Towards Realization of Vision 2030

KENYA POLICY BRIEFS

January 2020 *Volume 1, Issue 1*

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ABOUT

The Kenya Policy Briefs presents translations of research results from universities and research institutes for a policymaker and media audience. It targets those who formulate or influence policy. The briefs seek to provide evidence-based, high quality, and practical policy recommendations directly addressing issues under each objective of Kenya's Vision 2030 Medium Term Plan III as shown in the table. In each issue, the briefs are categorized into five series each addressing one of the five core components of Vision 2030:

Series 1: Economic Pillar
Series 2: Social Pillar
Series 3: Political Pillar
Series T: Themes (Cross Cutting Issues)
Series F: Foundations

MANUSCRIPT SUBMISSION

All submitted must be based on completed research work with recommendations based on evidence from the study. Submitted briefs will be reviewed for direct alignment to Vision 2030 objectives as provided in the table below, and for potential impact of the recommendations.

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Detailed submission instructions are on the publications homepage at http://uonresearch.org/journal/kpb

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	PILLAR/OBJECTIVE
1	**Series 1: Economic Pillar**
1A	**Agriculture and Livestock** – Innovative, Commercially-oriented and Modern Agriculture and Livestock Sector.
1B	**Manufacturing** – Robust, diversified and competitive manufacturing sector.
1C	**Tourism** – To be a top 10 long haul destination offering high-end diverse, and distinctive visitor experience.
1D	**Trade** – A formal sector that is efficient, multi-tiered, diversified in product range and innovative.
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2	**Series 2: The Social Pillar**
2A	**Health** – Equitable, Affordable and Quality Health Care of the Highest Standards.
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F5	**Public Sector Reforms** – A Citizen-Focused and Results-Oriented Public Service.
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F8	**Ending Drought Emergencies** – Planning for drought: An end to drought emergencies and food insecurity in Kenya.
F9	**Security, Peace and Building Conflicts Resolution** – A Nation of Peace and Stability.

Editorial

Research Output in Support of National Development and Economic Productivity

Prof. Madara M. Ogot

Key Messages

Research Output from Universities and research institutes should be aligned to national development goals.

Most of the research output in Africa (and Kenya) remains inaccessible as unpublished works.

Research output should be presented to policymakers in a form that is readily understood and applicable to national challenges

Universities and research institutions should be more involved in improving the lives of ordinary Kenya's by finding solutions to the challenges they face

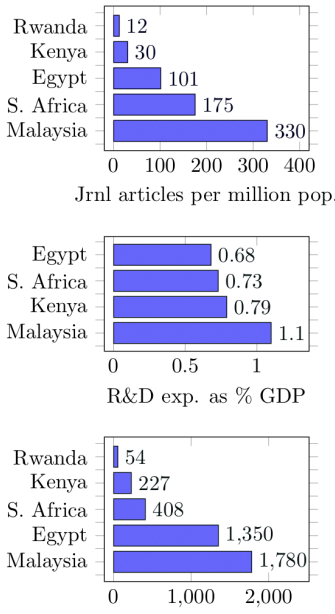
The inaugural issue of the *Kenya Policy Briefs* comes at a time when many are questioning whether universities and research institutions are doing enough in helping the country achieve its national development goals, especially in the context of Vision 2030. Globally, research has been recognised as a cornerstone of a nation's socio-economic development through, among others, finding practical solutions to problems communities face, and providing deeper insights and understanding of related socio-economic phenomena (Atuahene, 2011; Fussy, 2017; Pinheiro and Pillay, 2016). These can and should inform the development of effective and equitable policies. On the African continent, however, the research output often falls short of these ideals.

One must also recognise that policy-making is not a simple process. It involves personal interests, values, entrenched institutional positions, technical knowledge, among others (Hanney et al., 2003). Despite its complexity, researchers should make their contribution by presenting to policy-makers potential solutions (not just identification of problems) that taken in conjunction with information policymakers receive from their political staff and senior civil servants as well as practical factors such as administrative and institutional capacities, may provide the best course of action. A systematic channel for policymakers to access evidence-based research, therefore, improves the likelihood of implemented policies achieving their desired results. Providing this channel is the primary aim of the *Kenya Policy Briefs*.

Kenya's national development agenda, *Kenya Vision 2030,* provides a blueprint to transform the nation into "a newly industrialising, middle-income country, providing a high-quality life for all its citizens, by the year 2030." (GOK, 2013). Central to the development agenda, is university education that is expected to be "focused, efficient and able to create knowledge, and deliver accessible, equitable, relevant and quality training to sustain a knowledge economy that is internationally competitive." (GOK, 2012). The development blueprint is anchored on three main pillars (Economic, Social and Political) and cross-cutting themes anch-ored on several core foundations or enablers (see Table 1).

How is Kenya's research output performance measured through journal publications in comparison to select countries on the continent? With reference to Fig. 1 and despite spending more on Research and Development (R&D) as a per cent of Gross Domestic Product (GDP) than Egypt or South Africa, Kenya's research output is lower. This may be due, in part, to Kenya's much lower number of R&D researchers per million population.

Research output can be measured through several criteria. The use of academic papers and books, however, is the most widely accepted as a more quantifiable and objective measure of a country's knowledge stock (Inglesi-Lotz and Pouris, 2013; Hatemi-J et al, 2016). As a result, most of the research produced in Africa (with Kenya as no exception) remains inaccessible as they are often in the form of unpublished works such as research reports, technical papers, and working papers (Atuahene, 2011). Also, research is not viewed the same way in all Kenyan universities with many focussing on teaching and increasing their undergraduate student numbers.



Source: *Human Development Report (2016), UNESCO Science Report (2015).*

Figure 1: Country Comparison of Number of Researchers, Research Output and Expenditure

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Table 1: Vision 2030 Pillars, Themes and Foundations (Enablers)

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Further, research's role in national development is widely recognised. For example, Calma (2011, p.2) states that "achieving social relevance and economic benefit from research is the goal of universities and governments in many parts of the world." Knowledge, derived from research, is an essential part of sustainable development, especially today when universities are supposed to be at the centre of innovation and knowledge generation (Ramphele, 2004) and are key to achieving socio-economic transformation (Bloom, Cannings and Chan, 2006). Mbah (2015) is more emphatic stating that African universities must be involved in improving the living conditions of ordinary people. Universities should therefore exploit their unique role of being able "to access knowledge from all sources … synthesize it, adapt it, and generally make it useable by local communities … under local conditions. (Sawyer, 2004, p. 214)." In Africa, these systems are often not there resulting in continued knowledge poverty and material deprivation. Also, due to limited resources, research output is often descriptive, lacking the empirical rigour required to have an impact on national development (Moahi, 2007).

Research initiatives in Africa are expected to be aligned with national strategies designed to meet local challenges (Ahmed and Newton, 2005). In Kenya, there has been a sustained emphasis by government on the important role research plays towards meeting national development goals. Specifically, R&D is viewed as playing " … a vital role in industrial transformation, economic growth and poverty reduction" and that "... there is need to give R&D priority in national development." (GOK, 2005, p. 85). The *Kenya Policy Briefs*, therefore, aims to play a key role in this process by enabling researchers to present their research output, explicitly aligned to the objectives of Vision 2030, in the form of policy briefs that shall be readily accessible and understandable by policymakers in Kenya and beyond.

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Series 1 - Economic Pillar: Financial Services

Taming Predatory Lending for a Resilient Financial System and Economic Growth

Dr Joy Kiiru

Key Messages

Pricing for risk by financial institutions, and charging higher interest rates to more risky borrowers is not necessarily bad for the economy.

A more competitive formal financial system will keep bank interest rates low

Tame predatory lending by imposing regulations that protect poor borrowers

Consider social protection to aid the very poor and vulnerable. Credit/loans may cause more harm to them

Context

Kenya's credit market has gone a full circle in just about three years. Before 2016, interest rates were to a large extend liberalized, and relatively high to the frustration of policymakers. High interest rates are an obstacle to domestic investments while at the same time they contribute to bank profitability. The fact that banks were very profitable in the context of household and individual in-debtness with low returns on savings was perceived as unethical and unacceptable. A group of lawmakers moved a motion that was unanimously passed in parliament in 2016 to introduce interest rate controls2. The objective of the interest rate controls was to reduce the cost of credit, increase or expand access to credit while increasing the returns on savings. However, there is evidence that "the law on interest rate controls obtained the opposite effect. Specifically, it led to a collapse of credit to micro, small, and medium enterprises, as well as individual credit; shrinking of the loan book of the small banks; and reduced financial intermediation" (Alper et al. 2019 p.1). Three years down the line in 2019 the law that provided for interest rate controls was repealed.

The real problem with interest rate controls was the inability for banks to price for risk. As such, government bonds became more attractive to financial institutions as opposed to lending to micro and small enterprises which were perceived as risky despite their crucial role in employment creation, investments and economic growth. The interest rate controls, therefore, created a vacuum where the so-called risky borrowers (firms and individuals alike) had to look for other avenues to access to credit. This policy brief is critical especially in the wake of the 2019 financial access survey that showed that the percentage of people with access to credit services was at 82.9 per cent, up from 26.7 per cent in 2006 and 75.3 per cent in 2016.

The same survey found that financial health (the ability to cope with unexpected financial demands) was worsening. Much of the access to credit is fuelled by a proliferation of lenders using mobile phone technology to give quick small loans with terms that are otherwise unfair to the wellbeing of the borrower. This amounts to predatory lending, a lending practice with unfair or abusive loan terms on a borrower. It also amounts to a coercive practice that convinces a borrower to take a loan that they can do without. In this research, we

Roadside vendors and motorcycle taxis (Photo: Madara Ogot)

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focus on lending systems targeting the poor, to give policy recommendations for a healthy and resilient credit system in Kenya.

Approach

We used data collected through a survey to evaluate sources and impact of financial services to poor households. We utilized both theoretical and empirical econometric modelling methods to analyse the data.

We focus on lending modalities for poor households and entrepreneurs, in particular, solidarity lending and other socially secured loans to demonstrate that the so-called "informal collateral" ideally over-secure loans for the poor and is the genesis of predatory lending.

