Socio-economic impact study of key impacts from the LTWP project

Key findings from technical report
June, 2018

Quantifying Business Impact on Society

Executive summary

Executive summary

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 have commissioned a preliminary study of the emerging socio-economic impacts from the Lake Turkana Wind Power project in Kenya.

Based on best-available data from the project area, the study examines how core elements of the LTWP project – notably the LTWP access road, selected capacity building efforts in the project area and the project's future contribution to the national grid – can contribute to important socio-economic development objectives, both at the local and national level.

The study serves as an initial baseline and methodology for establishing a more comprehensive and longitudinal impact assessment and monitoring framework which can capture the full suite of benefits as well as costs from the Lake Turkana Wind Power project. It also serves as inspiration for how to measure the impact of wind farm investments in future projects.

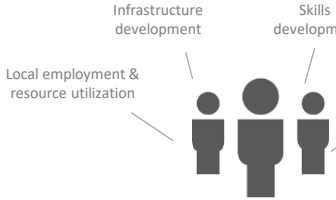
	Traffic and Transport	Rural Economy	Health & Education	Governance & Community Cohesion	Energy Supply & Costs
Caused by	LTWP access road	LTWP access road, Local capacity building, LTWP wind farm (first-order effects)	LTWP access road, Local capacity building	LTWP access road, Local capacity building	LTWP 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: LTWP technical report, Executive Summary

1 *First-order energy effects from wind farm development and operation*

2 *Second-order energy effects from wind energy use*

Inputs



LTWP wind farm

1

USD 870 m
invested in LTWP wind farm development

1,800-1,900 jobs
during construction with **320-350 jobs** expected during operation, approx. 75% from Marsabit

KES 24,903/month
average monthly salary paid to local community members (Vestas example), more than **five-fold** the total monthly expenditure per adult in Marsabit

2

LTWP access road

USD 30 m
invested in upgraded LTWP access road

Transport effects and induced outcomes for rural economy

2 days → 4 hours
reduction in travel time (max) along the upgraded rural road

x9 and x3.5
increase in bus and lorry traffic before/after rural road upgrade

16-37%
reduction in transport prices before/after rural road upgrade

'TILD' effects

20-30%
decrease in price for certain foods at local markets, potentially enabled by access road

Three-fold increase
in net gain for sale of fresh vs. dry fish for local fishermen enabled partly by upgraded road, equivalent to an extra **2,600 KES per fisherfolk**

Income multiplier?
income from LTWP and/or reduced transport can lead to induced spending levels of +50% based on evidence from other rural community in Kenya. More data needed to estimate this effect for LTWP project area.

Local capacity building (WoC/Vestas)

USD 11.5 m
Winds of Change's (WoC) future investment in local capacity building (20 years)

USD 0.82 m
Vestas' contribution to WoC's local capacity building projects during construction (focus of study)

Improved access
to local health and education facilities, enabled by selected WoC investments, including Vestas, and (potentially) upgraded access road

Strengthened governance
and security observed in project area due to increased government funding and improved access to project area (from road)

A changing community
several changes observed to community values and livelihoods, e.g. diversified diets and economic activities. Community conflicts appear to remain relatively stable before/after LTWP

Long-term impacts?

IM1**: Changes to rural income, consumption and poverty levels **(+)

IM2, IM3**: Changes to education and health (literacy, mortality) **(+)

IM4, IM5**: Changes to community cohesion and governance **(+/-)

Local/regional impacts

National impacts

+310MW
of reliable wind energy supply to Kenya's national grid

12.5%*
reduction in electricity outage hours for local companies *(*assumed)*

-20%
reduction in lost sales from outages

-10%*
reduction in electricity costs, respectively *(*assumed)*

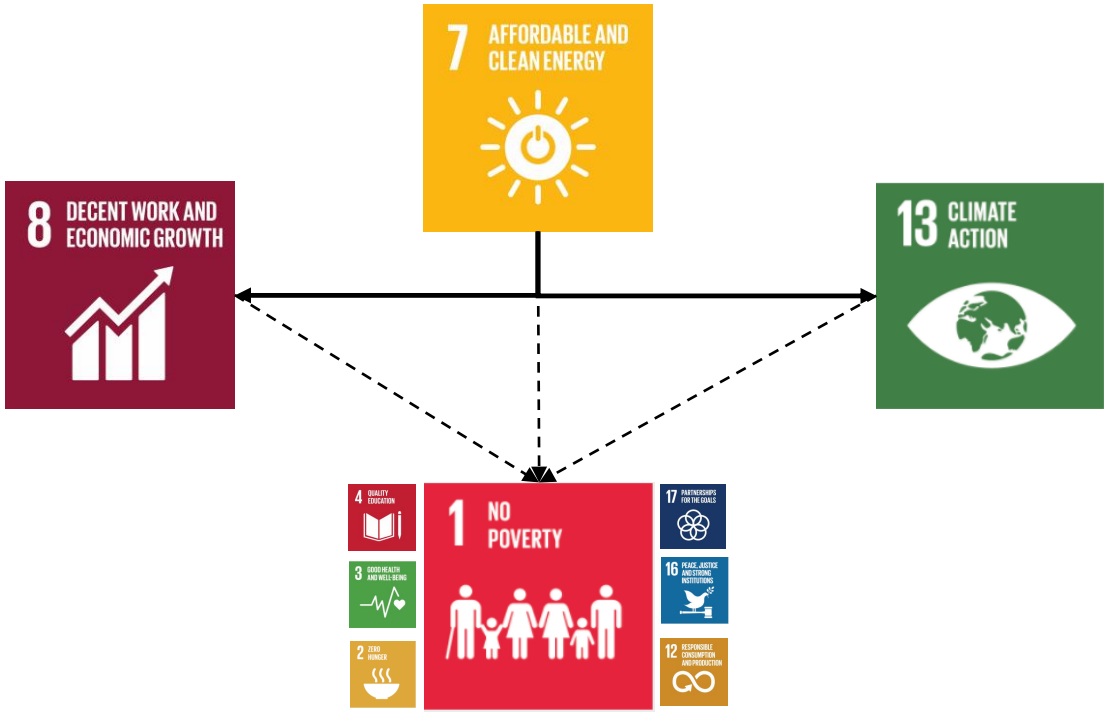
IM6**: Changes to energy supply & and costs **(+)

USD 560 m in output
USD 310 m in GDP
93,000 new jobs

NOTE: These numbers are potential gains based on a hypothetical scenario

Introduction

Client motivation: How does wind-farm development contribute to inclusive economic development?



Study objective and deliverables

Objective

- Generate preliminary and, where possible, quantifiable insights into emerging socio-economic impacts from selected elements of the LTWP project
- Provide inspiration for future impact assessment and monitoring efforts involving wind farm developments in low-income countries

Deliveries

- Identification of material socio-economic indicators from core elements of the LTWP project and an integrated framework for tracking progress of the LTWP project over the coming 20+ years

- Preliminary ex post and ex ante evaluations from the construction and (future) operation of LTWP, namely on traffic and transport, local market development and energy




Various pictures from project area taken by QBIS during 2017 field observation study

Review of existing knowledge

- Three strands of literature identified with relevance for the LTWP project and future wind farm investments
- Majority of existing evidence focused on first-order effects from wind farm development and operations in a developed country context (EU, US)
- Limited evidence on second-order socio-economic impacts from renewable energy access in developing country context with few exceptions
- Extensive literature on importance of rural road access stresses the importance of including auxiliary investments in impact study scope

	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: LTWP technical report, summary of findings from literature review

