

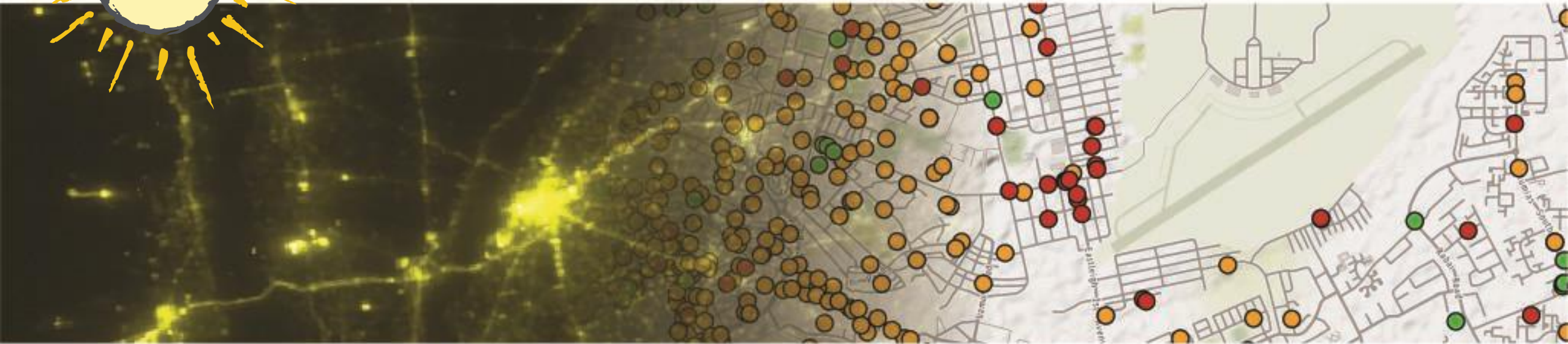


# IE CONNECT FOR IMPACT

Transforming the Growth Potential  
of Transport Investments

## Economic Corridors

Arianna Legovini, Alice Duhaut, Theophile Bougna

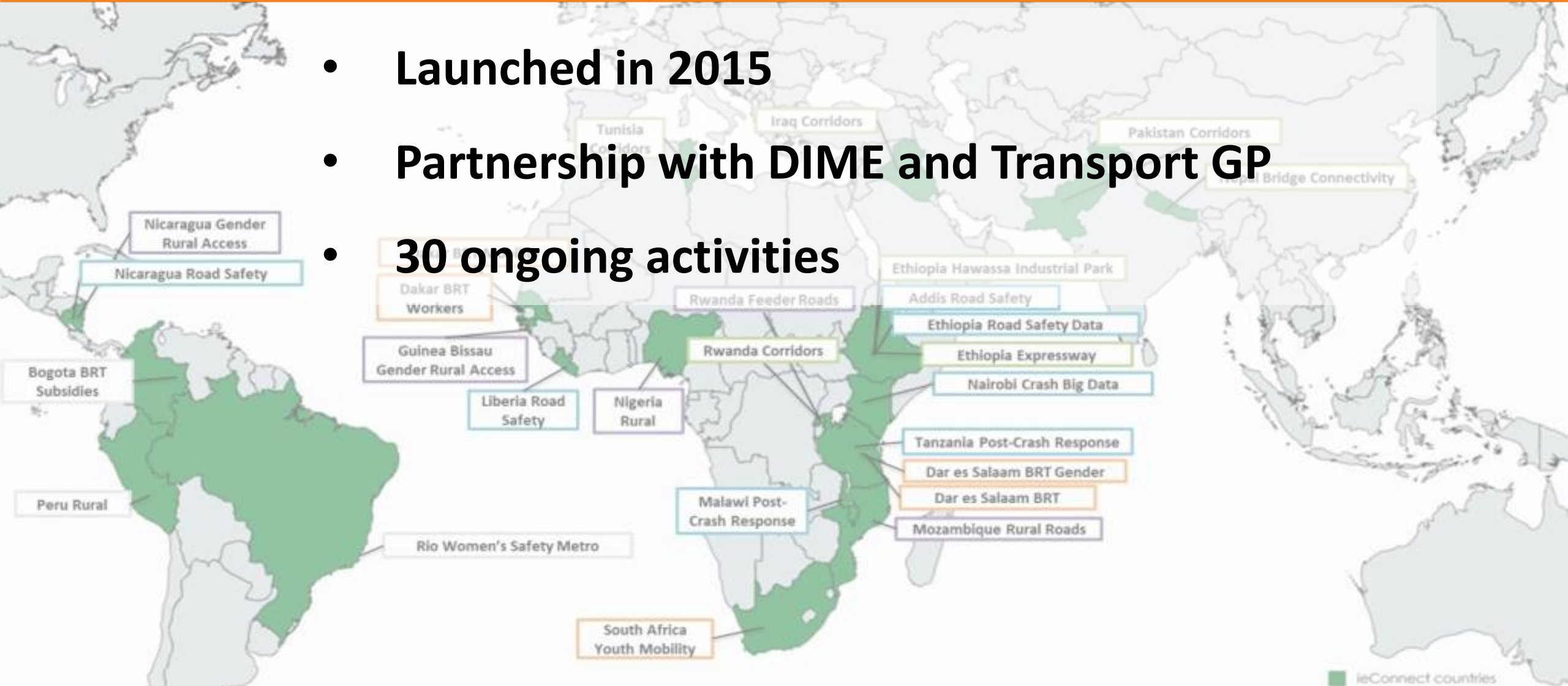


WebEx - March 31<sup>st</sup>, 2020



# ieConnect for impact

- Launched in 2015
- Partnership with DIME and Transport GP
- 30 ongoing activities



# Objectives

KNOWLEDGE GAP

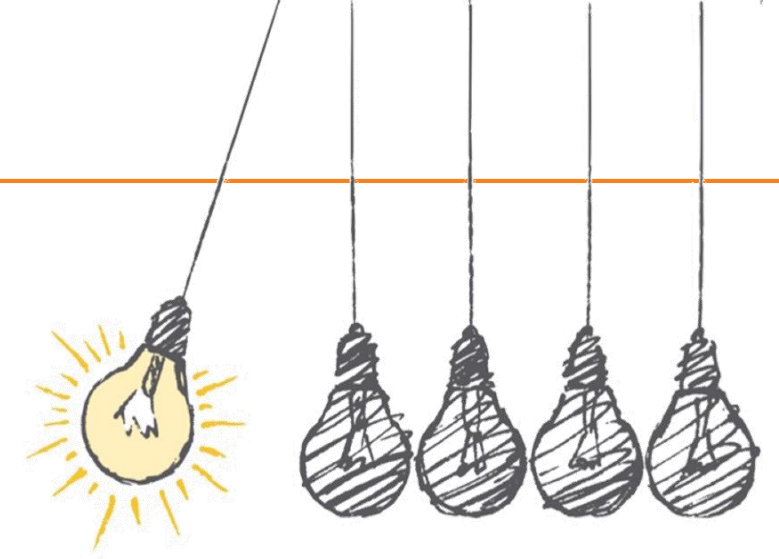


Generate **data and evidence** on impact



Understand the **mechanisms**

# DIME's Approach



- **{DATA}** Innovate in measurement & build data capabilities to understand the problem you are trying to solve
- **{AI}** Analyze data & find opportunities for targeting and prioritizing public resources and efforts
- **{IE}** Evaluate interventions to document success & justify scale up

# Understanding of the Problem



- **ACCESS**
  - Who is disconnected?
  - What are the conditions of the road?
  - How accessible are the markets people are trying to reach?
  - What are the other dimensions that impact accessibility:
    - Improvement in transport sector organization
    - Road safety and security of users

# Benefits of DIME's Approach



## Elements of DIME Model

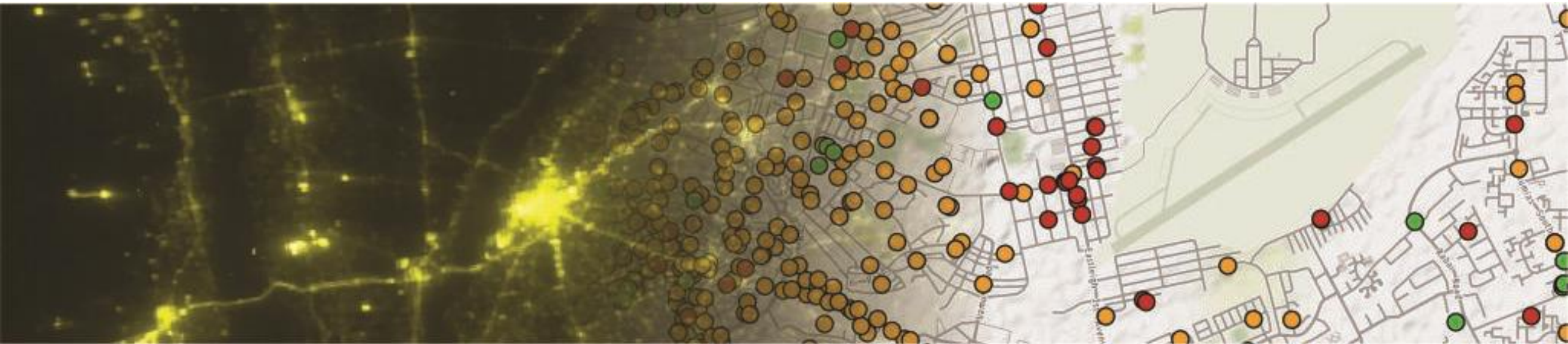
- Data collection and integration
- Artificial Intelligence/Analytics
- Impact Evaluation: measure the causal impact of interventions



## Improve

- Monitoring & program management
- Planning and prioritization
- Investments
- Regulation

# ieConnect 's Economic Corridors Approach



# DIME Approach to Study Economic Corridors

## SYSTEMATIC

- To **use new technologies** to build data systems
- To **test policy interventions** and inform mid-course decisions
- To use one project for **multiple experiments**
- To select most **relevant policy and research questions**



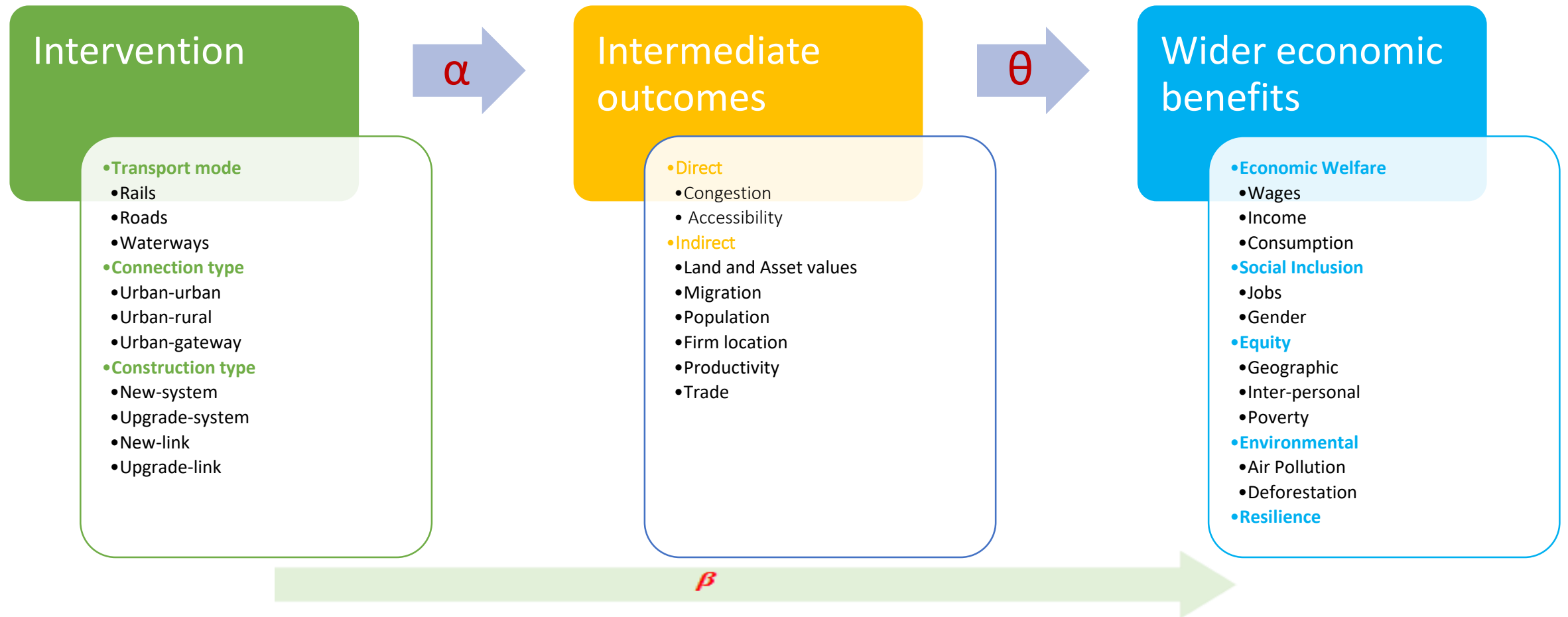
# Guided by Economic Theory

- **An Economic Corridor** is a geographically defined network connecting economic agents and activities to overcome frictions and unleash efficiencies
- **Traditional CBA** of transport investments focusses **only on a narrow set of direct benefits and costs**:
  - reduction in travel time, Vehicle Operating Costs (VOC) savings, etc.
- However, economic corridors can entail much **wider economic benefits and costs**:
  - Trade & economic activity, structural change, poverty reduction, pollution, deforestation, etc.



