

EVIDENCE-BASED EVALUATION

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS

18TH ODA EVALUATION WORKSHOP

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Evaluation 

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01 Value-addition of GIS for Evaluation

02 Application of GIS for Portfolio Analysis

03 Use of Nighttime Lights to Assess Impact
at the Project and Sector Level

Disclaimer: The views and opinions expressed in the presentation do not represent the views of ADB and IED.

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VALUE-ADDITION OF GIS FOR EVALUATION

WHY EVALUATE?

Objective

Development Effectiveness

Maximizing development effectiveness of ADB operations through evaluation feedback



How

Accountability

- Performance assessed by evaluation criteria?
- Did ADB do things right? Did ADB do the right things?

Organizational Learning

- What worked and what did not?
- What lessons are critical to improve development impact?

Resource Allocation

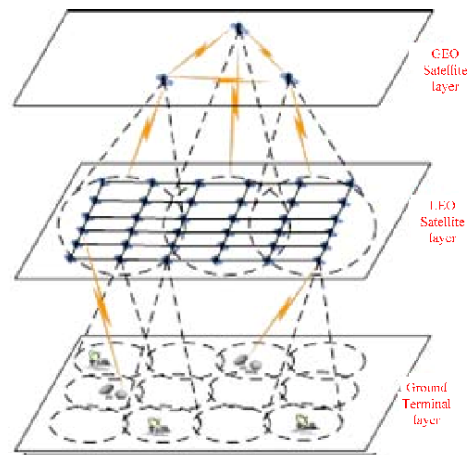
- How can ADB better improve resource allocation based on lessons and emerging demand?

GIS DATA AND APPLICATION

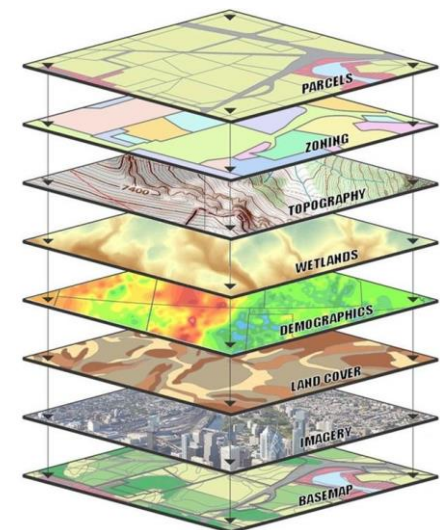
Sensing



Data Mapping



Application



Layers of GIS

Evaluation Criteria (Project) and Opportunities of Application of GIS

RELEVANCE	EFFECTIVENESS	EFFICIENCY	SUSTAINABILITY	IMPACT
Is the intervention doing the right thing? <ul style="list-style-type: none"> Consistency with the lending strategy of the government and ADB Adequacy of the design 	Is the project achieving its objective? <ul style="list-style-type: none"> Achievements of outputs and outcomes Implementation of safeguards 	How well are resources being used? <ul style="list-style-type: none"> Using indicators such as the economic internal rate of return Process efficiency 	Will the benefits last? <ul style="list-style-type: none"> Capacity to maintain the outcome over the projects economic life—O&M Environment including climate change 	What long-term changes did the project result in? <ul style="list-style-type: none"> Longer-term development outcomes (intended and unintended)



Value-addition with GIS

Review whether <u>locations</u> of projects are relevant (Geospatial portfolio)	Monitor or validate <u>outcome indicators</u>	Monitor progress and environmental safeguards by <u>satellite imagery</u> and video of <u>drones</u>	Monitor the status of physical investment and environment by <u>satellite imagery</u> , video of <u>drones</u> , and global database	<u>Impact assessment</u> by Nighttime light (economic growth), CO ₂ map, population map, poverty map, etc.
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TOC CAN BE SIGNIFICANTLY IMPROVED

INCLUDING IMPACT EVALUATION

1. Common issues in assessment with the Theory of Change (TOC)

Although it is widely assumed that investments promote economic growth and reduce poverty, there is little evidence to prove it

- a) Difficulty in finding data on some outcome and impact indicators
- b) Difficulty in measuring attribution of ADB
- c) Targets were unrealistic

2. How do GIS data help?

- a) Finding data
 - Access data remotely and retrospectively
 - Provide the same data accessibility and quality for all countries including fragility, conflict, and violence situations
- b) Attribution
 - Set flexibly configurable impact zones to count socioeconomic changes related to support
- c) Setting targets
 - Improve targets setting with configured socioeconomic data, Nighttime light (economic activities), CO₂ emissions, disaster, pollution, and land use
 - Improve assessment as results because results are comparable in a country and across countries
 - Increase transparency

APPLICATION OF GIS FOR PORTFOLIO ANALYSIS

DIGITIZED 163 PROJECTS

IMPLEMENTED FOR 2010–2018



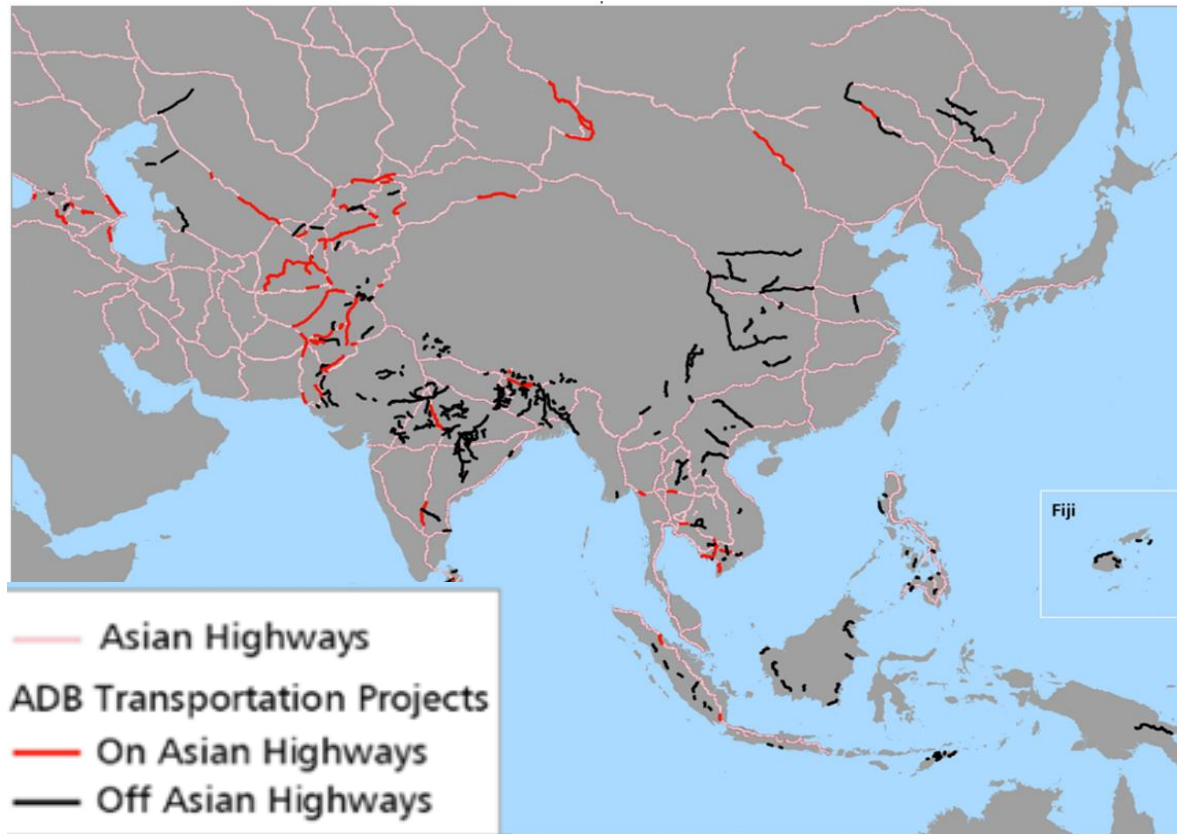
Locations of 163 Projects

Note: This presentation does not show any borderlines.