Methodology

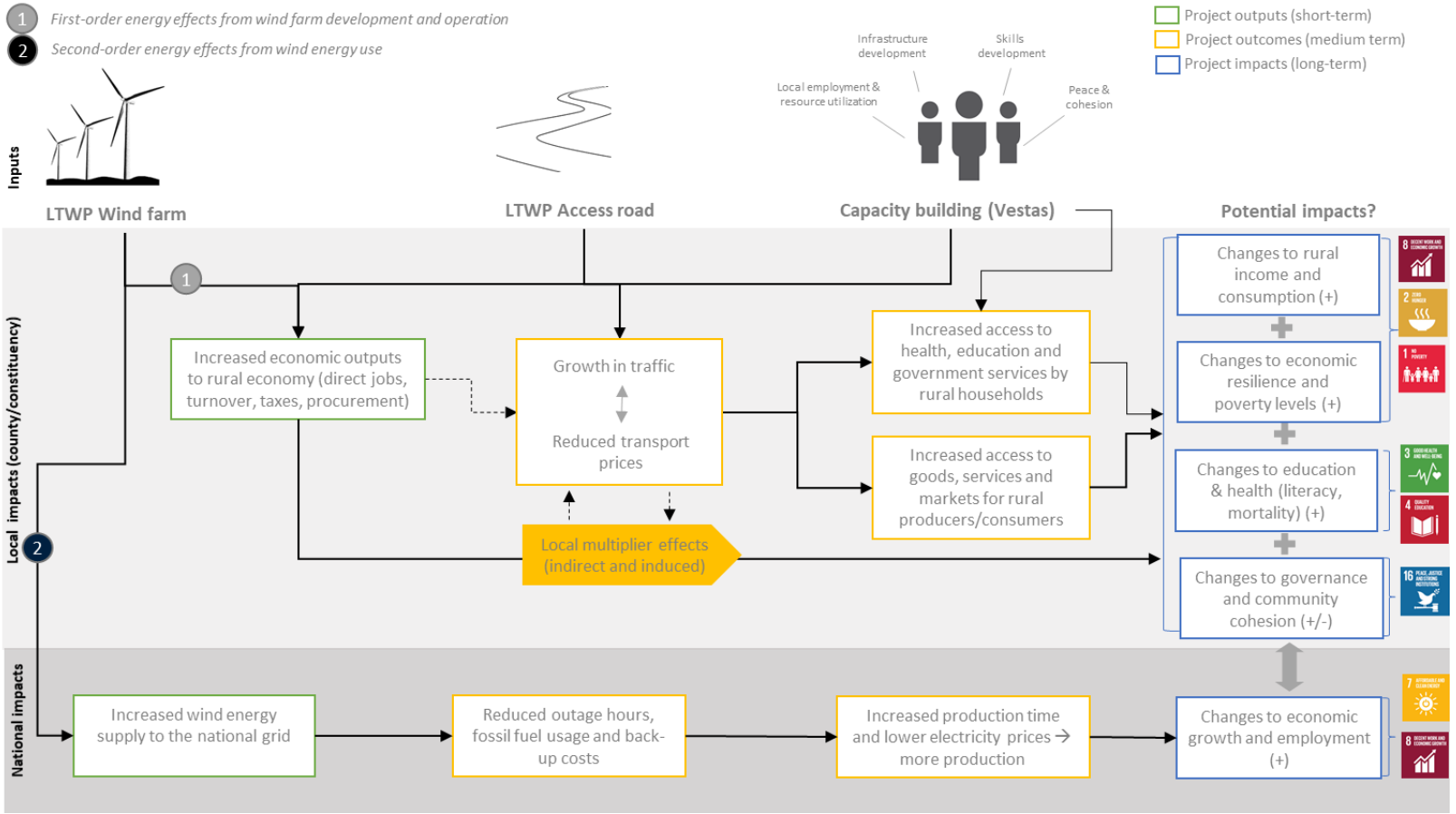
Introduction to impact pathway

- Impact pathways – or 'theories of change' – are a recognized foundation for impact assessments
- The impact pathway presented in this study is inspired by generic causalities and indicators identified in the existing literature as well as the unique features of the LTWP project identified during this study
- The LTWP impact pathway is a first important step in establishing an overview of some of the main outcomes and impacts that can be expected from the project. It can also be used as a starting point for future investments.

	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 are the concrete and often most visible results of a given investment.	Outcomes 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 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: LTWP technical report, Table 3.1: Potential impacts from renewable energy and auxiliary investments from existing literature

Simplified impact pathway for core elements of the LTWP project



Detailed version available in Appendix A of Technical report

LTWP pathway demonstrates several interfaces with the SDGs, also beyond the universal ‘core’ benefits of renewables

Three ‘core’ SDG impacts from renewable energy (all countries)

IM6

IM1, IM2, IM6

IM6

Delivery vehicle

IM1

IM1

IM4

IM3

IM1

IM4, IM5

Additional SDG impacts from LTWP impact pathway (developing countries)

Data sources

- **Document review**
- **Field visit 2017**
- **Traffic survey 2018**
- **National and county-level statistics**
- **Reference case studies from existing literature**

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: LTWP technical report, Table 4.3. Main data sources for preliminary impact evaluation

Study limitations

- Preliminary study does not capture the full suite of benefits that may flow from the LTWP project due to limitations in study scope
- Largely observational research design subject to restrictions in accessing data and views from local community members and villages impacted by the LTWP project
- Different options for strengthening the preliminary findings in this study – see research design B and C

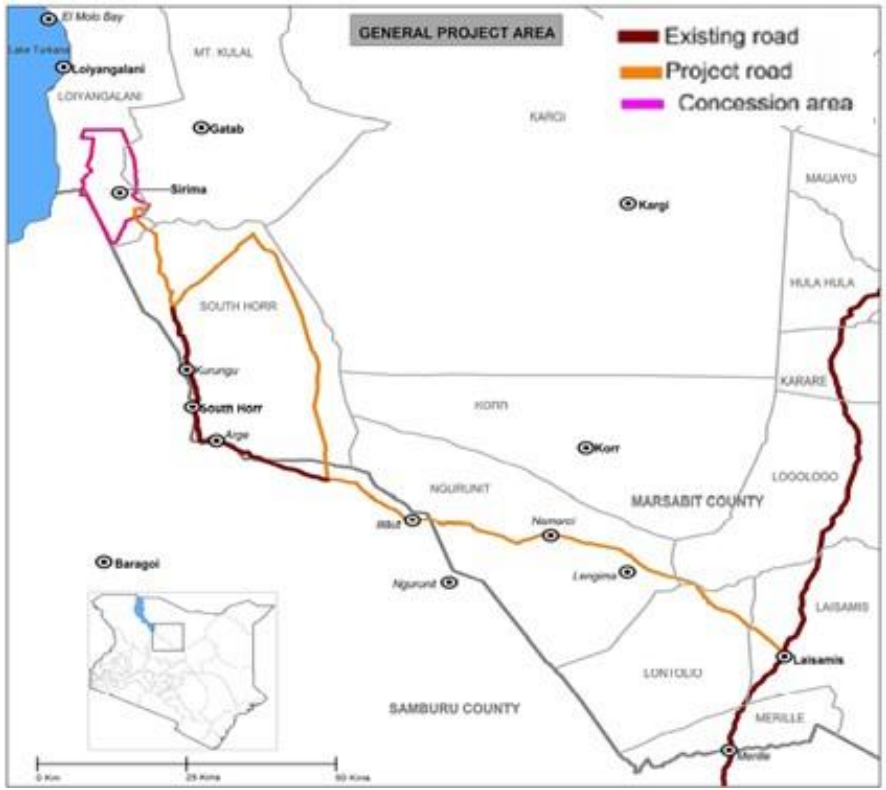
	A: Observational	B: Rapid Rural Appraisal	C: Panel Surveys
Deliveries	• Observations on current and prospective impacts of project based on largely secondary data and field observations	• Characterization of current and prospective impacts of project based on interviews and data from impacted communities 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: LTWP technical report, Table 4.4. Three research designs for rural impact assessments

Empirical context

Socio-economic context

- Located in the Laisamis constituency of Marsabit county, among poorest county in Kenya (of 47)
- Arid lands with limited agriculture, pastoralism ~80 percent of livelihoods, ~20 percent agro-pastoralism, formal employment and fishing from Lake Turkana
- High levels of poverty, illiteracy, mortality and dependence on traditional livelihoods compared to Kenya average
- Poor infrastructure, incl. roads, water scarcity, open defecation widely practiced, most shelters of temporary materials
- Highly vulnerable to climate change with frequent droughts further exacerbating wide-spread famine and poverty levels



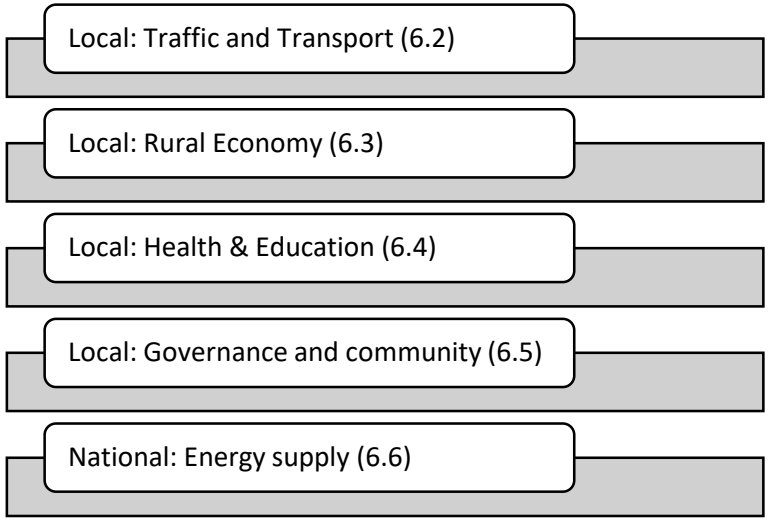
Overview of project area (source: Vestas)

Evaluation of key impact dimensions

Evaluation of key impact dimensions

The following slides will evaluate the key impact dimensions identified in the detailed LTWP impact pathway, cf. Appendix A, with specific focus on the outcomes and impacts.

For a gross-list of all the outcome and impact indicators included in the LTWP pathway, including proposed indicators for future impact assessments, please refer to Appendix C.