*Identify and test the conditions for successful corridor investments + complementary policy interventions*

# Economic Corridors : The Chain of Expected Results



## Identification challenges in corridor projects?

- Non-random placement of these corridors
- Solutions: Instrumental variables (see Redding and Turner, 2014) + new and high-frequency data

# Second: Bringing in the data

Guided by the theory of change and specific objectives of the project

Bring in "new" –GPS data, nighttime and day time satellite imagery ....

& "traditional" data sources – administrative data, surveys



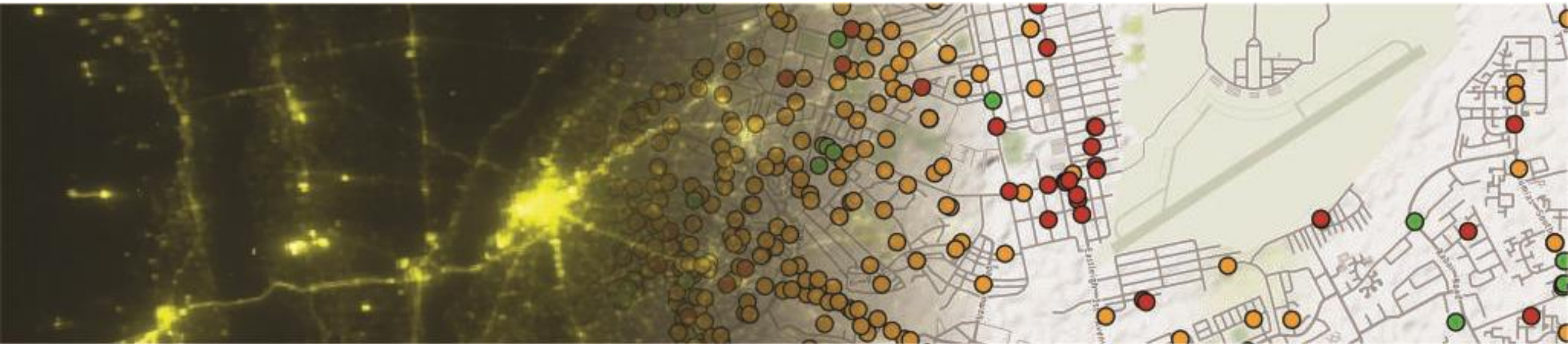
**More data often means more opportunities & stronger IEs!**



Three cases of ongoing IEs in Tunisia, Iraq, Pakistan : how to document the extent of the problem, track progresses made & think about wider economic costs and benefits?

Two cases in preparation: how to think about complementary interventions?

# Implementing our approach



# A Flavor of the ieConnect Corridors Portfolio

*Bringing new and existing data sources together to answer some of the big questions*

## 1. Feeding into the M&E and tracking targeted outcomes

- Measuring speed, congestion and accessibility – resources for scraping travel times

## 2. Indirect intermediate outcomes:

- Do corridors foster economic activity? Nighttime lights and market access in Iraq
- Do corridors induce urbanization? Evidence of Ethiopia using land use data

## 3. Evidence on the wider economic benefits:

- Do investments in infrastructure reduce the cost of distance within a country? Price series in Pakistan
- Do roads improve welfare? Poverty and night time lights in Pakistan

## 4. Can we improve corridors with complementary Interventions

- Last-mile connectivity in Guinea-Bissau
- Trade Investments in Southern Africa
- Trauma registries in Malawi

# Highway Upgrades in Tunisia

- The project upgrades roads from single carriageways to two carriageways separated by a median.
- We are studying impact of upgrading lane capacity of 3 existing roadway segments belonging to 2 separate corridors that branch from cities on coast to country's interior.
- Research focuses on effect of upgrades on economic activity, job creation, and road safety outcomes.

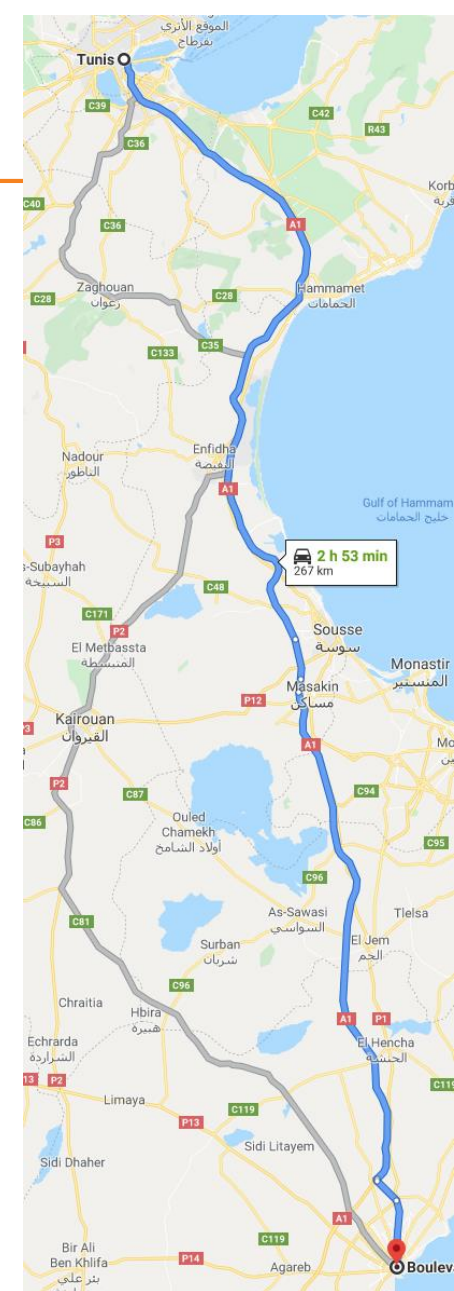


Nighttime Light Intensity

- Maximum
- Minimum
- Targeted Segments

# Measuring Travel Time and Congestion

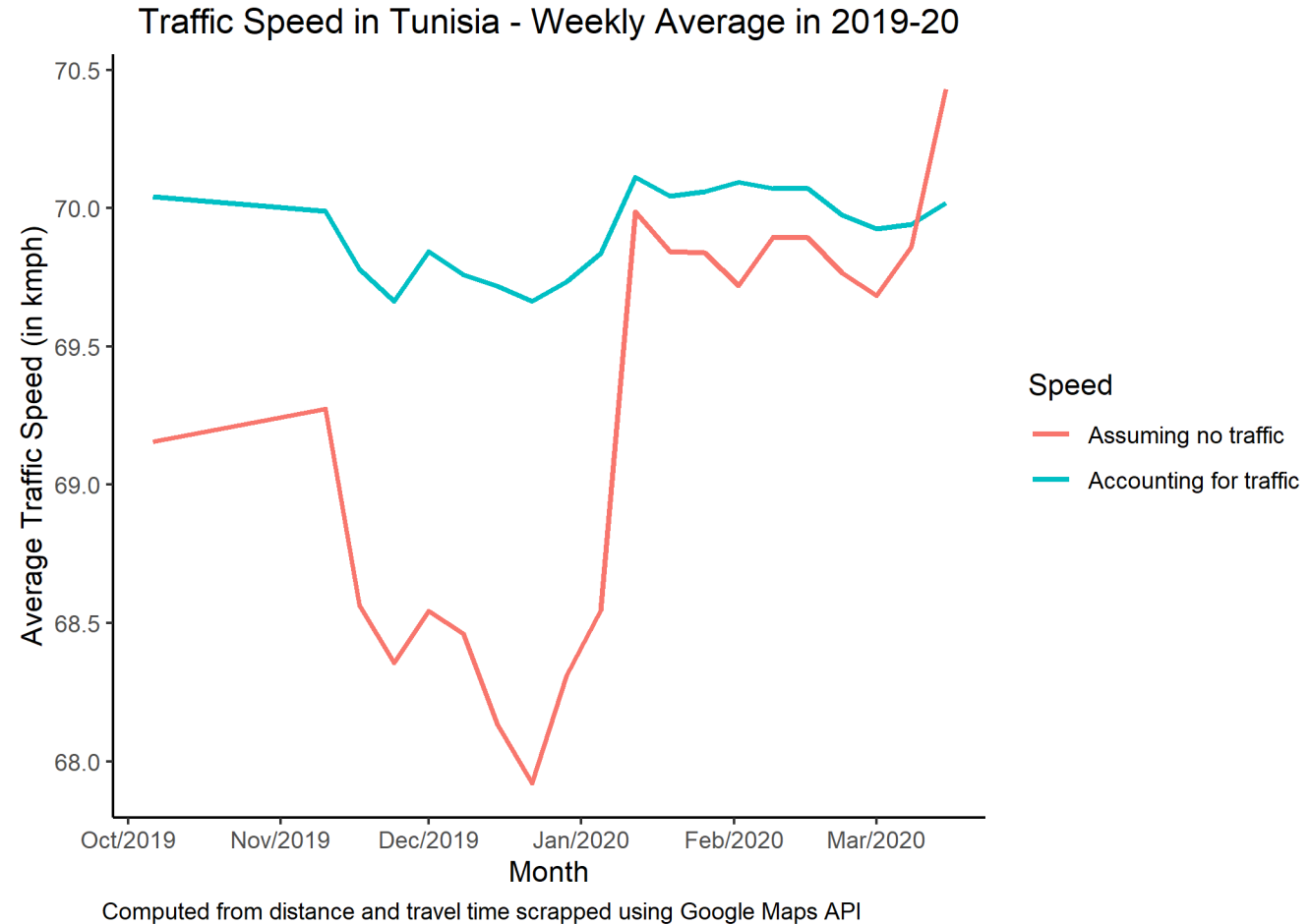
- We scrape travel times in real time from private sector sources, including Google Maps and Mapbox
- Allows examining changes in average speed and congestion over time



# Road Congestion Algorithm

Are areas affected differently depending on their position along the project corridors?

- We use Google maps API to track real-time road congestion
- This also has the advantage of tracking road congestion with and without traffic conditions.