INTERNAL. This information is accessible to ADB Management and staff. It may be shared outside ADB with appropriate permission.

OVERLAPPING WITH THE ASIAN HIGHWAYS

- Most support of ADB for interregional highways was in the Central and West Asia



Asian Highways and Project Locations

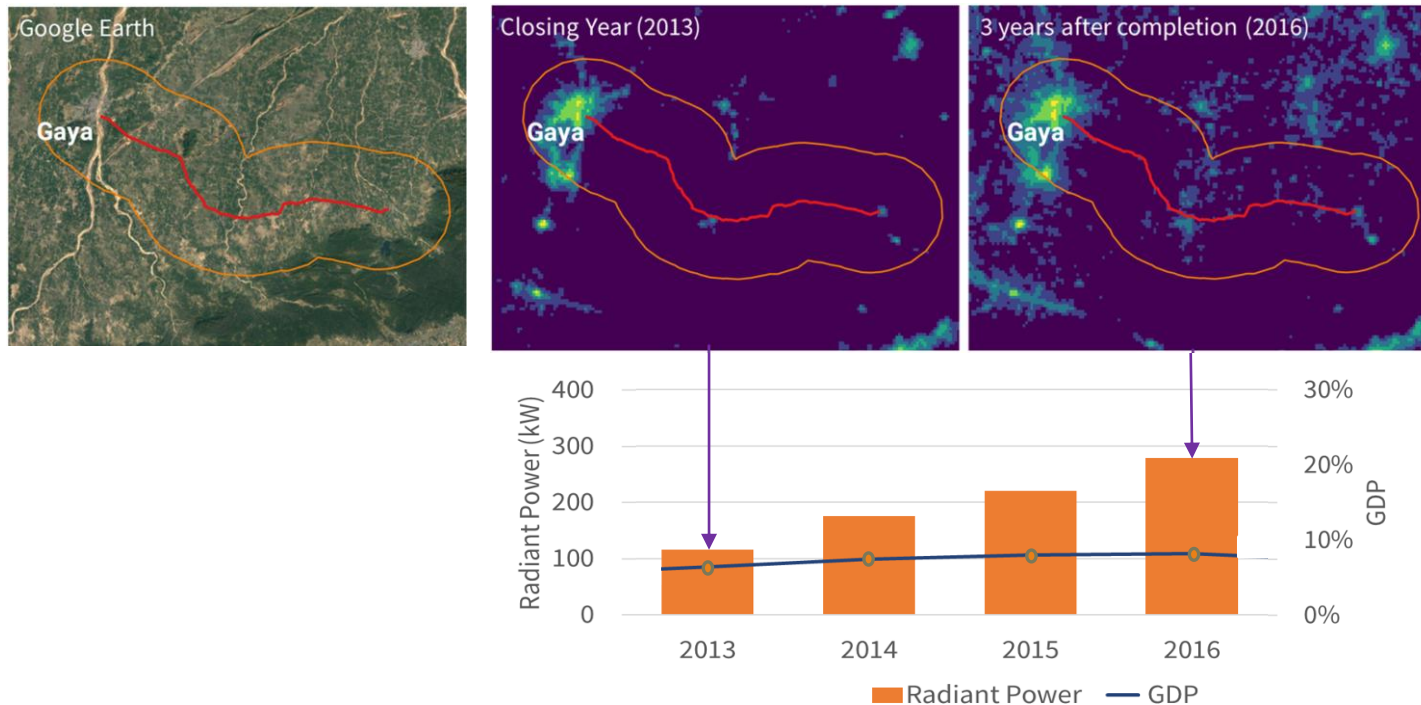
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BUFFER ZONE (IMPACT ZONE)

- Socioeconomic and environmental changes in buffer zones can be monitored
- Buffer zones can be **set freely** in size and shape

10-kilometer Buffer Zone of the State Highway in Gaya



The average annual increase rate is **34%** between 2013 and 2016

LAND USE IN BUFFER ZONE

- Changes of Land Use from 2017 to 2021
- Consistency with Nighttime light: Build area grew by 20%
- Daytime imagery captured the decrease in green (crop and trees)

Land Use in Buffer Zone of the State Highway in Gaya in 2017 and 2021

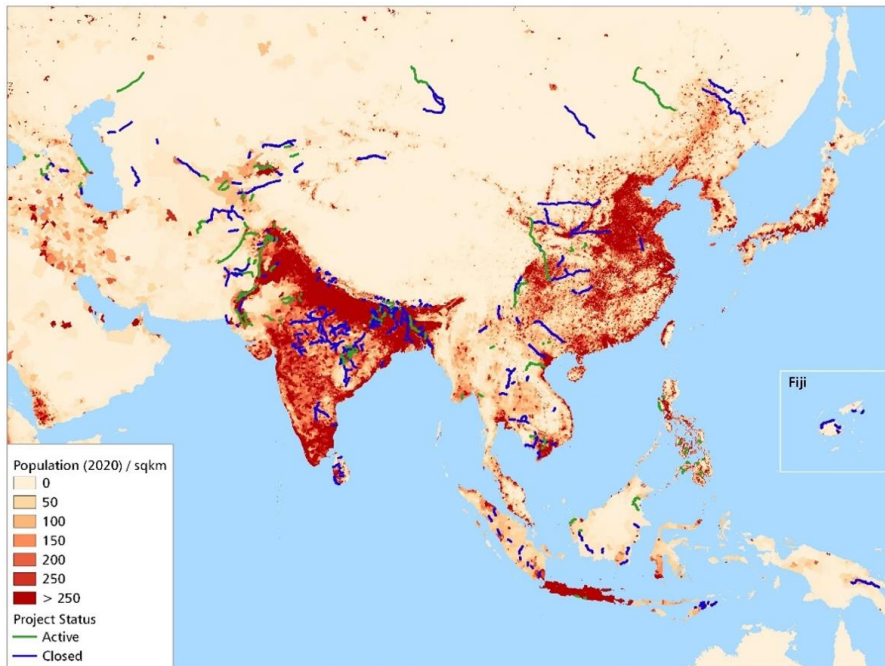


Source: esri



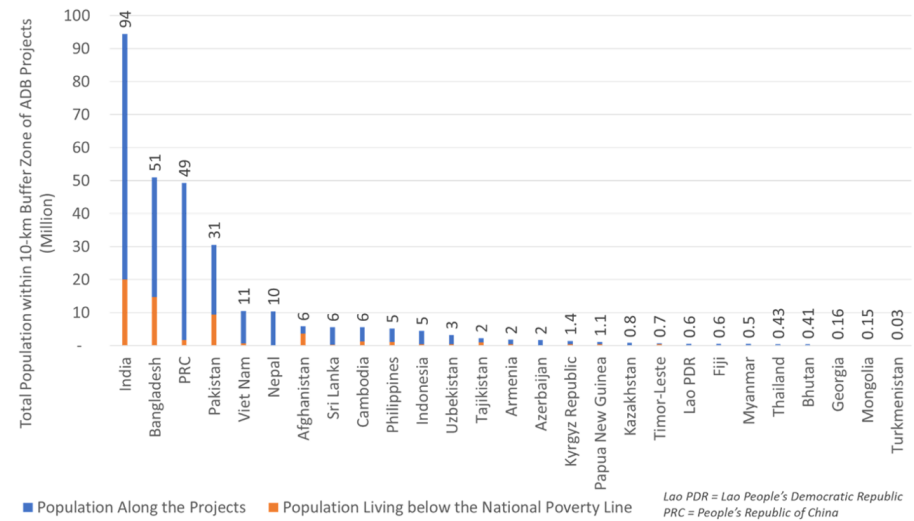
Land Type	Increase (%)
Build Area	20.4%
Corp	-7.1%
Trees	-20.1%

