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Final report

Socio-economic study of key impacts from Lake Turkana Wind Power (LTWP)

PRELIMINARY OBSERVATIONS ON KEY IMPACTS FROM THE LTWP PROJECT AND METHODOLOGICAL CONSIDERATIONS FOR FUTURE ASSESSMENTS

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1 EXECUTIVE SUMMARY

Investments in renewable energy are generally expected to deliver on three dimensions which are intrinsically linked to the 2030 Sustainable Development Goals: Climate change mitigation, increased access to affordable and clean energy and economic development and job creation.

In this context, wind energy holds significant potential, especially in a developing country context challenged by energy insecurity, poverty and climate change. Even so, existing evidence of the socio-economic impact potential of wind farm developments has to date largely focused on high-income countries with less evidence on the potential advantages or disadvantages to developing countries with high-level of poverty concentrations. Further, existing studies have tended to focus on distinct parts of the equation rather than the sum of impacts generated by integrated wind farm developments with auxiliary investments in rural economies.

To facilitate further insights into the socio-economic impact potential of large-scale wind farm investments in a developing country context, Vestas, IFU, Finnfund and Norfund (hereinafter the Clients) have commissioned a preliminary study of some of the emerging socio-economic impacts from their investment in the Lake Turkana Wind Power project in Kenya (hereinafter the LTWP project).

The LTWP project is a large-scale wind farm development which upon its completion is the largest of its kind on the African continent and Kenya's biggest single private sector investment in its history. Beyond commercial returns, the stated objective of the LTWP project is to provide a reliable, low cost energy base to the Kenyan population while ensuring that the local communities benefit from the project. With this study, the Clients wish to take the first step towards better understanding what impacts can be expected from their investments in various aspects of the LTWP project. At the same time, the Clients are seeking inspiration for how to approach future impact assessment and monitoring programs in future wind farm developments and investments.

Building on an extensive review of the existing literature, the study presents a so-called *impact pathway* which provides an initial overview of some of the main inputs, outputs, outcomes and impacts which can be expected from the elements of the LTWP project assessed in this study. Impact pathways are well-established as the foundation for impact assessments and has been used in this study to outline some of the main causalities and impact dimensions which are relevant to consider in an empirical evaluation. Specifically, the pathway identifies five impact dimensions which can be linked to the elements of the LTWP project included in this preliminary study: Traffic and Transport, Rural Economy, Health & Education, Governance & Community Cohesion and Energy Supply and Costs.

The study proceeds to analyze a selection of the outcome and impact indicators identified in the LTWP impact pathway within each of the five categories. The main results from the preliminary impact evaluation is included in **Table 1.1**.

Table 1.1: Executive summary – Overview of key results from preliminary impact assessment

	1. Traffic and Transport	**2. Rural Economy**	**3. Health & Education**	**4. Governance & Community Cohesion**	**5. Energy Supply & Costs**
Caused by	*LTWP access road*	*LTWP access road, Local capacity building, LTWP wind farm (first-order effects)*	*LTWP access road, Local capacity building*	*LTWP access road, Local capacity building*	*LTWP wind farm (second-order effects)*
Data	Traffic survey	Market survey, interviews with local NGO, job/salary data	Secondary data	Secondary data	Feasibility assessment (secondary data)
Key findings	● Transport time reduced from 1-2 days to 4 hours after LTWP access road ● Nine- and three-fold increase in passenger and freight transport, respectively, after LTWP access road ● Average transport price reduction after LTWP access road varies between 16% to 37%, depending on what is transported	● 20-30% price decrease for certain foods at local markets ● Growth of fresh fish market with a three-fold net value increase for local fishermen ● Direct job creation from LTWP Ltd. and sub-contractors (herein Vestas) of approx. 1,800-1,900 local jobs during construction. 320-350 jobs expected in operation	● Anecdotal evidence of increased access to, and quality of, health and education facilities from select local capacity building projects ●19% of bus passengers along project road are nurses and teachers ●Government officials suggest increased access for education and health authorities in area	● LTWP access road represents a six-fold increase of the county government's annual budget on infrastructure (2015/16) ● Increased presence of local government (services and security) observed by communities in project area ● Level and source of community conflict relatively stable before/after LTWP project acc. to ACLED conflict data	● Based on a rough assessment that LTWP can reduce power outages by 12.5%, it is estimated to generate USD 332 million in production, USD 176 million in GDP and 54,000 jobs at a national level. ● Further, a randomly chosen 10% decrease in electricity costs from LTWP will generate USD 228 million in production, USD 134 million in GDP and 39,000 jobs.

Source: QBIS Consulting, 2018

It is expected that the study will be able to serve the Clients on several dimensions:

Firstly, the study generates new insights into the impact potential of selected elements of the LTWP project in advancing Kenya's socio-economic objectives both at the national and local level. This will allow the Clients to engage stakeholders to the LTWP project in a fact-based discussion about the wider impacts of wind farm investments while serving as an initial baseline for future impact assessments and monitoring efforts of the LTWP project. To this end, there are some limitations to the current study which should be high-lighted. Notably, the LTWP impact pathway and the subsequent empirical analysis focuses on a selection of impacts from the LTWP project where data has been accessible within the project timeline and budget. A key constraint in this connection has been the study's limited access to impacted communities in the project area due to the security situation and general 'consultancy fatique' from other engagements running in parallel. It is recognized that to capture the full suite of benefits as well as challenges that flow from the LTWP project at large, additional indicators and data will likely be required, and we invite further collaboration to facilitate same. It should also be noted that the projected energy-related outcomes observed in this study are highly uncertain given that the LTWP wind farm is not yet operational. The main contribution of the study is therefore the methodology developed which can be applied by the Clients to estimate the future impacts of LTWP on power outages and electricity costs once real-time data on LTWP's future performance becomes available.

Secondly, and just as importantly, the study provides important methodological input for the Clients' internal deliberations on how to measure the impact of large-scale wind energy investments in developing countries going forward. The impact pathway presented in this study, while specific to the LTWP project, has been designed with replicability in mind. The Clients may therefore use the pathway, literature review, proposed indicators and methodological considerations regarding choice of research design which are included in this study to inspire for future assessments, with some adaptation to the specific project context.

Finally, with this study, the Clients have preliminary evidence of the shared benefits that can accrue from integrated wind farm developments with stated objectives to deliver tangible value to its host country and local communities. From the impacts considered in this study the true value of wind farm investment clearly extends well beyond the turbines with auxiliary investments in improved rural accessibility and local capacity building effectively acting as 'impact multipliers' and positively reinforcing the standard economic outputs (tax, turnover, jobs) which can be expected from any wind farm investment. This also underlines the possibility for investors, lenders and developers to increasingly plan their investments and tender processes with 'the end in mind', e.g. by choosing contractors with dedicated community development strategies, programs and on-ground experience.

Acknowledgements

The study has relied on the inputs and expertise from several organizations and individuals whom we would like to extend our appreciation to, including: Ms. Jacinta Murunga (Vestas), Mr. Stephen Orbora (Vestas), Mr. Felix Rottmann (LTWP Ltd.), Mr. Guyo Tuke Dabelo (GiZ), Mr. Torben Lundsgaard, GiZ, Mr. Dickson Mutua (Deputy County Commissioner Laisamis), Mr. Peter Galwersi (Peace Chairman Laisamis), Mr. James Kihoria (Deputy County Commissioner Loyangalani) and Mr. Benjamin Mwathi (Officer Commanding Police Department Loyangalani).

2 Introduction

2.1 Motivation

Investments in renewable energy are generally expected to deliver on three dimensions which are intrinsically linked to the 2030 Sustainable Development Goals: Climate change mitigation (Goal 13), increased access to affordable and clean energy (Goal 7) and economic development and job creation (Goal 8).

The International Energy Agency estimates that global energy demand will continue to rise by 30% between today and 2040, driven largely by developing economies in India, China, Southeast Asia, Africa and the Middle East (IEA, 2017). Renewables are expected to capture a significant share of this growth as OECD countries continue to decommission conventional capacity while non-OECD countries increasingly pursue renewables to cater for increasing electricity demand. By 2040, two-thirds of global investment in power plants will be in renewable energy as renewables become, for many countries, the least-cost source of new energy generation (NEO, 2017).

In this context, wind energy holds significant potential. From 2017-2040, 31% of annual net capacity additions is estimated to be in wind power with the rest coming from solar and other types (NEO, 2017). Further, with the cost of onshore wind energy being among the cheapest renewable energy sources, wind energy offers an attractive alternative to fossil fuel investments, as well as a new source of income and job creation for host countries all over the world.

Even though wind power is currently present in more than 90 countries, most onshore wind-farm installations to date have been in upper-middle-income to high-income countries with the three biggest host countries – China, United States and Germany – accounting for over 60% of total installed wind power capacity[1]. Wind power installations are however less common in low-income and low-to-middle income countries with region Africa among the lowest regional recipients at less than 1% of current installed capacity. Perhaps for this reason, existing evidence of the socio-economic impact potential of wind farms is largely focused on high-income countries, namely in US and Europe, with significantly less evidence on the potential advantages and disadvantages of large-scale on-shore wind installations in low and low-to-middle income countries with high level of poverty concentrations. As these countries are often characterized by relatively weaker government institutions, inequality and marginalized populations, there is an added onus on international project developers to better understand how their investments can facilitate important inclusive development objectives such as poverty reduction, health, education, inequality and peace, to name a few.

Moreover, existing insights on impacts of renewable energy investments have tended to focus on distinct part of the equation rather than the sum of its parts. As an example, there is an abundancy of studies that consider host country returns from wind farm development and operations in form of local jobs and economic value added, yet such evaluations rarely consider the wider socio-economic impacts from increases in renewable energy for host country energy consumers. Despite the significance of the

[1] Source: http://gwec.net/global-figures/interactive-map/

latter impacts from an economic development perspective, they are not routinely included in the existing literature on wind farm development with existing evidence reported by the IFC in 2013 as 'very scarce'. Finally, examples of the impacts from auxiliary investments in enhancing rural infrastructure and capabilities is a largely absent topic in the existing literature.

To address such knowledge gaps, Vestas, IFU, Norfund and Finnfund (hereinafter the Clients) have chosen to commission a socio-economic impact study of the *Lake Turkana Wind Power project* (LTWP project), a large-scale wind farm development project in a highly underdeveloped region of rural Kenya. Notably, upon its completion in June 2017, the Lake Turkana wind farm became the largest of its kind on the African continent and Kenya's largest single private sector investment in its history, thereby providing an exemplary reference study for future wind energy investments in similar socio-economic contexts.

To Vestas, understanding the wider impacts of its core business 'beyond the turbines' is an important part of the company's license to operate in its host countries and its overall commitment to accelerate progress towards the 2030 Sustainable Development Goals. As a leader in wind energy development in emerging markets, Vestas is particularly interested in understanding how responsible developers can contribute to stimulating local development, beyond the company's wind turbines. Similarly, as development finance institutions, IFU, Finnfund and Norfund have a critical role in enabling sustainable and private sector-led investments in renewable energy projects in developing countries. Like Vestas, IFU, Finnfund and Norfund are therefore interested in understanding and documenting the socio-economic impact potential of their investments in line with their overall objective to advance social and economic development in the countries that need it the most.

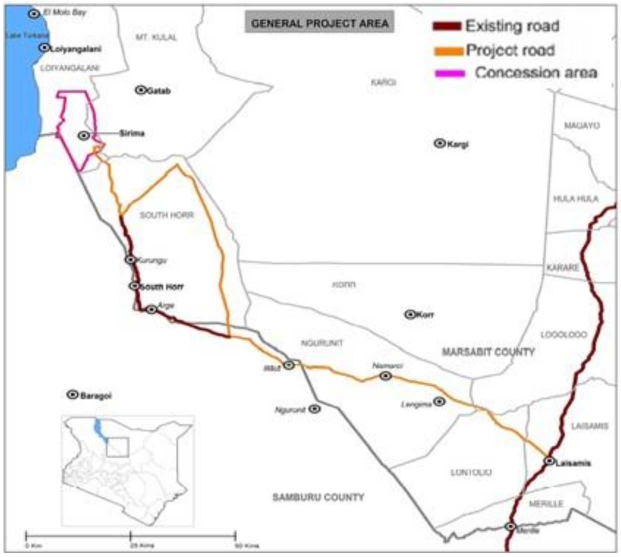
2.2 Introduction to the Lake Turkana wind power (LTWP) project

The Lake Turkana Wind Power project (*LTWP project*) is financed by a consortium of equity partners (*LTWP consortium*) consisting of IFU, Norfund, Finnfund, Vestas, KP&P Africa B.V, Aldwych International, Sandpiper Limited and a group of lenders. Vestas has a dual role in this context as one of the initial equity partners in the LTWP consortium as well as a key supplier to the LTWP project, which has been the company's largest single order to date in terms of number of turbines installed at a single wind farm[2]. Beyond Vestas, the main contractors for the LTWP construction and auxiliary infrastructure investments include Siemens, Civicon, SECO and RXPE (*Developers*). The company that owns and operates the LTWP wind farm is called LTWP Ltd. (*Operator*). Below some of the main attributes of the LTWP project are introduced for contextual purposes.

[2] Source: Vestas LTWP Fact Sheet

2.2.1 Wind farm

Figure 2.1: Overview of general project area



Source: Vestas internal presentation, October 2017

The main element of the LTWP project is the EUR 620 million (USD 870 million) investment by the LTWP consortium in a 365-turbine wind farm. As per its completion in 2017, the Lake Turkana wind farm is now the biggest of its kind in region Africa. With average wind speeds in excess of 11 m/s, the LTWP project is estimated to supply 310 MW of clean, reliable electricity capacity to the Kenyan national grid and is expected to be one of the most efficient wind farms in the world. The LTWP wind farm has a capacity factor of 60 percent compared to normal capacity factors in Europe which range between 30 and 35 percent[3].

The LTWP wind farm is located near the shore of Lake Turkana at 450 meters above sea level, more specifically in the Laisamis constituency of Marsabit County, approximately 50 km from the sub-county of Loyangalani in north-western Kenya, c.f. pink legend in **Figure 2.1** (‘concession area’). The wind turbines cover approx. 40,000 acres (16,000 hectares) of the larger 150,000-acre (61,000 hectares) concession site which has been leased by LTWP from the Government of Kenya for an initial period of 33 years with options for two renewals up to 99 years. The entire concession is equivalent to less than 1% of Marsabit County’s total acreage with the vast majority of the land kept open to pastoralists and local communities.

Construction of the wind farm was commenced in October 2014 and completed in June 2017. As of now, the 310 MW capacity wind farm is ready for commercial operations, yet delays persist in connecting the wind farm to the national grid due to delays in finalizing the transmission line, cf. section 2.2.4. Once operational, the Lake Turkana wind farm will produce the equivalent of 13 percent of Kenya’s total generation capacity as of today[4].

2.2.2 Access road

Even in high-income countries, wind farms are often constructed in underdeveloped rural areas with a challenging topography (Nasser and Osman, 2010). The lack of a proper road network leading to the

[3] Source: Vestas LTWP Fact Sheet

[4] Given that Kenya’s current electricity capacity is estimated at +2,299MW (c.f. section 6.6), the 13% cited in this study varies from the 15% cited in existing reports by Vestas and LTWP which are based on a national electricity capacity of 2,000MW.

project site, and within the project site itself, can pose significant challenges to the planning of wind farm construction, most notably the inland transportation of major equipment from seaports.

In the case of the LTWP project, the wind farm is located approximately 1,200km from the seaport of Mombasa and while the majority of the road leading from Mombassa to the concession area in Marsabit county is designated 'A-Class' (bitumen), the 'last mile' distance of existing rural road between the Laisami-Illaut-Kargi Junction (D371) and the Kargi Junction-Loiyangalani Road (C77) to the wind farm site were designated 'B and C-Class' roads with a mixture of gravel and murram.

A unique additional feature of the LTWP project, beyond the wind farm itself, has therefore been the auxiliary investment in a USD 30 million rehabilitation of the 207 km rural road, stretching from the sub-county of Laisamis in the south east to the sub-county of Loyangalani in the north west as illustrated by the orange legend in **Figure 2.1** ('project road'). The access road has been financed by the Dutch Government and the LTWP Consortium and constructed by LTWP Ltd. through Civicon. The road was completed in February 2016.

2.2.3 Local capacity building

A stated objective of the LTWP project is to uplift the socio-economic welfare of the communities living in and around the general project area. Beyond the potential welfare gains from the LTWP project's physical infrastructure components – i.e. the wind farm and access road – the owner and operator of LTWP (LTWP Ltd.) has created the Winds of Change Foundation (WoC) through which LTWP Ltd. has committed to invest a portion of the company's future operating revenues to improve the livelihoods of the communities in the project area. Once the wind farm is operational it is expected that LTWP Ltd., through WoC, will contribute about EUR 10 million over the operational life of the project (20 years), or approx. 500,000 EUR per annum. During the construction stages of the LTWP project from 2014-2017, several projects have already been implemented by WoC in partnership with key stakeholders to the LTWP project, herein IFU and Vestas, in areas such as education, health, water and community. An overview of selected community projects developed by WoC and key project partners in the project area to date is available at LTWP Ltd.'s website[5].

2.2.4 Transmission line

The development of a new transmission line is a separate infrastructure project which has not involved the LTWP consortium and is therefore not considered part of the LTWP project as such. Rather, the transmission line is considered an associated facility of the LTWP project and an important enabler of the successful delivery of wind power from the LTWP site to the national grid. The EUR 150M project, which is financed by the Spanish and Kenyan government, entails the construction of a 428km, 400kV overhead transmission line (T-Line) and a sub-station at Suswa, 90km north of Nairobi. The new T-line is being built by the government-owned Kenya Electricity Transmission Company Ltd (KETRACO) and, once complete, it will traverse from Suswa in the South to the LTWP site near Loiyangalani in the North, extending through the towns of Naivasha, Gilgil, Nyahururu, Rumuruti, Maralal and Baragoi. KETRACO

[5] For an overview of selected projects implemented by WoC with key project partners, see https://ltwp.co.ke/community-projects-map/

will own the T-Line and have a tolling arrangement with the utility provider, Kenya Power. Construction of the transmission line was initially expected to take 24 months, yet at the time of writing this report, the transmission line had not yet been completed. The lack of transmission line is currently preventing the commercial operation of the LTWP wind farm.

2.3 STUDY OBJECTIVE

The objective of the study is two-fold:

Firstly, the study aims at generating preliminary insights into how selected aspects of the LTWP project can advance important socio-economic objectives in its host country, Kenya, both at the national and local level. While several other reviews and assessments of the LTWP project have been performed to date[6], the Clients wish to use this study to develop an overview of relevant indicators which can be tracked over time and help engage key stakeholders to the LTWP project – also critical ones – in more fact-based discussions. The explicit purpose of this study has been to take the first initial step to this end by providing an overview of what types of impacts can be expected in a project of this sort as well as preliminary evidence on whether such impacts have started to manifest themselves, where possible. The methodology and initial findings from this study will be used by the Clients – notably IFU, Norfund and Finnfund as long-term equity partners – as inspiration for future evaluation and monitoring of some, or all, aspects of the LTWP project.

Secondly, the study aims at providing inspiration for the Clients' internal deliberations on how to measure the impact of large-scale wind energy investments in developing countries going forward, also beyond the LTWP project. The impact pathway presented in this study, while specific to the LTWP project, has therefore been designed with replicability in mind. The Clients may therefore use the pathway, indicators and methodological considerations included in this study (e.g. choice of research design) as a starting point for future assessments, with some adaptation to the specific project context.

The study has been carried out by QBIS Consulting within the agreed scope determined together with the Clients and based on best-available data from the project area and Kenya's current energy landscape. It is important to state that the study should not be considered a comprehensive evaluation of all potential outcomes and impacts from the LTWP project but is limited by the project scope, timeline, budget and – importantly – by data availability (see Chapter 4). It is recognized that to capture the full suite of benefits as well as challenges that flow from the LTWP project at large, additional indicators and data may be required beyond what is presented in this study, and we invite further collaboration to facilitate such insights.

[6] E.g. project environmental and social impact assessments (ESIA), monitoring reports and a report reviewing Vestas' CSR activities in the project area (ERM, 2016). Further, at the time of writing this report, a forthcoming mid-term review of the LTWP project based on input from more than 200 local stakeholders is awaiting publication

2.4 HOW TO READ THIS REPORT

This report is intended to serve as a technical background document for the Clients and a reference document when communicating the key findings from the study. The report is not intended for wide communication to uninitiated stakeholders given the level of detail and largely internal methodological considerations for the Clients' future impact assessment and monitoring efforts. It is advised that the Clients develop more targeted communication of the key findings from the study and offer interested stakeholders the opportunity to review the background report for more details.

For an overview of the main sections of the report, please refer to **Box 2.1**.

Box 2.1: Reader's guide to technical report

Chapter 3: Review of existing literature Chapter 3 provides an extensive overview of the existing literature on investments in renewable energy and rural roads. In this section the reader will gain an overview of the broader spectrum of impacts which may flow from investments in renewable energy and rural roads, also beyond the impacts and indicators covered in this report.	**Chapter 4: Methodology** Chapter 4 defines the scope and approach taken in this study and introduces an initial theory of change (the LTWP impact pathway) for key elements of the LTWP project. It also highlights some of the main limitations of the preliminary impact assessment and how such gaps may be addressed in future studies.	**Chapter 5: Empirical context** Chapter 5 describes the project context along three dimensions: The national level, the county level and the constituency level. Through this, the reader will gain a better understanding of the socio-economic context in which LTWP operates and basic socio-economic indicators at the national, county and, where possible, constituency level.
Chapter 6: Preliminary impact evaluation Chapter 6 evaluates selected aspects of the LTWP impact pathway along five key dimensions: Traffic and transport, Rural economy, Education and Health, Governance and Community Cohesion and Energy Supply and Costs. The first four dimensions reviews evidence of impacts at the local level (county/constituency) while the latter predicts impacts which may accrue at the national level (Kenya).	**Chapter 7: Conclusion and input for future evaluations** Chapter 7 summarizes the main findings from the preliminary impact evaluation in brief and suggests three key ways in which the Clients may benefit from the main findings from this report in future impact assessment and monitoring programs for the LTWP project and/or other wind farm investments.	**Appendices** The appendix section includes the detailed impact pathway (A) which has served as the main framework for the preliminary impact evaluation. It also includes a detailed list of relevant indicators (B) for each of the pathway's outcomes and impacts. Finally a detailed account of the field visit (C) and the traffic survey questionnaire (D) is also provided.

3 REVIEW OF EXISTING LITERATURE

To assist the Clients in the identification of relevant socio-economic indicators from the LTWP project as well as future wind farm investments, a comprehensive literature review has been conducted with emphasis on collecting and synthesizing existing experiences from renewable energy and auxiliary investments in developing countries. To this end, the study has identified three strands of literature which are summarized in **Table 3.1** and reviewed separately in the following parts of this chapter.

Table 3.1: Potential impacts from renewable energy and auxiliary investments from existing literature

	Impacts from wind farm development	Impacts from renewable energy access	Impacts from rural road access
Description	The socio-economic impacts from the construction, operation and decommissioning of wind farms and the costs and benefits to the local host communities	The socio-economic impacts from the increased supply of renewable energy to the national grid and resulting increases in energy availability, affordability and reliability	The socio-economic impacts from increased access to rural roads and the resulting trickle-down effects on traffic and transport, rural economy, education, health, governance and community cohesion
Observations from literature (+/-)	+ New revenue sources and local job creation from wind farm construction and operation in rural areas + Local capacity building and community empowerment - Aesthetic impacts - Cultural impacts - Human health and well-being - Marginalized communities and rights - Workplace accidents - Risk of inequitable benefit distribution	+ Improved environmental sustainability, energy security and fiscal balance + Induced economic growth from increased energy availability, affordability and reliability (GDP, job creation, tax income etc.) + Rural electrification opportunities through RETs (grid/off-grid) - Costs and challenges related to renewable energy variability and grid integration - Risk of inequitable benefit distribution	+ Transport cost reduction and traffic growth + Increased productivity, income, consumption, market development, employment and poverty reduction for impacted rural economies + Improved education, health and governance - Traffic accidents, environmental concerns, migration and exploitation - Risk of inequitable benefit distribution

Source: QBIS based on review of more than 70 scientific articles and reports

3.1 IMPACTS FROM WIND FARM DEVELOPMENT

The first strand of literature focuses on the socio-economic impacts related to the construction, operation and maintenance of the physical wind farm. There have been numerous studies focusing on the impacts to local communities and host countries from wind farm development and operation, with the bulk of the current evidence focusing on experiences from rural wind farm installations in developed countries namely the United States, OECD countries and the European region (see e.g. NRC, 2007; Reategui & Hendrickson, 2011; Entrix, 2009, OECD, 2012).

As an example of existing approaches, Reategui and Hendrickson (2011) uses an input-output model of the US economy to estimate the direct, indirect and induced job creation potential of a 1,000 MW wind power farm in the state of Texas and finds that the wind farm investment generates over 2,100 temporary and 240 permanent in-state jobs during the wind farm development period while generating economic in-state activity of nearly $260 million during construction (total for the period) and $35 million during operation per annum. In addition, the study finds that the wind farm generates $7 million in annual property taxes and an additional $5 million in income for rural landowners who lease their land for wind and energy projects. Along these lines, a review of 13 studies assessing the job creation potential of wind-farm development in the United States and Europe finds that renewable energy projects have a positive impact on local employment, creating more jobs than the fossil fuel-based energy sector per unit of energy delivered with wind farm development found to create between 0.71-2.79 total jobs per megawatt generated (Kammen et. al. (2004)).

While such studies at first glance tend to support and further strengthen the socio-economic case for wind farm development in rural communities, there are varying perspectives on whether such investments result in material and long-lasting benefits to the host communities. A 367 MW wind farm project in a rural county of southeastern Washington, US, found a modest direct, indirect and induced job creation potential from the wind farm project (189 temporary construction jobs and 53 permanent operations), with only a small portion of these jobs retained within the county itself while the majority went to regional urban centers outside the county (Entrix, 2009). Similarly, in a review of experiences with renewable energy investments across 10 OEC countries, the OECD (2012) concludes that renewable energy investments, including wind farm development, are more capital than labor intensive. The collective experience from the OECD countries shows that most of the long-term job creation potential takes place outside the rural host communities and along the renewable energy supply chain with local development impacts often limited due to use of international labour and equipment from foreign suppliers. As a result, the OECD concludes that renewable energy investments are *'not going to create lot of jobs, but rather some additional employment opportunities in rural areas'* (OECD, 2012).

To assist renewable energy investors in assessing and comparing the economic development potential from the construction and operation of power generation plants, the National Renewable Energy Lab (NREL) in the US has developed the so-called Jobs and Economic Development Impact (JEDI) model[7]. First modelled solely around wind farms, the JEDI tool has since been expanded to biofuels, solar power, coal, and natural gas power plants. Using input-output approaches similar to the examples mentioned above the JEDI model can help estimate the number of jobs and economic impacts to a local area (usually a state) that could reasonably be supported by a power generation plant.

Input-output models such as the JEDI tool can in theory be used on a county, regional, or national basis by incorporating additional data, yet there has been limited attempts to do so in a developing country context. To advance further insights into the potential impact of wind-farms on local jobs and economic development in developing countries such as Kenya, detailed data on income, consumption and intersectoral linkages is therefore required which is often difficult to come by, especially in the informal

[7] *See https://www.nrel.gov/analysis/jedi/*

rural economies that host the wind farms themselves. In two recent studies of the economic impacts of the renewable energy sector, Steward Redqueen (SRQ, 2016b) uses an input-output approach in e.g. India and Uganda to estimate the direct, indirect and induced job and economic impacts from renewable energy plants at the local level – so-called *first-order effects* – as well as the wider economic impacts from the increased energy supply generated by those same plants at the national level, also referred to as *second-order effects* (see section 3.2. for further details on the latter).

Finally, and beyond the economic and job creation impacts from the construction and operation of wind farms within a given host country, there are also studies that look at the other side of the coin in form of the potential costs and risks to the local host communities. Most of the literature looking at social conflicts from wind farm development, again, focus mostly on North America and Europe. Some of the main causes of opposition to wind farms have been synthesized by Pasqualetti (2011) and Bell et al. (2013) which found the main adverse impacts to consist of e.g. noise, dust, animal life, aesthetics, tourism, property values and general well-being. As a result, a number of guidelines and tools have emerged to help wind farm developers address and mitigate potential concerns from local communities in the construction and operation of wind farms and maintain their local license to operate[8].

With issues such as property values, aesthetics and tourism often dominating the list of concerns from local communities in a developed world context, there is little knowledge of the concerns to vulnerable and marginalized communities in a developing or emerging world context with high levels of poverty concentrations. A recent study of the Xavier community in Ceará state, Brazil (Gorayeb et. al., 2016), found that a wind farm establishment built close to a settlement of 66 indigenous people, had negative impacts on local livelihoods due to the absence of local employment opportunities; road blockages; privatization of common resources; noise from turbines; fear involving turbines; and internal conflicts among Xavier residents caused by the wind burial of lakes and reduction of fish supply. The Xavier residents were thus found to suffer from a food deficit because they were unable to access fish in former lakes used for artisanal fishing. With global renewable investments in developing countries now surpassing the rate of investment in industrialized countries (REN21, 2016), empirical evidence related to community concerns and conflicts specific to developing world populations is likely to be further substantiated in the coming years.

3.2 IMPACTS FROM RENEWABLE ENERGY ACCESS

The second strand of literature looks beyond the impacts of the physical energy installation (in this case the wind farms) and examines the wider impacts associated with increasing availability and supply of renewable energy. As previously stated, the benefits of increased renewable energy access for both developed and developing countries generally fall in three overall brackets; climate change mitigation, security of supply and economic growth.

The first two impacts of renewables – i.e. climate change mitigation and improved energy security – are well-documented in the existing literature (see e.g. Ölz et. al., 2007; Saghir, 2006; Bygaje, 2006). Widely

[8] See e.g. Delivering community benefits from wind energy development: A Toolkit, available at www.cse.org.uk

fluctuating oil and gas prices are generally found to have severe impacts on most countries, but the potential repercussions are often said to be disproportionately high for oil-importing, low-income countries who are particularly vulnerable to price increases which badly affect their balance of payments and energy supply (ESMAP, 2005b). Similarly, increased access to renewable energy sources is often hailed as an instrumental strategy for achieving a more environmentally sustainable growth trajectory for developing countries. Without investments in renewable energy sources and services, developing countries will continue to rely on fossil fuel imports and the unsustainable use of indigenous energy sources, such as traditional biomass, leading to increased global warming as well as local environmental degradation and resource scarcity (Saghir, 2006; Bugaje, 2006). As a result, the literature generally confirms the case for renewable energy investments in advancing important energy security and environmental goals in a developing country context. Due to the variability of several renewable energy technologies, including wind power, these technologies have also been reported to pose new challenges and costs[9] to the national grids and distribution networks within their host countries (Ölz et. al., 2007).

Beyond energy security and climate change impacts, the third impact – i.e. the links between increased renewable energy access and economic growth – is less understood, especially in a developing country context. While not specific to renewable energy per se, there is a substantial body of evidence preoccupied with establishing a causal link between increased energy access and economic growth (Stern, 1993; Chang et. al., 2001; Dogan, 2014; SRQ, 2016; Lemma et. al., 2016). In a review of the existing literature, Lemma et. al. (2016) finds that more than three quarters of the good quality statistical studies in this field finds a positive correlation between energy access and economic growth, with increased energy consumption being either the cause of, or the facilitator of, economic growth. Even so, results vary with the existing literature suggesting that the relationship between energy and economic growth is largely context specific and varies by country and within countries. Dogan (2014) e.g. assesses the relationship between energy consumption and economic growth in Kenya, Congo, Benin and Zimbabwe from 1971 to 2011, and finds that there is no causal relationship in Congo, Benin and Zimbabwe, whilst in Kenya changes in energy consumption led to measurable changes in economic growth.

Where energy access is a likely factor in stimulating economic growth, the reverse relationship has also found to be true. In other words; insufficient, unreliable or costly access to energy has frequently been found to be a major hurdle to economic development, especially in a developing country context. In many low-income countries, electricity consumption is hampered by frequent power outages which weaken the relationship between grid electricity consumption and economic growth (Adhikari and Chen, 2012). Notably, power outages have been found to affect economic output through such factors as loss of operating time and production; restart costs, equipment damage; and spoilage of raw or finished materials with an often-used indicator to monetize the impact of outages being the so-called Value of Lost Load (VoLL). As a result, back-up generation is frequently used by the companies who have the capacity and resources to do so, thereby incurring cost increases due to scale disadvantages and local

[9] In a recent study of the Belgian electric power system, Bruninx et. al. (2016) categorizes the integration costs of variable renewable energy sources into four categories – back-up costs, balancing costs, grid integration costs and subsidy costs.

transport of fuel to the site (Oseni and Pollitt, 2013). Overall, these types of deficits in a country's energy supply and access lead to higher electricity costs, rendering developing countries less competitive and with a lower output level compared to more energy stable countries.

To better capture the wider economic impacts of improved energy availability, affordability and – importantly – reliability in a developing country context, Steward Redqueen (2016a) recently found that significant investments in renewable energy (in this case hydro-power) in Uganda eliminated load shedding while reducing power outages for local firms from 28 to 12 hours per month. Through the establishment of an input-output model of the Ugandan economy, Steward Redqueen found that, beyond the jobs created by the energy plant itself, for every 1% increase in generation capacity, there was a 0.06% increase in GDP and 0.03% increase in employment, or so-called 'second-order effects'[10]. The total gains for Uganda were reported as GDP growth of 2.6%, 201,600 additional jobs and a substantial reduction in government fuel subsidies of USD 180 million per annum, equivalent to 5.7% of government expenditures. Examples such as the Ugandan one, although rare in the existing literature, underlines the need to look beyond the economic impacts and number of jobs created by the construction and operation of renewable energy plants. In a review of 35 studies in the energy sector, the IFC confirms that energy investments, including renewables, can have a significant impact on jobs and economic development if the analysis looks beyond direct employment (IFC, 2013).

Finally, renewable energy investments have in some cases been found to increase the ability of remote rural regions to produce their own energy (electricity and heat in particular) rather than importing conventional energy from outside. In cases where renewable energy investments lead to increased energy access and/or affordability for their rural host communities, there will naturally be a stronger impact on rural economic development beyond the relatively modest contributions from the physical plant itself as detailed in section 3.1. In a developing country context, however, the pace of rural grid electrification is often slow and for most remote areas, access to the national electricity grids as a result of large-scale renewable energy investments is not likely to occur within a foreseeable future (Ahlborg and Hammer, 2011). As a result, renewable off-grid energy investments are increasingly considered a complementary forerunner to the national grid for rural communities, helping to create demand within a future customer segment while having important impacts on the lives of the rural poor (Kanagawa and Nakata, 2007; World Bank, 2008b; Hiremath et al., 2009; Khandker et al., 2009; Ahlborg and Hammer, 2011).

3.3 Impacts from rural road access

The impact of auxiliary infrastructure investments involved in large-scale renewable energy projects is a largely absent topic in the existing literature on renewable energy outlined in the previous two sections. To better understand the potential impacts of the LTWP project's USD 30 million investment in upgrading the 208km public road from Laisamis to Loyangalani, the study has therefore conducted a separate review of the comprehensive literature looking specifically at the impacts from increasing

[10] Second-order growth (or forward) impacts are driven by the effective generation capacity of the project and depends on the installed capacity and capacity utilization (SRQ, 2016b).

access to rural roads. Relative to the impacts from wind farm development or increased energy supply to Kenya's national grid, the access road developed by LTWP has been identified as the potentially most important socio-economic impact driver to the impacted project communities[11] wherefore the literature review has allocated relatively more attention to this third strand.

Remoteness and isolation has long been identified as critical components of poverty and, at balance, the literature on rural roads indicates that road investments can be one of several important instruments to reducing poverty (ADB, 2002). Despite the wide range of impact studies of rural road investments conducted over the past decades, there is still surprisingly little hard evidence on the size and nature of these impacts and their distributional pattern within the targeted communities (Van De Walle, 2008). In a comprehensive methodological review of rural transport impact monitoring and evaluation programs, the Africa Transport Policy Program suggests that this knowledge gap stems not from a lack of impact studies per se but from methodological failings and lack of funding and support for following up on road impacts which typically take longer period of time to emerge (Airey, 2014). In a study of rural road development in Vietnam, Mu and Van De Walle (2011) e.g. found that the wider impacts of rural roads on transport-induced local market development and education took some six years to become statistically significant. Keeping these concerns in mind, it is nonetheless possible to deduct a number of likely impacts from investments in rural roads which are reviewed in in further detail below.

3.3.1 Traffic and transport impacts

To assess the wider trickle-down effects of rural roads on impacted communities – e.g. on income distribution, poverty, education, health and livelihoods – one must first understand the more immediate effects of rural roads on rural traffic and transport patterns. There is a large body of evidence preoccupied with assessing the more immediate traffic and transport outcomes, or effects, from rural road investments. In a study of two World Bank-funded rural road development projects in Bangladesh, Khandker et. al. (2009) found a reduction of about 15% on average unit transport costs, a reduction of 56% on average transport time and an increase of 86% on average daily traffic along the program roads with 139% increase for motorized vehicles. By comparing extensive household panel data before/after road implementation, the study further found that the effects on traffic and transport positively impacted local households who, on average, experienced approx. 37% lower transport costs because of access to improved roads[12].