Results

We present two main arguments derived from our research: One, policymakers should not worry about banks being able to price for risks and to charge “higher” interest rates to more risky borrowers. Moreover, if the banking system is competitive, interest rates will remain relatively low. The alternative to bank credit (be it for enterprises or individuals) include informal money lenders, investments groups (*chamas*), and digital mobile app loans. All these alternatives charge much higher interest rates and or impose unfair terms to the borrower. Our second argument demonstrates that in the Kenyan context, characterized by relatively high poverty levels and income inequalities, the demand for credit (both households and firms) is ripe. Poor people or enterprises seek credit as a matter of survival and easily discount or under-rate the real cost of credit. Their situation pre-disposes them to predatory lenders. Thus there is the need to regulate credit markets to ensure that access to credit not only adds to economic growth but also resilient financial systems.

Our study revealed that 10 per cent of the sample used at least 75 per cent of the loans for immediate consumption needs, another 57 per cent used at least 75 per cent of their loans for productive activity and only 33 per cent used the entire credit for productive activity. Loan repayments consisted of stringent regulations by both borrowers and microfinance institutions. For example, there were weekly meetings to collect all due loans, make loan instalments and mitigate imminent default by any group member. The loan officer would preside over the meetings and would not adjourn till all due loan instalments have been redeemed. In case of imminent threat of default for any outstanding loan instalment, the group officials were responsible. They carry out immediate fundraising including borrowing from informal money lenders just to redeem the group but with consequences to the defaulting member. Sanctions to the defaulter include threats, penalties, social stigma and alienation. Confiscation of private property was also rampant. However, its group members who confiscate each other's property in case of default. Repayment rates by joint liability groups stood well over 90 per cent. The poor are therefore trapped in a situation where default would lead to both economic and social costs. In our sample, only about 20 per cent of the respondents repaid their loan instalments through returns from their enterprises, the rest of the sample experienced distress repayments. Distress repayments include borrowing to repay (62 per cent), sale of pre-existing property (17 per cent) and actual confiscation of private property by group members (4 per cent).

Another important finding from our study is that the so-called better-off poor (not the poorest) are in a better position to benefit from small loans as long as the loans jump-start them into productive activities within their areas of expertise. Finally, the very poor are too poor to benefit from market-driven interventions like microcredit. What the very poor need are non-market interventions like social protection services as a matter of survival. Access to credit will not necessarily turn a poor person into an entrepreneur and hence the need for a realistic policy on access to credit and entrepreneurship to ensure that only viable enterprises or households access credit. The implication is far-reaching especially to mobile phone app-based lending that preys on the youth and other vulnerable persons.

Policy Recommendations

Short-Term

- Regulations that encourage the viable selection of households and entrepreneurs into solidarity borrowing groups should be encouraged. For example, outlawing informal contracts that allow group members to confiscate defaulters' private property.
- Financial resources even though held as security for loans advanced to solidarity groups, should be held in interest-bearing accounts, unlike the current scenario where such accounts bear no interest. “Forced savings" are part of the reason why poor people's loans are over-secured and should be discouraged or made to work for them.
- Consider social protection for the very poor, as they may benefit from market-driven interventions like credit.

Medium-Term

- Banking regulations should ensure a competitive banking system to keep interest rates low.
- Regulate digital lending to create a stable and resilient banking system.

Acknowledgements

This policy brief is derived from the research paper: Kiiru, Joy (2018): Institutional Moral Hazard and Inclusive Finance: When Good is Not so Good. *OIDA International Journal of Sustainable Development*, Ontario International Development Agency, Canada ISSN 1923-6654 (print) ISSN 1923-6662 (online).

The research was generously funded by the Federal Ministry of Economic Cooperation and Development BMZ – Germany.

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Series 1 – Economic Pillar: Agriculture and Livestock

Enhancing Sustainability in African Catfish Seed Supply for Improved Production in Kenya

Dr James Barasa

Key Messages

Farmed catfish production is low due to poor survival of fry (larvae) reducing seed availability, forcing search for seeds from natural sources

Increases exploitation pressure on natural populations, exposes fishermen to health risks

Careful choice and management of catfish brood stock and improved husbandry could increase survival of fry and seed availability for farmers.

Context

African catfish, *Clarias Gariepinus*, is an important farmed food fish species in Kenya. It is also used as live bait to catch Nile perch in Lake Victoria using longline hooks and so increases food and nutrition security, income and national development. The daily demand of 3 million live bait samples required by fishermen on the Kenyan side of Lake Victoria is largely unmet by hatchery and fish farms. This is mainly because of inadequate supply of quality seeds for use by farmers to stock their ponds (Rasowo et al., 2007) and for fishermen in Lake Victoria to use as live bait for Nile perch. Limited availability and supply of farm-raised catfish seeds are due to poor survival of catfish fry (Sulem et al., 2006), with farmers losing up to 99.8 per cent of the seed material (Hogendoorn, 1980) mainly due to use of poor quality brood stock of unknown ancestry (Barasa et al., 2014) and poor husbandry practices by farmers (Musa et al., 2012; Barasa et al., 2017). This occasions low annual average production of farmed catfish.

Consequently, fish farmers and bait traders collect catfish seeds from natural habitats. This is environmentally unfriendly and increases exploitation pressure on seeds from the natural habitats to health risks. Additionally, the quality of catfishnatural populations of catfish, and exposes fishermen collecting catfish collected from the natural habitats is not assured, requisite numbers are not met in a reasonable time, and the practice constitutes a loss of income by catfish hatchery operators and farmers as well.

In contrast, artificial propagation of catfish at hatcheries reduces exploitation pres-sure on natural populations of indigenous fish species of the Lake Victoria basin (Kaufman and Ochumba, 1993), generates income and livelihood oppor-tunities for farmers (Barasa et al., 2017; Mkumbo and Mlaponi, 2007) as well as guarantees quality and adequate numbers of seeds.

Identification and isolation of high-quality catfish brood stock for use at hatcheries in artificial propagation in combination with improved husbandry for resultant fry could be a suitable strategy to increase the availability of farm-raised catfish seeds to support expanded aquaculture in Kenya. To maintain the quality of such brood stock, nuclei hatcheries should be developed, to manage this stock. Such hatcheries will be charged with artificial propagation of catfish larvae for sale to farmers, who should consistently maintain best management practices on their farms.

Mature African catfish, Clarias Gariepinus, *from a farm in Kenya (Photo: Author)*

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Approach and Results

The culture of C. gariepinus in Kenya is poorly organized, with the sourcing of seeds from the natural (wild) aquatic habitats whose quality is not known, or from farmer-owned nearby hatcheries whose stocks are of mixed origin, poorly maintained, and suffer poor genetic quality that deprives the stocks of vigour to grow and survive. Similarly, farmers hardly practice good catfish husbandry on their farms, further reducing the quality or vigour of the fish. This inevitably leads to cannibalism among the batch of catfish fry or larvae, increasing mortality among the fry hatched in a batch resulting in low annual farmed production of catfish in Kenya.

In a recent study, the high genetic quality of catfish was found to correlate with higher fitness (Barasa, 2018). For instance, catfish from Lakes Victoria and Turkana had higher genetic quality than those from Lake Baringo (Barasa et al., 2017). The Lake Victoria catfish showed higher fertility as a fitness characteristic than Lake Baringo catfish. Therefore, farmers will benefit from using populations of higher genetic quality as a source of broodstock, as this is likely to increase survival of fry, and so achieve sustainability in seed production and availability.

Also, the relationship between mean relative fertility and the expected Heterozygosity (a measure of genetic variability) of Clarias gariepinus populations from Lakes Victoria, Baringo and Kanyaboli were investigated (see Fig. 1). The Lake Victoria populations had higher genetic quality (higher heterozygosity) and higher fertility than Lake Baringo populations. High heterozygosity means lots of genetic variability. Low heterozygosity means little genetic variability that can be attributed to forces such as inbreeding.

Policy Recommendations

Short-Term

- Ensure proper husbandry practices in the rearing of catfish on farms and hatcheries.
- Avoid movement of catfish brood stock and seeds across drainage basins

Medium-Term

- Establish and maintain nuclei hatcheries to manage multiplication and distribution of quality catfish seed
- Certify the established nuclei hatcheries to ensure best practices are used in seed multiplication.

Acknowledgements

Preparation of this policy brief was supported by the AgriFOSE2030 Programme and International Livestock Research Institute (ILRI) with financial support from the Swedish International Develop-ment Agency (SIDA). I hereby thank all staff of ILRI/AgriFOSE2030 Programme, and my mentor, Dr Geraldine Matolla whose valuable technical support enabled the development of this draft policy brief.

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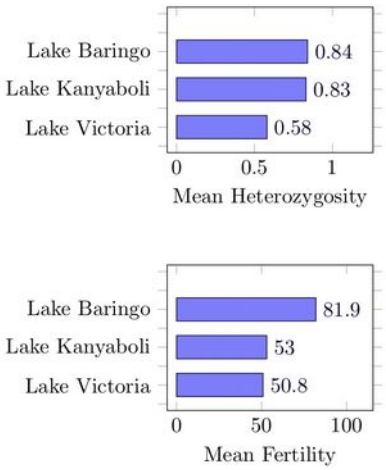

Figure 1: Comparison of mean relative fertility and the expected heterozygosity (a measure of genetic variability) of Clarias Gariepinus *populations*

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Series 1 – Economic Pillar: Agriculture and Livestock

Converting Agro-Waste into Biochar: Improving Soil Fertility and Productivity in ASAL Ecosystems

Elizabeth Ouna, Jesse T. Njooka, Shellemiah O. Keya, Raphael K. Wanjogu

Key Messages

Recycling rice-husk waste into biochar may increase soil nitrogen and phosphorus availability

Biochar has the potential to improve soil productivity and agronomic yield and nutritional quality of D. lablab *in rotational farming with cereals in Mwea and Bura.*

Biochar may reduce salt-toxicity as proved with Bura soil

Context

The prevalent constrain of food insecurity in the arid and semi-arid lands (ASALs) continue to worsen due to deteriorating soil health and increasing rate of population growth (Bai and Dent, 2006). The economic contribution of the ASAL's agricultural sector has continued to fall from 30 per cent to 20 per cent of the national Gross Domestic Product (GDP) primarily due to soil degradation. In Mwea, this is due to intensive and continuous cereal mono-cropping with minimal organic inputs; while in Bura, it is as a result of salinization (Muchena, 2008, GoK, 2009, 2012). Also, the feed value chain supports only 0.28 per cent of the GDP and its production continues to decline due to the slow growth rate of the feed production industry estimated at 300 thousand metric tonnes (MT) in 2003 growing to only 570 thousand MT in 2018, low germplasm of drought-tolerant crops, and limited crop farming due to extended drought under erratic low rainfall. This has resulted in reduced livestock population head in the ASALs from 75 per cent to 60 per cent of national livestock between 2009 and 2019.