MEASURING POPULATION



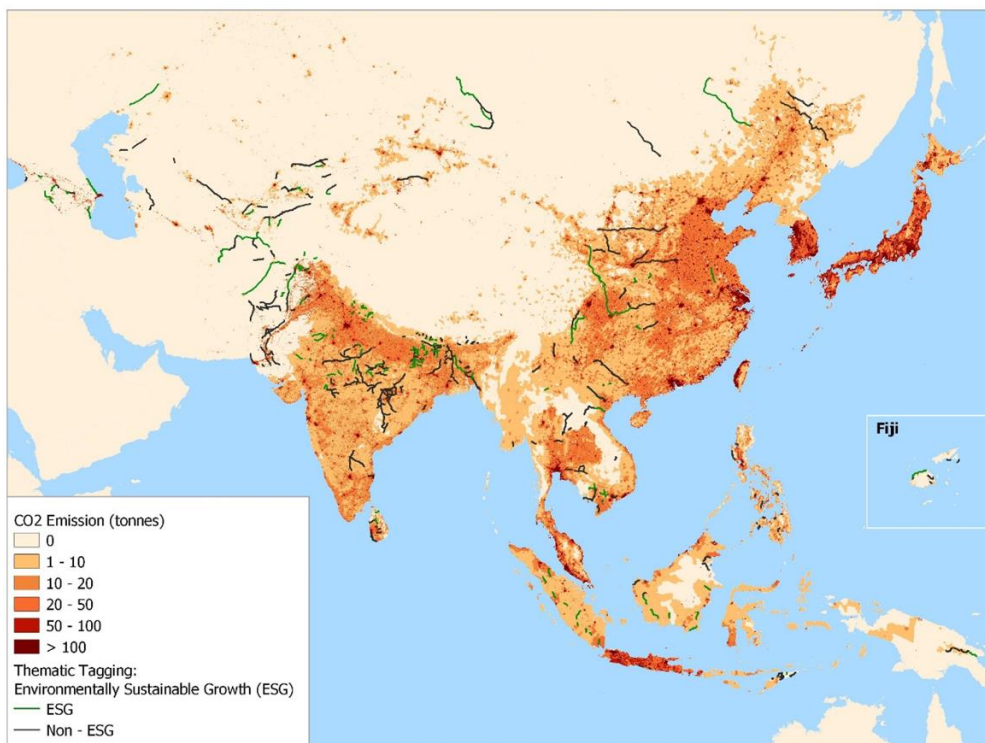
Source: US NASA

Population in 2020 and Project Locations



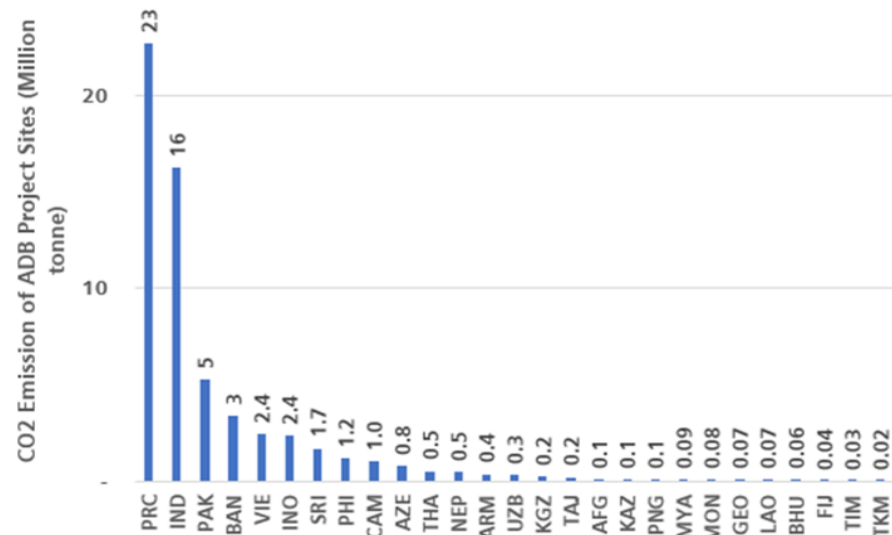
Population in Buffer Zones by Country

CO₂ EMISSIONS

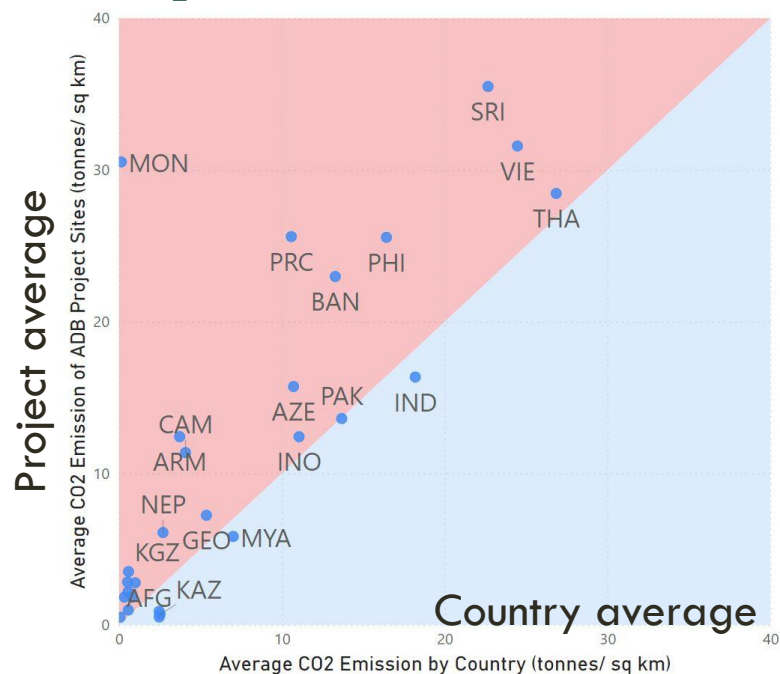


Source: EU Emission Database for Global Atmospheric Research

CO₂ Emission from Transport and Project Locations



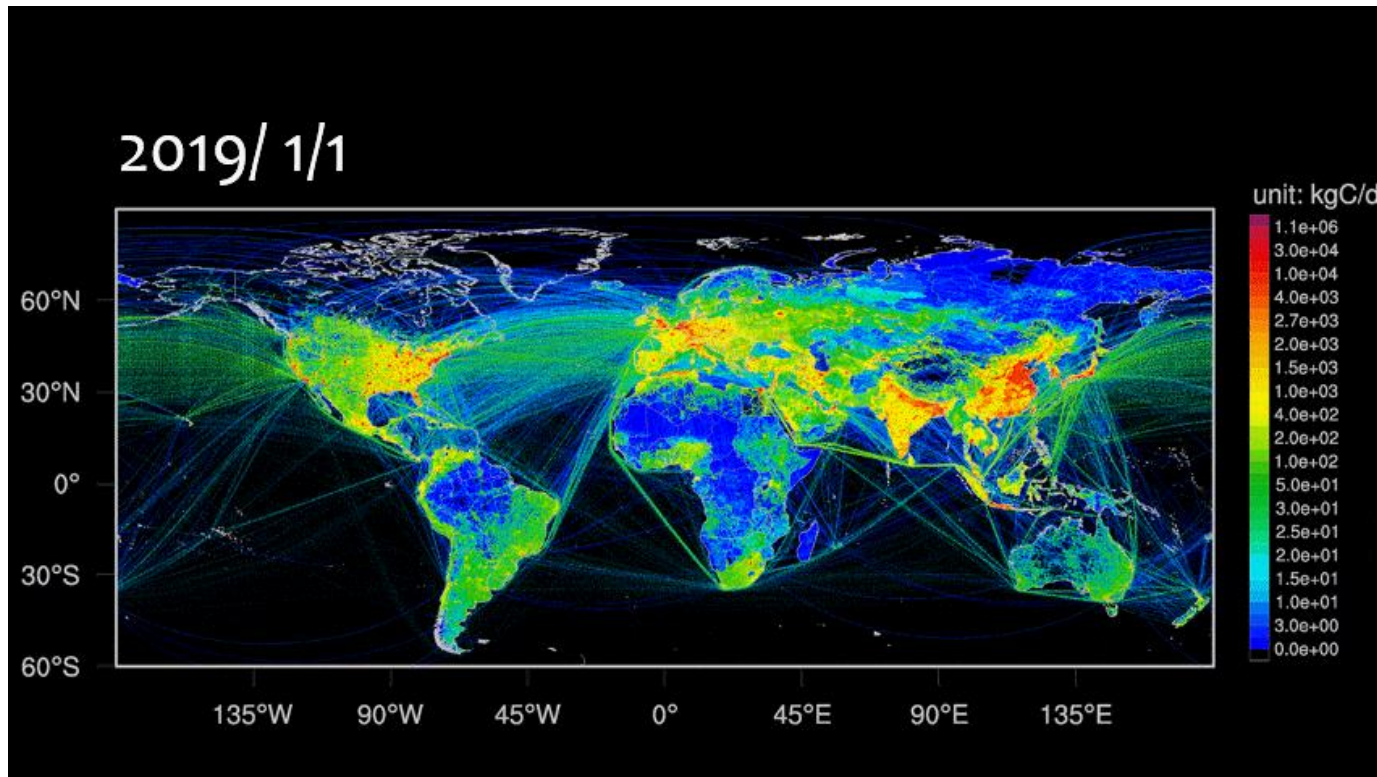
CO₂ in Buffer Zones by Country



CO₂ Density in Project Areas vs. Country Average

CO₂ EMISSION DATA ARE INCREASING

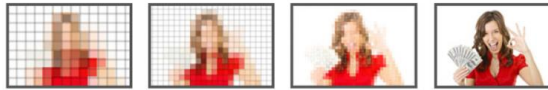
- Several CO₂ monitoring satellite programs are active provided by the US, Japan, Europe, the PRC, and other countries
- CO₂ data by sector are available, e.g., power, industry, residential, ground transport, and domestic and international aviation



Source: GRACED

