Quantifying Cities for Sustainable Development:
Generating Representative Population Data in Rapidly Growing Cities

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WHAT'S NEW AND WHY?

The research seeks to create a low-cost tool for gathering critical information about urban population dynamics in cities experiencing rapid spatial-demographic and socioeconomic change.

Such information is vital to the success of urban planning and development initiatives, as well as disaster relief efforts.

By improving the information base of the actors involved in such activities we aim to improve the lives of urban dwellers across the developing world, particularly the poorest and most vulnerable.

COMPONENTS OF LOW-COST TOOL

We apply a novel approach to spatial sampling in cities where census data are not considered a suitable basis for generating a sampling frame.

Short-format surveys are administered by mobile phones to substantially reduce enumeration costs.

Street-intercept surveys, which separate the site of interview from the place of residence, facilitates more efficient and inclusive enumeration.

Thematic survey modules are randomised during enumeration and statistical reconstruction is used *ex post* to fill in missing data.

SAMPLING THE CITY

A spatial sampling frame is derived from an analysis of readily available satellite imagery. First, major breaks in the urban landscape (e.g. main roads, canals, rail lines and other 'natural' barriers) are used to segment the city into organic units. Second, building density is estimated for each segment using classified satellite imagery in order to form the basis for stratification. Finally, clusters are randomly selected from strata roughly in proportion to their area relative to the total.
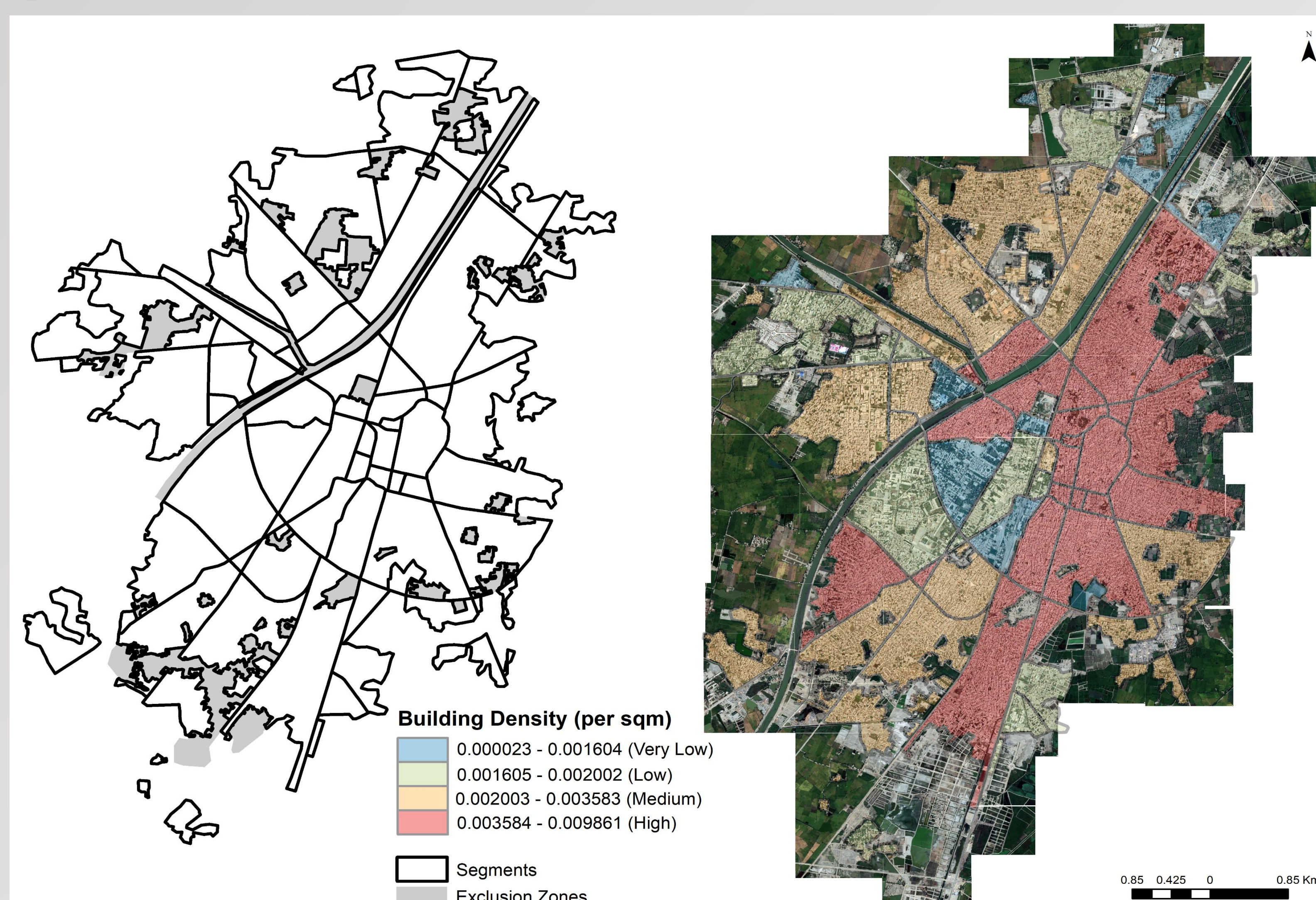

Building Density (per sqm)
0.000023 - 0.001604 (Very Low)
0.001605 - 0.002002 (Low)
0.002003 - 0.003583 (Medium)
0.003584 - 0.009861 (High)
Segments
Exclusion Zones
0.85 0.425 0 0.85 Km

Fig 1: Stratified Image of Larkana, Pakistan

SHORT-FORMAT SURVEYS

The survey instrument consists of a core module covering basic demographic information and four thematic modules.
All respondents are presented with the core module plus two randomly selected thematic modules.