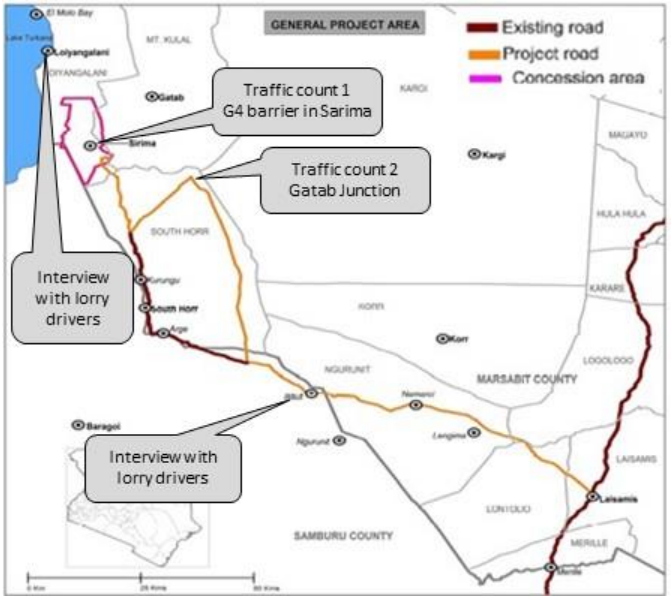
Evaluation of key impact dimensions
- Traffic and transport evaluation

Traffic survey intro and setup

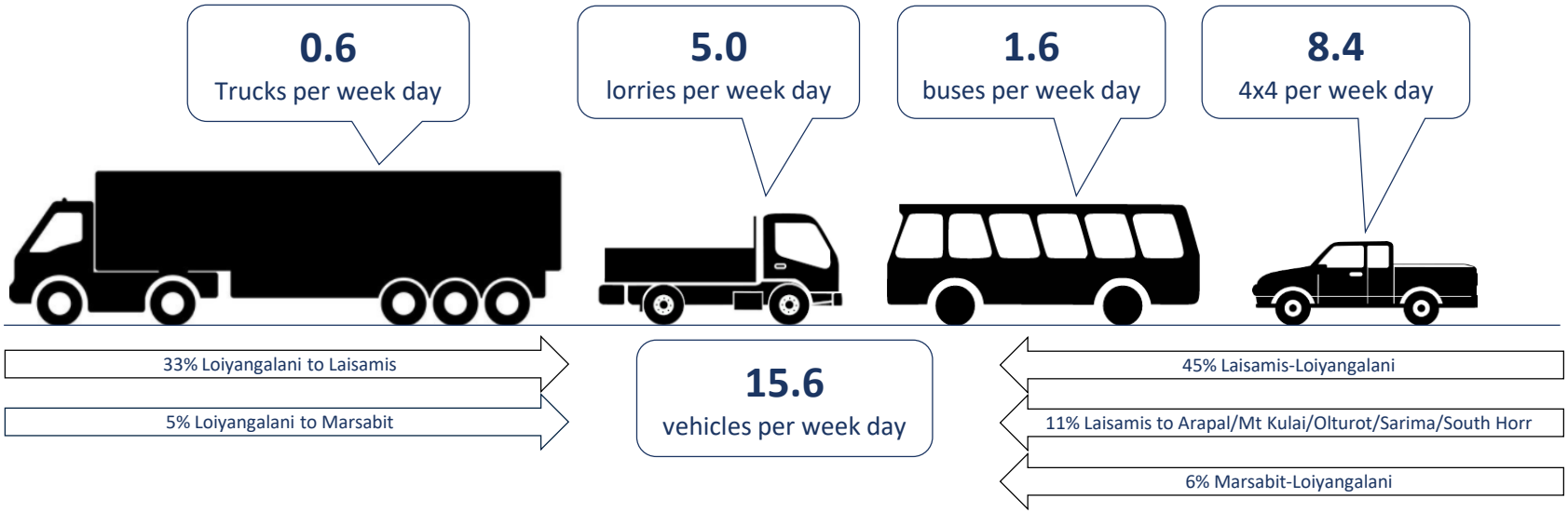
The purpose of the traffic survey was two-fold:

- Firstly, 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, 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

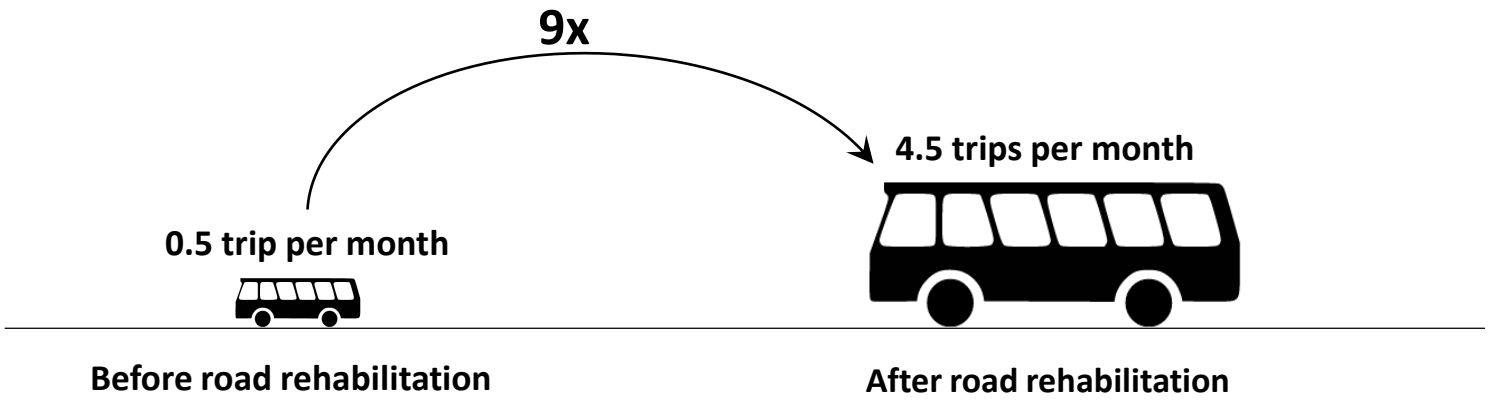
The traffic survey was conducted in the periods of January 22nd to January 25th and January 28th to February 1st, 2017. Results are subject to the limitation that traffic surveys should account for seasonal variations and other variations such as religious holidays. This can maybe be rectified in future assessments.



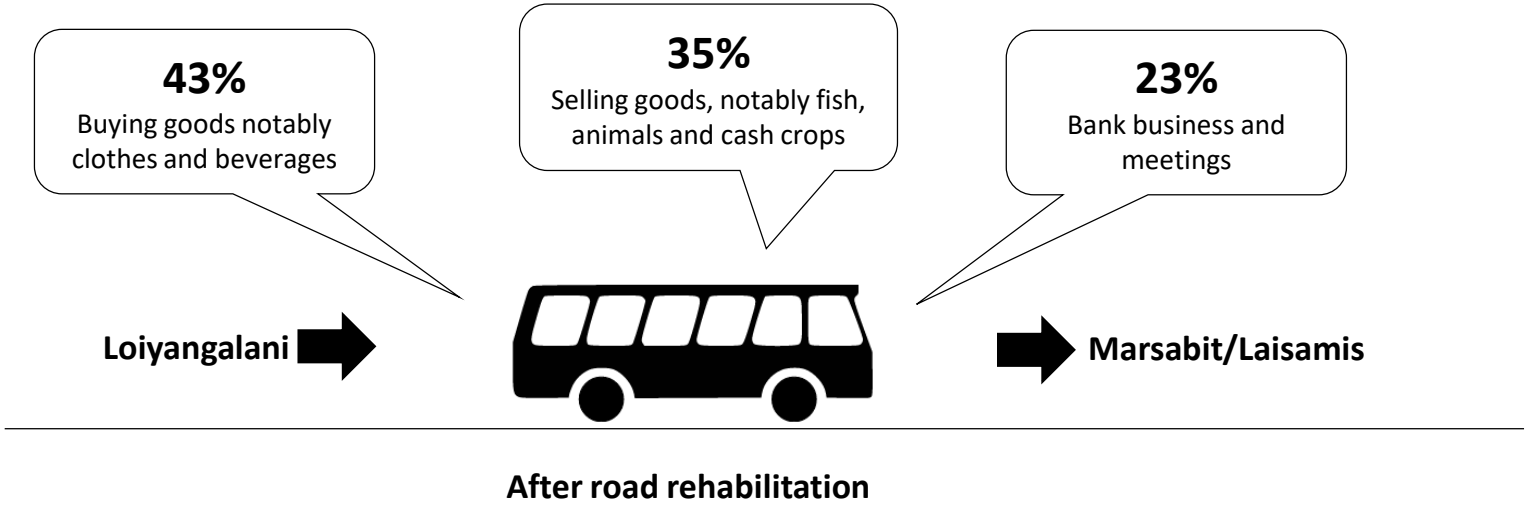
Traffic survey counted 15.6 vehicles per day on the Laisamis-Loiyangalani road - higher than anecdotal statements suggest