Following the Maputo Declaration 2006, Malabo Declaration 2014 and the publishing of Kenya's Vision 2030, and the United Nations Sustainable Development Goals, Kenya is expected to achieve an agricultural growth rate of 6 per cent per annum through an increase in the utilization of land, water resources, and in the rate of fertilizer application from 8 kilogrammes per hectare (Kg/Ha) to 50 Kg/Ha, including use of organic fertilizers. Negative environmental impacts associated with chemical fertilizers, however, remain a problem due to groundwater pollution by nitrate fertilizers and low germplasm of drought-tolerant legumes. An innovative upgraded technology for production of biochar, a carbonized form of organic waste generated by recycling in limited oxygen and heat, for soil amendment to improve soil health (nutrient stock and flows) in addition to the cultivation of locally available germplasm with traits for drought tolerance, can effectively address the constraints of food production in degraded soils resulting in a substantial increase in yield and nutritional quality improvement.

Approach and Results

In line with the Comprehensive Africa Agricultural Development Programme (Africa's policy framework for agricultural transformation, wealth creation, food security and nutrition, economic growth and

Plate 1: Rice Husks (Photo: Tim Mcdonnell)

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prosperity for all) to improve research, generated from the traditional kiln and a fabricated up-scaled carbonizer. Their qualities were compared to select superior biochar for soil amendment. *Dolichos lablab* Rongai (Bura ecotype) was cultivated in the amended soils of arid and semi-arid agro-ecosystems of Bura and Mwea.

The study was carried out in a greenhouse at the University of Nairobi and in open field research fields in Mwea and Bura belonging to National Irrigation Board for three years. The overall objective was to determine physical and chemical characteristics of biochar generated from the two technologies and select biochar with suitable quality to improve soil physical, chemical, and biological properties; and to assess the effect of biochar on crop yield and water use efficiency on a selected legume (*D. lablab* Rongai Bura ecotype) upon amendment in Mwea and Bura soils.

Domesticated and wild forage legumes (*Dolichos lablab cv Highworth, V. anguiculata, Arachis hypogea, Glycin max, Phaseolus vulgaris*, and *D. lablab* Rongai Bura ecotype) were collected from Mwea and Bura and three exotic pasture-legumes of *Stylosanthes* were evaluated for drought tolerance under Mwea and Bura ecosystems using the following criteria: dry matter production, grain yield, herbage biomass at maturity, water use efficiency, soil water retention, bulk density physical and chemical properties, promiscuity of the legumes to nodulation by rhizobia, and salt tolerance. Note that nodulation is the interaction between bacteria found in the soil and their plant hosts. It is very important for plants enabling them to access nitrogen, made available by the bacteria, from the air. The studies were carried out in field research stations of National Irrigation Board in Mwea and Bura, greenhouse and soil laboratories at the University of Nairobi between 2013 to 2017 (Ouna, 2019).

Effect of biochar on soil properties. Biochar generated amended in Mwea soils cultivated with *D. lablab* raised soil pH from 6.3 to 6.8, available phosphorus increased from 52 to 78 parts per million (ppm), and total mineralized soil nitrogen increased from 0.106 per cent to 0.276 per cent. Therefore it is extremely likely that biochar will raise pH in low fertile soil which has turned acidic towards neutral, increase the concentration of soil available phosphorus fertilizer and increase soil nitrogen. Also, under cultivation with *D. lablab* Rongai, while in Saline soils of Bura, biochar reduced salinity from 6.46 to 5.72 deciSiemens per metre (dS/m). dS/m is a measure of salinity based on electrical conductivity. This resulted in a significant increase in yield compared to crops grown in non-amended control in both Mwea and Bura soil.

technology, and adoption, biochar was

Effect of biochar on soil biological property. Biochar increased the population of Rhizobia from 100 thousand cells /gram(g) to 5.9 billion in the soil of Mwea and from 1 thousand cells/g to 0.58 million cells/g in Bura soil; enhanced nodulation effectiveness from 11 to 33 nodules/plant in Mwea soil and 3 to 18 nodules/plant in Bura soils; and increased nitrogen fixation efficiency in *D. lablab* Rongai. Therefore, biochar did affect soil health as soil fertility and ecosystem functions increased in amended soils.

Water retention capacity and water use efficiency. Biochar improved soil water retention from a volumetric water content of 3.7 cm3/cm3 in control to 7.5 cm3/cm3 at 10 tonnes/ha and water use efficiency at 4.99 kg/ha/mm compared to control at 2.2 kg/ha/mm.

Legume yield. Optimum seed biomass of *D. lablab cv.* Rongai increased to 1,680 kg/ha from 877 kg/ha in control while herbage biomass at 50 per cent flowering was at 2016 kg/ha against 907 kg/ha in control. During seasons of low rainfall or extended drought, it seems likely that plants grown in soils amended with biochar at 10 tonnes/ha will have higher biomass production than control. Amendments with biochar had an impact on legume crop yield in Mwea soil.

Policy Recommendations

Short-Term

- The practice of soil amendment with biochar should be included in the management of ASAL soils, and over-cultivated cereal growing zones where soils are acidic and of low fertility for sustainable soil fertility management to increase crop production.
- Improve benefit sharing of technology with local communities in the ASALs by planning to expand existing technology for production and distribution of biochar, for amendment of Mwea or Bura soil through stakeholder training and capacity development with relevant authorities to improve soil productivity.

Medium-Term

- Expand ecological niche of *D. lablab* Rongai, Bura ecotype to semi-arid (Mwea) and as a pulse forage crop, in arid feedlots (Bura) under biochar farming to improve the production of herbage and seed and quality for livestock and human nutrition in the ASALs.

Acknowledgements

Preparation of this policy brief was supported by the AgriFOSE2030 Programme and International Livestock Research Institute (ILRI) with financial support from the Swedish International Development Agency (SIDA). I hereby thank all staff of ILRI/AgriFOSE2030 Programme, and my mentor, Dr Geraldine Matolla whose valuable technical support enabled the development of this draft policy brief.

Plate 2: Dolichos lablab Rongai (Bura ecotype) (Photo: Authors)

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Series 2 – Social Pillar: Environment, Water, Sanitation and Regional Development

Cactus invasion: A Threat to Biodiversity and Food Security

Dr Eunice W. Githae

Key Messages

Invasive cactus degrades rangelands and reduces availability and accessibility of pasture and other natural resources.

Cactus invasion reduces biodiversity hence affecting ecosystem goods and services that are essential for human well-being.

There is limited information and lack of public awareness on the harmful impacts caused by invasive cactus.

Rural households lose between 50 and 100 thousand shillings a year because of cactus

Plate 1: Beautiful yellow flower of the pear cactus
(Photo: Stan Shebs, CC BY-SA 3.0, https://commons.wikimedia.org/)

Context

The prickly pear cactus has a negative impact on food security, biodiversity and human well-being. The cactus invades mostly arid and semi-arid lands (ASALs), which form more than 80% of Kenya's landmass. Livestock keeping is the main socio-economic activity in these areas. The plant is hardly appreciated due to the presence of spines and glochids (small spines on fruits) that cause injuries to people and livestock. In Narok County, the cactus invasion has increased rapidly over the last five years and has displaced people and pasture (Githae, 2018). The plant has been present in Laikipia County for more than 10 years and has invaded grazing land, contributing to the death of livestock and wildlife (Shackelton et al., 2017).

Several conservancies and national parks have also been invaded by the plant. The plant is not only a serious threat to a wide range of wildlife but also to plant diversity. For example, in the Serengeti-Mara ecosystem, prickly pear cactus is among the intentionally introduced plants that have displaced grass and other fodder plants (Witt et al., 2017). It has also occupied more than 500 km2 in the Tsavo East National Park and its surrounding areas (CABI, 2018). In Naibunga conservancy, the plant has occupied about 17,000 acres of land and invades at least 2 km of habitat per year (Daily Nation, 2017). The potential costs associated with the invasion of natural pasture are based on reduced grazing land, replacement of natural pasture, negative impacts on livestock health, and reduced mobility of livestock. Although the full cost of the impacts of cactus invasion in Kenya has not yet been quantified, rural households lose between 50 and 100 thousand shillings a year because of cactus (Shackleton, 2017). With the current changes in climate, the plant is likely to be a growing problem to rural livelihoods if appropriate measures to control its spread are not put into place.

Prickly pear cactus is among the most common introduced invasive plant in Kenya. Originally from America, the plant is widespread in the arid and semi-arid areas. Prickly pear is a spiny shrub with different shapes, which has attractive yellow flowers and purple-reddish fruits (Figure 2 and 3).

The cactus has invaded Asia, Africa and Europe. In Africa, it has been reported in several countries, including Eritrea, Ethiopia, Namibia, Morocco, South Africa and Kenya. The counties most widely invaded in Kenya are Samburu, Narok, Laikipia, Baringo, Nakuru, Kajiado and Taita Taveta with small patches occurring in the neighbouring counties. Cactus pear was first introduced in Laikipia in the early 1950s as an ornamental plant. Today, it has spread far and wide mainly through human use, for example as ornamental plants or as live fences. However, these uses cannot

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compensate for the overall negative impacts exposed by the invasion.

Their seeds are dispersed by baboons, birds and elephants. Broken pieces are scattered by animals as they move from one place to another. The plant can survive well during prolonged drought and the seeds can stay in the soil for almost two years as they wait to sprout during the rainy season. These characteristics enable the plant to be more aggressive than others.