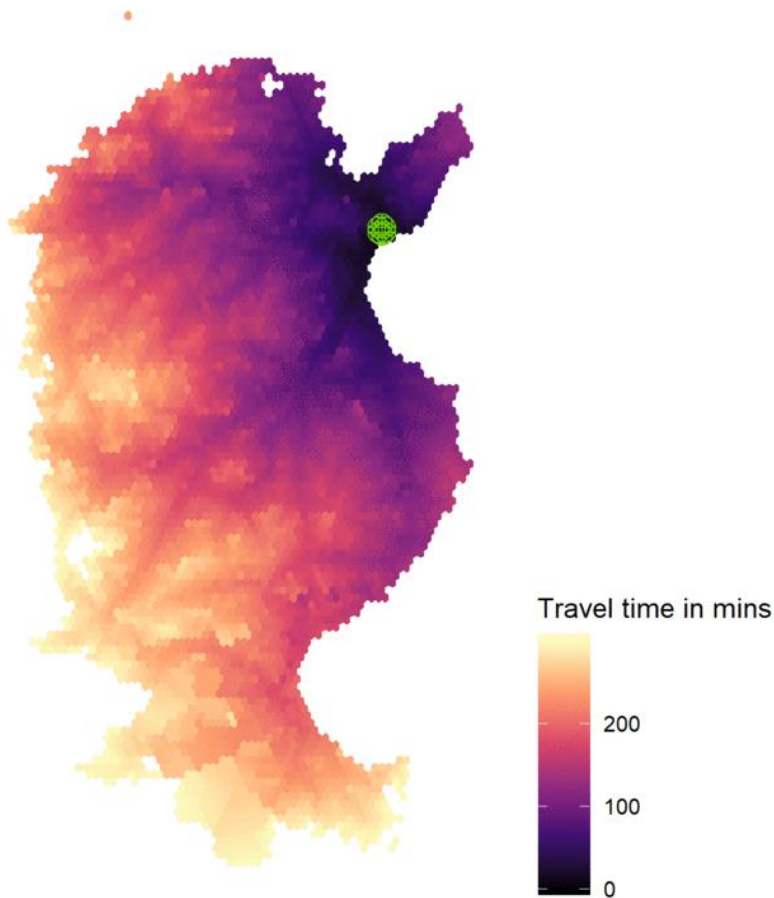




# Building Accessibility Maps

## Accessibility in Tunisia

Bir Bou Rekba



- We use travel time and distance scrapped from Google Maps API
- This gives us an estimate of traffic congestion along the origins and destinations covered by the project roads
- Based on these, we build accessibility maps that show the areas that can be reached from an origin point in the map

Routes in Tunisia



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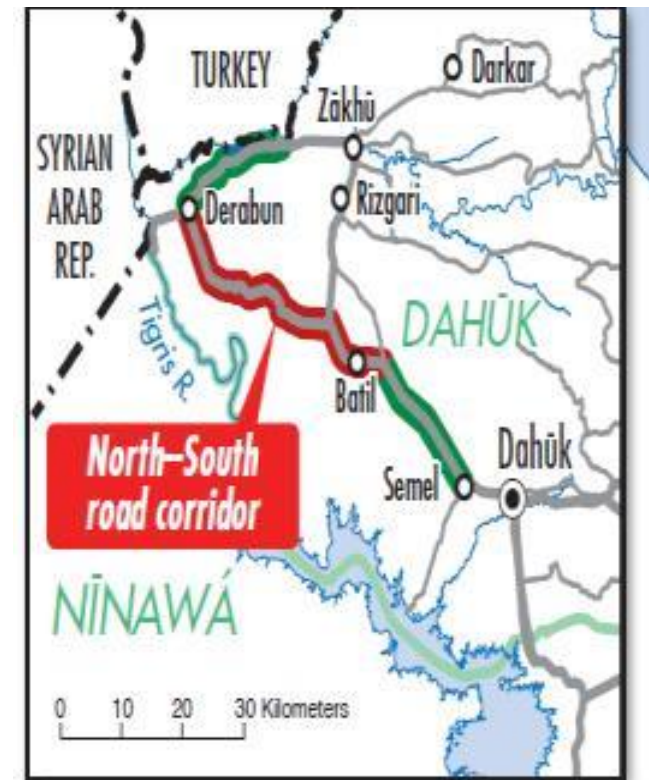
**Do corridors foster economic activity? Nighttime lights and market access in Iraq**



# Iraq Expressway 1 and N-S Corridor Project



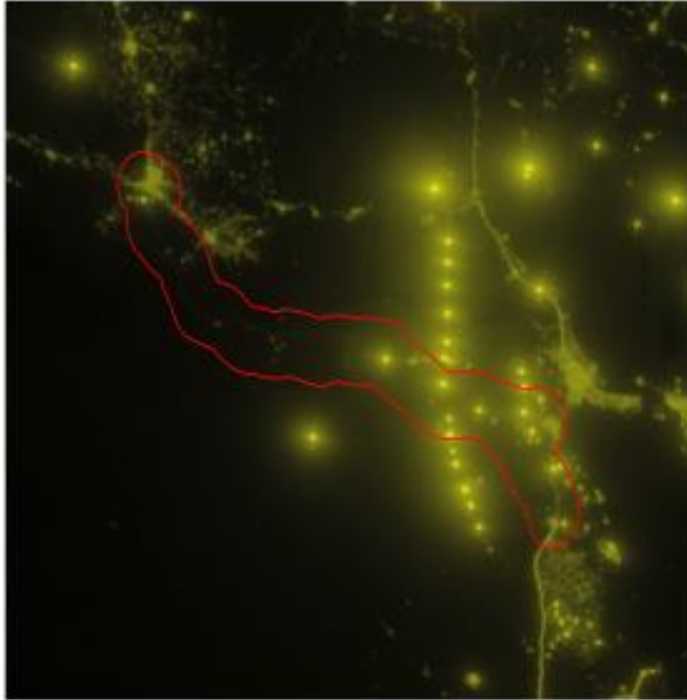
Sections of Expressway Rehabilitation (R7&8): 257km



Girsheen and Suheila Road: 23km



# Geospatial Impact Evaluation (GIE)



Infrastructure deficiencies limit Iraq's transport and trade corridors' abilities to play their role efficiently; unrest limits data collection.



Use geographically precise information on the timing and location of road improvement to examine changes in nighttime lights and market access by pixel for the Expressway.

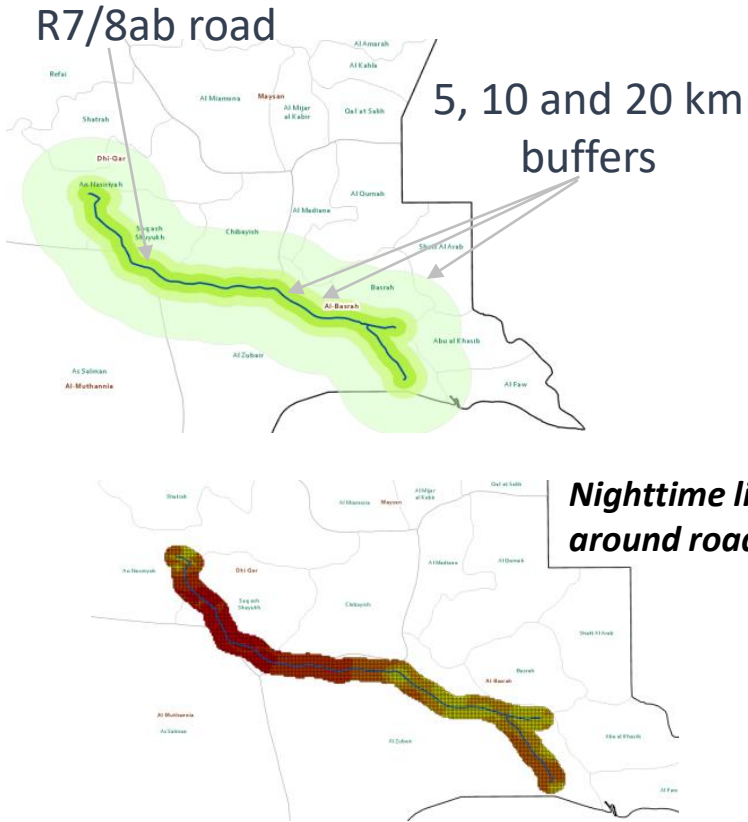


Merging multiple sources of spatial data (ESOC, LandScan, LSMS, WorldPop ) with quasi-experimental methods (triple difference, RDD, panel analysis, etc.) to determine the project's impacts.

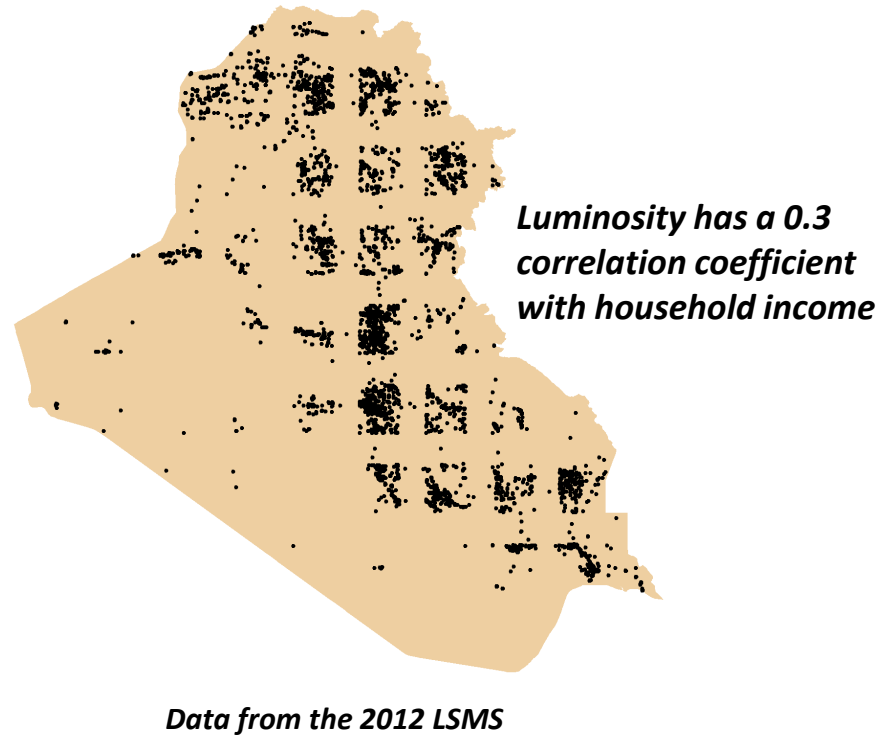
- ✓ Is there enough variation in the light **across the study area** and **over time** to detect substantive changes due to treatment?
  - ✓ **YES:** Between 2014 and 2019, 33% increase in the mean value of nighttime lights around the Expressway

# Nighttime Lights in Nearby Project Areas

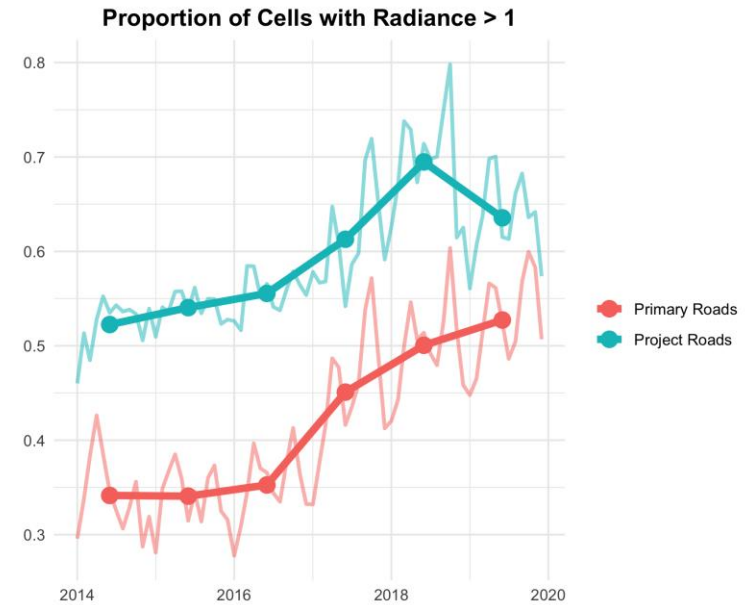
## Extracting Nighttime Lights near Project Roads