In another study of five different rural road projects across Indonesia, the Philippines and Sri Lanka, the Asian Development Bank (ADB, 2002) identified similar transport and traffic outcomes with an average time saving potential of 50% due to improved roads, increases in motorized vehicle use of 170% and an overall increase in travel frequency by impacted households (12 trips per month) compared to control households without access to the new road (9.9 trips per month).

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[11] According to LWTP Ltd.'s website *'one of the largest benefits to the communities around the LTWP wind power project has been the upgrading of 208km of the C77 public road from Laisamis to Sarima at a cost of USD 30 million.'* Source: https://ltwp.co.ke/faq/

[12] Khandker et al. (2009)

Differences in findings within the existing literature do however suggest that there is no guarantee that rural road improvements lead to beneficial traffic and transport outcomes such as reduced transport costs and time and increased traffic. Even in cases where transport providers have been able to reduce their vehicle operating costs (VOCs) due to reductions in maintenance costs brought about by rural road improvements, some studies suggest that the benefits are not always passed on to rural road users thereby stifling the rural development potential (see e.g. Teravaninthorn and Raballand, 2009). Often rural road transport providers on low volume roads thus face little competition and therefore little pressure to reduce prices. Further, a study commissioned by the World Bank in Malawi (Raballand et. al., 2011) found that even if rural road improvements lead to marginal transport price reductions *'reduced transport prices do not translate to poverty reduction if the poor cannot afford to use transport services or need other factors to increase production'* (p. 18).

Such contrasting cases emphasize the need for context-specific and empirical evidence to measure changing traffic and transport patterns before/after rural road implementation such as increases in traffic frequency and development in transport prices. Given that the ability of rural roads to reduce transport costs and increase accessibility to otherwise isolated households is *the* key factor in driving the wider trickle-down benefits to the impacted communities described below, evaluating and monitoring traffic and transport effects over time is an important first step of any impact evaluation involving rural road investments.

3.3.2 Rural economy impacts

In rural economies of Sub-Saharan Africa, subsistence farming, cash crop agriculture, livestock and/or fisheries is the primary source of livelihoods (Airey, 2014). There are several studies that examine the indirect interlinkages between rural road investments and resulting improvements in agricultural productivity and rural economies. The AICD (Africa Infrastructure County Diagnostic) found a positive relationship between crop production and road connectivity measured by travel time to local markets in Sub-Saharan Africa with total crop production vs. potential increasing to 45% from only 5% if travel time is reduced in half (Dorosh et. al., 2009). On a similar token, Khandker et. al. (2009) found a 5% reduction in input prices, 30% increase in crop output and 4% increase in crop prices after the introduction of rural road improvements in Bangladesh while in Madagascar input prices were found to increase with transport costs (Jacoby and Minten, 2008). Finally, empirical studies from Papa New Guinea concluded that farm gate prices for sweet potatoes declined 7% with every extra hour of travel time to the nearest transport facility (Gibson and Rozelle, 2003).

Similar to existing traffic and transport studies, there are large variations in impact studies on agricultural gains from rural roads. Raballand et. al. (2009) e.g. high-lights that findings on agricultural productivity fluctuate from -52% to +170% across various empirical studies. Jacoby and Minten (2008) e.g. found that agricultural productivity for rice farmers in Madagascar did not improve with increased access to road while research in Cameroon by Gachassin et. al. (2012) concluded that better access to roads still left agricultural households trapped in poverty as they did not have the necessary endowments (land, skills, labor) to increase production. Another study from Sierra Leone found that rural road improvement can even have adverse impacts on market and farm gate prices due to increased competition among local producers brought about by lower transport prices unmatched by the demand side (Casaburi et. al., 2013). Overall, such discrepancies in the literature indicate that positive traffic and transport effects from rural road investments may not always generate a positive chain of events and that such impacts largely depend on the local market condition and context.

Beyond potential improvements in agricultural productivity and incomes due to lower transport costs and reduced travel time, the literature identifies increased economic diversification as an indirect result of increased rural road access. In an extensive study of rural road improvements in Vietnam, Mu and van de Walle (2011) examine the so-called transport induced local market development – or TILD – impacts from rural roads and found significant average impacts in the presence and frequency of local markets as well as increased income diversification with a statistically significant rise in local non-agricultural trades over the six-year time-period studied. Similarly, Jacoby and Minten (2008) found that reducing transport costs in Madagascar led to a near doubling of household incomes, mostly due to an increase in non-agricultural earnings and reductions in the price of imported goods to local markets.

Observations such as these are all of material importance to understanding the longer-term and more complex interlinkages between road access, transport costs/time and rural economic development. In this equation, rural roads have been widely recognized for their poverty alleviation potential[13]. That said, even in cases where rural roads lead to important improvements in agriculture, local market development, economic diversification and/or household income and expenditures, such improvements are often characterized by significant heterogeneity. Or put differently, it may vary greatly who benefits from the investment and to what extent.

Some studies thus indicate that rural road investments disproportionately benefit the communities, households and/or individuals who are already better-off and therefore risks being largely non-inclusive (ADB, 2002; Bryceson and Howe, 1993; Raballand et. al., 2009). Other studies, however, find that road investments have led to measurable reduction of poverty. Experiences from Bangladesh e.g. indicates measurable reductions in both moderate (6%) and extreme (7%) poverty (Khandker et. al., 2009) while Mu and Van De Walle (2011) found that poorer communes in Vietnam tended to achieve bigger gains in terms of TILD than better-off communities, namely due to lower levels of initial market development. At balance, the literature seems to indicate that while rural roads *can* result in measurable long-term improvements for both poor and better-off households, this is not a guaranteed long-term impact. The extent to which rural roads lead to systemic poverty alleviation is in other words a highly contextual issue which is further influenced by several inter-related poverty attributes, incl. education and health, which shall be discussed further below.

3.3.3 Human capital impacts

In addition to potential trickle-down impacts of rural roads on the rural economy (e.g. agricultural productivity, input/output prices, local market development, economic diversification and household income and expenditures), rural roads have also been found to aid in the fulfilment of basic needs for poor communities and households, namely in form of improved access to health care and education

[13] As a result, the Rural Access Index, backed by the World Bank, is among the most important global indicators for measuring people's transport accessibility in rural areas where the majority of the poor live and is considered a key policy instrument in poverty alleviation.

facilities. A widely recognized feature of poverty is the inadequate access to basic human capital facilities that are essential to escape from poverty. In this context, roads are often believed to be important complementary inputs for human capital formation facilities to be effective (Gachassin et. al., 2010).

Again, there are several studies that confirm this relationship. A survey of 12,558 children in Zambia indicates that access to a passable road have increased the probability of primary school attendance by an average of 7.68% across two studied age groups (Nielsen, 1998). Lavy (1996) showed that access to a road in Ghana increases the probability of a child going to primary school by 6.55% on average; Khandker et. al. (2009) found that primary school attendance due to improved road access in Bangladesh increased between 14-20% and finally Mu and Van De Walle's road impact study in Vietnam found statistically significant and sustained evidence of improved primary school completion rates of between 15-25% over a period of six years (Mu and Van De Walle, 2011).

While the mentioned studies did not find evidence to support a favorable impact on girl schooling, recent research shows that this effect is often stronger for girls than boys since girls seem to be more constrained by poor access (Airey, 2014). Adding to these findings, it has further been argued that a key impact of rural road investments is the ability of rural schools to attract more qualified teachers with experiences from Tanzania suggesting that motivation for teachers assigned to rural schools increased after road rehabilitation as did pupil attendance levels (Kapsel, 2004). Findings such as these indicate that, over time, increased road access may have long-term effects on human capital in otherwise isolated rural areas and contribute to improving adult literacy, a well-established human development indicator and a recognized factor in poverty alleviation. To this end, a study in Morocco found a direct correlation between literacy rate and road access with households living 6 km or more from a road being 13% less literate than households living less than 2 km from a road (CID, 2010).

Another important, yet also indirect, long-term impact of rural road investments relates to the provision and utilization of health care facilities which often emerges as a major benefit of new roads (Howe and Richards, 1984; Odoki, et al., 2006). A study of the barriers to the care of HIV infected children in rural Zambia found that most participants (73%) reported difficulties accessing the HIV clinic, including insufficient money (60%), lack of transportation (54%) and roads in poor condition (32%) (van Dijk et al., 2009). Another study based on a review of clinic records in Ghana indicated that more women used the clinics after a road improvement, mainly for prenatal and neo natal services, and found that health workers were more inclined to visit communities thereby allowing for training of village health workers (I.T. Transport, 2005).

However, as pointed out by Airey (1991; 2014) improving rural transport will not necessarily increase better access for the poor, for whom health service fees, perceived quality of government health services and transport and opportunity costs may still be a barrier to health care. In a study looking specifically at Kenya, Airey (1991) showed that after building a new regional road the "better off" increased their use of a district hospital whereas user fees and transport costs continued to be constraints for the poor.

Finally, in his extensive review of existing studies on rural roads, Airey (2014) identifies a number of other indirect advantages of rural roads, including the potential for more effective governance as national governments are better able to access rural communities as well as the potential to reduce the transport burden for women in rural areas. The latter does however need to be seen in context with other research findings which shows that women do not necessarily benefit from the introduction of motorized vehicles and often resort to conventional transport services, even after significant rural road improvements have been made (Starkey et. al., 2013; Bryceson and Howe, 1993).

3.3.4 Negative impacts from rural roads

The existing literature also points to several potential negative outcomes and long-term impacts related to rural roads, one of the most obvious ones being the increased number of motorized vehicles that follow road improvement, thereby making it more dangerous for those who walk, cycle and use motorcycles (WHO, 2013). Obeng (2013) reports that pedestrian accidents account for over 40% of all road traffic accidents in Ghana, and Sub-Saharan Africa is reported to have the highest road traffic fatality rates in the world, averaging some 28 deaths per 100,000 people, a statistic which is probably understated as only a small proportion of accidents are reported in rural communities (gTKP, 2013). In household terms, road accidents can have a severe impact on family budgets since most casualties - 75% in the case of Kenya - are economically productive young adults (ibid).

According to Aeron-Thomas et. al. (2004), road accidents can be a key “trigger for poverty”. They studied the implications of road accidents in poor communities of Bangladesh and Bangalore and found that funeral costs and the loss of income from the victim plunged rural households into poverty. In addition to potential safety hazards from increased motorized traffic, Airey (2014) also identified several direct and indirect environmental impacts from the construction and use of rural road, ranging from impacts on soil, air quality, flora, fauna etc., as well as social conflicts relating land use, resettlements, ethnic minority considerations etc. much like the conflicts mentioned in relation to wind farm development in section 3.2.1. Further, Airey (2014) also points to the ambivalent role of roads in facilitating increased migration. Ambivalent because roads on one hand open new opportunities for information flow from regional and urban centers while reducing costs of travel for rural migrants who seek opportunities elsewhere. Yet at the same time, rural roads may also open previously inaccessible areas to land hungry farmers and investors who exploit underutilized land (Jacoby and Minten, 2008) and lead to increased cultural dilution.

4 METHODOLOGY

4.1 SCOPE

As illustrated in the literature review, a wide variety of impacts can flow from wind farm developments, renewable energy access and auxiliary investments in rural roads. It has not been possible to include all these impacts within the budget, data and timeline constraints of this study, which takes an outset in three main dimensions of the LTWP project:

1. Impacts from the LTWP wind farm – notably on local/national jobs and economic development
2. Impacts from the LTWP access road – notably on traffic and transport patterns and potential spill-over effects in the project area
3. Impacts from local capacity building – notably on reinforcing the impacts from 1 + 2 above in the project area

For simplicity reasons, the study uses the term "LTWP project" throughout the report to cover above three dimensions. We do so recognizing that the study is limited in the breadth and scope of impacts it considers for each of the above three dimensions. There are in other words more benefits (and potentially challenges) from the LTWP project at large than what is considered in this preliminary study. It should also be stated that several of the impacts included in this study are attributable not just to the Clients but to a wider coalition of actors – i.e. the Equity partners, Developers and Operator. The scope is further defined below.

4.1.1 Impacts from the LTWP wind farm

From Chapter 3, it is clear that a number of impacts can flow from the construction and operation of the LTWP wind farm (first-order impacts) as well as from increased access to wind energy to a country's national grid (second-order impacts).

In the assessment of impacts from the LTWP wind farm, the study has chosen to focus mainly on the contribution to economic output and job creation given the emphasis on this dimension in the existing literature (see Chapter 3) and the main research interests of the Clients.

Box 4.1: The LTWP project's main levels of influence

For simplicity reasons, the study distinguishes between "local" vs. "national" impacts. Local impacts can nonetheless be further distilled into county-level impacts (Marsabit) vs. the project area (Laisamis constituency), with the latter sometimes referred to as "local-local". When possible, the study will include data and observations at the most granular level (i.e. constituency), however, reliable and up-to-date data is generally more difficult to come by at the constituency level and will in several cases require additional data collection from the impacted households.

Consistent with existing studies, the study considers two types of impacts: The first, and relatively most simple, impact dimension is the economic activity created by the LTWP project through LTWP Ltd. and sub-contractors, herein Vestas, and the extent to which these activities benefit people living within the project constituency, county and/or Kenya, cf. **Box 4.1.** While the observations in this study are limited to direct employment numbers provided by LTWP Ltd. and salary data provided by Vestas as one of several contractors, the findings can be further extrapolated in future studies by including data from all sub-contractors and more detailed economic indicators on salaries, procurement, taxes etc. As illustrated in section 6.3.3, the observations can also be further strengthened by developing a local multiplier model to track how the salaries paid to employees of LTWP Ltd. and by sub-contractors such as Vestas are reinvested in the local economy.

The second, and relatively more complicated, dimension is the future contribution of the LTWP wind farm to economic growth and job creation from increased access to reliable, low-cost energy to the national grid. Given the often-significant impact on economic development and job creation from these types of impacts compared to first-order effects as illustrated in the literature review (3.2), the study has placed relatively higher emphasis on analysing these potentials. The second-order impacts are attempted captured in the study via a feasibility assessment building on reference studies and key assumptions on the future energy attributes and performance level of LTWP, once operational. Importantly, the findings in terms of GDP and jobs added to Kenya’s national economy are at this stage highly speculative and will need to be updated once actual performance data is available.

4.1.2 Impacts from the LTWP access road

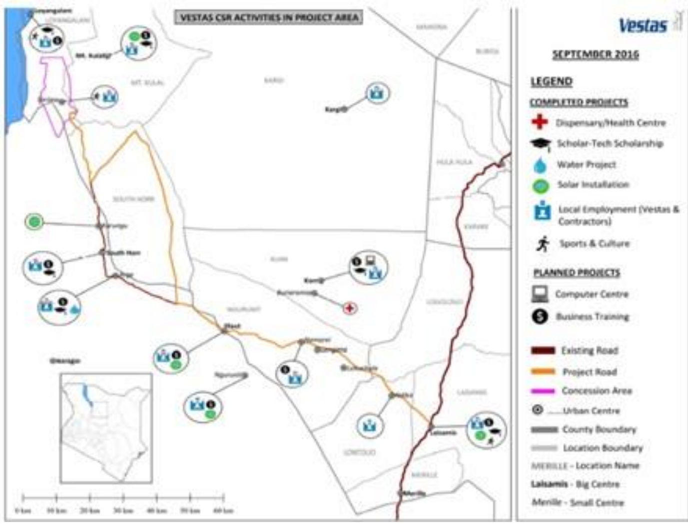
With the significance of rural roads in delivering measurable benefits to otherwise isolated communities established in section 3.3, the study focuses a substantial part of its attention on evaluating the preliminary effects on local traffic and transport patterns through a combination of traffic and market surveys and interviews in the project area. Contrary to the LTWP wind farm which is not yet operational it is possible to begin to estimate the actual benefits that are materializing from the project area from the LTWP access road. Since no *ex ante* data exists from before the road rehabilitation, the preliminary observations made in this study therefore serves a dual purpose as a first baseline for future studies as well as a preliminary evaluation of emerging changes in traffic and transport patterns based on the recollection of traffic survey respondents from before/after the access road rehabilitation.

Beyond the traffic and transport outcomes observed in this study, initial observations are also included throughout various sections of the analysis on the potential spill-over effects from increased rural road access, most notably on stimulating economic activity within the rural economy with a concrete case study from the local fishery trade in Lake Turkana. Other local development indicators from the access road are also briefly observed in the empirical assessment such as education, health and governance and community cohesion impacts, however, more data is generally required from the project area to further quantify these effects.

4.1.3 Impacts from local capacity building

The impact assessment of the LTWP project’s local capacity building efforts is limited to the efforts that have been implemented by LTWP Ltd.’s Winds of Change foundation in collaboration with Vestas. This is mainly because the study has had access to more substantial evidence on these particular efforts through access to previous Vestas-commissioned evaluations (ERM, 2017). It must be emphasized that Vestas is only one of several LTWP partners to have supported community development projects and employment in the Laisamis Constituency, and there are therefore wider positive impacts from the LTWP project’s capacity building efforts than the examples provided in this study. It should also be noted that Vestas has collaborated closely with LTWP Ltd.'s Winds of Change foundation on all these projects, several of which involve co-financing.

Figure 4.1: Overview of Vestas' local capacity building in project area



Source: Vestas internal presentation, October 2017

For Vestas' part, the capacity building projects fall into five main categories: i) mitigatory actions and awareness campaigns, ii) local employment & resources utilization, iii) infrastructure development, iv) skills development and v) peace and cohesion. In the period 2015-2017, Vestas has allocated approx. USD 820,500 to these activities in various parts of the project area, c.f. **Figure 4.1**. A selection of these initiatives are profiled in this study[14].

4.1.4 Notable omissions for consideration in future studies

While the methodological framework applied in this study is largely agnostic in nature (see section 4.2 and 4.3), meaning that it does not a priori rule out or favour specific impacts or indicators over others, several impacts have not been included in this study, either due to scope considerations and/or data constraints. As these impacts may still be beneficial to consider in future impact evaluation and monitoring programs of the LTWP project, they are briefly listed here:

- *Resettlement impacts:* The LTWP project has involved the resettlement of Sarima village which was located within the LTWP concession area. While resettlement impacts may be captured indirectly by some of the broader outcome and impact indicators proposed in this study (e.g. changes to community cohesion and conflict), the study has not carried out an independent investigation to this end. For an overview of some of the main outcomes from the Sarima village resettlement process, please refer to the Sarima Village Resettlement Process report available via LTWP Ltd.'s website and the forthcoming mid-term review of the LTWP project by Triple R Alliance.
- assessing resettlement impacts is a complex undertaking and requires access to the impacted stakeholders which has not been possible in this study[15].
- *Environmental and climate impacts:* The LTWP project is likely to impact both the local environment (e.g. LTWP wind farm construction, road construction) and Kenya's contribution to global climate

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[14] The study does not provide a comprehensive review of all Vestas' initiatives as they have been profiled in more detail in the separate evaluation report by ERM (2017).

[15] For additional details on Sarima and local perceptions on impacts from the resettlement process, please refer to the forthcoming mid-term review of the LTWP project by the Triple R Alliance.

change (e.g. if fossil fuels are replaced by wind energy). Some details on the prospective localized environmental impacts of the LTWP project can be found in the Environmental and Social Impact Assessment conducted pre-construction (ESIA, 2009), while Vestas' own estimates suggest that the LTWP project may be able to save Kenya approx. 16 million tons of CO_2 emissions compared to a fossil fuel plant[16]. As per agreement with the Clients, these dimensions have not been included in this study due to priority placed on assessing other indicators but may be included in future assessments.

- *Decommissioning impacts*: The LTWP project is expected to run over a 20-year period. Prospective impacts from future decommissioning have not been included in the study due to lack of clarity on what will happen in 20 years' time, e.g. upgrading of existing wind farm by LTWP Ltd. under a new contract, removal of the wind farm altogether, sale of wind farm to other buyers, etc.
- *WoC impacts*: As mentioned in section 4.1.3, the study has considered, and been given access to, an in-depth review of the benefits from Vestas' local capacity building initiatives which has inspired some of the indicators and examples included in this report, e.g. on education and health. There are however a much wider range of initiatives, and hence impacts, from LTWP Ltd.'s investments in the project area via WoC which will continue beyond the construction phase. To capture the full benefits of the LTWP project over time, future impact assessments and monitoring programs should be expanded to include relevant outcome and impact indicators for the full suite of WoC's current and future activities as well.

4.2 IMPACT TERMINOLOGY AND APPROACH

Throughout this report, we use the broad terminology '*impacts'* to signify the potential long-term changes caused – directly or indirectly, positively or adversely, now or in the future – by the Lake Turkana Wind Power project in Kenya, either at the local or national level. In this context, socio-economic impact assessments can be a helpful tool to determine whether certain strategic goals such as local economic development or poverty reduction are being met in a specific investment, thereby providing investors and developers with more systematic and fact-based evaluations of project benefits which can be tracked over time. Socio-economic impact assessments are however a broad umbrella with a great deal of variety among the approaches, resources and tools available to corporate practitioners, investors and researchers, each with their own purpose and raison d'etre[17]. Given the diversity of the impacts considered in this particular study, the study applies a combination of best-practice impact guidelines and evaluation techniques, notably:

- *The Measuring Impact Framework (WBCSD, 2008)*: Developed by more than 20 leading companies and the International Finance Corporation, the Measuring Impact Framework has been applied to help scope the impact assessment of the LTWP project and the impact pathway presented in the following section. Importantly, the framework is agnostic in terms of which metrics and impacts should be included. Rather, it emphasizes the explorative process of developing results chains and

[16] Source: Vestas LTWP Fact Sheet

[17] For a review of ten prominent socio-economic impact measurement frameworks often favored by corporate practitioners, see WBCSD's "Measuring Impact: A guide for businesses" available here: https://www.ongawa.org/wp-content/uploads/2013/06/WBCSD-Guide-to-Measuring-Impact.pdf

selecting indicators and metrics according to the specific empirical context while classifying impacts at the "input", "output," "outcome," and "impact" level as further detailed in section 4.3.

- *Cost-Benefit Analysis (EC, 2014)*: CBA is an analytical tool which is used by a wide number of international institutions to help appraise an investment decision and assess the potential welfare changes attributable to it in monetary and quantifiable terms. The purpose of CBA is to help decision makers facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives. While this study does not include a detailed CBA per se, some of the underlying principles of CBA such as comparing do-nothing with investment scenarios have been applied in several aspects of the analysis.
- *Input-Output modelling (I-O)*: The input-output modelling technique is a well-established statistical modelling tool that uses company, country and industry data to generate quantitative estimates of jobs supported and economic value added in a national economy and are generally considered academically rigorous by external stakeholders such as local governments. IO models can be used to estimate job and economic outputs at both the local (e.g. county level) and national level but due to lack of sufficient data from the project area the I-O approach has been applied solely to the feasibility assessment of the increased energy supply from LTWP to the national grid.

4.3 Analytical framework: Impact pathway for the LTWP project

Beyond commercial returns, the stated objective of the LTWP project is to provide a 'reliable, low cost energy base' to the Kenyan population while ensuring that the 'local communities benefit' from the project[18]. To help the Clients assess whether these objectives – i.e. providing a reliable, low cost energy base and benefiting local communities – are likely to be achieved, the study has developed an overview of the current and prospective socio-economic impacts which are likely to accrue from the LTWP wind farm, the LTWP access road and from (Vestas') local capacity building efforts in the project area.

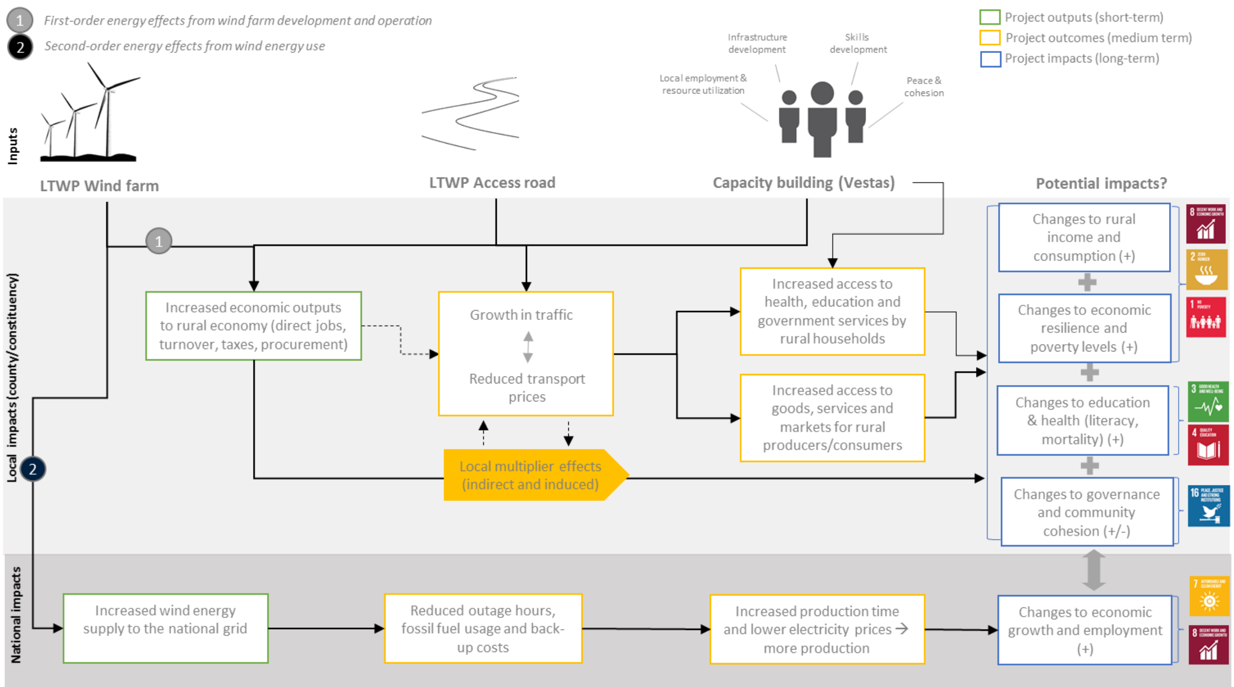
Impact pathways are well-established as the foundation for impact assessments and can be used to help guide the formation of hypotheses on socio-economic value creation or destruction, and the main causalities driving same. Sometimes referred to as 'theories of change', impact pathways, once developed, can be effective measurements to test project assumptions and causalities in an empirical context (WBCSD, 2017; Airey, 2014).

The pathway for this preliminary impact study is partly inspired by a selection of the impact dimensions identified in the existing literature, c.f. **Table 3.1**, as well as the unique characteristics of the LTWP project identified during the initial data collection and scope considerations for this study. In that sense, it represents both generic and project-specific attributes making it suitable for replicability in future impact assessments, with some adaptation. Notably, not all wind farm development projects will include access roads or local capacity building to the same extent as the LTWP project which will invariably change the scope and magnitude of future impact pathways.

[18] https://ltwp.co.ke

The impact pathway developed for the purpose of this study is illustrated in a simplified version in **Figure 4.2** with the detailed version of the impact pathway enclosed in Appendix A.

Figure 4.2: Simplified impact pathway for key elements of the LTWP projects



Source: QBIS Consulting, 2018, based on detailed impact pathway developed for LTWP study

As illustrated by the different colored boxes in

Figure 4.2 and further outlined in *Appendix A*, impact pathways consist of four main elements, respectively inputs, outputs, outcomes and impacts which are exemplified in

Table 4.1.

Table 4.1: Inputs, outputs, outcomes and impacts

	Inputs	Outputs	Outcomes	Impacts
Definition	Inputs are the sources, or origins, of the societal gains that the impact evaluation is trying to capture. In this case: the LTWP wind farm, the access road and Vestas' local capacity building investments.	Outputs (c.f. the green boxes in **Figure 4.2**) are the concrete and often most visible results of a given investment.	Outcomes (c.f. yellow boxes in **Figure 4.2**) are the short to intermediate changes that occur as a direct or indirect result of the project's main outputs, sometimes also referred to as 'effects' (Airey, 2014).	Impacts (c.f. blue boxes in **Figure 4.2**) are systemic and long-term in nature and reflect the broader changes that occur within the community or society at large as an indirect result of the project's outputs and outcomes.
Time to manifest	Short-term	Short-term	Medium-term	Long-term
Data availability and source	High – can often be supplied by company/investor	High – can often be supplied by company/investor	Medium to low – will often require collection of primary and secondary data	Low – will almost always require collection of more extensive primary and secondary data over time

Source: QBIS Consulting inspired by the Measuring Impact Framework (WBCSD, 2008)

Given that companies/investors will typically have data on inputs and outputs from the investment itself, the study has focused on identifying evidence on the latter two, i.e. outcomes and impacts. Further, as signified by the arrows in

Figure 4.2, impact pathways are rarely linear and different investments and activities (inputs) may contribute to, and mutually, reinforce the same types of outcomes and impacts. The increased income from LTWP Ltd. and sub-contractor employment, herein Vestas, may e.g. mutually reinforce the increased income to local fishermen enabled by the LTWP access road, thereby contributing to the same outcome and impact indicators albeit through varying vehicles.

Finally, from the detailed impact pathway enclosed in Appendix A, it is possible to distill five core impact dimensions from the three main interventions (inputs) included in this study. These dimensions will serve as the main structure for the empirical findings in the preliminary impact evaluation (Chapter 6) and are detailed in **Table 4.2**.

Table 4.2: The five impact dimensions included in the LTWP impact pathway

Dimension	**1. Traffic and Transport**	**2. Rural Economy**	**3. Health & Education**	**4. Governance & Community Cohesion**	**5. Energy Supply & Costs**
	Local	**Local**	**Local**	**Local**	**National**
Outcome indicators	•Reduced transport costs •Reduced road impassability •Reduced travel time •Increase in traffic volumes, services and modes •Increase in traffic accidents	•Increase in economic activity •Improved access to inputs, goods and services •Increased productivity/reduced losses •Increased access to local markets ('TILD')	•Improved access to, and quality of, education and health facilities •Improved retention/ recruitment of teachers and health staff to rural areas •Strengthened oversight from education and health authorities	•Greater oversight and funding from government agencies •Improved response to security incidents (non-accidents) •Increased exposure to non-traditional values and norms •Changes to inter- and intra-community conflicts	•Reduced power outages •Reduced electricity costs •Improved current account and more stable currency
Impact indicators	N/A (outcomes only)[19]	•Changes in rural income levels and sources •Changes in local consumption levels and patterns •Changes in economic resilience and poverty levels	•Changes in skills and learning enhancement (literacy, numeracy) •Changes in employability •Changes in health service utilization and coverage •Changes in mortality rates	•Changes in rule of law and utilization/coverage of government services •Changes to social capital and community cohesion	•Changes in national production, GDP and employment
Caused by	LTWP access road	LTWP access road, Local capacity building, LTWP wind farm (first-order)	LTWP access road, Local capacity building	LTWP access road, Local capacity building	LTWP wind farm (second-order)

Source: QBIS Consulting, 2018, based on detailed impact pathway in Appendix A

4.4 DATA COLLECTION AND ANALYSIS

Once an impact pathway has been developed, it is possible to begin to test its main dimensions, indicators and causalities in an empirical context. The results from the preliminary impact evaluation in Chapter 6 are based on a combination of primary and secondary data collected during end 2017/early 2018, c.f. **Table 4.3**.

[19] Traffic and transport are generally considered short- to medium term outcomes, or 'effects', in the existing literature rather than long-term impacts in their own right.

Table 4.3: Main data sources for preliminary impact evaluation

Document review	Review of existing project material and documentation provided by Vestas and IFU, incl. previously commissioned environmental and social impact assessments commissioned by the LTWP consortium (ESIA, 2009) and Vestas (ERM, 2017) as well as general project descriptions, documents, and FAQs
Field visit – 2017	Field visit in project area carried out ultimo Nov/primo Dec 2017 by QBIS accompanied by Vestas' local staff (Ms. Jacinta Murunga and Mr. Stephen Lorongo Orbora). The field visited included interviews with local government officials, interview with local NGO (GiZ), and observation studies in selected villages in the project area followed by data population by Vestas' local staff based on inputs from local chiefs. In addition, a meeting was held with Stratmore Energy Research Center in Nairobi. Following the field visit, data from the project area was populated by Vestas' local staff based on inputs from local chiefs. Due to constraints in the project area, it was not possible to carry out interviews with community groups or members impacted by the project (see section 4.5 for further discussion on study limitations). A detailed overview of the field visits and the communities profiled is provided in Appendix B.
Traffic survey – 2018	Traffic survey in project area (Loiyangalani-Laisamis) was carried out in January 2018 over a 7-day period. The traffic survey was based on a pre-defined questionnaire defined by QBIS and carried out by locals based on guidance from Vestas' local staff, see Appendix D.
National and county-level statistics	Review of best-available national, county and, where possible, constituency level statistics, including the 2015/16 Kenya Integrated Budget Household Survey, county specific reports commissioned by the Kenya National Bureau of Statistics (KNBS, 2015; 2018) and the County Government's first integrated development plan (CIDP, 2013-2017).
Reference case studies from existing literature	An in-depth review of the existing literature on wind farm development, energy access and rural road access has been conducted. For selected categories in the impact pathway where project-specific data is not yet available, the study refer to existing reference studies identified during the literature review, c.f. Chapter 3.

Source: QBIS Consulting, 2018

4.5 Study limitations and considerations for future assessments

Impact studies can vary greatly in the type and magnitude of the data collected and the rigor with which such data is evaluated. Even the most advanced impact assessments often leave gaps or uncertainties for further assessment and most impact studies will be subject to a number of limitations (Airey, 2014). In **Table 4.4**, three typical research designs are outlined, each of which come with their own benefits and limitations.

Table 4.4: Three research designs for rural impact assessments

	A: Observational	B: Rapid Rural Appraisal	C: Panel Surveys
Deliveries	• Observations on current and prospective impacts of project based on largely secondary data and field observations	• Characterization of current and prospective impacts of project based on interviews and data from impacted communities and households over time	• Establishment of comprehensive community and household level statistics (baseline) for ongoing performance monitoring over time
Data collection	• Field observations • Expert interviews • Secondary data • Reference studies	• Elements from research design A *plus*: • Primary data collection from impacted communities and households, e.g. via focus group interviews and/or surveys with selected households (*Rapid Rural Appraisal*).	• Elements from research design A *plus*: • Primary data collection via panel surveys with a wider selection of households and control households (potentially in combination with focus group interviews)
Pros	• Existing studies can be leveraged to minimize resource strain (cost, time) of project and stay within budget	• Increased credibility (relative to A) with potential to use additional data to better assess	• The 'gold-standard' of rural impact evaluation allowing a detailed baseline for monitoring rural economy outcomes impacts over time
Cons	• Limits to credibility of findings due to lack of primary data at community/HH-level	• Additional time and resources on data collection and analysis; medium pull on local resources; some difficulties in comparing results over time and controlling for biases	• Additional time and resources for data collection and econometric modeling, high pull on local resources; potentially 'overdone' given size of impacts

Source: QBIS Consulting, 2018, based on a methodological review of impact studies in a developing country context

Research design A is observational in nature and largely describes the research design applied in this study where it has not been possible to collect primary data from the impacted populations in the project area, beyond the data collected via the local traffic and market survey. This research design often relies heavily on secondary data, e.g. national household surveys, which can be tracked over time. This approach has some obvious benefits in terms of time, costs, and low invasiveness as well some clear limitations, namely the lack of data from impacted households in the project's constituency, e.g. on local consumption, expenditure and poverty levels. While the Kenya Integrated Budget Household Survey 2015/16 provides some insights on basic socio-economic indicators which may be useful for future assessments, the data that is currently available via the survey is at a county level only which will not be adequate for this particular project. Finally, even if secondary data does exist at the household level, this approach may be challenged on its credibility due to lack of consultation with impacted communities or leaving out important dimensions altogether that are not already included in official statistics.

On the other side of the spectrum, a more comprehensive research design, *Research design C*, requires a more extensive data collection from the impacted communities and households. Sometimes referred to as 'double-difference' approaches, these types of research designs allow for more robust statistical and econometric impact evaluations by comparing before/after scenarios for impacted households with before/after scenarios for control households. In theory, they can be conducted with or without the use of panel surveys, although the latter is generally preferred when seeking to establish causalities to complex long-term impacts such as rural economy and poverty reduction (Airey, 2014). Importantly, while such approaches represent the current "gold standard" in quantitative socio-economic impact evaluations in rural communities, they too have limitations and drawbacks. To conduct such assessments, significant resources are required for highly qualified specialists as well as extensive data collection and analysis which increases both the time and cost of the evaluation and may be unwarranted for the size and expected impacts of the investment in question. Most importantly, the findings from such efforts, while defendable, may not always yield the expected results and still provide insubstantial or less than conclusive data.

In cases where the required resources for such ‘gold-standard’ approaches are either not available or uncalled for due to the size and expected impact of the investment itself, *Research design B* can provide a more pragmatic solution while still addressing some of the limitations in research design A, namely the lack of primary data from the impacted communities. The resource intensity of comprehensive quantitative and statistical approaches which can often take years to complete has led some specialists to argue that furthering the understanding of impacts is best grounded in participatory and qualitative methodologies, sometimes referred to as Rapid Rural Appraisals (RRA) (Airey, 2014; FAO). RRA approaches refer not to a single technique but to a range of investigation procedures whose chief characteristics are that they take a relatively shorter time to complete, tend to be relatively cheap to carry out and make use of more 'informal' data collection procedures. The techniques rely primarily on expert observation coupled with semi-structured interviewing of farmers, local leaders and officials with data collection part often executed over a period of weeks, or at most months, rather than over several years. Household surveys can also be applied, although in a more targeted and less comprehensive form (i.e. fewer households, fewer indicators) than the panel surveys in research design C. Whatever the purpose of the RRA, it must however involve the people who are the intended beneficiaries of investment in question.