Controlling and Preventing Further Spread

The most applied methods of controlling cactus are manual such as chopping, burying and burning. These are difficult, involve a lot of labour, and cannot provide a lasting solution. Chemicals, on the other hand, are used after chopping but the plant regenerates after some time. The control of prickly pear cactus in other countries such as South Africa is entirely reliant on a bio-control insect, which was also introduced in a pilot project in Laikipia and showed a positive result. However, local pastoralists reported that the insect was released in a few areas and the plant was spreading faster in the neighbouring areas where it had not invaded before, especially in the mountains and valleys (Daily Nation, 2017). Complete removal of cactus plants may also leave the ground bare that could lead to further environmental degradation. Successful management of the plant, therefore, requires an integrated management plan of the infested areas.

Several national strategies have a focus on biodiversity conservation through control of invasive alien species. These include the National Wildlife Strategy 2030, the Kenya Vision 2030, and the National Strategy and Action Plan for the Management of Invasive Species in Protected Areas in Kenya. Based on these, this brief recommends several approaches to manage and reduce the negative impacts of cactus invasion that can be applied by the Ministry of Environment, Water and Natural Resource, Ministry of Agriculture, Livestock and Fisheries, Ministry of Tourism, and county governments that are affected by the invasion. These could lead to functional and resilient ecosystems that can support livestock production and wildlife; restored and conserved biodiversity; and high level of awareness and understanding of the harmful effects, possible solutions and best practices.

Policy Recommendations

Short-Term

- Map and list threatened areas and species to improve biodiversity conservation.
- Identify possible areas of future invasion based on human activities and climate.
- Increase awareness and understanding of the harmful effects of cactus invasions and their possible solutions and best practices. This can be through the development of educational materials and undertaking public outreach.
-

Medium-Term

- Rehabilitate open areas with indigenous trees.
- Develop and implement policy guidelines to prevent further invasion.
- Rehabilitate and restore rangeland eco-systems through integrated management plans.

Acknowledgements

Preparation of this policy brief was supported by the AgriFose2030 program, International Livestock Research Institute (ILRI) and the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) with financial support from the Swedish International Development Agency (SIDA). I wish to thank Stephen Wambugu for his valuable technical input and Anne Nyamu for the excellent editorial support.

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Cactus purplish-red fruits.
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Series 2 – Social Pillar: Environment, Water, Sanitation and Regional Development

Mangrove Degradation: Reversing the Trend through Community Engagement

Virginia W. Wang'ondu

Key Messages

- *Community Sensitisation on growth characteristics of mangrove species to understand implications of over-utilisation*
- *Development of holistic mangrove reforestation programme inclusive of all species*
- *Funding of research that promotes biotechnological improvement of mangroves*

Context

Mangrove forests in Kenya cover approximately 61,271 hectares along a 536 km coastline supporting the livelihood of approximately 3 million Kenyans. The Lamu County coastline accounts for 61 per cent of mangrove forest cover (GoK, 2017), while Mombasa and Kwale Counties account for the remaining 29 per cent. Mangroves protect the shoreline and provide habitat and shelter for marine fish and other organisms that are a source of food. The wood from the trees are also utilized by communities for house construction, boat building and furniture making; and as a source of medicine, dye, firewood, charcoal and fencing poles. Mangroves are also very important in protecting the shoreline from erosion and excessive damage by floods, hurricanes and tsunamis. Thus, they are critical in sheltering and maintaining habitats and breeding grounds vital for growth, survival and reproduction of marine animals and fish. The trees also absorb carbon dioxide from the atmosphere thus contributing to climate change mitigation. The increase in levels of carbon dioxide has led to global warming resulting in unpredictable changing weather conditions being experienced in different parts of the world including prolonged droughts, unusually heavy rains, flooding, hurricanes, and tsunamis.

More than 3,000 fish species, crabs, shrimps, prawns, molluscs, oysters, among others live, shelter and breed in the mangrove forests. Marine fishing is an important economic activity and a major income earner producing 8,000 tons of marine fish, generating KES 100 million annually, and contributing approximately 0.5 per cent of all the goods and services produced in the country. Marine fish is also an important protein source for inland and coastal communities. Destruction and clearance of mangrove forests through logging and over-harvesting directly affects inshore and offshore commercial fisheries through lack of food, and loss of shelter and breeding grounds for most fish, threatening their survival. Also, the decline in fish numbers causes a loss of vital income and a much-needed protein source resulting in malnutrition and food insecurity. In Kenya, the loses are estimated at KES 582 million every year for inshore fisheries within the mangroves.

The Kenya population census carried out in 2009 reported a total coastal human population of 3.04 million (GoK, 2017). As the population has steadily increased, so has the demand for fish and over-exploitation of the mangrove forests for

Mongroves Trees
(Photo: Karthik Easvur CC BY-SA.jpg)

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firewood, construction materials, and other resources. Coastal communities have a preference for certain mangrove species because of their likeable attributes and suitability for specific purposes. For example, there is a preference for construction wood from three species namely *Rhizophora mucronata, Ceriops tagal* and *Bruguiera gymnorrhiza* leading to their over-harvesting and over-exploitation.

A mangrove forest cover loss of 20 per cent (450 ha/year) was recorded between 1985 and 2009 of which Mombasa County experienced a 70 per cent loss (Bosire et al., 2013). This puts coastal people who rely directly on mangroves at risk of losing their livelihoods and experiencing increased poverty levels and is likely to escalate if the destruction is not adequately addressed, completely stopped, and urgent restoration of degraded forests and re-afforestation of coastlines initiated and encouraged.

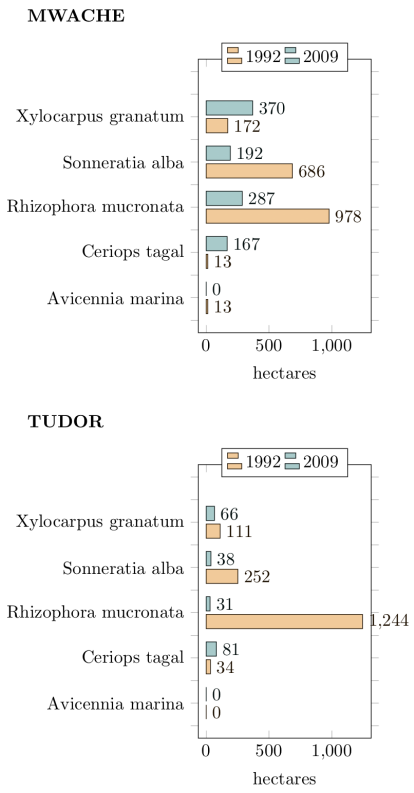

Figure 1 Mangrove species cover change between 1992 to 2009 (Modified from Bosire et al., 2013)

Our Study

This policy brief is based on a study in Mida creek, Watamu Marine National reserve, Kilifi County (a marine protected area) that investigated the effect of open access to mangrove forests on mangrove productivity, benthic (ecological region at the bottom of the rivers/ocean) biodiversity and fish productivity. In Kenya, the coastal communities largely depend on three main mangrove trees types, Rhizophora mucronata, Ceriops tagal and Bruguiera gymnorrhiza, whose seeds take longer to mature – more than 18 months. The seeds of non-preferred tree types take 4 to 6 months to mature (Wang'ondu et al., 2013). The long maturity of preferred species seeds affects their availability for planting through natural regeneration or reforestation. Besides, these trees take 10 to 15 years before they reach the maturity stage suitable for harvesting. In our study, it was observed that continued cutting of these preferred species before maturity, primarily for house construction, has affected the stand structure of mangroves forests near human habitation (Wang'ondu et al., 2017). This contributes to forest cover loss and seed scarcity for natural regeneration and artificial planting. Old trees that are left are poor seed producers, making seedlings for re-afforestation to be in short supply or unavailable. Also, most of the community nurseries grow one species, R. mucronata, that is easy to grow in the nursery.

Community Participation

There is, therefore, an urgent need to create awareness, educate and train the communities on sustainable utilization of mangrove trees, conservation of threatened tree species and the need for sustainable seed propagation and re-afforestation efforts to achieve desirable forest cover, restore degraded coastlines, enhance marine animal life and improve community livelihoods through increased incomes and food security. Recently, coastal communities have actively participated in mangrove conservation through community conservation groups. Women, who were not initially allowed to participate in mangrove planting and protection, are spearheading mangrove conservation efforts. This has greatly boosted the number of tree nurseries and trees planted, improving forest management and protection of restored areas.

For example, in Kwale County the Mikoko Pamoja community project has endeavoured to conserve mangrove forest from destruction through a carbon market initiative. The community is financially compensated for conserving mangrove forests. Its duplication in other counties is key, backed by other conservation efforts. In addition, coastal farmers through Community Forest Associations (CFAs), guided by the Kenya Marine Fisheries Research Institute, Kenya Forest Service (KFS), Worldwide Fund for Nature, and other organizations have sought alternative trees, for example, Eucalyptus, Cypress, Casuarina, Mukeu and Mvule, to meet wood and fuel needs. However, since some the value of mangroves cannot be replaced by these trees, more effort needs to be directed toward the increase mangrove forest cover. It is evident that community participation has and will continue to play a major role in mangrove conservation.

Policy Recommendations

Short-Term

- Ministry of Environment and Forestry through KFS and CFAs to promote utilization of non-preferred mangroves species for certain needs
- Community sensitization by KFS on growth characteristics of mangrove species to understand the implications of over-utilization of certain species.
- KFS to organize training sessions in line with seed development and growth characteristics of mangrove species.

Medium-Term

- Ministry of Environment and Forestry to develop a holistic mangrove reforestation programme which is inclusive of all species.
- Government funding of research that promotes the biotechnological improvement of mangroves whose genetic resource is reduced.

Acknowledgements

Preparation of this policy brief was supported by AgriFose2030 and ILRI/ReSAKSS through training on policy brief writing. Research informing this policy brief was funded by VLIR-UOS. I would like to thank Dr Esther Kanduma and UoN mentors team for their valuable technical input.

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Series 2 – Social Pillar: Environment, Water, Sanitation and Regional Development

Domestication of the Ramsar Convention in Kenya

Dr Parita Shah

Key Messages

Government of Kenya needs to do better in term of policies to integrate the Ramsar Convention.

Policies should be focused on having more prescriptions to meet Ramsar obligations.

The Wetland Conservation and Management Policy should be the pillar of domestication of the Ramsar Convention.

