

Towards a global GIS-based M&E system for development projects

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Monitoring and evaluation using GIS grids

- Colombia's illegal crops substitution program (PNIS)
- IFAD's Evaluation of the Central America's Dry Corridor
- Parish-level local statistics for Colombia

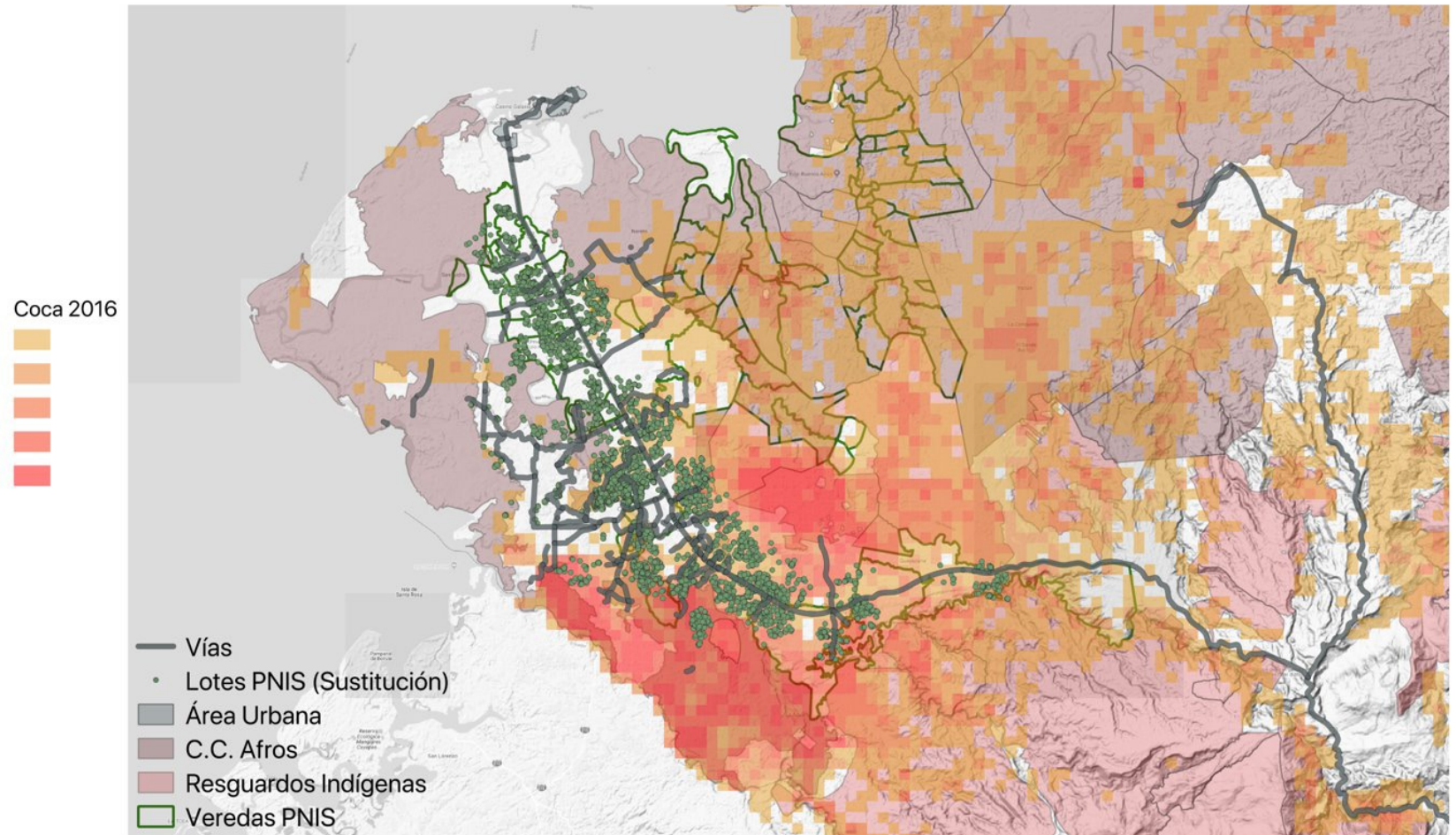
Colombia's program for illegal crops substitution (PNIS)

- Chapter 4 of the 2016 peace agreement between FARC and the Government of Colombia (GOC)
 - **Cash transfers** and **targeting of individual** plots rather than communities.
 - PNIS granted close to **\$10,000 to each coca-growing** household, part of it in cash.
 - The initial cash transfer was made in exchange for **voluntary coca eradication**.
 - UNODC was in charge of **in-plot verification** for every participating family.
- **Question**: is the crop substitution money well spent?