Regardless of which research design is chosen for future evaluation purposes, the LTWP project is still in its relative infancy. This also means that the preliminary outcomes and impacts observed in this study are likely to further materialize, and potentially change, over time. To fully understand how the impacts from the LTWP project will evolve – especially in relation to complex interdependencies within the rural economy and linkages to rural poverty levels in the project area – a continuous impact evaluation and monitoring program will be required, which will depend on comparable baseline data that can be measured and monitored over the investment’s entire lifecycle. To this end, it is recommended to consider how elements from research design B and/or C may be further incorporated into the largely observational impact evaluation conducted in this study. It is also recommended to expand the scope of the preliminary impact evaluation conducted in this study to cover the full suite of impacts from the LTWP project, including the local community initiatives implemented by WoC and other project partners, now and in the future.

Finally, in addition to the above-mentioned limitations in evaluating impacts at the local project area level, there are also some noteworthy limitations to the evaluation of the potential energy outcomes and impacts described in section 6.6. Through a feasibility assessment, the study has applied an input-output model of the Kenyan economy to convey the potential energy outcomes of the LTWP project at the macro-economic level, yet since the LTWP wind farm is not yet operational this limits the potential to investigate whether such benefits will indeed materialize. Once LTWP is operational and connected to the national grid, it will be relevant to update the energy results based on actual performance data thereby allowing the Clients to empirically test the energy-specific potentials conveyed in this study.

5 Empirical context

5.1 Kenya's socio-economic and energy context – The national level

With a population of approx. 48.5 million in 2016, a youthful and growing population, a dynamic private sector, a relatively skilled workforce, improved infrastructure, a new constitution, and a pivotal economic role in the East Africa region, Kenya has the potential to become one of Africa's great success stories[20]. Following a major constitutional reform in 2010 (devolution), political power has increasingly been delegated from the statutory level to Kenya's 47 counties, which has led to important improvements in political and economic governance and improved public service delivery at the local level, namely in Kenya's rural areas which is host to 74% of its total population[21].

Nonetheless, key development challenges remain including wide-spread poverty, inequality, and climate change. Despite Kenya's recent economic recovery and relatively high growth rates, such challenges will need to be addressed if sustained growth rates are to transform the lives of ordinary Kenyan citizens in the years to come. While Kenya has made progress in areas such as reducing child mortality, achieving universal primary school enrolment and narrowing gender gaps in the population, 33.6% of the population still live below the income poverty line of $1.90 PPP/day, of which 10.7% live in severe poverty, and an additional 32% live near the poverty line (UNDP, 2016). According to the latest available Human Development Index (2015), Kenya ranks 146th out of 188 countries on income inequality indicating that the economic growth recorded during the last decades is distributed on relatively few hands with less than 0.1% of the population in Kenya owning more wealth than the bottom 99.9% (Oxfam, 2017). Further, while poverty rates in Kenya have declined substantially over the past decade, the total share of overall poor declined only marginally from 16.6 million in 2005/06 to 16.4 million in 2015/16 according to the most recent integrated household survey from Kenya National Bureau of Statistics (KNBS, 2018)[22]. In other words, the pace of poverty reduction has only just overtaken the pace of population growth. In 2015/16, 36.1% of the Kenyan population continued to live below the national poverty line of Ksh 3,252 (rural and peri-urban areas) and Ksh 5,995 (core-urban areas) while 32% of the population did not meet the food poverty line threshold of 2,250 Kcal per day (KNBS, 2018). Finally, extreme poverty – defined as consumption expenditure per person lower than Ksh 1,954 for rural and peri-urban areas and lower than Ksh 2,551 for core-urban areas – accounted for 8.6% of the population in 2015/16, or 3.8 million individuals, with a larger proportional share of extreme poverty observed in Kenya's rural areas.

In terms of environmental sustainability, Kenya also faces challenges at several levels including climate change, land degradation, forest degradation, water scarcity and pollution, biodiversity loss, poor waste management and pollution. Climate change poses a particular challenge due to current and expected

[20] Source: http://www.worldbank.org/en/country/kenya/overview#1
[21] Source: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=KE
[22] The Kenya household survey distinguishes between three types of poverty: Overall poverty, Food poverty and Extreme or Hardcore poverty (KNBS, 2018).

increases in climate-related extreme weather events such as droughts and floods putting further strain on the 16.4 million individuals living in food poverty according to the latest household survey (KNBS, 2018). According to UNDP, the mean annual temperature in Kenya has increased by 1.0°C since 1960 representing an average rate of 0.21°C per decade (César et. al., 2014). This is especially a challenge to the agricultural sector, which relies on predictable rainfall and temperatures, and supports approx. 80 per cent of the predominantly rural population.

To address some of these challenges, Kenya's Vision 2030 growth plan launched in 2007 aims at transforming Kenya into a *"middle-income country providing a high-quality life to all its citizens by the year 2030"* (GoV, 2007). With Vision 2030, Kenya aims at achieving an average GDP growth rate of 10% per annum from 2012 to 2030 while delivering *'equitable social development in a clean and secure environment'* (p. 2).

To achieve this vision, the Kenyan government has identified energy as one of the main pillars of success. Recognizing that the various projects and priorities recommended under the Vision 2030 plan will further increase domestic energy demand over the next decades, especially in the agricultural and manufacturing sectors, the Government of Kenya has made it a priority to '*generate more energy at lower costs and increase efficiency in energy consumption.' (GoV, 2007, p. 8)*. One way that Kenya plans to do so is through the increased exploration of renewable energy sources.

There are currently three main sources of energy in Kenya – biomass (68%), petroleum (21%) and electricity (9%) (IEA, 2015). Biomass constitutes the largest source of energy consumed in Kenya in the form of wood fuel and charcoal, which is extensively used in the rural areas by mostly poor households for cooking and heating purposes. In terms of fossil fuels, although oil and gas discoveries are being made in Kenya, it has yet to start extraction and production from its reserves, and therefore entirely relies on imports of both crude and refined oil. As mentioned elsewhere in this report, the principal challenge of Kenya's high petroleum consumption is the corresponding vulnerability of the economy to price fluctuations. Finally, as described in more detail in the energy feasibility assessment in section 6.6, electricity in Kenya is generated primarily from hydro-power and fossil fuel with wind currently representing approx. 1% of the electricity mix (ERC, 2014-2015).

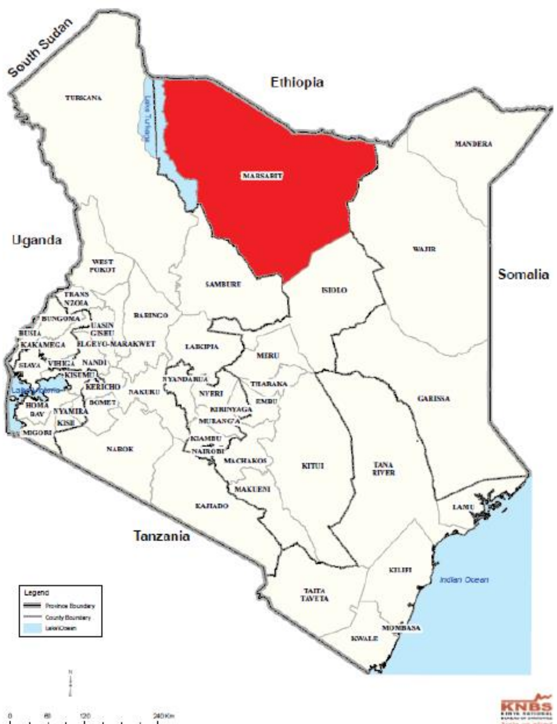
In the context of Kenya's stated ambition to reduce dependency and consumption of fossil fuels and increase the use of renewable energy sources, wind power is often stated to hold significant promise to Kenya's future development. Prior to the LTWP project, experiences with wind for power generation in Kenya were limited to the national energy company, KenGen, which has installed smaller projects in Ngong Hills (ERG, 2015). Nonetheless, the potential for wind generation in Kenya is one of the highest in Africa with the average wind speed in large parts of the country reaching over 6 m/s, and the areas surrounding Lake Turkana (over 9 m/s) and the coast (5-7 m/s) being particularly attractive (GiZ, 2015).

5.2 Profile of Marsabit County and LTWP project area – The local level

5.2.1 Profile of Marsabit County – "Local level"

The LTWP project site is located within the Laisamis constituency of Marsabit County. With an estimated population of over 316,000 people in 2015/16 (KNBS, 2018), the county of Marsabit is part of Kenya's arid lands, which covers an area of approx. 71,000 km2 in the Northern part of Kenya, bordering Ethiopia to the north, Lake Turkana to the west, Samburu County to the south and Wajir and Isiolo counties to the east, c.f. **Figure 5.1**.

Figure 5.1: Overview of Marsabit county



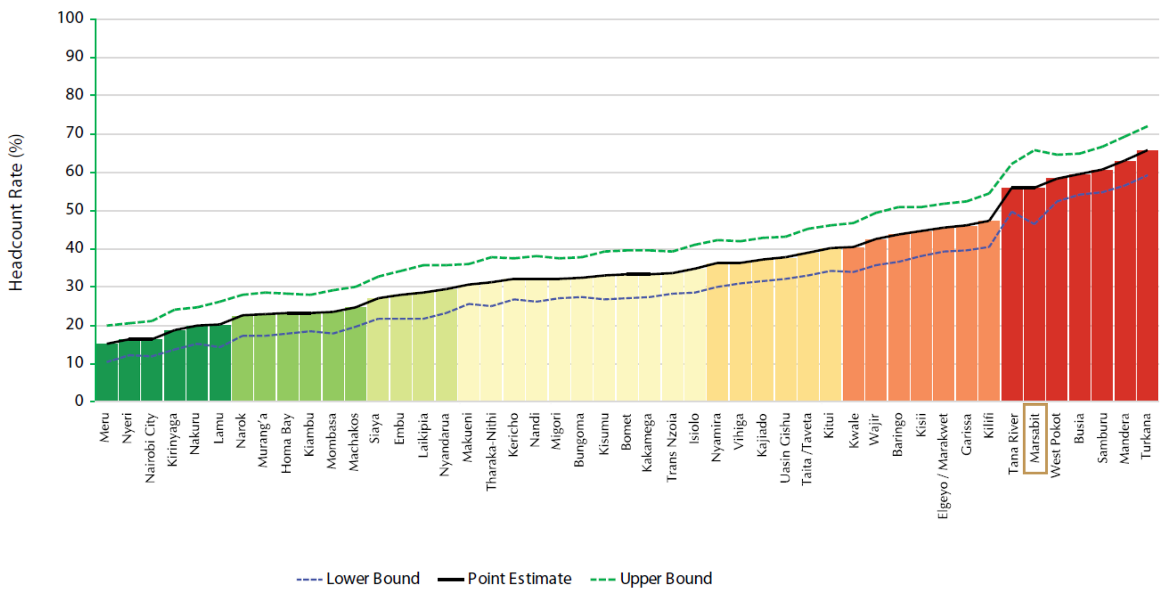
Source: Kenya Population and Housing Census (2009) in Marsabit County's CIDP (2013-2017)

Most of the county comprises an extensive plain lying between 300 to 900 m above sea level. There are no permanent rivers with the majority of the county covered by rocky, stony and rugged lava plains with poor soil development. The land is largely arid, rainfall is low and unreliable, and droughts are frequent all of which limits crop production: only 2 percent of the county population practices crop farming and at present only 0.3 percent (5,060 ha) of the total estimated arable area (1,582,750 ha) is under food and cash crop production, with maize, sorghum, millet, beans, fruits and vegetables being the main crops. Instead, livestock keeping is the main economic activity in the county with main livestock including cattle, goats, camels, donkeys, and poultry. Pastoralists account for approx. 80 percent of the population, agro-pastoralists for 16 percent, with the remainder of the population being employed in other livelihoods, including formal employment and fishing in Lake Turkana, the latter of which is particularly prevalent in the Loyangalani sub-county of the LTWP project area (WFP, 2015).

Lack of access to water is a significant challenge in the region with 60 percent of the households relying on boreholes, springs and wells. Most parts of the county frequently experience acute water shortages and the mean distance to the nearest water point is 25 km. The combination of arid land, frequent droughts and water shortages means that Marsabit is a chronically food deficient county. Recurrent droughts occur every one to three years and pose major challenge for the development of the county, incl. significant losses for the local population and resources being required for emergency relief rather than longer-term development. Drought further reduces the availability of and access to water, leading to loss of livestock, shortage of food and loss of biodiversity. A 2015 report categorized the acute food insecurity phase for all livelihood zones in the county as stressed (WFP, 2015), with the county government identifying food security and poverty as the region's major development challenges (CIDP 2013-2017).

According to the latest available integrated household survey from 2015/16 (KNBS, 2018), an estimated 201,000 people were found to live in overall poverty in Marsabit county, equivalent to 63.7% of the population, down from 92% in 2005/06. This improvement mirrors the overall reductions in poverty seen at the national level, although at a seemingly much higher rate (~30%). Nonetheless, Marsabit county remains one of the poorest counties in Kenya, with more than half (56%) of the population currently unable to purchase enough food to meet the basic caloric intake requirements c.f. **Figure 5.2**, and 23.8%, or 75,000 people, living in extreme poverty.

Figure 5.2: Food poverty incidences across Kenya's 47 counties



Source: KNBS, 2018

According to the county government, the root causes to the region's wide-spread poverty are multifaceted and interrelated. As an example, cultural practices are believed to play a role in hindering development as livestock is often seen as a measure of wealth which prevent the pastoralist communities from engaging in economic diversification (CIDP 2013-2017). Other factors include a poor rural road network, persistent droughts, environmental degradation, insecurity and raids, over-dependence on foreign aid, increasing occurrences of HIV/AIDS, high illiteracy and inadequate water for domestic and livestock use (ibid). For a combined overview of relevant county statistics compared, where possible, to the national average, see **Table 5.1**.

Table 5.1: Socio-economic indicators, County vs. National, KIBHS 2015/16

Indicators	Marsabit	Kenya
Demographics		
Population size ('000), 2015 projected	316	45,371
Average household size by number of people	5	4.1
Female as % of population	48.1%	51.2%
Proportion of households with male head	67%	67.6%
Child dependency ratio	106.4	74.7
Livelihood		
Mean monthly food expenditure (Kshs) per adult equivalent	2,983	4,239
Mean monthly non-food expenditure (Kshs) per adult equivalent	1,510	3,572
Total monthly expenditure per adult equivalent	4,493	7,811
Proportion of households seeking and accessing credit	33.9%	90.1%
Household characteristics		
Proportion of manyattas (traditional) households	61.4%	8.4%
Proportion of households with corrugated iron sheet roofs	38.3%	81.7%
Proportion of households with stone/brick walls	9.8%	24.8%
Proportion of households with cement floor	20.4%	47.3%
Proportion of households with earth flooring	73.5%	29.6%
Sanitation and utilities		
Proportion of households with unprotected water source	56.6%	26.0%
Proportion of household with no toilet facility (open defacation)	51.5%	8.4%
Proportion of households with distance to water >30 minutes	14.5%	11.6%
Proportion of households connected to the national electricity grid	17.9%	41.4%
Proportion of households with firewood as main cooking fuel	81.9%	54.6%
Poverty		
Proportion of individuals living below national poverty line	64%	36%
Proportion of individuals living below national food poverty line	56%	32%
Proportion of individuals living in extreme poverty	23.8%	8.6%
Proportion of households experiencing severe drought and floods	29.8%	13.7%
Proportion of households experiencing death of livestock	18.0%	8.9%
Proportion of households experiencing severe water shortage	15.7%	2.8%
Education		
Net attention ratio - primary school	53.2%	82.4%
Net attention ratio - secondary school	23.7%	37.5%
Share of population with no educational attainment	62.6%	49.7%
Literacy share of population	37.8%	84.5%
Health and nutrition		
Malaria share of total reported illness	31.0%	37.0%
Diarrhea share of total reported illness	10.3%	7.3%
HIV AIDS share of total reported illness	1.5%	0.4%
Share of sick/injured people using public health facilities	64.9%	73.4%
Share of population receiving free maternal and child health care (MCH)	95.6%	37.6%
Share of population with health insurance	1.7%	19.0%
Children weight-for-height below -2SD	25.0%	6.7%
Children weight-for-height below -3SD	2.6%	11.5%
Justice		
Proportion of households reporting grievances	3.1%	16.0%
Share of disputes related to family matters	21.5%	1.1%
Share of disputes related to tenants vs. landlords	28.3%	8.6%
Share of disputes related to labour (employee/employer disputes)	5.1%	0.1%
Conflict resolution via religious leader/institution	21.5%	0.8%
Conflict resolutions via traditional leader/elder	28.3%	7%
Conflicts resolutions via police	2.9%	11.7%
Conflict resolution via courts	11.4%	9.3%

Source: Selection of indicators from the latest available Kenya Integrated Household Budget Survey, 2015/16 (KNBS, 2018)

5.2.2 Profile of the LTWP project area - "Local-Local" level

While detailed and updated secondary statistics are available at the county-level via the 2015/16 Kenya Integrated Budget Household Survey, c.f. **Table 5.1**, it is more difficult to find updated and comparable secondary data at the constituency level (Laisamis) and sub-county/ward level (the Loyangalani and Laisamis wards) [23]. With reliable and up-to-date secondary data further limited at the individual community/village level (e.g. the towns of Illaut, Korr, Mt. Kulal, Sarima etc.) this can pose some challenges from an impact measurement perspective and may require more extensive primary data to be collected from the impacted households.

While of older date, a 2013 review of Marsabit county from KNBS includes some socio-economic indicators at the constituency level, which indicates that, in 2013, the LTWP project area lacked behind the county average on almost every single socio-economic indicator c.f. **Table 5.2**.

Table 5.2: Comparison of selected indicators – county vs. constituency level

Selected socio-economic indicators	Marsabit county (2013)	Laisamais constituency (2013)	Marsabit county (2015/16)
Key indicators			
Population size ('000)	288	64.9	316
Average household size (# people)	5.4	4.9	5
Female as % of population	48.4%	51.4%	48.10%
Child dependency ratio	0.957	1.158	1.064
Proportion of pop. who work for pay (*)	9.90%	5.30%	N/A
HHs with corrugated iron sheet roofs	28.2%	7.1%	38.30%
HHs with stone/brick walls (*)	6.5%	3.6%	9.8%
HHs with cement floor	16.6%	6.3%	20.40%
HHs with earth flooring	82.0%	92.6%	73.50%
HHS with unprotected water source	62.2%	58.2%	56.60%
HHs with no toilet facility (open defacation)	73.1%	90.97%	51.50%
Gini coefficient	0.365	0.252	N/A
Proportion of population with no educational attainment	68.2%	81.0%	62.60%

Source: 2013 data from Marsabit county and Laisamis constituency is from Ngugi et. al. (2013). 2015/16 data from Marsabit county is from KNBS (2018) and is included here for reference only, see Table 5.

To further assess the conditions in the project area and form an overview of data availability and accessibility for the preliminary evaluation, a field study of the LTWP project area was conducted by QBIS in November 2017. As a first step to establish a baseline of socio-economic indicators at the village/town level, seven villages in the project area were selected of which six were visited during the field study. These visits were strictly for observation purposes given that interviews with local community members was not possible at this point as previously described (c.f. section 4.5). It should also be stated that the village of Sarima was not included in this initial selection upon the Clients' request as detailed assessments of the resettlement process have been carried out separately, c.f.

[23] For a detailed break-down of the administrative units within Marsabit county – constituencies, sub-counties/wards and towns – see KNBS (2015): "County Statistical Abstract, Marsabit County"

section 4.1.4. To capture the full effects of the LTWP project, it is advised that any future impact assessments and monitoring programs includes data from Sarima as well.

Based on the observations made during the field study and the data submitted from local officials and Vestas's project staff on the ground, the seven villages can be characterized by several of the same features as the county overall, including poor infrastructure, inadequate access to basic services, high illiteracy levels, food insecurity caused by frequent droughts and a marginalized population. From the field visit, it was observed that three of the four tribes in the project area are pastoralists, with the forth tribe having fishing from Lake Turkana as their primary livelihood. Traditional nomadic shelters (manyattas) are the predominant shelter type, water is scarce and open defecation is widely practiced. Primary and secondary school attendance rates are below the national average, especially for girls due to traditional cultural practices, including early marriage.

Over the past 4-5 years, multiple external factors have influenced the development of the villages in the general project area in various ways and independently of each other according to the government representatives consulted during the field study. The most important factor is however believed to be the LTWP project which has had several interfaces with the local communities living in and around the project site and the upgraded road, both prior to and during the construction phase. There have also been other important developments in the general project area with potentially positive as well as negative impacts to local livelihoods, including the 2016 upgrading of the A2 road from Merille River to Marsabit which has significantly reduced transportation time from Laisamis to Nairobi. In addition, the devolution of government power to the county-level has had an impact on the project area with an increased influx of governmental resources to the area. Finally, a severe and recent drought in 2016-2017 has led to wide-spread famine in the project area, increased malnutrition rates and livestock deaths, depleting community resources and increasing already high poverty levels.

An overview of best-available socio-economic data from the seven villages based on Vestas' data sources are presented in **Table 5.3** with further details on each village enclosed in the community profiles in Appendix B. It should be stated that this data has not been verified by official and externally published statistics which is not currently available at the individual village level.

Table 5.3: Profile of seven villages in the LTWP project area

	Laisamis	Namerei	Korr	Kargi*	Illaut	South Horr	Loyangalani
Relative development level**	High	Low	Low	Medium	Low	Medium	High
On/off project road	On	On	Off	Off	On	Off	Off
Demographics							
# people	18,421	4,600	N/A	12,406	3,000	1,886	7,253
# households (HHs)	3,070	1,200	N/A	2,080	969	278	2,972
Main ethnicity	Rendile	Rendile	N/A	Rendille	Rendile	Samburu	Turkana
Other ethnicities	Samburu	Samburu	N/A	None	Samburu	Rendille	Elmolo
Livelihood (% of HHs by income)							
Livestock	88%	92%	>99%	100%	99%	97%	67%
Fishing	0%	0%	0%	0%	0%	0%	25%
Small business/trading	6%	5%	<1%	4%	1%	16%	3%
Formal employment	6%	5%	<1%	6%	12%	71%	4%
Farming	0%	0%	<1%	0%	0%	22%	0%
Education							
Primary school net enrollment rate (boys, girls)	58%/50%	39%/ 23%	N/A	56%/43%	48%/32%	49.7%/45.4 %	52%/50%
Basic needs and services							
% of HHs with stone/brick walls	10%	<1%	0%	1%	1%	6%	7%
% of HHs using bush/open defecation	65%	97%	N/A	91%	98%	78%	67%
% of HHs using unprotected well/spring as water source	No info	No info	N/A	52%	98%	No info	7%
% of HHs using lake as water source	0%	0%	0%	0%	0%	0%	25%
Health facilities (public/private)	2	1 (Govt)	1 (Govt)	2	1 (Govt)	2	2
% HHs with electricity*	7%	1%	N/A	3%	1%	18%	4%
Resources & cohesion							
Conflicts with other communities (source of conflict)	Pasture, Water, Land	Pasture, Water, Land	Pasture, Water, Land	Pasture, Water, Land	Pasture, Water, Land	Pasture, Water, Land	Fishing, Pasture, Water, Land

Source: QBIS based on data submitted by Vestas' local representatives in Kenya from chiefs in the area.
**Kargi was not included in the field visit but data was populated by Vestas after the field visit*
***The relative development level is based on field observations and only refers to the relative intra-community profile, i.e. not relative to cross-county or national statistics.*

6 Preliminary impact evaluations of LTWP

6.1 Introduction

The following chapter takes an outset in the consolidated list of outcome and impact indicators identified in the detailed impact pathway, cf. Appendix A. As mentioned previously in the report, these indicators are limited to the elements of the LWTP project included in this study and do therefore not cover the full suite of impacts which will likely flow from the LTWP project at large. Further, several of the indicators included in the impact pathway will require additional data and monitoring over time to allow for a proper assessment. This is especially true for "impact" indicators which contrary to outputs and outcomes will often take longer time to manifest and require more data observations and analysis than what has been possible within the boundaries of this study.

The first four sections – Traffic and Transport (6.2), Rural Economy (6.3), Education & Health (6.4) and Governance and Community Cohesion (6.5) – will review a selection of outcome and impact indicators at the *local level* (i.e. the county and/or project area). The fifth section – Energy Supply and Costs (6.6) – will conduct a feasibility assessment of the expected impacts from the LTWP project at the *national level*. For a gross-list of all the outcome and impact indicators included in the LTWP pathway, including a proposed list of detailed indicators for future impact assessments and ongoing monitoring programs, please refer to Appendix C.

6.2 Traffic and transport evaluation

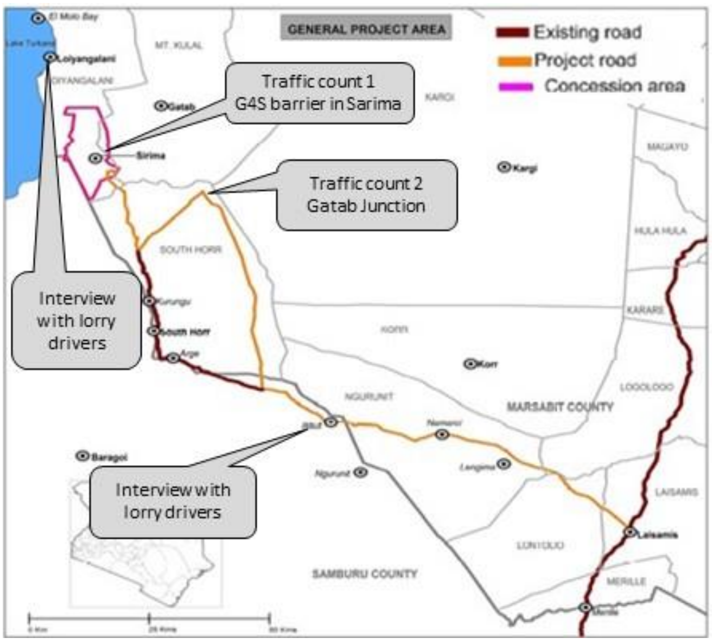
According to the county government, one of the main obstacles to development in Marsabit county and the LTWP project area is the poorly developed road network within the county (CIDP, 2013-2017). The county's approximately 5,000 km roads are mainly earth surface roads which are prone to erosion and rendered impassable during the rainy seasons, leading to high transportation costs. Further, according to the government, the county's poor road network reduces cross-border and in-country trade while adversely affecting provision of essential services such as health, education, security and extension services.

A core feature of the LTWP project is the USD 30 million investment in the upgraded road from the sub-counties of Laisamis to Loyangalani. From a local impact perspective, this investment has been identified as the single most important vehicle through which the project will deliver material socio-economic benefits to the local project area[24].

In the literature review in Chapter 3, it was described how evaluating and monitoring traffic and transport effects over time is an important first step of any impact evaluation involving rural road investments. It was also described how such impact evaluations ideally should be based on context-specific and empirical evidence to measure changes in traffic and transport patterns before and after rural road implementation.

[24] See e.g. https://ltwp.co.ke/faq/, question 2.

To assess the changes brought about by the upgraded road, a traffic survey was conducted in the general project area over a 14-day period from mid to late January 2018. The purpose of the traffic survey was two-fold: Firstly, the aim was to establish a baseline that measures the traffic and transport patterns in the project area today, i.e. after the road rehabilitation yet relatively early in the project's lifecycle. Secondly, the aim was to compare these findings with recollections of transport and traffic patterns before the road rehabilitation from road users. Given that no traffic baseline data exists from before the road rehabilitation, the traffic survey has relied on recall techniques through interviews with the surveyed road users – namely passengers of busses and lorries, and lorry drivers – who were specifically asked about their perceptions of changes in traffic and transport patterns before/after the upgraded road. This is not as accurate as actual traffic data, but if these perceptions are relatively consistent, it can provide useful estimates.



The traffic survey was based on a pre-defined questionnaire developed by QBIS, cf. Appendix D, and carried out by local community members based on guidance from Vestas' local staff. It included traffic counts at the G4S barrier in Sarima and Gatab junction, 31 interviews with bus passengers during four bus rides on four different dates between Loiyangalani and Laisamis/Marsabit as well as 10 interviews with lorry drivers when loading and offloading of goods in Loiyangalani and Illaut during market days. Ideally, traffic surveys should account for seasonal variations and other variations such as religious holidays.

While this was not possible within the time constraints of this study it can be considered in future assessments. In addition, the interpretation of the survey results should take into consideration the sample representativeness. The survey covers four bus rides over a period of two weeks, where a total of 14 bus rides were registered and hence around 29% of total bus rides. On each bus ride, around 8 interviews were carried out, which approximately covers around 13% of the around 60 passengers riding on each bus. Also, the survey includes 10 interviews with lorry and truck drivers out of a total of 50 lorry and truck trips registered over the two-week period, cf. sections below, and hence covers around 20% of total lorry and truck trips in the period.

The results of the traffic survey as well as the interviews conducted during the 2017 field visit are summarized in **Table 6.1**, which provides an overview of the observations from the traffic and transport-specific assessment. The remaining parts of this section will review a selection of these indicators in more detail where evidence is strongest, notably OC1.4 and OC1.5.

Table 6.1: Overview of outcome (OC) and impact (IM) indicators – Traffic and Transport

	Indicators	Caused by	Observations	Data
●	OC1.1. Lower transportation costs	LTWP access road	Assessment of this indicator will require additional data from the project area. Reference studies document that poor roads frequently lead to high variable operating costs and that reduced transport costs can be an important effect of rural road investments (Raballand and Teravaninthorn, 2009).	Reference studies only
○	OC1.2. Lower impassability	LTWP access road	Interviews indicate that during recent rains in the project area, the road was reported closed only 2 days and otherwise open for traffic. Before the road rehabilitation transportation during the wet season was reported to take up to 6-7 days.	QBIS 2017 interviews
○	OC1.3. Reduced travel time	LTWP access road	Interviews indicate that that transportation time during the dry season has been significantly reduced, from 1-2 days before road rehabilitation to 4 hours after the road rehabilitation.	QBIS 2017 interviews
○	OC1.4. Growth in traffic volume, services and modes	OC1.1 – OC1.3	Traffic survey results indicate a nine-fold increase in the number of bus passenger trips between Loiyangalani and Marsabit, from 0.5 trip/week to 4.5 trips/week. The availability of commercial busses has increased from almost never to being available daily, typically with one bus trip per day, but some days two or more busses are reported on Loiyangalani and Marsabit road. The weekly number of lorry loads have increased three-fold from around 1.4 per week to 4.6 per week.	QBIS 2017 interviews + traffic survey
○	OC1.5. Lower transportation prices	OC1.4.	Traffic survey results indicate that bus fares between Loiyangalani and Marsabit have been reduced by around 20% from around 1,000 KES/trip (10 USD/trip) to around 800 KES/trip (8 USD/trip). For passengers travelling on lorries, trip prices have reduced by around 37% from around 833 KES/trip to around 525 KES/trip. Across all load types transported, interviews indicate that average price per lorry had been reduced by around 22% from an average of 67,612 KES/lorry load to an average of 56,368 KES/lorry load.	QBIS 2017 interviews + traffic survey
○	OC1.6. Increase in traffic accidents	OC1.4	Interviews suggest that there are more traffic accidents on the project road that previously, in particular due to higher speeds. Most accidents since road rehabilitation have been solo accidents (vehicles only). Local traffic marshals hired by LTWP Ltd. and partners such as Vestas contribute to mitigating risks (ERM, 2017).	QBIS 2017 interviews, ERM (2017)

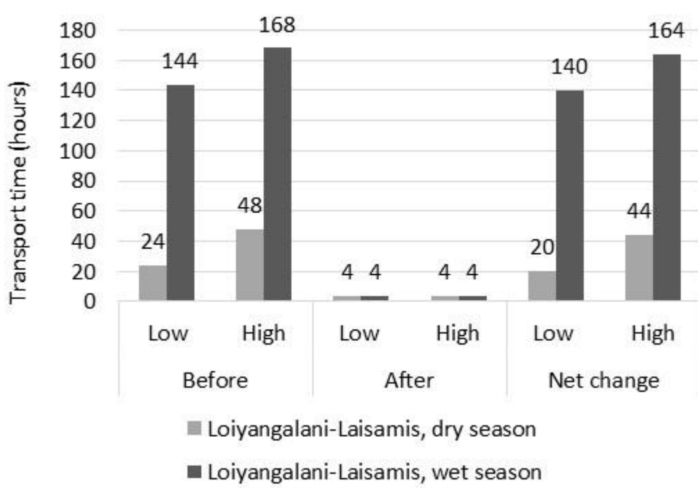
○ = Primary data acquired ○ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

6.2.1 Changes in transport costs, impassability and transport time

From existing studies of rural road investments, some of the most commonly cited short-term effects of improved rural roads include reduced transport costs for local transport providers (OC1.1.), reduced road impassability (OC1.2.) and decreased transport time (OC1.3.) to reach key destinations such as local markets, hospitals, education facilities etc.

Data is currently insufficient to document changes in the costs incurred by local transport providers along the Loyangalani-Laisamis road. In Sub-Saharan Africa, poor roads are however frequently perceived as being the main cause of high variable operating costs, since they increase fuel consumption, increase maintenance costs by damaging the vehicles, reduce the life of tires, reduce vehicle utilization because of lower speeds, and reduce the life of trucks (Raballand and Teravaninthorn, 2009). More specifically, in a study of transport costs and prices in Sub-Saharan Africa by the World Bank it was suggested that rehabilitating key rural corridors from fair to good condition in East Africa could lead to a 15% reduction in transport costs (ibid).

Figure 6.1: Transport time, Loiyangalani to L, 2018



Source: Traffic survey, January 22nd to February 1st, 2018

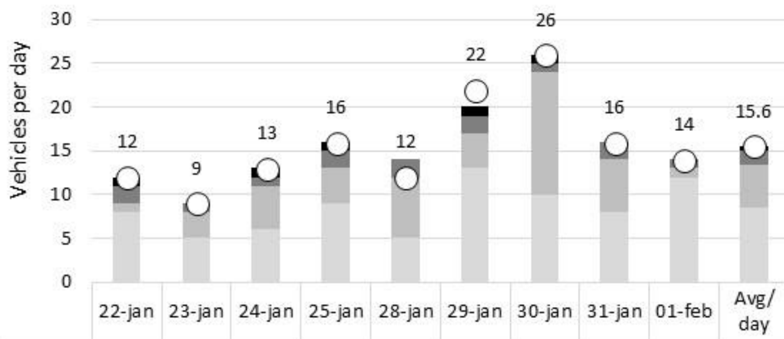
In terms of road impassability and transport time, QBIS' interviews in the project area during the 2017 field visit indicated that that transportation time during the dry season has been significantly reduced, from 1-2 days before road rehabilitation to 4 hours after the road rehabilitation. In the wet season, transportation was likewise reported to take up to 6-7 days before the road rehabilitation. During the recent rains in the project area, the road was reportedly only closed only 2 days and otherwise open for traffic, cf. **Figure 6.1**.

Despite the anecdotal nature of these accounts, they do suggest that the LTWP access road is likely to have contributed positively to local transport providers and users, enabling them to engage in more frequent travels at a, potentially, lower price. The following section will test such assumptions in more detail based on the data and interviews collected in the traffic survey.

6.2.2 Changes in traffic volume, services and modes

To assess the changes in traffic volume, services and modes (OC1.4) which are likely to have been enabled, at least in part, by the changes in transport costs, impassability and transport time described above, traffic counts were conducted on the project road in the periods of January 22nd to January 25th and January 28th to February 1st, 2017. This included four weekdays of week 4 and a Sunday and three weekdays of week 5. The results show that daily traffic level on the road is between 9 and 26 vehicles with an average of 15.6 vehicles per day, cf. **Figure 6.2**. Particularly the number of busses is higher than initially expected and reported by the experts interviewed in the project area. During the field visit in the project area carried out ultimo November 2017, interviews with local stakeholders (government representatives and GiZ) indicated bus services 2-3 times per week.

Figure 6.2: Traffic counts, January 22nd to February 1st, 2018



	22-jan	23-jan	24-jan	25-jan	28-jan	29-jan	30-jan	31-jan	01-feb	Avg/ day
■ Trucks	1		1	1		1	1			0.6
■ Busses	2	1	1	2	2	2	1	2	1	1.6
■ Lorries	1	3	5	4	7	4	14	6	1	5.0
■ 4 x 4	8	5	6	9	5	13	10	8	12	8.4
○ Total	12	9	13	16	12	22	26	16	14	15.6

Source: Traffic survey, January 22nd to February 1st, 2018

However, the traffic counts show average bus services of 1.6 per day in the weekdays as well as on the Sunday included. This indicates that there are bus services at least 6 times per week. Also, with an average of five vehicles per day, the number of lorries is higher than initially stated during the field study, indicating some changes in the economic activities in the project area as described in section 6.2.3.

To better understand what sectors within the rural economy potentially benefits from the increase in traffic services, the trip purposes of passengers travelling on the upgraded road was further explored through interviews with drivers and passengers of 4x4s, bus passengers and lorry and truck drivers, 70 simple interviews with 4x4s, 31 interviews with bus passengers and 10 interviews with lorry and truck drivers.

From the interviews with the drivers and passengers of the 4x4s, it followed that out of a total of 76 4x4s driving on the road in the survey period, 15 were carrying tourists visiting the area. Further, during the survey period, a total of 31 passengers were interviewed on the busses driving from Loiyangalani to Laisamis/Marsabit. The interviews showed that 81% of these passengers was going to Marsabit, while only 13% was going to Laisamis, cf. **Figure 6.3**. For most of the passengers, the purpose of the trip was buying and selling goods, but also bank business and other business such as meetings were among the purposes, cf. **Figure 6.4**.

