on affordable and clean energy (SDG 7) and climate action (SDG 13). Similarly, the NREEEP envisions that 30% of the electricity mix will be renewable energy by 2030. This vision statement on renewable energy mix is popularly referred to as EV: 30:2030. The investment plan for the energy mix agenda is coordinated by the Nigerian Energy Regulatory Commission (NERC) and uses appropriate methodology agreed upon by the project stakeholders (developers and consumers) to compute feed-in tariffs that reflect the cost and benefit of energy provision and investment. Nigeria has also witnessed improvement in the ease of doing business index and corruption perception index (USAID, 2019) which have influenced the level of confidence that investors have in the Nigerian business environment. Similarly, the potential for expansion of energy reach in the country has also spurred more investment in the electricity section (off-grid and on-grid).

5.2 Policies on drought, desertification, erosion, climate change and biodiversity

The policies include the National Drought and Desertification Policy, National Policy on Drought Preparedness, National Policy on Climate Change, National Adaptation Strategy and Action Plan, National Erosion and Flood Control Policy, National Forestry Policy and the National Biodiversity Strategy and Action Plan. The Federal Ministry of Environment and the relevant ministries, departments and agencies are charged with the responsibility of implementing these policies with specific programmes and projects including the Land Degradation Neutrality Target Setting (LDNTS), Reducing Emission from Deforestation and Forest Degradation (REDD+), and the Great Green Wall Programme (GGWP).

The land degradation neutrality target setting programme (LDNTS, 2018) is benchmarked with the sustainable development goals (SDGs) with a baseline of 2015. The specific targets of land degradation neutrality are to improve land productivity, rehabilitate land with low productivity, retard further degradation and reduce soil sealing. The operational frameworks are implemented at national,

regional and continental levels. The programme activities are in form of afforestation, reforestation and soil reclamation. There are various engagements in the schemes like the Africa Forest Landscape Restoration Initiative, Reducing Emissions from Deforestation and forest Degradation (REDD+), and the green belt Sahelian projects. Similarly, the Great Green Wall Programme (GGWP) promotes alternative livelihoods through the establishment of 1,280 ha of community vegetable gardens and procurement and distribution of over 100,000 improved woodstoves, solar cookers, and solar lanterns as well as a pilot project on bio-gas production (UNCCD, 2016). The domestic funding sources are national budgets, ecological funds and other sources. The international and regional funding sources include the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD), African Union Commission and the Economic Community of West African States (ECOWAS).

5.3 Agriculture Transformation Agenda and Agriculture Promotion Policy

The Agriculture Transformation Agenda was implemented from 2011-2014 (FMARD, 2015). The policy succeeded in creating a database of reported farmers even though it is grossly inadequate for identifying genuine farmers and their locations. Similarly, the creation of special funds to support farmers did not lead to improvement in the backlog of unpaid Growth Enhancement Scheme funds. The increase in rice paddy production from 2.0 to 2.5 million tons has not bridged the demand gap as the import of rice has increased and exceeded USD 1 billion/annum. Market access is critical for food security. The re-establishment of some commodity marketing boards might have created illegal food imports which undermined the efforts of farmers and deprived them of market opportunities

On the other hand, the current agricultural policy is termed the Agriculture Promotion Policy (FMARD, 2015). The policy document has three thematic areas: (i) productivity enhancements; (ii) crowding in private sector investment; and (iii) Ministry of Agriculture and Rural Development institutional realignment. The sub-themes of productivity enhancements include measures for accessing land for agricultural enterprises; soil amendment and fertility; accessing information and knowledge; accessing inputs; production systems management; storage facilities; processing facilities; and marketing and trade facilities and infrastructure. The sub-themes on crowding in private sector investment are access to finance and agribusiness investment development. Table 5 highlights the constraints and expected policy impact of agriculture promotion. It can be deduced that the policy, which is expected to be revised by 2020, is currently under-performing in the areas of facilitating access to agricultural land and finance, improvement of soil fertility and irrigation for agricultural productivity, and empowerment of women and youth.

Tab 5: Summary of Constraints and Expected Policy Impact of Agriculture Promotion Policy (2016 – 2020)

Theme	Item	Constraints	Expected policy response	Remarks
Productivity enhancements	Access to land and land management	Unconducive land use rights for agricultural activities, including access to loans due to request for collateral assets	Incentivize land use rights to raise investment and productivity	Situation is changing. There is improvement in land rights and agri-preneurship
	Soil fertility	Soil fertility and desertification	Erosion control and tree planting	Situation is expected to change. Plan underway to plant 25 million trees
	Irrigation	Inadequate investment in equipment and facilities	Promote water conservation by harvesting	Changing. Plan underway to plant 25 million trees
Crowding in private sector investment	Access to finance	Inadequate access to credit and insurance	Increase public sector funding of agriculture to 10% of the national budget	Situation is not changed. Current allocation is still less than 3%
Ministry of Agriculture and Rural Development institutional realignment	Youth and women	Inadequate entrepreneurship capacity of women and youth	Increase and build entrepreneurship capacity for women and youth	Situation is changing. More women and youth are engaging in agri-preneurship
	Climate smart agriculture	Mismanagement of agricultural land, water and genetic resources	Use of appropriate technologies in the management of agricultural land, water and genetic resources	Situation is changing. Climate smart agriculture is increasingly being promoted.

(Agricultural Promotion Policy according to FMARD, 2015)

6 Conclusion and policy implications

This report contains a systematic review of literature on the nexus of climate change, land use, energy, livelihoods and sustainable development in Nigeria. The review process follows the sustainable livelihoods framework and specifically provides information on: 1) situation and trends in energy and land use change, 2) observed and projected impacts of climate change, 3) technological, socioeconomic and policy actions for sustainable land management and climate change adaptation and mitigation, 4) evaluation of existing major policies and investments, and 5) conclusion and policy implications.

Based on the assessment of literature in this study, the key trends and problems include inadequate attention to the agricultural sector over the years, which has caused a major setback in food security and productivity. Climate change has further worsened the problem through desertification, drought and flooding across the country. There is inadequate energy supply, distribution and low per capita consumption in Nigeria. The use of fuel wood for heating and cooking has significantly contributed to deforestation and has worsened land degradation. The implications of these factors are that food security is threatened and economic growth is hampered. Land degradation negatively impacts the environment and the rural poor whose livelihoods depend on it. Adequate attention should be paid to the agricultural sector through sustainable land management. Additionally, opportunities in the renewable energy sector should be further harnessed and forests and land use policies should be enforced to ensure sustainable livelihoods. Policies and investment plans on land use, energy/electricity and agricultural livelihoods in Nigeria are not coherent and lack consistency in implementation. Therefore, there is a need for productive, viable and sustainable policies and programmes that support climate change mitigation, land use, energy and sustainable development in Nigeria. Another important suggestion is the need for the provision of a renewable energy mix (off-grid) in forms that are easily accessible and affordable by households. Adequate attention should be paid to the provision of bio-energy in the wider bio-economy and the sustainable livelihoods framework, including the transformation of solid waste, wood waste and agricultural waste into bio-gas and energy.

Overall, the investment landscape in Nigeria is improving, and various opportunities for investment in agricultural livelihoods, renewable energies, carbon trading and green bonds should be harnessed through public-private partnerships for overall sustainable development in Nigeria. There are favourable policies and incentives, especially in the agricultural and renewable energy sectors in Nigeria. Investment opportunities in agriculture and energy/electricity offers concessionary interest rates and tax holidays, including through build, operate and transfer business models. The country's potential for renewables and a sustainable energy mix should be vigorously harnessed for the multiple benefits of energy security, sustainable land use management, livelihood generation and overall sustainable development of the country. The country should also ensure policy consistency, legal frameworks and adequate financing of projects and programmes.