The survey is designed to be administered in 10-12 minutes total. Responses are collected on mobile phones using the World Bank's freely available Survey Solutions application.
A subset of respondents complete all modules to facilitate validation of the *ex post* statistical reconstruction.

STREET-INTERCEPT SURVEYS

Respondents are approached in public and semi-public spaces in order to reduce time between surveys and increase the inclusivity of the exercise.

Where respondents are within the neighbourhood where they live, their questionnaire is geotagged at the site of interview. Where a survey takes place away from the respondents' neighbourhood, their place of residence is recorded with a pin drop activity.

STATISTICAL RECONSTRUCTION

The intentionally partial questionnaires are completed through statistical reconstruction.

Responses to the Core module are correlated with responses to the randomised thematic modules, providing models for reconstructing unanswered modules. These are cross-validated with a subset of fully administered questionnaires from the sample.
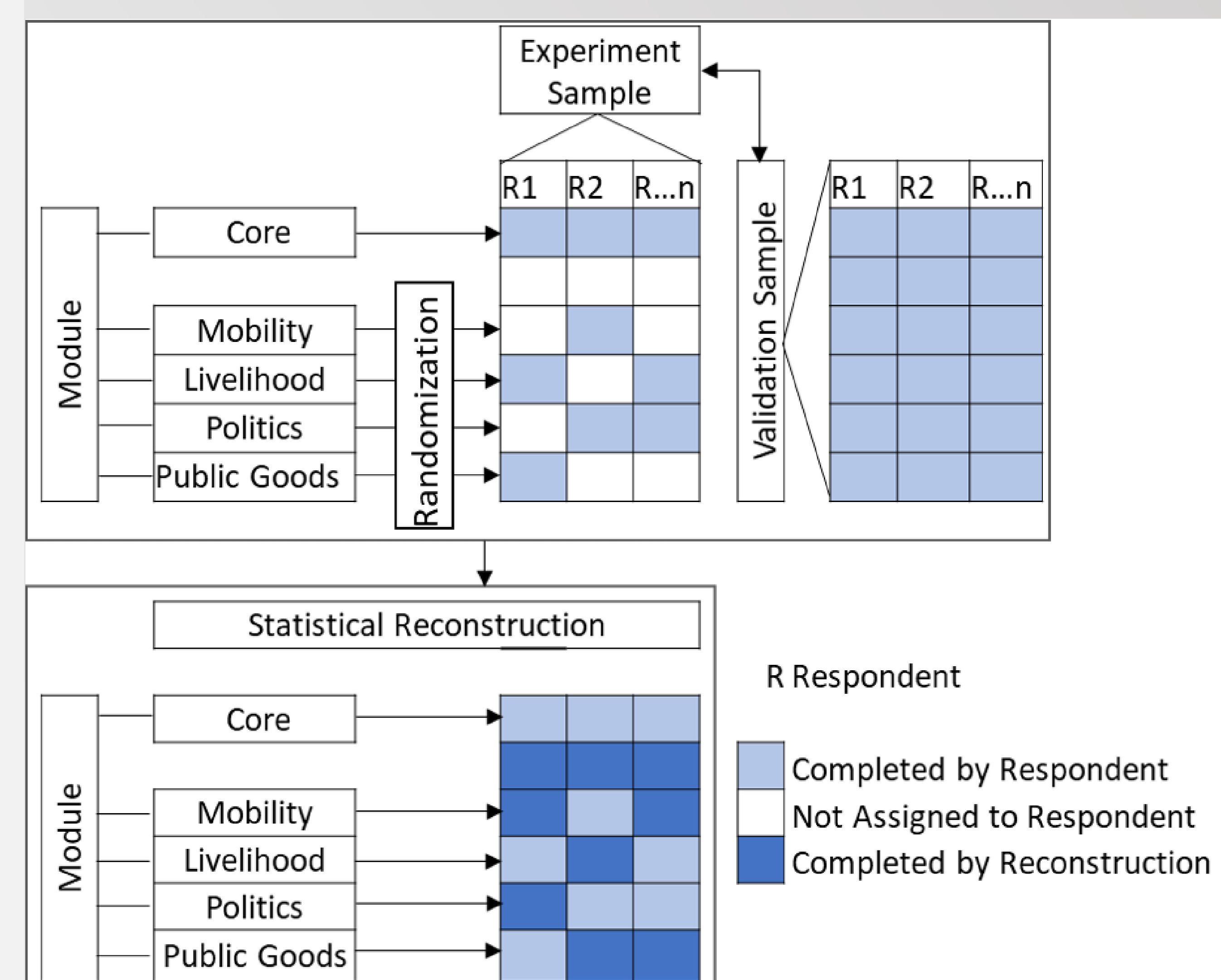

Fig 2: Conceptual image of Statistical Reconstruction

PROJECT PLAN AND OUTPUTS

A pilot survey will be executed in Larkana, Pakistan in early 2020.

The final project report will provide a detailed explanation of the methodology, as well as guidance on the data and software tools required to reproduce the method.

REFERENCES

Driscoll, J. et al (2014). *J. Surv Stat & Meth* 2:78-95.
Deaton, A. (1997). The World Bank
Grannis, R. (1998). *Am J. Sociol* 103: 1530–1564
Mitlin, D. (2013). Routledge.
Talen, E. (2018). *J. Urban* 11: 480–502

FUNDING