Figure 6.3: Where are you going with bus?

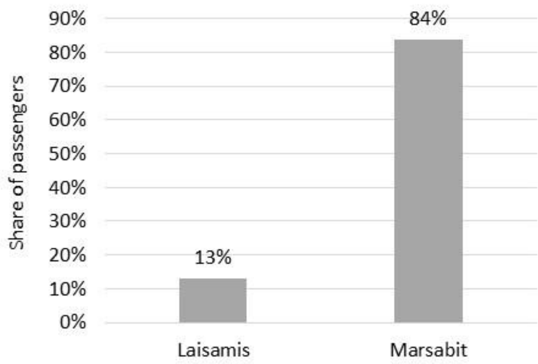
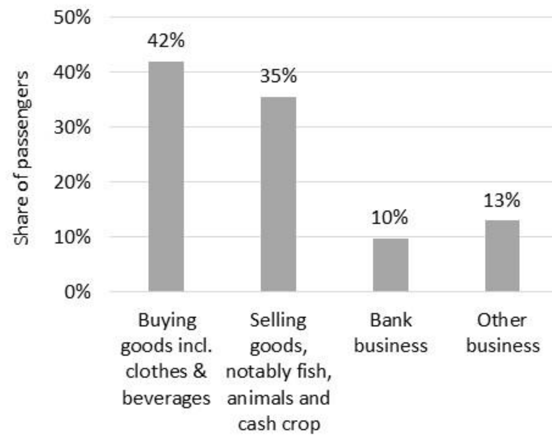


Figure 6.4: Purpose of trip with bus?



Source: Traffic survey, January 22nd to February 1st, 2018

Most notably, the overall trip frequency has increased significantly after the Loiyangalani-Laisamis road was rehabilitated according to the interviewed passengers. After the road rehabilitation, 61% of the 31 passengers now take the bus 1-2 times per month, while the remaining passengers take the bus four or more times per month, cf. **Figure 6.5**. However, before the road rehabilitation, only 40% of the 31 passengers took the bus 1-2 times per month, while 54% of the 31 passengers never took the bus, cf. **Figure 6.6**.

Figure 6.5: How often do you take the bus for this purpose, after?

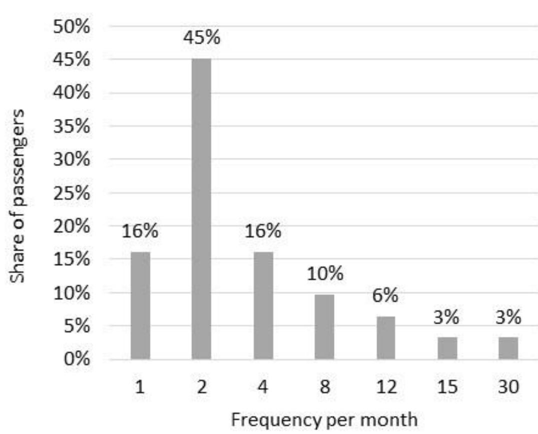
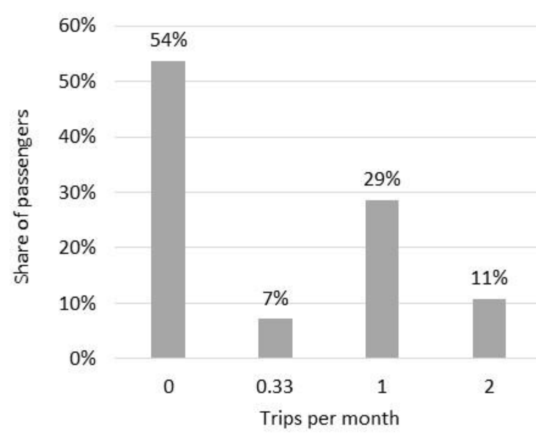
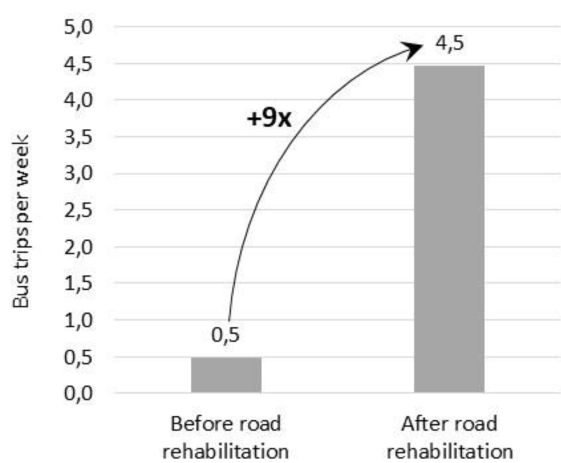


Figure 6.6: How often do you take the bus for this purpose, before?



Source: Traffic survey, January 22nd to February 1st, 2018

Figure 6.7: Bus trips per month, before and after road rehabilitation



Source: Traffic survey, January 22nd to February 1st, 2018

This change in traffic patterns corresponds to a nine-fold increase in the average number of bus trips after the rehabilitation of the Loiyangalani-Laisamis road. Before the rehabilitation, the passengers travelled on average 0.5 times per month. After the rehabilitation, this travel intensity has increased to 4.5 bus trips per month, cf. **Figure 6.7**. This finding is consistent with other studies reporting (Airey, 2014), although the impacts of the LTWP road appear to be more significant. The relatively high increase in bus trips may be a result of a positive perception bias in the interviews, but such biases are partly mitigated by the relative consistency in answers across the surveyed passengers.

In order to understand who benefits from the increased bus services along the Loyangalani-Laisamis road, 42% of the bus passengers said they were business people or shop owners, 32% was involved in livestock or fishing, 19% was teachers or nurses, while the last 6% was selling cash crop, indicating the relatively broad range of economic activities supported by the upgraded road and resulting increase in traffic services. When asked about the occupation of their family, a less diverse pattern emerged which largely reflects the socio-economic and non-diversified composition of the project area as profiled in section 5.3. For 87% of the 31 passengers, their families were involved in livestock or fishing, while 10% owned a shop and 3% was involved in farming, cf. **Figure 6.8**.

Figure 6.8: The livelihood of bus passengers' families

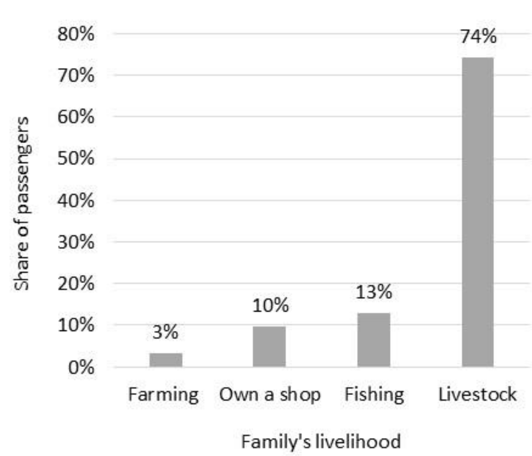
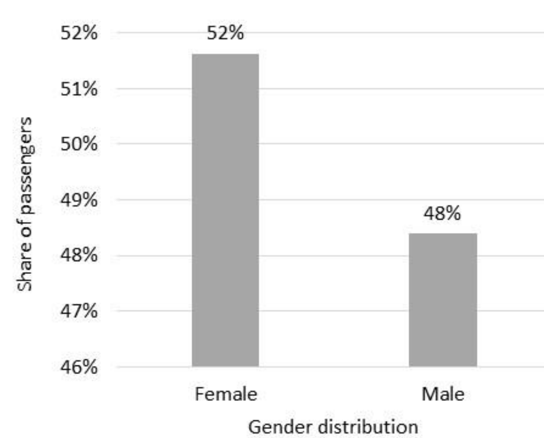


Figure 6.9: The gender distribution among the bus passengers



Source: Traffic survey, January 22nd to February 1st, 2018

In terms of gender and age distribution, the gender split among the 31 passengers was almost even, with 52% females and 48% males riding the bus, cf. **Figure 6.9**, while the average age of the passengers was 43, with the youngest passenger being 31 and the oldest 65.

Observations such as sources of livelihood, gender and age are important considerations when evaluating the effects of rural roads over time and the extent to which such investments may benefit marginalized groups, including women, elderly and poor households. While the traffic survey finds a relatively equal representation of men and women, the livelihoods of the surveyed passengers – business people, shop owners, teachers and nurses – does indicate that the increased bus services likely benefit the households who are already relatively better-off in the project area as observed in existing studies (e.g. ADB, 2002; Bryceson and Howe, 1993; Raballand et. al., 2009). To further assess and confirm this assumption, data on personal income is needed, which is not possible to collect through traffic survey methods such as bus interviews due to cultural taboos about personal finances. As discussed in section 4.5, such insights would require more in-depth analysis of the income and consumption patterns of households in the project area.

6.2.3 Changes in transport prices

As bus passengers were interviewed while driving in the bus and hence in the presence of the bus driver, it was decided not to ask them about the price of the bus fare due to cultural sensitivities. Instead this information was obtained through interviews with local government officials and a local NGO during the 2017 field visit to the project area. These interviews indicated that passenger fares with commercial buses (up to 60 passengers) from Loiyangalani to Marsabit have been reduced from around 1,000 KES/trip (10 USD/trip) to 800 KES/trip (8 USD/trip).

To better understand the impacts of the rural road on goods freighted to and from local markets, including changes in the relative price of freighted goods transportation, a total of 10 lorry drivers were interviewed while loading and offloading goods in Loiyangalani and Illaut. On average, each of these 10 lorry drivers carried 3.1 different loads on their truck and hence 31 loads in total. Each of these 31 loads has a destination and an origin that either is inside or outside the project area.

The interviews of the lorry drivers show that the origin of the cargo transported on the project road primarily comes from outside the project area, i.e. are imported goods. Particularly, the goods come from Meru (around 200 km south of Laisamis) and Nyahururu (360 km south-west of Laisamis), while there is currently less cargo transport between the communities and towns located in the project area, cf. **Figure 6.10**. Overall, two out of three loads are transported into the project area, while one of three loads is transported out of the project area.

Figure 6.10: Lorry cargo origins

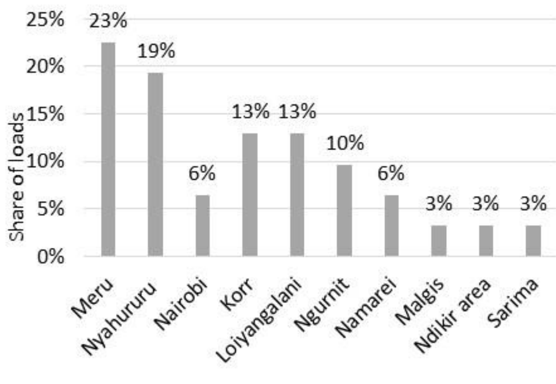
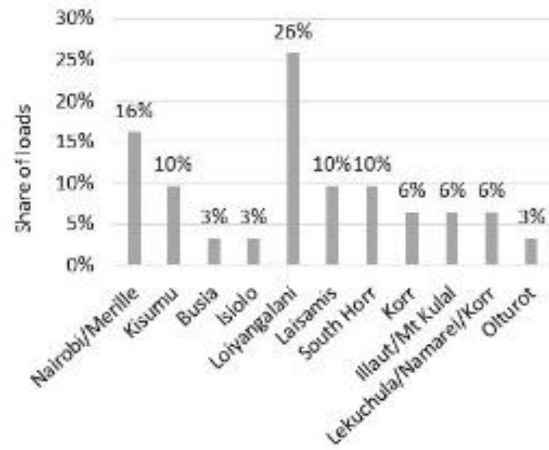


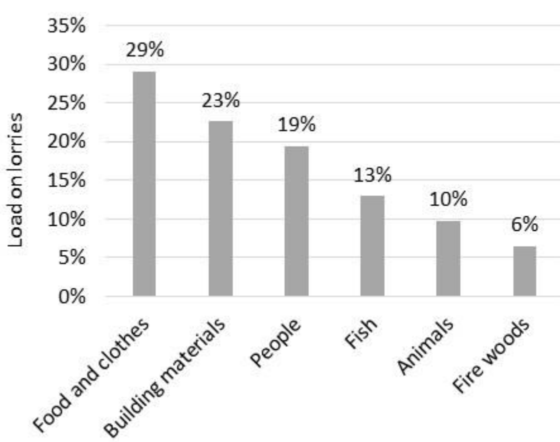
Figure 6.11: Lorry cargo destinations



Source: Traffic survey, January 22nd to February 1st, 2018

The main destination of the cargo is Loiyangalani, which accounts for approx. 40% of all goods transported into the project area, followed by Laisamis, South Horr and a range of other towns in the project area. However, some cargo is also destined for Nairobi and Merille outside the project area, cf. **Figure 6.11**. Among the 31 loads on the 10 lorries interviewed, food and clothes, building materials and fire woods are among the most frequent cargo transported into the project area while fish, animals and people are most frequently transported out of the project area, cf. **Figure 6.12**.

Figure 6.12: Cargo on lorries in traffic survey



Source: Traffic survey, January 22nd to February 1st, 2018

Fish is currently transported on lorries to both Kisumu and Busia, which probably means that it is dry fish as Kisumu and Busia both have markets for dry fish only. Animals are transported to Isiolo and Merille, while people are transported to Merille. For all cargo types, including transport of passengers, the purpose of both inbound and outbound trips is typically associated with reaching the markets in the destined towns. Like bus passengers, lorry drivers were asked about how their lorry load frequency had developed after the rehabilitation of the Loiyangalani-Laisamis road.

Their perception was that the weekly number of lorry loads had increased from around 1.4 per week to 4.6 per week corresponding to more than a tripling in the number of loads, cf. **Figure 6.13**.

Figure 6.13: Lorry load frequency before and after road rehabilitation

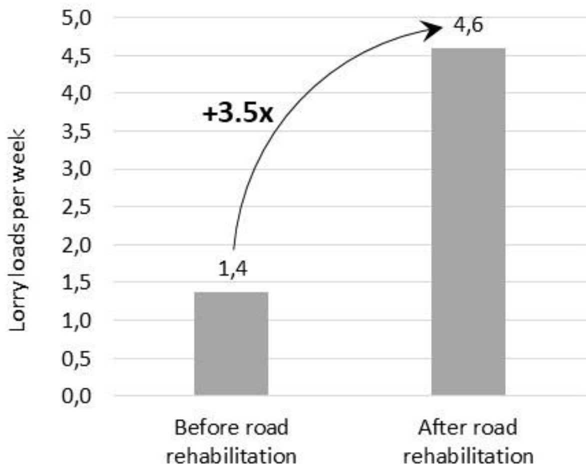
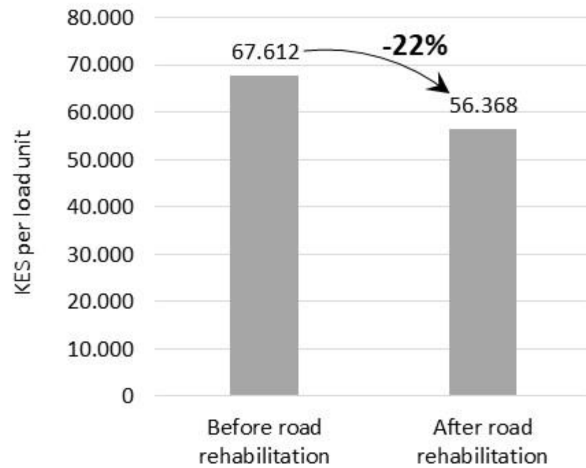


Figure 6.14: Price per load before and after road rehabilitation



Source: Traffic survey, January 22nd to February 1st, 2018

In addition, lorry drivers were also asked about how prices per load unit had developed since the road rehabilitation. Across all the different load types transported, lorry drivers assessed that the average price had been reduced by around 22% from an average of 67,612 KES per lorry load before the road rehabilitation to an average of 56,368 KES per lorry load after the road rehabilitation, cf. **Figure 6.14**.

A closer inspection of lorry load frequencies shows that the biggest increase in freighted goods has been in food and clothes for which transport has increased from around 0.3 trips per week before the road rehabilitation to around 2.1 trips per week after the road rehabilitation corresponding to more than a seven-fold increase, cf. **Table 6.2**. For other goods such as building materials, fish and animals and fire woods, lorry load frequency has increased by a factor of around 2.0 to 3.2, while transport of people on lorry has increased by a factor 3.2. On average, lorry load frequency has increased by a factor 3.5 from before to after the road rehabilitation indicating a substantial change in demand and supply of cargo load and hence increased economic activity.

Table 6.2: Lorry loads per week, before and after rehabilitation of the Loiyangalani-Laisamis road

Load type	Total loads in survey	Loads per week Before	Loads per week After	Change Before-after
Food and clothes	9	0.3	2.1	7.3
Building materials	7	0.2	0.5	3.3
People	6	5.0	16.0	3.2
Fish	4	0.3	0.8	2.5
Animals	3	0.5	1.0	2.0
Fire woods	2	3.0	9.0	3.0
Average across load type	**31**	**1.4**	**4.6**	**3.5**

Source: Traffic survey, January 22nd to February 1st, 2018

As a likely result of the increase in supply and demand facilitated by the upgraded road, the price of transporting cargo loads has also been reduced, although not in the same scale as the increase in load frequency. Across all the different load types transported, the price has on average been reduced by 22%, however, price changes vary across load types. The biggest reduction in price is for people, where the price has dropped from 833 KES per person before the road rehabilitation to 525 KES per person after the road rehabilitation corresponding to a 37% reduction. Coincidentally, this is equal to the results of the World Bank-funded study of rural road development in Bangladesh by Khandker et. al. (2009) that found a 37% reduction in transport costs for local households before and after road implementation, cf. **Table 6.3**.

Table 6.3: Price per lorry load, before and after rehabilitation of the Loiyangalani-Laisamis road

Load type	Total loads in survey	KES per load Before	KES per load After	Change Before-after
Food and clothes	9	90,000	67,600	-25%
Building materials	7	99,000	80,500	-19%
People	6	833	525	-37%
Fish	4	123,333	103,333	-16%
Animals	3	87,500	82,000	-6%
Fire woods	2	5,000	4,250	-15%
Average across load type	**31**	**67,611**	**56,368**	**-22%**

Source: Traffic survey, January 22nd to February 1st, 2018

Food and clothes, which also had the highest increase in load frequency, has had second biggest drop in transport prices from an average of 90,000 KES per load before the road rehabilitation to an average of 67,600 KES per load after the road rehabilitation corresponding to a 25% reduction. For other load types, the price reductions vary between 6% for animals and 19% for building materials.

6.2.4 Summary of traffic and transport outcomes

Based on the findings from the 2017 traffic survey and interviews, it can be concluded that a number of transport and traffic effects from have already materialized from the LTWP access road: Firstly, transportation time has been reduced from 1-2 days before road rehabilitation to 4 hours after the road rehabilitation with road impassability also reportedly having been reduced. Secondly, even though there are no comparable traffic statistics from before the road rehabilitation, perceived changes in transport patterns by the road users suggest a nine-fold increase in the number of bus passenger trips and a three-fold increase in the number of freight trips. Thirdly, and as a likely end-result of the two previous factors, the average price of the movement of people and goods in the area have been observed by road users to have decreased by 16%-37%.

Table 6.4: Traffic survey results compared to results from other impact studies

	Traffic survey	Other studies	Authors
Traffic volume			
- Motorized traffic	Not surveyed	+ 170%	Airey (2014)
- Annual Average Daily Traffic		+ 86%	ADB (2016)
- Motorized traffic		+ 139%	ADB (2016)
Transport patterns			
- Passenger trips	From 0.5 to 4.5 trips/week	From 9.9 to 12 trips/month	Airey (2014)
- Freight trips	From 1.4 to 4.6 trips/week		
- Bus service	0 to 1.6 services/day	Declining, if price above break-even	Raballand et. al (2012)
Transport time			
- All transport modes	From 1-2 days to 4 hours/trip	- 50%	ADB (2002)
- Average transport time		- 56%	ADB (2016)
Transport prices			
- Passengers, busses	- 20%		
- Passengers, lorries	- 37%		
- Freight, lorries	- 16%	- 15%	Khandker et. al (2009)
Transport costs			
- Unit transport costs	Not surveyed	- 15%	ADB (2016)
- VOC + other indirect costs		- 15%	Raballand and Teravaninthorn (2009)
- Transportation costs		- 37%	Khandker et. al (2009)

Source: QBIS

These findings are largely consistent with existing studies which have found positive effects on reduced transport time, increased volumes and reduced prices from rural road investments as described in section 3.3. While some studies find that the benefits of rural road improvements are not always passed on to rural road users e.g. due to transport monopolies (see e.g. Teravaninthorn and Raballand, 2009), this does not seem to be the case in the rehabilitation of the Loiyangalani-Laisamis road where transport prices are observed to be markedly lower than prior to the rehabilitation. In fact, the changes observed for the LTWP road are in some cases even more pronounced than what existing studies have found, cf. **Table 6.4**., which may entitle further monitoring to explore whether such benefits are representative and sustainable over time.

Finally, some studies suggest that even if rural road improvements lead to transport price reductions as seems to be the case with the LTWP road, it will not necessarily translate to poverty reduction if the poor cannot afford to use transport services (Raballand et. al., 2011). These and other issues will be explored further in the next section which will discuss some of the more indirect outcomes and impacts of the LTWP road on the wider rural economy which are complemented by other features of the LTWP project, notably the jobs created by the LTWP development and supporting investments in local capacity building by Vestas in collaboration with WoC.

6.3 RURAL ECONOMY EVALUATION

Shorter transport time, lower transport prices and more frequent transport of passenger and freight as reported in the traffic survey, hold the potential for more rural economic activity. However, as described in section 3.3, there are some discrepancies in the literature indicating that positive traffic and transport effects from rural road investments may not always generate a positive chain of events that benefit the rural poor, and that such impacts largely depend on the local market conditions and rural economy context. As observed by Jacoby (2008*) 'rural road construction is more like a tide that lifts all boats than a highly effective means of reducing income inequality'*.

In this section, we first look further into the potential spill-over effects from the rehabilitation of the Loiyangalani-Laisamis road on economic activity within the project area. These spill-over effects are important to understand given the potential long-term and sustained implications of increased access and mobility in an otherwise isolated rural community. Put differently: while the preliminary impacts may seem modest, the breath and depth of these impacts can be significant and, importantly, continue to grow over time. As a concrete example of an emerging spill-over effect within the rural economy, an in-depth case study of fresh fish cold chain development enabled, at least in part, by the LTWP access road is provided.

The LTWP access road isn't the only contribution to the rural economy. Notably, as described in section 3.1, large scale wind farm developments can be an important source of local job creation and economic output in their own rights. Based on the data available in this study, observations are made on the direct job creation effects of the LTWP project during construction and operation. Using Vestas as an example, a methodology is provided to assess how the salaries paid to local community members may, even if of temporary nature, benefit the rural economy more widely over time.

Table 6.5 provides an overview of some of the key outcome and impact indicators identified in the rural economy section of the LTWP impact pathway and the preliminary observations made in this study based on the best-available data. The subsequent section focuses more specifically on the spill-over effects from the LTWP access road (OC2.2-OC2.4) and the economic outputs (in this case jobs) from the construction and operation of the LTWP wind farm (OC2.1).

Table 6.5: Overview of outcome (OC) and impact (IM) indicators – Rural Economy

Indicators	Caused by	Observations	Data
◌ OC2.1. Multiplier effects from local salaries	Wind farm construction and operation, Local capacity building	Estimated 1,800-1,900 locals (county) temporary jobs during construction. Vestas alone has hired 127 people from the project area, contributing 270,000 USD to local households in salaries. Multiplier effects not possible to establish in this study due to lack of data from impacted households (model suggested).	LTWP Ltd. (job data), Vestas (job and salary data)
◌ OC2.2. Increased access to inputs (equipment, storage, trucking, services etc.)	LTWP access road	Examples from GiZ and EU suggests that the access road has created a favourable investment environment for new fishing equipment, boats, cold storage, trucks, etc., allowing local fishermen access to better inputs for fresh fish production.	QBIS 2017 interviews
◌ OC2.3. Improved productivity and reduced losses (fishery, livestocks)	LTWP access road	The investments and development of cold chain and marketing for fresh fish by GiZ and EU following the rehabilitation of the Loiyangalani-Marsabit road have enabled a shift from dried fish to fresh fish, thereby allowing fishermen to recover additional value from their catch (IM1.1)	QBIS 2017 interviews
○ OC2.4. Increased access to local markets ('TILD')	LTWP access road	Nine-fold increase in number of bus trips to local markets since road rehabilitation. Almost 80% of bus passengers travel to and from markets to buy and sell stuff. More than three-fold increase in the number of lorry loads going into the project area with basic goods.	Traffic survey
◌ IM1.1. Changes in rural income levels and sources of income	OC2.1-OC2.4	Salaries from LTWP employment has injected a significant amount of cash into the project area which may/may not lead to permanent changes in income levels (e.g. if salaries are reinvested in opening local shop etc.). Example from fishery case study shows a tripling in the price that fishermen receive for their catches. Also, the 20%-30% reduction in market prices may increase the purchasing power of the population in the project area.	QBIS 2017 interviews, local market survey, LTWP Ltd. and Vestas job numbers
● IM1.2. Changes in direct, indirect and induced local consumption	IM1.1.	Assessment of this indicator will require additional data from the project area.	Reference studies only
● IM1.3. Changes in economic resilience and poverty levels	IM1.1.	Assessment of this indicator will require additional data from the project area.	Reference studies only

○ = Primary data acquired ◌ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

6.3.1 Spill-over effects from the LTWP access road on the rural economy

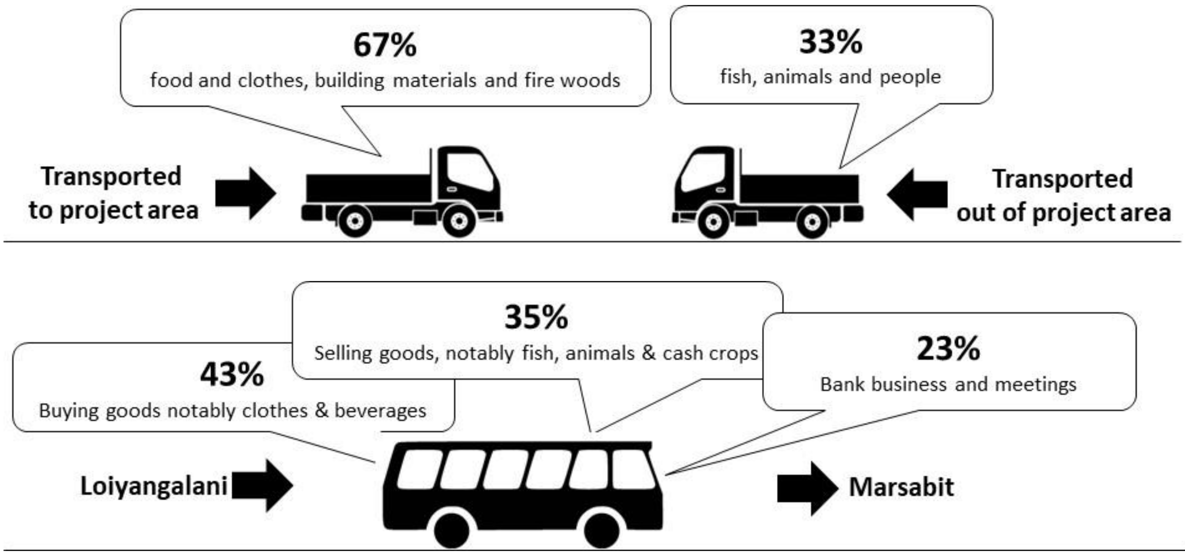
It is well-established in the existing literature that transport-specific outcomes from rural road rehabilitations can lead to important spill-over outcomes and long-term impacts for otherwise isolated rural economies. In an extensive study of rural road improvements in Vietnam, Mu and van de Walle (2011) examine the so-called transport induced local market development effects – or *TILD* – from a rural road rehabilitation and find significant long-term impacts in the presence and frequency of local markets as well as increased income diversification with a statistically significant rise in non-agricultural trades over the six-year time-period studied. Similarly, Jacoby and Minten (2008) finds that reducing transport costs in Madagascar led to a near doubling of household incomes, mostly due to an increase in non-agricultural earnings and reductions in the price of imported goods to local markets.

Whether such impact will materialize following the rehabilitation of the LTWP access road is too early to conclude, but from the interviews conducted with key stakeholders in the project area during this study there are some preliminary indications of increased local economic activity and at least one example of the road rehabilitation having led to income diversification opportunities as we shall elaborate on later in this section.

The 2017 field study interviews indicated that the road rehabilitation has increased access to local markets and inputs as well as the customer base, affecting both the range of goods available but also services offered. For instance, Loiyangalani market was said to have seen an increase in number of shops and services available since road rehabilitation.

These anecdotal indications were confirmed in the traffic survey. As described in section 6.2, the frequency of transport service has increased significantly since the road rehabilitation, and so has the number of trips. It is thus worth noting that the traffic survey revealed that the purpose of passenger and cargo trips is mostly market oriented. Almost 80% of the bus passengers travelled in order to either buy and sell stuff at the local markets, while 67% of the lorry loads were transported into the project area containing goods such as food, clothes, building materials and fire woods, cf. **Figure 6.15**.

Figure 6.15: Goods transport in and out of the project area

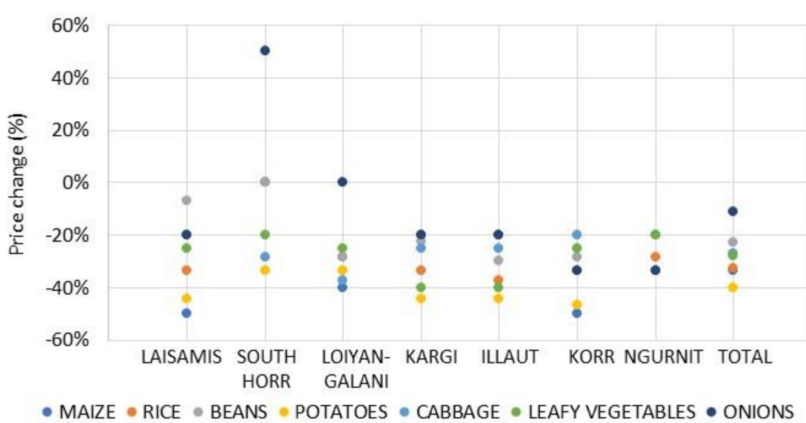


Source: Traffic survey, January 22nd to February 1st, 2018

Also, bus fares between Loiyangalani and Marsabit have been reduced by around 20% since the road improvement, while lorry fares for passengers have reduced by around 37%. Since this strengthens the purchasing power of households, this is equivalent to an income increase.

In addition, since the road rehabilitation, there are indications that prices of several vegetables such as maize, rice, beans, potatoes, cabbage and onions have reduced 20-30% on most markets in the project area, cf. **Figure 6.16**

Figure 6.16: Market prices changes, before/after road rehabilitation



Source: Interviews with a total of around 110 market participants (five shop owners and eight buyers at every town as well as members (licenced traders/area chief/assistant chief) of the committee controlling selling of goods in all licensed shops at every town).

This market data has been collected through interviews with people attending market days. The data reflects their perception of how prices have developed since the road rehabilitation. Unlike the reduction in transport prices, the weakness of these data is that other factors could have influenced the prices not just the road rehabilitation.

Nonetheless, these price reductions further strengthen the purchasing power of household incomes and can thereby lead to increased income in the project area. The combination of the changes in travel and transport patterns – i.e. more travels at lower prices – and the perceived price reductions of goods at local markets indicate that the project area is experiencing increased economic activity. To further confirm this development and further isolate the main causalities behind it, it is recommended to monitor the frequency of local markets in the project area, the availability and costs of imported goods from outside project area at local markets and the share of local produce, goods and livestock reaching remote markets outside project area (export). In doing so, comparison of project villages on the access road with control villages off the access road can be one way to begin to isolate the impacts from the LTWP access road.

6.3.2 Case study: Development of fresh fish cold chain and marketing from Lake Turkana

We now turn to a concrete example of how the road rehabilitation has led to increased income diversification and contributed to raising income levels in the project area by enabling the development of fresh fish cold chain and marketing from Lake Turkana.

6.3.2.1 Context

The Kenyan population is on an upward trend creating more demand for freshwater fish, which is increasingly recognized as a source of safe, healthy "white" protein.[25] Considering that Lake Turkana is the largest lake in Kenya - about 50% bigger in size compared Lake Victoria[26] - this situation should provide an opportunity for expanding fish production. However, there is currently relatively little fishery in Lake Turkana at least compared to Lake Victoria that contribute to around 90% of total freshwater capture fisheries in Kenya.

In Marsabit county, on the eastern side of Lake Turkana, the current fish production volumes are estimated at 0.630 TMT or 630 metric tons per year, worth around KES 45.5 million or around USD 450,000.[27] Compared to the total freshwater wild catch fish in Kenya of around 155-183 TMT, Lake Turkana's share corresponds to around 0.41%-0.35%.

About 80% of the fish catch on the eastern side of Lake Turkana is transported and sold to destinations outside the county, mainly to Kisumu, Busia, Nairobi, Uganda and the Congo. Those involved in fishing in in Marsabit County mainly reside near the lake in Laisamis and North Horr sub-counties. The main fishing and landing areas are in Loiyangalani, El Molo Bay, Moite, Illeret and Telesgaye. The fish species commercially harvested in Lake Turkana are tilapia, labeo and Nile perch. The local communities engaged in fisheries industry are the El Molo, Dasanach, Turkana, Rendille, Samburu, Gabbra, Burji and Garri.[28]

[25] Lattice Consulting (2016).
[26] According to State department of fisheries Bulletin 2014, the area of Lake Turkana is estimated to 6,405 km^2, while the area of Lake Victoria is 4,128 km^2
[27] Marsabit county (2014).
[28] Ibid.

The low capture fisheries levels of Lake Turkana have many reasons. For instance, the fishers in the lake mainly use artisanal craft, which is unsuitable for navigating the open waters sections of the lake which suffer strong diurnal wind patterns. Also, fish harvested in Lake Turkana suffers high post-harvest losses due to lack of hygiene and sanitation facilities for its handling, and the bulk of what remains is dried under dusty conditions, resulting in a five-fold loss in market value.[29] Thus, selling fish in sundried or salted form causes a major loss in market value of the fish.[30] However, in addition to more value added, there is another urgent reason for investing in the fishery of Lake Turkana.

As described in section 5.2.1, the climate is changing in Marsabit County. Changes in weather patterns have accelerated the rate at which rangelands are turning into deserts with rains having become sporadic and unpredictable, causing loss of biodiversity. This further causes widespread suffering and asset loss among drought-prone communities, particularly the pastoralist communities. Many of the pastoralist communities in the impacted areas are therefore trying to diversify their livelihood activities including fishing.[31]

https://www.tearfund.org/2017/09/kenya_drought_even_the_camels_are_dying/

http://theinformer.co.ke/372/drought-situation-in-isiolo-marsabit-counties-worsens/

As previously mentioned, over 80% of the households in Marsabit County are pastorlists and keep livestock, which is the main driver of the economy. Thus, when the livelihood of pastoralist is threatened, it threatens the entire county economy. The County Government of Marsabit being aware of the need for livelihood diversification has among others pushed for the use of better methods in fish capturing, processing, storage and marketing. These objectives require improvement in fishing equipment used to capture fish, storage, preservation and marketing to reduce post-harvest economic losses.

6.3.2.2 Initiatives to strengthen local fish production and trade

In 2015, the German-based NGO, GIZ (through its Climate Change Adaptation Program (CCAP)) in collaboration with the Fisheries Department in Kenya, started developing a Community Development Action Plan for the fishing community in Loiyangalani consisting of around 2,500 fisherfolks. One of the

[29] SNV (2005).
[30] Marsabit country (2014).
[31] Marsabit country (2014) and GIZ (2017).

main objectives of this program to increase fish production at least by 10% per year through improved fish harvesting methods and preservation.[32]

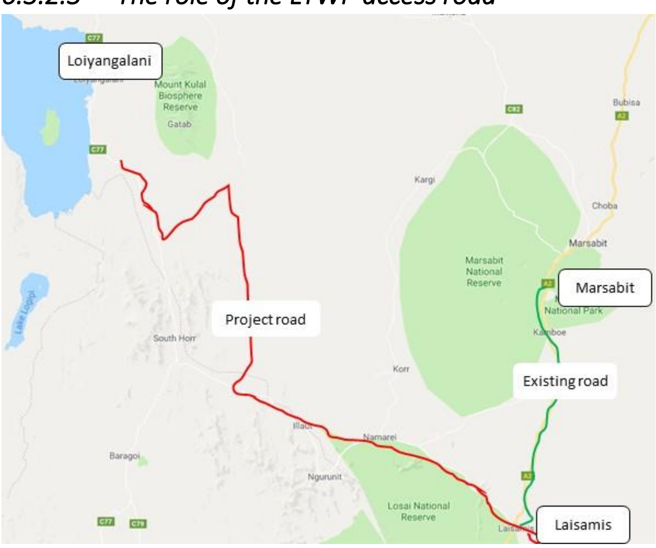
Before 2015, most of the fishing community had no capacity and know-how on how to handle fish and fish products. They used to sell dry fish to market outlets like Busia and Kisumu at a lower price with delayed payments. The Loiyangalani Fish Marketing Cooperative (LFMC) and Beach Managements Units (BMUs) were weak in terms of managerial and marketing skills. CCAP started building the capacity of selling fresh fish which as described has more value as compared to dry fish. The cooperative was revived and strengthened through trainings and amendments of by-laws to involve in fresh fish marketing on behalf of the members where the payment was and is in instant.