7 References

- Adaramola, M.S., Paul, S.S., and Oyedepo, S.O. (2011). Assessment of electricity generation and energy cost of wind energy conversion systems in North Central Nigeria. *Energy Conversion and Management* 52(12), 3363-3368. <https://doi.org/10.1016/j.enconman.2011.07.007>.
- Adejuwon, J.O. (2005). Food crop production in Nigeria. I. Present effects of climate variability. *Climate Research* 30(1), 53-60. <https://www.jstor.org/stable/24869233>.
- Adejuwon, J.O. (2006). Food security, climate variability and climate change in Sub Saharan West Africa: A final report submitted to Assessments of Impacts and adaptations to Climate Change (AIACC). Project No. AF 23. The International START Secretariat: Washington, DC, USA. Available at: https://sedac.ciesin.columbia.edu/aiacc/progress/FinalRept_AIACC_AF23.pdf (Accessed on November 13th, 2020).
- Adeoti, A.I., Olayide, O.E., and Coster, A.S. (2010). Flooding and welfare of fishers' households in Lagos State, Nigeria. *Journal of Human Ecology* 32(3), 161-167. <https://doi.org/10.1080/09709274.2010.11906335>.
- Adesiji, G.B., Falola, A., and Abikoye, O.G. (2015). Effect of agricultural programmes on the livelihood of the vulnerable group: A case study of the Fadama III programme in Kwara State, Nigeria. *Acta Universitatis Sapientiae, Agriculture and Environment* 7(1), 23-35. <https://doi.org/10.1515/ausae-2015-0002>.
- Ajayi, O., Agbola, S.B.; Olokesusi, B.F., Wahab, B., Taiwo, O.J., Gbadegesin, M., Taiwo, D.O., Kolawole, O., Muili, A., Adeola, M.A., Olutade, O.G., Shiji, F., and Abiola, N.A. (2012). Flood management in an urban setting: A case study of Ibadan Metropolis. In: Martins, O., Idowu, O.A., Mbajiorgu, C.C., Jimoh, O.D., and Oluwasanya, G.O. (eds.), *Hydrology for disaster management. A special publication of the Nigerian Association of Hydrological Sciences* (pp. 65-81).
- Amaechi, L.N. (2018). Food security and sustainable agricultural development in Nigeria. *The International Journal of Social Sciences and Humanities Invention* 5(6), 4765-4768. <https://doi.org/10.18535/ijsshi/v5i6.01>.
- Anyadike, R.N.C. (2009). Climate change and sustainable development in Nigeria: Conceptual and empirical issues. African Institute for Applied Economics, Enugu Forum Policy Paper 10. Available at: <https://media.africaportal.org/documents/Polycypaper10.pdf>. (Accessed on January 21st, 2020).
- Borok, M.I., Agandu, A.J., and Morgan, M.M. (2013). Energy security in Nigeria: Challenges and way forward. *International Journal of Engineering Science Invention* 2(11), 1-6. Available at: [http://www.ijesi.org/papers/Vol%202\(11\)/Version-1/A0211010106.pdf](http://www.ijesi.org/papers/Vol%202(11)/Version-1/A0211010106.pdf). (Accessed on November 18th, 2020).
- DFID (Department for International Development) (2001). Sustainable Livelihoods Guidance Sheets. 27 pp. Available at: www.livelihoods.org/info/info-Guidancesheets.htm//6. (Accessed on November 4th, 2008).
- Dutse, U.Y., and Ibrahim, D.B. (2013). Potential challenges of climate change to the Nigerian economy. *IOSR Journal of Environmental Science, Toxicology and Food Technology* 6(1), 7-12.
- Ebele, N.E., and Emodi, N.V. (2016). Climate change and its impact in Nigerian economy. *Journal of Scientific Research & Reports*, 10(6), 1-13. <https://doi.org/10.9734/JSRR/2016/25162>.
- El Tantawi, A.M., Anming, B., and Ruma, M.M. (2018). Climate change in the semi-arid region of Nigeria and possible impacts on livelihoods. In: Friedrich-Ebert-Stiftung (ed.), *Climate Change and Socio-ecological Transformation in Nigeria: Challenges and Opportunities* (pp. 51–87). Friedrich-Ebert-Stiftung. Available at: <http://library.fes.de/pdf-files/bueros/nigeria/15450.pdf>. (Accessed on November 13th, 2020).

- ELD Initiative (2013). The rewards of investing in sustainable land management. Interim Report for the Economics of Land Degradation Initiative: A global strategy for sustainable land management. Available at: www.eld-initiative.org/. (Accessed on January 21st, 2020).
- Elum, Z.A., and Momodu, A.S. (2017). Climate change mitigation and renewable energy for sustainable development in Nigeria: A discourse approach. *Renewable and Sustainable Energy Reviews* 76, 72-80.
- Energypedia (2019). Nigeria energy situation. Available at: https://energypedia.info/wiki/Nigeria_Energy_Situation. (Accessed on January 21st, 2020).
- Ezeaku, P., and Davidson, A. (2008). Analytical situation of land degradation and sustainable management strategies in Africa. *Soil Science* 4, 1813-223504.
- FAO Statistics (1992). Irrigation sub-sector reviews. Investment Centre Report. 89-91.
- FAO (2020). FAO tracks climate smart agriculture practices in Northeast Nigeria with support from Norway. Available at: <http://www.fao.org/nigeria/news/detail-events/en/c/1188031/>. (Accessed on January 21st, 2020).
- FAO (2020). Nigeria at a glance. Accessed on January 21, 2020. Available at: <http://www.fao.org/nigeria/fao-in-nigeria/nigeria-at-a-glance/en>.
- Federal Government of Nigeria (FGN) (2012). Nigeria's path to sustainable development through green economy: A country report to the Rio+2012. Abuja, Nigeria.
- FGN (2017). Implementation of the SDGs: A national voluntary review. Available at: <https://sustainabledevelopment.un.org/content/documents/16029Nigeria.pdf>. (Accessed on January 21st, 2020).
- Federal Ministry of Agriculture and Rural Development (FMARD) (2015). Agricultural Promotion Policy. 59pp.
- Federal Ministry of Power (FMP) (2015). National renewable energy and energy efficiency policy. Available at: <http://admin.theiguides.org/Media/Documents/NREEE%20POLICY%202015-%20FEC%20APPROVED%20COPY.pdf>. (Accessed on January 21st, 2020).
- Federal Ministry of Power (FMP) (2020). Power statistics. Available at: <http://www.power.gov.ng>. (Accessed on January 21st, 2020).
- Geist, H., and Lambin, E. (2001). What drives tropical deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. Land-Use and Land-Cover Change (LUCC) Project, International Geosphere-Biosphere Programme (IGBP). LUCC Report Series 4. Available at: <https://agris.fao.org/agris-search/search.do?recordID=GB2013200077>. (Accessed on January 21, 2020).
- Geist, H., and Lambin, E. (2002). Proximate causes and underlying driving forces of tropical deforestation. *BioScience* 52(2), 143–150.
- GIZ (2015). The Nigerian energy sector: An overview with a special emphasis on renewable energy, energy efficiency and rural electrification. Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH. Available at: <https://www.giz.de/en/downloads/giz2015-en-nigerian-energy-sector.pdf>. (Accessed on January 21st, 2020).
- Global Forest Watch (2019). Land use in Nigeria. Available at: www.globalforestwatch.org. (Accessed on January 21st, 2020).
- Idowu, A., Ayoola, S., Opele, A., and Ikenweiwe, B. (2011). Impact of climate change in Nigeria. *Iranica Journal of Energy & Environment* 2, 145-152.
- Ikpefan, F., and Okeke, R. (2018). Agency to Lagos, Ogun, and Osun, 31 others: Prepare for floods. *The Nation Newspaper*, Friday, May 11, p. 9.

- IPCC (2007). Climate Change 2007 – Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. In: Parry, M. L.; Canziani, O. F.; Palutikof, J. P.; van der Linden, P. J., and Hanson, C. E. (eds.). Cambridge University Press, Cambridge, UK.
- IPCC (2007). Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf. (Accessed on January 21st, 2020).
- IPCC (2012). Managing the risks of extreme events and disasters to advance climate change adaptation (SREX). Special Report of the Intergovernmental Panel on Climate Change (IPCC). Geneva, IPCC Secretariat. Available at: <https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation>. (Accessed on January 21st, 2020).
- Olsson, L., Barbosa, H., Bhadwal, S., Cowie, A., Delusca, K., Flores-Renteria, D., Hermans, K., Jobbagy, E., Kurz, W., Li, D., Sonwa, D.J., and Stringer, L. (2019). Land degradation. In: Shukla, P.R., Skea, J., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.-O., Roberts, D.C., Zhai, P., Slade, R., Connors, S., van Diemen, R., Ferrat, M., Haughey, E., Luz, S., Neogi, S., Pathak, M., Petzold, J., Portugal Pereira, J., Vyas, P., Huntley, E., Kissick, K., Belkacemi, M., and Malley, J. (eds.), Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (pp. 345-436). Available at: https://www.ipcc.ch/site/assets/uploads/sites/4/2019/11/07_Chapter-4.pdf. (Accessed on November 18th, 2020).
- Izuchukwu, O.O. (2011). Analysis of the contribution of agricultural sector on the Nigerian economic development. *World Review of Business Research* 1(1), 191-200.
- Kissinger, G., Herold, M., and De Sy, V. (2012). Drivers of deforestation and forest degradation: A synthesis report for REDD+ policymakers. Lexeme Consulting, Vancouver Canada, August 2012. Available at: <https://www.cifor.org/knowledge/publication/5167>. (Accessed on January 25th, 2020).
- Kunlere, I.O., Ogwugwa, V.H., and Olubodu, O.O. (2018). How new climate change realities are inspiring smarter Nigerian societies. In: Friedrich-Ebert-Stiftung (ed.), Climate change and socio-ecological transformation in Nigeria: Challenges and opportunities (pp. 17-50). Available at: <http://library.fes.de/pdf-files/bueros/nigeria/15450.pdf>. (Accessed on November 18th, 2020).
- Lambin, E.F., Geist, H.J., and Lepers, E. (2003). Dynamics of land use and land cover change in tropical regions. *Annual Review of Environment and Resources* 28, 206-241.
- LDNTSP (Land Degradation Neutrality Target Setting Programme) (2018). Nigeria: Final report of the Land Degradation Neutrality Target Setting Programme. 47 pp. Available at: https://knowledge.unccd.int/sites/default/files/ldn_targets/Nigeria_LDN_TSP_Country_Report.pdf. (Accessed on January 25th, 2020).
- Le, Q.B., Nkonya, E., and Mirzabaev, A. (2016). Biomass productivity-based mapping of global land degradation hotspots. In: Nkonya, E., Mirzabaev, A., and von Braun, J. (eds.). Economics of land degradation and improvement – A global assessment for sustainable development (pp. 55-84). Springer International Publishing.
- Lebel, T., and Ali, A. (2009). Recent trends in the Central and Western Sahel rainfall regime (1990–2007). *Journal of Hydrology* 375, 52-64.
- Matemilola, S., and Elegbede, I. (2017). The challenges of food security in Nigeria. *Open Access Library Journal* 4, e4185. <https://doi.org/10.4236/oalib.1104185>.

