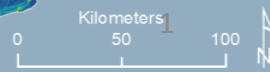
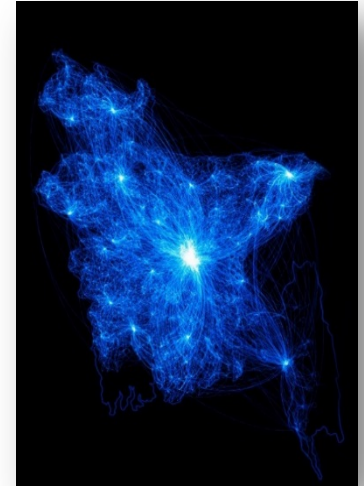


High resolution mapping of
female welfare through data
integration

Prof. Andrew Tatem



- WorldPop: Research program in Dept Geography & Environment focused on methods for improving the demographic evidence base in low/middle income countries
- Flowminder: Non-profit foundation working with data providers and international/government agencies to operationalize and scale research in support of vulnerable populations and sustainable development in low/middle income countries
- 50+ staff; focus on data science and integration in fields of spatial demography and mobility to support disease, disaster and development applications



Key partners and donors

Microsoft®
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Vodafone Foundation
Mobile for Good



**BILL & MELINDA
GATES foundation**



Asian Development Bank





SUSTAINABLE DEVELOPMENT GOALS



Gender equality across all health and development goals is key to the Sustainable Development Goals



SUSTAINABLE DEVELOPMENT GOALS

1

Leave no one behind



5

GENDER EQUALITY



6

CLEAN WATER AND SANITATION



7

AFFORDABLE AND CLEAN ENERGY



8

DECENT WORK AND ECONOMIC GROWTH



13

CLIMATE ACTION



14

LIFE BELOW WATER



Understanding where and who to target health and development interventions at across countries requires a strong baseline evidence base

The image features a central white text box with a blue border containing the question "Why map indicators of female welfare?". This text box is surrounded by several overlapping, colorful speech bubbles in shades of orange, pink, red, and teal. Below the text box, there are four large, colorful question marks in teal, pink, orange, and tan. The background is a light gray with a subtle circular pattern.

Why map indicators of female welfare?



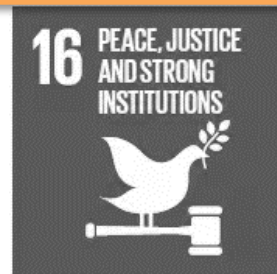
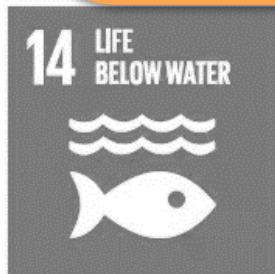
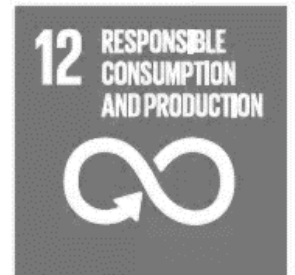
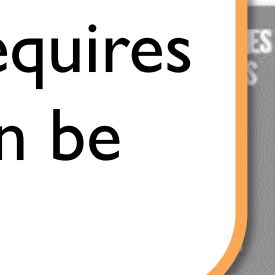
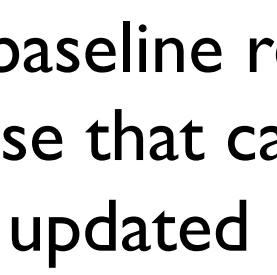
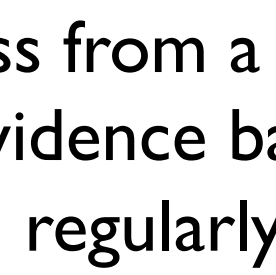
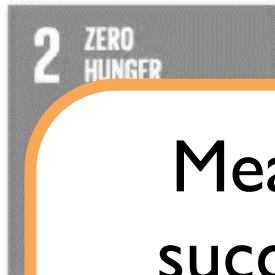
Targeting of interventions