Since then, the fresh fish market has been expanded and the quality of dry fish has been improved through the construction of modern drying structure. The quality of both fresh and dry fish has further improved through development of cold chain facilities and modern dryers respectively.

In addition, the EU/IDEAS Program will fund the procurement of more engine boats, refrigerated trucks, transportation boats, additional deep freezers and cool boxes etc. all in the effort to create an enabling environment for the fisher folks to benefit and realize the fish value chain.

Today, measurable improvements have been accomplished in terms of pilot cold chain facilities established by CCAP, fresh fish currently marketed by the cooperatives in Marsabit, while expansion and completion of a complete cold chain is under way funded by EU and the County Government of Marsabit.

6.3.2.3 The role of the LTWP access road



The rehabilitation of the Loiyangalani-Laisamis road has played a key role in making these initiatives and investments successful. A barrier for the marketing of the fresh fish is the fact that pastoralists seldom eat fish and therefore that the market for fresh fish is limited within the project area. Success of the initiates and investments therefore required that the fresh fish could be transported to other markets frequently and without incurring excessive transportation costs that would reduce or completely eat the profit. For fish landed in Loiyangalani, these markets were in Marsabit, or further down the A2 towards Nairobi as well as Nairobi itself.

[32] GIZ (2017)

This made the marketing of fresh fish dependent on relatively cheap transport services, notably busses since the fresh fish primarily are transported in smaller units. According to interviews with stakeholders and bus passengers, cf. section 6.2, regular bus service was almost non-existing before the rehabilitation of the Loiyangalani road with average trip frequency around 0.5 trips per month. After the road rehabilitation, the frequency increased nine-fold to 4.5 bus trips per month and each day 1-2 commercial busses are now available for passengers and their cargo.

This daily transport service has been vital for the sale of fresh fish. Even though the fish is frozen, frequent transport service is vital for securing stable supply to the markets and hence becoming a trusted supplier. Also, frequent transport service is vital for bringing the fish to market when the prices are optimal.

6.3.2.4 Estimated benefits for local fishery communities

The benefits for the fishing community at Loiyangalani from the shift from dried to fresh fish are significant. Before, the fishing community had very limited possibilities of selling fresh fish other than in Loiyangalani, where demand was low. Consequently, they used to sell dry fish to market outlets like Busia and Kisumu at a lower price (on average around 53 KES/kg) and with delayed payments (+4 weeks), and sometimes with no payment at all due to fish traders claiming quality issues.

Today, with the development of a cold chain structure at Loiyangalani and marketing of fresh fish by a cooperative, the fishermen are paid a much higher price (on average around 167 KES/kg) and payment is instant since it is the cooperative that buys the fish from the fishermen and not the traders. Further, since it is the cooperative that sell the fish at the markets some of the profit from the market sale can be returned to the fishermen.

In Marsabit, the market price is typically more than double of the price paid to the fishermen (on average around 367 KES/kg for Tilapia and around 400 KES/kg for Nile Perch). The difference between this market price and the purchasing price at lake side minus transport costs and some administrative costs can be returned to the fishermen.

Today, the cost of transport from Loiyangalani to Marsabit is around 2,000 KES for 70kg cool box plus 1,000 KES to return cool box, which corresponds to around 43 KES/kg. Next year, the transport costs are expected to be reduced due to the EU providing a 5-ton refrigerated truck to the fishing cooperative. It has not been possible to assess VOC incl. driver for this truck and instead, the cost is approximated from the average trucking price in Kenya, which is around 0.02 KES/kg/km or around 3.5 KES/kg kg for the 233 km from Loiyangalani to Marsabit.[33]

[33] See: http://www.tfa4africa.com/wp-content/uploads/2015/08/2015-east-africa-logistics-performance-survey.pdf

Based on these observations, the net benefits from the shift from dried to fresh fish for the fishing community at Loiyangalani are assessed to be 114 KES/kg for the individual fisherman and 157/190 KES/kg in 2017 and 190/230 KES/kg in 2018 (when the 5-ton truck hopefully has arrived). It has not been possible to obtain data on the costs of administration in the cooperative, so the assessments of the benefits for the cooperative are without these costs, cf. **Table 6.6**.

Table 6.6: Net impacts of investments in fresh fish production and marketing

	Do-nothing		Investment		Net impact	
(KES/kg)	2017	2018	2017	2018	2017	2018
Fish price, lakeside Loiyangalani						
- Tilapia	53	53	167	167	114	114
- Nile Perch	53	53	167	167	114	114
Fish price, Marsabit						
- Tilapia	0	0	400	400	400	400
- Nile Perch	0	0	367	367	367	367
Transport costs						
- Loiyangalani-Marsabit	0	0	43	4	43	4
Net income, fishermen						
- Tilapia	53	53	167	167	114	114
- Nile Perch	53	53	167	167	114	114
Net income, cooperative						
- Tilapia	0	0	157	197	157	190
- Nile Perch	0	0	190	230	190	230

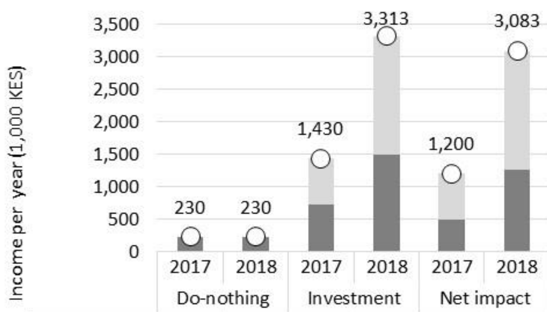
Source: QBIS based on interviews and data from GiZ and Shippers Council of East Africa.

Due to the recurrent drought, the number of fishermen has increased markedly over the past two years as not least pastoralists have been forced to seek new sources of income and livelihood. The potential volume that can sustainably be harvested is not known but according to GiZ there are indications that the current level of exploitation is far below the sustainable potential.

From January to November 2017, around 3,300 kg Tilapia and around 880 kg Nile Perch were sold as fresh fish at the market in Marsabit. The total sale for 2017 is expected to be around 4,300 kg. For the coming years, the annual sale of fresh fish to Marsabit and other markets such as Nairobi is expected to increase to nearly 9,000 kg.

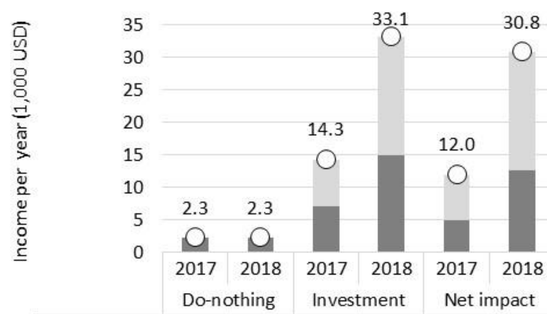
With a unit net benefit of 114 KES/kg, this means that the facilitated shift from dried to fresh fish generated an assessed total net benefit for the fishermen of around 489,000 KES in 2017 and nearly around 1.3 million KES in the coming years. In addition, the fact that it is now the cooperative that handles the marketing means that the unit net benefit of 157/190 KES/kg in 2017 and 190/230 KES/kg from the market sale will be returned to the fishing community with another around 711,000 KES in 2017 and around 1.8 million KES in the coming years, cf. **Figure 6.17** and **Figure 6.18** for corresponding numbers in USD.

Figure 6.17: Net benefits of fresh fish production (KES)



	Do-nothing 2017	Do-nothing 2018	Investment 2017	Investment 2018	Net impact 2017	Net impact 2018
Cooperative	0	0	711	1,823	711	1,823
Fishermen	230	230	720	1,490	489	1,260
Total	230	230	1,430	3,313	1,200	3,083

Figure 6.18: Net benefits of fresh fish production (USD)



	Do-nothing 2017	Do-nothing 2018	Investment 2017	Investment 2018	Net impact 2017	Net impact 2018
Cooperative	0.0	0.0	7.1	18.2	7.1	18.2
Fishermen	2.3	2.3	7.2	14.9	4.9	12.6
Total	2.3	2.3	14.3	33.1	12.0	30.8

Source: QBIS based on interviews and data from GiZ and Shippers Council of East Africa.

As mentioned, the Marsabit County Agriculture Sector Plan for 2013-2017 estimates that current fish production volumes on the eastern side of Lake Turkana are around 630 tons per year and worth around KES 45.5 million or USD 450,000.[34] This corresponds to around 714 USD/tons. By comparison, the net impact of fresh fish is estimated at around 1,400 USD/tons for the fishermen, around 2,026 USD/tons for the cooperative and around 3,426 USD/tons for fishermen and cooperative overall.

According to interviews with GiZ, it is indisputable that the rehabilitation of the Laisamis-Loiyangalani road has played a key role in generating the assessed benefits of the fresh fish investments. Without the road rehabilitation, transport of fresh fish to the markets in Marsabit would have been unreliable, slow and costly. Transport would have taken 1-2 days instead of 4 hours – an addition that would have been unhealthy for the quality of fresh fish – and since commercial busses seldom were available, the fish would have had to be transported in 4x4 vehicles or lorries adding considerably to the transportation costs. Thus, the rehabilitation of the Loiyangalani-Laisamis road has critically increased the return of the investments in fresh fish cold chain and marketing.

Even though the current volumes of fresh fish are relatively modest, they are expected to grow significantly in the coming years. Thus, following not least the rehabilitation of the Laisamis-Loiyangalani road and the improvement of the Northern Corrido, a new fresh fish project is about to launched. The project is funded by the EU’s 10th European Development Fund (EDF) and headed by the Department of Agriculture, Livestock and Fisheries in Marsabit.[35]

The aim of the project is to increase the annual fish catch by 25% (currently assessed to 576,000 pieces per year) and over a period of 5-10 years replace 60% of the current dried fish catch with fresh fish

[34] Marsabit county (2014).

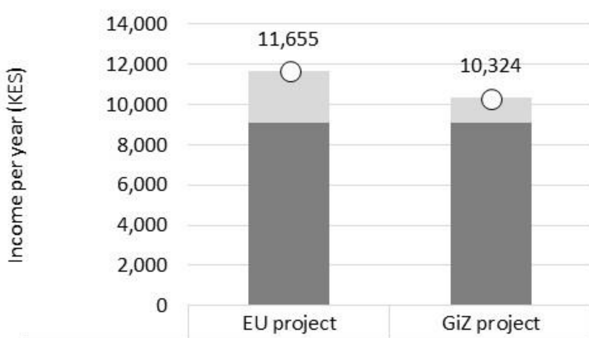
[35] EU (2018).

catch. In addition, the aim is to increase the per capita income among fisher-men by 15% and the number of jobs in the fish chain by 25%.[36]

The target group is the estimated 2,500-3,000 fisher-households along Lake Turkana shores in Marsabit County. Today, these households as well as other actors distributed along the fish chain have an estimated annual income from selling fried fish of around KES 52 million (520,000 USD). Of this, around KES 25 million (225,000 USD) or around 48% is assessed to go to the 2,500-3,000 fisher-households corresponding to an annual income of 9,100 KES (91 USD).[37]

If the project is successful, it is expected to generate an estimated total gross income of around KES 22 million (220,000 USD) from sale of fresh fish from the first year onwards. Considering that the price of fresh fish is around three times higher than the price of dry fish and assuming that the fresh fish will replace the dried fish completely, i.e. not growth in catch volume, this corresponds to a net value added around KES 15 million (150,000 USD) per year. Of this, an assessed around KES 7.1 million (71,000 USD) will go the fisher-households. With the assessed 2,500-3,000 fisher-households, this means an annual net value added of around 2,600 KES (26 USD) per fisher-household[38]. For contextual purposes, this is roughly equivalent to one month's expenditure on food per adult equivalent in Marsabit County in 2015/16 as previously illustrated in **Table 5.1**.

Figure 6.19: Value-added from fresh fish



	EU project	GiZ project
Value-added	2,564	1,233
Income-before	9,091	9,091
Income-after	11,655	10,324

Source: GiZ and EU.

By comparison, the GIZ-CCAP project is expected to generate a value added for fisher-men and their co-operative of around 30,800 USD in 2018 and onwards. According to GiZ, the Loiyangalani fisher co-operative has around 278 members, while around 2,500 fisherfolks sell their fish through the co-operative. Assuming conservatively that all of the around 2,500 fisherfolks have benefitted from the sale of fresh fish, the average net value added will be around KES 1,200 (12 USD) per fisherman. So, the new project will double the net value added per fisherman as well as increase the number beneficiaries, cf. **Figure 6.19** on the left.

To achieve its goal, the EU funded project will among others purchase and install the following:

1) Motorized (15 horse-power engine) fishing boats
2) Two rescue (280 horse-power engine) boats
3) Transport (180 horse- power engine) boats
4) Two refrigerated trucks

[36] Ibid.
[37] Ibid.
[38] Ibid.

5) Satellite communication telephones (V-Sat) (Thuraya)
6) Solar-driven storage units along the shore-lines
7) Cold store generators
8) Digital weighing scales for 10 landing locations
9) Fish-weighing and member-management software

As for the GIZ-CCAP project, the rehabilitation of the Laisamis-Loiyangalani road has played a key role for the EU funded project:

> *"The recent construction and completion of two big projects in the county, namely the Northern Corridor Road and Lake Turkana Wind Power have contributed to enhancement of an enabling environment for investments in the fish value chain that can contribute to Vision 2030's national twin-goal of poverty reduction and wealth creation and also the Sustainable Development Goals (SDGs) of zero hunger and reduced poverty."*
>
> *"The two projects mentioned above will provide the road infrastructure required to transport the fresh fish efficiently to profitable markets in Nairobi and other Counties, and provide electricity required to operate refrigeration for fish preservation and power electrical appliances in fish processing plants. As such, the proposed project will benefit from the resultant infrastructure."*
>
> *EU (2018)*

Considering the significant value added from fresh fish and these projects, the biggest worry is not whether fish catch volumes will grow but rather whether volumes will grow too much and possibly result in overfishing, which is increasingly an issue among stakeholders. According to GiZ (2017), the expected increase in fish catch volumes combined with the construction of the Gibe III Dam and climate changes may lead to serious short and medium-term impacts, and severe longer-term impacts, which require appropriate mitigation strategies and continuous balancing against the county's economic growth objectives.

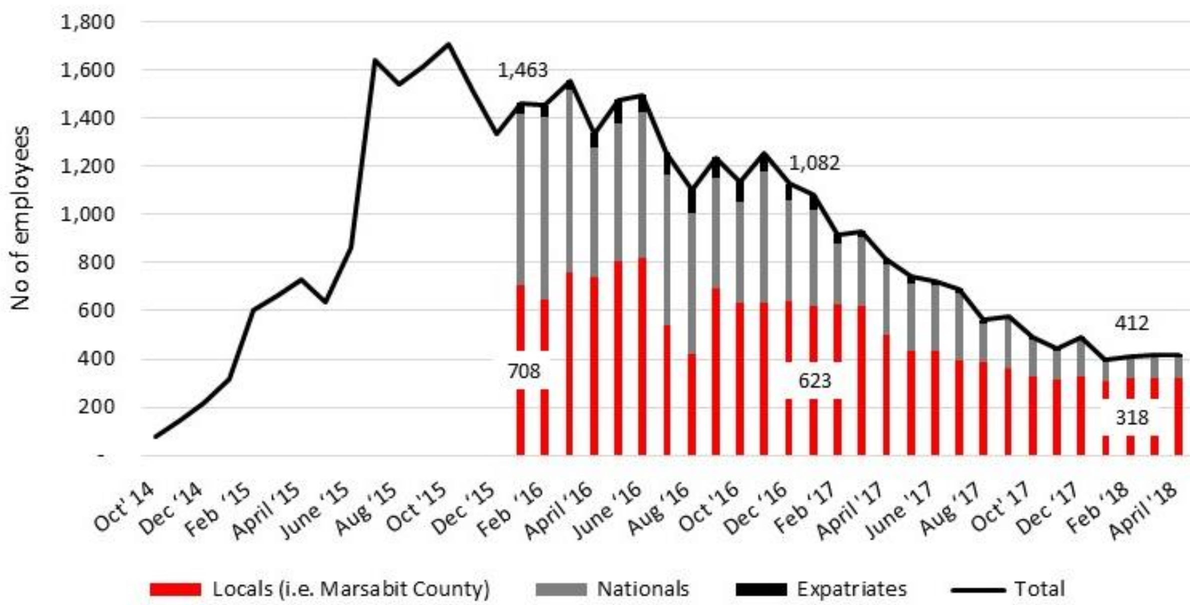
6.3.3 Job creation effects from wind farm construction and operation

As described in section 3.1, wind farm developments are often more capital than labor intensive. Even so, a frequently cited benefit in existing impact studies of wind farm investment is the creation of local jobs and economic activity in rural areas with limited economic activity.

An important part of the LTWP project has been a stated commitment to deliver tangible benefits to its local host community. One of the main vehicles for this is through the local capacity building efforts of WoC and its key partners, herein Vestas, where a key focus area has been to ensure that the local communities would be able to partake in, and benefit from, the LTWP project's core activities. To this end, LTWP Ltd. set up dedicated employment offices prior to the construction phase to ensure equitable distribution of employment opportunities among the communities in the project area. According to LTWP Ltd.'s website, since construction activities started in October 2014, the project has reportedly employed more than 2,500 people, about 75% of which came from within Marsabit County.

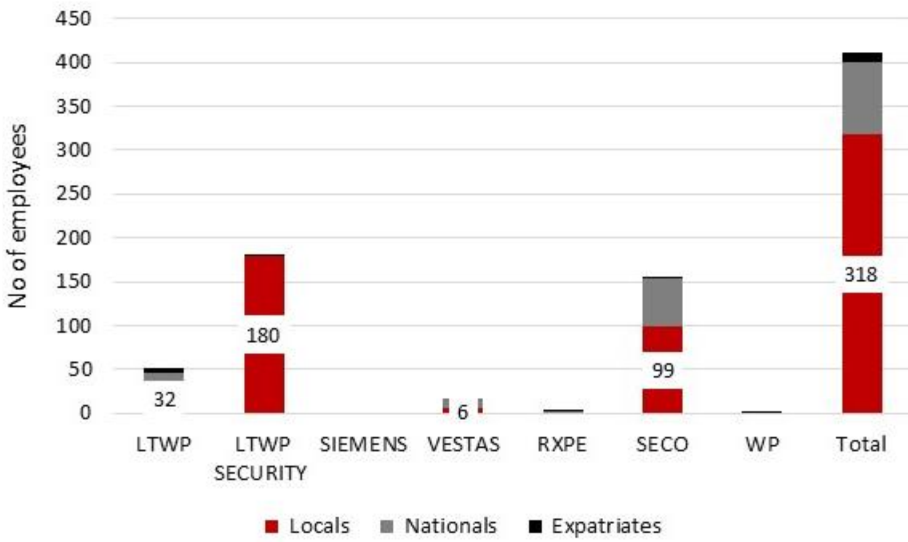
The number of people employed by the various LTWP developers, or sub-contractors, as well as by LTWP Ltd. itself has varied over the period since the project's inception in 2014. With construction completed in June 2017, the total number of employees hired by the LTWP project has decreased significantly from the project's peak period in Oct. 2015 to the latest available numbers from LTWP Ltd. reporting that the project currently employs a total of 412 people, of whom 318 or 77% reportedly come from Marsabit County, cf. **Figure 6.20**.

Figure 6.20: LTWP employment, Oct. 2014-Mar. 2018



Source: Job numbers provided by LTWP Ltd., 2018

Figure 6.21: LTWP employment per February 2018



Source: Job numbers provided by LTWP Ltd., 2018

Unfortunately, it has not been possible to provide a full account of this employment split, but for illustration **Figure 6.21** shows the employment split as per February 2018, where a total 412 people was employed by LTWP. As evident, LTWP Ltd., LTWP Security and SECO are the largest employers at this point in time.

Once the wind farm is operational, LTWP Ltd. estimates that the total number of employees will further decrease and fluctuate between 320-350 people with no further details on how many are expected to come from Marsabit county and/or the project area[39].

As a strategic partner to the LTWP project, one of the core focus areas of Vestas' local capacity building efforts has been to contribute to local employment within the project area itself (i.e. the "local-local" level). Based on data supplied by Vestas, the total budget for its local capacity building in the construction period (2015-2017) is estimated to around 820,500 USD, of which salaries for local employment in the project area constituted around 270,000 USD, cf. **Figure 6.22**. The local employment budget was used to hire community members from the project area as traffic marshals, community educators, liaison officers and patrol teams, cf. **Figure 6.23**.

[39] See https://ltwp.co.ke/faq/

Figure 6.22: Vestas CSR budget, 2015-2017

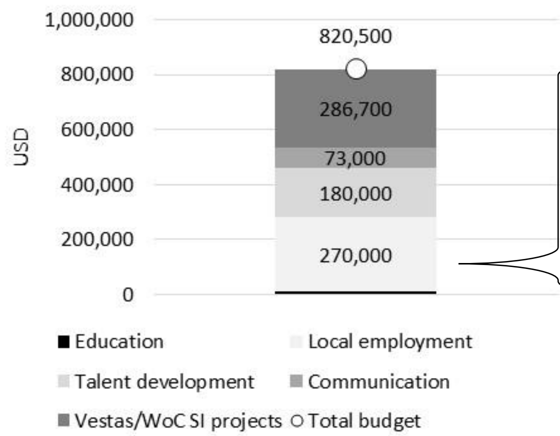
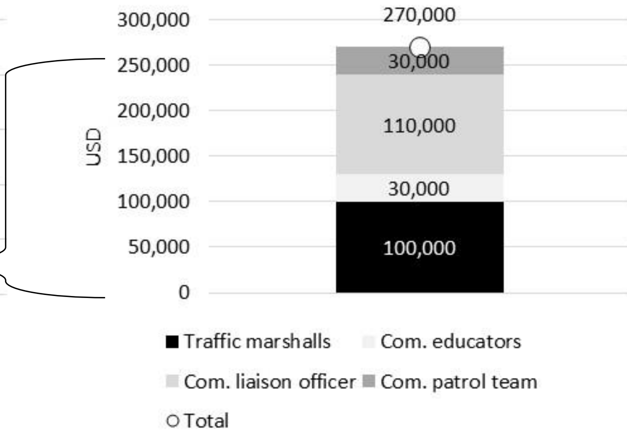


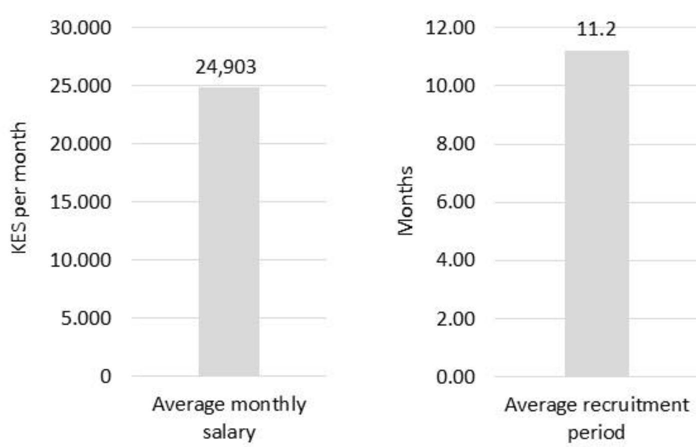
Figure 6.23: Vestas budget for local employment, 2015-2017



Source: QBIS based on interviews and data from Vestas.

In the period 2015-2017, Vestas employed a total of 127 local people. The wider impact of Vestas' local capacity building efforts, including its local employment activities, has been investigated separately by ERM (2017). Although largely based on anecdotal accounts, it is apparent from this investigation that the salaries have allowed the local community members hired by Vestas to purchase goods, pay for their children's education, improve their housing conditions and support their extended families.

Figure 6.24: Average salary and recruitment period for Vestas' local employees, 2015-2017



Source: QBIS based on Vestas data

Also, since the local employees had been educated about the temporary nature of their employment, many of them had put money aside for the future or to pay for classes to develop their skills, thereby increasing their ability to access employment beyond their contract with Vestas. The skills pursued by Vestas' local employees were reported to include training in child development, teaching, tourism and construction. On average, each employee has earned around 25,000 KES per month over a recruitment period of around 11.2 months, cf. **Figure 6.24**.

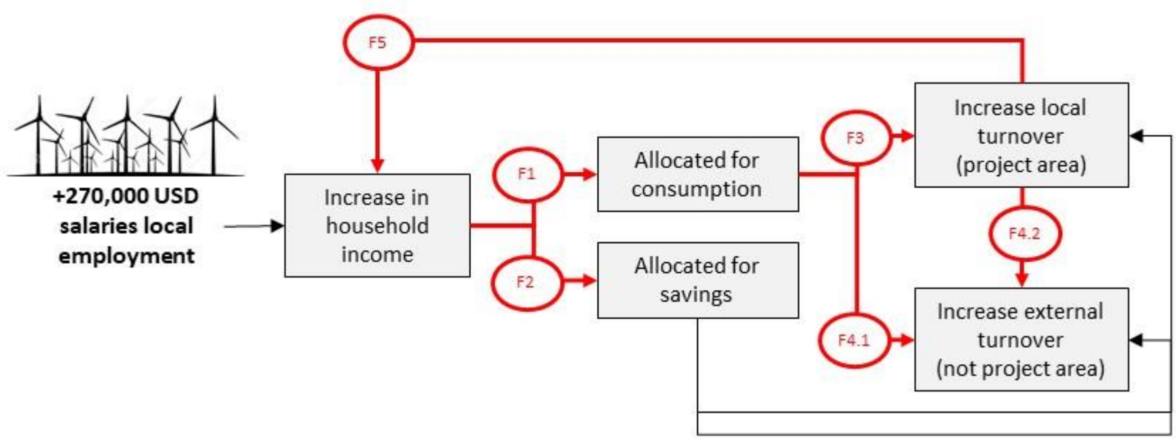
Despite the temporary nature of the majority of the employment opportunities offered by the LTWP project through LTWP Ltd. and sub-contractors such as Vestas, the recruitment of local community members during the construction phase and the current preservation period has undoubtedly injected cash into the project area. As mentioned, anecdotal evidence indicates that the locals hired by Vestas have used at least some of the salaries to purchase goods, pay for their children's education, enhance their employability through skill training, improve their housing conditions as well as support their extended families (ERM, 2017). Apart from support to their children and to possible savings, such spending will lead to increased turnover in shops and companies, either inside or outside the local area. Since traveling outside the local area to shop is expensive and likely reserved for the better-off households, it is likely that most of the money is retained within the local area.

Because of the direct jobs created by the LTWP project, herein Vestas, turnover of shops and companies will then increase and in turn, give rise to profit and purchase of goods and intermediate inputs from the suppliers of the shops and companies. The question is how much economic value is created from this and, moreover, how much of this potential value creation stays in the project area and how much is channeled out of the project area.

The transport patterns identified in the traffic survey, cf. section 6.2, indicates that there is a relatively high degree of import of basic necessities into the project area. This also means that the goods bought at local markets will not necessarily give rise to increased production inside the project area but rather outside the project area. This is not surprising considering that the main sources of livelihood in the project area is pastoralism as previously described. That said, some of the spending from the LTWP project's local salaries will stay in the area and generate additional value within the rural economy. For instance, if the local salaries from LTWP Ltd. and its subcontractors are spent on fish from Lake Turkana, local meat, animals or home-grown fruit and vegetables, this will further benefit other local people.

Put differently, for each shilling earned through LTWP-related employments, it is important to assess how much has stayed/stays in the local area and create additional value, and how much leaves the project area to create value elsewhere, e.g. at the county or national level. A straightforward way to try to answer this question is through estimating the possible flow of the local salary spending, cf. **Figure 6.25**.

Figure 6.25: Spending flows of salaries from local employment (example: Vestas salaries)



Source: QBIS

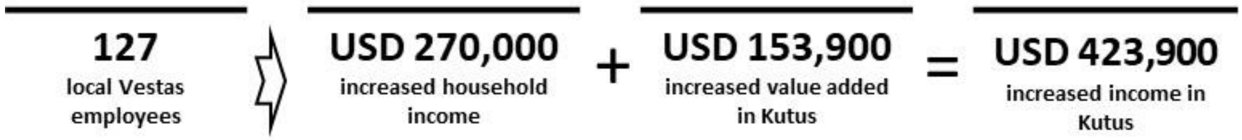
A spending flow such as this is a fairly simple way to assess the wider economic effects from the LTWP project's (herein Vestas') investments in local employment and can be developed based on interviews with former local employees and shop owners as well as market participants. Interviews with former local employees can e.g. help assess how much of their salary they have allocated for consumption and how much they have allocated for savings incl. their children's education, cf. F1 and F2 in **Figure 6.25**. Interviews with former employees can also help assess what kind of goods and services they have purchased and where they have purchased them, cf. F3 and F4 .1 in **Figure 6.25**. Interviews with shop owners can help strengthen this assessment as well as assessing how much of their sales that are imported from outside the project area, cf. F4.2 in **Figure 6.25**. Finally, interviews with people selling their products on the markets can help assess the value of the volume and prices of these goods. By combining the data from these interviews, it will be possible to conduct an assessment of how much of each shilling spent on consumption stays within the project area, cf. F5 in **Figure 6.25**.

This is a very simple way of trying to establish some rough multiplier effects without having to perform more cumbersome exercises such as establishing comprehensive Social Accountability Matrices (SAMs). SAMs have been widely used to capture the interdependences that exist within a socio-economic system such as e.g. a rural community in a developing country. When, for example, households get increased income, they could spend more money on fresh food or beverages. They might then go to a shop and spend a larger share of their income there. As a result, the shop needs to obtain more products from the food production sector, which raises its demand for agricultural products. Because of this increasing demand, more labor, input is needed which increases the income of certain households even more, who again could spend more money. This kind of interdependency between sectors and households can be captured within a SAM.

As an example of this, Lewis and Thorbecke (1992) established a SAM for the Kutus region in Kenya to analyze certain aspects of regional development. Among other things, the authors looked at how sectoral production influences the level and distribution of household income and how increases in household income, in turn, impact on regional value added through household expenditure linkages. The latter objective is relevant as an illustration of what kind of value added that can come from increases in household income from e.g. temporary local employment.

For illustrative purposes: if Vestas had invested the same amount in local employment for the people of Kutus (in 1992) as for the LTWP project, the value added to the local economy would have been 0.57 KES for each shilling spent by small farming households on extra consumption. For the 127 employees, the USD 270,000 paid in salaries would then have generated additional income of around USD 153,900 thereby creating a total income of USD 423,900 in the Kutus region.

Figure 6.26: Fictive illustration of value added from Vestas local employment in Kutus



Source: QBIS based on Lewis and Thorbecke (1992)

Using the same approach and assuming approximately same salary levels and recruitment period as Vestas for LTWP employment overall, the potential value added from the total number of people employed by LTWP at large can be illustrated using the same method. As described, each Vestas employee earned around 25,000 KES per month over a recruitment period of around 11.2 months. If we assume same salary and recruitment period for all local LTWP employees – a reasonable assumption as large income discrepancies can cause local unrest – it follows that all local employees to the LTWP project would have received a total of around USD 3.1 million in salaries since the beginning of 2016. This in turn would have generated additional income of around USD 1.7 million thereby creating a total income of USD 4.8 million in the Kutus region. This is based on an average of 1,090 local employees over the period (around 670 in 2016 and around 410 in 2017) that each has been employed around 11.2 months.

Figure 6.27: Fictive illustration of value added from LTWP local employment in Kutus

Source: QBIS based on Lewis and Thorbecke (1992)

While the numbers above are helpful to illustrate the wider multiplier effects that may flow from the LTWP project's (herein Vestas') efforts to stimulate local employment, regions are very different and it is not advised to apply multipliers from the Kutus region to the project area. The project area has its own unique economic composition that needs to be assessed to obtain value added multipliers that reflect the flows and interdependencies of the project area. Since developing a SAM for the project area and/or county is resource and time demanding, the above-mentioned spending flow approach can be a time and resource efficient alternative, cf. **Figure 6.25**. Determining the spending flow of salaries from LTWP employees will however require collection of primary data from the impacted populations in the project area, which as previously mentioned has not been possible in this study.

6.3.4 Summary of findings

In this section, two main impacts were reviewed. First, and in line with findings from existing studies, it was illustrated how the rural road rehabilitation can have important induced impacts for local producers in the project area and lead to development of local markets and income diversification. Interviews in the project area indicate that the road rehabilitation has increased access to local markets and inputs as well as the customer base, affecting both the range of goods available but also services offered. As demonstrated in the traffic survey, the transport of people to and from markets has increased nine-fold, while the number of cargo loads has increased more than three-fold. Also, interviews with market participants indicate that that prices of several vegetables have reduced 20-30% on most markets in the project area. Further, a concrete example of how the road rehabilitation has led to economic diversification and increased income was given in terms of the development of fresh fish cold chain and marketing by GiZ and other donors, which have greatly benefitted from the road rehabilitation. The full breadth and depth of these types of spill-over impacts from the LTWP access road is too early to assess at this point and will require additional data from the project area. The findings presented here do however provide early indications of increased local economic activity and diversification opportunities which are relevant to monitor going forward.

The section also reviewed data from LTWP Ltd. and Vestas on the number of local jobs created and the total salaries paid to local employees. LTWP Ltd. estimates that approx. 2,500 people have been employed by the project at large during the construction and preservation period (2014-2018), approx. 75% of which come from within Marsabit county. A closer review of the job numbers confirms this and suggests that the direct job creation from the LTWP project during the construction phase was around 1,800-1,900 local jobs in Marsabit County while employment today (in the preservation stage) stands at 412 jobs, of whom 318 (77%) comes from Marsabit County. While it has not been possible to analyze how many of the local (county) jobs are within the project area (local-local), an example from Vestas was provided who has contributed to 127 jobs within the project area during the construction phase. It was estimated that Vestas' salaries for local employment constituted around 270,000 USD in the same period. The rural economy will benefit if salaries from Vestas, as well as from LTWP Ltd. and other sub-contractors, are spent in shops and companies owned by people living in the area. It has not been possible to assess the potential multiplier effects from the local employment opportunities offered by the LTWP project, herein Vestas', due to lack of data from the project area. Such assessments are usually done by establishing a Social Accountability Matrix (SAM), but since making a SAM for the project area is resource and time demanding, a more pragmatic alternative was proposed as input for the Clients' future deliberations.

6.4 EDUCATION AND HEALTH EVALUATION

The following section will present key observations from the review of the education and health-specific outcomes and impacts identified in the impact pathway. There are many ways in which the LTWP project through its various vehicles – employment, the access road, local capacity building – can contribute to improving education and health in the project area. To mention a few: Salaries from employees hired by LTWP Ltd. or sub-contractors such as Vestas may be spent on sending children to school or providing additional health care for family members. Local community members who have been hired and trained by the LTWP project may, even if employment was temporary, have acquired new skills which they along with the additional income can set aside for opening their own business or which may increase their employability. Local capacity building projects by WoC and partner companies such as Vestas can help improve infrastructure and amenities of local schools and health facilities, increase awareness on important health issues and improve sanitation. Finally, as described in the literature review on rural roads there may be several important spill-over effects on education and health indicators from the LTWP access road such as improved access to local schools and health facilities and improved recruitment of health and education personnel which may subsequently lead to longer-term impacts such as improved literacy and mortality.

While such impacts are important to consider, and further substantiate, in any impact assessment and monitoring program aimed at capturing the full suite of benefits from the LTWP project, it has not been possible to provide a quantitative and comprehensive evaluation of these impacts within the scope, time and data limitations of this preliminary study. Recognizing these limitations, this section introduces a 'theory of change' for education and health impacts focusing on two main features of the LTWP project, namely i) potential spill-over effects from the LTWP access road and ii) education and health impacts from local capacity building initiatives, in this case exemplified by Vestas' initiatives under the Winds of Change umbrella. Given that the study has not collected primary data on these impacts, the observations draw on reference studies on rural roads as well as a recent, more qualitative, evaluation report by ERM (2017) which includes several observations on the perceived benefits of Vestas' local capacity building programs based on interviews with selected beneficiaries. As previously mentioned, WoC is also implementing other activities funded directly by LTWP Ltd. or by other contractors on the Project. These activities are not considered here.

6.4.1 Education outcomes and impacts

In its first County Integrated Development Plan (2013-2017), the County Government of Marsabit reports a significant strain on the county's education system, low primary and secondary enrollment and high drop-out rates. Despite the provision of free primary and secondary education in Kenya, there is low literacy in Marsabit county compared to the national average as previously illustrated in **Table 5.1**. Enrolment and transition rates to tertiary education are likewise low, with high drop-out rates partly due to retrogressive cultural practices. These factors translate into high unemployment as the youth cannot compete in the labor market within and outside the county and in 2013, only 5.3% of the population in the Laisamis constituency worked for pay, the vast majority of whom were those with a secondary education (Ngugi et. al., 2013).

While detailed and up-to-date education statistics for the LTWP project area (i.e. Laisamis constituency) is difficult to come by, the interviews conducted with local community members by ERM in 2016 high-lighted several challenges related to education in the project area at a more qualitative level, including high drop-out rates with girls more likely to drop out for cultural reasons, need for support to keep children in school, need to improve access to higher (tertiary) education and significant repair and maintenance issues at the individual schools (ERM, 2017).