- Mereu, V., Santini, M., Cervigni, R., Augeard, B., Bosello, F., Scoccimarro, E., Spano, D., and Valentini, R. (2018). Robust decision making for a climate-resilient development of the agricultural sector in Nigeria. In: Lipper, L., McCarthy, N., Zilberman, D., Asfaw, S., and Branca, G. (eds.), *Climate smart agriculture: Natural resource management and policy*, vol. 52. Springer, Cham.
https://doi.org/10.1007/978-3-319-61194-5_13
- Millennium Ecosystem Assessment (2005). *Ecosystems and human well-being: Synthesis*. Island Press, Washington, DC. Available at:
<https://www.millenniumassessment.org/documents/document.356.aspx.pdf>. (Accessed on January 25th, 2020).
- Morgan, S. (2017). *Climate Change Mitigation Opportunities Index 2017: Navigating in-country opportunities for technology-enabled sustainable investing*. Institute for Sustainable Investing. Available at: https://www.morganstanley.com/content/dam/msdotcom/ideas/climate-change-mitigation-index/MorganStanley_EIU-ClimateChangeIndex_Report.pdf. (Accessed on January 25th, 2020).
- Muhammad-Lawal, A., Salau, S.A., and Olawusi, C.O. (2015). Sorghum storage and pest control among farming households in Kwara State, Nigeria. *Tropical Agricultural Research & Extension*, 18, 68-75. <https://doi.org/10.4038/tare.v18i2.5326>.
- Munishi, P.K.T., Shear, T.H., and Temu, R.P.C. (2006). Household level impacts on forest resources and the feasibility of using market-based incentives for sustainable management of the forest resources of the Eastern Arc Mountains of Tanzania. In: *Proceeding of Africa Mountains High Summit Conference*, 6 – 10 May 2002. 12pp. U.N. Offices, Nairobi, Kenya.
- National Bureau of Statistics (NBS) (2019). *Nigeria Gross Domestic Report Q1 2019 Agriculture*. Available at: <https://nigerianstat.gov.ng/download/937>. (Accessed on January 25th, 2020).
- Nkwunonwo, U.C., Malcolm, W., and Brian, B. (2015). Flooding and flood risk reduction in Nigeria: Cardinal gaps. *Journal of Geography and Natural Disaster* 5, 136.
- Obersteiner, M., Huettner, M.M., Kraxner, F., McCallum, I., Aoki, K., Bottcher, H., Fritz, S., Gusti, M., Havlik, P., Kindermann, G., Rametsteiner, E., and Reyers, B. (2009). On fair, effective and efficient REDD+ mechanism design. *Carbon Balance and Management* 4, 11. <https://doi.org/10.1186/1750-0680-4-11>.
- Odekunle, T.O. (2004). Rainfall and the length of the growing season in Nigeria. *International Journal of Climatology* 24, 467–79.
- Odjugo, P.A.O. (2005). An analysis of rainfall pattern in Nigeria. *Global Journal of Environmental Science* 4(2), 139-145.
- Odunuga, S., Badru, G., and Mumin, B. (2014). Climate change, sea level rise and coastal inundation along part of Nigeria Barrier Lagoon Coast. *Journal of Applied Sciences and Environmental Management* 18(1), 41-47.
- Oduze, D.I. (2019). A review of the Nigerian agricultural promotion policy (2016-2020): Implications for entrepreneurship in the agribusiness sector. *International Journal of Agricultural Policy and Research* 7(3), 70-79.
- Ogunlela, V., and Ogungbile, A.O. (2006). Alleviating rural poverty in Nigeria: A challenge for national agricultural research system. *Journal of Food Agriculture and Environment* 6, 3-4.
- Okoye, C. (2019). Reform of engineering education: Key prop for sustainable economic development in Nigeria. A keynote paper delivered at the annual conference of the society of engineers, Enugu, Nigeria.
- Olaniyan, K., Benjamin, C., McLellan, I.D., Ogata, S., and Tezuka, T. (2018). Estimating residential electricity consumption in Nigeria to support energy transitions. *Sustainability* 10(5), 1440. <https://doi.org/10.3390/su10051440>.

- Olayemi, S.O. (2016). Challenges of a changing climate and the industrial sector experience: A review of evidence in Nigeria. *Global Journal of Arts, Humanities and Social Sciences*, 4(11), 1-11.
- Olayide, O., Alene, A., Ikpi, A., and Nziguheba, G. (2009). Manure marketing in the savannas of Nigeria: Implications for sustainable food security. *Journal of Food, Agriculture & Environment*, 7(2), 540-545.
- Olayide, O.E., and Ikpi, A.E. (2013). *Agricultural production and rural welfare in Nigeria: Assessing agricultural production and rural welfare*. Saarbrücken Scholars' Press, Saarbrücken.
- Olayide, O.E., Tetteh, I.K., and Popoola, L. (2016a). Differential impacts of rainfall and irrigation on agricultural production in Nigeria: Any lessons for climate-smart agriculture? *Agricultural Water Management* 178, 30-36.
- Olayide, O.E., Tetteh, I.K., Porter, J.R., and Popoola, L. (2016b). Review and analysis of vulnerability to rainfall variability and policy responses to agricultural water supply in Nigeria. *Journal of Food, Agriculture and Environment* 14(2), 152-155.
- Olayide, O.E., and Alabi, T. (2018). Between rainfall and food poverty: Assessing vulnerability to climate change in an agricultural economy. *Journal of Cleaner Production* 196, 1-10.
- Olomola, A.S., and Nwafor, M. (2018). *Nigerian agriculture sector performance review: A background report for the Nigeria 2017 Agriculture Joint Sector Review*. Food Security Cluster.
- Onuoha, F.C. (2008). *Environmental degradation, livelihood and conflicts: A focus on the implications of the diminishing water resources of Lake Chad for North-eastern Nigeria*. African Centre for Strategic Research and Studies, National Defense (formerly War) College, Abuja, Nigeria.
- Onyia, C. (2015). Climate change and conflict in Nigeria: The Boko Haram challenge. *American International Journal of Social Science* 4(2), 181-190.
- Oyedepo, S.O. (2012). Energy and sustainable development in Nigeria: The way forward. *Energy, Sustainability and Society* 2, 15. <https://doi.org/10.1186/2192-0567-2-15>.
- Oyedepo, S.O., Dunmade, I.S., Adekeye, A., Attabo, A.A., Olawole, O.C., Babalola, P.O., and Oyebanji, J.A. (2019). Bioenergy technology development in Nigeria: Pathway to sustainable energy development. *International Journal of Environment and Sustainable Development* 18(2), 175-205. <https://dx.doi.org/10.1504/IJESD.2019.099513>.
- Ozor, N. (2009). *Implications of climate change for national development: The way forward*. African Institute for Applied Economics, Enugu Forum, Policy Paper 10.
- Pender, J., Ringler, C., Magalhaes, M., and Place, F. (2009). *The role of sustainable land management for climate change adaptation and mitigation in Sub-Saharan Africa*, TerraAfrica. 8pp.
- Reichhuber, A., Gerber, N., Mirzabaev, A., Svoboda, M., López Santos, A., Graw, V., Stefanski, R., Davies, J., Vuković, A., Fernández García, M.A., Fiati, C., and Jia, X. (2019). *The land-drought nexus: Enhancing the role of land-based interventions in drought mitigation and risk management. A Report of the Science-Policy Interface*. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany.
- Roche, M.A., Verolme, H., Agbaegbu, C., Binnington T., Fishedick, M., and Oladipo, E.O. (2019). *Achieving Sustainable Development Goals in Nigeria's power sector: Assessment of transition pathway*. *Climate Policy* 20(7), 846-865. <https://doi.org/10.1080/14693062.2019.1661818>.
- Sanz, M.J., De Vente, J.L., Chotte, J.L., Bernoux, M., Kust, G., Ruiz, I., Almagro, M., Alloza, J.A., Vallejo, R., Castillo, V., and Hebel, A. (2017). *Sustainable land management contribution to successful land-based climate change adaptation and mitigation: A report of the science-policy interface*. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany.
- Scott, A., and Miller, C. (2016). *Accelerating access to electricity in Africa with off-grid solar: The market for solar household solutions*. Overseas Development Institute.