## Do nighttime lights correlate with socioeconomic indicators?

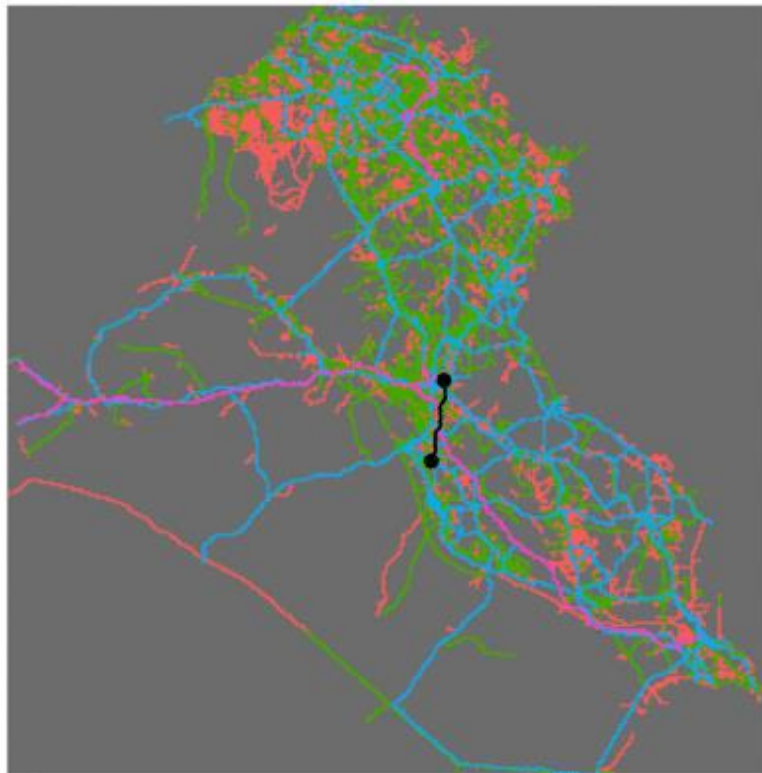


## Are there similar pre-trends in project roads vs. similar roads?

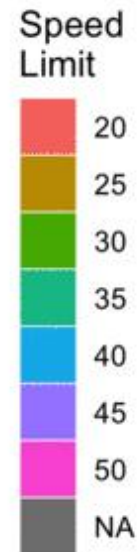


# Market Access, Speeds and Shortest Paths

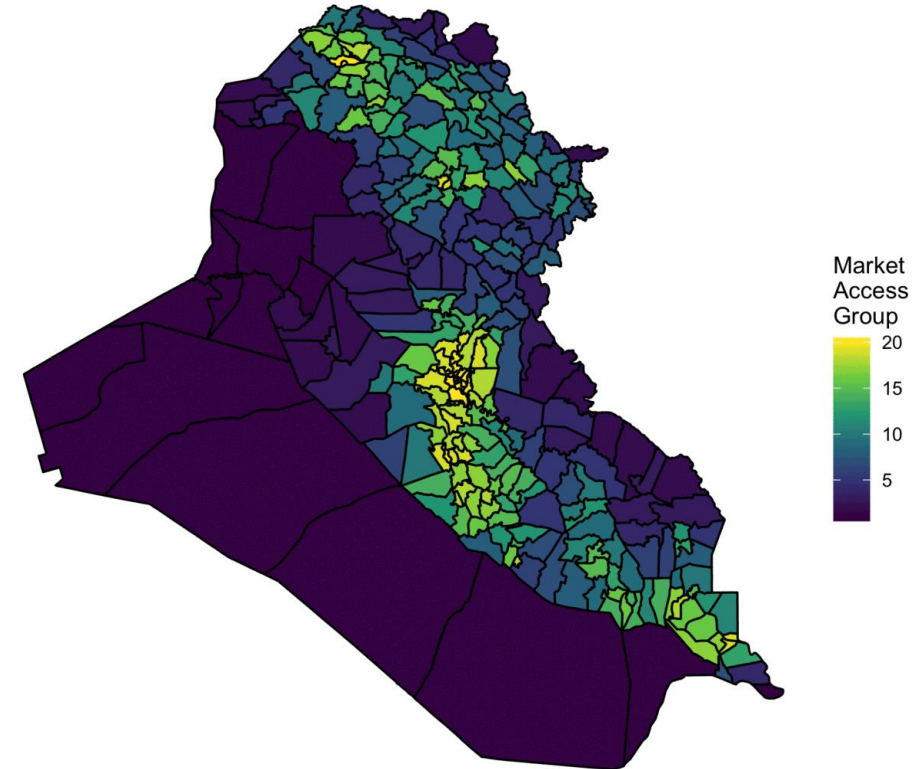
Shortest Paths from Baghdad to All Sub-Districts



Road data: Open Street Maps



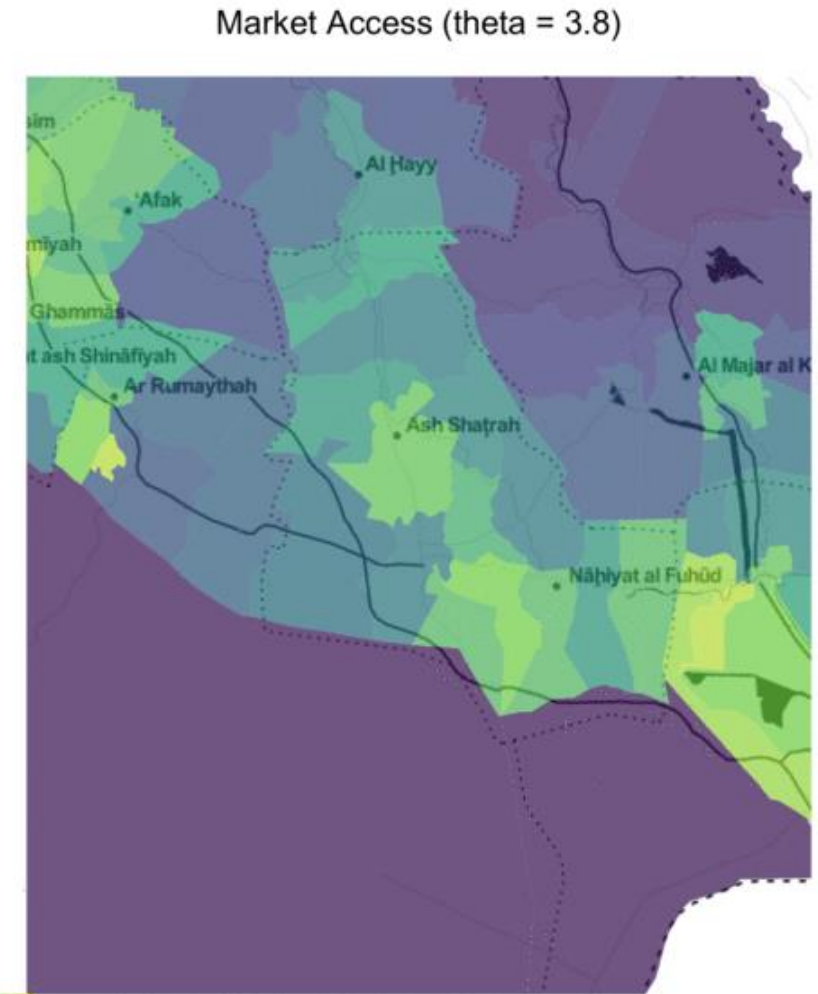
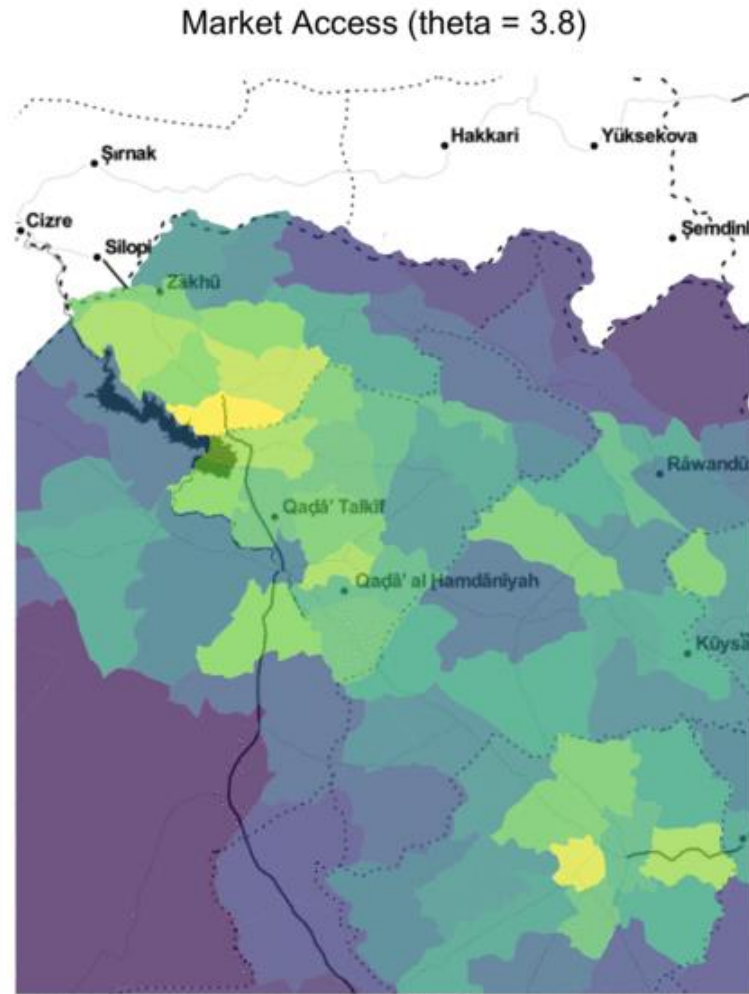
Market Access (theta = 3.8)



Market access: Break into 20 quantiles  
WorldPop: estimates the number of people per 100-meter pixel in 2015

# Market Access Near Project Areas

We will investigate: how are changes in market access associated with nighttime lights and other indicators?





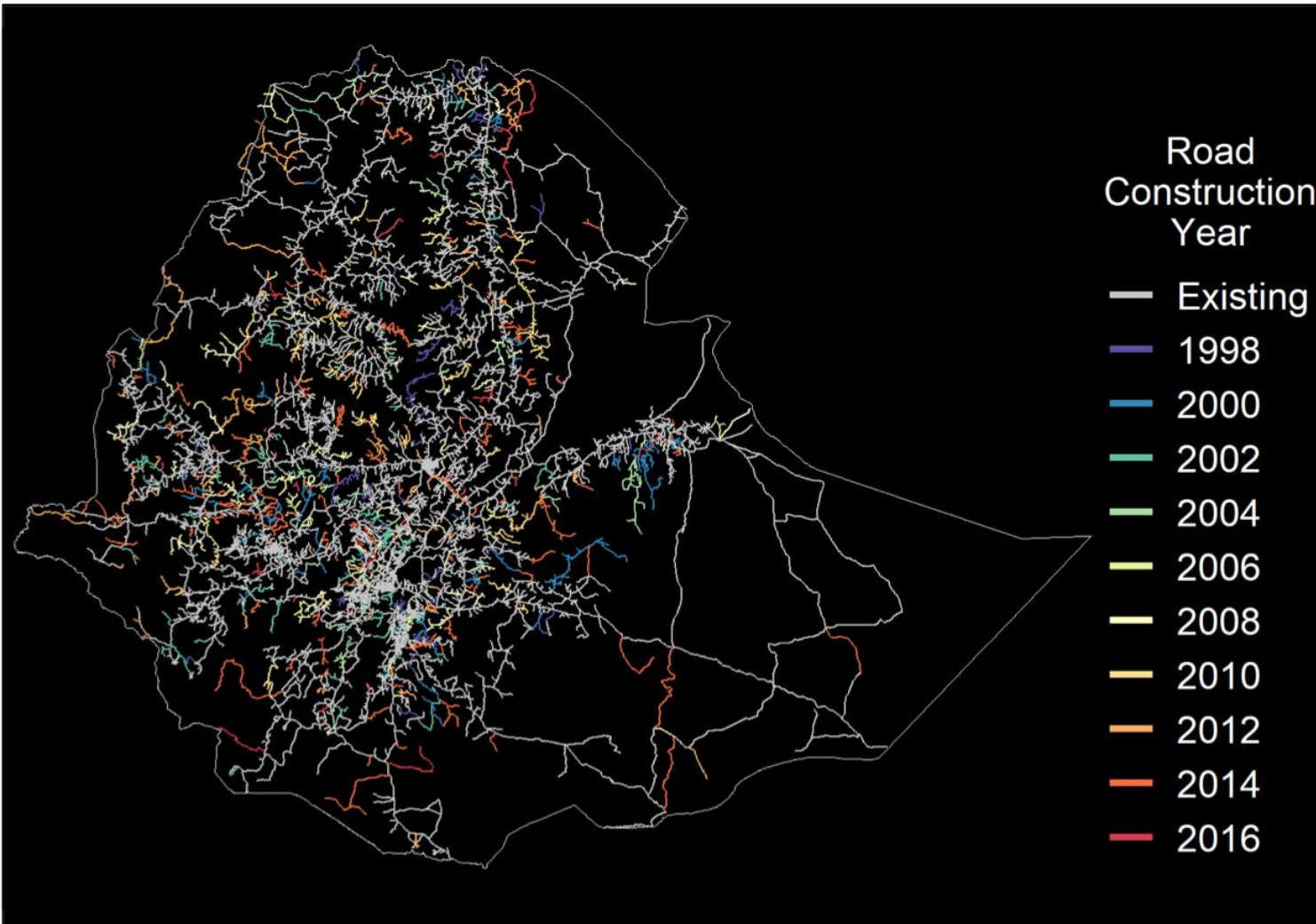
# A Flavor of the ieConnect Corridors Portfolio

*Bring new and existing data sources together to answer some of the big questions*

Are corridors linked to land use changes? Evidence of Ethiopia's urbanization



# Estimating the Impact of the RSDP in Ethiopia



- Aim to promote growth, high value agriculture, and light manufacturing
- Issue: Transportation infrastructure inadequate
- Solution: **Road Sector Development Program** (RSDP) started in 1997 to build new roads and upgrade, rehabilitate, and maintain existing roads