Monitoring of impact

Tackling inequality



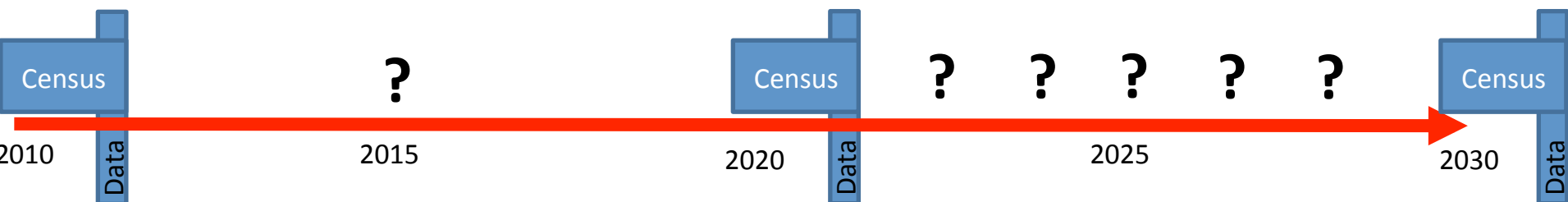
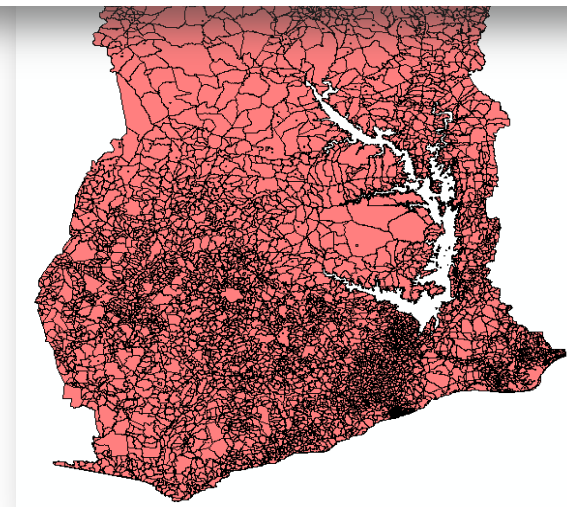
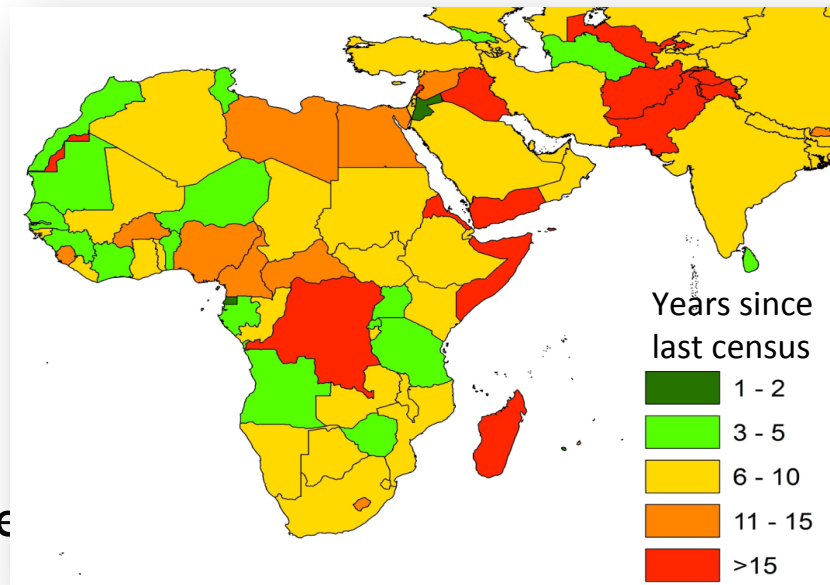
SUSTAINABLE DEVELOPMENT GOALS



Measuring and mapping the success of interventions and progress from a baseline requires an evidence base that can be regularly updated

The challenge

- National census data will continue to be most important datasource
- Civil Registration and Vital Statistics systems improving, but remain weak
- Census provides denominators and numerators for all SDGs, and requisite subnational detail
- But, the 2015-2030 SDG period typically includes just one census datapoint
- And in some settings the situation is more challenging



What do we have to help us?