- Simonyan, K.J., and Fasina, O. (2013). Biomass resources and bio-energy potentials in Nigeria. *African Journal of Agricultural Research* 8(40), 4975-4989.
- Summers, D.M., Bryan, B.A., Nolan, M., and Hobbis, T.J. (2015). The costs of reforestation: A spatial model of the costs of establishing environmental and carbon planting. *Land Use Policy* 44, 110-121.
- Ugwu, S.D. (2007). Contributions of agricultural development programmes (ADPs) to rural livelihood in Nigeria and food security in Nigeria. *Agricultural Journal* 2(4), 503-510. Available at: <https://medwelljournals.com/abstract/?doi=aj.2007.503.510>. (Accessed on November 18, 2020).
- UNCCD (2016). Global Support Programme: Land Degradation Neutrality Target Setting Programme, Methodological note to set national voluntary Land Degradation Neutrality (LDN) targets using the UNCCD indicator framework. Available at: [https://knowledge.unccd.int/sites/default/files/2018-08/LDN Methodological Note_02-06-2017 ENG.pdf](https://knowledge.unccd.int/sites/default/files/2018-08/LDN%20Methodological%20Note_02-06-2017%20ENG.pdf). (Accessed on February 15th, 2020).
- United Nations Environment Programme (UNEP) (2012). UNEP Rise Centre on Energy, Climate and Sustainable Development, Department of Management Engineering, Technical University of Denmark (DTU). Available at: www.eneprisoe.org/. (Accessed on February 15th, 2020).
- United Nations Environment Programme (UNEP) (2013). Atlas of our changing environment. Available at: <https://na.unep.net/atlas/webatlas.php?id=58>. (Accessed on February 15th, 2020).
- USAID (2019). Nigeria: Power Africa Factsheet. Available at: <https://www.usaid.gov/powerafrica/nigeria>. (Accessed on February 15th, 2020).
- World Bank (2008). World Development Report (WDR) 2008: Agriculture for development. The World Bank, Washington, DC.
- World Bank and International Energy Agency (IEA) (2017). Sustainable energy for all: Global tracking framework: Progress toward sustainable energy. World Bank, Washington DC, USA. Available at: <https://www.seforall.org/sites/default/files/GTF%20Executive%20Summary%202017.pdf>. (Accessed on February 15th, 2020).

1. Evers, Hans-Dieter and Solvay Gerke (2005). Closing the Digital Divide: Southeast Asia's Path Towards a Knowledge Society.
2. Bhuiyan, Shajahan and Hans-Dieter Evers (2005). Social Capital and Sustainable Development: Theories and Concepts.
3. Schetter, Conrad (2005). Ethnicity and the Political Reconstruction of Afghanistan.
4. Kassahun, Samson (2005). Social Capital and Community Efficacy. In Poor Localities of Addis Ababa Ethiopia.
5. Fuest, Veronika (2005). Policies, Practices and Outcomes of Demand-oriented Community Water Supply in Ghana: The National Community Water and Sanitation Programme 1994 – 2004.
6. Menkhoff, Thomas and Hans-Dieter Evers (2005). Strategic Groups in a Knowledge Society: Knowledge Elites as Drivers of Biotechnology Development in Singapore.
7. Mollinga, Peter P. (2005). The Water Resources Policy Process in India: Centralisation, Polarisation and New Demands on Governance.
8. Evers, Hans-Dieter (2005). Wissen ist Macht: Experten als Strategische Gruppe.
- 8.a Evers, Hans-Dieter and Solvay Gerke (2005). Knowledge is Power: Experts as Strategic Group.
9. Fuest, Veronika (2005). Partnerschaft, Patronage oder Paternalismus? Eine empirische Analyse der Praxis universitärer Forschungsk Kooperation mit Entwicklungsländern.
10. Laube, Wolfram (2005). Promise and Perils of Water Reform: Perspectives from Northern Ghana.
11. Mollinga, Peter P. (2004). Sleeping with the Enemy: Dichotomies and Polarisation in Indian Policy Debates on the Environmental and Social Effects of Irrigation.
12. Wall, Caleb (2006). Knowledge for Development: Local and External Knowledge in Development Research.
13. Laube, Wolfram and Eva Youkhana (2006). Cultural, Socio-Economic and Political Constraints for Virtual Water Trade: Perspectives from the Volta Basin, West Africa.
14. Hornidge, Anna-Katharina (2006). Singapore: The Knowledge-Hub in the Straits of Malacca.
15. Evers, Hans-Dieter and Caleb Wall (2006). Knowledge Loss: Managing Local Knowledge in Rural Uzbekistan.
16. Youkhana, Eva; Lautze, J. and B. Barry (2006). Changing Interfaces in Volta Basin Water Management: Customary, National and Transboundary.
17. Evers, Hans-Dieter and Solvay Gerke (2006). The Strategic Importance of the Straits of Malacca for World Trade and Regional Development.
18. Hornidge, Anna-Katharina (2006). Defining Knowledge in Germany and Singapore: Do the Country-Specific Definitions of Knowledge Converge?
19. Mollinga, Peter M. (2007). Water Policy – Water Politics: Social Engineering and Strategic Action in Water Sector Reform.
20. Evers, Hans-Dieter and Anna-Katharina Hornidge (2007). Knowledge Hubs Along the Straits of Malacca.
21. Sultana, Nayeem (2007). Trans-National Identities, Modes of Networking and Integration in a Multi-Cultural Society. A Study of Migrant Bangladeshis in Peninsular Malaysia.
22. Yalcin, Resul and Peter M. Mollinga (2007). Institutional Transformation in Uzbekistan's Agricultural and Water Resources Administration: The Creation of a New Bureaucracy.
23. Menkhoff, T.; Loh, P. H. M.; Chua, S. B.; Evers, H.-D. and Chay Yue Wah (2007). Riau Vegetables for Singapore Consumers: A Collaborative Knowledge-Transfer Project Across the Straits of Malacca.
24. Evers, Hans-Dieter and Solvay Gerke (2007). Social and Cultural Dimensions of Market Expansion.
25. Obeng, G. Y.; Evers, H.-D.; Akuffo, F. O., Braimah, I. and A. Brew-Hammond (2007). Solar PV Rural Electrification and Energy-Poverty Assessment in Ghana: A Principal Component Analysis.