In this context, the LTWP project can serve as a potentially important private-sector vehicle which can help the county government and civil society organizations working in the area address some of the core challenges which are currently stifling education progress. As illustrated in the overview of key education indicators identified from the LTWP impact pathway, c.f. **Table 6.7**, there are (at least) two theories of change, or causalities, which are relevant to consider in future assessments.

Firstly, as identified in the literature review in Chapter 3, there is ample evidence from other studies indicating that improved rural roads can lead to at least three important education outcomes: i) increased access to primary, secondary and tertiary education facilities for an otherwise isolated rural population, ii) improved recruitment and retention of qualified teachers to rural areas and iii) increased access for education authorities to provide oversight and quality control to remote rural schools (see e.g. Nielsen, 1998; Lavy, 1996; Khandker et. al., 2009; Kapsel, 2004; Mu and Van De Walle, 2011 and CID, 2010; and EC, 2009). As can be seen in the indicator overview in **Table 6.7**, there is some evidence which may suggest emerging spill-over effects from the LTWP access road on education, notably better access for education authorities to reach the project area and improved access (shorter time, lower price) for teachers to reach local schools. In the long-term, these types of outcomes have been found to lead to measurable impacts on skills and learning enhancement (see e.g. CID, 2010) which, in turn, can improve employability, and vice versa (EC, 2009a).

Secondly, auxiliary investments in local capacity building aimed at increasing local employment, improving primary and secondary education and developing vocational skills can have important long-term impacts on the beneficiary communities which mutually reinforces any potential impacts which may accrue from the LTWP project road. As an example, ERM's interviews with a small selection of local community members hired by Vestas suggests that at least a portion of the salaries earned will be allocated to their children's education and/or to further improve their vocational skills (ERM, 2017). Assuming this spending pattern is representative across all employees hired by the LTWP project, this may have a wider effect on education expenditure in the area and increase access to education for more people. Another example of how local capacity building can lead to positive education outcomes is Vestas' collaboration with WoC to improve infrastructure at selected local education institutions.

Table 6.7: Overview of outcome (OC) and impact (IM) indicators – Education

	Indicators	Caused by	Observations	Data
◌	OC3.1. Improved access to, and quality, of education facilities	LTWP access road, Local capacity building	Anecdotal evidence from ERM's 2016 interviews suggests that Vestas' investments in solar power and equipment have improved security and learning environment/quality at the Mt Kulal Girl Secondary School, now allowing students to study during evenings. ERM interviews also suggest that at least part of the money earned by local community members hired by Vestas may be refunnelled into primary, secondary and/or tertiary education activities. There is no data to document that the LTWP access road has reduced the distance/cost to reach local schools. This effect has however been documented in other studies (see e.g. Nielsen, 1998; Lavy, 1996; Khandker et. al., 2009).	ERM interviews (2017)
◌	OC3.2. Improved retention/recruitment of qualified teachers to local schools	LTWP access road, Local capacity building	The traffic survey indicated that 19% - almost one fifth – of the passengers travelling by bus are nurses and teachers. Reference studies suggest that improved access to rural roads makes it easier to attract and retain qualified teachers along with better access to teaching equipment and quality facilities, see e.g. (see e.g. Kapsel, 2004).	Traffic survey (2017)
◌	OC3.3. Strengthened oversight from education authorities	LTWP access road	Interviews with government officials during QBIS' 2017 field visit (DCC Loyangalani, DCC Laisamis) indicated that county education authorities visit the schools in the area more frequently, in part due to the access road, in part due to increased resources from devolution.	QBIS interviews (2017)
●	IM2.1. Changes in skills and learning enhancement (literacy and numeracy)	OC3.1 – OC3.3	Assessment of this indicator will require additional data from the project area. Existing studies on rural roads generally finds a positive relationship between reduced distance to education facilities and long-term changes in skills and learning enhancement, incl. literacy (see e.g. Mu and Van De Walle, 2011 and CID, 2010)	Reference studies only
●	IM2.2. Changes in employability	IM2.1.	Assessment of this indicator will require additional data from the project area. Employability is generally considered a material impact metric from education sector interventions (see e.g. EC, 2009a).	Reference studies only

○ = Primary data acquired ◌ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

In 2016, Vestas and WoC e.g. donated solar systems, water tanks, roof gutters and school equipment to the Mt. Kulal Girls Secondary School which was reported by EMR to provide the school with improved lighting at night, allowing students extended access to the education during the evening and reducing safety and security issues, incl. risks of snake bites and assaults. The interviews conducted by ERM further suggested that the community feels that security has improved in the area due to the light provided by the school while teachers feel that they have better equipment to administer the education of their pupils.

Figure 6.28 provides an initial theory of change for how some of the core elements of the LTWP project considered in this study – notably the access road and Vestas' local capacity building initiatives – may drive important education outcomes and impacts.

Figure 6.28: Theory of change: Education

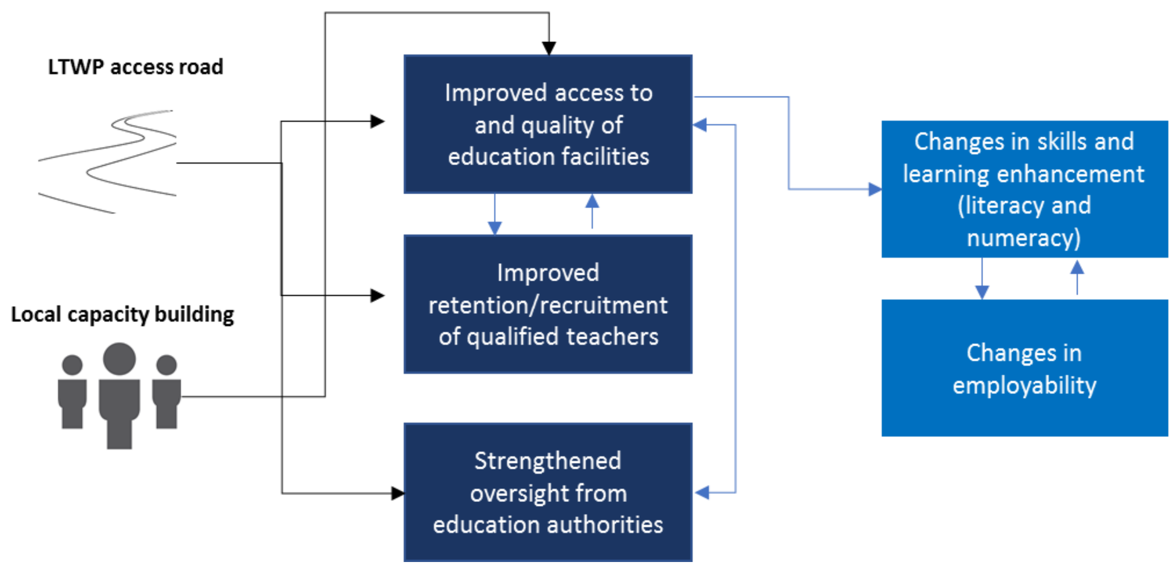


Figure 6.29

Source: QBIS Consulting based on main causalities identified in LTWP impact pathway

6.4.2 Health outcomes and impacts

Similar to the previous section on education, detailed health statistics at the constituency and/or village level is currently limited. From the broader profiling of Marsabit county published in the government's 2013-2017 CIDP, it is however clear that the county faces deep and systemic health-related challenges which pose significant obstacles to its economic and human development objectives. While the county government allocates a significant portion of its gross revenue and expenditures to health, one of the main challenges across the region is limited access to health services due to long distances from facilities as well as socio-cultural-religious practices which affect the health-seeking behavior and lead to poor demand for services (CIDP, 2013-2017).

Further, even though the devolution in 2010 has led to a significant increase in the number of healthcare workers at a county level according to figures from the county government, health personnel is still only one-third of what is required to service its health facilities (ibid). Due to these and other factors, Marsabit county lacks behind the national average on most health indicators as previously seen in **Table 5.1**.

The challenges outlined by the Marsabit county government are mirrored in ERM's characteristic of health challenges in the LTWP project area which found that the interviewed community members perceive limited access to healthcare as a key issue due to long distances to health clinics. Further, where clinics exist they often lack resources to facilitate proper treatment (health worker, drugs and equipment) with main health issues in the area including maternity care, malaria, cancer and diarrheal diseases (ERM, 2017). Finally, HIV/AIDS and the spread of STDs was raised by communities as a main concern. **Table 6.8** provides an overview of the main observations collected during the review of health-specific outcomes and impacts.

Table 6.8: Overview of outcome (OC) and impact (IM) indicators – Health

	Indicators	Caused by	Observations	Data
○	OC4.1. Improved access to, and quality of, health facilities	Wind farm construction and operation (jobs), Access road, Local capacity building	Existing interviews with hospital staff (ERM, 2017) indicate positive health outcomes of Vestas' local capacity building efforts in the area, namely due to reduced travel times and costs and improved quality of care from better vaccine and drug storage, powering of labs and more equipment (ERM, 2017). Also likely positive impacts from LTWP access road (see e.g. Howe and Richards, 1984; Odoki, et al., 2006; van Dijk et al., 2009), however additional data required to asses this.	ERM interviews (2017)
●	OC4.2. Improved retention/recruitment of medical staff	Access road, Local capacity building	Assessment of this indicator will require additional data from the project area. Existing studies find that poor working conditions such as lack of staff, high back-load and lack of proper equipment is a key deterrent for health workers in rural areas (see e.g. Mbemba et. al., 2016).	No data (reference studies only)
○	OC4.3. Strengthened oversight from health authorities and health workers	Access road	Government interviewees during 2017 field visit (DCC Loyangalani, DCC Laisamis) both state that authorities are generally more present in the area now, in part due to the access road, in part due to increased resources from devolution.	QBIS interviews (2017)
○	IM3.1. Changes in health service utilization and coverage	OC4.1 – OC4.3	ERM's 2016 interviews with hospital staff indicates that one project has led to an increase in patient visits (20% during the night) due to extended opening hours and night treatments (c.f. OC4.1). The interviews also indicate that unless the increased patient uptake is matched by increased health staff, the quality of health care overall may not improve. No health-related impacts observed from LTWP access road, however, this causality has been extensively covered in other studies (see e.g. Howe and Richards, 1984 and Odoki, et al., 2006).	ERM interviews (2017)
○	IM2.2. Changes in mortality rates (general population, <5 yr population)	IM3.1.	ERM's 2016 interviews indicates that Vestas' donations to the Buriaramia Dispensary has already now led to reduction in mortality among women related to issues from childbirth as a result of reduced travel (c.f. OC4.1). No data available to support mortality impacts from LTWP access road, however, reference studies in a.o. Zambia suggests plausible linkages to child mortality (Airey, 2014).	ERM interviews (2017)

○ = Primary data acquired ○ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

Again, from the existing literature on rural roads there is evidence that road investments can lead to several positive health outcomes and impacts, most notably by reducing the time and cost of reaching local health clinics potentially leading to long-term impacts on public health utilization and coverage rates and mortality (see e.g. Howe and Richards, 1984; Odoki, et al., 2006; van Dijk et al., 2009). Similar to the education section, there is some anecdotal evidence to suggest that health governance may have strengthened in the area (see also the section on Governance, 6.5.1) and that it might be easier, or more attractive, for nurses to reach rural clinics. To confirm such effects additional (primary) data collection would be required.

Meanwhile, there are several examples of how investments in local capacity building in the project area by LTWP project partners such as Vestas and IFU (via WoC), can contribute to strengthening the local health sector. ERM's interviews with local community members thus suggest that Vestas' investments in improving infrastructure at local health facilities have led to important health outcomes and impacts which positively reinforce any potential impacts which may, or may not, accrue from the LTWP access road.


Picture of Laisamis sub-county hospital (source: Vestas)

As an example, Vestas has funded and collaborated with WoC to install solar equipment for lighting and power at the Laisamis District Hospital and the Buriaramia Dispensary. As a result, an estimated population of 9,000 and 3,000 respectively have been provided with improved access to healthcare, mainly as a result of lower travel times, lower costs of care and extended treatment (access) hours.

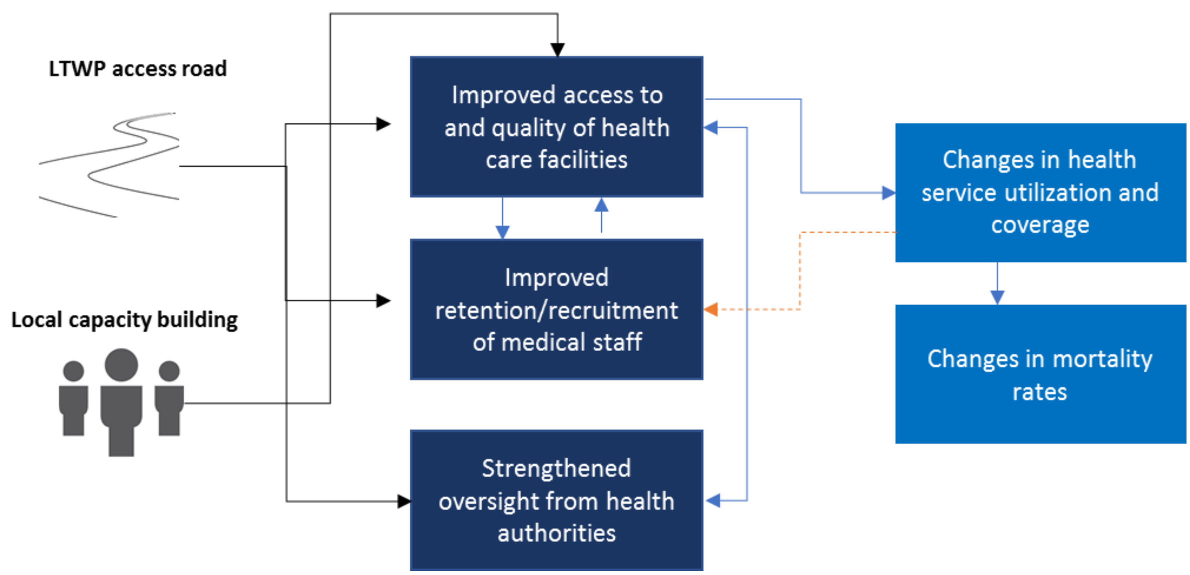
In terms of travel times, Vestas' donations to the Laisamis District Hospital are reported by ERM to have reduced the distance to reach health care from >11 km to <4 km from the furthest Manyatta. Anecdotal accounts from ERM's interviews with selected hospital staff suggests that with the help of Vestas and WoC at the Laisamis District Hospital there has been a reduction in child-birth related mortality of women in the area who no longer must travel long distances to private dispensaries to receive proper care. While it is not possible to further substantiate these accounts with data, the literature generally supports that increasing access to skilled childbirth delivery has a positive impact on maternal and child mortality rates (see e.g. Atouye et. al., 2015; Koblinsky et. al., 2008).

Similarly, ERM also reports that the cost of healthcare has been reduced in both Laisamis and Buriaramia as the communities no longer have make use of private health clinics to substitute public ones. Another benefit, exemplified by the case of Buriaramia, is that the light provided by Vestas has allowed extended access to healthcare in the evenings and nights for emergencies and deliveries of babies, while in both cases the additional power generated by the solar panels have enabled the health facilities to improve storage of drugs and vaccines.

Finally, an unintended yet common negative health impact of large-scaled infrastructure developments in rural areas and the increased mobility that often comes with same, is increased prostitution and STDs (also see Community Cohesion, section 6.5.2). To mitigate the risk of increased spread of STDs in the LTWP project area, IFU launched a three-month HIV/AIDS awareness campaign during the construction phases in early 2015 in partnership with WoC and a local community-based organization named CEDIM. The purpose of the campaign was to build local knowledge of HIV/AIDS in the project area and to inform people on the seriousness of the disease, prevention methods and where/how to get tested in Marsabit County. Preliminary evaluations of the campaign indicate that it has significantly increased local understanding of the disease and that it has helped to counter the stigma associated with HIV/AIDS[40].

Figure 6.30 provides an initial theory of change for how selected elements of the LTWP project as discussed above may drive important health outcomes and impacts in the project's main area of influence. As indicated by the orange arrow, it is important to also consider unintended and potentially negative impacts of such interventions. As an example, ERM's community interviews briefly cites that extended opening hours at the Laisamis District Hospital as a result of improved lighting and power has led to increased pressure on local health workers, thereby potentially making it more difficult – rather than easier – to attract qualified health personnel and leading to lower rather than improved quality of care. Dynamics and unintended feedback loops such as these are important to understand as well and are typically captured best through a combination of quantitative and qualitative approaches.

Figure 6.30: Theory of change: Health



Source: QBIS Consulting, 2018

[40] *Source: https://ltwp.co.ke/community-projects-map/?location=health*

6.4.3 Summary of findings

This section has reviewed the education and health-specific outcomes and impacts from the impact pathway with focus on impacts caused by the LTWP access road and supporting investments in local capacity building by Vestas and IFU in collaboration with WoC. Recognizing that data is limited to fully assess these effects, the section introduced a high-level theory of change and provided specific examples of how local capacity building in the education and health sector, herein those funded by project partners such as Vestas and IFU, as well as the LTWP access road can lead to important outcomes and long-term impacts in the project area. More data is required from the project area to fully assess these types of effects to which end this study may serve as a starting point for future indicator selection and assessment.

6.5 Governance and community cohesion

In the following section, key observations will be provided related to potential outcomes and impacts on governance and community cohesion in the project area. Like the previous section on education and health, the observations are limited to largely anecdotal accounts provided during the field visit as well as best available data and statistics from the county, and to a lesser extent, the sub-county level. The observations in this section could generally benefit from a more comprehensive data collection and assessment as part of future monitoring efforts as well as a wider perspective on the full suite of initiatives by LTWP Ltd. and WoC which may also impact on governance and community cohesion beyond the observations included here. To this end, a forthcoming mid-term review of the LTWP project by Triple R alliance includes several observations with potential implications for governance and community cohesion, including changes to stakeholder perceptions on the general security situation in the area and changes related to the resettlement of Sarima village. These perspectives have not been included in this study but should be seen as an important complementary input.

Table 6.9 provides an overview of the key observations related to governance and community cohesion which have been observed in this study.

Table 6.9: Overview of outcome (OC) and impact (IM) indicators – Governance and Community Cohesion

	Indicators	Caused by	Observations	Data
○	OC5.1. Greater oversight and funding from government agencies	LTWP access road, Local capacity building, LTWP wind farm	Interviews with local government officials indicate a stronger governance presence in the project area now, in part due to the LTWP road and the presence of the LTWP project at large, incl. local security. In the context of the county government budget, the significant capital injections from the LTWP project at large, incl. in local infrastructure, capacity building and employment, is an important aid to the county government efforts in the project area and region, potentially freeing up funds for other priorities.	QBIS interviews (2017)
○	OC5.2. Improved response time to security incidents	LTWP access road	Interviews with government officials in the project area suggests that response time to security incidents or medical emergencies have been reduced due to better road access + availability of mobile coverage.	QBIS interviews (2017)
○	OC6.1. Increased exposure to non-traditional values, norms and livelihoods	LWTP access road, Local capacity building	Interviews with government officials highlight several changes to community values and livelihoods, e.g. diversified diets and economic activity. Some accounts of increased prostitution and spread of STDs in the project area (see ERM, 2017), although these trends were also reported to have been present prior to LTWP.	QBIS (2017), ERM (2017)
○	OC6.2. Changes to inter- and intra-community conflicts	LTWP access road, Local capacity building, LTWP wind farm	Community conflicts remain pertinent over water, grazing, fishing, and cattle rustlings which was also the case prior to the LTWP project. Secondary conflict data from the area suggests that causes of conflict are mainly intra-community issues.	QBIS (2017), ERM (2017), ACLED (2000-2018)
●	IM4.1. Changes in rule of law and utilization and coverage of government services	OC5.1., OC5.2.	Long-term changes not yet documented and will require additional data. Reference studies indicate that especially rural roads may have long-term and positive impact on government spending and reach in rural areas (see e.g. ADB, 2002).	Reference studies only
●	IM5.1. Changes to social capital and community cohesion	OC6.1., OC6.2.	Long-term changes not yet documented and will require additional data. Community conflict in project area, incl. source of conflict and severity, to be continuously monitored over time.	Reference studies only

○ = Primary data acquired ○ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

6.5.1 Governance outcomes and impacts

There are many factors that impact the efficiency and effectiveness of the public sector in isolated rural areas. As mentioned in Chapter 3, studies on the long-term impacts of rural roads suggest that there can be positive linkages between investing in improved rural roads and strengthening local governance in rural communities. Notably, rural roads have been found to improve the reach and coverage of government services in otherwise isolated communities, e.g. in areas such as health, education, security, judgement administration and civil registration. Reversely, when roadside communities are more likely to be able to reach such services due to shorter travel times (e.g. to a local health facility), this positively reinforces the uptake of any additional investments provided by the government (ADB, 2002).

Interviews with government officials from the Loyangalani and Laisamis wards during the 2017 field trip suggest that one of the most important spill-over benefits of the LTWP project from the perspective of the local government is the effect of the project road in increasing accessibility to otherwise isolated communities in the project area. Both officials suggested that there is a stronger presence of local government agencies and services in the LTWP project area today compared to before the LTWP project was initiated. This is attributed partly to the new access road and partly to the increased allocation of funds from the national to the county level from Kenya's 2010 devolution reform. On a similar token, both officials suggested that response time to security incidents and medical emergencies have reduced due to better road access as well as improved availability of mobile coverage, although it has not been possible to document this with data.

To be able to track if the LTWP access road will indeed translate into long-term improvements in, and expansions of, government services and expenditures in the project area, a more comprehensive set of indicators will need to be established and monitored over time. To this end, existing county and sub-county level statistics, c.f. **Table 6.10**, can be a good starting point, along with more granular indicators such as average response time to security incidents, student/teacher ratios at public schools, public school enrollment rates, number of visits by government officials to local communities, share of county resources allocated to the project area vs. less remote areas, number of security incidents reported to government etc.

Table 6.10: Example of statistics on public service availability at the county and sub-county level

Institution type	County level (Marsabit)	Sub-county level (Laisamis and Loyangalani)
Public primary schools	• 216 primary schools, 166 public, year unknown (CIDP, 2012-2015) • 209 primary schools, 169 public in 2014 (KNBS, 2015)	26 public primary schools in Laisamis and 18 in Loyangalani, 2014 (KNBS, 2015)
Public secondary schools	• 31 secondary schools, 27 public, in 2014 (KNBS, 2015) • 32 secondary schools, public share and year unknown (CIDP 2013-2017)	Three public secondary schools in Laisamis and two in Loyangalani, none private, 2014 (KNBS, 2015
Public health facilities	• 111 in total, 71 of which were public, in 2014 (KNBS, 2015) • 74 in total (four hospitals, 58 dispensaries and 22 health centres) (CIDP, 2012-2015)	Not identified
Public health workers	• 623, year unknown (CIDP, 2012-2015) • 540 registered medical staff in 2014 (KNBS, 2015)	Not identified
National Police Service	87 units in total, in 2014 (KNBS, 2015)	11 units in Laisamis and 14 in Loyangalani, 2014 (KNBS, 2015)
Judiciary units	Five units, in 2014 (KNBS, 2015)	0 (KNBS, 2015)
Prisons service	Two units, in 2014 (KNBS, 2015)	0 (KNBS, 2015)
Children's services	Two units, in 2014 (KNBS, 2015)	0 (KNBS, 2015)
National Registration Bureau	16 units, in 2014 (KNBS, 2015)	One in Laisamis and one in Loyangalani, 2014 (KNBS, 2015)

Source: Example of various statistics of governance services at county- and sub-county (ward) level from KNBS (2015) and CIDP (2013-2017)

Beyond the impacts of improved road accessibility, the local government is also likely to benefit from the sheer influx of capital to the rural economy from the construction and operation of the LTWP wind farm, investments in local capacity building and the access road. To put these investments into context, the county budget for Marsabit was KES 5.8 billion in 2015-2016 (USD 58 million) when the LTWP road was constructed. In this accounting period, the county had reserved approx. KES 550 million (USD 5.5 million) for "public works", which includes funds to upgrade the county's rural road network, c.f. **Table 6.11**.

Table 6.11: Marsabit county budget, expenditures 2015/2016 (KES)

Budget lines	Gross total estimates	% of budget
County assembly	526,000,000	9%
County executive services	517,581,909	9%
Finance management services	986,268,307	17%
Agriculture	313,622,833	5%
County public services	59,372,340	1%
Education youth affairs	264,038,209	5%
County health services	1,066,903,989	18%
Administration and ICT	213,780,010	4%
Physical planning and development	217,049,475	4%
Public works	549,625,269	9%
Water services	752,908,824	13%
Trade and industry	129,038,535	2%
Culture and social services	238,622,233	4%
TOTAL VOTED EXPENDITURE (KES)	5,834,811,933	100%

Source: Programme Based Budget, 2015-2016, Marsabit County, available at http://marsabit.go.ke/

With the LTWP project's USD 30 million investment in the upgraded access road from Laisamis to Loyangalani, the access road alone has enabled a six-fold increase in the government's planned expenditure on infrastructure improvements in the same period. Further, taking Vestas' contributions to local community projects as a specific example, the company's combined 820,500 USD investment during the construction phase serves as an important contribution to several of the county's existing budget lines, incl. water, health and education. While Vestas is only one of several LTWP partners to invest in local community projects, Vestas' investments during the construction period is equivalent to approx. 30% of the entire annual education budget for Marsabit county (2015/2016). If additional investments from the LWTP project at large are added to this – such as county revenues from land concession and future operations, taxes from salaries to local employees (c.f. section 6.3.3), local community investments by other sub-contractors and the EUR 500,000 annual commitment by LTWP Ltd. to invest in local community projects – the contribution from the LTWP project is likely to provide a significant aid to the Marsabit county government in realizing important socio-economic objectives, both in the project area and beyond (see e.g. CIDP 2013-2017).

6.5.2 Community cohesion outcomes and impacts

As described in Chapter 3, large-scale infrastructure investments in wind farms as well as rural roads have been observed to impact local communities in several ways. While some impacts are perceived as positive by most stakeholders – e.g. increased economic activity, improved mobility to local markets, spill-over effects on health and education etc. – outside investments in otherwise isolated rural communities can also lead to significant local unrest and cohesion issues which, if unmitigated, can offset the positive impact potential of such investments and challenge the project's overall license to operate.

Critical reports have started to emerge in recent years on the LTWP project's overall impact on local communities and the potentially adverse impacts on land acquisition and indigenous people's rights. A journalistic inquiry by Danwatch (2016) claimed that there was a lack of community consultation during the 2007 land acquisition process which has led to the current law suit against LTWP[41] as well as a surge in prostitution, violence and alcoholism in the resettled communities of Sarima due to unfulfilled project expectations. A report by IWGIA the year before (2015) similarly criticizes the LTWP project for the lack of recognition of indigenous people in the project area.

Interviews with local government officials during the 2017 field study as well as the ERM interviews conducted with community members in 2016 provide a more nuanced picture with the LTWP project generally viewed in favorable terms by local communities, despite the current frustrations associated with the delay in operations. Government officials in the Loyangalani and Laisamis wards noted that there have been several changes in the community as a result of the project, including new diets (fish more commonly eaten, leafy vegetables now available), and an overall change in cultural habits and understanding. In ERM's more detailed review of Vestas' local capacity building activities in the local area, community members indicated that the LTWP project at large, herein Vestas' efforts, has had several benefits on local community cohesion and stability, e.g. by allowing for increased collaboration between people from different tribes (Turkana, Samburu and Rondille), improving fluency in Swahili, improved driving skills, more vehicles and increased modernization, i.e. moving away from traditional dress and way of life, and a stronger connection to Kenya due to the national interest of the LTWP project (ERM, 2017). The community members also stated that there are several challenges associated with such lifestyle changes, including increased prostitution and spread of sexually transmitted diseases (STDs), even though these changes were generally believed to have been in the project area for a long time (ERM, 2017).

Varying stakeholder accounts such as these emphasize the high level of complexity and cultural sensitivities involved in assessing the community cohesion component of large-scale infrastructure projects of this kind. What is perceived as a positive impact by some (e.g. "modern lifestyles"), may for example be considered a negative by others. For an overview of some of the positive and negative community cohesion impacts expressed by stakeholders to the LTWP project, c.f. **Table 6.12**.

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[41] Due to the current law suite under development, the study will not assess the impacts of resettlement in Sarima as this is being addressed separately.

Table 6.12: Example of varying stakeholder perceptions of community cohesion impacts

Example of positive community cohesion impacts	Example of negative community cohesion impacts
• Increased collaboration and understanding between tribes • Change in diets and consumption patterns • Increased diversification of economic activity • Change in perceptions and awareness (e.g. HIV/AIDS, road safety, health, education) • Improved security presence by police due to road and national interest of LTWP project • Increased sense of belonging/integration with rest of Kenya	• Increased risk of STDs and HIV/AIDS • Increased alcoholism and prostitution • Increased competition for and conflict over resources (e.g. jobs, donations, land) • Increase in extortion practices to receive compensation, e.g. setting up incidents • Increased unrest as a result of layoffs (temporary jobs) and delay of LTWP operations and WoC investments • Increase in livestock deaths and accidents (e.g. from road traffic and/or conflict)

Source: QBIS 2018, based on review of ERM report (2017, Vestas material and external reports (Danwatch, IWGIA)

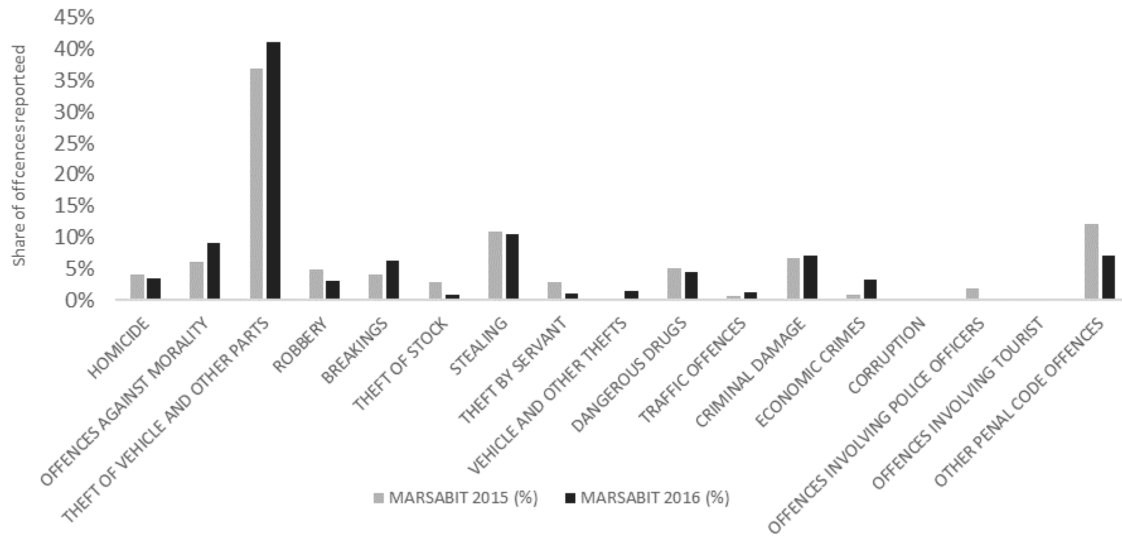
The high levels of ambiguity involved in assessing community cohesion impacts, underlines the importance of establishing fact-based impact monitoring programs which can help capture important changes, positive and negative, to the impacted communities over time, thereby mitigating the risk for potentially unsubstantiated criticism.

Beyond potential changes to lifestyle, an important aspect of such assessments should be the extent to which the LTWP project through its various vehicles impacts security and stability in its host communities. Anecdotal accounts and observations during the 2017 field visit suggest that the degree and source of community conflicts in the project area has remained relatively consistent before and after the LTWP project with the majority of conflicts pertaining to intra-community and tribal issues over land, water, cattle and, in some communities, fish. ERM's 2016 interviews suggests that the LTWP project may in fact have contributed to improving the security situation in the area due to increased economic activity (less idle time for criminal activity), increased presence of security forces in the area and improved access for police to respond to security accidents as discussed in the previous section (ERM, 2017).

At a county level, some conflict and security statistics can be found in the annual crime situation reports published by the Kenya National Police Service. According to the most recent report (NPS, 2016), there were 675 reported crimes in Marsabit county overall in 2016 vs. 468 crimes in 2015. A similar increase has happened at the national level where the average number of crimes across all 47 counties was 1,632 in 2016 compared to 1,536 in 2015. While this seems to indicate an increase in criminal activity both at the national and the county level, one has to exercise some caution in interpreting this data as an increase may not reflect higher criminal activity, but rather the increased presence of, and trust in, the local police as a viable pathway to justice.

The reports also give some insight into the causes of conflict within Marsabit county, which are relatively consistent with the rest of the country, with major crimes including theft of vehicles and other parts, stealing, criminal damage and other causes (ibid).

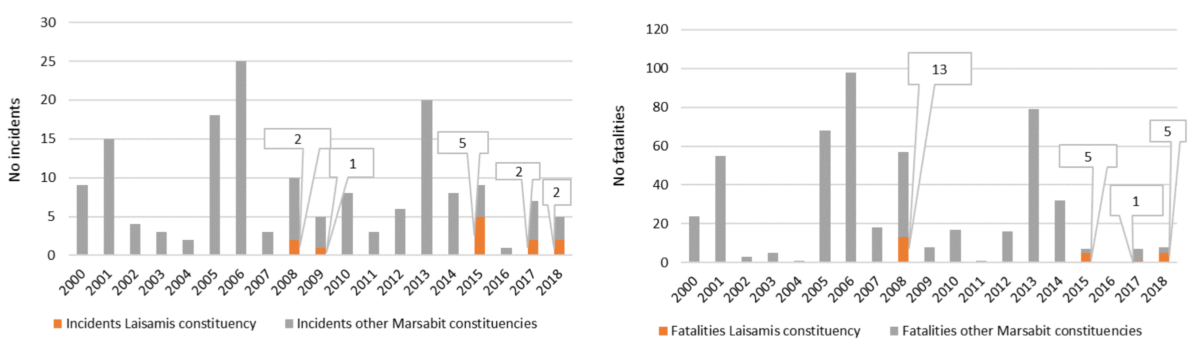
Figure 6.31: **Types of crimes reported in Marsabit county, 2015/16**



Source: Kenya National Police Service, Crime Situation Reports, 2015/16

While the government does not publish crime rates and/or grievances at the constituency and sub-county/ward level, some security related data can be found through ACLED - Armed Conflict Location & Event Data Project - which is a disaggregated conflict collection, analysis and crisis mapping project. Contrary to the official crime statistics, the data from ACLED can be broken down at constituency level, sub-county/ward level and individual town/village level, allowing for potential impacts from the LTWP project to be better isolated and tracked, c.f. **Figure 6.32**.

Figure 6.32: Incidents and fatalities in Marsabit county vs. Laisamis constituency, 2000-2018



Source: ACLED data, 2000-2018, accessible here: https://www.acleddata.com

The ACLED numbers indicate that security incidents and fatalities as a result of community conflict occur in relatively random spurts within the county overall as well as within the Laisamis constituency. Since 2015, when the construction phase of LTWP wind farm and the access road were in progress, there seems to be a slight peak in incidents and fatalities in the Laisamis constituency. A further analysis of the reported incidents and fatalities show that the majority of the conflicts in the project area, both before and after 2015, pertain to intra-community issues, incl. raids, robbery and theft, which is unrelated to the LTWP project. Only one of the observed community conflicts in the most recent period relates specifically to the LTWP project (c.f. grey cell in **Table 6.13**) while the rest appear to be mainly related to violence within and between tribes as well as political protests.

Table 6.13: Description of observed conflicts within Laisamis constituency, 2000-2018

Year	Village/ward	Type of conflict	Fatalities	Description
2008	Mt Kulal, Loyangalani ward	Violence against civilians	2	*April 2008:* Two people killed by bandits during an overnight raid at Mount Kulal, Turkana District.
2008	Mt Kulal, Loyangalani ward	Battle with police	11	*December 2008:* Police reservists from Turkana and local herdsmen clashed over grazing pasture as drought continued to hit most parts of the area. 11 estimated fatalities.
2009	Laisamis town, Laisamis ward	Violence against civilians	0	*June 2009:* Armed raiders attack civilians, steal cattle.
2015	Kargi, Kargi/South Horr ward	Riots/protests	0	*January 2015:* Protesting the availability of jobs offered by LTWP, with local residents blocking the road leading to the LTWP project site for several days, holding hostage a truck driver ferrying supplies.
2015	Larachi, Loyangalani ward	Violence against civilians	5	*August 2015:* Turkana attackers kill five in a suspected cattle rustling operation. The attack caused tension in the area.
2017	South Horr, Kargi/South Horr ward	Riots/protests	0	*April 2017:* Residents of South Horr protested against the cancellation of the nominations in the Jubilee Coalition primary elections on 28/04/2017. They sat on the border of Samburu and Marsabit counties questioning why the nominations are held in the neighbouring Samburu and all other wards in Marsabit county but not in South Horr. No fatalities. The source does not indicate the exact time of the event.
2017	Laisamis town, Laisamis ward	Violence against civilians	1	*June 2017:* The county commander said several people have been arrested in connection with an attack on a lorry carrying camels along Laisamis Road. One person was killed. The attackers transferred the animals to another truck and drove off.
2018	Laisamis, Laisamis ward	Violence against civilians	3	*April 2018:* Three members of the same family are killed in an attack based on community rivalry in or near Salima village in Laisamis sub county.
2018	Laisamis, Laisamis ward	Violence against civilians	2	*April 2018:* Two people were killed and seven others injured after armed men raided a village in Laisamis sub county on April 11, 2018. The attack is believed to be linked to a rivalry between two communities and to the attack just three days prior.