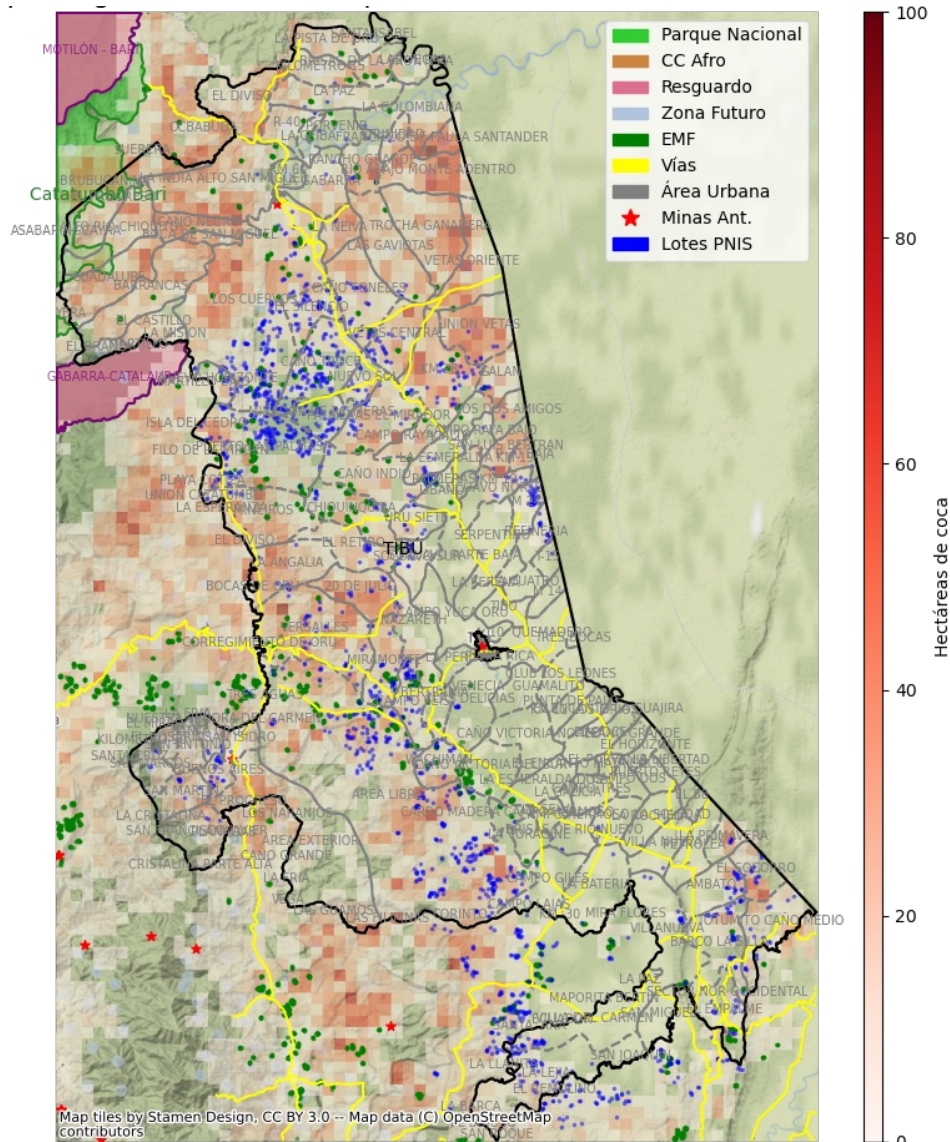
Problem: Good targeting in rural areas is difficult

Coca substitution plots vs. coca plots

- Data sources in developing countries are **scarce and out of date**.
- Smallest **administrative units** tend to be too big for good targeting.
- Development programs tend to reach those who **are more accessible**.
- Problems like illegal activities and poverty are usually **not close to roads**. Need for alternative techniques.



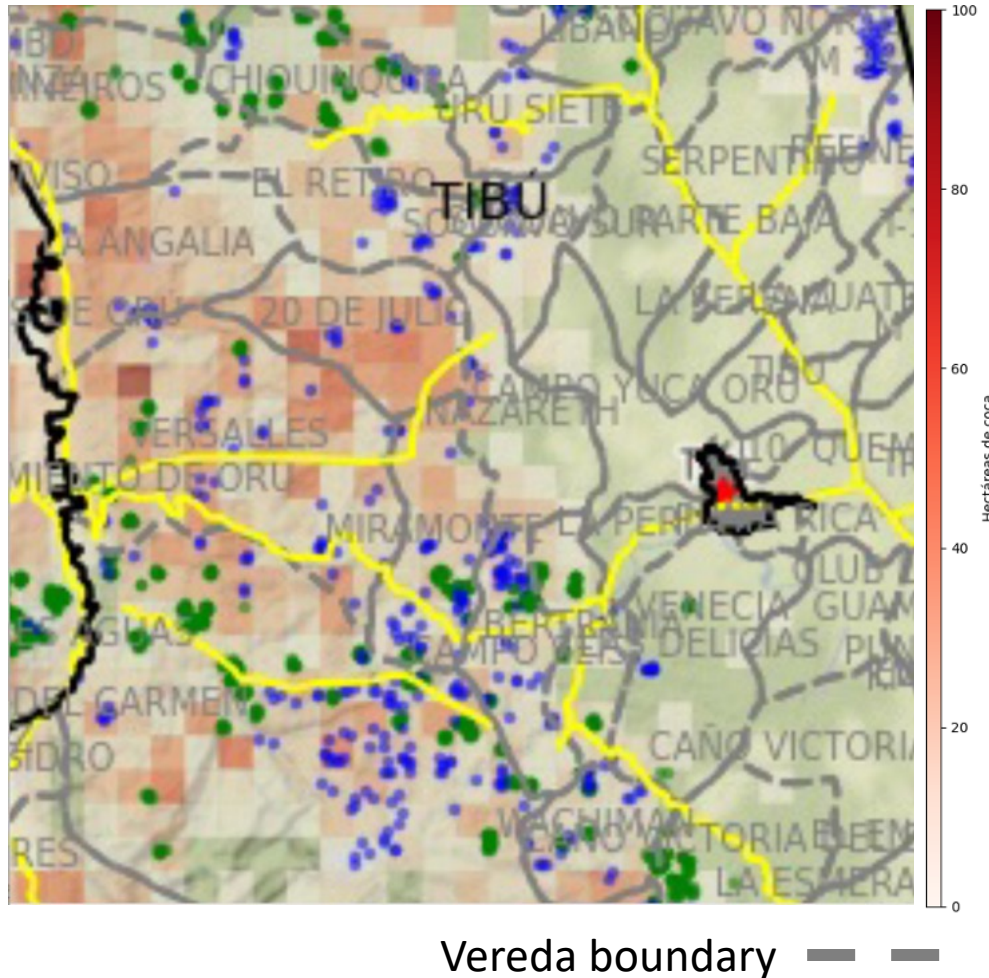
The importance of targeting smaller or custom units



- Colombia has 1120 municipalities.
- The largest municipality is half the size of England.
- **33,000+** parishes or *veredas*.
- Most public data is at the municipality level.
- Where do we get data for smaller or custom targeting units?



