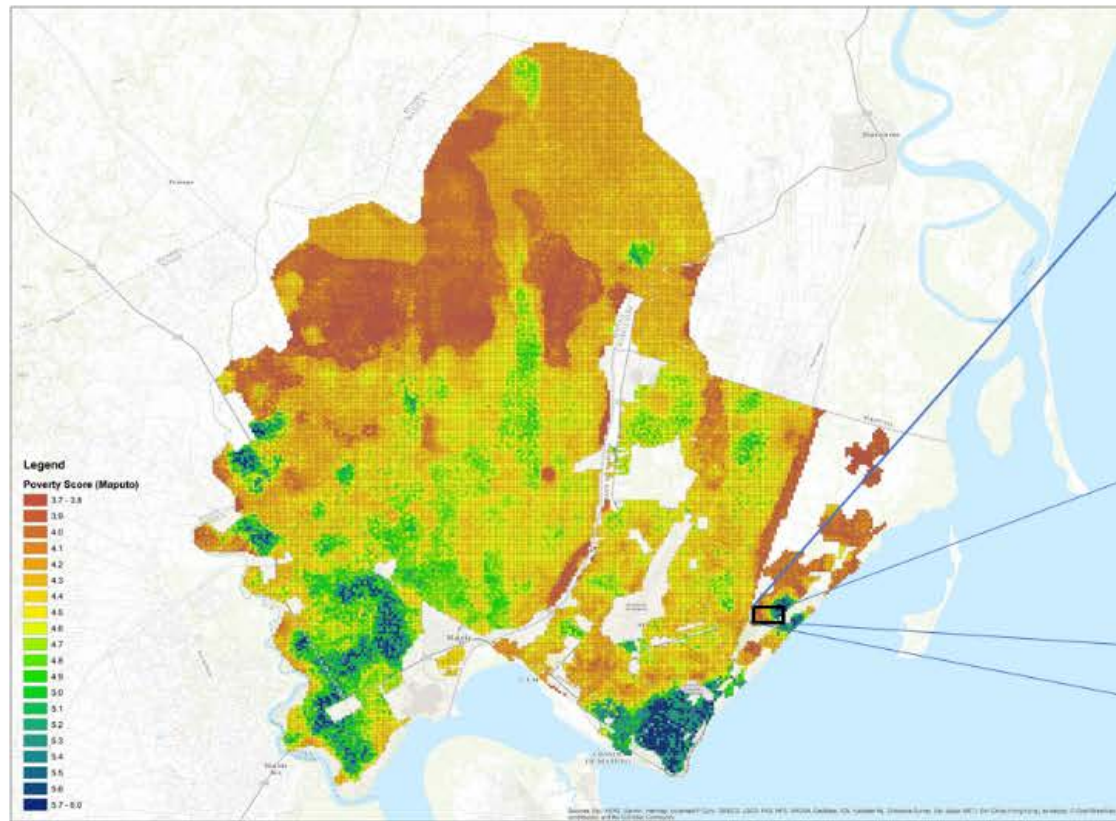# Using Satellite Data to Support Poverty Reduction Example from Mozambique

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The output: Average Poverty Score in a resolution of 115mx115m for all major cities

Why the operational interest in high resolution poverty maps?

The urban productive social safety net (PASP) in Mozambique, with first enrolment of beneficiaries in 2015, is to expand.

The program is work-for-money on community projects.

The program seeks to target households through a three-step procedure:

1) Geographical targeting using poverty maps

2) Community based targeting

3) Validation using household level proxy means testing

So far, targeting in the urban component of the project has worked without any geographical targeting from poverty maps

How did we get there?

## We empirically test two different approaches:

Method 1:

- Using convolution neural networks (CNN) to estimate Poverty Scores directly from satellite images

Method 2:

- Using machine learning based Random Forest prediction model based on the following inputs:
  - Density and quality of building structures, extracted from satellites images using a Convolutional Neural Network (CNN).
  - Distance to center of city and nearest road of various quality, extracted from OpenStreetMaps