Context

The Ramsar Convention is an international treaty for the conservation and sustainable use of wetlands. Wetlands are a critical component of the natural environment. They reduce the impact of flooding by absorbing excess water, are habitats for plant and animal species, and are a major source of water-human activities. Wetlands are critical for the maintenance of life on earth. Kenya's wetland cover is approximately 14,000 km2, which is 3 to 4 per cent of the country's surface area (Government of Kenya, 2015). To protect Kenya's wetlands, the country signed the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) on October 5, 1990, and ratified it on June 5, 1991. By 2019, the country had designated six Ramsar sites, namely, Lake Nakuru (1990), Lake Naivasha (1995), Lake Bogoria (2001), Lake Baringo (2002), Lake Elementaita (2005), and River Tana (2012). The domestication of the Ramsar Convention in Kenya through better integration of the convention obligations into policy frameworks would assure the conservation and protection of the Country's wetlands. The focal agency is the Kenya Wildlife Service working with other government institutions including the National Environmental Management Authority, Ministry of Environment and Natural Resources, and stakeholders such as the World Wildlife Fund.

Approach and Results

Domestication of the convention was evaluated on the extent to which its obligations are integrated into Kenya's policy frameworks, specifically the Wetlands Conservation and Management Policy (GoK, 2015), Environment Policy (GoK, 2013), Wildlife Policy (GoK, 2012), National Constitution of Kenya (GoK, 2010), and the Sessional Paper No. 6 on Environment and Development (GoK, 1999). Selected obligations were: 1-Designation of wetlands for inclusion in the List of Wetlands of International Importance; 2-Conservation, wise use and management of wetlands and migratory stocks of waterfowl; 3-Formulation and implementation of plans to promote conservation and wise use of wetlands; 4-Research, monitoring and exchanging of data and training; 5-increasing waterfowl population in wetlands without altering wetlands; 6-Consultation and cooperation between countries, communities and other stakeholders through education, public participation; 7-Representatives to Conference of Parties be trained experts in wetlands/waterfowl management; 8-Parties to inform International Union for Conservation of Nature of every change in the ecological character of wetlands; 9-Regular reporting on conservation, management and wise use of wetlands and biodiversity, and 10-Establishing natural reserves on wetlands.

The Obligation Integration Susceptibility Index (OISI) was used to measure the extent of integration of the obligations into

Lake Naivasha (Photo: Wikimedia)

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the policy frameworks. Scores of 90-100 per cent are regarded as Excellent; 70-89 per cent as Very Good; 50-69 per cent as Good; 40-49 per cent as Poor. while those below 40 per cent are regarded as Very Poor. The OISI results indicated that the Wetland Policy had 52 prescriptions for all 10 obligations, thus its obligation integration was 100 per cent or excellent in the OISI scale. For the other policies: the Wildlife Policy had 17 prescriptions for 9 obligations (90 per cent integration-excellent); Sessional Paper Number 6 had 10 prescriptions for 7 obligations (70 per cent-Very Good); the Environment Policy had 15 prescriptions for 6 obligations (60 per cent integration-Good); the Constitution of Kenya had 5 prescriptions for 3 obligations (30 per cent integration-Very Poor) (Shah, 2016).

Individual Policy Prescriptions (IPP) were used to assess the level of integration by checking the policy prescriptions with the obligations (see Figure 1). All five policies had prescriptions addressing 2-Conservation, wise use and management of wetlands and migratory stocks of waterfowl corresponding to a 100 per cent score. This was followed by 3-Formulation and implementation of plans to promote conservation and wise use of wetlands with a score of 42.8 per cent. The remaining obligations had very few prescriptions with 1-Designation of wetlands for inclusion in the List of Wetlands of International Importance having the least with an IPP score of 0.78 per cent (Shah, 2016).

Policy Recommendations

Short-Term

- Involve stakeholders in developing/amending policies including direct communities, academia, water resource authorities and non-governmental organisations.
- Develop a communication strategy for community-based wetland management initiatives.

Medium-Term

- Amending existing policies to include all Ramsar obligations. This would pave way for the country to have more wetlands under protected area status.
- Have more policies to safeguard wetlands, for example, a Biodiversity Policy should be given priority. The Wetlands Policy on its own is not enough.
- Policies in draft form should be amended and signed for domestication. This would make communities at the grass-root level better aware of conservation strategies.
- Harmonize different roles played by different agencies and put them under one institution for the protection of Ramsar sites.
- Develop a mechanism whereby economic values of all wetland uses can be assessed.

Acknowledgements

This policy brief is the outcome of a larger research study entitled 'Domestication and Application of Biodiversity Related Multilateral Environmental Agreements (MEAs) in Kenya' by Parita Shah in 2016. The research was partially funded by the Deans' Committee, the University of Nairobi in 2014 and 2015.

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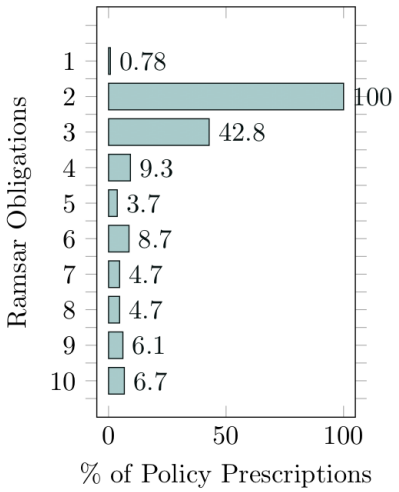

Figure 1: Level of Ramsar Convention obligation integration in policy prescriptions (per cent of integrated obligations versus national policies).

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Series 2 – Social Pillar: Environment, Water, Sanitation and Regional Development

Sanitation challenges, groundwater perspectives and their intertwined relationships in Kisumu, Kenya

Japhet R. Kanoti, Prof. Daniel O. Olago, Prof. Nobert O. Akech, Prof. Christopher M. Nyamoi, Dr Simeon Dulo, Dr Richard Ayah, Prof. Richard Taylor

Key Messages

Groundwater is the preferred alternative water source during times of shortages and in areas not served by piped water supplies.

Pit latrines are the main sanitation facilities in Kisumu where sewerage extends over less than 20 per cent of the city.

Pit latrines contribute to microbial contamination of shallow groundwater in Kisumu.

The sub-surface can be used both as a source of water and as a repository of human waste.

Context

Groundwater constitutes a potential source of safe water in both rural and urban settings in Kenya. Both national and county governments are striving to realize the United Nations' Sustainable Development Goal 6: Access to safe water for all by the year 2030. Further, Section 43 of the Constitution of Kenya on economic and social rights, guarantees access to safe water and adequate quantities. The sub-surface is also used in most parts of Kenya as a repository of human waste through pit latrines and as a source of groundwater from shallow wells. Pit latrines are hand-dug with the depths of less than 30m. In localities with shallow groundwater tables, these pit latrines can intercept the water table.

Like the pit latrines, shallow wells are often hand-dug and commonly located close to or within household compounds. Wells provide a vital source of safe water to millions of people, in rural and urban Kenya, who are either not connected to a piped water supply or are where piped supplies are intermittent. Conjunctive use of the shallow sub-surface as a repository of human waste and a source of water poses a threat to groundwater quality. Often these water points and sanitation facilities are located close to each other.

This research under the AfriWatSan project assessed groundwater and sanitation challenges based on field surveys, sampling, analyses, and interviews as well as reviews of the literature and historical borehole data in Kisumu, Kenya. Previous studies in the area have shown that the number of shallow wells, buildings, unimproved pit latrines and sanitary risks have increased tremendously between 1999 and 2019. This study confirmed that the main water and sanitation challenges in Kisumu are: (1) inadequate, poor and deteriorating water quality, (2) poor waste disposal management systems, and (3) poor sanitation services. There is a need for the introduction of new and sustainable groundwater approaches supported by science and decision-making processes that involve all stakeholders. Current deficiencies in the provision of adequate water and dignified sanitation to the poor in Kisumu can be remedied through improved knowledge on shallow aquifer dynamics and innovative research. It was noted that apart from the donor agencies and multi-national NGOs, private investors are unwilling to invest in water projects in Kisumu due, in part, to government legislation that constrains the cost that may be levied on water.

A typical hallow well

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Approach and Results

Kisumu County is one of the 47 counties in Kenya. It is located between longitudes 33° 20'E and 35° 20'E and latitudes 0° 20'South and 0° 50'South (County Government of Kisumu, 2018). Total land area is 2086 km2 with ~567 km2 covered by water. Kisumu is situated on the shores of Lake Victoria, the second-largest freshwater lake in the world. Due to poor investment in the water sector, only a fraction of the city's water demand is met through the piped supply from treated surface water. The main water treatment works are situated in Dunga, on the shore of Lake Victoria. Massive pumps are used to lift water from Lake Victoria to the treatment plant. The second source of water is the Kajulu gravity water intake along River Kajulu. Alternative sources of water include shallow wells and boreholes constructed by communities and donor agencies. However, these alternatives have their challenges ranging from vulnerability to contamination, over-abstraction and depletion.

Water coverage in Kisumu is about 75 er cent (KIWASCO, 2017). The supply is, however, intermittent due to old and dilapidated water infrastructure, power outages, and the climate associated with high and low discharges of the River Kajulu. The shallow aquifer underlying Kisumu supplies water to large areas during supply shortages from the Dunga and Kajulu intakes. Secondly, 82 per cent of households in Kisumu are not connected to the sewerage system and rely on pit latrines and /or septic systems for faecal waste disposal (KIWASCO, 2017). Limited access to safely managed water and sanitation infrastructure and services compromises public health. Understanding the risks posed by these two practices is essential for expanding access to safe water and sanitation practice in low-income settings.

The AfriWatSan project, financed by the UK government (DFID) and The Royal Society (UK), sampled water from existing 22 sites in Otonglo, Obunga, Manyatta A and Manyatta B settlements and newly drilled six monitoring boreholes distributed randomly in these informal settlements. The results confirm the presence of faecal bacteria in groundwater at varying levels. Springs and shallow wells within Obunga and Manyatta were heavily contaminated with colonies exceeding 1000 in 100ml of water (Kanoti et. al, 2018). All sources of water were contaminated by faecal bacteria and thus, according to WHO, unsuitable for drinking (Figure 1). Such faecal microbiological contamination can lead to outbreaks of waterborne diseases that pose a risk to human health, especially for vulnerable members of the community that include children, elderly and sick people.