Regional statistics: aggregating GIS layers into polygons

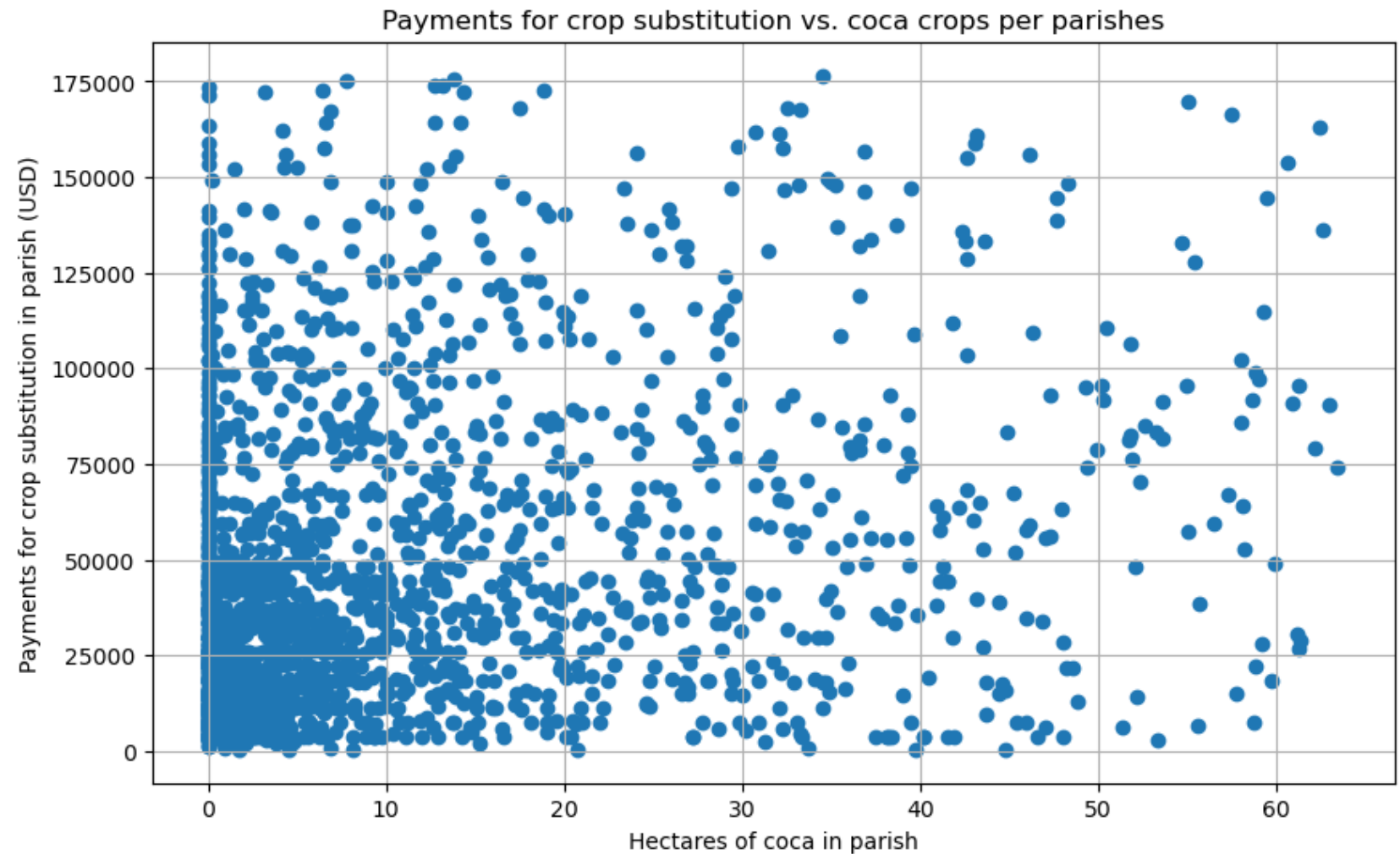


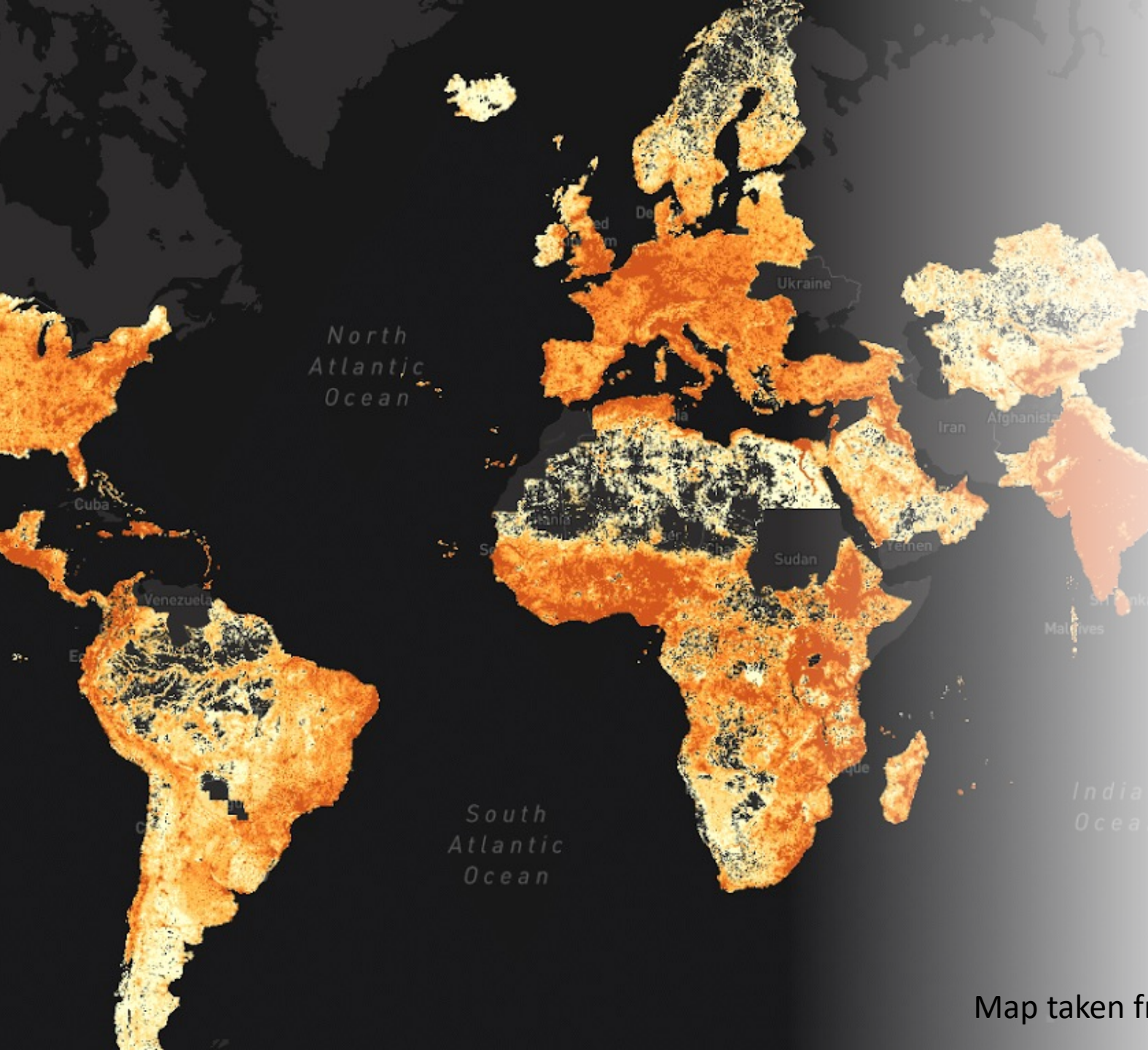
- UNODC produces a **1 km² grid** with coca crops density every year.
- **Raster layers** can be aggregated into polygons.
- Aggregation can create **local statistics** for smaller administrative or custom units: towns, parishes or villages.