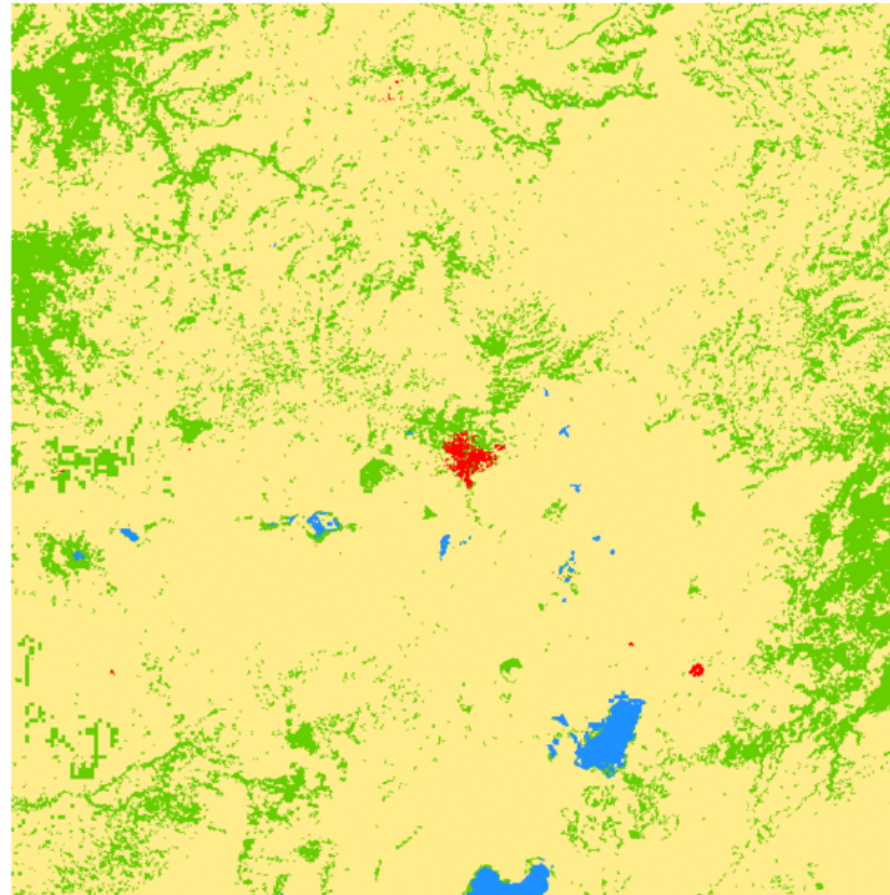


- Did it transform Ethiopia's landscape towards less agricultural land more urban areas?

# Satellite Imagery and Land Use in Ethiopia

## Urbanization around Addis Ababa

Land Cover: 1996



Land Class

- Agriculture
- Urban
- Vegetation
- Water/Wetlands

### Land Cover

- Description:* Classifies land cover annually from 1992 to 2015. We consider urban areas and cropland
- Source:* European Space Agency Globcover Dataset

### Vegetation

- Description:* Use NDVI, a vegetation index, as a proxy for crop yields
- Source:* Landsat

### Nighttime lights

- Description:* Captures luminosity for 1 km pixels from 1992 to 2013 annually. Light intensity correlates well with local GDP level (Storeygard & Donaldson (2016)).
- Source:* Defense Meteorological Satellite Program Operational Line Scanner (DMSP-OLS)

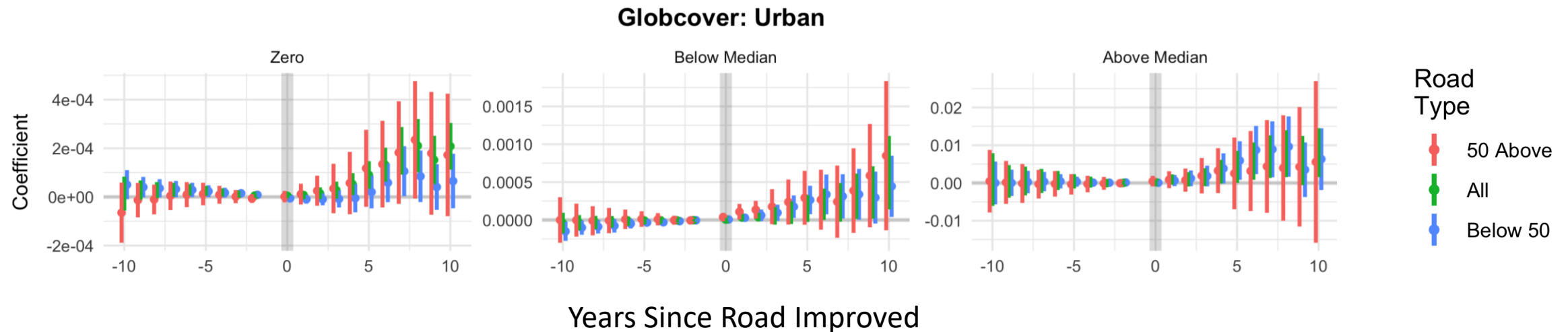
# Satellite Imagery and Land Use in Ethiopia

## Methods

- Examine trends in variables before and after road improvement
- Break down results by baseline nighttime light level & by speed limit of improved road

## Results

- Increased growth in urban area after road improvement
- In woredas with high baseline NTL, increased growth mainly seen in areas near roads with speed limit less than 50km/hr



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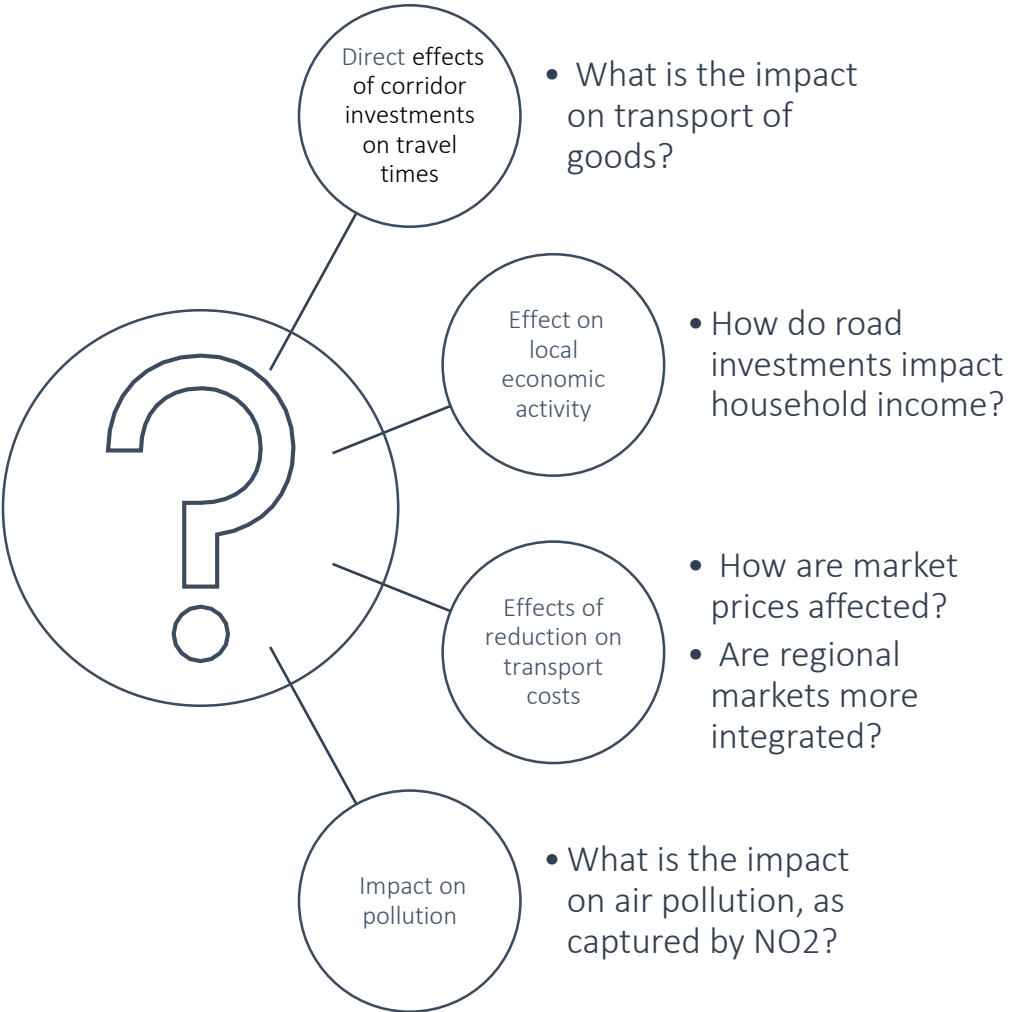
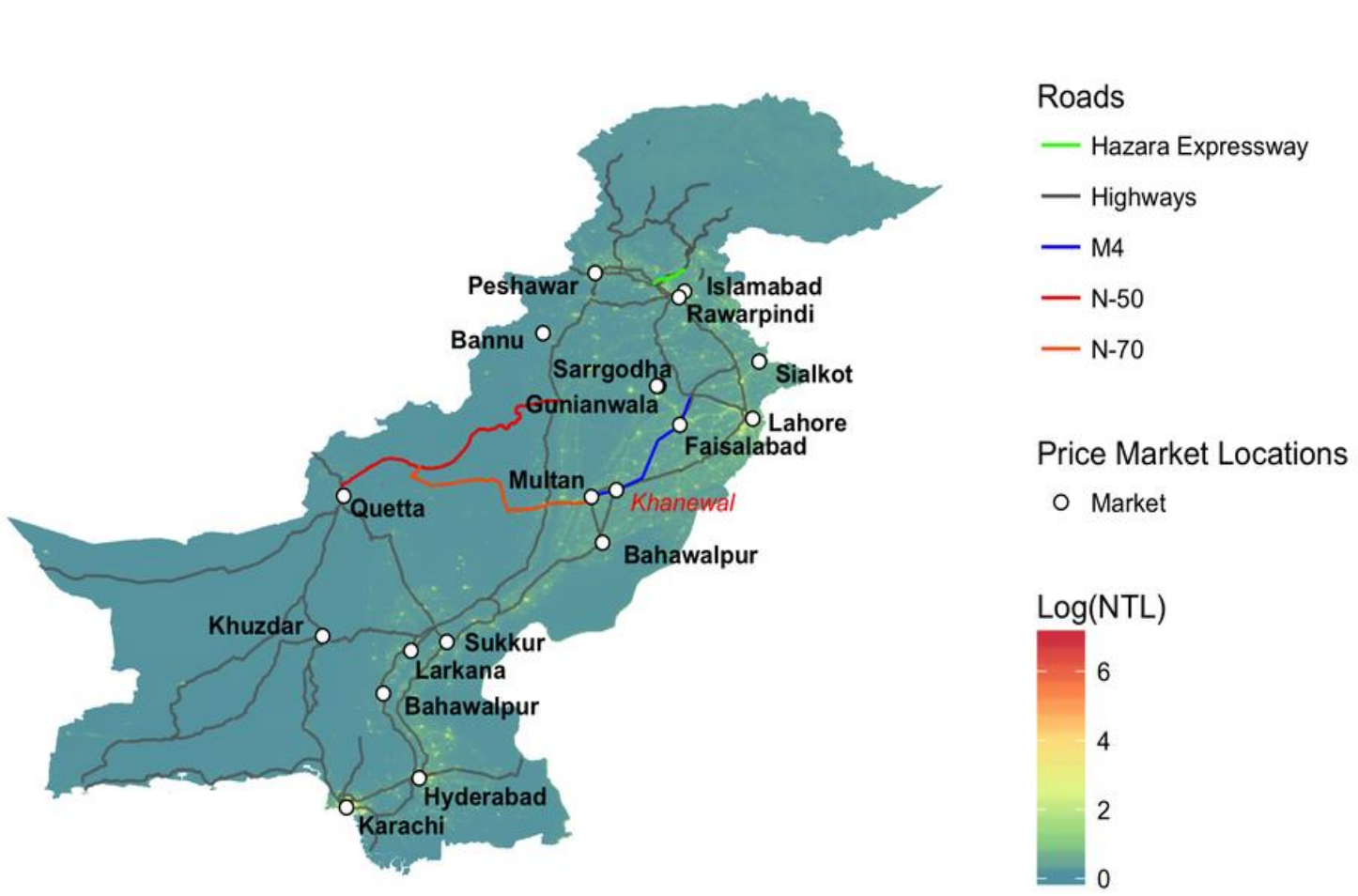
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*Bring new and old data sources together to answer some of the big questions:*