Pumping tests conducted on six newly drilled research boreholes further revealed that Kisumu shallow aquifer is not one extensive unit, but rather an aggregation of more localized aquifer units. Groundwater yields vary from less than 1 m3/hour near RIAT in the lowlands where the geology is dominated by volcanic rocks to 4 m3/hour in Manyatta B where the geology consists of sedimentary rocks (Kanoti et. al, 2018). Such heterogeneity in hydrogeological properties poses a distinct challenge when promoting the use of shallow groundwater to meet UN SDG 6 and Kenya's Constitutional obligation on human rights. It also poses a significant challenge for governance, requiring coherent management of the groundwater resource at the local scale and the engagement of local communities.

Policy Recommendations

Short-Term

- Provision of affordable and safe water is an international and national priority. Low-income consumers are dependent on shallow groundwater and other unsafe waters. Efforts are needed to provide safe water to all.
- Simple water treatment should be encouraged. Such measures include boiling water from wells and springs and storing it in safe containers for drinking
- Pit latrines are currently constructed without any regard to proximity to water points. Public health official in consultation with other professionals should advise on the suitable location of pit latrines
- Poorly constructed pit latrines present health risks, especially for children and vulnerable persons, due to their lack of cleanliness and safety at night.

Medium-Term

- There is a need for the introduction of a new water development approach that involves all stakeholders. The perception that water is a human right and free makes investors perceive that the government may interfere in the water business. This should be discussed.
- Kisumu suffers water shortages due to many causes that include inadequate and poor surface water quality, low investment in the water sector, high non-water revenue, poor waste disposal management and poor sanitation services. These short-comings should be addressed.
- Steps should be taken to arrest the environmental degradation that is evident in Kisumu and surrounding areas where deforestation and settlement on high gradient areas increase runoff, which has negative implications on recharge and flash floods.

Acknowledgements

This brief is an output from the AfriWatSan project funded by The Royal Society Africa Capacity Building Initiative and the UK Department for International Development (DFID) (Grant Ref. AQ140023). The views expressed and information contained in it are not necessarily those of or endorsed by the Royal Society or DFID.

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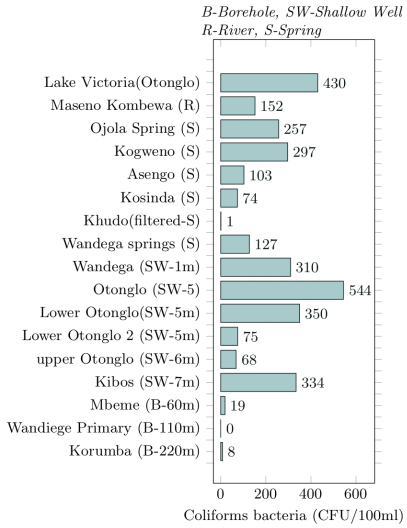

Figure 1: Contamination of water sources in the informal settlements in Kisumu. The bacteria values are reported as colony forming units (CFU) in 100 ml of water

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Series 2 – Social Pillar: Health

Implications of the Minamata Convention on Mercury on Oral Health in Kenya

Dr. Olivia A. Osiro, Dr. Bernina K. Kisumbi, Prof. David K. Kariuki, Prof. Loice W. Gathece

Key Messages

Dental amalgam is scheduled for a global phase-down
Several phase-down strategies are available to ensure that oral health is not affected by the unavailability of affordable dental treatment.
he expected impact is improved oral health status of Kenyans through the adoption of disease prevention and health promotion.
Furthermore, through improved access to affordable restorative dental care using low-cost alternative filling materials.

Context

The Minamata Convention on Mercury was convened by the United Nations Environment Programme in 2013 (UNEP, 2013) to discuss the environmental impact of mercury from industrial and other wastes. Dental amalgam, one of the oldest and affordable filling materials, is considered a mercury-based product and was listed, among others. The meeting recommended a global phase-out of all such products by 2020 except dental amalgam which was scheduled for a global phase-down.

This means that while industries and products that utilize mercury will be banned, usage of dental amalgam will be reduced for the time being. Moreover, reduction strategies for dental amalgam were documented for adoption by parties. Kenya is a signatory to the convention and is at an advanced stage towards becoming a party. This has huge implications for access to restorative dental treatment for a majority of the Kenyans (Osiro et al., 2019).

Dental caries or tooth decay is a ubiquitous public health problem. It affects 60-90 per cent of adults in industrialized countries (Petersen, 2004; Petersen, 2007). In Kenya, nearly 25 per cent of adults and 50 per cent of children under 5-years suffer from the condition (Fig 1) (Kenya National Oral Health Survey, 2015).

Despite the high national prevalence of tooth decay, oral health is poorly funded and receives only 0.0016 per cent of the national budget for health, limited to 8 per cent of the total Government expenditure (Kaimenyi, 2004). This provision is grossly inadequate. Therefore, access to restorative dental care remains limited for the majority and often, removal of offending teeth is a cheaper alternative. Tooth loss affects mastication and speech and is associated with reduced quality of life (Petersen, 2004; Petersen, 2007).

For those who can access treatment in the form of fillings, dental amalgam remains the most readily available and preferred filling material in low- and middle-income countries, including Kenya as it is inexpensive, easy to use, and strong enough to withstand chewing forces (Petersen et al., 2009). Therefore, the phase-down of dental amalgam will have implications on oral health status in Kenya through the unavailability of affordable dental treatment. The strategies recommended for the phase-down of dental amalgam as documented in the convention report are presented in Box 1.

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Box 1: Minamata Convention, Annex A, Part II4

Nine measures to phase down the use of dental amalgam:

(i) Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration;

(ii) Setting national objectives aiming at minimizing its use;

(iii) Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration;

(iv) Promoting research and development of quality mercury-free materials for dental restoration;

(v) Encouraging representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best management practices;

(vi) Discouraging insurance policies and programmes that favour dental amalgam use over mercury-free dental restoration;(vii) Encouraging insurance policies and programmes that favour the use of quality alternatives to dental amalgam for dental restoration;

(vii) Restricting the use of dental amalgam to its encapsulated form;

(vii) Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.

Approach and Results

Our research explored locally available raw materials to determine whether they may be used to develop mercury-free alternative dental filling materials. A low-cost mercury-free alternative may be utilized in affordable non-invasive procedures to reduce the need for advanced dental treatment and may also provide job opportunities in the relevant industry.

In a laboratory-based study, we evaluated local aluminosilicate materials for use in cement for dental fillings. We have identified those based on kaolin to be the most promising due to their stability in moisture and the ability to release fluoride, an essential element in the prevention of tooth decay (Fig. 2). Further research is necessary to develop the prototype to acceptable quality that has adequate strength to withstand chewing forces.

Policy Recommendations

The measures in Box 1 are thematically interconnected to promote oral health through disease prevention, reduce the need for restorations and encouraging best practice in the handling of dental amalgam waste.

Short-Term

- To set national objectives aimed at dental caries prevention and health promotion, to minimize the need for dental restoration;
- To encourage representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best waste management practices.
- To promote research and development of quality mercury-free materials for dental restoration.
- Implementation of disease prevention and health promotion programmes to reduce dental disease prevalence.

Medium-Term

- Promotion and support from a national agency to improve prospects and eventual uptake of a locally developed mercury-free dental restoration product for minimally invasive procedures.

Acknowledgements

This policy brief is derived from a PhD awarded by the University of Nairobi in 2019. Support for this work is from the University of Nairobi, Kenya, the Consortium for Advanced Research Training in Africa (CARTA), the National Research Fund, Kenya and the DAAD, Germany.

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Fig 1: Gum disease and dental caries

Fig 2: Kaolin-based dental cementcylinders for compressive strength tests

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Series 2 – Social Pillar: Gender, Youth and Vulnerable Groups

The Response of the Criminal Justice System to Spouse Abuse in Kenya

Dr Scholastica A. Omondi

Key Messages

The existence of the family as the basic unit of society is threatened by spouse abuse (SA)

The criminal justice system is ineffective and not suitable for resolving SA cases.

The impact of SA on family members negatively affects their ability to contribute towards national development at their maximum

There is need for SA prevention policy and an alternative dispute resolution mechanism.

Context

Spouse abuse (SA) is commonly known as domestic violence. It is also referred to as family violence, domestic disputes, intimate partner violence, wife abuse, wife battering, husband battering, and gender-based violence. SA also refers to violence between intimates living together or who have previously cohabited. SA is perpetrated in the form of physical, psychological, and verbal acts used to achieve control over an intimate partner It characteristically includes acts of physical and mental cruelty progressing from a slap or shove, to a punch or kick, and more extreme manifestations of violence including suffocation, strangulation, attempted murder, and actual murder. The term violence or abuse is often used in a narrow as well as wider sense. In the narrow sense, it describes the use or threat of physical force against the victim, constituting the crime of assault. In the wider definition within the family context, it includes physical assault, sexual or psychological assault, mental and emotional harassment.

SA results in negative health consequences for the victim. SA is acknowledged globally as a major social problem that affects the victims, their families, and the community in general irrespective of the social, economic, religious or cultural group. While there are no comprehensive statistics for male victims of SA, in Kenya, 44 per cent of men and 45 per cent of women have experienced SA (KDHS, 2014). This indicates an increase in gender-based violence for both men and women. Reporting of SA by male victims is low due to social stigma associated with being a victim, negative attitude of the police towards prosecution of SA, and the socialization that a male has to be dominant over the female spouse. As a result, many male victims of SA do not report the abuse for intervention but suffer the consequences. Despite the above statistics of the known reported incidences of SA to the criminal justice system (CJS), research indicates that the majority of the incidences go unreported while only a smaller percentage is documented.

The objective of this policy brief is to highlight the systemic weakness of the CJS as a response mechanism to SA and to make recommendations for policy interventions that can effectively protect the family as the basic unit of the society from the negative impact of SA. Unless the response mechanism is effective, the family unit remains threatened as vulnerable victims fail to report SA for intervention. There is an urgent need for an effective intervention mechanism that can resolve SA and protect the family.