Local statistics produce insights about targeting

The GOC had spent **USD 23 million** paying for crop substitution in parishes that had **no coca crops**, at least not in the official UNODC census.

706 parishes with no coca were receiving payments.





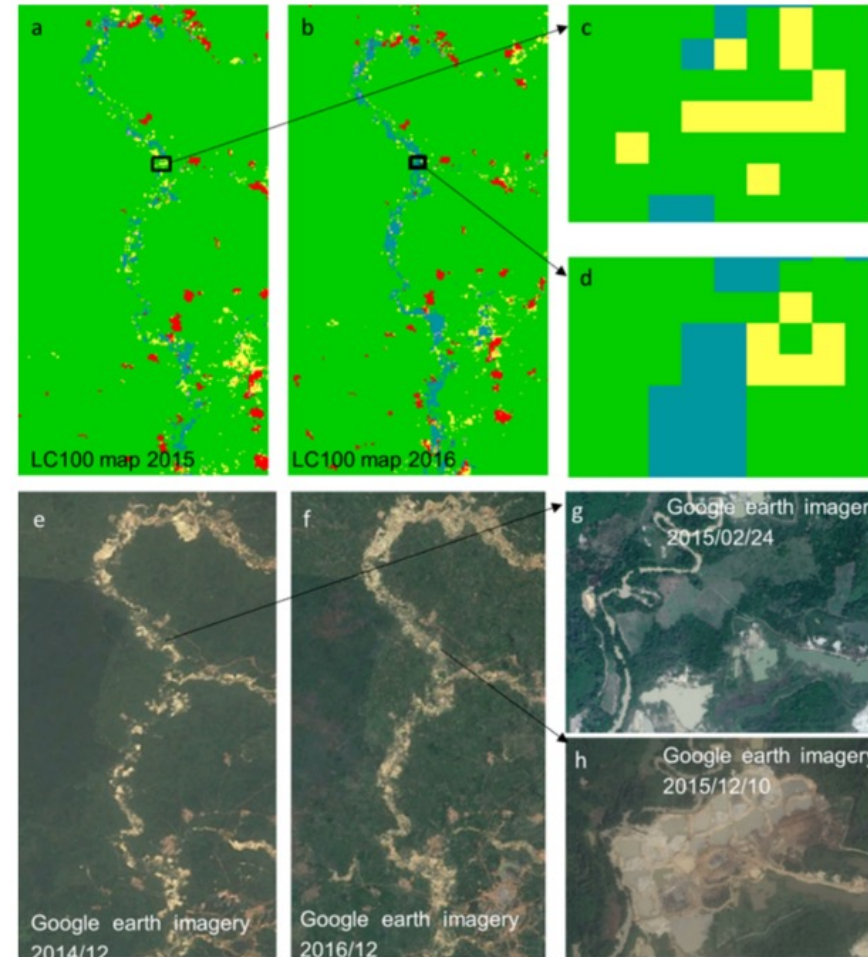
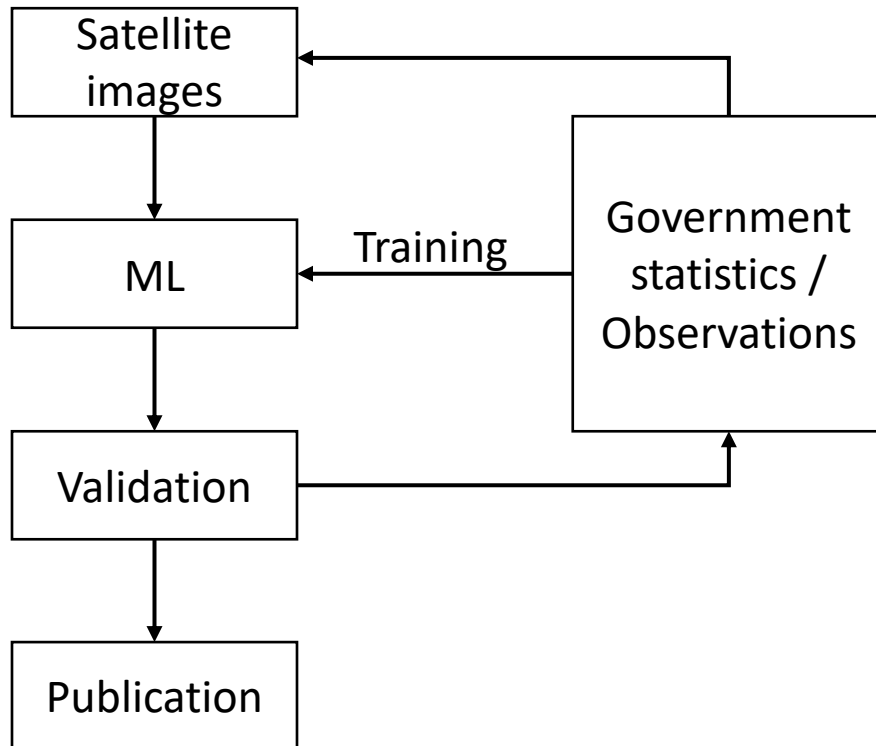
There has been an explosion of GIS global databases In the last decade

There is global gridded data on:

- Travel times (access to market)
- Roads and navigable rivers
- Tree cover and deforestation
- Land use and soil quality
- Topography
- Weather
- Population
- GDP
- Urban expansion

Map taken from: <https://stamen.com/population-explorer/>

Most grids are produced through a combination of satellite images, ML and government statistics