REMAINING TECHNICAL CHALLENGES

1. Resolution



- Improving day by day and data quality of each satellite are different
 - Use the same resolution/satellite or smooth data.
- Different resolutions (raster) by GIS data, e.g., NTL: 500 m, CO₂: 11 km
 - Make sure the resolution is fine enough to assess a subject.

2. Volatility



- Frequent data, even daily are available. But these does not grow straightforward as we forecast/wish. It depends on human or global activities.

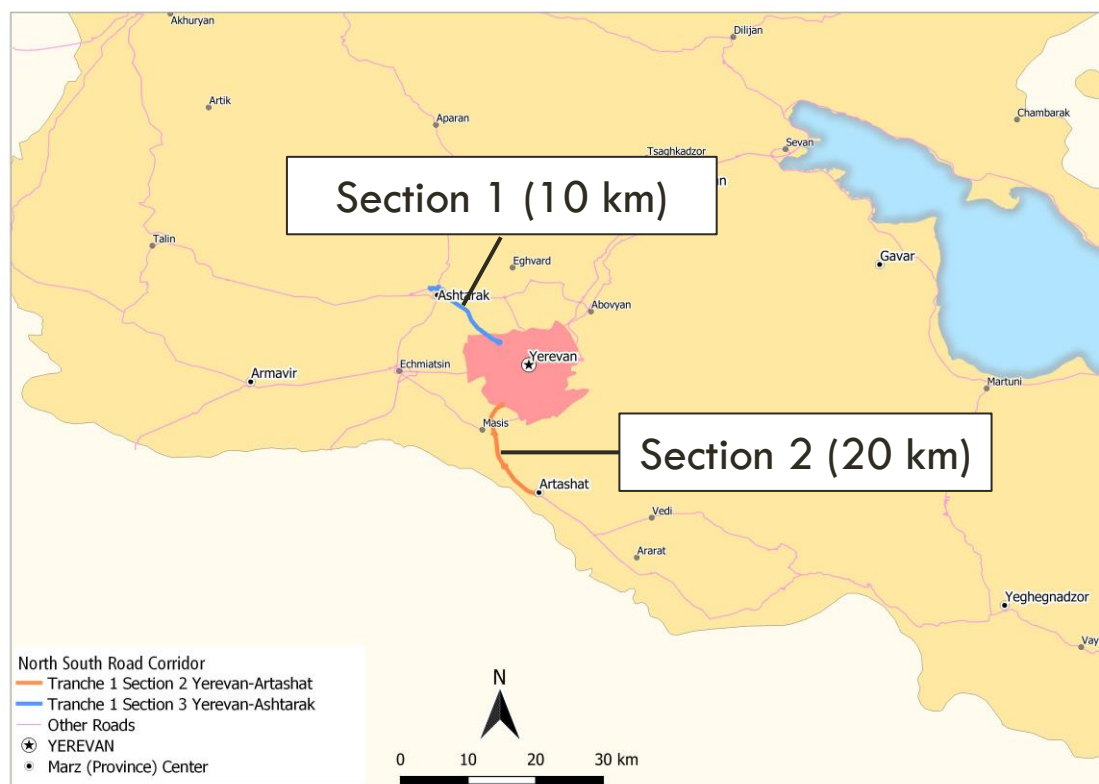
3. Reliability



- Now many entities, public and private, published GIS data. Data need to be validated for our use.

USE OF NIGHTTIME LIGHTS TO ASSESS IMPACT (PROJECT LEVEL)

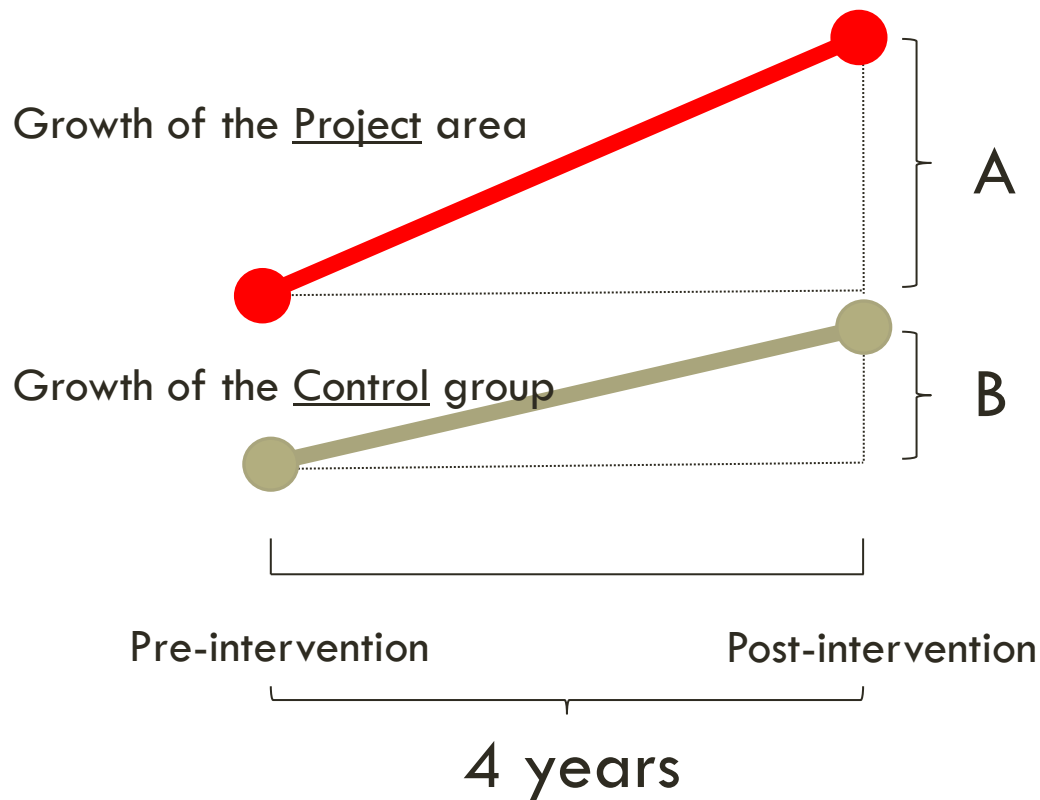
ADB SUPPORT FOR NORTH–SOUTH ROAD CORRIDOR IN ARMENIA



North–South Road Corridor Investment Program (Tranche 1)