Method 1

Average Poverty Score all 115x115m cells

Method 2

Average Poverty Score for all 115x115m cells
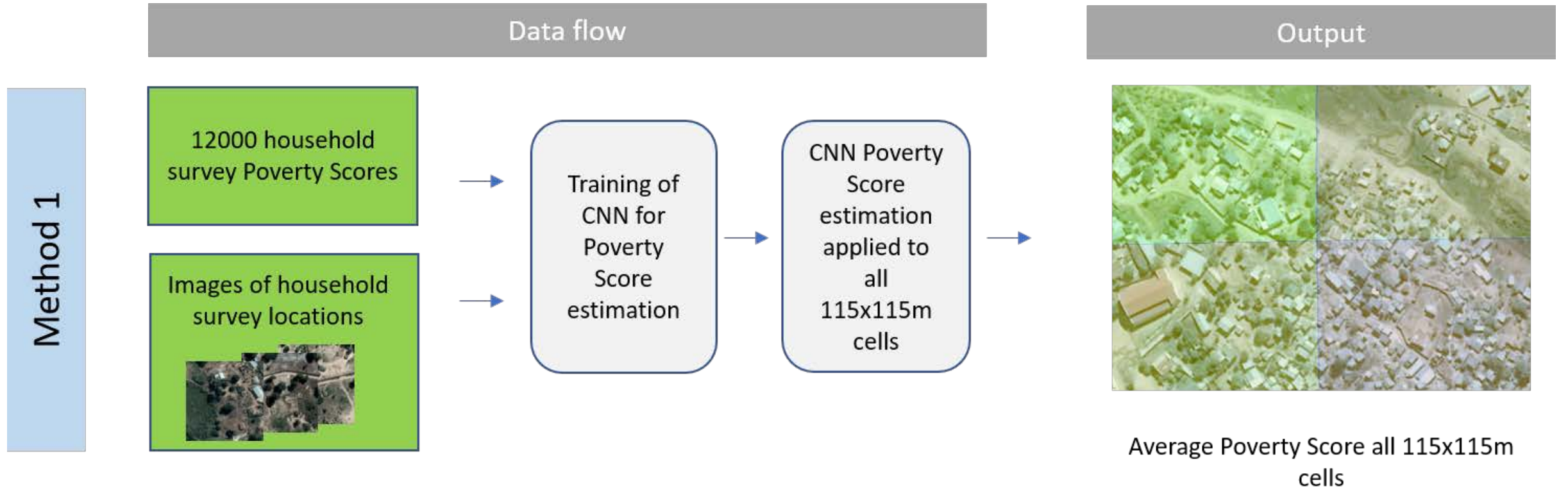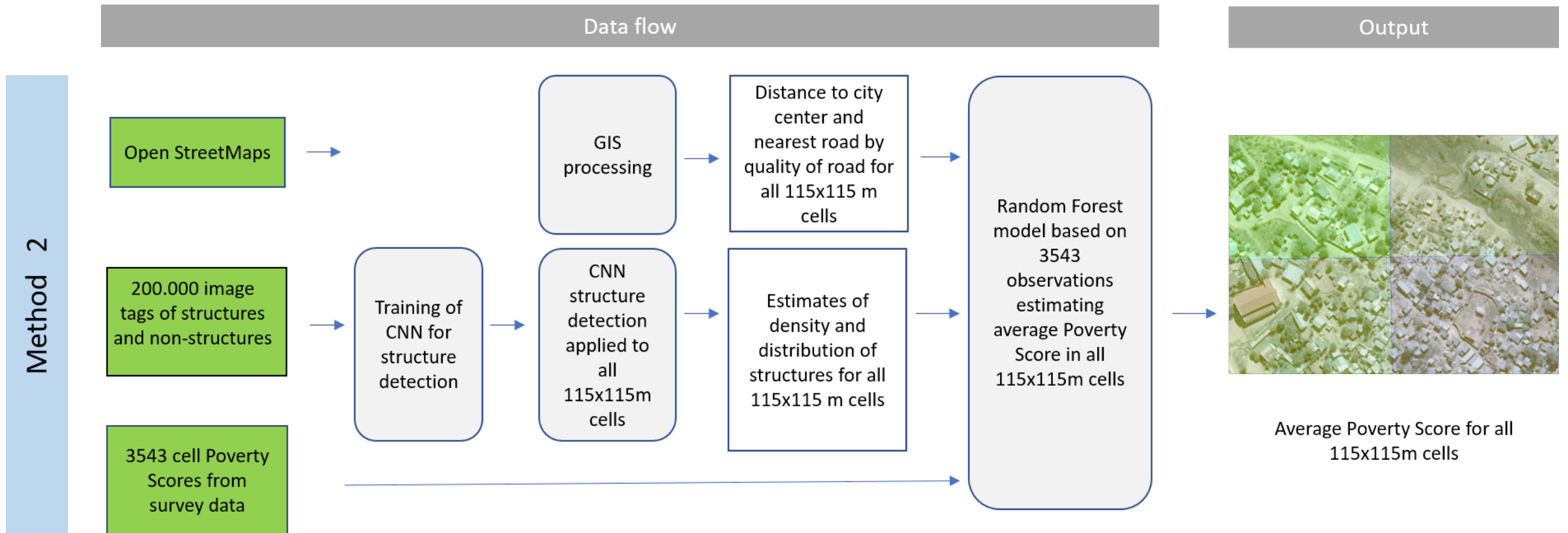
Example structure detection