Source: ACLED data, Laisamis constituency, 2000-2018

6.5.3 Summary of findings

This section has presented key observations related to the LTWP project's potential impacts on governance and community cohesion in the project area. Similar to the section on education and health, the observations are based mainly on anecdotal accounts with some secondary data at the county and sub-county level, e.g. on local conflict levels. With these limitations in mind, the analysis suggests that the LTWP project may have important long-term impacts on governance and community cohesion issues: Firstly, the LTWP project has seemingly increased the presence of local governance and security forces in the project area which is partly attributed to the access road as well as the LTWP project's 'general presence'. Similarly, the significant influx of capital from the construction and (future) operation of the LTWP project is likely to be a considerable contribution to the local county budget in areas such as infrastructure, health, water and education. Secondly, the LTWP project can materially impact the fabric of the impacted communities with changes in lifestyle already observed as an indirect result of the increased mobility and increased diversification in services and goods in the area. The potential negative side-effects of increased mobility and economic development in otherwise isolated communities, including spread of STDs, alcoholism and prostitution, underlines the importance of LTWP Ltd. and key project partners such as Vestas and IFU in mitigating project risks and improving awareness on topics such as HIV/AIDS, c.f. section 6.4.2. Finally, the LTWP project may also impact the security situation in the project area, both positively – e.g. by enabling a stronger security presence in the area, reducing response times and increasing collaboration between different tribes – and negatively, e.g. by leading to (new) conflicts over project benefit sharing, community resettlements and allocation of resources within the impacted communities and tribes. More evidence is needed to track the level and sources of community conflict over time, yet secondary conflict data from 2000-2018 seem to suggest that, so far, the level and sources of community conflicts have remained relatively consistent before/after the LTWP project.

6.6 Energy supply and costs evaluations

In the final section of the LTWP impact evaluation, the study will turn its attention to the important, yet currently less understood, impacts from the increased supply and consumption of renewable energy in a developing country context. These types of impacts, which were classified as second-order energy impacts in the literature review, cf. section 3.2, extend beyond the localized impacts assessed in the four previous sections to also consider the wider economic changes that can occur at the national level once the LTWP wind farm is fully operational.

With the LTWP wind farm still not connected to the national grid within the timeframe of this study, it is not possible to conduct an ex-post impact evaluation of the LTWP project's impacts on Kenya's energy supply and costs. Instead, the following section will present the key results from a feasibility assessment of LTWP's potential energy-related outcomes and impacts at the macro-economic level. Due to lack of knowledge of LTWP's actual effects on electricity supply and costs, the feasibility assessment is based on a number of key assumptions which are further detailed below.

A high-level overview of the analysis of LTWP's outcomes and impacts on Kenya's energy supply and costs is summarized in **Table 6.14**. In the remaining parts of this section, important context on Kenya's current energy landscape will be presented, incl. the wider economic implications of Kenya's current power outages and back-up generation needs, after which two discrete hypothetical impact scenarios will be constructed and analyzed for LTWP.

Table 6.14: Overview of outcome (OC) and impact (IM) indicators – Energy Supply and Costs

	Indicators	Caused by	LTWP – key findings	Data
◌	OC7.1. Reduced power outages and sales losses	Wind farm construction and operation (2nd order)	Since LTWP is not yet connected to the grid, findings consist of feasibility assessments of the potential impacts of reduced power outages due to substitution away from unstable hydro power to more stable wind power particularly during droughts. The findings indicate that an assessed 10%-15% reduction in power outages is associated with 5.1% reduction in lost sales.	Data from World Bank Enterprise Survey
◌	OC7.2. Reduced electricity costs and prices	Wind farm construction and operation (2nd order)	Since LTWP is not yet connected to the grid, findings consist of assessments of the potential for reducing electricity prices due to substitution away from expensive thermal (fossil) energy to cheaper wind energy. To allow for comparison with other studies, it is assumed that LTWP can contribute with a 13% decrease in electricity prices and costs.	Data from World Bank Enterprise Survey
●	OC7.4. Improved current account and more stable currency	Wind farm construction and operation (2nd order)	Not assessed in feasibility study but suggested included once LTWP is operational. Existing studies indicate that increased renewable energy access is likely to especially benefit oil-importing, low-income countries who are particularly vulnerable to price increases that badly affect their balance of payments and energy supply (ESMAP, 2005b).	Reference studies only
◌	IM6.1. Increased production, GDP and jobs	OC7.1.-OC7.2.	Since LTWP is not yet connected to the grid, findings consist of two feasibility assessments: 1) An assumed reduction in power outages by 10%-15% is estimated to generate USD 332 million in production, USD 176 million in GDP and 54,000 jobs at a national level. 2) A randomly chosen 10% reduction in electricity prices due to use of cheaper wind power instead of expensive thermal (fossil) power is associated with a 0.26-0.28% increase in production, GDP and jobs corresponding to USD 222 million in production, USD 134 million GDP and 39,000 additional jobs.	IO model for Kenya based on MRIO

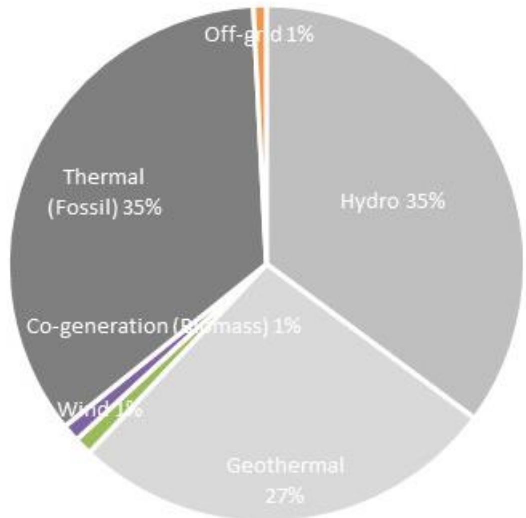
○ = Primary data acquired ◌ = Some data acquired (anecdotal and/or secondary sources) ● = Insufficient data for indicator review

6.6.1 The societal costs of unreliable electricity supply

Electricity in Kenya is generated primarily from hydro, thermal and geothermal power. In 2018, Kenya had an installed electricity generation capacity of 2,336MW comprising of hydro (821MW), thermal (816MW), geothermal (627MW), wind (26MW) and off-grid (19MW), c.f. **Figure 6.33**.

Importantly, since hydropower – which is largely reliant on unpredictable weather conditions – accounts for a relatively large share of Kenya's current electricity supply, Kenya has a high frequency of power outages. According to the latest available World Bank Enterprise Survey, 89.4% of Kenyan firms experienced power outages compared to 78.9% for all Sub-Saharan countries.[42]

Figure 6.33: **Kenya's electricity mix (2015)**



Source: Ministry of Energy

The World Bank Enterprise surveys from 2007 and 2013 along with a more recent survey from Kenya Power and Lightning Company's (KPLC) from 2017 provide specific insights on both the number and duration of electrical outages experienced by Kenyan firms. While there has been a slight reduction in number of power outages from 2007-2017 (from 5.8 outages per month in 2007 to 3.8 in 2017), the average duration of power outages has increased in the same period (from 4.4 hours in 2007 to 5.7 hours in 2017), c.f. **Figure 6.34** and **Figure 6.35**.

[42] See: http://www.enterprisesurveys.org/data/exploreeconomies/2013/kenya

Figure 6.34: Number of electrical outages per month

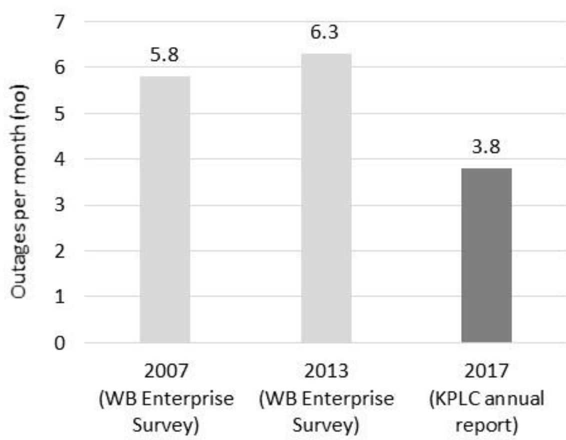


Figure 6.35: Average duration of electrical outages

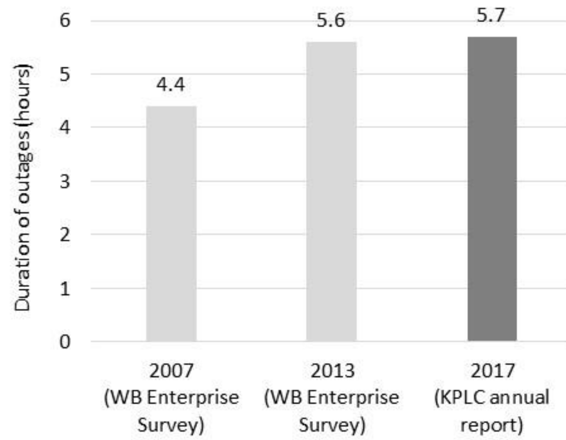


Figure 6.36: Total hours of electrical outages per month

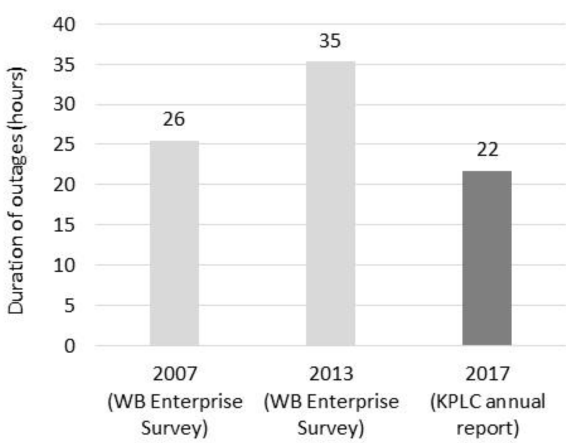
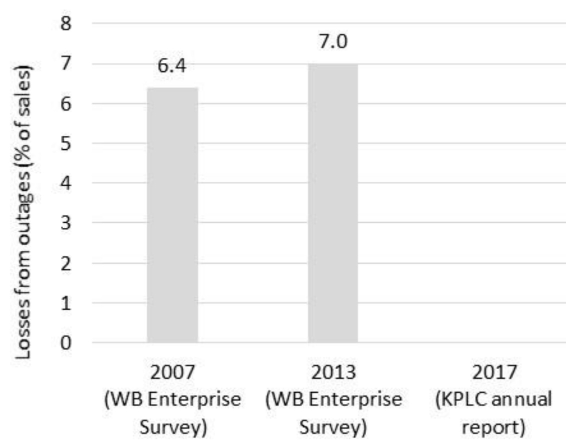


Figure 6.37: Economic losses from electrical outages



Note: The 2017 data from KPLC covers all electricity customers in Kenya, not only firms as the World Bank Enterprise Survey and it is based on a different survey methodology than the World Bank Enterprise Survey. The 2017 data is therefore not directly comparable to the 2007 and 2013 data and should only be regarded as an indication.

Source: World Bank Enterprise Survey 2007/2013 and Kenya Power and Lightning Company (KPLC) annual report 2016/2017.

As a result, and despite some improvements since 2007 and 2013, Kenyan firms experience an average of 22 hours of electricity outage per month according to the latest available data from KPLC in 2017, cf. **Figure 6.36**. As further demonstrated in **Figure 6.37**, the economic implications of Kenya's high level of electricity outages can be substantial with average loss of sales from outages estimated to around 6.5% of sales in 2007 and around 7.0% of sales in 2013 according to the latest available World Bank Enterprise Surveys.

Table 6.15: Electricity outages and the consequences, 2013

	Firms experien-cing outages (%)	Outages per month (no)	Duration of outages (hours)	Total outages time per month (hours)	Sales loss from outages (%)	Firms owning or sharing a generator (%)	Electricity coming from a generator (%)
Kenya	**89.4**	**6.3**	**5.6**	**35.3**	**7.0**	**57.4**	**14.0**
Manufacturing							
- All sectors	87.9	5.9	5.8	34.2	7.8	57.2	12.6
- Food	81.8	5.1	6.3	32.1	7.8	53.9	14.3
- Garments and textiles	95.7	6.2	5.3	32.9	7.0	59.0	13.7
- Chemical, plastic & rubber	95.0	7.6	5.8	44.1	8.6	74.5	9.9
- Other manufacturing	94.7	6.7	4.9	32.8	7.8	58.2	10.6
Services							
- All services	90.1	6.5	5.5	35.8	6.7	57.5	14.6
- Retail	89.4	6.0	5.7	34.2	5.2	52.2	15.5
- Other services	90.5	6.8	5.4	36.7	7.6	60.9	14.1
Firm size							
- Small (5-19)	87.6	6.5	5.8	37.7	6.9	46.0	14.0
- Medium (20-99)	92.0	5.8	5.6	32.5	6.6	66.2	15.5
- Large (100+)	91.8	6.4	4.8	30.7	8.8	90.7	11.1
Location							
- Central	82.0	4.9	6.8	33.3	5.4	51.9	16.7
- Kisumu	99.3	7.3	4.4	32.1	9.5	69.5	11.6
-Mombasa	91.3	6.4	5.3	33.9	6.4	57.8	14.2
- Nairobi	94.9	7.9	8.4	66.4	7.8	42.6	14.8
- Nakuru	72.5	5.2	3.1	16.1	7.0	59.9	13.2

Source: World Bank Enterprise Survey 2013.

That electricity outages can lead to significant economic losses is supported by several studies examining the linkages between power stability and economic growth[43]. This effect is further exacerbated in a developing country context where electricity outages are frequent and where local firms are forced to adopt different strategies to cope with the poor electricity supply, including choice of business, choice of location, output reduction, factor substitution and self-generation. While all these strategies are observable among Kenyan firms, the most commonly adopted strategy by Kenyan firms is investments in self-generation. According to the World Bank Enterprise Survey (2013), around 57% of Kenyan firms

[43] For instance, Steinbeck and Foster (2010) find that outage costs correspond to USD 0.13-0.76/kwh in selected African countries. In an older study from Israel by Bental and Ravid (1982), outage costs are estimated to USD 0.40/kwh, while Pasha et al. (1989) find that outage costs overall account for 8.8% of industrial output value added in Pakistan and USD 0.58/kwh for planned outages versus USD 1.02/kwh for unplanned outages.

either own or share a generator from which they derive around 14% of their electricity, c.f.**Table 6.15** which provides a comprehensive overview of the electricity outages and losses in Kenya.

As evident from **Table 6.15**, some variation between sectors is present, but the general pattern is that all firms in Kenya, regardless of sector, are impacted by power outages and their resulting implications on firm performance and costs, including wide-spread use of generators. Even so, generators do not necessarily fully mitigate the negative implications from electricity outages as they are seldom strong enough to substitute the electricity from the grid. Consequently, so-called unmitigated losses[44] continue to occur, e.g. from damage to equipment, stock, loss of output, restart costs, etc.

Based on a variety of econometric techniques, Osani and Pollitt (2013) estimate the costs from outages for firms in 12 African countries. For Kenya, the authors find that electricity from generators are three times more expensive than electricity from the grid (0.36 versus 0.12 USD/kwh) with unmitigated costs of outages estimated to constitute with around 52% of total outages costs, cf. **Table 6.16**.

As a result of these factors – and as also illustrated in the World Bank data in **Table 6.15** – outages generate measurable losses for Kenyan firms. Osani and Pollitt (2013) estimate the total losses from outages in Kenya to around 1.80 USD/kwh of which 51.6% or 0.93 USD/kwh are unmitigated losses. Based on the data provided in this study, it can be calculated a Kenyan company with electricity use of around 1,500 kwh per month[45], 35.3 outage hours per month and around 170 production hours per month would in other words lose approx. 660 USD per month or approx. 6,700 USD per year from electricity outages in 2013.

[44] Unmitigated outage losses are equal to the total outage losses if no portion of the potential losses or damages due to power outages is mitigated e.g. if a firm has not invested in backup generation. For a firm that has invested in a generator, unmitigated outage losses are the portion of the losses that the firm is unable to alleviate due to the inadequate backup capacity or the unreliability of the backup.
[45] See: https://africacheck.org/factsheets/factsheet-cost-electricity-kenya/

Table 6.16: Estimated costs of outages - Osani and Pollitt (2013)

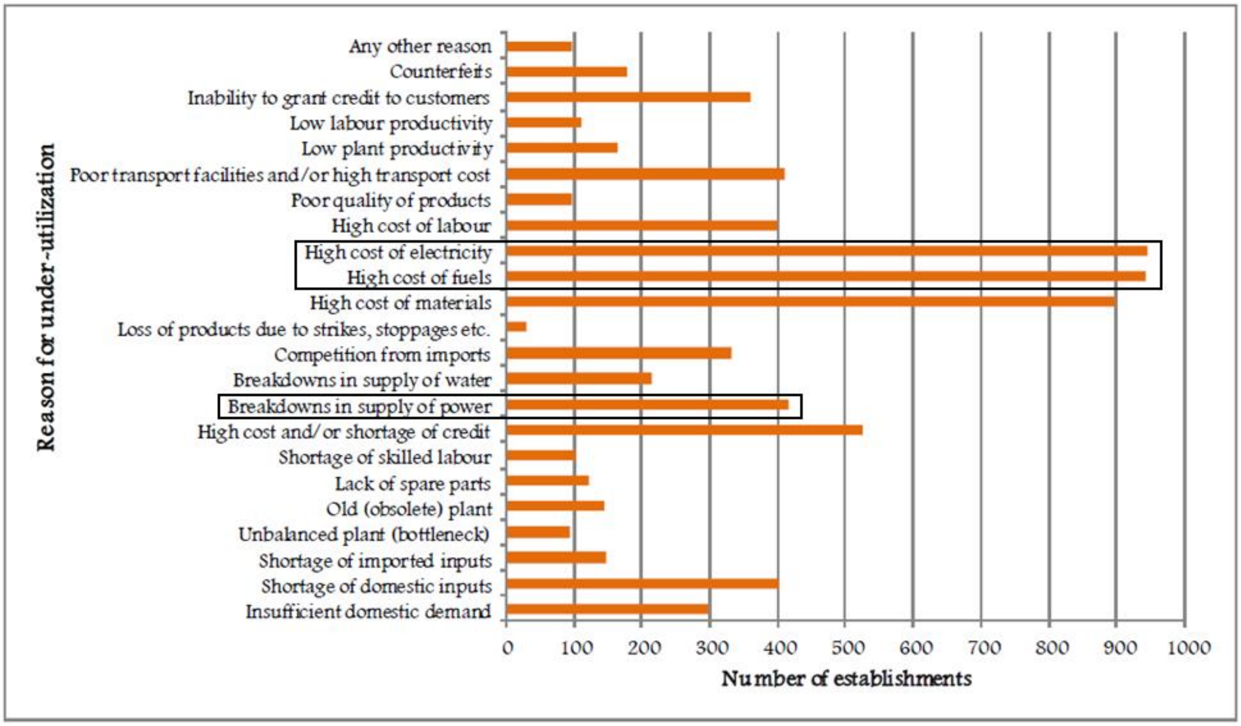
	1	2	3	4	5	6
	Generator costs (USD/kwh)	**Electricity price** (USD/kwh)	**Unmitigated outage costs** (USD/kwh)	**Total outage cost** (USD/kwh)	**Unmitigated outage costs** (%)	**Total annual outage costs** (USD/KW)
Kenya	**0.36**	**0.12**	**0.93**	**1.80**	**51.6**	**6,751[1)]**
Algeria	0.16	0.06	0.57	1.23	46.3	
Egypt	0.30	0.05	0.37	0.81	45.7	
Gambia	0.44	0.20	1.31	2.33	56.2	
Ghana	0.46	0.11	0.49	0.97	51.0	
Mali	0.56	0.24	0.40	0.79	51.0	
Morocco	0.56	0.14	0.43	0.84	51.2	
Mozambique	0.57	0.10	0.38	0.60	63.3	
Nigeria	0.48	0.05	2.39	3.32	72.0	
Senegal	0.57	0.21	0.99	1.90	52.1	
South Africa	0.54	0.04	0.43	0.83	51.8	
Zambia	0.58	0.03	0.39	0.62	63.0	

[1)] Based on 35.5 outages hours per month, 1,500 kwh per month and 171 production hours per month.
Source: Osani and Pollitt (2013).

Based on the observations so far it seems fair to conclude that the costs from electricity outages in Kenya are substantial. In fact, the implications of electricity outages have been identified as *the* main culprit in the low production utilization among Kenyan firms: In a 2010 survey carried out by Kenya National Bureau of Statistics (KNBS), Kenya's production utilization was assessed by respondents to around 61% across manufacturing sectors, corresponding to around 171 hours out of a potential of 278 hours[46]. In the same survey, companies point specifically to high costs of electricity and fuels (also used in generators) as the single most important causes for Kenya's low production utilization, while breakdown of power supply is perceived as the fifth biggest barrier, c.f. **Table 6.17**.[47]

[46] Source: Kenyan Census of Industrial Production (CIP) from 2010 carried out by Kenya National Bureau of Statistics (KNBS)
[47] See: https://www.knbs.or.ke/download/cip-report-2010/

Table 6.17: Perceived reasons for low production utilization among Kenyan manufacturing firms



Source: Kenyan Census of Industrial Production, 2010.

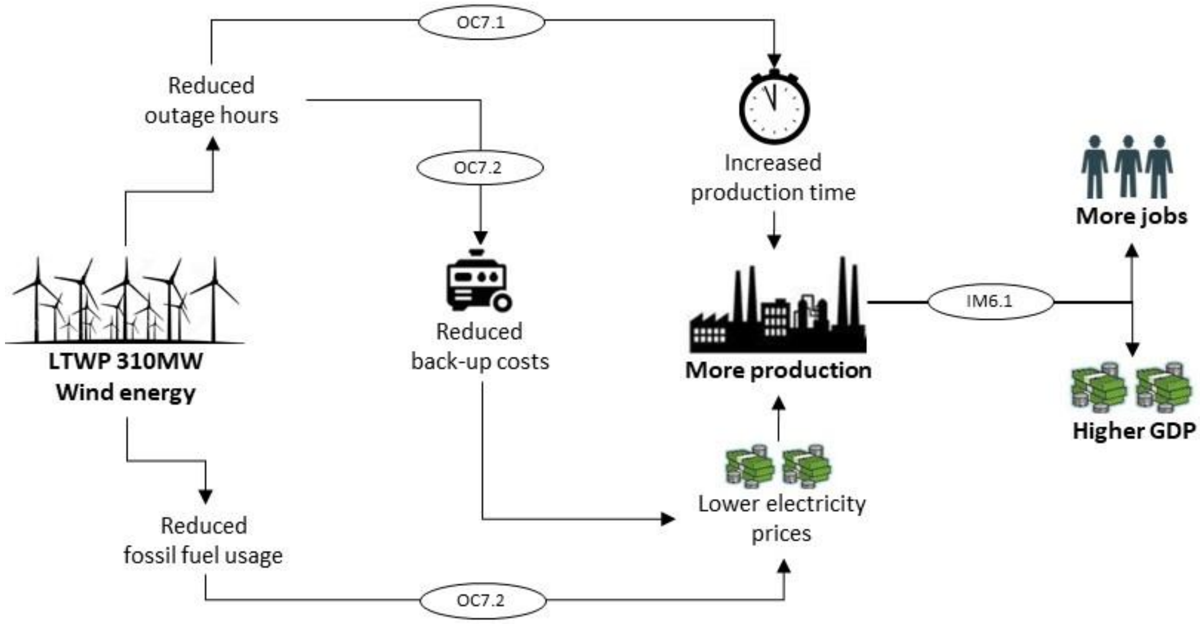
6.6.2 Energy impact hypothesis for LTWP

In the context of the challenges outlined in the previous section, the question is whether the 310MW wind energy generated by LTWP can help reduce the number and duration of outages in Kenya. This is an important question from an impact perspective as fewer outages will provide Kenyan companies with more production time and fewer operational costs, which can in turn lead to increased economic outputs, GDP and jobs to the Kenyan economy. Notably, benefits might also accrue from the additional electricity capacity provided by LTWP which, in cases where demand exceeds supply, will result in a downwards pressure on electricity prices, all else being equal. However, in Kenya, the biggest challenge is currently not a lack of capacity but rather a lack of reliability and efficiency in the supply of electricity.[48]

To this end, the following energy impact hypothesis is presented which illustrates how LTWP may help Kenya reduce its electricity outages and electricity prices/costs. Moreover, it shows how such efforts can contribute to driving economic development and job creation (c.f. IM6.1 in the LTWP impact pathway), cf. **Figure 6.38**.

[48] Interviews with Strathmore Energy Research Center.

Figure 6.38: The LTWP energy hypothesis: Reducing outages and fossil fuel use



As illustrated by the arrows above, it is assumed that the main vehicles through which LTWP will deliver economic value to Kenya is two-fold: Firstly, by reducing outage hours, Kenyan companies will be able to increase their production, cf. OC7.1. in **Figure 6.38**. Secondly, by reducing fossil fuel usage and reducing the need for back-up generators, the cost of electricity will likewise be reduced, cf. OC7.2 in **Figure 6.38**.

It is not yet possible to confirm if the core impacts illustrated in the LTWP energy hypothesis are correct due to lack of data and observations on LTWP's actual energy performance. As a result, a number of assumptions are made based on available reference studies and a review of existing evidence on Kenya's energy supply and costs.

For the quantification of potential changes in GDP and jobs as a result of reduced outages and electricity prices, the study uses an input-out model of the Kenyan economy. The input-output model has been created from 51x51 industry by commodity tables from MRIO[49], cf. **Box 6.1**.

[49] See: http://www.worldmrio.com/

Box 6.1: Input-output model of the Kenyan economy

For the energy analysis a system of input-output models has been set up. The input-output models are based on an input output table for the economy of Kenya in 2015. The input output table is a transformation into standard industry by industry format of a commodity by industry supply-use table for Kenya in 2015 from the Eora MRIO database.[50] Since no consistent employments statistics are available, total employment is assumed to be distributed proportionally to the reported compensation of employees in each sector. Total employment is set at a round number of 15 million people.

A first input output model is setup to study the impact of changes in the output price of the electricity sector on other sectors in the economy. In this cost-push input-output price model quantities are fixed, while prices change. A description of this and the other models used is to be found in section 2.6 in Miller and Blair (2009). A second input-output output model is set up to study the effect of a change in the real wage resulting from changes to output prices in the economy. This model is a standard demand-pull input-output quantity model. Private consumption is made endogenous in the model, by assuming total private consumption to be equal to a fixed proportion of total compensation of employees as described by an exogenous parameter. The model is set up in such a way that this parameter is adjusted proportionally to changes in the real wage. A decline in the real wage will result in lower private consumption and lower activity in the economy, and hence lower employment and GDP. Because private consumption is endogenous, a fall in GDP will lead to a further induced decline of private consumption and thus again in GDP. The difference in effects with respectively endogenous and exogenous private consumption is called “induced effects”.

A third input-output model is setup is setup to study the impact of a change in production capacity of one or more industries on the rest of the economy. This model is used to simulate the impact on production, GDP and employment of changes in lost sale due to fewer power outages. In Kenya. In each sector, the production capacity can be raised or lowered by changing total amount of primary inputs in the sector. This type of model is often characterized as a Gosh supply-push input-output quantity model.

6.6.3 Feasibility assessment I: Impacts from reduction in power outages

Outages in Kenya happen for, at least, two reasons. Firstly, Kenya’s distribution and transmission network is generally in poor shape (IEA, 2015; FUAS). Despite investments in improved network performance, distribution and transmission losses remain a critical issue with the rate of losses being 18.9% in 2017 (KPLC, 2018). Secondly, outages occur due to Kenya’s high reliance on hydro power that especially in recent years has proved unstable due to more frequent droughts and hence more unplanned power outages (ADB, 2011).

While wind and hydropower are both variable energy sources, it is likely that the introduction of 310MW energy to the national grid can reduce some of the electricity outages resulting from hydro power, especially during the dry seasons. Thus, LWTP is located in some the windiest areas in the world with a long-term average wind speed of more than 11.5 m/s.[51] Likewise, the 420 km expansion of the national transmission line in support of the LTWP investment may also help upgrade the hard-pressed national transmission network. Consultations with energy experts during the 2017 field study, including the Energy Research Institute at the Strathmore University in Nairobi, have however made it clear that it is very difficult to say by how, and to what extent, LTWP will be able to reduce electricity outages in Kenya.

[50] See: http://www.worldmrio.com/
[51] See: https://www.dewi.de/dewi/fileadmin/pdf/publications/Magazin_37/02.pdf

In the absence of solid documentation, the feasibility assessment of LTWP's potential impacts on power outages builds on two fictive reduction scenarios:

Scenario 1: In order to minimize risk of optimism bias and deviating results, the purpose of this scenario to compare methodology and results with other similar studies. Thus, due to numerous assumptions and incomplete data, feasibility and impact study results always entail some degree of measurement error. In addition, regardless of type of client and consultant, there is often a built-in incentive to try to boost the results by overestimating benefits and underestimating costs. Therefore, it is important to compare results with other similar studies to minimize these shortcomings.[52] The study used for comparison is Steward Redqueen (2016a). This study found that investments in a renewable energy plant in Uganda eliminated load shedding and reduced power outages for local firms from 28 to 12 hours per month, corresponding to a 58% reduction. To enable comparison, this scenario investigates the impacts from a 58% reduction in electricity outages from energy provided by LTWP. It is important to emphasize that there is no indication that the LTWP will reduce outages with 58%. Therefore, considering a 58% reduction in electricity outages is purely for reasons of comparison.

Scenario 2: In the absence of actual analyses and studies, the purpose of this scenario is to show the most likely impacts of LTWP in terms of reducing electricity outages. Considering that LTWP will provide 320MW in addition to Kenya's existing of 2,336MW, the scenario assesses the impacts of a 10%-15% reduction in electricity outages from LTWP. It is important to emphasize that this assessment needs to be updated once the windmills are in operation and analyses of their actual impacts are available.

6.6.3.1 Scenario 1: Comparison with other similar studies

As mentioned, the purpose of this scenario is purely to compare methodology and results with other similar studies to minimize risk of optimism bias and deviating results. The study used for comparison is Steward Redqueen (2016a) finding a 58% reduction in electricity outages from investments in renewable energy plant in Uganda.

The proportional relationship between outages and production and hence GDP and jobs in Kenya has already been illustrated previously in this section, cf. **Table 6.15**. A closer review of this data shows that– for Kenya overall - an average of 35.5 outages hours per month gave rise to 7.0% lost sales revenue in 2013 which corresponds to 0.20% lost sales per outage hour.

When examining the relationship between outages and lost sales (resulting from lost production), it is important to take into consideration that some outage time can be mitigated, while some outages are unmitigated and therefore produce economic losses. As previously mentioned, Osani and Pollitt (2013)

[52] See for instance, "Reference Class Forecasting" proposed by professor Bent Flyvbjerg at Oxford University. See: http://eureka.sbs.ox.ac.uk/717/

estimated the unmitigated losses from outages to be around 52% for Kenya based on data from the World Bank Enterprise survey 2007. Using the same World Bank Enterprise survey data, this study estimates the unmitigated losses to around 50% for Kenya overall. Considering differences in methods between this study and Osani and Pollitt (2013), the differences in results between the two assessments are rather supportive of each other.

Since Osani and Pollitt (2013), the 2013 World Bank Enterprise survey offering newer data has been published. Using the 2013 survey data, the unmitigated losses are assessed to around 41% suggesting an improvement in terms of firms becoming better at mitigating the potential losses from outages since 2007, cf. **Table 6.18**.

Table 6.18: Electricity outages and unmitigated losses, Enterprise Survey 2013

	1)	2)	3) = 1)/[2)+1)]	4)	5) = 4)/ 3)
	Total outages time per month (hours)	**Production time per month** (hours)	**% outage time of production time** (%)	**% sales loss from outages** (%)	**% unmitigated losses from outages** (%)
Kenya	35.3	171	17.1	7.0	40.8
Manufacturing					
- All sectors	34.2	173	16.5	7.8	47.3
- Food	32.1	171	15.8	7.8	49.3
- Garments and textiles	32.9	190	14.7	7.0	47.6
- Chemical, plastic & rubber	44.1	184	19.3	8.6	44.5
- Other manufacturing	32.8	173	15.9	7.8	49.0
Services					
- All services	35.8	171	17.3	6.7	38.7
- Retail	34.2	171	16.7	5.2	31.1
- Other services	36.7	171	17.7	7.6	42.9
Firm size					
- Small (5-19)	37.7	171	18.1	6.9	38.1
- Medium (20-99)	32.5	171	16.0	6.6	41.3
- Large (100+)	30.7	171	15.3	8.8	57.7
Location					
- Central	33.3	171	16.3	5.4	33.0
- Kisumu	32.1	171	15.8	9.5	60.0
-Mombasa	33.9	171	16.6	6.4	38.6
- Nairobi	66.4	171	28.0	7.8	27.9
- Nakuru	16.1	171	8.6	7.	81.1

Source: World Bank Enterprise Survey 2013 and CIP 2010 from KNBS.

The unmitigated losses are assessed using the latest Kenyan Census of Industrial Production (CIP) from 2010 carried out by Kenya National Bureau of Statistics (KNBS) indicating an average of 171 production hours per month.[53] If no production barriers existed, the total production hours per month could be higher, e.g. 12 hours per day corresponding to 278 hours per month assuming 23 monthly working days.

However, since production barriers do exist, it is preferred to use the admittedly rather old 2010 data from the KNBS study to adjust for lower than optimum production hours. As an example: Using optimum production hours of e.g. 278 hours would have generated unmitigated losses of around 55%, which in turn would have generated higher impact from reduced outage time and therefore overestimated potential GDP and jobs impacts.

Using the ratio of outage hours out of total production hours over lost sales out of total sales as an indicator for unmitigated losses can unfortunately produce skewed results. The objective of the ratio is to determine how many of the total outage hours that transform into lost sales but involving an uncertain assessment of total production hours in this calculation can skew the results.

Therefore, to test for possible skewness, an alternative assessment without total production hours is applied. Considering that the relationship in focus is the one between outage hours and lost sales, a simple linear log-log model for these two variables is estimated:

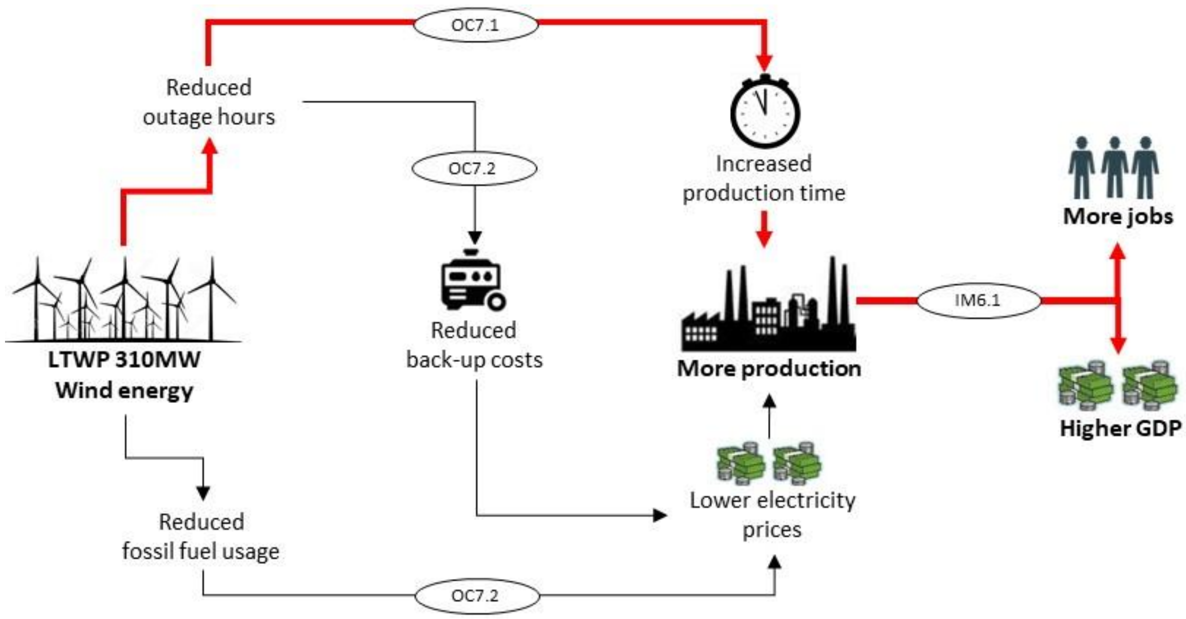
$$\text{Equation 1:} \log(lost\ sales\ ) = \alpha + \beta \cdot \log(outage\ hours)$$

The log-log form generates elasticities and based on the few observations for Kenya in 2013, β is estimated to 0.36 suggesting that 10% reduction in outage time is associated with 3.6% lost sales. Using the model for all 139 countries included in the 2013 World Bank Enterprise survey, β is estimated to 0.44 suggesting that 10% reduction in outage time is associated with 4.4% lost sales. In comparison, the assessment of unmitigated losses in **Table 6.18**, suggests that a 10% reduction in outage time is associated with 4.1% lost sales. Thus, despite different methods, the results do seem to match within reasonable limits which is reaffirming in terms of possible skewness.[54]

[53] The CIF data does not include service sectors, firm sizes or locations. For these dimensions, the overall average of 171 production hours is assumed to be valid. This assumption is due to lack of data and will result in very rough assessments.