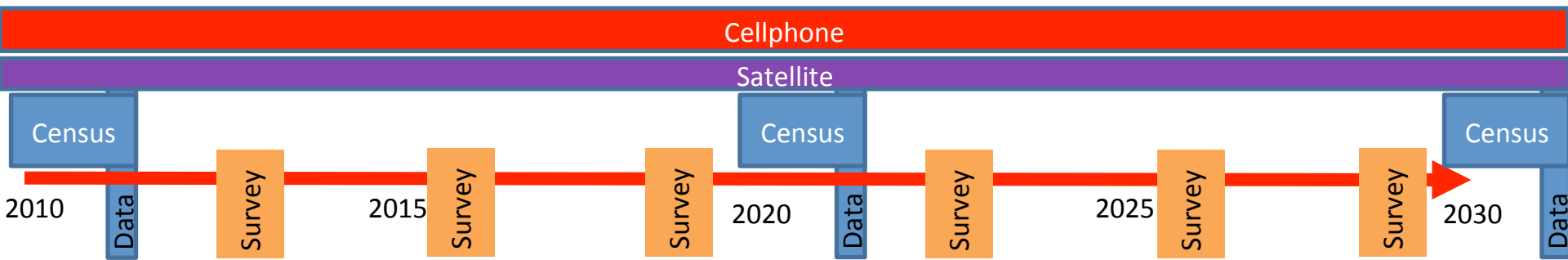
Geolocated household surveys



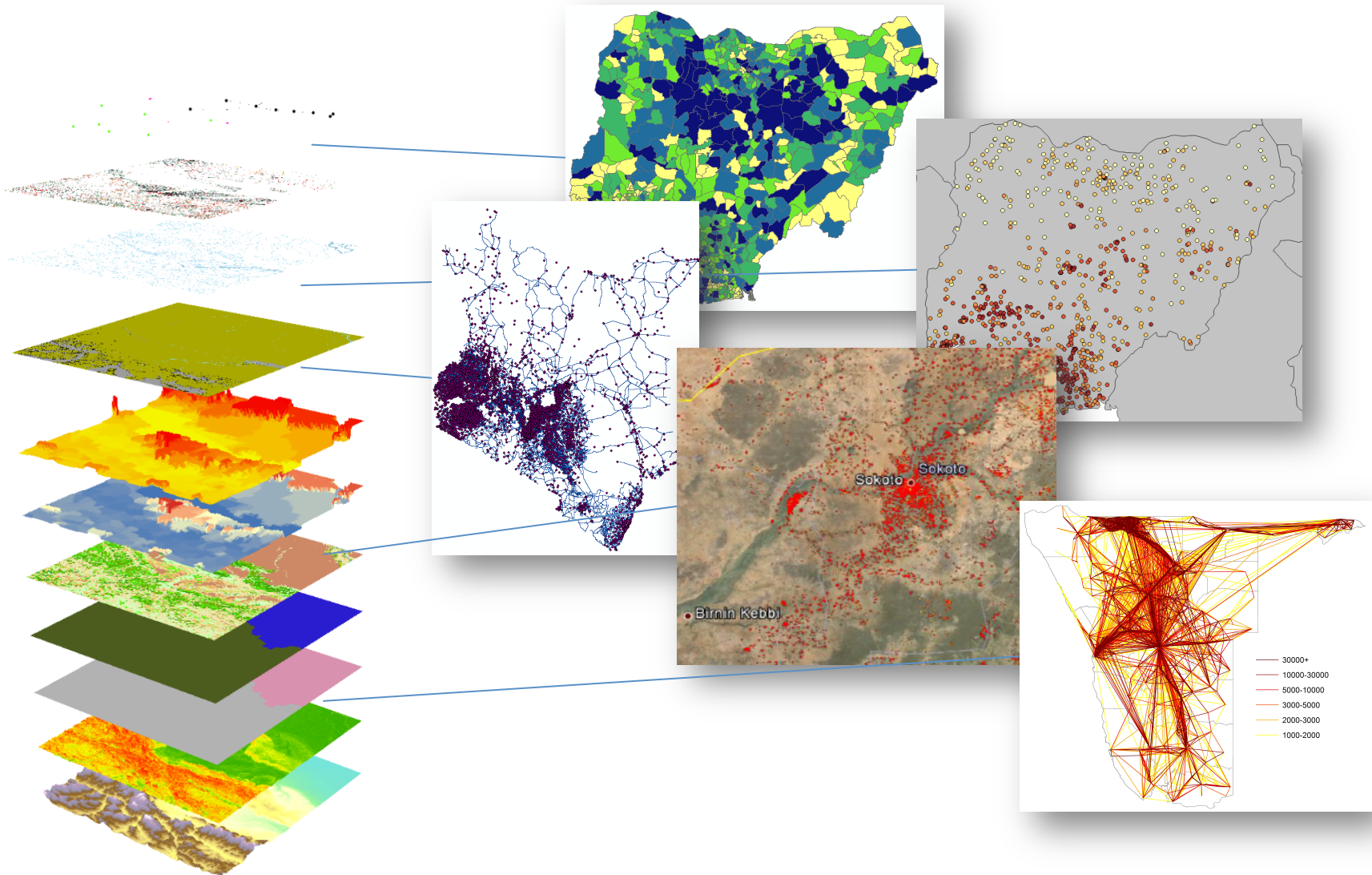
Satellite and GIS data



Cellphone data

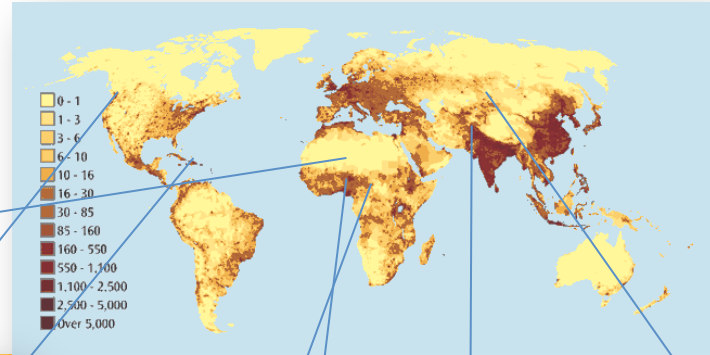


Data integration

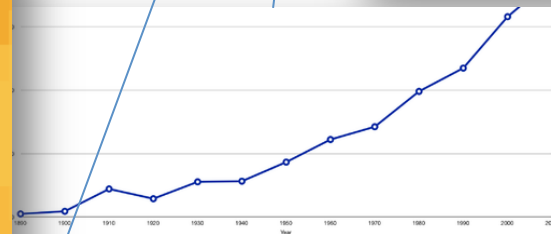
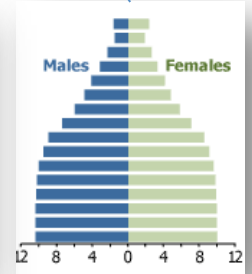
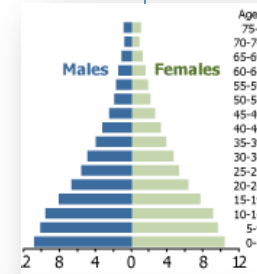


Spatial Demography

- Where is everybody?