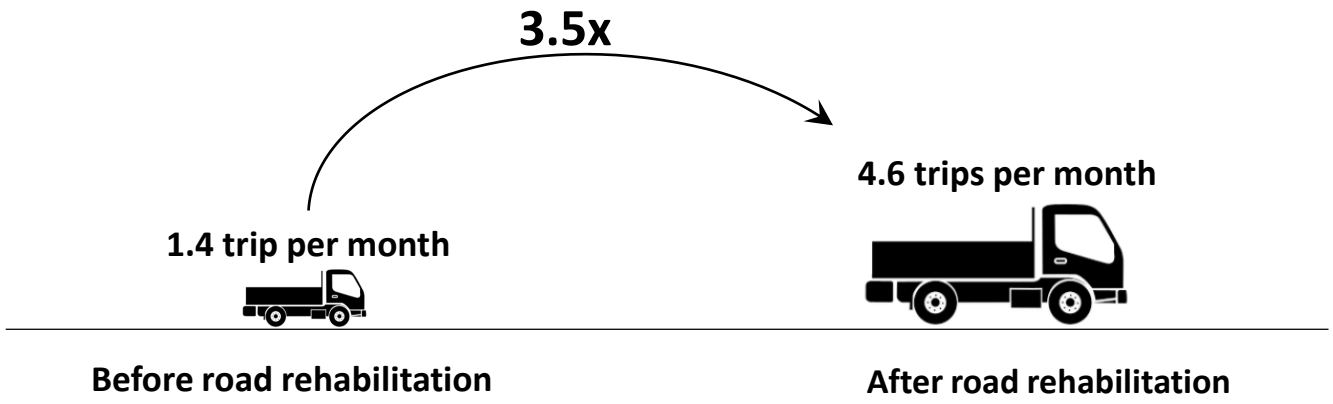
The interviewed bus passengers say their travel frequency have increased nine fold since road rehabilitation



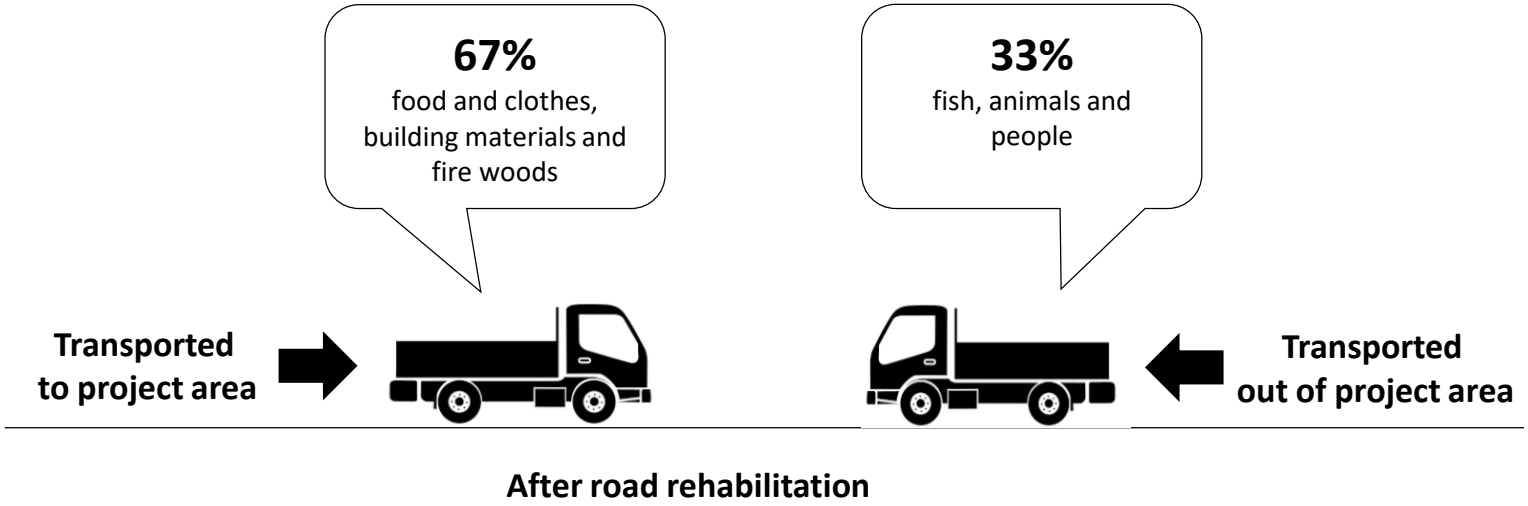
The passengers' purposes for taking the bus are mostly buying and selling stuff indicating increased economic activity



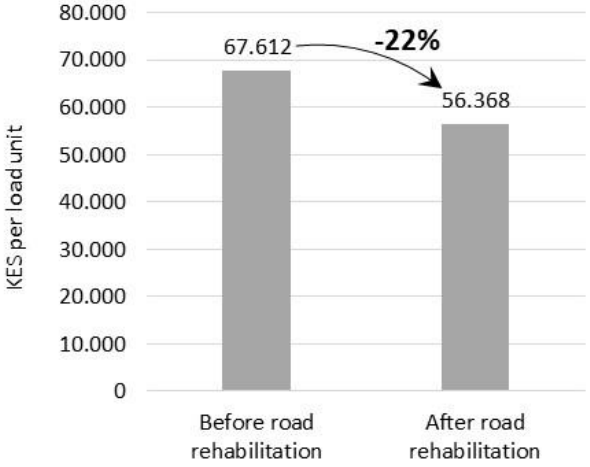
The interviewed lorry drivers say their travel frequency has increased by a factor 3.5 since road rehabilitation



Two-third of total loads is transported to the project area, while one-third of total loads is transported out of the project area



Across the different load types transported, price has on average been reduced by 22%. However, price changes vary across load types.



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%**

Summary of traffic survey with references to impact pathway

For each of the evaluations of the key impact dimensions, a table will summarise the findings and make references to the impact pathway, cf. Appendix A.

For the traffic survey as well as selected interviews conducted during the 2017 field visit, such a table is presented to the right. It provides an overview of the traffic and transport-specific outcomes identified in the LTWP impact pathway.

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

Indicators	Caused by	LTWP – key findings	Data
● OC1.1. Lower transportation costs	Access road	No findings. 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).	No data (reference studies only)
◌ OC1.2. Lower impassability	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	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
○ 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

○ = Empirical evidence confirms outcome/impact ◌ = Some/limited empirical evidence – additional data needed to confirm outcome/impact

● = No empirical support found for outcome/impact – data to be acquired

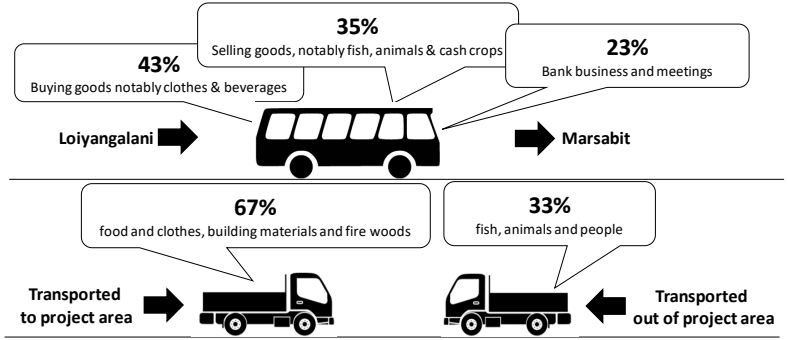
Evaluation of key impact dimensions
- Rural economy evaluation

Transport-induced local market development (TILD)

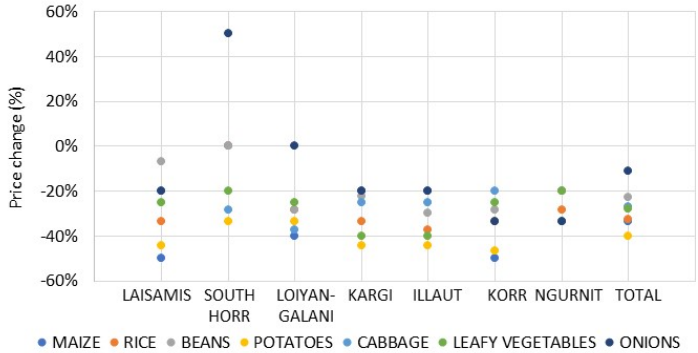
The transport impacts from rural road rehabilitations can have important induced impacts for local producers (OC2.2, OC2.3) and lead to development of local markets and income diversification (OC2.4).

Whether such impact also will materialize following the rehabilitation of the Loiyangalani-Marsabit road is too early fully assess, but there are some indications of increased local economic activity in the area and at least one example of the road rehabilitation helping develop new products and markets for a product (fresh fish)

To further confirm this development, it is recommended to monitor the frequency of local markets in the project area



Market prices changes, before/after road rehabilitation



Development of fresh fish cold chain and marketing

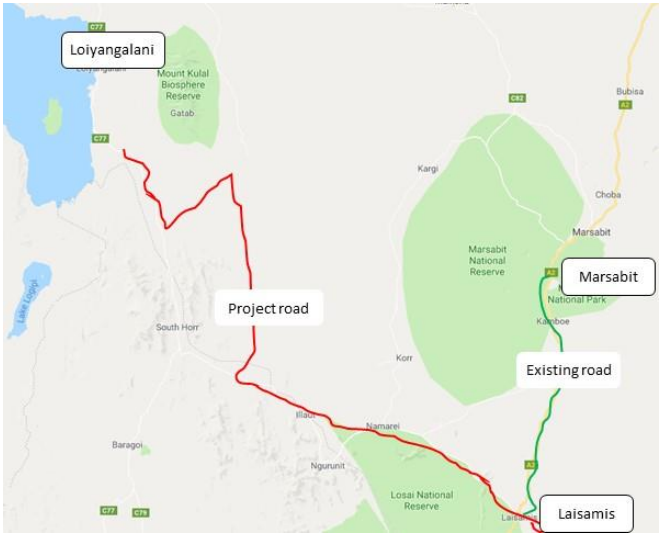
The development of fresh fish cold chain and marketing is a concrete example of how the road rehabilitation has helped develop new products and markets. There are at least two good reasons to develop a fresh fish cold chain:

Firstly, Kenyan population is on an upward trend creating more demand for freshwater fish. Considering that Lake Turkana is the largest lake in Kenya - about 50% bigger in size compared Lake Victoria - 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.