**Do investments in infrastructure reduce the cost of distance within a country?**

**Price series in Pakistan**

# Understanding Impacts of Pakistan's Corridor Investments



# Measuring intra-national trade costs

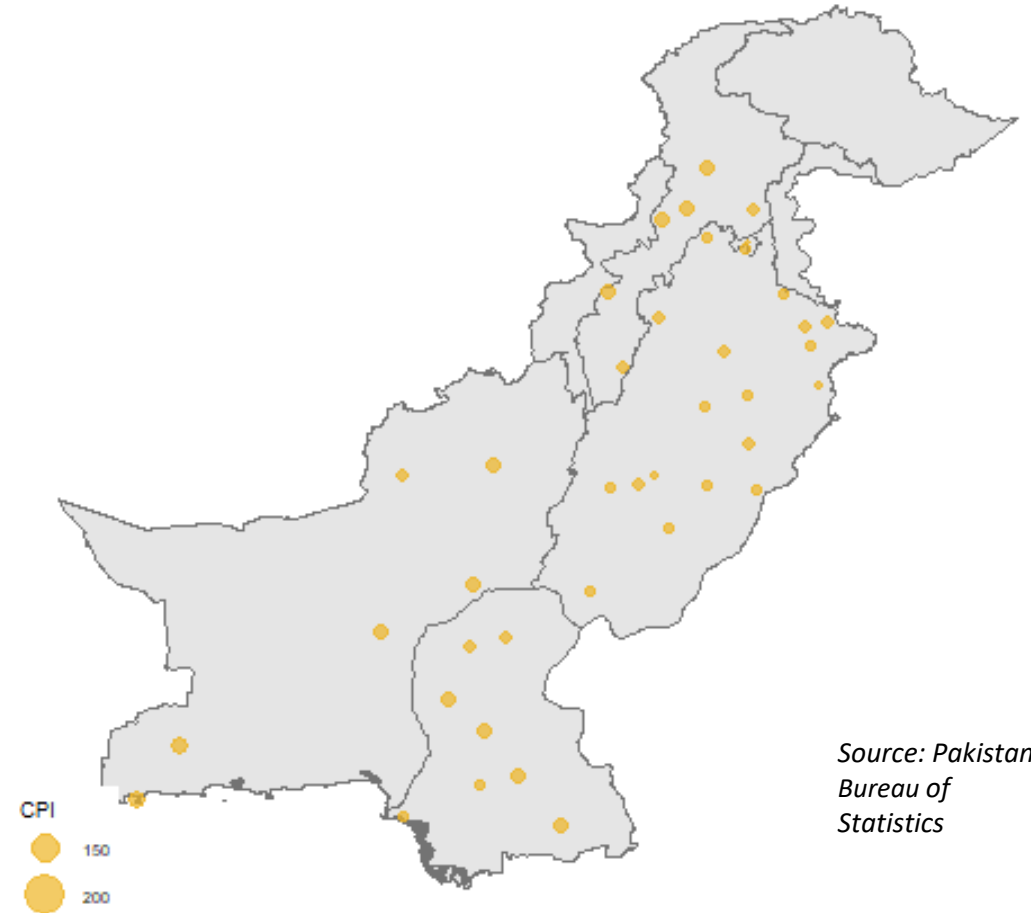
- Cities far away face different prices : distance is costly
- Without intranational trade costs, arbitrage possibilities would disappear



- How do final consumer prices change as a result of changes in transport infrastructure?
- Market prices from 76 markets across 40 cities

Consumer Price Index in Pakistan's Cities

Year:2008



Source: Pakistan Bureau of Statistics



# Measuring intra-national trade costs

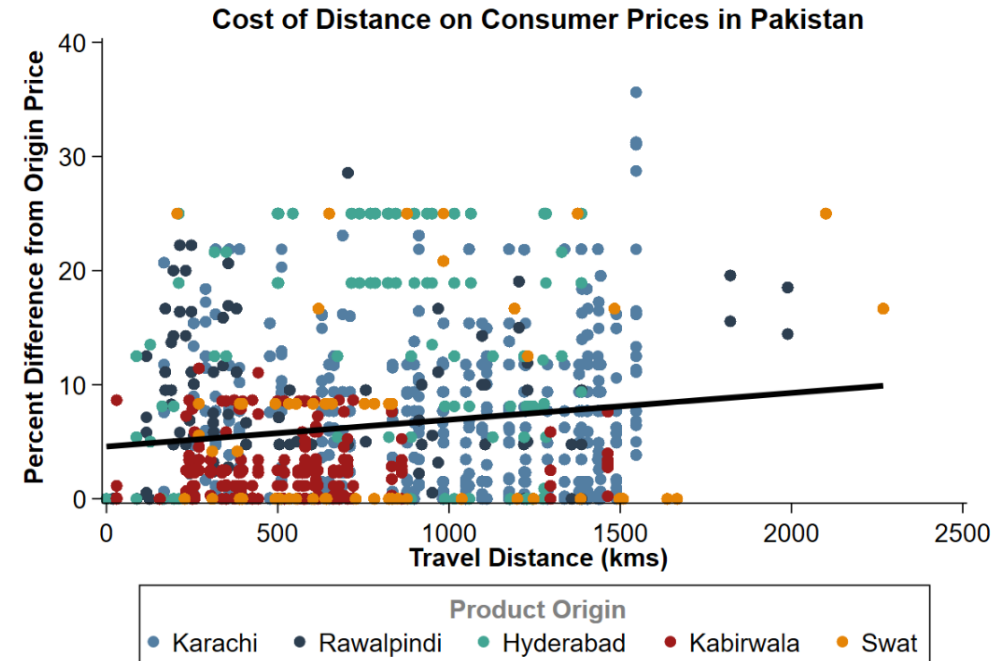


Example of transport investment affecting the routes for Himalayan Rock Salt



## Distance is costly

Increase in 100 km between origin and destination results in 0.2% difference in consumer prices

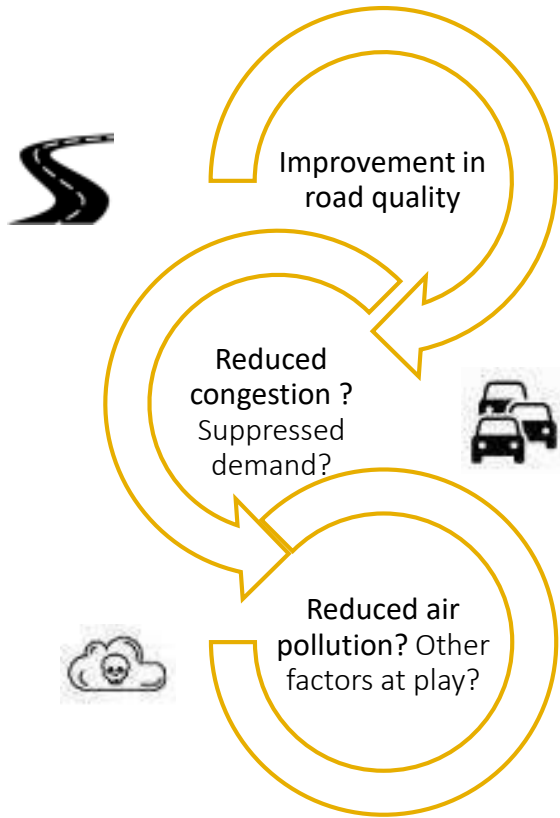


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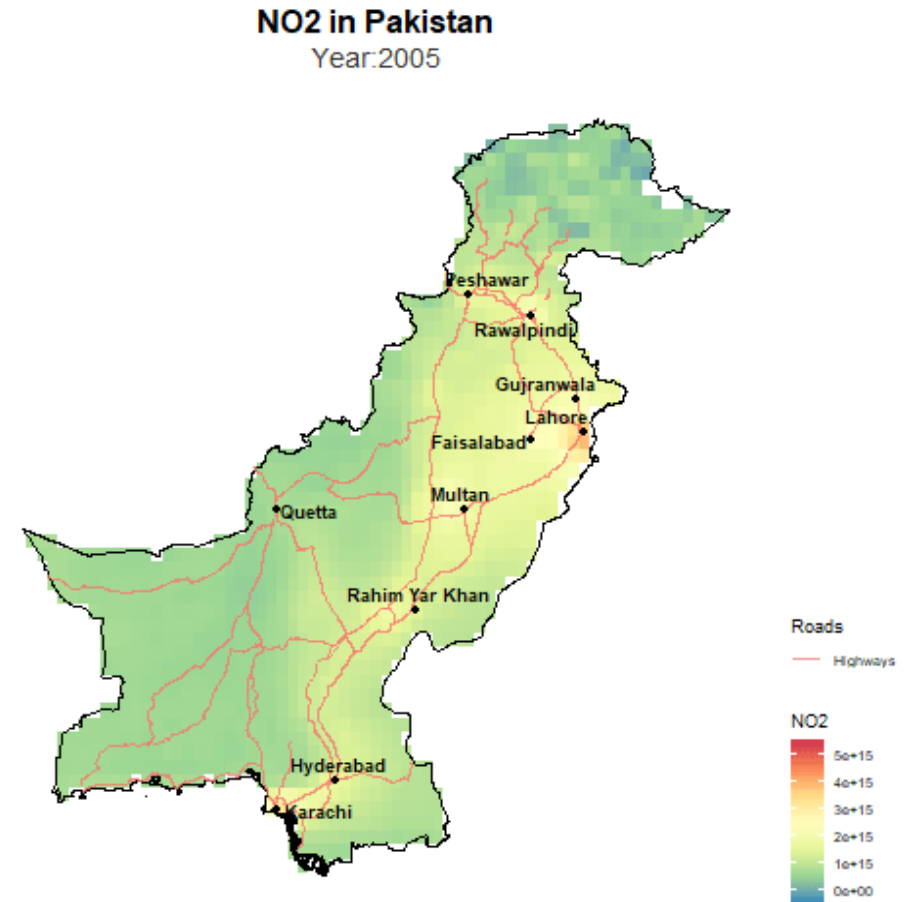
*Bring new and old data sources together to answer some of the big questions:*

**Do roads increase pollution? Pollution from the sky in Pakistan**

# Measuring Air Pollution from Satellite Imagery



- Using satellite imagery, we infer the levels of  $\text{NO}_2$  at pixel-level (750m x 750m on the ground)
- Values above  $5 \times 10^{15}$  molecules/cm<sup>2</sup> are generally considered polluted and values above  $1 \times 10^{16}$  are considered highly polluted
- Important issue for Pakistan: Lahore experienced a 50% increase in  $\text{NO}_2$  from 2005 to 2017 – not all due to transport!



*Values of tropospheric NO<sub>2</sub> 10<sup>15</sup> molec/cm<sup>2</sup> as measured from satellite imagery*

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  - Trade Investments in Southern Africa
  - Trauma registry in Malawi

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*Bring new and old data sources together to answer some of the big questions:*

## **Last-mile connectivity in Guinea-Bissau**

- Trade Investments in Southern Africa
  - Trauma registry in Malawi

# Guinea-Bissau Road Project

What is the impact of road construction, improvement and **last mile connectivity** on local economic development?



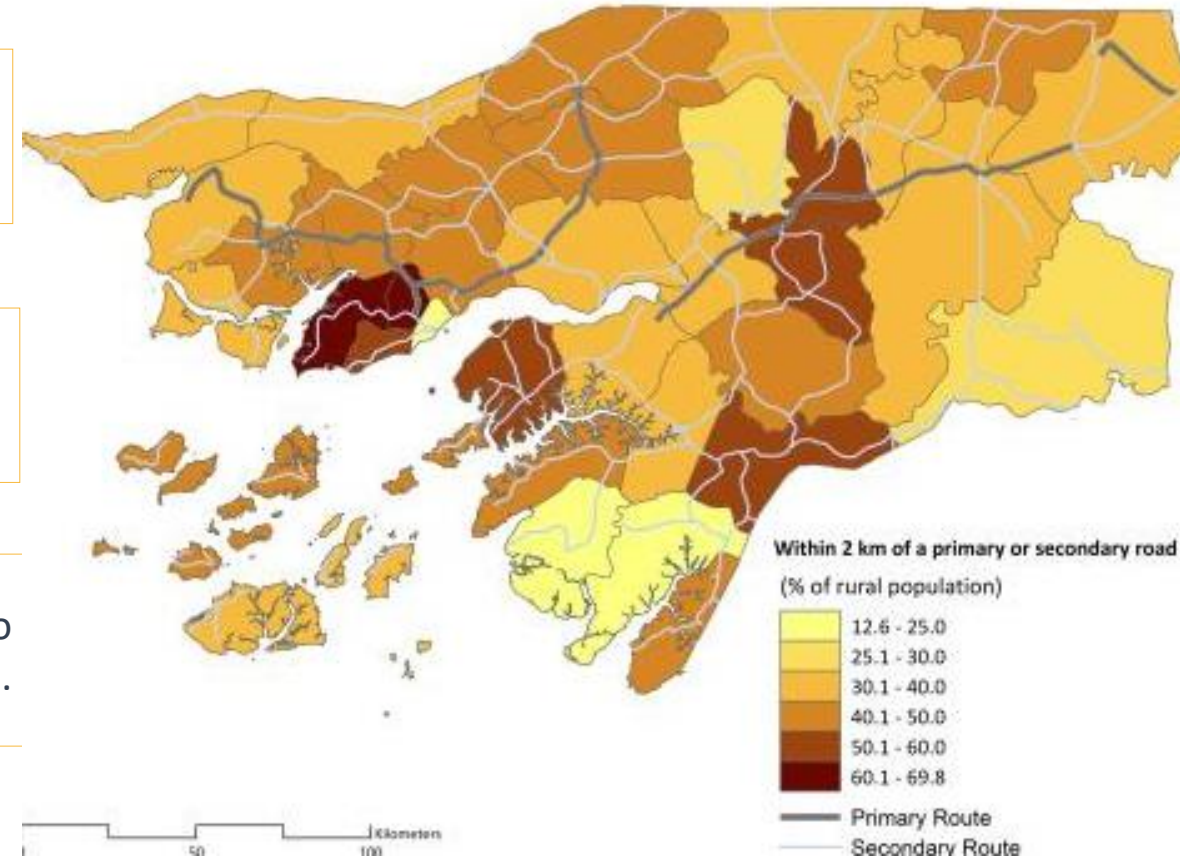
After a period of instability, transport infrastructure policy in GB has expanded to include social objectives like poverty reduction, job creation, personal security.