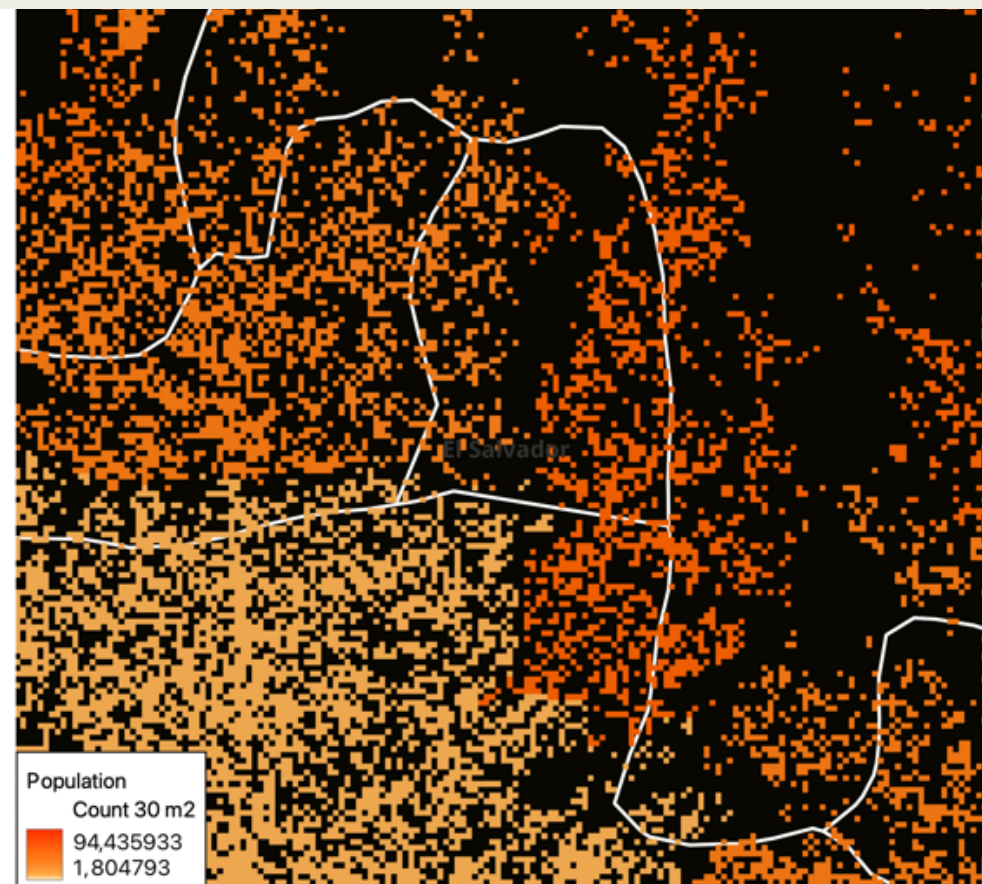


Images from: <https://land.copernicus.eu/>

Leveraging the global grids to produce local statistics

- Zonal stats from raster grids can be calculated for superimposed polygons of any shape.
- The operation is feasible using open-source tools like R or Python or using GIS software like QGIS.
- Standard methodologies can be applied for many areas of the world.
- Many global grids are open access and updated frequently.