Secondly, alternative livelihoods are needed. 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. Many of the pastoralist communities in the impacted areas are therefore trying to diversify their livelihood activities including fishing.

Road rehabilitation key to success of fresh fish cold chain

- In 2015, GIZ (through its Climate Change Adaptation Program (CCAP)) in collaboration with the Fisheries Department in Kenya started developing a Community Development Action Plan for fishing community in Loiyangalani.
- 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.
- Success of the initiates and investments therefore required that the fresh fish could be transported to Marsabit frequently and without incurring excessive transportation costs that would reduce or completely eat the profit.



Shift from dry to fresh increased the value of fish three-fold

- **Before**, the fishing community at Loiyangalani had very limited possibilities of selling fresh fish other than in Loiyangalani. They used to sell dry fish to market outlets like Busia and Kisumu at a lower price (30-50 KES/piece (0.75kg)) and with delayed payments (+4 weeks), and fresh fish only in Loiyangalani town.
- **After**, development of a cold chain structure at Loiyangalani and marketing of fresh fish by the cooperative in Marsabit town have created instant payment for the consignment. The fresh fish market is newly organised due to better access to Marsabit town. The market has increased trade and prices of fresh fish from 30-50 KES per piece of Tilapia to currently 100-150 KES per piece.

Before CCA-GIZ et al. and LTWP road rehabilitation

Today, fresh Tilapia is sold at 100-150 KES/piece (0.75kg)

After CCA-GIZ et al. and LTWP road rehabilitation

Before, 30-50 KES/piece (0.75kg) for dried Tilapia

	Before		After		Net impact	
(KES/kg)	2017	2018-	2017	2018-	2017	2018-
Fish price, lakeside Loiyangalani						
Tilapia	53	53	167	167	113	113
Nile Perch	53	53	167	167	113	113
Fish price, Marsabit						
Tilapia (250-300 KES/piece(0.75kg)			367	367	367	367
Nile Perch (400 KES/kg)			400	400	400	400
Transport costs						
Loiyangalani-Marsabit			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			157	197	157	197
Nile Perch			190	230	190	230

Next year, EU will provide a 5 ton refrigerated truck. It has not been possible to assess VOC incl. driver for this truck. Instead, the cost is approximated by the trucking price from Nairobi to Bujumbura, Burundi which is 0.02 KES/kg/km or 3.5 KES/kg for the 233 km from Loiyangalani to Marsabit

The cooperative buys the fresh fish from the fishermen and transport it to the market in Marsabit. Thus, its income is the Marsabit market price minus transport and buying price of fish in Loiyangalani

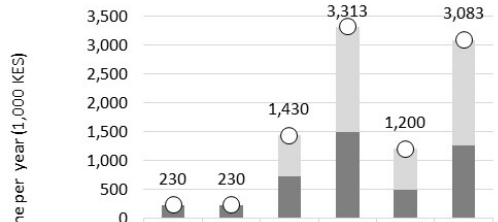
Today, 2,000 KES from Loiyangalani to Marsabit for 70kg cool box with Matatu plus 1,000 KES to return cool box. That is 43 KES/kg

Extra income from fresh fish sale was 12,000 USD in 2017, expected to rise to 31,000 USD in coming years

- The total sale of fresh fish for 2017 is expected to be around 4,300 kg. For the coming years, 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 will generate a total net benefit for the fishermen of around 489,000 KES in 2017 and nearly around 1.3 million KES in the coming years.
- The fact that it is now the cooperative that handles the marketing means that the unit net benefit from the market sale returns to the fishing community with another around 711,000 KES in 2017 and 1.8 million KES in the coming years.

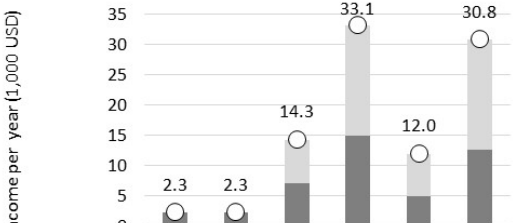
Marsabit County Agriculture Sector Plan for 2013-2017 estimates that current fish production volumes on the eastern side of Lake Turkana are around 630 tons per year and worth around KES 45.5 million or USD 450,000. This corresponds to around 714 USD/tons. By comparison, the net impact of fresh fish 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.

Net benefits of fresh fish production (KES)



	2017	2018	2017	2018	2017	2018
	Do-nothing		Investment		Net impact	
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

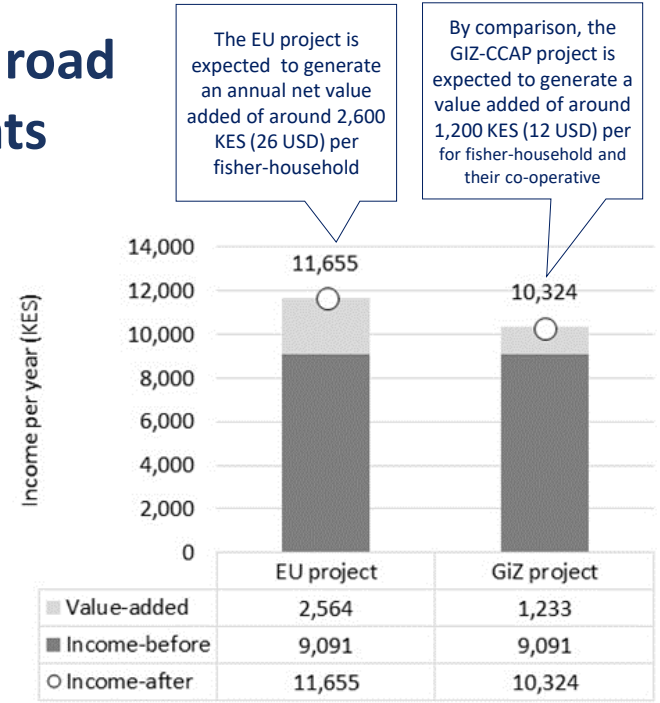
Net benefits of fresh fish production (USD)



	2017	2018	2017	2018	2017	2018
	Do-nothing		Investment		Net impact	
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

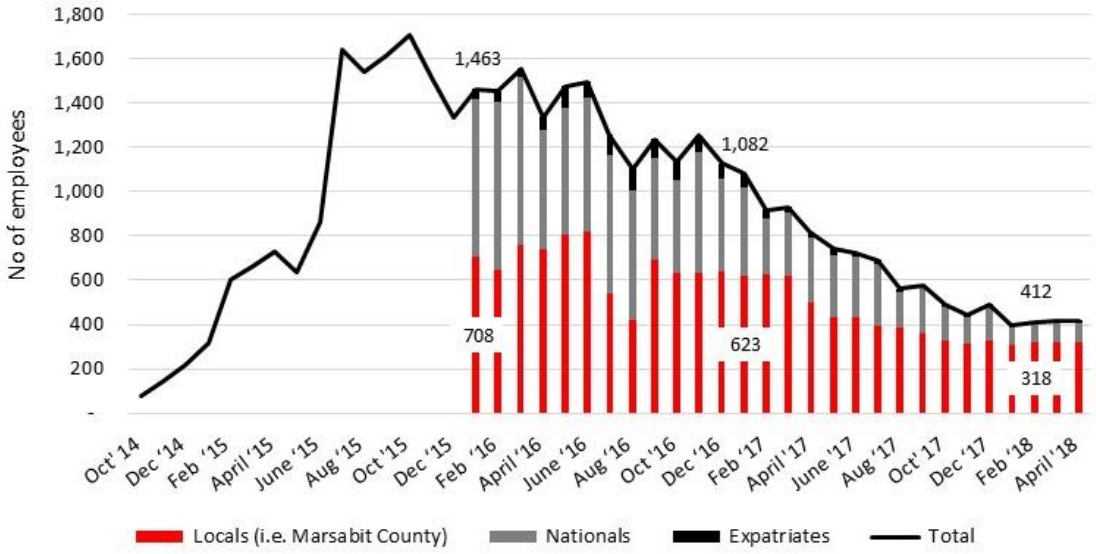
Rehabilitation of the Laisamis-Loiyangalani road has been vital for attracting new investments

- Following rehabilitation of the Laisamis-Loiyangalani road and the improvement of the Northern Corridor, 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
- 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 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%.