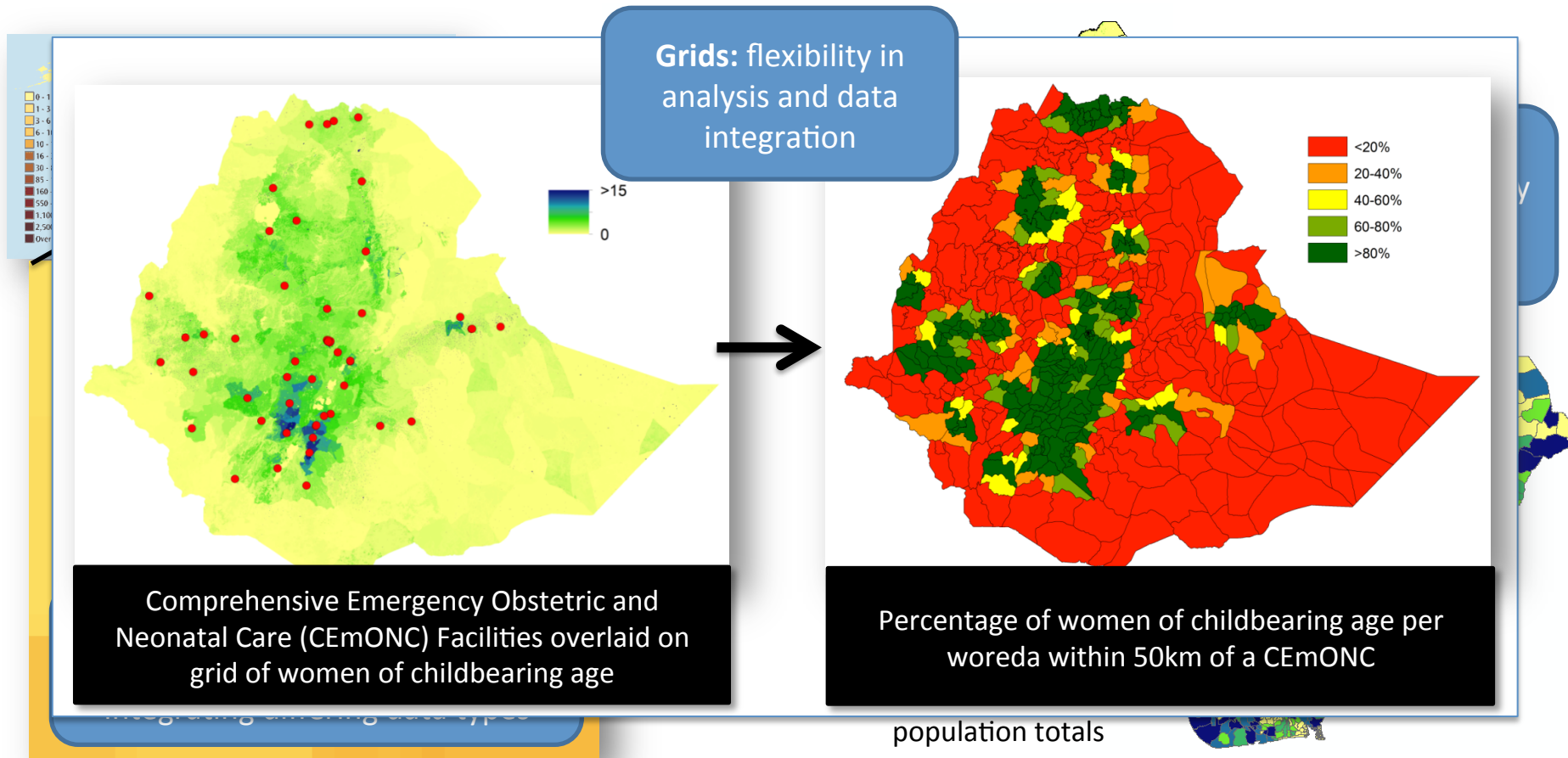


- Who is there?



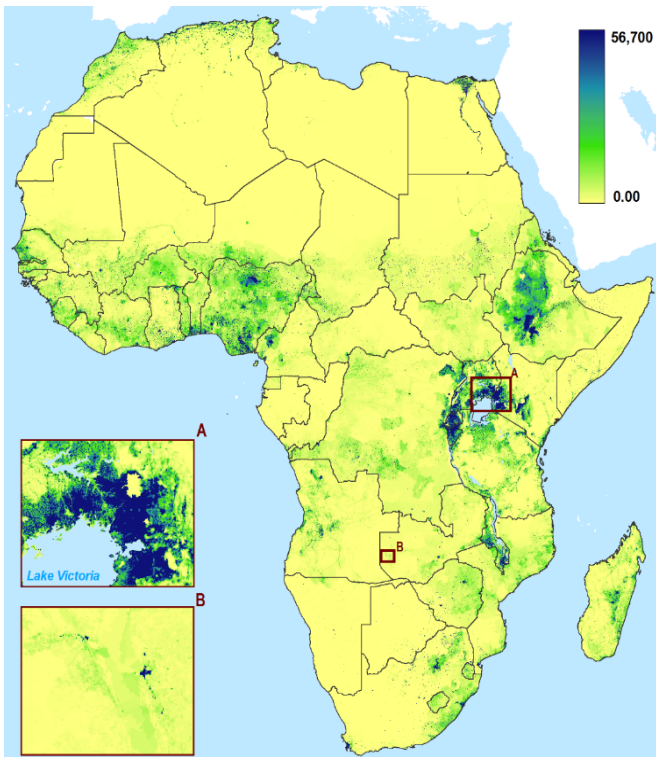
mobile is the population?