- By applying the CNN-detector in a sliding window approach over each of the 400x400 pixel cell images, the CNN-detector provides a count for number of windows with more than 50% probability for a structure, leading to an estimate of structure density.
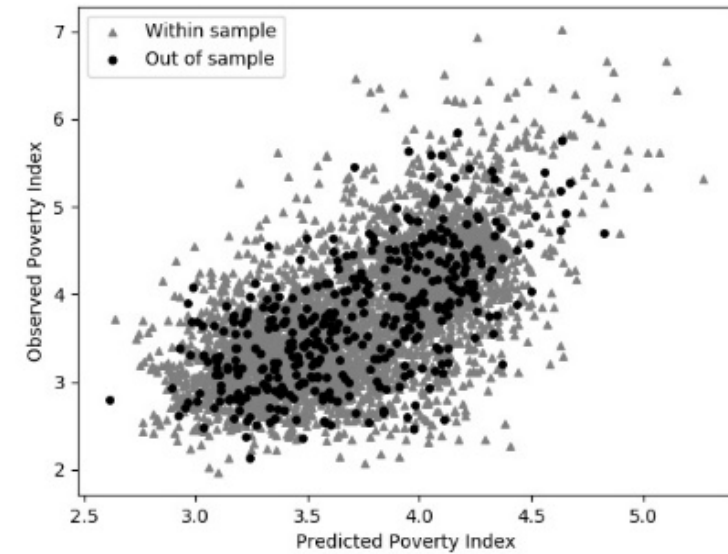
Method 1:Accuracy of prediction models at cell and Bairo level

Observed and predicted results for Bairos
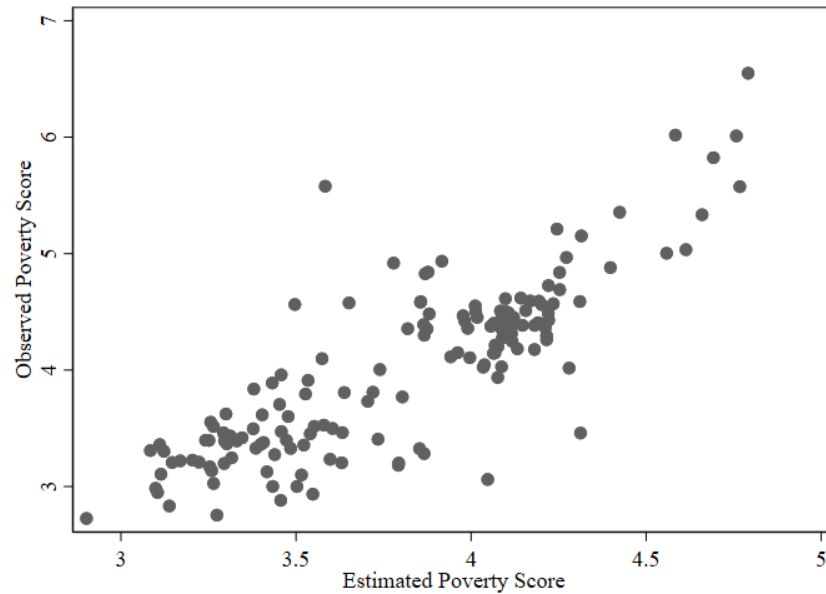
Aggregation level	R square		Spearman rank correlation	
	Within sample	Out of sample	Within sample	Out of sample
Bairo	0.69	0.58	0.80	0.76