Salary economic multiplier effects 1:4

- While wind farm developments are more capital than labour intensive, an often-cited benefit in existing impact studies is the creation of local jobs and economic activity in rural areas with limited economic activity
- 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
- With construction completed in June 2017, the total number of employees hired by the LTWP project has decreased significantly and currently the project employs a total of 412 people, of whom 318 or 77% reportedly come from Marsabit County

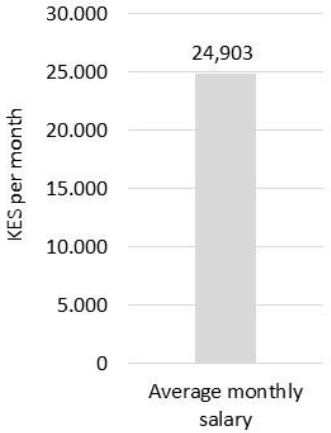


Salary economic multiplier effects 2:4

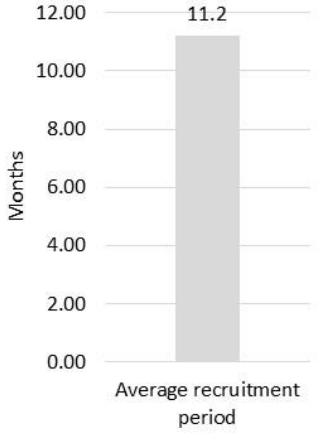
Vestas is emphasised due to data availability. It is expected that other LTWP partners have had similar salary levels and recruitment periods

- In the period 2015-2017, Vestas employed a total of 127 local people. On average, each employee has earned around 25,000 KES per month over a recruitment period of around 11.2 months.
- 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.
- 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, improve their housing conditions as well as support their extended families (ERM, 2017).

Average Vestas salary, 2016-2017



Average Vestas recruitment period, 2016-2017

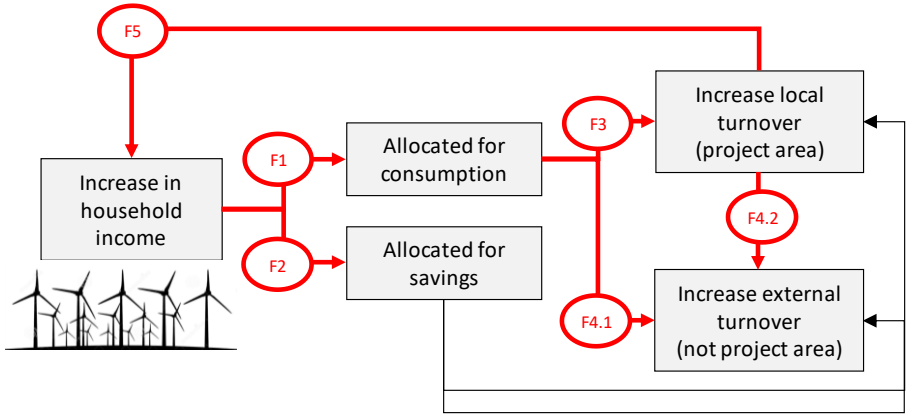


Salary economic multiplier effects 3:4

- Some of this spending will lead to increased turnover in shops and companies, either inside or outside the local area. For each shilling earned, it is important to assess how much has stayed in the local area and created additional value, and how much that has left the project area to create value elsewhere, e.g. at the county or national level, cf. spending flow on the right. Assessing F1-F5 is proposed to be part of a possible next step.

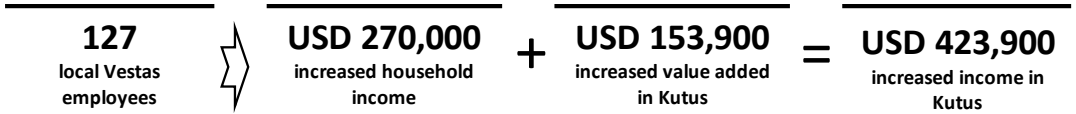
- F1-F5 is a very simple way of trying to establish some rough multiplier effects without having to perform more cumbersome exercises such as establishing comprehensive Social Accountability Matrices (SAMs). Lewis and Thorbecke (1992) established a SAM for the Kutus region in Kenya to analyse how sectoral 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.

Spending flows of salaries from local LTWP employment

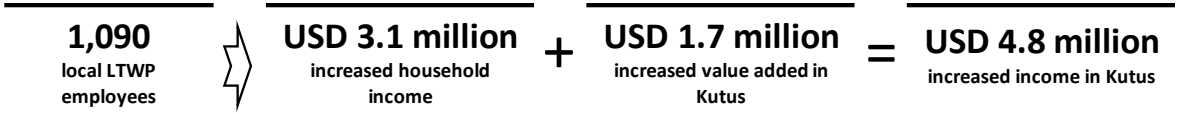


Salary economic multiplier effects 4:4

- 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.



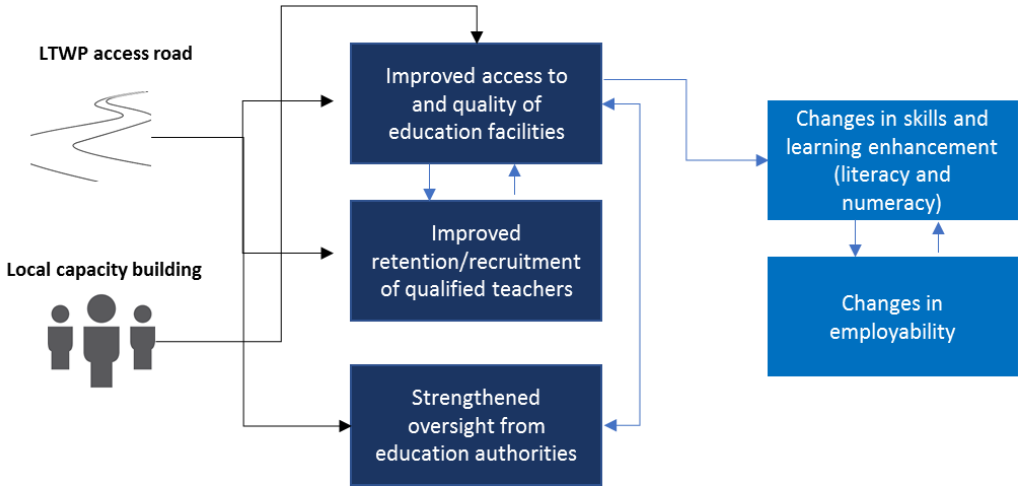
- If we assume same salary and recruitment period for all local LTWP employees, it follows that all local employees to the LTWP project would have received a total of around USD 3.1 million in salaries since the beginning of 2016. This in turn would have generated additional income of around USD 1.7 million thereby creating a total income of USD 4.8 million in the Kutus region.



Evaluation of key impact dimensions
- Education, health, governance and community cohesion evaluation

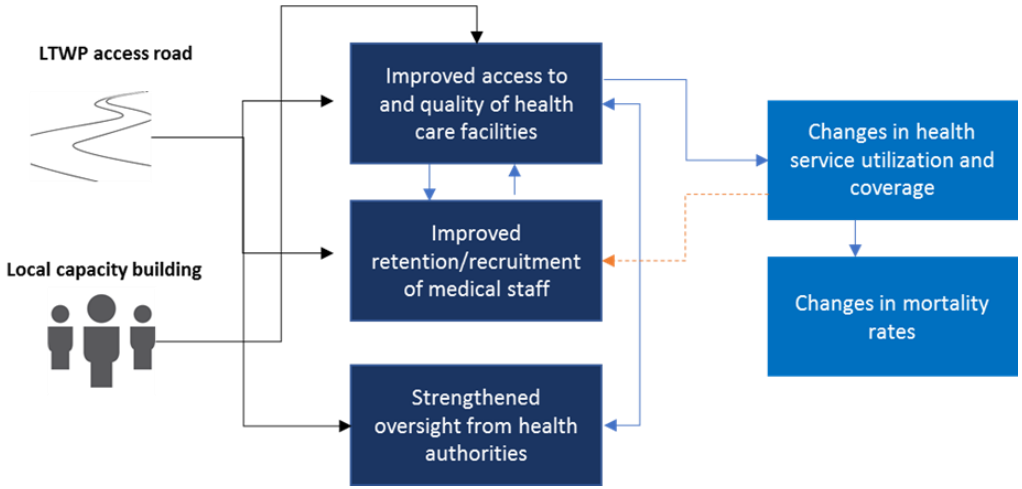
Education outcomes and impacts

- Previous studies (ERM, 2017) reports several benefits from Vestas/WoC initiatives in local project area
- As an example, Vestas/WoC's investments in the Mt. Kulal school has resulted in longer study hours and improved security for local communities due to improved lighting at night
- Vestas' employment of 127 local employees during construction has also helped increase expenditure on education in project area
- Reference studies also suggest important education benefits from rural road investments – see theory of change. More data needed from project area to confirm if this is the case.