Benefits of 'gridded' demographic data

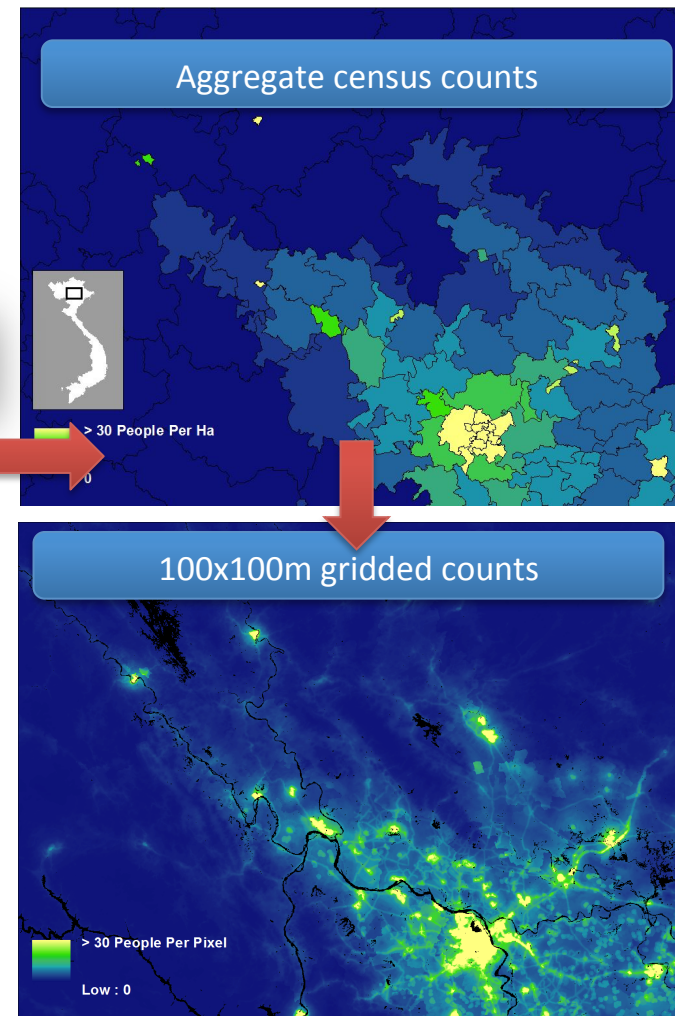
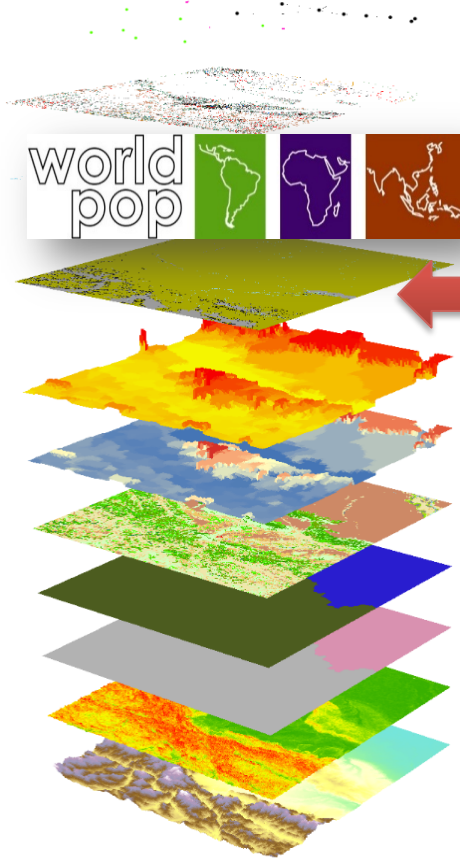