This impact assessment aims to measure changes in transport costs and accessibility through improvement and construction of 60 km roads and 50 km of **feeder roads**.

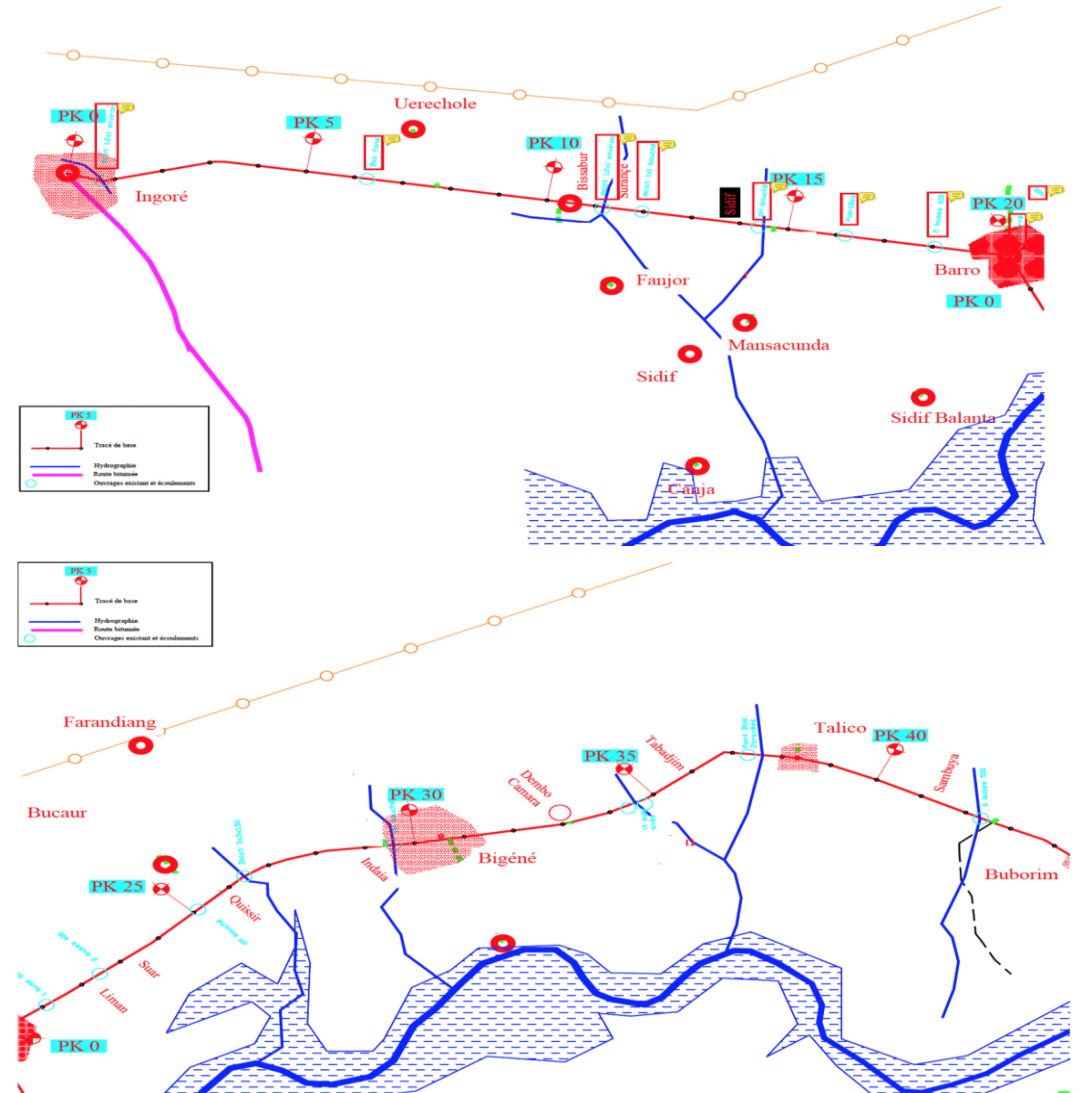


The project will rely on difference-in-difference approaches to measure change in treatment and control localities outcomes.



# Last-mile Connectivity in Guinea-Bissau Road Project

- 40 percent of rural Africans live within **two kilometers** of an all-season road which is the lowest level of rural accessibility in the developing world (Gwilliam et al, 2008)
- Feeder roads connection to the main trunk road ensure **last mile connectivity** and help magnify the wider economic benefits of the economic corridors
- Without last mile connectivity, **women** in particular find their access to **education and healthcare**, especially maternal care, severely hampered, thereby contributing to Guinea-Bissau's very high ratio of maternal mortality (790 deaths per 100,000 live births)



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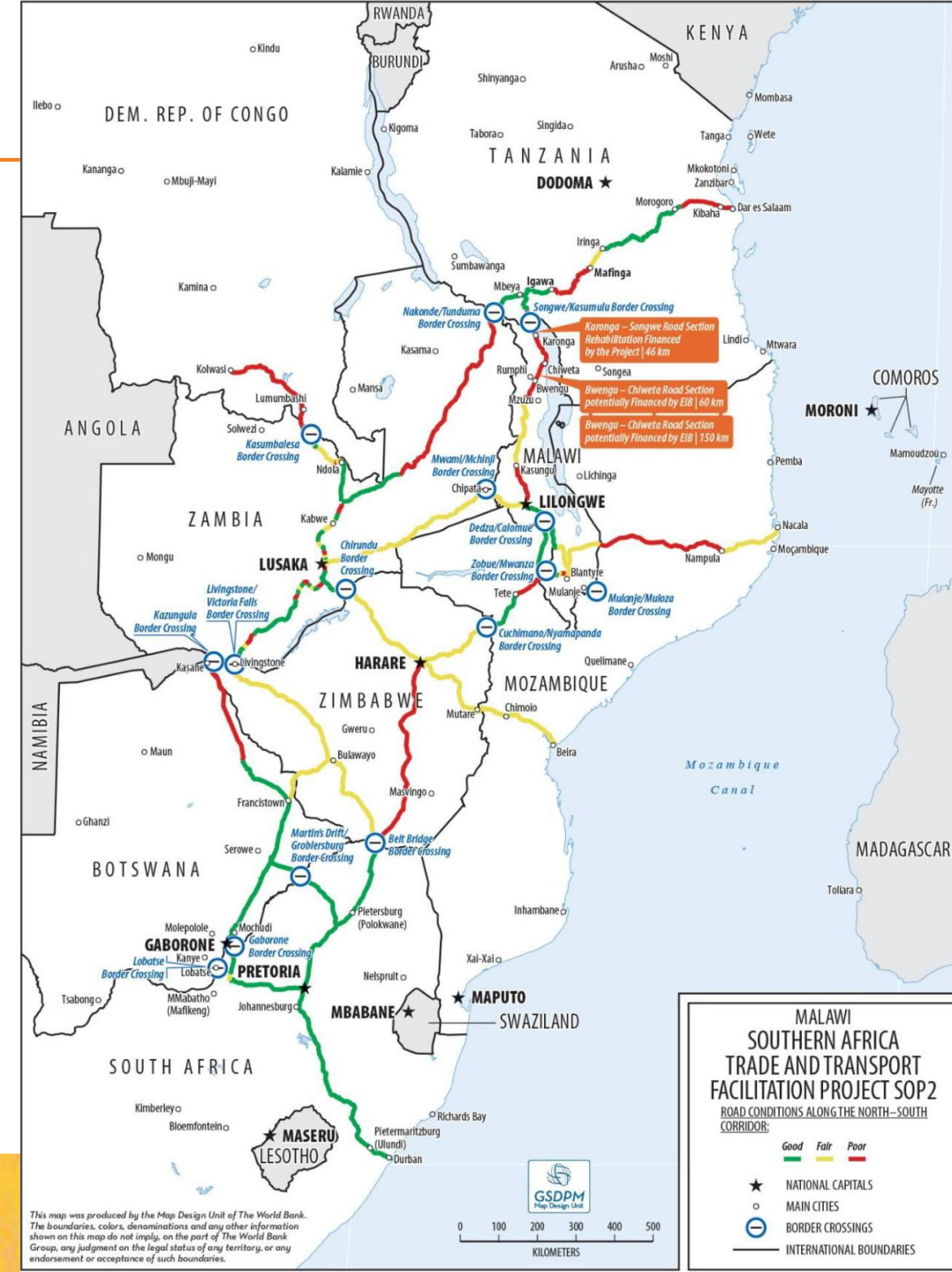
*Bring new and old data sources together to answer some of the big questions:*

**Trade Investments in Southern Africa**



# Trade Infrastructure in Southern Africa

- Transport and Trade facilitation projects are often **based on a bundle of measures**
  - Hard Infrastructure
  - needed to implement the World Trade Organisation's Trade Facilitation Agreement
- Why are some trades routes more used than others?
  - Hard infrastructure to reduce transport costs, but are they enough?
  - Soft intervention : ease of trading across borders



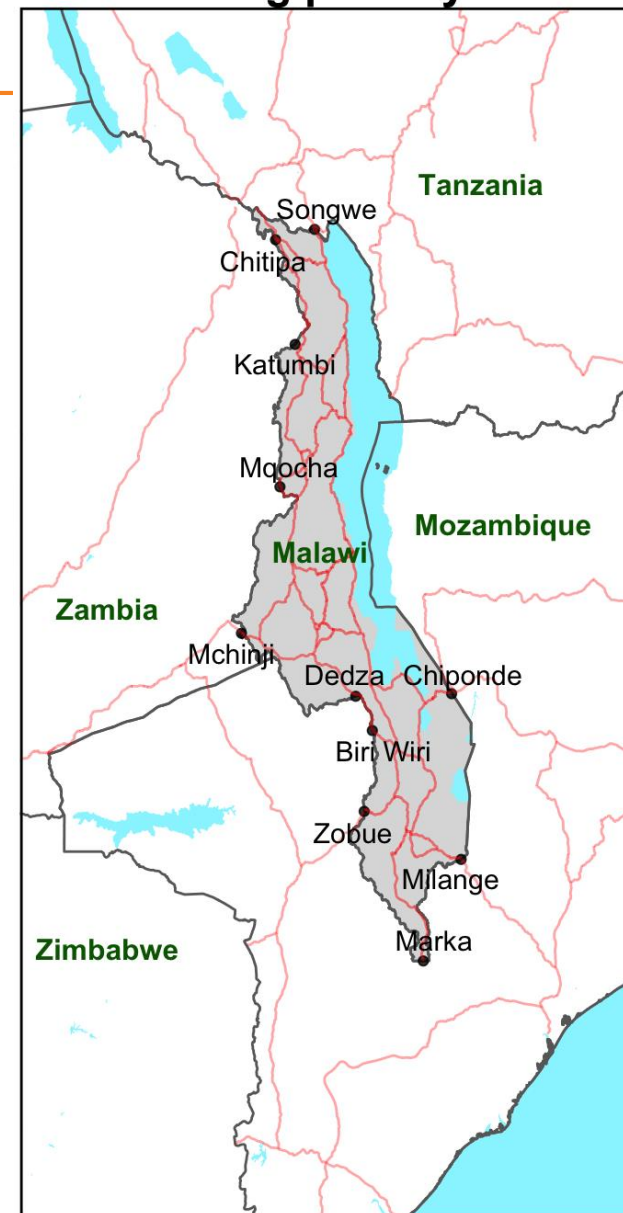
THE CONNECT FOR IMPACT



# Trade Infrastructure in Southern Africa

- Study a **multicomponent trade facilitation projects in Malawi** and in Southern Africa
- Merging high frequency customs records and survey data
- Key questions:
  - What are the impacts of import procedures on customs efficiency and the ease of trading across borders ?
    - Are the new procedure improving bordering crossing?
    - Are they allowing for easier tariffs and taxes collection?
    - Are traders well informed about the routes ?