Health outcomes and impacts

- Similar to education, reference studies suggest important health-related spill-over effects from rural road investments – more data needed from project area to confirm/reject the theory of change on health
- ERM report (2017) high-lights important impacts from Vestas/WoC's investments in local health facilities, notably Laisamis District Hospital and Buriaramia Dispensary
- Among key benefits: Reduced travel time, better quality of care (vaccines, light during surgery), increase in patient visits and reduced mortality among women



Governance outcomes and impacts

- Interviews with local government officials indicate stronger government presence in the project area now. This is in part due to the LTWP road and the presence of the LTWP project at large, incl. local security, as well as a result of more resources to the area in general following government reforms
- The local government also benefits from the sheer influx of capital from the LTWP project. As an example, the USD 30 m investment in the rehabilitated access road from Laisamis to Loyangalani represents a six-fold increase in the budget reserved by the county government to upgrade local infrastructure in the same period ('public works', equivalent to approx. USD 5.5 m)

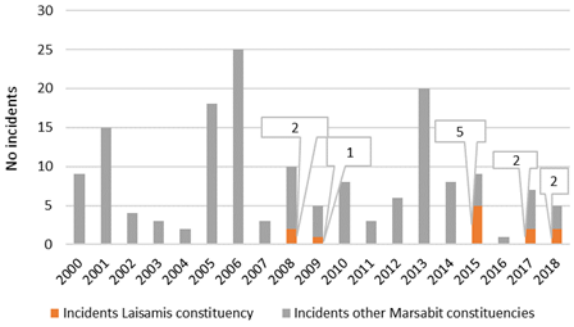
Budget lines	Gross total estimates	% of budget
County assembly	526,000,000	9%
County executive services	517,581,909	9%
Finance management services	986,268,307	17%
Agriculture	313,622,833	5%
County public services	59,372,340	1%
Education youth affairs	264,038,209	5%
County health services	1,066,903,989	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: LTWP technical report, Table 6.11: Marsabit county budget, expenditures 2015/2016 (KES)

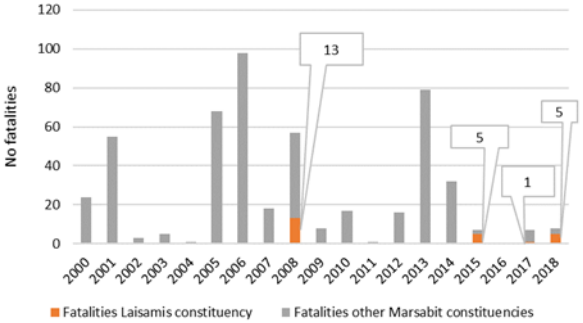
Community cohesion outcomes and impacts

- Interviews with government officials and previous reports 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 changes were also reported to have been present prior to LTWP
- Community conflicts remain pertinent over water, grazing, fishing, and cattle rustlings which was also the case prior to the LTWP project. Secondary conflict data (ACLED) from the area suggests that causes of conflict are mainly intra-community issues unrelated to the LTWP project.

Incidents (Marsabit vs. Laisamis)



Fatalities (Marsabit vs. Laisamis)



For detailed description of incidents and fatalities, please refer to technical report

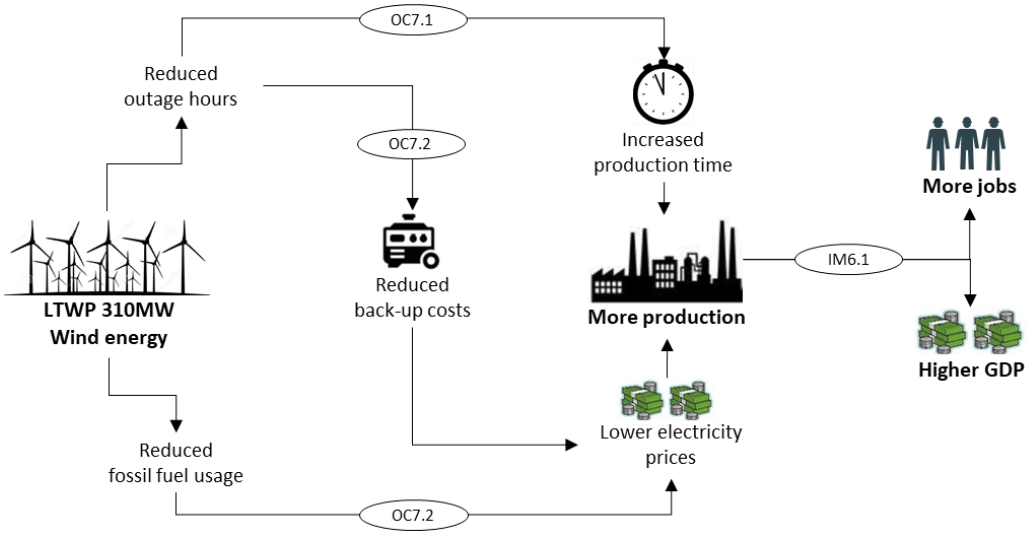
Evaluation of key impact dimensions

- Energy supply and cost evaluations

Potential outcomes and impacts from LTWP 310MW

It is assumed that the main vehicles through which LTWP will deliver economic value to Kenya is two-fold:

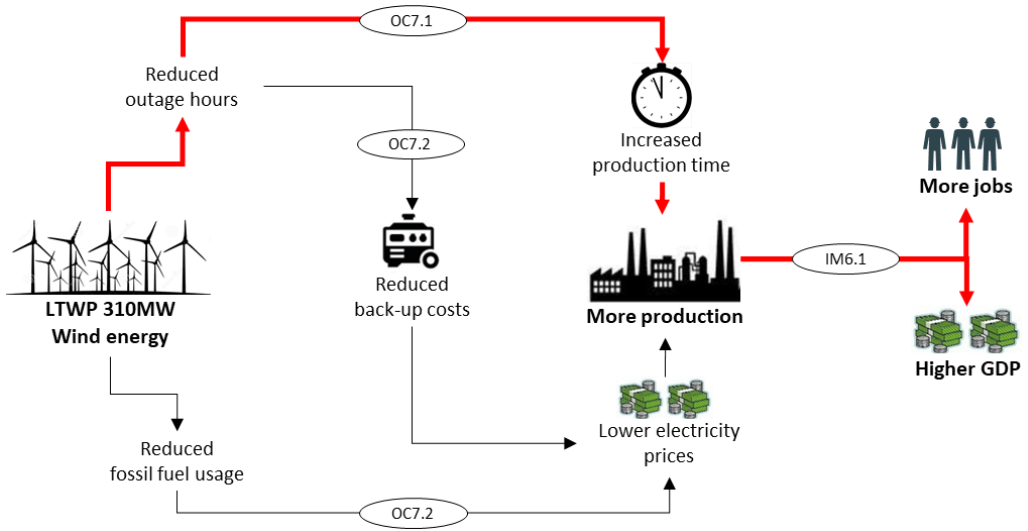
- Firstly, by reducing outage hours, Kenyan companies will be able to increase their production, cf. OC7.1.
- Secondly, by reducing fossil fuel usage and reducing the need for back-up generators, the cost of electricity will likewise be reduced, cf. OC7.2.



Feasibility assessment I: Impacts from reduction in power outages

Power outages in Kenya happen for, at least, two reasons.

- Firstly, Kenya's distribution and transmission network is generally in poor shape. Despite investments in improved network performance, distribution and transmission losses remain a critical issue with the rate of losses being 18.9% in 2017.
- 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.

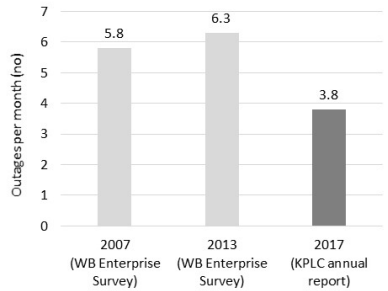


Reduced power outages and sales losses

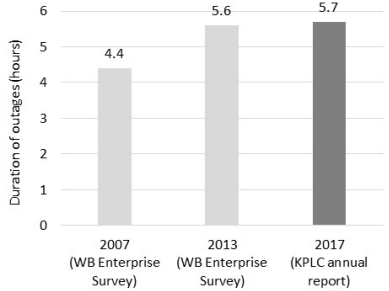
The World Bank Enterprise surveys from 2007 and 2013 along with a more recent survey from Kenya Power and Lightning Company's (KPLC) from 2017 provide specific insights on both the number and duration of electrical outages experienced by Kenyan firms.

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)

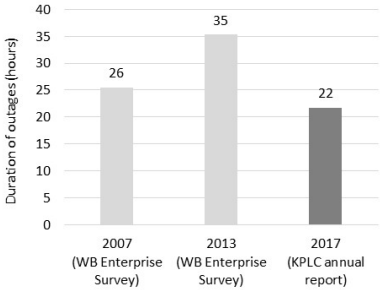
Number of electrical outages per month



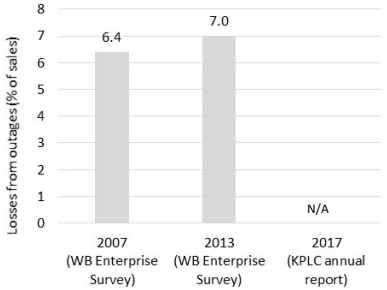
Average duration of electrical outages



Total hours of electrical outages per month



Economic losses from electrical outages



Unmitigated losses from outages are estimated to around 41%

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.

When estimating the unmitigated losses, we use an average of 171 production hours/month (2010 census, KNBS). 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.