26. Eguavoen, Irit; E. Youkhana (2008). Small Towns Face Big Challenge. The Management of Piped Systems after the Water Sector Reform in Ghana.
27. Evers, Hans-Dieter (2008). Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development
28. Ampomah, Ben Y.; Adjei, B. and E. Youkhana (2008). The Transboundary Water Resources Management Regime of the Volta Basin.
29. Saravanan.V.S.; McDonald, Geoffrey T. and Peter P. Mollinga (2008). Critical Review of Integrated Water Resources Management: Moving Beyond Polarised Discourse.
30. Laube, Wolfram; Awo, Martha and Benjamin Schraven (2008). Erratic Rains and Erratic Markets: Environmental change, economic globalisation and the expansion of shallow groundwater irrigation in West Africa.
31. Mollinga, Peter P. (2008). For a Political Sociology of Water Resources Management.
32. Hauck, Jennifer; Youkhana, Eva (2008). Histories of water and fisheries management in Northern Ghana.
33. Mollinga, Peter P. (2008). The Rational Organisation of Dissent. Boundary concepts, boundary objects and boundary settings in the interdisciplinary study of natural resources management.
34. Evers, Hans-Dieter; Gerke, Solvay (2009). Strategic Group Analysis.
35. Evers, Hans-Dieter; Benedikter, Simon (2009). Strategic Group Formation in the Mekong Delta - The Development of a Modern Hydraulic Society.
36. Obeng, George Yaw; Evers, Hans-Dieter (2009). Solar PV Rural Electrification and Energy-Poverty: A Review and Conceptual Framework With Reference to Ghana.
37. Scholtes, Fabian (2009). Analysing and explaining power in a capability perspective.
38. Eguavoen, Irit (2009). The Acquisition of Water Storage Facilities in the Abay River Basin, Ethiopia.
39. Hornidge, Anna-Katharina; Mehmood Ul Hassan; Mollinga, Peter P. (2009). 'Follow the Innovation' – A joint experimentation and learning approach to transdisciplinary innovation research.
40. Scholtes, Fabian (2009). How does moral knowledge matter in development practice, and how can it be researched?
41. Laube, Wolfram (2009). Creative Bureaucracy: Balancing power in irrigation administration in northern Ghana.
42. Laube, Wolfram (2009). Changing the Course of History? Implementing water reforms in Ghana and South Africa.
43. Scholtes, Fabian (2009). Status quo and prospects of smallholders in the Brazilian sugarcane and ethanol sector: Lessons for development and poverty reduction.
44. Evers, Hans-Dieter; Genschick, Sven; Schraven, Benjamin (2009). Constructing Epistemic Landscapes: Methods of GIS-Based Mapping.
45. Saravanan V.S. (2009). Integration of Policies in Framing Water Management Problem: Analysing Policy Processes using a Bayesian Network.
46. Saravanan V.S. (2009). Dancing to the Tune of Democracy: Agents Negotiating Power to Decentralise Water Management.
47. Huu, Pham Cong; Rhlrs, Eckart; Saravanan, V. Subramanian (2009). Dyke System Planing: Theory and Practice in Can Tho City, Vietnam.
48. Evers, Hans-Dieter; Bauer, Tatjana (2009). Emerging Epistemic Landscapes: Knowledge Clusters in Ho Chi Minh City and the Mekong Delta.
49. Reis, Nadine; Mollinga, Peter P. (2009). Microcredit for Rural Water Supply and Sanitation in the Mekong Delta. Policy implementation between the needs for clean water and 'beautiful latrines'.
50. Gerke, Solvay; Ehlert, Judith (2009). Local Knowledge as Strategic Resource: Fishery in the Seasonal Floodplains of the Mekong Delta, Vietnam
51. Schraven, Benjamin; Eguavoen, Irit; Manske, Günther (2009). Doctoral degrees for capacity development: Results from a survey among African BiGS-DR alumni.

52. Nguyen, Loan (2010). Legal Framework of the Water Sector in Vietnam.
53. Nguyen, Loan (2010). Problems of Law Enforcement in Vietnam. The Case of Wastewater Management in Can Tho City.
54. Oberkircher, Lisa et al. (2010). Rethinking Water Management in Khorezm, Uzbekistan. Concepts and Recommendations.
55. Waibel, Gabi (2010). State Management in Transition: Understanding Water Resources Management in Vietnam.
56. Saravanan V.S.; Mollinga, Peter P. (2010). Water Pollution and Human Health. Transdisciplinary Research on Risk Governance in a Complex Society.
57. Vormoor, Klaus (2010). Water Engineering, Agricultural Development and Socio-Economic Trends in the Mekong Delta, Vietnam.
58. Hornidge, Anna-Katharina; Kurfürst, Sandra (2010). Envisioning the Future, Conceptualising Public Space. Hanoi and Singapore Negotiating Spaces for Negotiation.
59. Mollinga, Peter P. (2010). Transdisciplinary Method for Water Pollution and Human Health Research.
60. Youkhana, Eva (2010). Gender and the development of handicraft production in rural Yucatán/Mexico.
61. Naz, Farhat; Saravanan V. Subramanian (2010). Water Management across Space and Time in India.
62. Evers, Hans-Dieter; Nordin, Ramli, Nienkemoer, Pamela (2010). Knowledge Cluster Formation in Peninsular Malaysia: The Emergence of an Epistemic Landscape.
63. Mehmood Ul Hassan; Hornidge, Anna-Katharina (2010). 'Follow the Innovation' – The second year of a joint experimentation and learning approach to transdisciplinary research in Uzbekistan.
64. Mollinga, Peter P. (2010). Boundary concepts for interdisciplinary analysis of irrigation water management in South Asia.
65. Noelle-Karimi, Christine (2006). Village Institutions in the Perception of National and International Actors in Afghanistan. **(Amu Darya Project Working Paper No. 1)**
66. Kuzmits, Bernd (2006). Cross-bordering Water Management in Central Asia. **(Amu Darya Project Working Paper No. 2)**
67. Schetter, Conrad; Glassner, Rainer; Karokhail, Masood (2006). Understanding Local Violence. Security Arrangements in Kandahar, Kunduz and Paktia. **(Amu Darya Project Working Paper No. 3)**
68. Shah, Usman (2007). Livelihoods in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. **(Amu Darya Project Working Paper No. 4)**
69. ter Steege, Bernie (2007). Infrastructure and Water Distribution in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. **(Amu Darya Project Working Paper No. 5)**
70. Mielke, Katja (2007). On The Concept of 'Village' in Northeastern Afghanistan. Explorations from Kunduz Province. **(Amu Darya Project Working Paper No. 6)**
71. Mielke, Katja; Glassner, Rainer; Schetter, Conrad; Yarash, Nasratullah (2007). Local Governance in Warsaj and Farkhar Districts. **(Amu Darya Project Working Paper No. 7)**
72. Meininghaus, Esther (2007). Legal Pluralism in Afghanistan. **(Amu Darya Project Working Paper No. 8)**
73. Yarash, Nasratullah; Smith, Paul; Mielke, Katja (2010). The fuel economy of mountain villages in Ishkamish and Burka (Northeast Afghanistan). Rural subsistence and urban marketing patterns. **(Amu Darya Project Working Paper No. 9)**
74. Oberkircher, Lisa (2011). 'Stay – We Will Serve You Plov!'. Puzzles and pitfalls of water research in rural Uzbekistan.
75. Shtaltovna, Anastasiya; Hornidge, Anna-Katharina; Mollinga, Peter P. (2011). The Reinvention of Agricultural Service Organisations in Uzbekistan – a Machine-Tractor Park in the Khorezm Region.
76. Stellmacher, Till; Grote, Ulrike (2011). Forest Coffee Certification in Ethiopia: Economic Boon or Ecological Bane?

77. Gatzweiler, Franz W.; Baumüller, Heike; Ladenburger, Christine; von Braun, Joachim (2011). Marginality. Addressing the roots causes of extreme poverty.
78. Mielke, Katja; Schetter, Conrad; Wilde, Andreas (2011). Dimensions of Social Order: Empirical Fact, Analytical Framework and Boundary Concept.
79. Yarash, Nasratullah; Mielke, Katja (2011). The Social Order of the Bazaar: Socio-economic embedding of Retail and Trade in Kunduz and Imam Sahib
80. Baumüller, Heike; Ladenburger, Christine; von Braun, Joachim (2011). Innovative business approaches for the reduction of extreme poverty and marginality?
81. Ziai, Aram (2011). Some reflections on the concept of 'development'.
82. Saravanan V.S., Mollinga, Peter P. (2011). The Environment and Human Health - An Agenda for Research.
83. Eguavoen, Irit; Tesfai, Weyni (2011). Rebuilding livelihoods after dam-induced relocation in Koga, Blue Nile basin, Ethiopia.
84. Eguavoen, I., Sisay Demeku Derib et al. (2011). Digging, damming or diverting? Small-scale irrigation in the Blue Nile basin, Ethiopia.
85. Genschick, Sven (2011). Pangasius at risk - Governance in farming and processing, and the role of different capital.
86. Quy-Hanh Nguyen, Hans-Dieter Evers (2011). Farmers as knowledge brokers: Analysing three cases from Vietnam's Mekong Delta.
87. Poos, Wolf Henrik (2011). The local governance of social security in rural Surkhondarya, Uzbekistan. Post-Soviet community, state and social order.
88. Graw, Valerie; Ladenburger, Christine (2012). Mapping Marginality Hotspots. Geographical Targeting for Poverty Reduction.
89. Gerke, Solvay; Evers, Hans-Dieter (2012). Looking East, looking West: Penang as a Knowledge Hub.
90. Turaeva, Rano (2012). Innovation policies in Uzbekistan: Path taken by ZEFa project on innovations in the sphere of agriculture.
91. Gleisberg-Gerber, Katrin (2012). Livelihoods and land management in the Ioba Province in south-western Burkina Faso.
92. Hiemenz, Ulrich (2012). The Politics of the Fight Against Food Price Volatility – Where do we stand and where are we heading?
93. Baumüller, Heike (2012). Facilitating agricultural technology adoption among the poor: The role of service delivery through mobile phones.
94. Akpabio, Emmanuel M.; Saravanan V.S. (2012). Water Supply and Sanitation Practices in Nigeria: Applying Local Ecological Knowledge to Understand Complexity.
95. Evers, Hans-Dieter; Nordin, Ramli (2012). The Symbolic Universe of Cyberjaya, Malaysia.
96. Akpabio, Emmanuel M. (2012). Water Supply and Sanitation Services Sector in Nigeria: The Policy Trend and Practice Constraints.
97. Boboyorov, Hafiz (2012). Masters and Networks of Knowledge Production and Transfer in the Cotton Sector of Southern Tajikistan.
98. Van Assche, Kristof; Hornidge, Anna-Katharina (2012). Knowledge in rural transitions - formal and informal underpinnings of land governance in Khorezm.
99. Eguavoen, Irit (2012). Blessing and destruction. Climate change and trajectories of blame in Northern Ghana.
100. Callo-Concha, Daniel; Gaiser, Thomas and Ewert, Frank (2012). Farming and cropping systems in the West African Sudanian Savanna. WASCAL research area: Northern Ghana, Southwest Burkina Faso and Northern Benin.
101. Sow, Papa (2012). Uncertainties and conflicting environmental adaptation strategies in the region of the Pink Lake, Senegal.