Observed and predicted results for cells

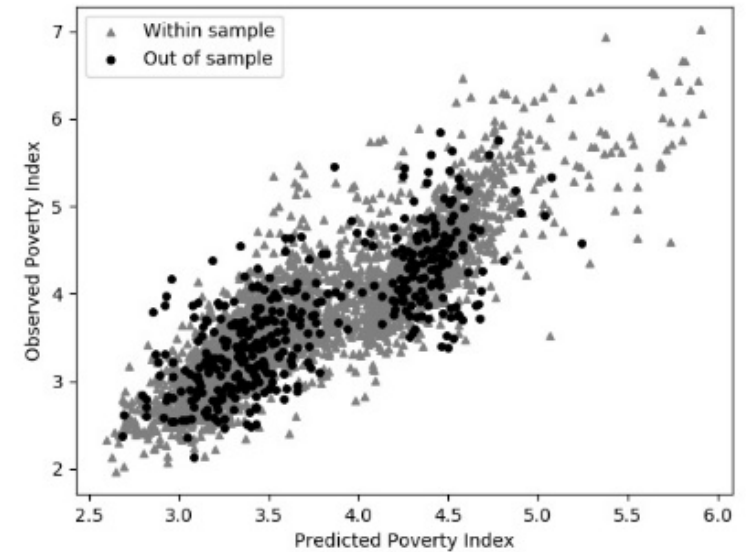| Aggregation level	R square		Spearman rank correlation	
	Within sample	Out of sample	Within sample	Out of sample
Cells	0.36	0.38	0.60	0.62

Method 2:Accuracy of prediction models at cell and Bairo level

Observed and predicted results for Bairos
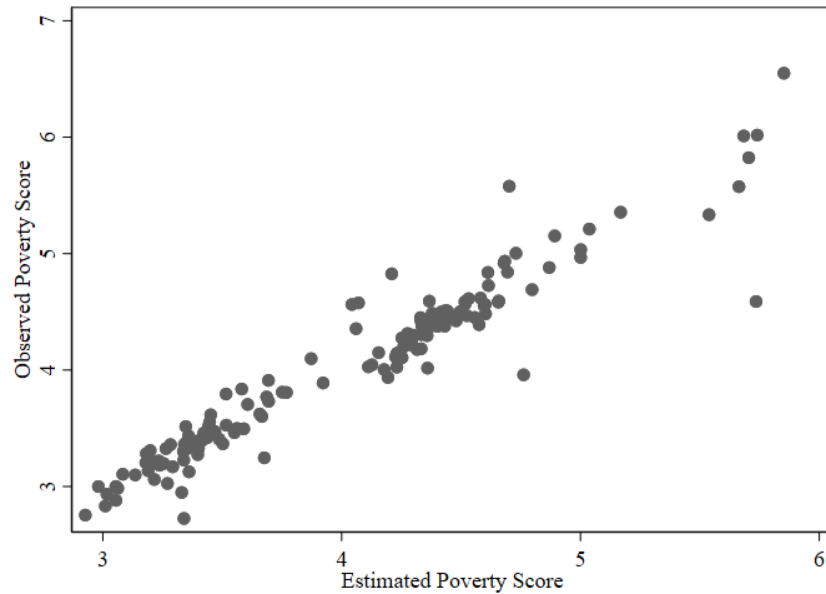
Aggregation level	R square		Spearman rank correlation	
	Within sample	Out of sample	Within sample	Out of sample
Bairo	0.92	0.66	0.96	0.83

Observed and predicted results for cells

Aggregation level	R square		Spearman rank correlation	
	Within sample	Out of sample	Within sample	Out of sample
Cells	0.75	0.58	0.89	0.76

Next steps and ideas

Building further experience by application in other countries

- Does it work as well in other cities?
- Are models transferable, ei can the models quickly learn patterns in new cities reducing need for training data?

Building further experience by other public policy problems

- Real time tracking of urban growth in size and quality, supporting general planning.
- Estimation of other subjects like population, children out of school, road use, demand for public services.
- Impact assessment of investments (like roads etc.)
- Identifying disaster impact.

Further evaluation of accuracy

- Internal consistency is high, but are samples representative enough to guarantee accuracy when applied to a full city?
- Looking into methods that also provide estimates of standard errors.
- Looking for settings with knowledge of full truth for full evaluation of accuracy.

- The CNN model can provide recent estimates of urban density and type/quality of structures, updated more less by a push of a button.

Structure density in Tete 2018
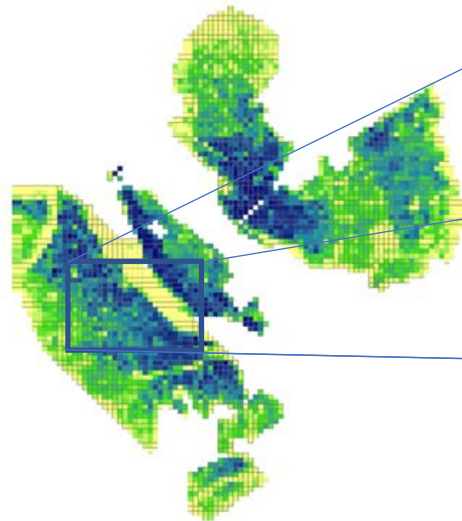
Growth in structures in Tete 2007-2016

Thank you