Population grid and municipalities in El Salvador



Data source: Columbia University - SEDAC

A standardized workflow

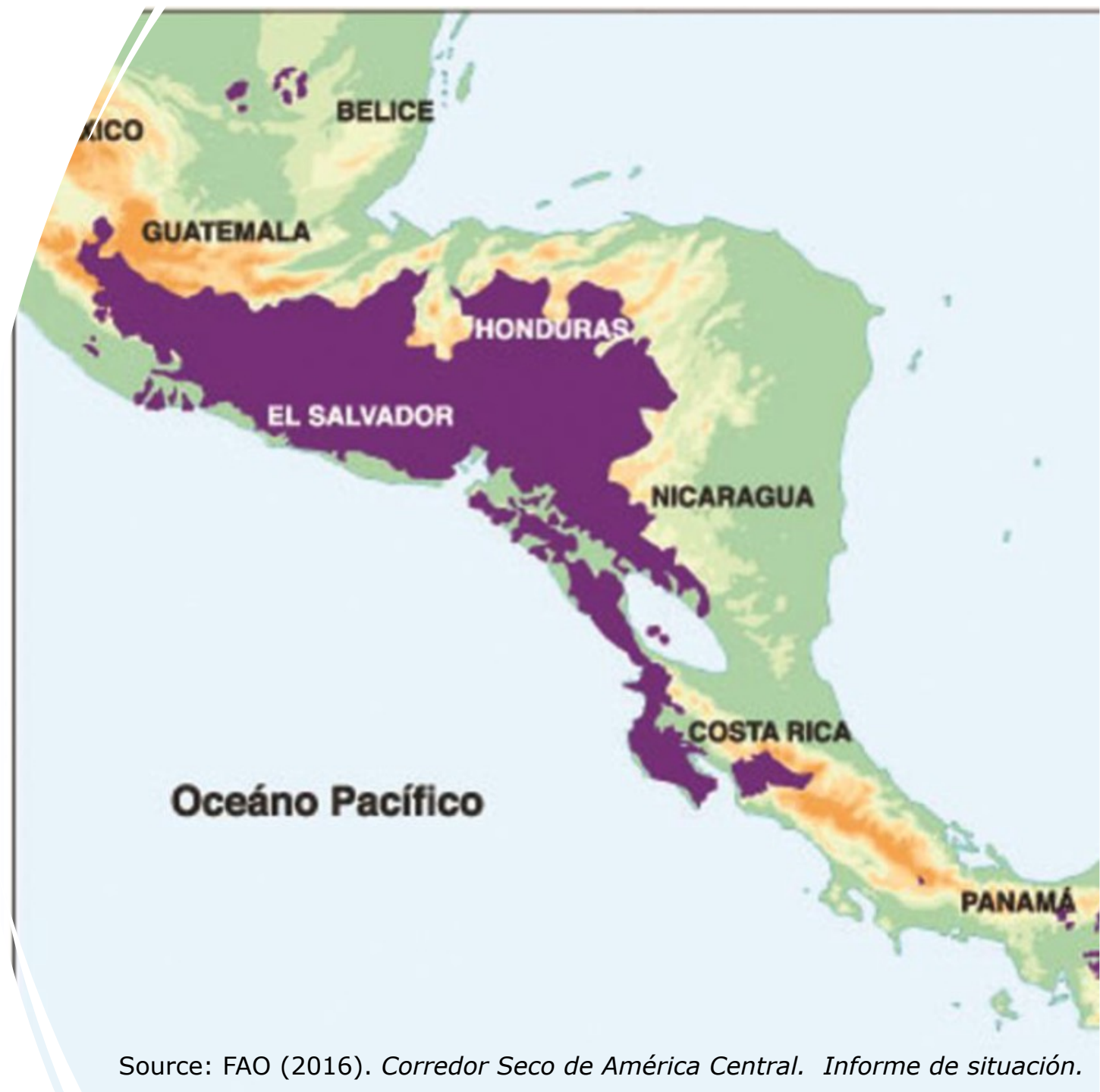


Para cada Vereda	
Identificación de veredas	DPTOMPIO
	ID
	CODIGO_VER
	NOM_DEP
	NOMB_MPIO
	NOMBRE_VER
	AREA_HA
Área sembrada de coca	COD_DPTO
	coca10_HA
	coca11_HA
	coca12_HA
	coca13_HA
	coca14_HA
	coca15_HA
	coca16_HA
PNIS	coca17_HA
	A_ERRA
	A_PIE
	PAGOS
Infraestructura	num_lotes
	dis_rio
Zonas de Manejo Especial	dis_via
	area_conse
	area_parqu
	area_resgu
Erradicación Forzosa	area_vered
	EMF2016_HA
	EMF2017_HA
	EMF2018_HA



Use case: IFAD's evaluation of its strategy in Central America's Dry Corridor

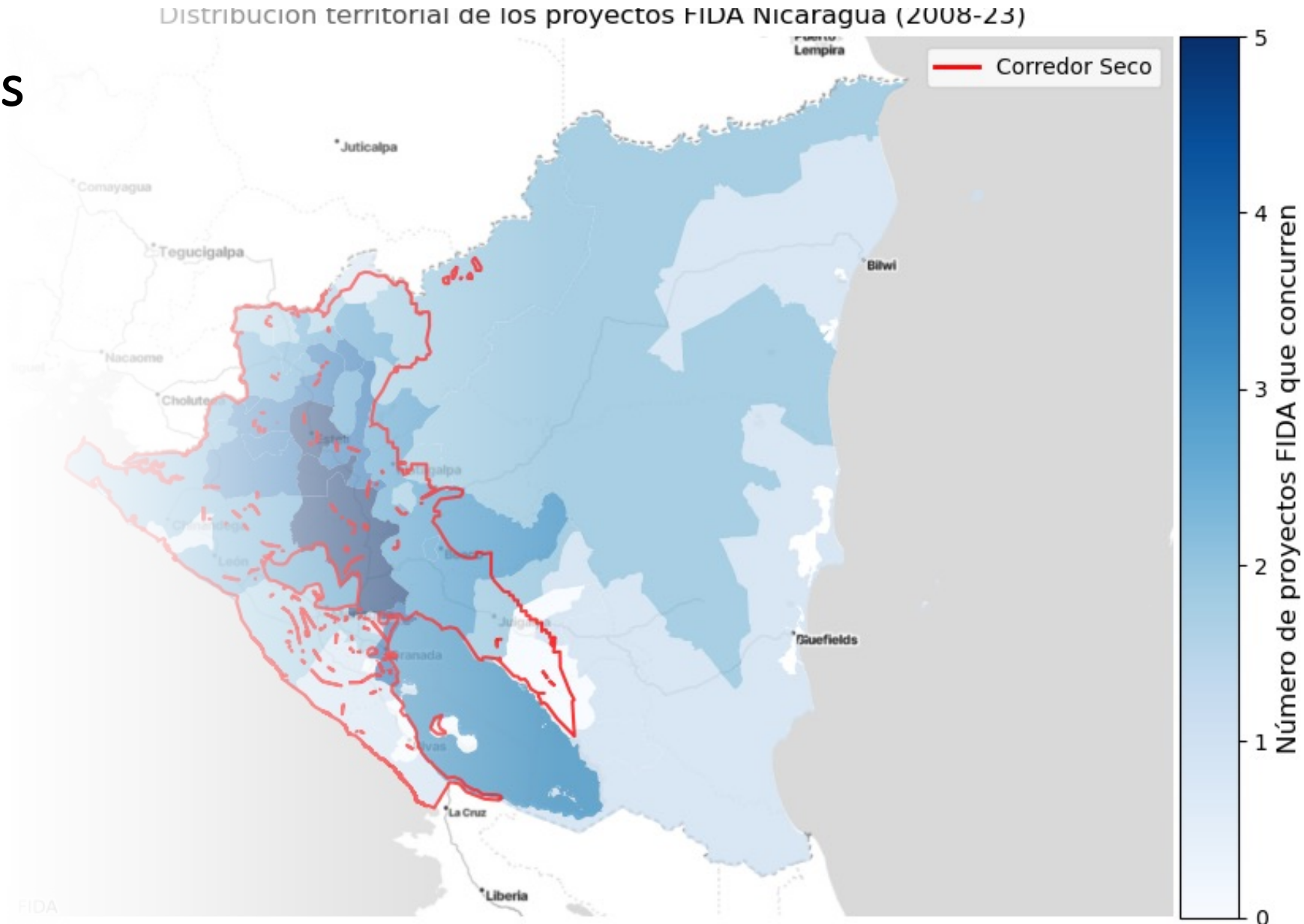
- An **ecozone** with extreme drought conditions that spans areas of **Honduras, Nicaragua, El Salvador and Guatemala** where many IFAD-financed programs were implemented during the last 15 years.
- Most of the **administrative information** was dated and not available at the municipal level.
- We wanted to check if IFAD's resources had been concentrated in the **municipalities that needed them the most**.
- Time and budget **constraints**.



Source: FAO (2016). *Corredor Seco de América Central. Informe de situación.*

Getting local statistics for ad hoc groups of municipalities

- We created groups of municipalities by the **number of IFAD programs** operating.
- All municipalities belonged to the Dry Corridor.
- Then we used **global information grids** to get local statistics for each group.