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

Other estimation

$$\text{Equation 1: } \log(lost\ sales) = \alpha + \beta \cdot \log(outage\ hours),$$
$$\beta = 0.36\ for\ Kenya\ and\ 0.\beta = 44\ for\ all\ countries$$

Reference study

Osani and Pollitt (2013) 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 for 2007, this study estimates the unmitigated losses to around 50% for Kenya overall.

Impacts on lost sales and production of 50% 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	50	40.8	20.4	7.0	5.6	**1,245**

Potential reduction of outage hours is assessed using two scenarios

Scenario 1:

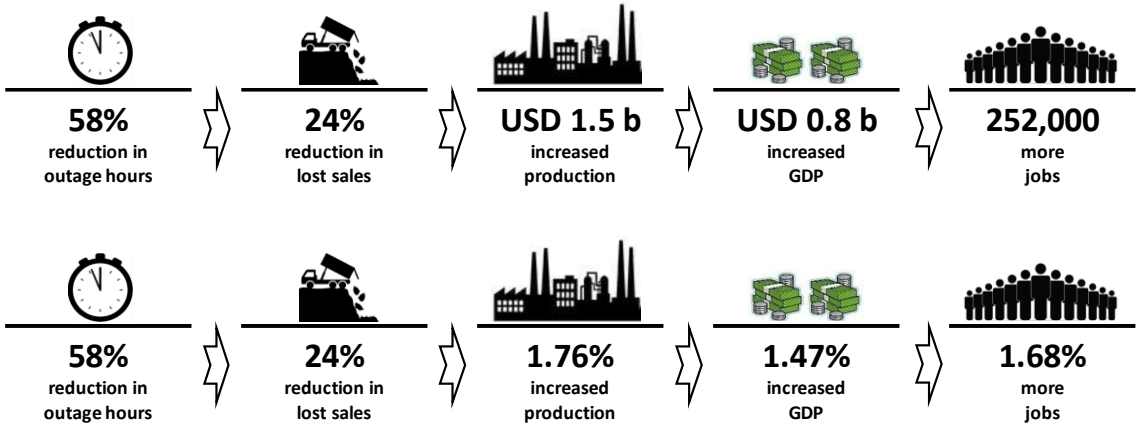
In order to minimize risk of optimism bias and deviating results, the purpose of this scenario to compare methodology and results with other similar studies. The study used for comparison is Steward Redqueen (2016a). This study found that investments in a renewable energy plant in Uganda eliminated load 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 knowledge of actual impacts of LTWP, 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 (corresponding to nearly 14%), 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.

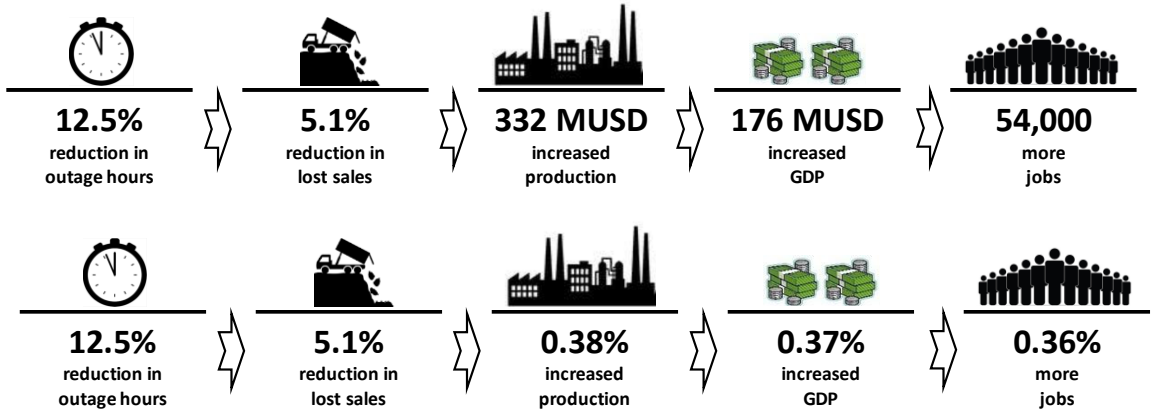
Scenario 1: Impacts on production, GDP and jobs of 58% reduction in outage hours

- Using the input-output model, the increased production value from a 58% reduction in outages generate USD 817 million in additional GDP and with 252,000 additional jobs
- This corresponds 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%. It is assessed that the difference is due to different estimates of production hours



Scenario 2: Impacts on production, GDP and jobs of 10%-15% reduction in outage hours

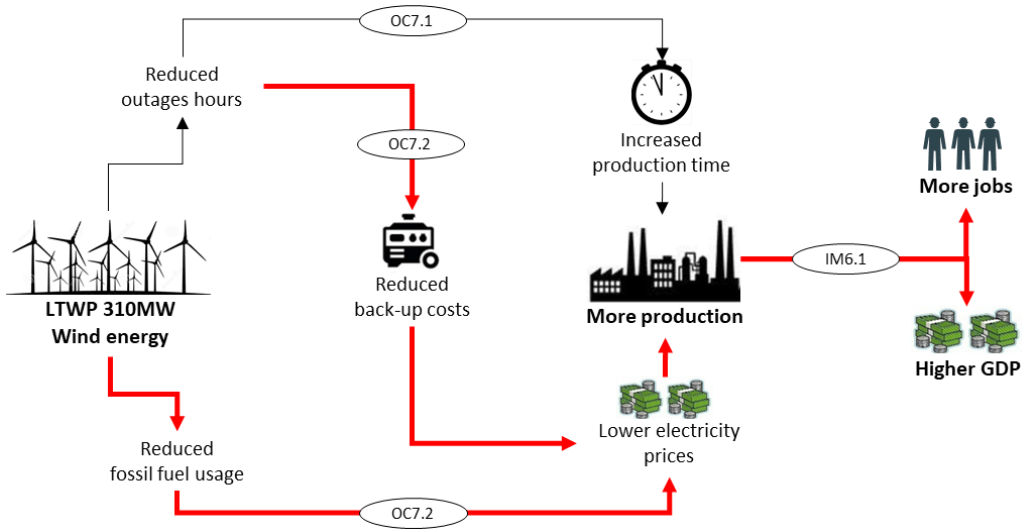
- If LTWP enables a 10%-15% reduction in outage hours, Kenyan companies across all sectors will benefit from a 5.1% average reduction in lost sales, corresponding to a reduction in lost sales from 7.0% to 6.6%. This is in turn assessed to generate an increase in overall production value in Kenya of USD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



Feasibility assessment II: Impacts from lower electricity prices

LTWP has potential for reducing electricity prices for at least two reasons

- Reduced use of generators from reduced number of power. According to WB Enterprise Survey around 57% of Kenyan firms had a generator suppling around 14% of their electricity and the costs of these are estimated to be three times higher than getting electricity from the grid
- Reduced use of thermal (fossil) sources accounting for around 21% of Kenya's total electricity generation capacity in 2016/2017. LTWP can produce – and potentially replace – around 13% of Kenya's total electricity capacity



To allow references to other studies, we consider 13% reduction in electricity price

Alvarez and Valencia (2015) find that changing the structure of electricity generation in favour 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.

However, differences in methods between Alvarez and Valencia (2015), Steward Redqueen (2016a) and this study, put some limitations to the comparison. It is more of a Reference Class Forecasting exercise.

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.[1] 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 15.2 million people.

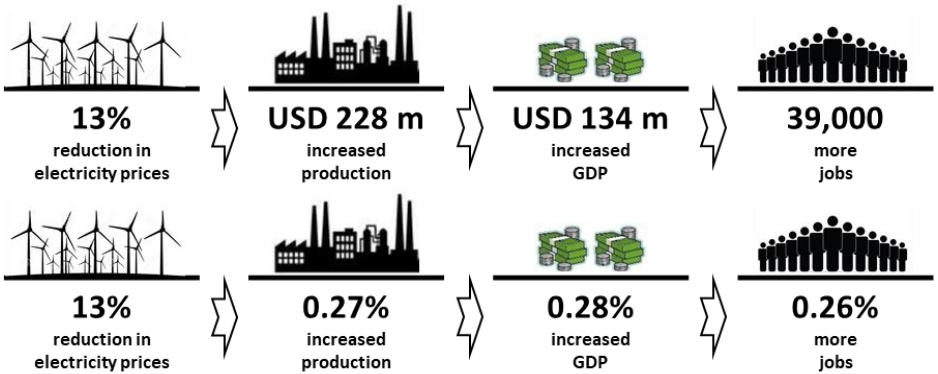
A first input output model is setup to study the impact of changes in the output price of the electricity sector on other sectors in the economy. In this cost-push input-output price model quantities are fixed, while prices change. A description of this and the other models used is to be found in section 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.

Impacts on production, GDP and jobs of 13% reduction in electricity price

Using the input-output model, the 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.

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.



Next steps

Next steps – some options for discussion

	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	• Approach A *plus*: • Collection of community and household perspectives, e.g. via focus group interviews and/or surveys with selected households (*Rapid Rural Appraisal*)	• Approach A *plus*: • Panel surveys with a wider selection of households vs. 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

QBIS

Thank you for listening