DIFFERENCE IN DIFFERENCE = A-B

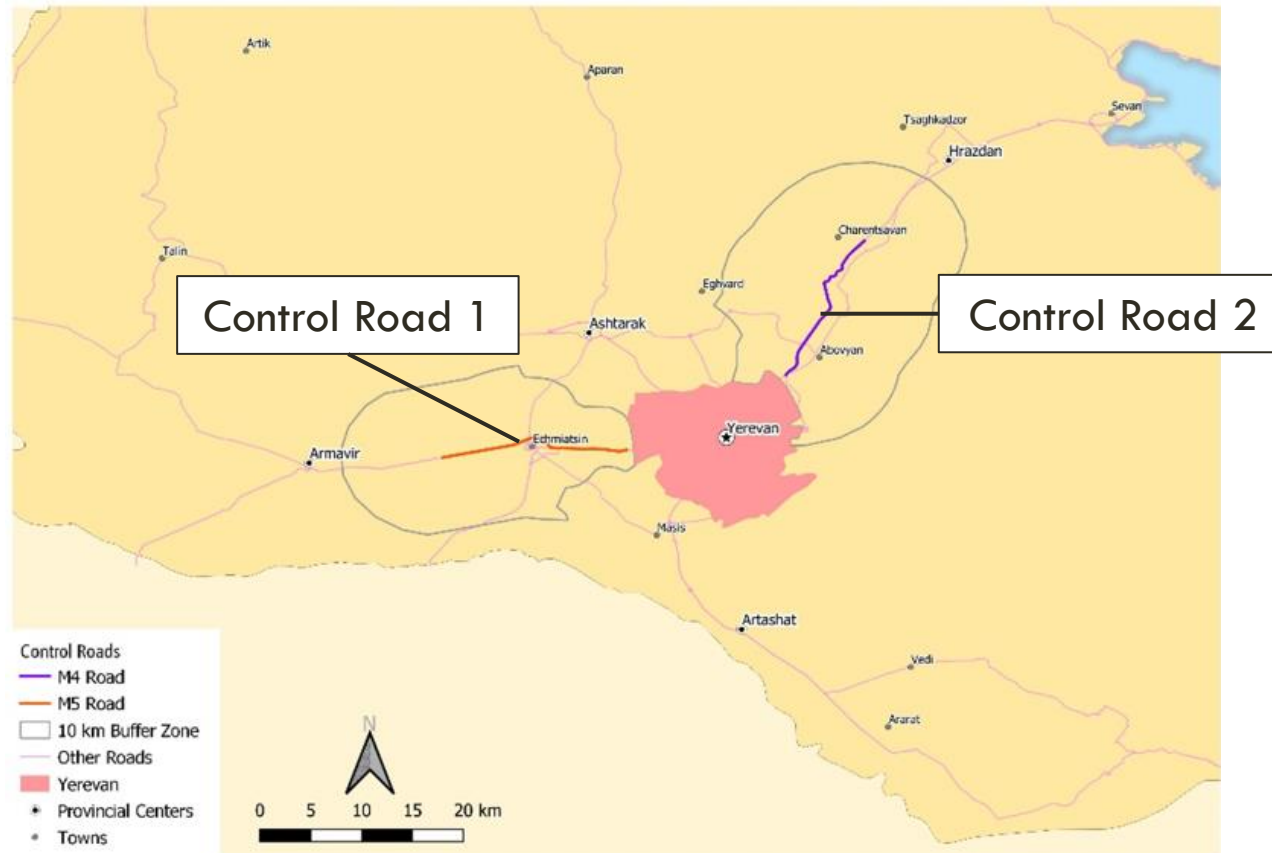
SAME TIMEFRAME BUT DIFFERENT LOCATIONS



Difference of Difference (Case 1)

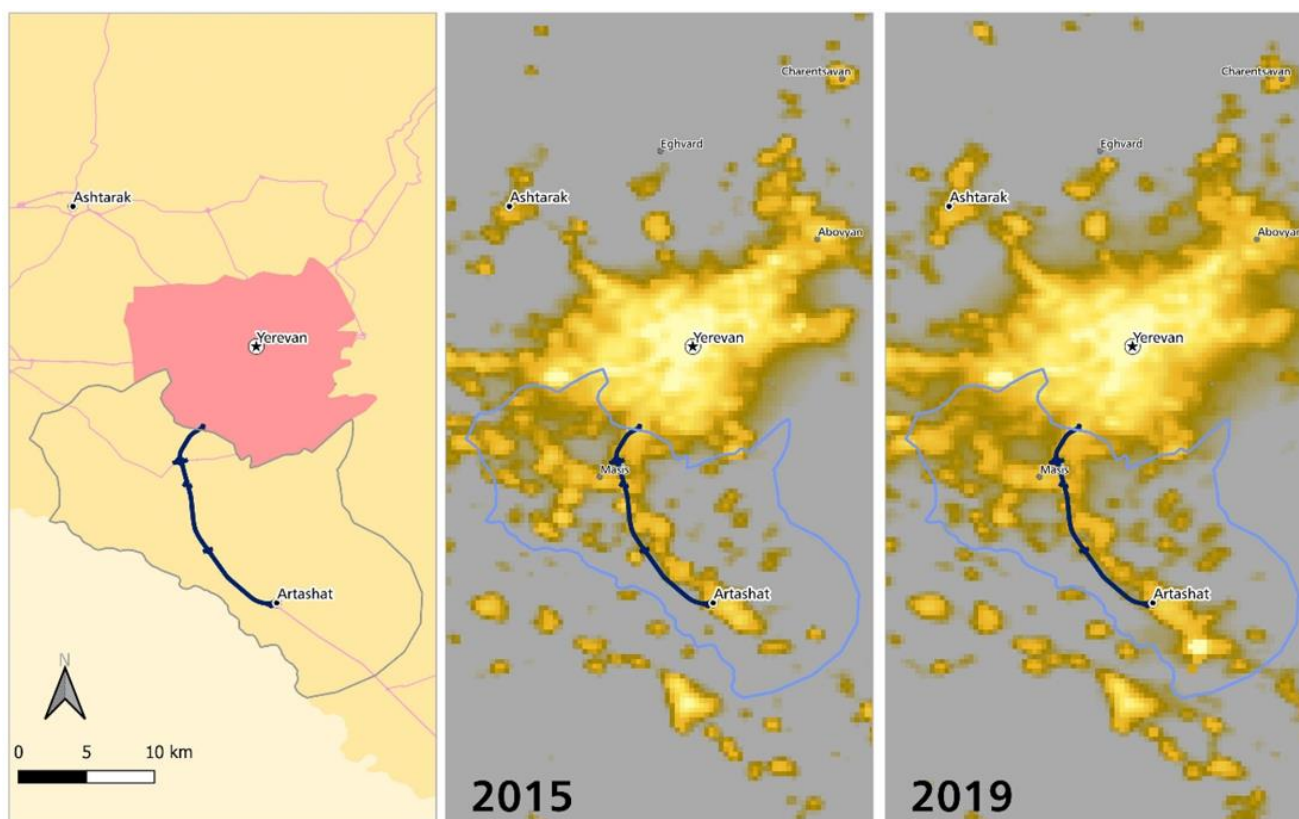
DID originated in the field of econometrics and uses a quasi-experimental design that makes use of data from treatment and control groups to obtain an appropriate counterfactual to estimate a causal effect.