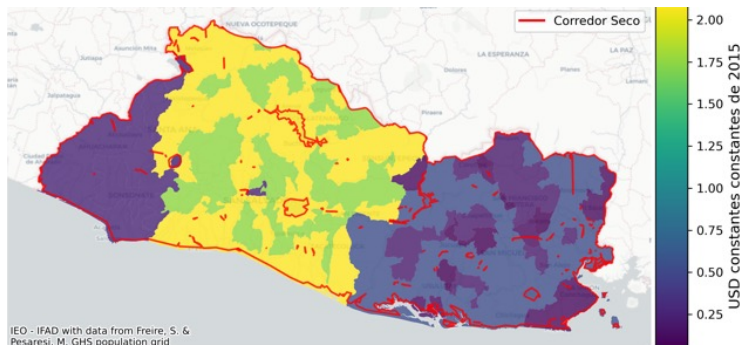


Panel data from global grids: Central America's Dry Corridor Evaluation

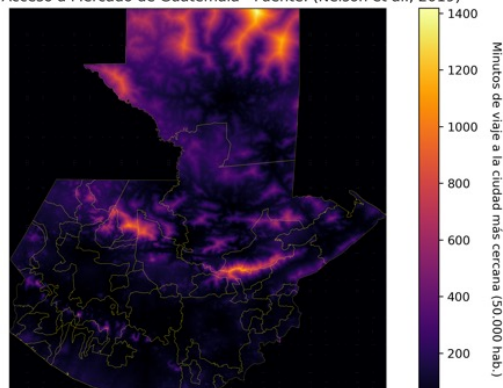
Indicator	Unit	Resolution	Frequency / time range	Source
Population circa 2020	Number of inhabitants	30 m2	Five years / 2000-2020	Columbia University - SEDAC
Per capita income in the area in USD	USD (constant 2011 PPP)	927 m2	Yearly / 1990-2015	Kummu, Taka y Guillaume (2018)
Elevation above sea level in meters	Meters above sea level	30 m2	Permanent layer	NASA - DEM
Travel time to the nearest major city in minutes	Minutes	927 m2	2015	Nelson et al. (2019)
Tree cover	Hectares; percentage	30 m2	2000-2022	Hansen et al. (2013)
NDVI	A ratio between -1 and 1	4.3 m2	Biannual or monthly / 2015-2023	Planet - NICFI
Weather related sources.	Degrees and millimeters	Various	Monthly or daily	Various

Standardized methodology for 4 countries with a common ecozone

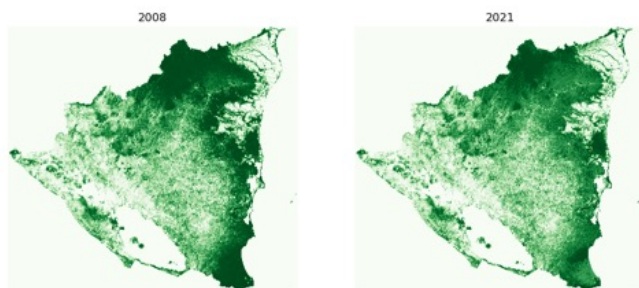
An example from Guatemala



Mapa de Acceso a Mercado de Guatemala - Fuente: (Nelson et al., 2019)



Tendencia de la deforestación en Nicaragua

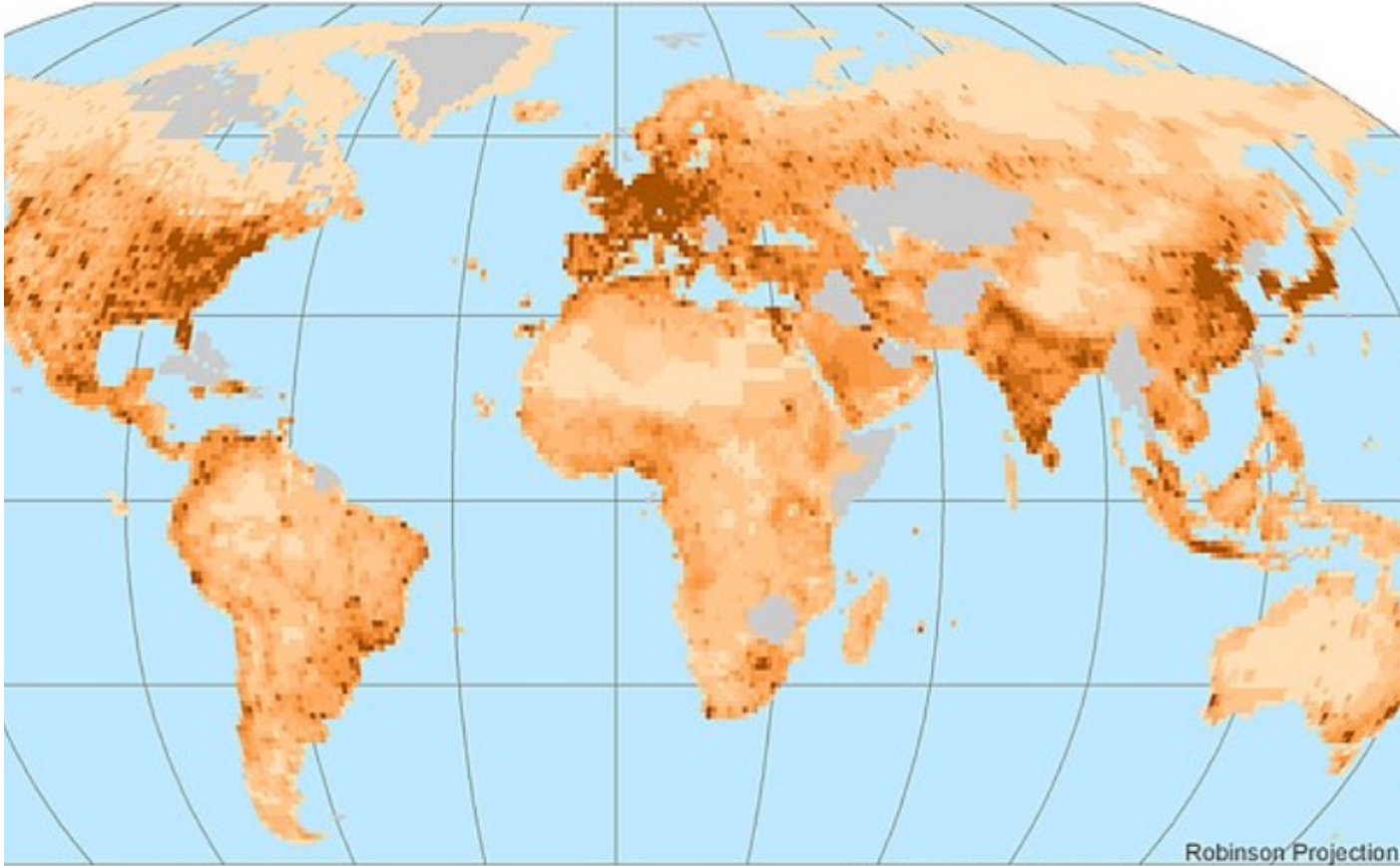


FIDA - Con datos de Hansen (2021)