Mapping population distributions

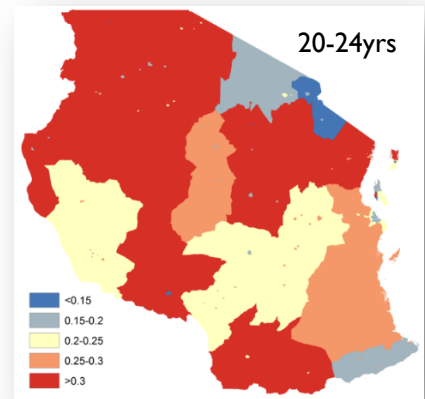
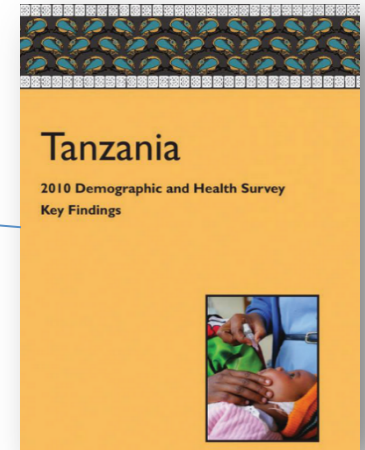
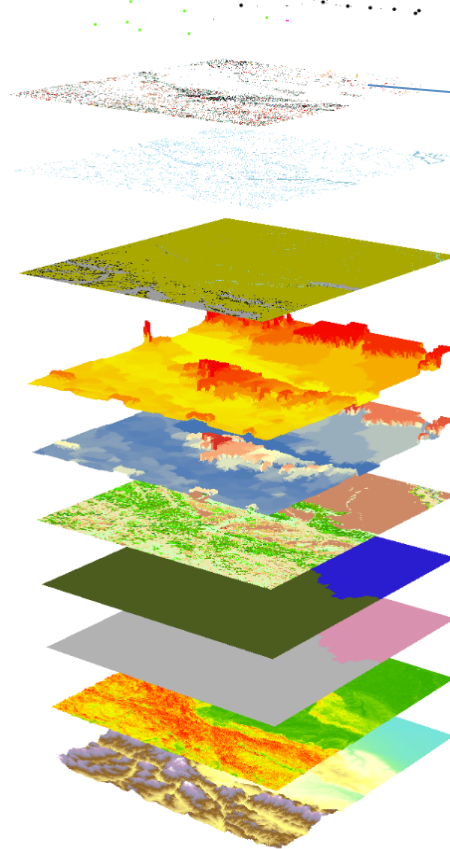
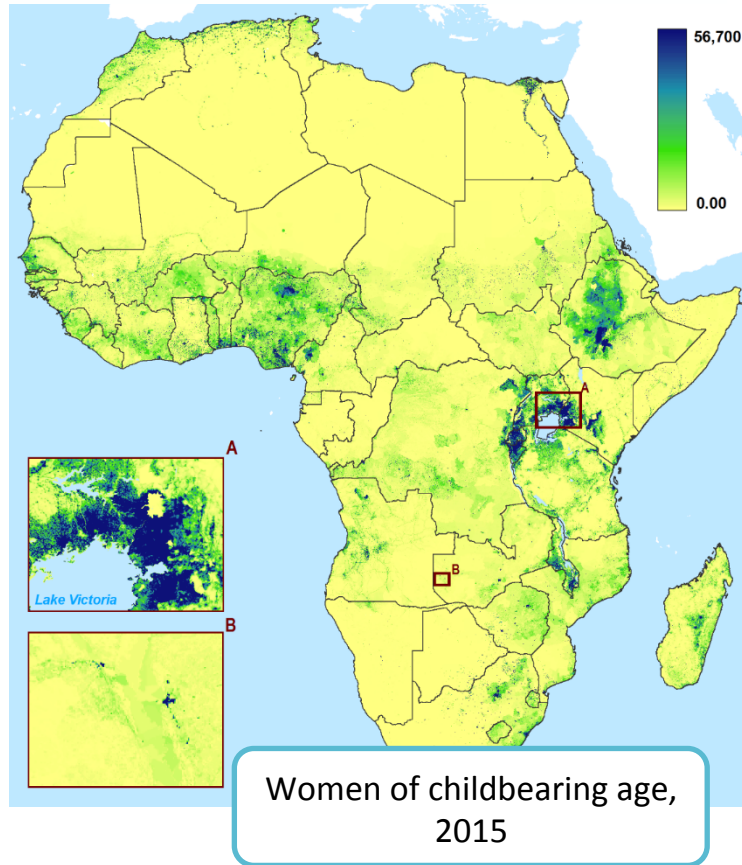
Integration with satellite/GIS data related to human population distribution patterns to disaggregate counts to regular grids



Numbers of people per 1x1km 2015



Mapping the distributions of women, pregnancies and births



Mapping pregnancies and births

GHANA

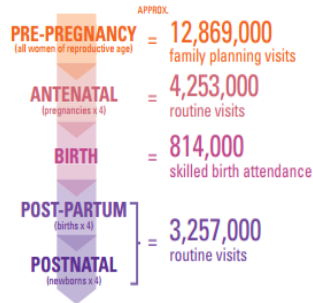
In 2012, of an estimated total population of 25.4 million, 15.1 million (59%) were living in rural areas and 6.5 million (26%) were women of reproductive age; the total fertility rate was 3.9. By 2030, the population is projected to increase by 39% to 35.3 million. To achieve universal access to sexual, reproductive, maternal and newborn care, midwifery services must respond to 1.1 million pregnancies per annum by 2030, 59% of these in rural settings. The health system implications include how best to configure and equitably deploy the SRMNH workforce to cover at least 83.8 million antenatal visits, 16 million births and 64.1 million post-partum/postnatal visits between 2012 and 2030.

WHAT WOMEN AND NEWBORNS NEED (2012)

1,063,000 PREGNANCIES A YEAR = HOW MANY EPISODES OF CARE?

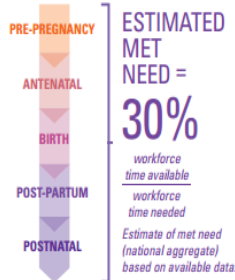


Number and distribution of pregnancies (2012)



WORKFORCE AVAILABILITY (2012)

Country classification of staff working in MNH ¹	Time spent on MNH %
Midwives	4,185 100
Midwives, auxiliary	na na
Nurse-midwives	na na
Nurses	273 80
Nurses or nurse-midwives, auxiliary	na na
Clinical officers & medical assistants	na na
Physicians, generalists	1,123 -
Obstetricians & gynaecologists	549 -



MIDWIFERY EDUCATION²

Minimum high-school requirement to start training	Grade 12+
Years of study required to qualify (rounded)	3
Standardized curriculum? Year of last update	Yes, 2013
Minimum number of supervised births in curriculum	40
Number of 2012 graduates/as % of all practising midwives	1,146/27
% of graduates employed in MNH within one year	100%