102. Tan, Siwei (2012). Reconsidering the Vietnamese development vision of “industrialisation and modernisation by 2020”.
103. Ziai, Aram (2012). Postcolonial perspectives on ‘development’.
104. Kelboro, Girma; Stellmacher, Till (2012). Contesting the National Park theorem? Governance and land use in Nech Sar National Park, Ethiopia.
105. Kotsila, Panagiota (2012). “Health is gold”: Institutional structures and the realities of health access in the Mekong Delta, Vietnam.
106. Mandler, Andreas (2013). Knowledge and Governance Arrangements in Agricultural Production: Negotiating Access to Arable Land in Zarafshan Valley, Tajikistan.
107. Tsegai, Daniel; McBain, Florence; Tischbein, Bernhard (2013). Water, sanitation and hygiene: the missing link with agriculture.
108. Pangaribowo, Evita Hanie; Gerber, Nicolas; Torero, Maximo (2013). Food and Nutrition Security Indicators: A Review.
109. von Braun, Joachim; Gerber, Nicolas; Mirzabaev, Alisher; Nkonya Ephraim (2013). The Economics of Land Degradation.
110. Stellmacher, Till (2013). Local forest governance in Ethiopia: Between legal pluralism and livelihood realities.
111. Evers, Hans-Dieter; Purwaningrum, Farah (2013). Japanese Automobile Conglomerates in Indonesia: Knowledge Transfer within an Industrial Cluster in the Jakarta Metropolitan Area.
112. Waibel, Gabi; Benedikter, Simon (2013). The formation water user groups in a nexus of central directives and local administration in the Mekong Delta, Vietnam.
113. Ayaribilla Akudugu, Jonas; Laube, Wolfram (2013). Implementing Local Economic Development in Ghana: Multiple Actors and Rationalities.
114. Malek, Mohammad Abdul; Hossain, Md. Amzad; Saha, Ratnajit; Gatzweiler, Franz W. (2013). Mapping marginality hotspots and agricultural potentials in Bangladesh.
115. Siriwardane, Rapti; Winands, Sarah (2013). Between hope and hype: Traditional knowledge(s) held by marginal communities.
116. Nguyen, Thi Phuong Loan (2013). The Legal Framework of Vietnam’s Water Sector: Update 2013.
117. Shtaltovna, Anastasiya (2013). Knowledge gaps and rural development in Tajikistan. Agricultural advisory services as a panacea?
118. Van Assche, Kristof; Hornidge, Anna-Katharina; Shtaltovna, Anastasiya; Boboyorov, Hafiz (2013). Epistemic cultures, knowledge cultures and the transition of agricultural expertise. Rural development in Tajikistan, Uzbekistan and Georgia.
119. Schädler, Manuel; Gatzweiler, Franz W. (2013). Institutional Environments for Enabling Agricultural Technology Innovations: The role of Land Rights in Ethiopia, Ghana, India and Bangladesh.
120. Eguavo, Irit; Schulz, Karsten; de Wit, Sara; Weisser, Florian; Müller-Mahn, Detlef (2013). Political dimensions of climate change adaptation. Conceptual reflections and African examples.
121. Feuer, Hart Nadav; Hornidge, Anna-Katharina; Schetter, Conrad (2013). Rebuilding Knowledge. Opportunities and risks for higher education in post-conflict regions.
122. Dörendahl, Esther I. (2013). Boundary work and water resources. Towards improved management and research practice?
123. Baumüller, Heike (2013). Mobile Technology Trends and their Potential for Agricultural Development
124. Saravanan, V.S. (2013). “Blame it on the community, immunize the state and the international agencies.” An assessment of water supply and sanitation programs in India.
125. Ariff, Syamimi; Evers, Hans-Dieter; Ndah, Anthony Banyouko; Purwaningrum, Farah (2014). Governing Knowledge for Development: Knowledge Clusters in Brunei Darussalam and Malaysia.
126. Bao, Chao; Jia, Lili (2014). Residential fresh water demand in China. A panel data analysis.

127. Siriwardane, Rapti (2014). War, Migration and Modernity: The Micro-politics of the Hijab in Northeastern Sri Lanka.
128. Kirui, Oliver Kiptoo; Mirzabaev, Alisher (2014). Economics of Land Degradation in Eastern Africa.
129. Evers, Hans-Dieter (2014). Governing Maritime Space: The South China Sea as a Mediterranean Cultural Area.
130. Saravanan, V. S.; Mavalankar, D.; Kulkarni, S.; Nussbaum, S.; Weigelt, M. (2014). Metabolized-water breeding diseases in urban India: Socio-spatiality of water problems and health burden in Ahmedabad.
131. Zulfiqar, Ali; Mujeri, Mustafa K.; Badrun Nessa, Ahmed (2014). Extreme Poverty and Marginality in Bangladesh: Review of Extreme Poverty Focused Innovative Programmes.
132. Schwachula, Anna; Vila Seoane, Maximiliano; Hornidge, Anna-Katharina (2014). Science, technology and innovation in the context of development. An overview of concepts and corresponding policies recommended by international organizations.
133. Callo-Concha, Daniel (2014). Approaches to managing disturbance and change: Resilience, vulnerability and adaptability.
134. Mc Bain, Florence (2014). Health insurance and health environment: India's subsidized health insurance in a context of limited water and sanitation services.
135. Mirzabaev, Alisher; Guta, Dawit; Goedecke, Jann; Gaur, Varun; Börner, Jan; Virchow, Detlef; Denich, Manfred; von Braun, Joachim (2014). Bioenergy, Food Security and Poverty Reduction: Mitigating tradeoffs and promoting synergies along the Water-Energy-Food Security Nexus.
136. Iskandar, Deden Dinar; Gatzweiler, Franz (2014). An optimization model for technology adoption of marginalized smallholders: Theoretical support for matching technological and institutional innovations.
137. Bühler, Dorothee; Grote, Ulrike; Hartje, Rebecca; Ker, Bopha; Lam, Do Truong; Nguyen, Loc Duc; Nguyen, Trung Thanh; Tong, Kimsun (2015). Rural Livelihood Strategies in Cambodia: Evidence from a household survey in Stung Treng.
138. Amankwah, Kwadwo; Shtaltovna, Anastasiya; Kelboro, Girma; Hornidge, Anna-Katharina (2015). A Critical Review of the Follow-the-Innovation Approach: Stakeholder collaboration and agricultural innovation development.
139. Wiesmann, Doris; Biesalski, Hans Konrad; von Grebmer, Klaus; Bernstein, Jill (2015). Methodological review and revision of the Global Hunger Index.
140. Eguavoen, Irit; Wahren, Julia (2015). Climate change adaptation in Burkina Faso: aid dependency and obstacles to political participation. Adaptation au changement climatique au Burkina Faso: la dépendance à l'aide et les obstacles à la participation politique.
141. Youkhana, Eva. Postponed to 2016 (147).
142. Von Braun, Joachim; Kalkuhl, Matthias (2015). International Science and Policy Interaction for Improved Food and Nutrition Security: toward an International Panel on Food and Nutrition (IPFN).
143. Mohr, Anna; Beuchelt, Tina; Schneider, Rafaël; Virchow, Detlef (2015). A rights-based food security principle for biomass sustainability standards and certification systems.
144. Husmann, Christine; von Braun, Joachim; Badiane, Ousmane; Akinbamijo, Yemi; Fatunbi, Oluwole Abiodun; Virchow, Detlef (2015). Tapping Potentials of Innovation for Food Security and Sustainable Agricultural Growth: An Africa-Wide Perspective.
145. Laube, Wolfram (2015). Changing Aspirations, Cultural Models of Success, and Social Mobility in Northern Ghana.
146. Narayanan, Sudha; Gerber, Nicolas (2016). Social Safety Nets for Food and Nutritional Security in India.
147. Youkhana, Eva (2016). Migrants' religious spaces and the power of Christian Saints – the Latin American Virgin of Cisne in Spain.
148. Grote, Ulrike; Neubacher, Frank (2016). Rural Crime in Developing Countries: Theoretical Framework, Empirical Findings, Research Needs.