Number of FIDA projects	0	1	2
Number of municipalities	38	84	10
Population circa 2020	1.864.312	3.061.566	482.733
Population density (inhabitants/hectare)	1,56	2,01	1,03
Income per capita in 2015 (USD)	\$7.178	\$4.469	\$3.916
Elevation	848	1.196	1.308
Travel time to nearest city (minutes)	100	90	228
Tree cover 2021 (%)	44,2	48,8	66
Tree cover 2008 (%)	47,1	51,6	73,1
Deforestation rate 2008-21 (%)	-6,1	-5,4	-9,6

- Some information gaps remained: nutrition, ethnicity and education, for example.

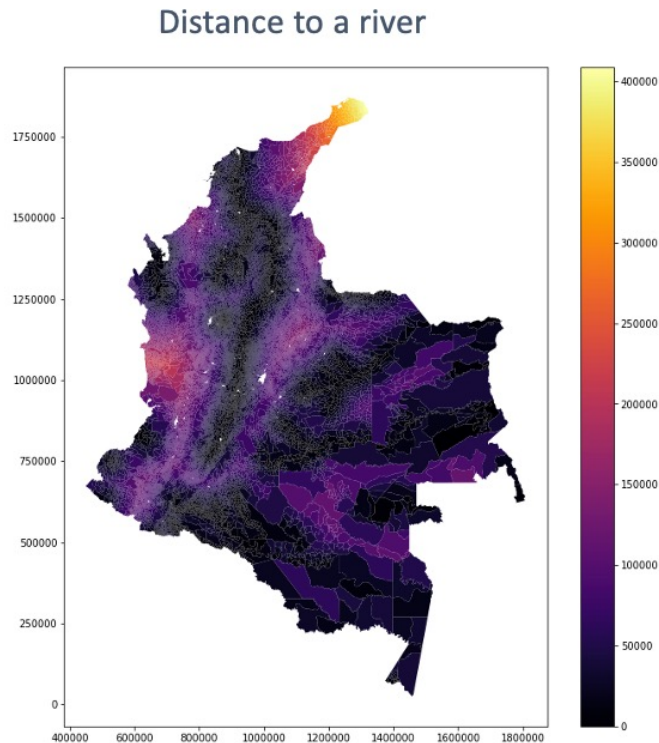
Advantages of using GIS global grids



Map Credit: CIESIN Columbia University, April 2016.

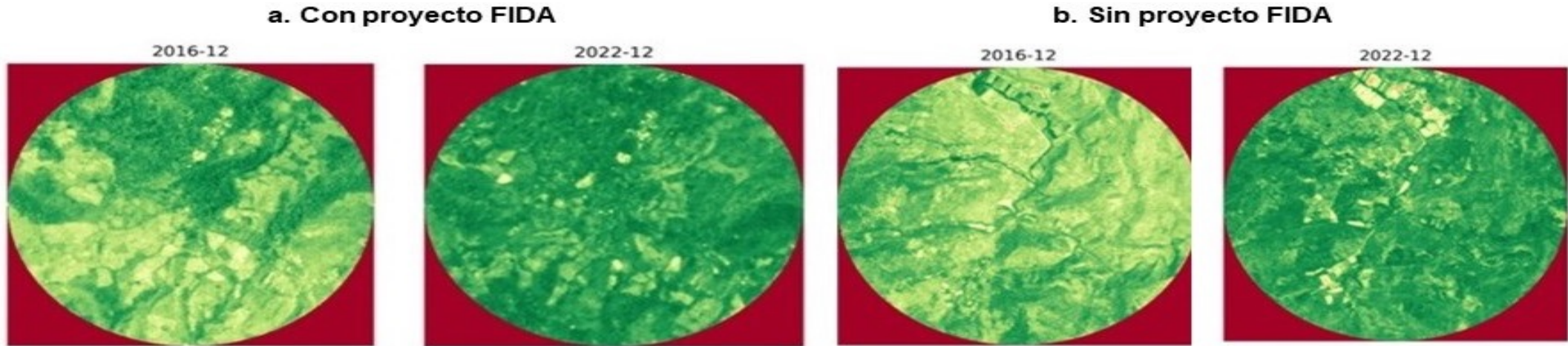
- **Preprocessed grids** reduce the difficulties of using satellite images.
- **Standard methodologies** can be applied in any location of the world.
- As the grids are updated, it will be possible to build **panels of data** to target and evaluate.
- **Custom AOI:** Sub-municipal, “village” or polygon level analysis.
- Analyze **subregions, ecozones or groups of countries** that do not match administrative units.

Additional variables associated to 33,000+ parishes in Colombia



- Illegal mining area (2021)
- Illegal crops (coca) area (2000-22)
- Crops substitution payments (2016-2020)
- Force eradication area (2016-2020)
- Deforestation (2000-22)
- Landmines' victims (2016-2020)
- Data from the agricultural census (2014):
 - Crops
 - Machinery
 - Productive activities

GIS data – coordinates of visited sites (NDVI)



Medias y diferencia de medias por proyecto en el NDVI de los puntos visitados

Proyecto		Promedio inicio proyecto	Promedio post-proyecto	Diferencia (Final – Inicio)
Sitios con proyecto (tratamiento)	Emprende Sur	0,628	0,669	0,041
	NICADAPTA	0,621	0,742	0,121
	NICAVIDA	0,699	0,738	0,038
	PRODENORTE	0,511	0,636	0,125
	PROLENCA	0,677	0,745	0,068
	Rural Adelante	0,675	0,678	0,003
	Total NDVI sitios con proyecto	0,648	0,701	0,053
Sitios sin proyecto (control)	Sin proyecto	0,690	0,736	0,046