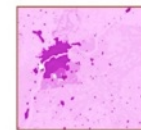
MIDWIFERY REGULATION

Legislation exists recognizing midwifery as an autonomous profession	Yes
A recognized definition of a professional midwife exists	Yes
A government body regulates midwifery practice	Yes
A licence is required to practise midwifery	Yes

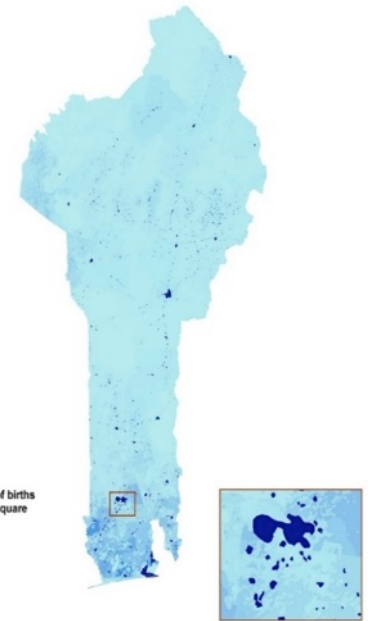
Mali



Number of pregnancies per grid square



Benin



Number of births per grid square

THE STATE OF THE WORLD'S MIDWIFERY 2014

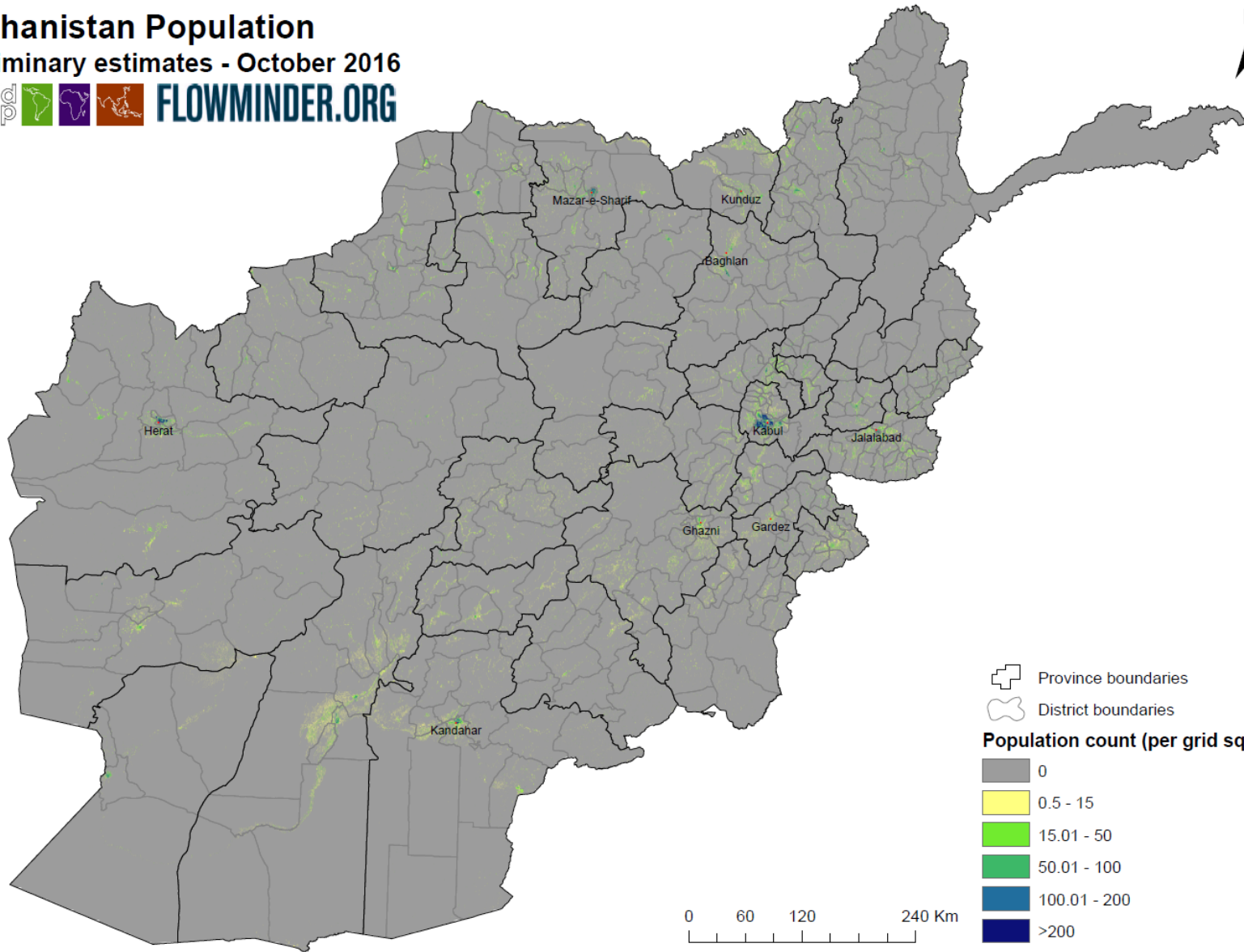
A UNIVERSAL PATHWAY.
A WOMAN'S RIGHT TO HEALTH





Afghanistan Population







Preliminary estimates - October 2016

world pop  FLOWMINDER.ORG



-  Province boundaries
-  District boundaries

Population count (per grid square)