149. Sharma, Rasadhika; Nguyen, Thanh Tung; Grote, Ulrike; Nguyen, Trung Thanh. Changing Livelihoods in Rural Cambodia: Evidence from panel household data in Stung Treng.
150. Kavegue, Afi; Eguavoen, Irit (2016). The experience and impact of urban floods and pollution in Ebo Town, Greater Banjul Area, in The Gambia.
151. Mbaye, Linguère Mously; Zimmermann, Klaus F. (2016). Natural Disasters and Human Mobility.
152. Gulati, Ashok; Manchanda, Stuti; Kacker, Rakesh (2016). Harvesting Solar Power in India.
153. Laube, Wolfram; Awo, Martha; Derbile, Emmanuel (2017). Smallholder Integration into the Global Shea Nut Commodity Chain in Northern Ghana. Promoting poverty reduction or continuing exploitation?
154. Attemene, Pauline; Eguavoen, Irit (2017). Effects of sustainability communication on environments and rural livelihoods.
155. Von Braun, Joachim; Kofol, Chiara (2017). Expanding Youth Employment in the Arab Region and Africa.
156. Beuchelt, Tina (2017). Buying green and social from abroad: Are biomass-focused voluntary sustainability standards useful for European public procurement?
157. Bekchanov, Maksud (2017). Potentials of Waste and Wastewater Resources Recovery and Re-use (RRR) Options for Improving Water, Energy and Nutrition Security.
158. Leta, Gerba; Kelboro, Girma; Stellmacher, Till; Hornidge, Anna-Katharina (2017). The agricultural extension system in Ethiopia: operational setup, challenges and opportunities.
159. Ganguly, Kavery; Gulati, Ashok; von Braun, Joachim (2017). Innovations spearheading the next transformations in India's agriculture.
160. Gebreselassie, Samuel; Haile Mekbib G.; Kalkuhl, Matthias (2017). The Wheat Sector in Ethiopia: Current Status and Key Challenges for Future Value Chain Development.
161. Jemal, Omarsherif Mohammed, Callo-Concha, Daniel (2017). Potential of Agroforestry for Food and Nutrition Security of Small-scale Farming Households.
162. Berga, Helen; Ringler, Claudia; Bryan, Elizabeth; El Didi, Hagar; Elnasikh Sara (2017). Addressing Transboundary Cooperation in the Eastern Nile through the Water-Energy-Food Nexus. Insights from an E-survey and Key Informant Interviews.
163. Bekchanov, Maksud (2017). Enabling Environment for Waste and Wastewater Recycling and Reuse Options in South Asia: the case of Sri Lanka.
164. Kirui, Oliver Kiptoo; Kozicka, Martha (2018). Vocational Education and Training for Farmers and Other Actors in the Agri-Food Value Chain in Africa.
165. Christinck, Anja; Rattunde, Fred; Kergna, Alpha; Mulinge, Wellington; Weltzien, Eva (2018). Identifying Options for the Development of Sustainable Seed Systems - Insights from Kenya and Mali.
166. Tambo, Justice A. (2018). Recognizing and rewarding farmers' creativity through contests: experiences and insights from four African countries.
167. von Braun, Joachim (2018). Innovations to Overcome the Increasingly Complex Problems of Hunger.
168. Bekchanov, Maksud; Evia, Pablo (2018). Resources Recovery and Reuse in Sanitation and Wastewater Systems: Options and Investment Climate in South and Southeast Asian Countries.
169. Kirui, Oliver K.; von Braun, Joachim (2018). Mechanization in African Agriculture: A Continental Overview on Patterns and Dynamics.
170. Beuchelt, Tina; Sarah Nischalke (2018). Adding a gender lens in quantitative development research on food and non-food biomass production: A guide for sex-disaggregated data collection
171. Daum, Thomas (2018). Of Bulls and Bulbs: Aspirations and perceptions of rural youth in Zambia.
172. Salvatierra-Rojas, Ana; Torres-Toledo, Victor; Mrabet, Farah; Müller, Joachim (2018). Improving milk value chains through solar milk cooling.
173. Desalegn, Gashaw; Ali, Seid Nuru (2018). Review of the Impact of Productive Safety Net Program (PSNP) on Rural Welfare in Ethiopia.

174. Muli, Celestine; Gerber, Nicolas; Sakketa, Tekalign Gutu; Mirzabaev, Alisher (2018). Ecosystem tipping points due to variable water availability and cascading effects on food security in Sub-Saharan Africa.
175. Njiraini, Georgina; Ngigi, Marther; Baraké, Evelyn (2018). Women in African Agriculture: Integrating Women into Value Chains to Build a Stronger Sector.
176. Bekchanov, Maksud; Evia, Pablo; Hasan, Mohammad Monirul; Adhikari, Narayan; Gondhalekar, Daphne (2018). Institutional framework and financial arrangements for supporting the adoption of Resource Recovery Reuse technologies in South Asia.
177. Mirzabaev, Alisher; Njiraini, Georgina Wambui; Gebremariam, Gebrelibanos; Jourdain, Damien; Magaia, Emílio; Julio, Felita; Mosse, Gerivásia; Mutondo, João; Mungatana, Eric (2019). Transboundary Water Resources for People and Nature: Challenges and Opportunities in the Olifants River Basin.
178. Gupta, Anil; Shinde, Chintan; Dey, Anamika; Patel, Ramesh; Patel, Chetan; Kumar, Vipin; Patel, Mahesh (2019). Honey Bee Network in Africa: Co-creating a Grassroots Innovation Ecosystem in Africa.
179. Kabran, Estelle Gnankon; Eguavoen, Irit (2019). Ferry transportation in Abidjan: Establishment, operation and sustainability of a paratransit system.
180. Sakketa, Tekalign Gutu; von Braun, Joachim (2019). Labor-intensive public works programs in sub-Saharan Africa: Experiences and implications for employment policies.
181. Legesse, Ermias Engida; Srivastava, Amit; Kuhn, Arnim; Gaiser, Thomas (2019). Household income implications of improved fertilizer accessibility and lower use inefficiency: Long-term scenarios for Ethiopia.
182. Daum, Thomas; Capezzone, Filippo; Birner, Regina (2019). The forgotten agriculture-nutrition link: Estimating the energy requirements of different farming technologies in rural Zambia with time-use data.
183. Ganguly, Kavary; Gulati, Ashok; von Braun, Joachim (2019). Making Skill Development Aspirational: Indian Agriculture and Food Sector.
184. Gulati, Ashok; Juneja, Ritika (2019). Agricultural Credit System in India: Evolution, Effectiveness and Innovations.
185. Chaudhry, Rabia (2019). "An island of excellence?" How the Pakistan military reflects on its presence in the development sector.
186. Mai Le, Quyen; Kelboro, Girma (2019). When heritage goes ways apart: Heritagization and local involvement at the Complex of Monuments in Hue, Vietnam.
187. Eguavoen, Irit; Attemene, Pauline; Kouame, Fulgence; Konan, Eugène Kouadio; Madhy, Chérif Aidara; Gleisberg-Gerber, Katrin (2019). Dernier refuge ou presqu'île d'opportunités? Démographie et conditions de vie à Adjahui-Coubé, une habitation spontanée à Abidjan.
188. Von Braun, Joachim (2019). AI and Robotics Implications for the Poor.
189. Daum, Thomas; Birner, Regina (2019). African agricultural mechanization Myths, realities and an emerging research agenda.
190. Wortmann-Kolundžija, Eli (2019). Empowering smallholder farmers through farmer organizations: Insights from Kenya and Burkina Faso.
191. Youkhana, Eva (2020). Actors networks in critical urban studies – protest against the subprime crisis in Madrid.
192. Tegegne, Azage; Feye, Getachew Legese (2020). Study of selected livestock innovations in Ethiopia.
193. Purwaningrum, Farah; Tayeb, Azmil; Rahmat, Siti Rahyla; Hornidge, Anna-Katharina (2020). Orientation shift? Understanding the 'Third Mission' of the University in Malaysia's Science System.
194. Seré, Carlos (2020). Investing Sustainably in African Livestock Development: Opportunities and Trade-Offs.
195. Gulati, Ashok; Das, Sandip (2020). India-Africa Partnership in Trade and Investment: With Focus on the Agriculture and Food Sector.
196. Scheiterle, Lilli; Birner, Regina (2020). Considerations on the role of institutions and networks in the bioeconomy: three case studies from Ghana and Brazil.