SETTING CONTROL GROUPS



Two Control Groups

NIGHTTIME LIGHT ALONG SECTION 2 IN 2015 AND 2019



Nighttime Light along Section B in 2015 and 2019

IMPACT OF ECONOMIC DEVELOPMENT

Growth Rate and DID

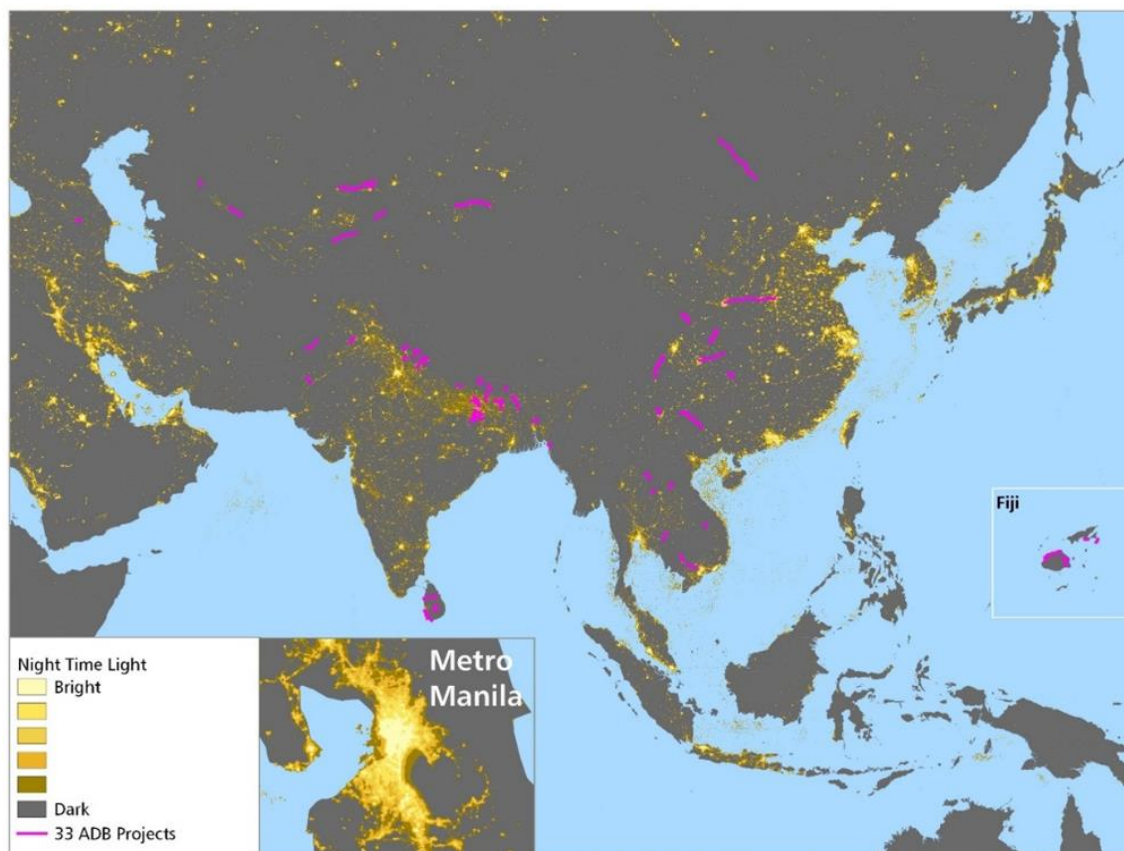
Without Project	With Project	DID
6.0%	9.8%	3.8%
	It can be translated as 40% of the economic growth was <u>attribution</u> of the project	

DID = difference-in-difference

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USE OF NIGHTTIME LIGHTS TO ASSESS IMPACT (SECTOR LEVEL)

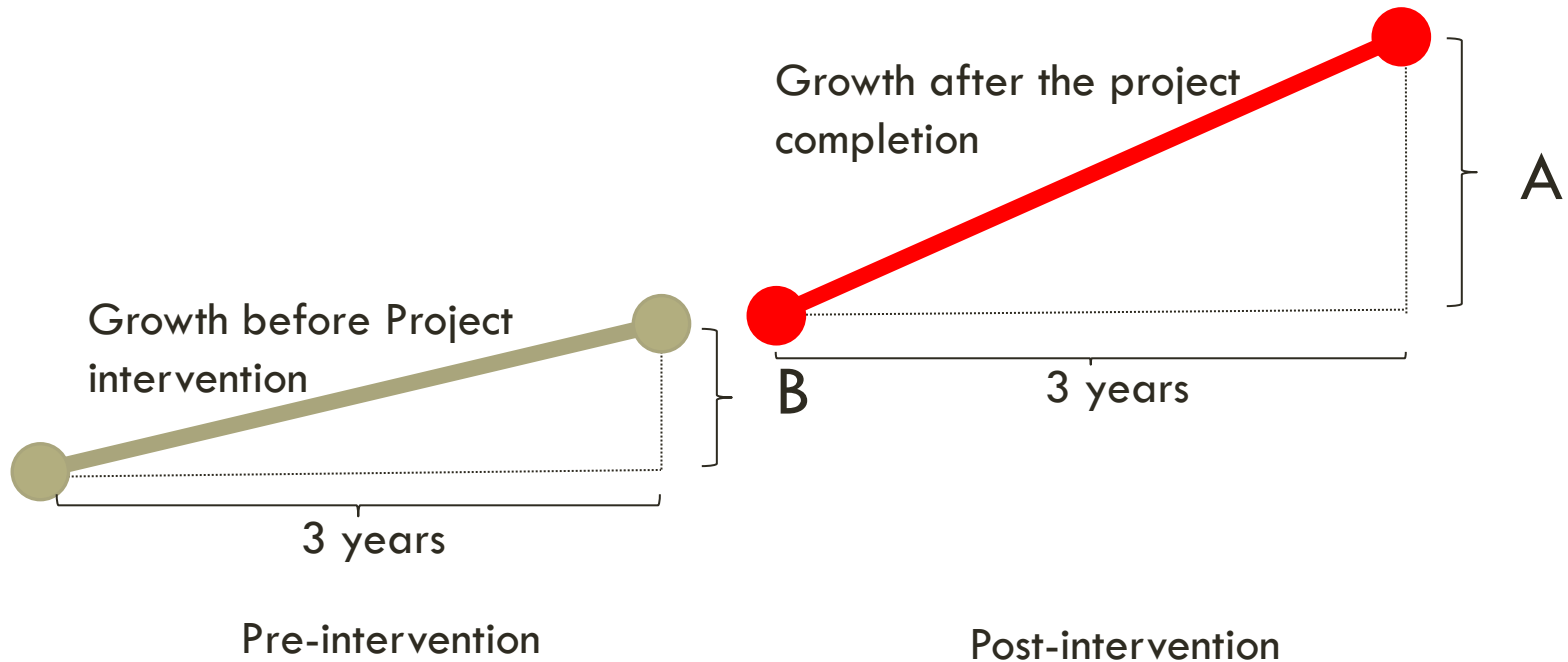
NIGHTTIME LIGHT OF 33 COMPLETED PROJECTS



Locations of 33 Projects

DIFFERENCE IN DIFFERENCE = $A - B$

SAME LOCATION BUT DIFFERENT TIMEFRAME



Difference of Difference (Case 2)

IMPACT OF ECONOMIC DEVELOPMENT

Growth Rate and DID of 33 Projects

Without Project	With Project	DID
6%	11%	5%
	It can be translated as 45% of the average economic growth was <u>attribution</u> of 33 projects	

DID = difference-in-difference.