**Border posts in Malawi and connecting primary roads**



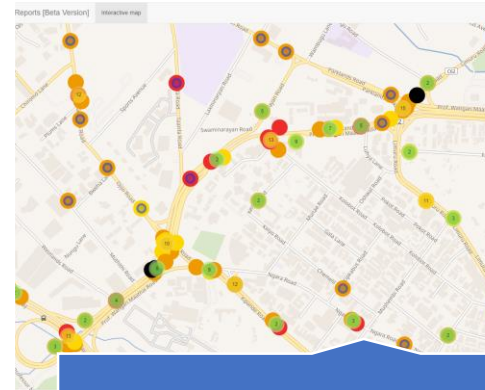
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**Road safety on the corridors: Trauma registry in Malawi**

# Trauma Registries to Support Cross-Sectoral Policies for Road Traffic Crashes in Malawi

- **Goal:** Save lives through post-crash care
- **Gaps in existing data systems:** Health MIS consist of monthly aggregate data but no information on the cases including severity and lot of missing data
- **Solution:** **Trauma registries** with demographics, mode of transport to hospital, geographic location of trauma, time of trauma, hospital arrival, vital signs, details on up to 3 injuries, daily outcomes
- **3 key elements:** Digital data collection, wide coverage (10 health facilities) and real-time
- **76,427 Trauma Entries as of March 30, 2020**



Data at the Scene



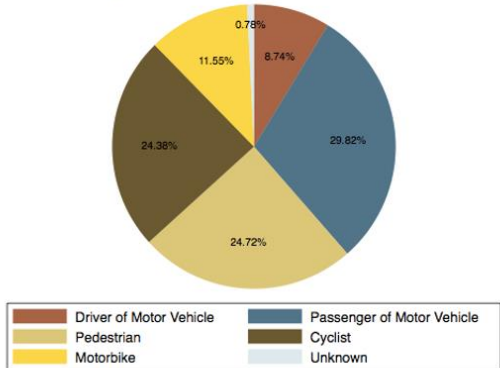
Data on Ambulances



Trauma Registries in Health Facilities

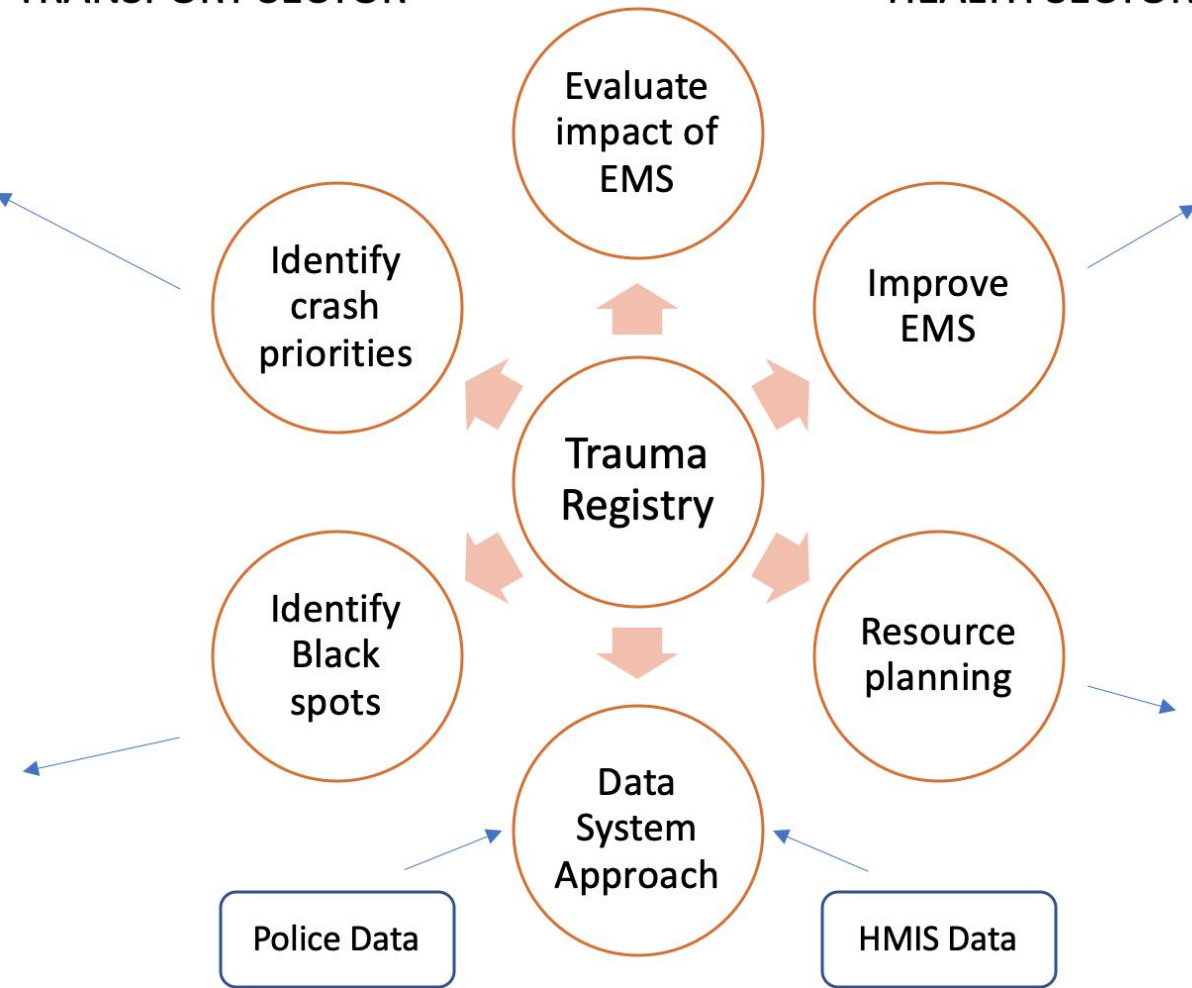
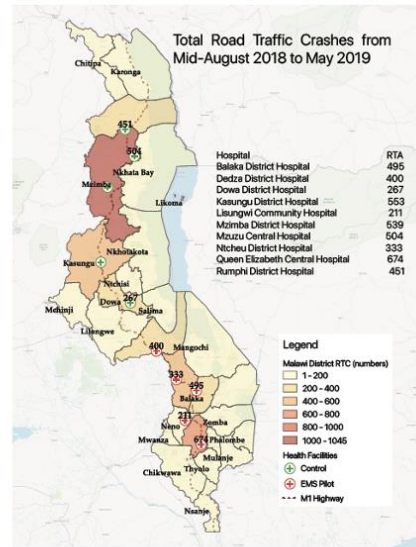
# Building Data Collaborations Across Transport and Health Sectors

Types of Road Traffic Crash Victims

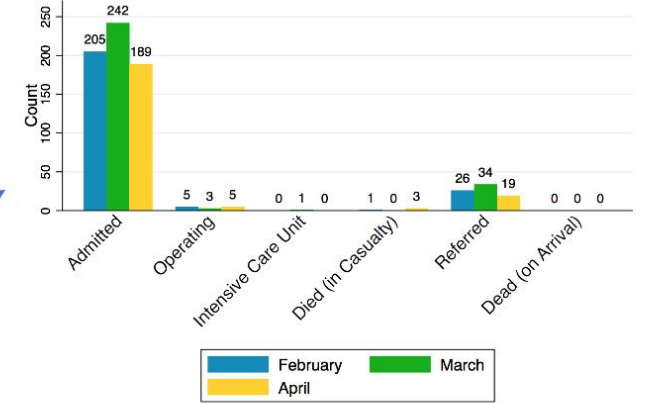


## TRANSPORT SECTOR

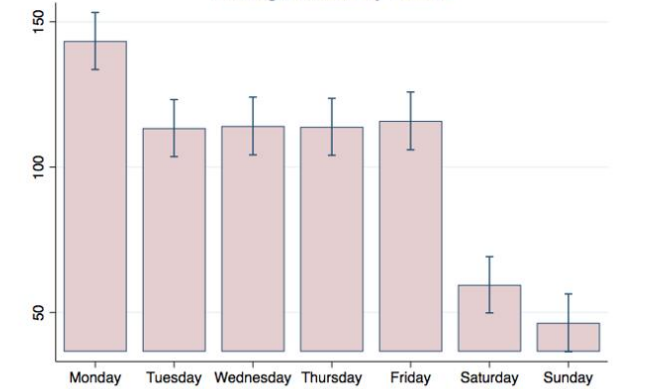
## HEALTH SECTOR



Trauma Outcome for Inpatient Cases Last Three Months



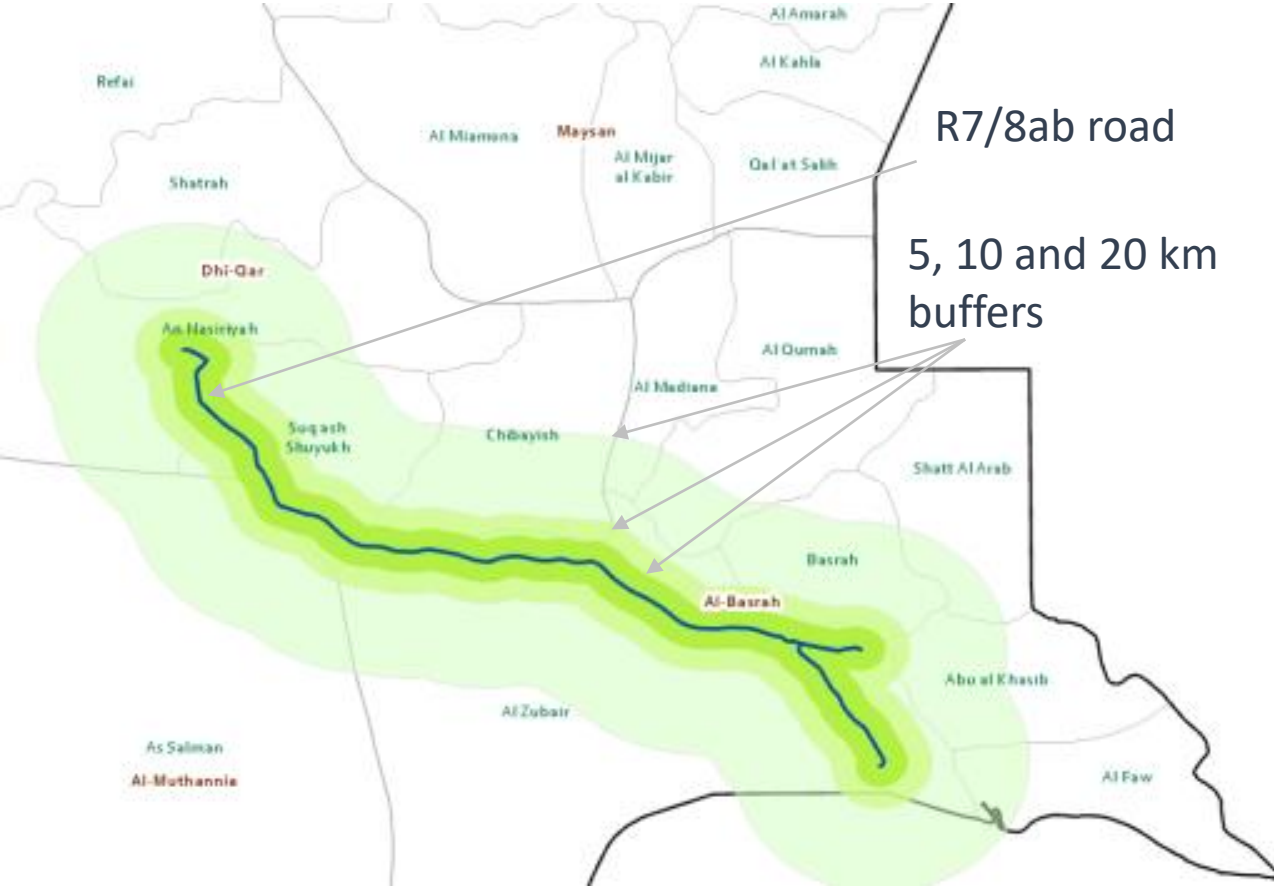
Average Weekday Cases



# EXTRA SLIDES



# Nighttime Light around R7&8 and along Expressway



Example: Mean Nighttime Light Data 2012