- 197. Sylla, Mouhamadou Bamba; Dimobe, Kangbéni; Sanfo, Safietou (2021). Burkina Faso – Land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security.**
- 198. Admassie, Assefa; Abebaw, Degnet (2021). Ethiopia – Land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security.**
- 199. Coulibaly, Ousmane (2021). Mali – Land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security.**
- 200. Adamou, Rabani; Ibrahim, Boubacar; Bonkaney, Abdou Latif; Seyni, Abdoul Aziz; Idrissa, Mamoudou; Bello, Nassourou (2021). Niger – Land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security.**
- 201. Olayide, Olawale Emmanuel (2021). Nigeria – Land, climate, energy, agriculture and development: A study in the Sudano-Sahel Initiative for Regional Development, Jobs, and Food Security.**

<http://www.zef.de/workingpapers.html>

ZEF Development Studies

edited by
Solvay Gerke and Hans-Dieter Evers

Center for Development Research (ZEF),
University of Bonn

Shahjahan H. Bhuiyan

Benefits of Social Capital. Urban Solid Waste Management in Bangladesh

Vol. 1, 2005, 288 p., 19.90 EUR, br. ISBN 3-8258-8382-5

Veronika Fuest

Demand-oriented Community Water Supply in Ghana. Policies, Practices and Outcomes

Vol. 2, 2006, 160 p., 19.90 EUR, br. ISBN 3-8258-9669-2

Anna-Katharina Hornidge

Knowledge Society. Vision and Social Construction of Reality in Germany and Singapore

Vol. 3, 2007, 200 p., 19.90 EUR, br. ISBN 978-3-8258-0701-6

Wolfram Laube

Changing Natural Resource Regimes in Northern Ghana. Actors, Structures and Institutions

Vol. 4, 2007, 392 p., 34.90 EUR, br. ISBN 978-3-8258-0641-5

Lirong Liu

Wirtschaftliche Freiheit und Wachstum. Eine internationale vergleichende Studie

Vol. 5, 2007, 200 p., 19.90 EUR, br. ISBN 978-3-8258-0701-6

Phuc Xuan To

Forest Property in the Vietnamese Uplands. An Ethnography of Forest Relations in Three Dao Villages

Vol. 6, 2007, 296 p., 29.90 EUR, br. ISBN 978-3-8258-0773-3

Caleb R.L. Wall, Peter P. Mollinga (Eds.)

Fieldwork in Difficult Environments.

Methodology as Boundary Work in Development Research

Vol. 7, 2008, 192 p., 19.90 EUR, br. ISBN 978-3-8258-1383-3

Solvay Gerke, Hans-Dieter Evers, Anna-K.

Hornidge (Eds.)

The Straits of Malacca. Knowledge and Diversity

Vol. 8, 2008, 240 p., 29.90 EUR, br. ISBN 978-3-8258-1383-3

Caleb Wall

Argorods of Western Uzbekistan. Knowledge Control and Agriculture in Khorezm

Vol. 9, 2008, 384 p., 29.90 EUR, br. ISBN 978-3-8258-1426-7

Irit Eguavoen

The Political Ecology of Household Water in Northern Ghana

Vol. 10, 2008, 328 p., 34.90 EUR, br. ISBN 978-3-8258-1613-1

Charlotte van der Schaaf

Institutional Change and Irrigation Management in Burkina Faso. Flowing Structures and Concrete Struggles

Vol. 11, 2009, 344 p., 34.90 EUR, br. ISBN 978-3-8258-1624-7

Nayeem Sultana

The Bangladeshi Diaspora in Peninsular Malaysia. Organizational Structure, Survival Strategies and Networks

Vol. 12, 2009, 368 p., 34.90 EUR, br. ISBN 978-3-8258-1629-2

Peter P. Mollinga, Anjali Bhat, Saravanan V.S. (Eds.)

When Policy Meets Reality. Political Dynamics and the Practice of Integration in Water Resources Management Reform

Vol. 13, 2010, 216 p., 29.90 EUR, br., ISBN 978-3-643-10672-8

Irit Eguavoen, Wolfram Laube (Eds.)
Negotiating Local Governance. Natural Resources Management at the Interface of Communities and the State
Vol. 14, 2010, 248 p., 29.90 EUR, br., ISBN 978-3-643-10673-5

William Tsuma
Gold Mining in Ghana. Actors, Alliances and Power
Vol. 15, 2010, 256 p., 29.90 EUR, br., ISBN 978-3-643-10811-1

Thim Ly
Planning the Lower Mekong Basin: Social Intervention in the Se San River
Vol. 16, 2010, 240 p., 29.90 EUR, br., ISBN 978-3-643-10834-0

Tatjana Bauer
The Challenge of Knowledge Sharing - Practices of the Vietnamese Science Community in Ho Chi Minh City and the Mekong Delta
Vol. 17, 2011, 304 p., 29.90 EUR, br., ISBN 978-3-643-90121-7

Pham Cong Huu
Floods and Farmers - Politics, Economics and Environmental Impacts of Dyke Construction in the Mekong Delta / Vietnam
Vol. 18, 2012, 200 p., 29.90 EUR, br., ISBN 978-3-643-90167-5

Judith Ehlert
Beautiful Floods - Environmental Knowledge and Agrarian Change in the Mekong Delta, Vietnam
Vol. 19, 2012, 256 S., 29.90 EUR, br., ISBN 978-3-643-90195-8

Nadine Reis
Tracing and Making the State - Policy practices and domestic water supply in the Mekong Delta, Vietnam
Vol. 20, 2012, 272 S., 29.90 EUR, br., ISBN 978-3-643-90196-5

Martha A. Awo
Marketing and Market Queens - A study of tomato farmers in the Upper East region of Ghana
Vol. 21, 2012, 192 S., 29.90 EUR, br., ISBN 978-3-643-90234-4

Asghar Tahmasebi
Pastoral Vulnerability to Socio-political and Climate Stresses - The Shahsevan of North Iran
Vol. 22, 2013, 192 S., 29.90 EUR, br., ISBN 978-3-643-90357-0

Anastasiya Shtaltovna
Servicing Transformation - Agricultural Service Organisations and Agrarian Change in Post-Soviet Uzbekistan
Vol. 23, 2013, 216 S., 29.90 EUR, br., ISBN 978-3-643-90358-7

Hafiz Boboyorov
Collective Identities and Patronage Networks in Southern Tajikistan
Vol. 24, 2013, 304 S., 34.90 EUR, br., ISBN 978-3-643-90382-2

Simon Benedikter
The Vietnamese Hydrocracy and the Mekong Delta. Water Resources Development from State Socialism to Bureaucratic Capitalism
Vol. 25, 2014, 330 S., 39.90 EUR, br., ISBN 978-3-643-90437-9

Sven Genschick
Aqua-`culture´. Socio-cultural peculiarities, practical senses, and missing sustainability in Pangasius aquaculture in the Mekong Delta, Vietnam.
Vol. 26, 2014, 262 S., 29.90 EUR, br., ISBN 978-3-643-90485-0

Farah Purwaningrum
Knowledge Governance in an Industrial Cluster. The Collaboration between Academia-Industry-Government in Indonesia.
Vol. 27, 2014, 296 S., 39.90 EUR, br., ISBN 978-3-643-90508-6

Panagiota Kotsila
*Socio-political and Cultural Determinants of
Diarrheal Disease in the Mekong Delta.
From Discourse to Incidence*
Vol. 28, 2014, 376 S., 39.90 EUR, br., ISBN 978-
3-643-90562-8

Huynh Thi Phuong Linh
*State-Society Interaction in Vietnam.
The Everyday Dialogue of Local Irrigation
Management in the Mekong Delta*
Vol. 29, 2016, 304 S., 39.90 EUR, br., ISBN 978-
3-643-90719-6

Siwei Tan
*Space and Environment in the Industrialising
Mekong Delta.
A socio-spatial analysis of wastewater
management in Vietnam*
Vol. 30, 2016, 240 S., 29.90 EUR, br., ISBN 978-
3-643-90746-2

<http://www.lit-verlag.de/reihe/zef>



zef

Center for
Development Research
University of Bonn

Working Paper Series

Authors: Olawale Emmanuel Olayide

Contacts: waleolayide@yahoo.com

Photo: Daniel Callo-Concha

Published by:
Zentrum für Entwicklungsforschung (ZEF)
Center for Development Research
Genscherallee 3
D – 53113 Bonn
Germany

Phone: +49-228-73-1861

Fax: +49-228-73-1869

E-Mail: presse.zef@uni-bonn.de

www.zef.de