- *The weighted average of GDP growth rate of 16 countries before and after completion was 12% and 6% respectively.*
- *The project areas was strongly growing, despite the economic growth of entire countries was slowdown.*

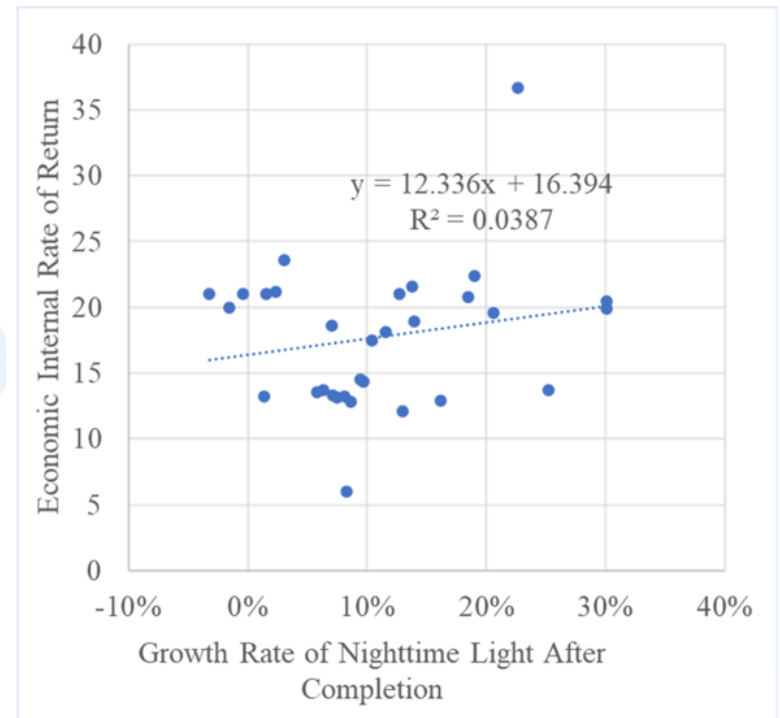
TRIANGULATION WITH EIRR

- Positive correlation was observed, while it was not statistically significant yet

EIRR measures benefits of travelers including time saving, vehicle cost saving, and reduction of accidents (road users)



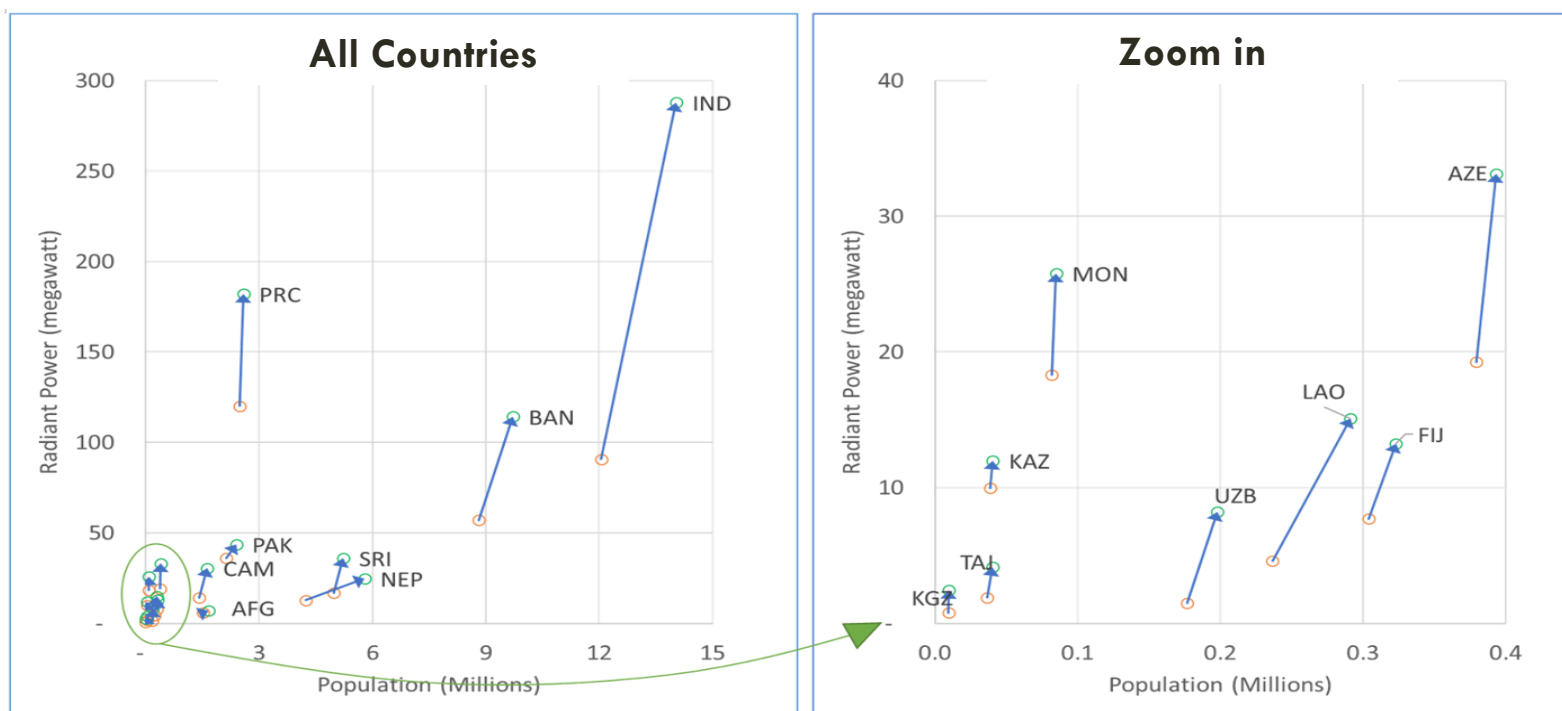
NTL measures socioeconomic activities in areas (mainly local people)



Correlation between Growth Rate of NTL and EIRR

TRIANGULATION WITH POPULATION GROWTH

- Economic activities increased right after completion, but population moved slower



AFG = Afghanistan, AZE = Azerbaijan, BAN = Bangladesh, CAM = Cambodia, FIJ = Fiji, IND = India, KAZ = Kazakhstan, KGZ = Kyrgyz Republic, Lao PDR = Lao People's Democratic Republic, MON = Mongolia, NEP = Nepal, PAK = Pakistan, PRC = People's Republic of China, SRI = Sri Lanka, TAJ = Tajikistan, UZB = Uzbekistan