Approach and Results

A study was conducted in Nairobi in 2015 on the effectiveness of the CJS in protecting the family against SA. As the capital city, Nairobi is representative of the

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population of the country. Respondents and key informants were purposively sampled based on their report to the CJS and their role in handling SA victims, respectively. The majority of the respondents (80 per cent) of the respondents were categorical that the CJS' approach of arresting the perpetrator, prosecuting him/her under the adversarial trial procedure was counterproductive to their main aim of resolution of the abuse. The major weaknesses of the CJS in resolving SA are:

- the adversarial nature of the CJS.
- lack of a specific crime known as spouse abuse.
- lack of a mandatory reporting policy.
- lack of a no-drop policy
- strict rules of evidence that fail to take into account the vulnerability of SA victims
- the bureaucracy and formality associated with the trial process

These identified weaknesses need to be addressed if the CJS is to respond to SA effectively and protect the family as the basic unit of society. The government has a constitutional obligation under Article 45(1) of the Constitution to protect the family.

The study concluded that the CJS is not effective in resolving SA. This means that more cases of SA are not reported. The implication is that many victims of SA suffer the consequences of unresolved SA silently, in some cases leading to homicides or suicides. SA, therefore, remains a threat to the family unit. Those affected by SA cannot contribute to nation-building to their maximum potential due to the effect of SA on their performance. There is a need for an alternative suitable and effective dispute resolution mechanism that addresses SA while preserving and protecting the family unit. Although the CJS is perceived to deter potential offenders from committing crimes, it is ineffective in resolving SA. The prosecution of a spouse in SA cases tears the family apart and perpetuates the already strained marital relationship. The CJS should be preserved for specific cases that deserve prosecution and punishment of the offending spouse.

Policy Recommendations

The measures in Box 1 are thematically interconnected to promote oral health through disease prevention, reduce the need for restorations and encouraging best practice in the handling of dental amalgam waste.

Short-Term

- Train and maintain a register of multidisciplinary professionals who can be called upon to resolve SA cases to protect the family
- Develop a policy on the preservation and protection of the family as the basic unit of society. The aim should be to prevent SA, but where it occurs, resolve it and protect the family.
- Develop policies that would require mandatory reporting of SA, mandatory prosecution of reported cases that persist despite attempts to resolve the abuse, and a no-drop policy

Medium-Term

- Operationalize Article 159 of the Constitution and enhance the capacity of existing alternative dispute resolution mechanisms to address SA.
- Amend the Protection Against Domestic Violence Act No. 2 of 2015 to create an offence known as Spouse Abuse and provide for the penalty.
- Where the violence persists despite attempts to resolve the same, prosecute the offending spouse.

Acknowledgements

I acknowledge the input of the following: Prof. Wilson Otengah and Dr Daniel Muia who supervised the thesis that produced the findings which inform this policy brief. Thanks to all the staff and postgraduate students of Kenyatta University Sociology Department

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Series 3 – Political Pillar: Governance and the Rule of Law

A Case for Providing Electricity Subsidies In Urban Informal Settlements

Dr Amollo Ambole, Peris Njoroge, Christer Anditi, Dr George O. Outa

Key Messages

Kenya lacks pro-poor electricity policies aimed at informal settlements leading to informal/illegal connections.

There is an urgent need for pro-poor energy policies to enhance access to safe energy for informal settlement households.

There is need for long-term collaborative partnerships that build trust between the informal settlement dwellers, government, and service providers.

Plate 1- Illegal/informal electricity connections
(Photo: Lou Del Bello/Climate Change News)

Context

This policy brief highlights research findings from a two-year project using Nairobi's Mathare settlement as a case study. The research established that close to 93 per cent of the residents have access to electricity. However, 50 per cent of the connections are informal or illegal, meaning that they are not provided directly by the mandated electric power supply agency: the Kenya Power and Lighting Company, and are thus not metered.

A key feature is that self-made electricians connect households to the grid at a minimal monthly charge of about Ksh. 300 to cover for repairs and maintenance. This indicates that there is a demand for the services, but they are not affordable to the people, and it has therefore led to their opting for alternatives to meet their needs. These illegal connections pose a danger to the self-made electricians as well as those who benefit from the unregulated electricity. Moreover, the illegal connections are also a risk to Kenya Power's revenue as they provide an avenue for households in the informal settlements to enjoy unmetered electricity for which the utility provider cannot collect revenue.

Due to the lack of a smart metering system, Kenya Power cannot detect illegal taps into their network. Smart meters have worked in various developed countries. Although this might be an expensive and time-consuming endeavour, it could be the long-lasting solution Kenya needs to deal with the challenge of illegal connections. Another plausible solution is the reduction of the electricity cost of electricity for households in the informal settlement.

This policy brief holds that this price reduction can be achieved through subsidies. The argument is that subsidizing the costs associated with legal connection to the grid will go a long way in reducing the informal/illegal connections and therefore improve access to clean and safe energy for the residents.

Approach and Results

The research informing this brief was carried out by research partners in Kenya, Uganda and South Africa from 2017 to 2019, who set out to better understand how sustainable energy solutions in urban informal settlements can be achieved through collaborative efforts between community members, experts and policy actors. The research partners used participatory methods to facilitate solution co-design and knowledge co-production by bringing together a diverse range of stakeholders to establish viable pro-poor

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energy solutions that meet the objectives of the Kenya Vision 2030 policy blueprint, while also ensuring sustainable energy access for all as subsumed under the global Sustainable Development Goal 7.

In Kenya, researchers conducted a survey of 100 households in four villages in Mathare Valley informal settlement in 2017. The survey provided insights into the energy situation in the settlement in relation to health perceptions and other socio-economic factors. Following this exercise, the team held a co-design workshop and policy seminar that brought together participants from Mathare informal settlement, Nairobi County government, Ministry of Energy, Kenya Power, the Energy and Petroleum Regulatory Authority (EPRA), University of Nairobi and other research agencies such as Stockholm Environment Institute (SEI) and IRD-Kenya. From the research, the team concluded that Kenya's energy policy and regulations are highly standardized and might therefore not work for the urban informal settlement dwellers. For instance, despite the removal of the standing charge and the reduction in electricity cost under the 'Lifeline Tariff', a majority of Mathare residents still cannot afford to meet the cost of electricity because of their meagre earnings, averaging of Ksh. 18 thousand per household. This is a clear indication that more needs to be done to ensure that informal settlement dwellers also enjoy access to safe and reliable electricity.

Some initiatives have been promoted to ease the burden of electricity cost for households; however, they have done little to solve the electricity problems that residents in informal settlements are facing. The Global Partnership Output-Based Aid (GPOBA) Slum Electrification Program supported by the World Bank and Kenya Power and Lighting Company is one of the significant initiatives that were rolled out to solve electrification issues of informal settlements. However, despite households getting connected through this programme the illegal connections have not reduced. The residents' claim that the switchboards that were provided do not serve their needs efficiently. They, therefore, settle for the illegal connections which cater to their multiple energy needs such as cooking, heating, refrigeration and lighting.

Key findings

- 50 per cent of the electricity connections in Mathare are informal/illegal
- Residents opt for informal/illegal connections because they are cheap at Ksh.300 (US$3) per month.
- Residents are willing to get legal connections but only if the cost of connection and power bills are affordable.
- The GPOBA slum electrification project has done little to solve the residents' electricity challenges. The radio boards are not sufficient to cater for the household's multiple needs, i.e/, heating, refrigeration, cooking, and charging gadgets.

Policy Recommendations

Short-Term

Appropriate electricity subsidies should be put in place to:

- Phase-out informal/illegal connections by providing incentives in terms of safety, pricing and security of supply to encourage residents to switch to legal connections,
- Enable the Energy and Petroleum Regulatory Authority to create a special tariff for the informal settlement dwellers considering their low income.

Medium-Term

- Invest in understanding the needs of consumers and build a relationship of trust particularly between informal settlement dwellers, government, and service providers.
- Design centralised solar power and biogas energy stations in informal settlements that can be used to serve communities at a cheaper cost.
- Invest in the installation of a smart metering system to enable Kenya Power to detect any illegal electricity connections to the network.

Acknowledgements

This policy brief is informed by research generated by an interdisciplinary research team on the multi-country research project: Co-Designing Energy Communities, (in short CoDEC (http://codec.livinglab.co.ke/). CoDEC research was carried out in Kenya, Uganda and South Africa from 2017 to 2019 under the leadership of Dr Amollo Ambole. The CoDEC research project was supported by the Leading Integrated Research for Agenda 2030 In Africa (LIRA2030) programme. The programme is being implemented by the International Science Council (ISC), in partnership with the Network of African Science Academies (NASAC), with support from the Swedish International Development Cooperation Agency (Sida). Additional funding support came from the Africa Climate Change Leadership programme supported by IDRC.

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Series F – Foundations : Ending Drough Emergencies

Drought Risks Livelihoods in Laikipia County

Dr Amon Mwangi Karanja

Key Messages

Sustainable drought adaptation strategies such as planting of drought-resistant seeds, timely planting, and planting early maturing varieties should be adopted to increase crop production.

Structured livestock off-take and feed storage could sustain animal production during drought.

Rainwater harvesting and drilling of new boreholes can improve water availability and access for the agro-pastoralists in Laikipia County.

Plate 1: People and Livestock Sharing a water point in Laikipia County (Photo: Author)

Context

In the last 30 years, frequent droughts have occurred in Kenya resulting in food insecurity, scarce pastures, and loss of livelihoods and human lives. Drought sets a vicious cycle of socioeconomic impacts beginning with crop failure, unemployment, erosion of assets, decrease in income and poor nutrition (UNISDR, 2012). In Kenya, drought adversely affects rain-fed agriculture, water resources, hydropower generation, and ecosystems. The average drought cycle in Laikipia County has reduced from 5 to 3 years affecting both crop and livestock production. In the county between 1984 to 2014, 53 per cent of the period received below normal rainfall while 40 per cent of the period received above-normal rainfall. More years, therefore, recorded below normal rainfall increasing the frequency of drought. For example, the 2009 drought impacted over 75 per cent of the crops, while 77.7 per cent of the households lost their livestock. Pastoral and agro-pastoral livelihoods are more vulnerable to the effects of drought in arid and semi-arid parts of the county due to over-reliance on rain-fed agriculture and natural pasture. Occurrences of drought leave households devastated and unable to cope without external support.