[54] Ideally, equation 1 should be estimated using the full Enterprise survey data on firm level, but this requires special permit from the World Bank. See: https://www.enterprisesurveys.org/Portal/Login.aspx?ReturnUrl=%2fportal%2felibrary.aspx%3flibid%3d14&libid=14

Figure 6.39: The impacts of reduced outages hours



Subject to the reservations concerning data, the assessments of the unmitigated losses in **Table 6.18** are used to assess the impacts on lost sales and hence production, GDP and jobs from reduced outages hours, cf. red line in **Figure 6.39**.

As illustrated in **Table 6.18** the World Bank Enterprise Survey data covers various manufacturing and service sectors. Even though the Enterprise Survey sector definitions do not fully correspond to the applied input-output model's 51 sector definitions, it is possible to roughly bridge the two data sources' sector definitions, and thereby enable individual assessments of the sectors included in the World Bank Enterprise survey. Since the Enterprise survey does not cover the agricultural sector, this sector has been assigned data corresponding to the data applied for the national level, which will generate some uncertainty in the assessment.

Subject to these reservations, the following conclusions can be drawn on the impact of outages: Assuming that LTWP will enable a 56% reduction in outage hours, Kenyan companies across all sectors will benefit from a 23.7% average reduction in lost sales, corresponding to a reduction in lost sales from 7.0% to 5.3%. This is in turn assessed to generate an increase in overall production value in Kenya of USD 1.5 billion, cf. **Table 6.19**

Table 6.19: Impacts on lost sales and production of 58% reduction in outage hours

	1)	2)	3) = 1) x 2)	4)	5) = 3) * 4)	6)
	% reduction in outage hours (assumed) (%)	% unmitigated losses from outages (%)	% reduction in lost sales (%)	% lost sales before LTWP (%)	% lost sales after LTWP (%)	Increased production after LTWP (MUSD)
Kenya	58	40.8	23.7	7.0	5.3	**1,496**
Manufacturing						
- All sectors	58	47.3	27.4	7.8	5.7	441
- Food	58	49.3	28.6	7.8	5.6	146
- Garments and textiles	58	47.6	27.6	7.0	5.1	26
- Chemical, plastic & rubber	58	44.5	25.8	8.6	6.4	44
- Other manufacturing	58	49.0	28.4	7.8	5.6	226
Services						
- All services	58	38.7	22.4	6.7	5.2	805
- Retail	58	31.1	18.1	5.2	4.3	96
- Other services	58	42.9	24.9	7.6	5.7	709
Agriculture						
- All sectors	58	40.8	27.4	7.0	5.3	249

Source: QBIS based on World Bank Enterprise Survey 2013, CIP 2010 from KNBS and MRIO.

With USD 805 million, the service sectors are assessed to gain the biggest increase in production value, while the manufacturing sectors are assessed to gain USD 441 million and the agricultural sectors USD 249 million. The overall increase of USD 1.5 billion corresponds to a 1.76% increase in overall production value in Kenya.

From the increased production value, the wider impacts on GDP and jobs can also be assessed. Here the feasibility assessment finds that USD 817 million can be generated in additional GDP along with 252,000 additional jobs[55] from a 58% reduction in power outages. Again, the service sectors are assessed to gain most; USD 455 million in GDP and 153,000 jobs. This also make the service sectors the biggest job generator as the ratio between GDP and jobs is around 337 jobs per 1 million GDP. The agricultural sectors are the second biggest job generator with 313 jobs per 1 million GDP, while the manufacturing sectors come last with 221 jobs per 1 million GDP, cf. **Table 6.20**.

[55] The employment impacts are based on 15.2 million employed persons in Kenya which includes 12.6 million informally employed people (see: https://www.africaresearchinstitute.org/newsite/publications/kenya-failing-create-decent-jobs/) and 2.4 million wage employed people (see: https://www.knbs.or.ke/download/kenya-facts-2015/)

Table 6.20: Impacts on production, GDP and jobs of 50% reduction in outage hours

	Increased production after LTWP (MUSD)	Increased GDP after LTWP (MUSD)	Increased jobs after LTWP (jobs-FTEs)	Jobs per 1 million GDP (jobs/GDP)
Kenya	**1,496**	**817**	**252,000**	**308**
Manufacturing				
- All sectors	441	161	36,000	221
- Food	146	42	9,000	207
- Garments and textiles	26	11	3,000	309
- Chemical, plastic & rubber	44	14	5,000	342
- Other manufacturing	226	94	19,000	199
Services				
- All services	805	455	153,000	337
- Retail	96	48	19,000	389
- Other services	709	407	134,000	330
Agriculture				
- All sectors	249	201	63,000	313

Source: QBIS based on World Bank Enterprise Survey 2013, CIP 2010 from KNBS and MRIO.

It is important to add that the assessed employment impacts are based on 15.2 million employed persons in Kenya. According to Kenya National Bureau of Statistics (KNBS), Kenya had around 2.4 million wage employed persons in 2014.[56] According the Africa Research Institute, this figure had increased to 2.6 million in 2015, but in parallel the number of informally employed persons had increased from 11.9 million in 2014 to 12.6 million in 2015.[57] Thus, around 15.2 million in total in 2015, but with far most people employed in the informal sector and with the informal employment growing fastest in terms of people.

In summary, a 58% reduction in outage hours is assessed to generate a 23.7% reduction in lost sales corresponding to a reduction in lost sales out of total sales from 7.0% to 5.3%. This is turn is assessed to generate in USD 1.5 billion in additional production value, USD 0.8 billion in additional GDP and 252,000 additional jobs to the Kenyan economy, cf. **Figure 6.40**.

In percentages, such impacts correspond to 1.76% increase in production, 1.47% increase in GDP, and 1.68% increase in jobs. In comparison, Steward Redqueen (2016a) found that a 58% reduction in outage hours increased production value by 2.7% and GDP by 2.5%. So, the resulting impacts are less significant than the Ugandan study. One of the reasons for the more conservative results found in this study, is due to differences in how the share of mitigated/unmitigated losses is calculated and, in particular, whether actual production hours or maximum production hours are applied in this calculation. In this study, we have chosen a conservative approach which uses actual versus maximum production hours, however, if

[56] See: https://www.knbs.or.ke/download/kenya-facts-2015/
[57] See: https://www.africaresearchinstitute.org/newsite/publications/kenya-failing-create-decent-jobs/

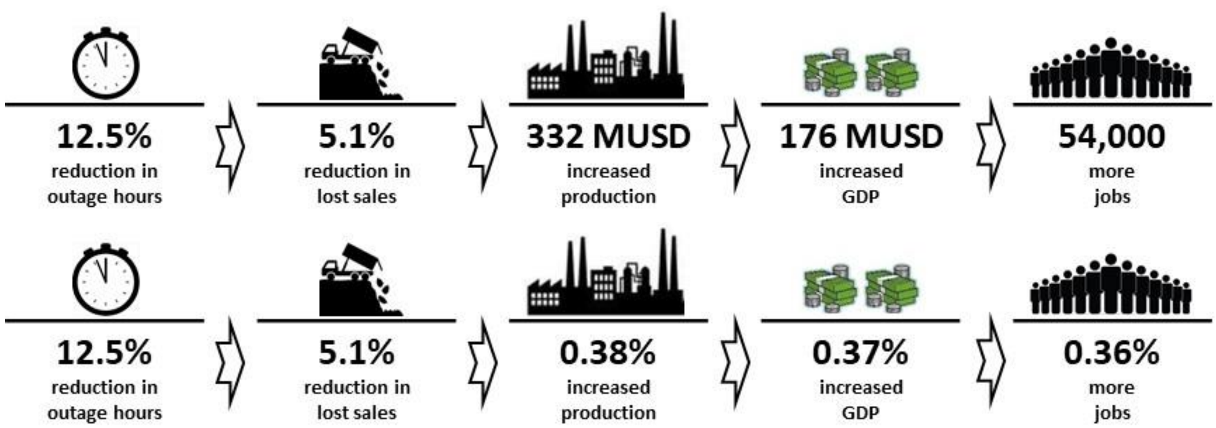
this discrepancy in approach is adjusted for, the findings from the LTWP feasibility assessment of reduced outage hours would have generated relatively comparable results with the Ugandan study.

6.6.3.2 Scenario 2

As emphasized, with the LTWP windmills still not connected to the national grid, it is not possible to conduct an ex-post impact evaluation of LTWP's impacts on electricity outages. In the absence of actual analyses and studies, the purpose of this scenario is to show the most likely impacts of LTWP in terms of reducing electricity outages. Considering that LTWP will provide 320MW in addition to Kenya's existing of 2,336MW, the scenario assesses the impacts of a 10%-15% reduction in electricity outages from LTWP.

If LTWP enable a 10%-15% reduction in outage hours, Kenyan companies across all sectors will benefit from a 5.1% average reduction in lost sales, corresponding to a reduction in lost sales from 7.0% to 6.6%. This is in turn assessed to generate an increase in overall production value in Kenya of USD 332 million, cf. **Figure 6.40**.

Figure 6.40*: Impacts on production, GDP and jobs of 50% reduction in outage hours*



Note: For the sake of simplicity, the 10%-15% is presented with an average of 12.5%.

The increased production value is further assessed to create USD 176 million in GDP and 54,000 jobs. In percentages, this corresponds to 5.1% reduction in lost sales, 0.38% increase in production, 0.37% increase in GDP and 0.36% increase in the number of jobs.

6.6.4 Feasibility assessment II: Impacts from lower electricity prices

Whenever firms experience outages, those who can will turn on their generators to try to mitigate the losses. As mentioned in section 6.6.1, in 2013, the World Bank survey reported that around 57% of Kenyan firms had a generator suppling around 14% of their electricity, cf. **Table 6.15** while Oseni and Pollitt (2013) estimated that using a generator was three times costlier than getting electricity from the grid, cf. **Table 6.16**. In 2017, prices of electricity were around 0.22-0.23 USD/kwh, which means that the price of using generators for approx. 14% of Kenyan firms' electricity consumption was around 0.66-0.69 USD/kwh.

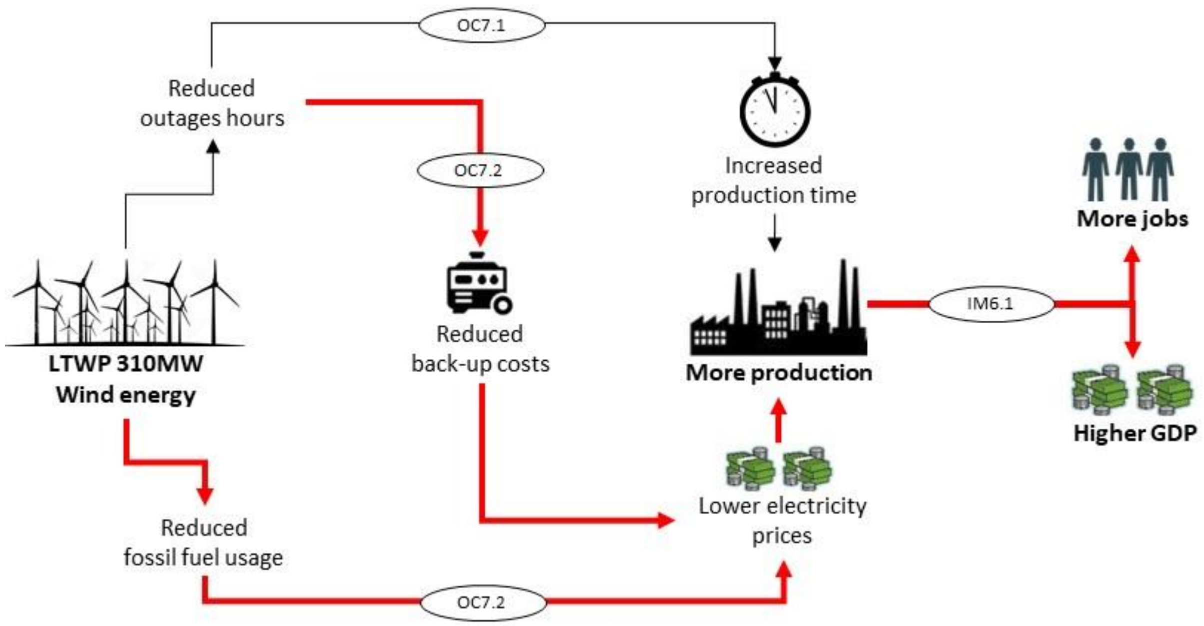
However, a high level of outages can also have other consequences for the price of electricity. In Kenya, the variability of hydro power supply during droughts is often compensated by increasing power production at the fossil fuel plants, which increases the cost of power production. As an example, LTWP Ltd (2009) describes how KenGen in 2000 rented 100MW extra diesel generators at a total extra cost of USD 632 million, while losses of rationing electricity and outages were estimated to be around USD 1,400 million. Further, in 2017, KPLC (2017) reported that fuel cost had increased from USD 126.9 million in 2016 to USD 221.2 million in 2017 due to increased usage of thermal (fossil) sources caused by less than expected power from the hydro plants. In 2017, Kenya's total power purchase costs, excluding fuel and foreign exchange costs, were USD 506.2 million.

In connection with the social and environmental impact assessment of LTWP, ADB (2011) estimated that LTWP could save Kenya up to EUR 100 million per year on imports of heavy fuel oil for emergency power, thereby strengthening Kenya's current account and helping stabilize the Kenya currency. With fluctuating oil and gas prices, reducing dependency on fossil fuels would further help reduce Kenya's vulnerability to price increases and energy supply issues (see e.g. ESMAP, 2005b).

Considering that thermal (fossil) sources accounted for around 21% of Kenya's total electricity generation capacity in 2016/2017, and that LTWP has been stated to produce – and potentially replace – around 13%[58] of Kenya's total electricity capacity, LTWP has a significant potential for reducing fossil fuel usage for electricity supply in Kenya. By substituting fossil fuel with wind energy, cf. OC7.2 in **Figure 6.41**, while providing a more stable power supply that can reduce the costs of generators, cf. OC7.1. in **Figure 6.41**, it is assumed that LTWP has a significant role to play in lowering the price of electricity, cf. **Figure 6.41**.

[58] According to KPLC (2017), Kenya had installed capacity of 2,333MW in 2017. LTWP's 310MW constitutes around 13% of this installed capacity.

Figure 6.41: The impacts of reduced fossil fuel and back-up systems (generators) usage

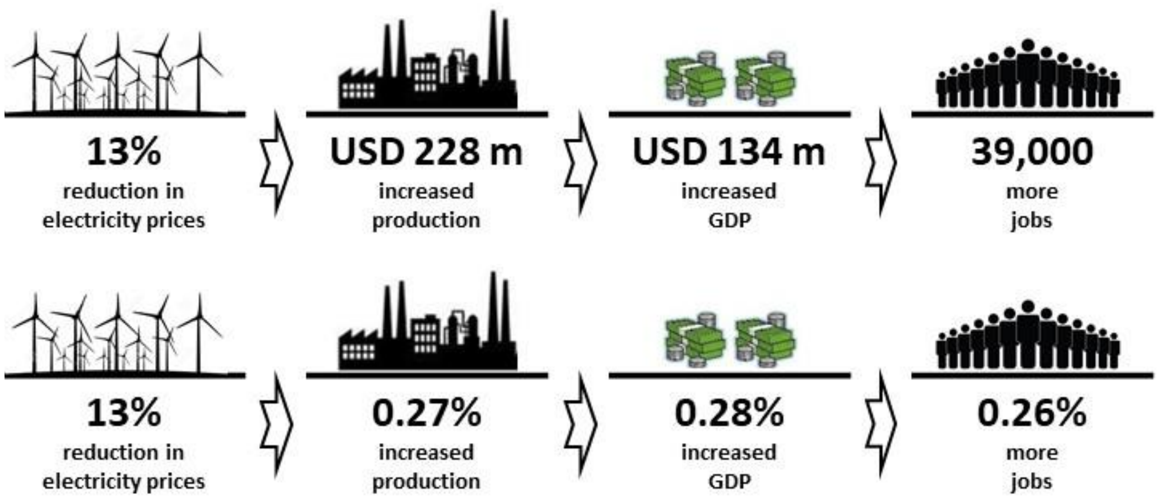


Like outages, it is however difficult to say by how much LTWP potentially can reduce electricity costs and prices. Alvarez and Valencia (2015) find that changing the structure of electricity generation in favor of natural gas and away from fossil fuel could lead electricity prices to decline by 13%, boost manufacturing output by 1.4%-3.6%, and increase overall GDP by up to 0.6%. Steward Redqueen (2016a) found that a 26% increase in power prices in Uganda would be associated with a 2.2% decrease in manufacturing production and a 0.3% decrease in GDP. Bridging to Alvarez and Valencia (2015), Steward Redqueen (2016a) results correspond to a 13% increase in power price would generate a 1.1% decrease in manufacturing production and a 0.15% decrease in GDP.

To allow for easy comparison between the LTWP feasibility assessment and the findings from Alvarez and Valencia (2015) and two Steward Redqueen (2016a), a fictive 13% reduction in electricity prices from the LTWP investment has been applied. Since neither Kenya, Uganda and Mexico are directly comparable in terms of structure of electricity generation or electricity use by industry and households, this comparison has its limitation and should be considered purely indictive. This also due to the fact that the methodologies of studies are different. In this study, using the described input-output model, cf. **Box 6.1**, we simulate the impact of a 10% increase in the output price of electricity in the economy by adjustment of the costs of primary inputs in the sectors. Steward Redqueen (2016a) also apply an input-output model but uses a different approach to simulate the impact of changes in the electricity price. Alvarez and Valencia (2015) apply yet another approach in terms of a panel VAR setting. Comparing results should be done with caution but is on the other hand necessary to minimize risk of optimism bias and deviating results.[59]

Subject to these reservations, this study finds that an assumed 13% reduction in electricity prices from LTWP would be associated with an increase in overall production (not only manufacturing) of around USD 228 million. Similar to the approach applied for outages, this increase is in turn associated with around USD 134 million increase in GDP and around 39,000 additional jobs, cf. **Figure 6.42**.

Figure 6.42*: Impacts on production, GDP and jobs of 10% reduction in electricity price*



In percentages, this corresponds to 0.28% increase in GDP. By comparison, Alvarez and Valencia (2015) assessed a 0.6% increase in manufacturing GDP from a 13% reduction in electricity prices, while Steward Redqueen (2016a) assessed a 0.15% decrease in manufacturing GDP from a 13% increase in electricity prices. Thus, this study's results are located between the results of Alvarez and Valencia (2015) and Steward Redqueen (2016a). While this does indicate some consistency in terms of the potential impacts from changes in electricity prices, it is important to emphasize that input-output models as well as econometric models always are subject to uncertainty and that their results should be regarded as indications of the sizes of potential impacts rather than facts.

6.6.5 Summary of findings

Since LTWP is not yet operational, this section has conducted a feasibility assessment of the potential impacts of the 310MW additional energy which will supplied by LTWP to the national grid. To this end, the analysis has focused on two main vehicles through which the main benefits for Kenya's economy are believed to occur: 1) reduced power outages enabled partly by increased security of supply, e.g. during droughts and 2) reduced electricity prices due to reduced consumption of expensive thermal (fossil) energy sources as well as less usage of back-up generators.

[59] This is also referred to as Reference Class Forecasting as proposed by professor Bent Flyvbjerg at Oxford University. See: http://eureka.sbs.ox.ac.uk/717/

The main findings of the feasibility assessment are:

Ad 1): An assessed 10%-15% reduction in power outages is associated with 5.1% reduction in lost sales, which in turn is associated with a 0.36%-0.38% increase in production, GDP and jobs, corresponding to USD 332 million in production, USD 176 million in GDP and 54,000 additional jobs.

Ad 2): A randomly chosen 13% reduction in electricity prices due to use of cheaper wind power instead of expensive thermal (fossil) power is assessed to be associated with a 0.26-0.28% increase in production, GDP and jobs corresponding to USD 228 million in production, USD 134 million in GDP and 39,000 additional jobs.

The underlying assumptions behind the results presented in this section will needless to say require empirical testing and, likely, some adjustments once LTWP is in full operation and performance data starts to emerge. As mentioned throughout this section, the results from the feasibility assessment are therefore also accompanied by a great level of uncertainty and should be regarded as rough estimates rather than factual impacts.

Finally, it should be stated that if LTWP's 310MW wind power is used to replace some of Kenya's current thermal (fossil) power consumption, it will lead to a measurable reduction in emissions and thereby contribute to Kenya's climate change mitigation efforts. Further, as an oil-importing, low-income country, Kenya is particularly vulnerable to oil price increases, and reduced usage of fossil fuels enabled by LTWP can therefore also have measurable fiscal effects, e.g. on Kenya's balance of payments and currency (see e.g. ESMAP, 2005b). The climate and fiscal related impacts of increased renewable energy consumption have not been reviewed in the preliminary energy feasibility assessment but is recommended to be included in future studies once actual performance data is available.

7 CONCLUSION AND INPUT FOR FUTURE EVALUATIONS

Taking an outset in selected features of the Lake Turkana Wind Power project in Kenya, this study has offered insights into some of the key outcomes and impacts from wind farm developments and auxiliary investments in access roads and local capacity building. As these insights are anchored in a developing country context characterized by high concentrations of rural poverty and energy instability, the study contributes with novel insights to the existing evidence on wind energy developments which has tended to focus mostly on socio-economic implications of wind farms in high-income host countries.

While the LTWP project is still in relative infancy, the study has identified several preliminary impacts from the investment, most notably in terms of the observed changes in traffic and transport patterns from the upgraded access road. Based on the large body of evidence from rural road investments in developing countries, it is highly plausible that the observed traffic and transport changes discovered in this study will have long-lasting spill-over effects in the project area. Importantly, such effects can be mutually reinforced by the efforts of LTWP Ltd. and key partners such as Vestas in enhancing local capacity in the host communities e.g. in areas such as infrastructure development, local employment, skill development and peace and cohesion.

Beyond the local level, the study also offers novel insights on the energy-related outcomes and impacts of the LTWP project at the macro-economic level. Again, these types of impacts are often left out of existing impact assessments of wind farm developments, which tend to focus solely on economic value-added and job creation from the local operation of wind farms ('first-order effects') rather than the wider economic gains from enhanced renewable energy supply and access ('second-order effects'). Given that energy performance data from the future operation of LTWP does not yet exist, the study has conducted a feasibility assessment to illustrate the energy-related contributions of LTWP to Kenya's economic development, once operational. Due to the uncertainty involved in these types of feasibility assessments, the assessment can be empirically tested and adjusted once the wind farms are connected to the national grid.

Overall, the study can be used by the Clients in three ways:

Firstly, it can be used as an early indication of whether the wider purpose of the LTWP project is being fulfilled, which is to provide a 'reliable, low cost energy base' to the Kenyan population while ensuring that the 'local communities benefit' from the project. While this study has provided some preliminary insights to this end, additional data collection and monitoring will be required if the Clients wish to further substantiate the wider spill-over effects from the LTWP project including, but not necessarily limited to, some of the core impact dimensions introduced in this study. More specifically, it is recommended that such efforts gather additional data from the impacted households and communities, either through pragmatic rapid rural appraisals or a more comprehensive panel survey approach or, alternatively, a combination of the two. To this end, it should also be explored if more granular data (i.e. at the sub-county and town/village level) can accessed from the 2015/16 Kenya Integrated Budget Household Survey and used for developing a more comprehensive baseline which can be tracked over time.

Secondly, the study offers a methodological framework which can be applied by the Clients to assess the impacts from future wind energy investments in developing countries. The impact pathway presented in this study, while specific to the LTWP investment and the pre-defined scope for the assessment, has been designed with replicability in mind. The Clients may therefore use the pathway, including the core outcome and impact dimensions and suggested gross-indicators (Appendix C), as a starting point for future assessments, with some adaptation to the specific project context. An important aspect of future assessments will be the choice of appropriate research design to allow for proper empirical testing of the impact pathway. As stated in the study's methodology section, impact studies can vary greatly in the type and magnitude of the data collected and the rigor with which such data is evaluated. Even the most advanced impact assessments can leave gaps or uncertainties for further assessment, and costs and benefits of additional data collection and analysis, including choice of appropriate research design, therefore need to be carefully weighed and set into proportion with the size and magnitude of the expected impacts. Further, with investments such as the LTWP project that extend over several decades, it is recommended to design the impact evaluation as a longitudinal monitoring program rather than a one-off exercise. A preliminary data collection on core indicators should ideally be initiated *ex ante* in order to develop a comparable baseline – e.g. on traffic and transport, rural economy, education, health, governance and social capital – which can be monitored over time. This approach requires consistency in the choice of i) which impact dimensions to monitor and ii) what indicators to apply and, iii) how data is collected, thereby allowing for comparability of results over time. It is the authors' hope that this study will contribute to the Clients' efforts to evaluate the wider impacts from renewable investments, also beyond the LTWP project.

Thirdly, with this study, preliminary evidence has been established on the shared benefits that can accrue from integrated wind farm developments with stated objectives to deliver tangible value to its host communities. In that sense, the impact of the LTWP project extends well beyond the turbines themselves with auxiliary investments in improved rural accessibility and local capacity building effectively acting as 'impact multipliers' and positively reinforcing the standard economic outputs (tax, turnover, jobs) which are to be expected in any wind farm investment. This also underlines the possibility for investors, lenders and developers to increasingly plan their investments and tender processes with 'the end in mind', e.g. by choosing contractors with dedicated community development strategies, programs and on-ground experience. By planning their investments for shared benefits, wind farm investors, lenders and developers will not only help strengthen the project's license to operate, e.g. by reducing the risk of community conflict and delays, but also increase the positive impact potential of their investments in a developing country context in line with the Sustainable Development Goals.

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APPENDIX A: DETAILED IMPACT PATHWAY

See attached PDF

APPENDIX B: FIELD VISIT OVERVIEW

Purpose and scope of field visit

To assess the local context of the LTWP project and get an overview of available data for the study, a field study was carried out in November 2017 by QBIS Consulting accompanied by Vestas Eastern Africa CSR Relationship Manager and Community Liaison Officer. The main purpose of the field visit was to collect data on potential impacts from the LTWP investment in the general project area – i.e. the Loyangalani district of Marsabit County – while meeting with central energy stakeholders in Narobi to better understand the national energy context. Data related to impacts on the environment and the resettlement of Sarima village were deliberately excluded from the field study as they are not considered part of the scope of this study but rather covered in other assessments.

Due to multiple factors including Kenyan elections, severe drought in the project area and unavailability of representatives from LTWP/Winds of Change, the initial field visit scope which involved interviews with local community members in the project areas was reduced to an observation study of select villages combined with interviews with selected local government officials and NGOs and experts in the area. **Appendix-Table 1** provides an overview of the main activities and interviews conducted during the field visit.

Appendix-Table 1: Overview of field visit, November 2017

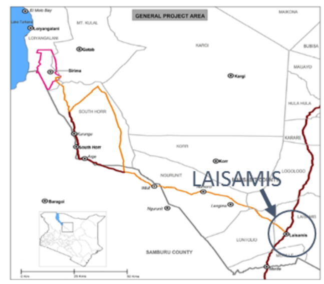
Day	Activity	Interviewees
November 27	- Meeting with GiZ, Nairobi - Transportation Nairobi-Shaba	GiZ Team Leader, Adaptation to Climate Change in Northern Kenya (Mr. Torben Lundsgaard)
November 28	- Transportation Shaba – Laisamis - Meeting with Laisamis DCC and Peace Chairman - Transportation Laisamis-Concession area, including observation along Project road and in Laisamis, Namerei, Illaut, Korr	Deputy County Commissioner Laisamis (Mr. Dickson Mutua) Peace Chairman Laisamis (Mr. Peter Galwersi)
November 29	- Transportation Concession Area – Loyangalani - Meeting with Loyangalani DCC and OPC - Observation in Loyangalani - Transportation Loyangalani – Concession Area - Meeting with Strathmore Energy Research Center	Deputy County Commissioner Loyangalani (Mr. James Kihoria) Officer Commanding Police Department Loyangalani (Mr. Benjamin Mwathi) Researcher Izael Da Silva Researcher Geoffrey Ronoh
November 30	- Transportation Concession Area – Laisamis, including observation along Project road and off project road through South Horr and Kurungu - Transportation Laisamis – Shaba	

Profiles of select villages from field visit

Prior to the field visit, seven villages were identified as relevant for the observation study based on pre-defined criteria to ensure the broadest possible representation of the project area, including village size, data availability, tribal orientation, distance to project road and development stage. Importantly, each of the seven villages are likely to have been directly or indirectly impacted by LTWP's core activities as well as WoC and/or Vestas' capacity building efforts in the area, although potentially to varying extends. As an example, the overview includes three villages directly on the project road (Laisamis, Namarei, Illaut) and five villages located off the project road (Korr, Kargi, South Horr, Kurungu, and Loyangalani) which may influence the extent to which benefits accrue and are distributed within the project area over time.

Laisamis

Laisamis is the largest town in the project area with a population of approx. 18,500. The town is well-connected to Marsabit town through the newly upgraded A2 road network. During the field visit it was observed that Laisamis has the most developed market in the project area with many small-scale businesses along the A2 road as well as multiple shops in the service industry and a fuel station. Laisamis was also reported to be electrified by a "mini-grid" powered by generators. Cement and construction materials were observed and available. Soil is barren with low shrubs.



Laisamis has two health facilities, of which the Laisamis sub-county hospital has received support from Vestas in form of solar equipment for improved lighting and power, potentially benefiting an estimated 9,000 people according to Vestas' internal estimates (ERM, 2017).

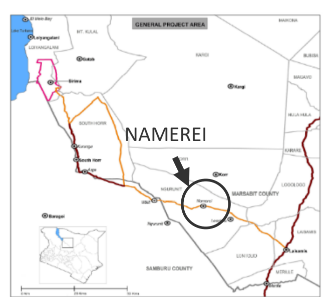
Pictures from field observations in Laisamis (Nov. 2017)

1) Fuel station, Laisamis

2) Small shops incl butcher along the A2 road, Laisamis

Namerei

A small village of approx. 4,500 people on the project road with scattered traditional shelters and less than 5 permanent buildings (i.e. relatively low development level). The village was observed to have barren soil with only low shrubs and few trees, and hence highly dependent on livestock. No market and no shops/services were observed during the field visit but as Namerei is directly on the project road, very small shops may exist.



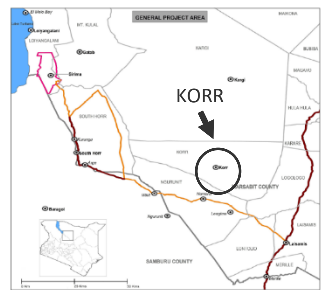
Pictures from field observations in Namerei (Nov. 2017)

1) Images of new settlement btw. Namerei & Laisamis, 500 meters from road

2) Permanent house under construction in Namerei

Korr

A very small village (population unknown) off the project road with scattered traditional shelters and relatively low development level. Barren soil with only low shrubs and few trees and highly dependent on livestock. No local markets were observed during field visit. Vestas has invested in several local capacity building projects in and around Korr, namely installation of solar systems to upgrade the Burriaramia Dispensary and the Korr IT center aimed at increasing the capacity and skills of the local workforce.



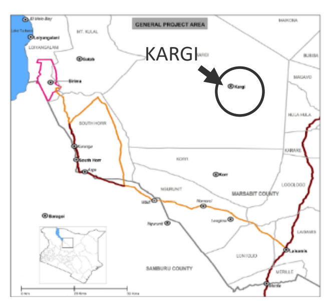
Pictures from field observations in Korr (Nov.2017)

1) Manyattas - traditional shelters of temporary materials

2) Dispensary Korr (solar power provided by Vestas)

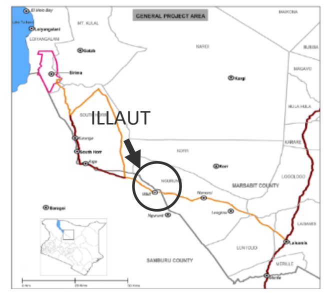
Kargi (not included in field visit)

A larger town of approx. 12,500 people off the project road, reportedly with markets at the same development level as Loyangalani and South Horr (e.g. cement is supposedly sold in the market). The trip to Kargi was not conducted but data from local field interviews confirms that Kargi is relatively well-developed as seen in the relatively high school attendance and presence of two health facilities. Kargi is on the Loyangalani-Kargi-Marsabit route, however, this road is less used now due to the project road. Travelers, lorries and busses to Marsabit generally prefer the project road due to the better condition.



Illaut

A small village of approx. 3,000 people at a relatively low development stage directly on the project road. The town stretches along the road with scattered temporary shelters and a few small shops for refreshments. A local market, including livestock, exists and held twice per month has been observed. No permanent structures were observed in the market, however, only temporary ones. Barren soil with only low shrubs, few trees with the town highly dependent on livestock. Vestas has supported the town of Illaut with a solar system at the town's only health facility, Illaut Dispensary, to increase access to lighting and power (ERM, 2017).



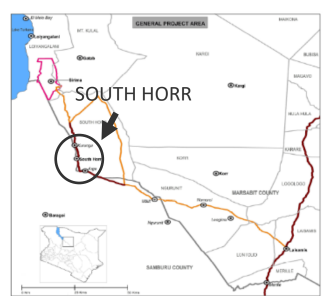
Pictures from field observations in Illaut (Nov. 2017)

1) Illaut market – temporary structures only

2) Camel heard near Illaut

South Horr

A small to medium-sized village of approx. 2,000 people according to best available data from Vestas although the town was observed as bigger during field study. Many permanent structures, especially in market and along main road. Market is developed, e.g. sells cement, and has many permanent shops. Arid climate, however, receives more water than elsewhere in the project area and offers some farming opportunities – e.g. fruit trees, kitchen gardens, etc. – and farmers sell produce.



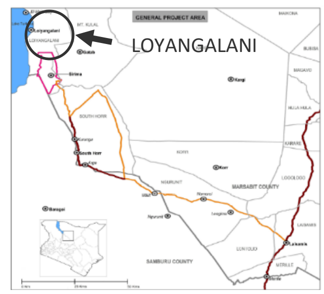
Pictures from field observations in South Horr (Nov. 2017)

1) Butchery, South Horr, no running water or electricity

2) Green house, South Horr

Loyangalani

Most developed town and market, other than Laisamis and possibly Kargi with a population of approx. 7,000 people. Loyangalani is located 40 km from the town of Sarima where the project road ends. The 40 km road connecting Loyangalani with Sarima is in poor condition. The main street has many shops and services in permanent structures, also multiple guest houses and restaurants were observed. Fishing and livestock are the main sources of livelihoods.



Pictures from field observations in Loyangalani (Nov. 2017)

1) One of the guest houses catering tourists, Loyangalani..

2) Loyangalani market, estimated to approx. 80 shops

APPENDIX C: INDICATORS FROM IMPACT PATHWAY AND RAW OBSERVATIONS

See attached PDF

APPENDIX D: TRAFFIC SURVEY QUESTIONNAIRE

Questions for bus passengers

1) What is your name
2) Where do you live (area, town, or similar)?
3) Where did you get on the bus/lorry?
4) Where are going to with the bus/lorry?
5) What is the purpose of your trip?
6) How often do you take the bus/lorry for this purpose?
7) Do you take the bus/lorry for other purposes?
    a. If yes, please state these purposes:
    b. If yes, how often do you take the bus/lorry for these purposes? Please state the number of times for each purpose.
8) Before the road was rehabilitated, how often did you take the bus/lorry for these purposes?
9) What do you do for a living (e.g. livestock, fishing, other)?
10) What does your family do for living (e.g. livestock, fishing, other)?
11) How old are you?

Questions for lorry drivers

1) What types of freights are you transporting and for whom?
    a. Freight type 1: Type:____________________Customer:____________________
    b. Freight type 2: Type:____________________Customer:____________________
    c. Freight type 3: Type:____________________Customer:____________________
    d. Freight type 4: Type:____________________Customer:____________________
2) From where and to where are you transporting this freight?
    a. Freight type 1: From where:_________________To where:_________________________
    b. Freight type 2: From where:_________________To where:_________________________
    c. Freight type 3: From where:_________________To where:_________________________
    d. Freight type 4: From where:_________________To where:_________________________
3) How often do you transport these types of freight today (number of times per month/quarter)?
    a. Freight type 1: Frequency:____________________no of times/month-quarter
    b. Freight type 2: Frequency:____________________ no of times/month-quarter
    c. Freight type 3: Frequency:____________________ no of times/month-quarter
    d. Freight type 4: Frequency:____________________ no of times/month-quarter
4) How often did you transport these types of freight before the Laisamis-Loiyangalani road was rehabilitated (number of times per month/quarter)?
    a. Freight type 1: Frequency:____________________no of times/month-quarter
    b. Freight type 2: Frequency:____________________ no of times/month-quarter
    c. Freight type 3: Frequency:____________________ no of times/month-quarter
    d. Freight type 4: Frequency:____________________ no of times/month-quarter
5) What is the transport price today measured in KES per kg/tons?

a. Freight type 1: Price_______________Kes/kg-tons
b. Freight type 2: Price_______________Kes/kg-tons
c. Freight type 3: Price_______________Kes/kg-tons
d. Freight type 4: Price_______________Kes/kg-tons

6) What were the transport price before the Laisamis-Loiyangalani road was rehabilitated measured in KES per kg/tons?
   a. Freight type 1: Price_______________Kes/kg-tons
   b. Freight type 2: Price_______________Kes/kg-tons
   c. Freight type 3: Price_______________Kes/kg-tons
   d. Freight type 4: Price_______________Kes/kg-tons