Increase in Nighttime Light and Population by Country

VALUE FOR MONEY

- Elephant vs. Fireflies

Figure A: Aggregate Change of NTL per Country

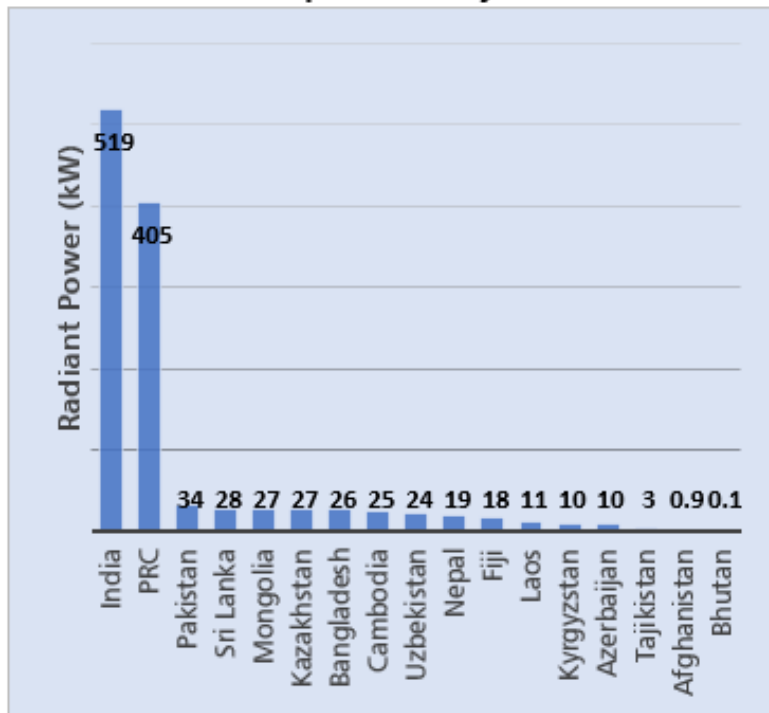
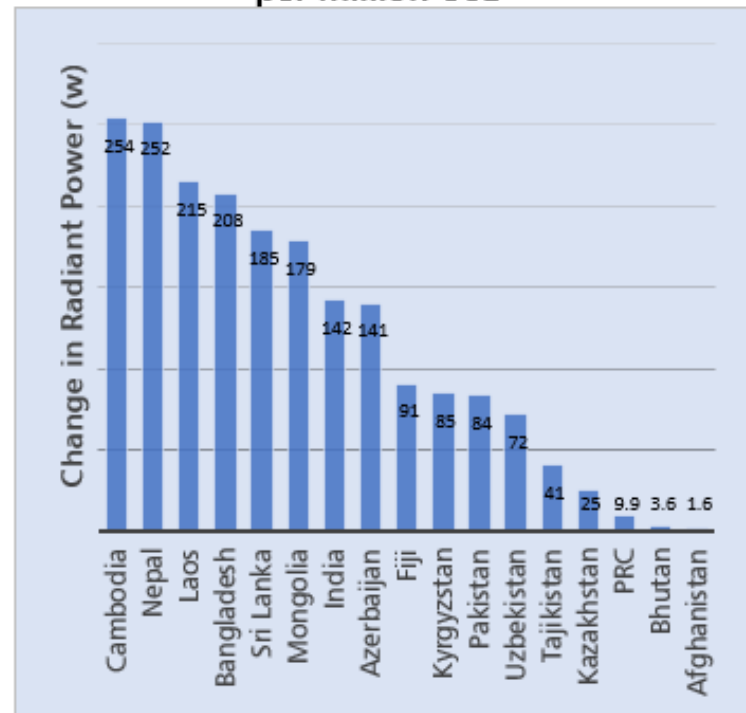


Figure B: Aggregate Change of NTL per million USD



48 Completed Projects (different datasets from 33 projects)

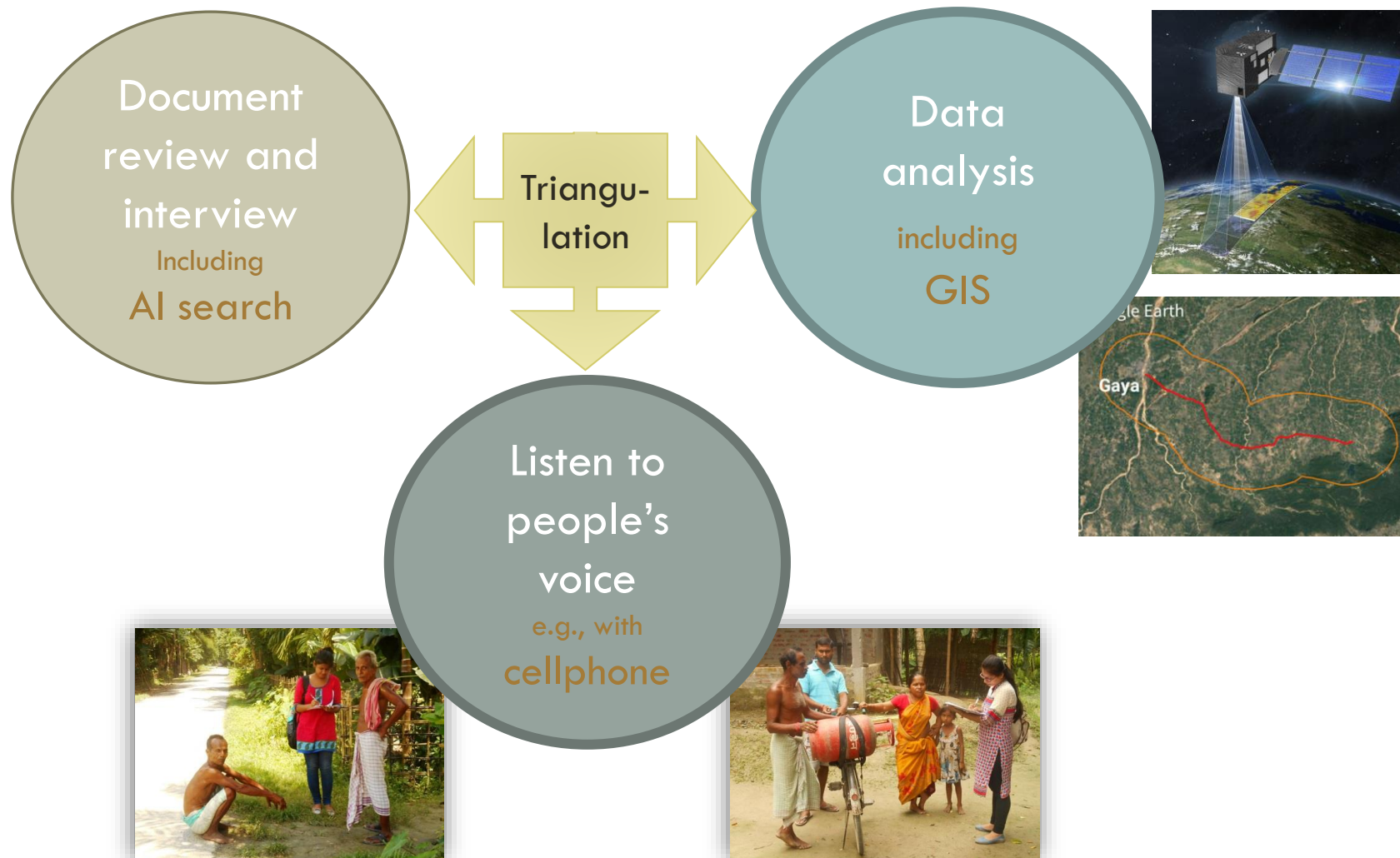
RECAPTURED KEY MESSAGES

Item	Key Messages
1. Mandatory?	<ul style="list-style-type: none"> No, but it helps us quantify things which has been common understandings for a long time but difficult to prove or monitor.
2. Best occasions?	<ul style="list-style-type: none"> Impact evaluation Monitoring of global agendas, SDGs
3. FCV situations?	<ul style="list-style-type: none"> Same data access and quality with developed counties
4. Efficiency?	<ul style="list-style-type: none"> Cost saving: Free data (not all GIS data) Time saving: Remotely and retrospectively accessible
5. Replacing the existing methods?	<ul style="list-style-type: none"> No, it supplements the existing methods E.g., for a road project, EIRR counts benefit of road users, GIS counts benefit of residents
6. Challenges?	<ul style="list-style-type: none"> More practices to develop guidelines Data validation and clearing house

EIRR = economic internal rate of return; FCV = fragility, conflict, and violence; GIS = geographic information system; SDG = Sustainable Development Goal.

BALANCE ON EVALUATION PLATFORM

INNOVATION IS EVERYWHERE





THANK YOU