There are county and national level efforts to mitigate the effects of drought including the National Agriculture and Livestock Extension Program, food relief, generation and dissemination of climate forecasts, as well as ministerial and institutional intervention programmes such as Njaa Marufuku, ASAL based and rural livelihoods support programme, Laikipia community development assistance, among others. Despite efforts, effects of droughts on household livelihoods in the county remain unclear. Identification of livelihoods at risk during drought informs the relevant stakeholders on the priority areas in resource allocation and decision making to minimize drought effects among vulnerable households. Knowledge of the major livelihoods affected by drought in the county is important to various stakeholders in minimizing its effects. Against this background, this study sought to quantify and assess the effects of drought on livelihoods in Laikipia County.

Livelihoods Losses in Laikipia County

The effects of drought are as a result of the interplay between natural events and response by society (Wilhite et al., 2007). Laikipia County experiences food shortages, lack of pasture, and high prices of goods during drought. Food shortages result from reduced crop yields (57 per cent) or total crop failure (26 per cent). Also, drought reduces forage production and water supplies putting serious pressure on the livestock industry (UNDP, 2000), and making animals more susceptible to diseases (World Bank, 2013). Unavailability of fodder coupled with competition for pasture and water between domestic animals and wildlife make livestock more vulnerable to drought than crops. For example, 75 per cent and 13 per cent of the households in the county reported experiencing few and total livestock losses,

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respectively, during droughts resulting in reduced household income.

Further, droughts present long-lasting environmental challenges in the county. Drying of rivers (78.9 per cent), lack of wood fuel (11.6 per cent) and increased fire incidences (8.8 per cent) were reported as main the aftermaths of droughts. Drying of rivers leads to increased distances for people and animals to water points, creating the potential for human-human and human-wild-life conflict. (Plate I). Increased fire incidence results in loss of biodiversity and potentially altering the ecosystem.

How to Cope with Droughts in Laikipia: An Agro-pastoralists' Perspective.

There are various drought coping mechanisms adopted by households in the county (see Figure 1). These include seasonal migration with animals and engaging in business, reduction of the herd, buying of fodder, and planting of drought-tolerant crops. The low adoption of drought-tolerant crops in this arid and semi-arid part of Kenya may be indicative of the missing link on the dissemination of information on sustainable drought coping mechanisms by extension officers working in the area. Drought adaptation is critical in protecting livelihoods and food security in many developing countries (FAO, 2008).

Though seasonal migration with the animals is the most preferred drought coping strategy among pastoralists, it is unsustainable in an area known to have deep-rooted land conflicts, especially with ranchers, farmers, horticulturalists, conservation area wardens, and government authorities. This leaves pastoralists with the reduction of their herd as a sustainable coping mechanism, before the onset of drought. For example, the weekly live-stock markets in Rumuruti town (Plate 2) offer an opportunity for the pastoralists to reduce their herds before the onset of drought hence minimizing losses.

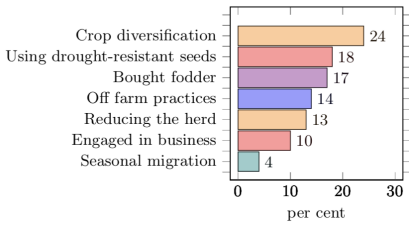

Figure 1: Preferred Drought Coping Mechanisms

The same survey found that financial health (the ability to cope with unexpected financial demands) was worsening. Much of the access to credit is fuelled by a proliferation of lenders using mobile phone technology to give quick small loans with terms that are otherwise unfair to the wellbeing of the borrower. This amounts to predatory lending, a lending practice with unfair or abusive loan terms on a borrower. It also amounts to a coercive practice that convinces a borrower to take a loan that they can do without. In this research, we focus on lending systems targeting the poor, to give policy recommendations for a healthy and resilient credit system in Kenya.

Policy Recommendations

Short-Term

- Increased awareness on drought-resistant crop varieties such as millet, sorghum and dolichos in Laikipia to minimize crop losses during drought. Credit should be extended all households to enhance businesses opportunities as a coping mechanism during drought
- Structured livestock off-take when droughts are predicted to minimize livestock losses among pastoralist

Medium-Term

- Rainwater harvesting and drilling of new boreholes can improve water availability and access for the agro-pastoralists of Laikipia County.

Acknowledgements

This brief is a product of the author's PhD research work, Karanja, A. (2014) Effects of drought on household livelihoods and adaptation strategies in Laikipia West Sub- County for the period 1984-2014. Unpublished PhD, Egerton University.

Preparation of this policy brief was supported by the AgriFose2030 programme and the International Livestock Research Institute (ILRI) with financial support from the Swedish International Development Agency (SIDA). I wish to thank Charles Recha for his technical inputs during the preparation of this policy brief.

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Plate 2: Weekly Livestock Market in Rumuruti Town
(Photo: Authors)

Series F – Foundations : Information and Communication Technology

Digital Innovation for Building Liquidity for Agricultural Payments

Prof. John Mburu, Esther Mujuka, Sijmen de Hoogh, Vyone Mingate and Ad Rietberg

Key Messages

Digitizing payments from off-takers to smallholder farmers is a strong entry point for integrating digital financial services into agriculture value chains.

Digitized value chains create more efficient markets.

Demand exists for digitized payment ecosystem that allows savings and credit restricted for the purchase of agricultural innovations.

Agri-innovation wallet links smallholder farmers to buyers, input suppliers and credit, increasing farm productivity and incomes.

Context

The share of agriculture finance as a proportion of outstanding national credit remains below 5 per cent and shows little signs of improvement (CBK, 2015), despite several commercial and microfinance institutions in Kenya having established agribusiness departments. Some of the key barriers include the high risk associated with agriculture due to production and price risks; and lack of collateral and reliable data on smallholder farmers. The transaction costs incurred in reaching remote rural populations are also high. The decline in agricultural productivity in Kenya has been attributed to poor access to farm credit and financial services (World Bank, 2015). This gap hampers national efforts to ensure food security, improve livelihoods and spur the growth of the rural economy.

To address this challenge, improved access to rural financial services has been proposed (AGRA, 2015). Agri-innovation wallet, a promising solution to the problem, is a novel value chain financing option that links farmers, input suppliers, markets and the financial provider. It is an e-wallet platform that facilitates timely and efficient transactions. It targets the unbanked smallholder farmers in contract farming. The off-taker pays the farmer through the wallet and the farmer saves money restricted for the purchase of agricultural innovations. Input suppliers are also paid through the system and if need be, farmers access overdrafts for the purchase of agricultural inputs. Digital financial services lower transaction costs making credit more available. A study was carried out to assess farmers' willingness to save and borrow funds through the agri-innovation wallet for the purchase of agricultural inputs. Specifically, the study sought to test and monitor the proportion of farmers who would purchase innovations with funds in their agri-innovation wallet and the effect of the innovation on agricultural productivity and the farmers' income.

Approach and Results

The project targeted tomato farmers in Makueni County and potato farmers in Nyeri, Nyandarua and Nakuru Counties. The potato farmers were specifically located in Naromoru, Olkalau and Keringet, respectively. Both the tomato and potato farmers were engaged in contract farming. A baseline survey was carried out before the implementation of the project to prepare baseline information on several indicators against which to the performance and impact of the programme would be assessed. The survey laid the foundationfor attribution of results to the project interventions. End-line evaluation of the

Plate 1- Farmer using mobile-based service (Photo: Technoserve.org)

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agri-innovation wallet project was undertaken to assess project outcomes and achievements.

Agri-innovation wallet enhanced savings and credit access for agricultural inputs. Results revealed that agri-innovation wallet enhanced convenience for saving and timely access to credit. This optimized decision making for increased productivity and income. It was found that the agri-innovation wallet savings contributed to yield increases of up to 18 per cent and 15 per cent in potato and tomato value chains respectively. Incomes increased by up to 155 per cent and 92 per cent in potato and tomato value chains, respectively.

Demand for saving and borrowing among smallholder farmers is unmet. The willingness to save and to borrow from innovation wallet among both tomato and potato farmers maintained an upward trend, corroborating the growing body of literature that affirms that Kenyan farmers are credit constrained. For example, in most cases, potato farmers depend on credit to procure certified seed. Thus, without credit, they would not be able to plant certified seed and therefore their yields would remain low.

ICT-based innovations are gaining popularity among smallholder farmers. Farmers are increasingly interested in using ICT solutions and innovations to meet their farming needs. The project experienced no difficulties or complaints about the use of mobile-based saving and borrowing. Thus up-scaling of the agri-innovation wallet technology is tenable since Kenya is a frontrunner in the uptake of mobile technology in Africa. The wallet proved adaptable due to its simplicity and affordability as farmers only required a feature phone that is within reach for many smallholder farmers.

The value proposition of agri-innovation wallet is that it incorporates merchants, off-takers and financial providers within the same ecosystem. Digitizing payments from off-takers to their smallholder suppliers is a strong entry point for integrating digital financial services into agriculture value chains. Otherwise, smallholder farmers are likely to continue depending on cash which is costly to collect, to send and which can be stolen or misappropriated. Digital payments reduce the frequency of transactions improving transparency through quicker, traceable payments. The high volume of transactions in agricultural value chains creates a multiplier for any inefficiencies, such as cash payments. Digital payments facilitate access to financial services for smallholder farmers by lowering transaction costs, providing flexibility, and improving the customer experience as reflected in higher gains in yield and income.

Policy Recommendations

Short-Term

Appropriate electricity subsidies should be put in place to:

- Liberalize interest rates
- Build the capacity of self-regulating non-traditional agricultural finance (NTAF) under the Central Bank of Kenya
- Adopt a smart subsidies approach by only providing subsidies that support the growth of the NTAF without distorting the market

Medium-Term

- Develop a rural finance policy that removes barriers to agricultural finance and promotes innovation.
- Integrate crop insurance for smallholder farmers within the Insurance Act.
- Incentivize NTAF through investment in infrastructures such as roads and power and network coverage in the rural areas.

Acknowledgements

The agri-innovation wallet learning project was funded through MEDA by IDRC, Canada and was jointly implemented by University of Nairobi, COIN22 and Dodore Kenya.

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