-  0
-  0.5 - 15
-  15.01 - 50
-  50.01 - 100
-  100.01 - 200
-  >200

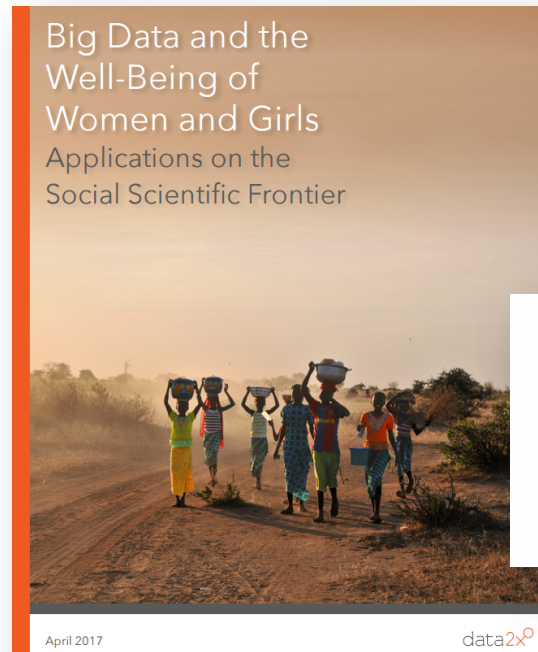
0 60 120 240 Km



Denominators



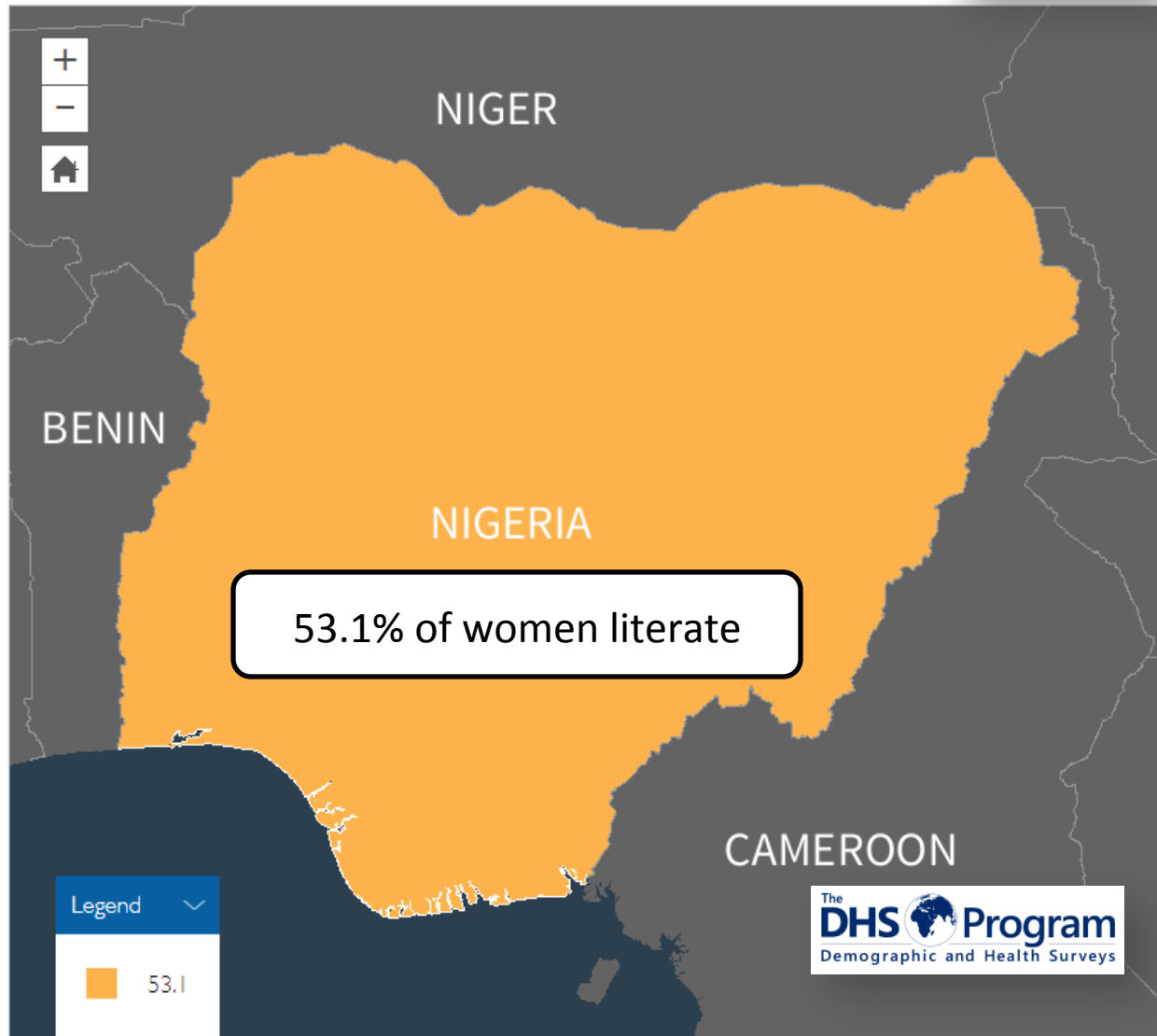
Numerators





Household
surveys

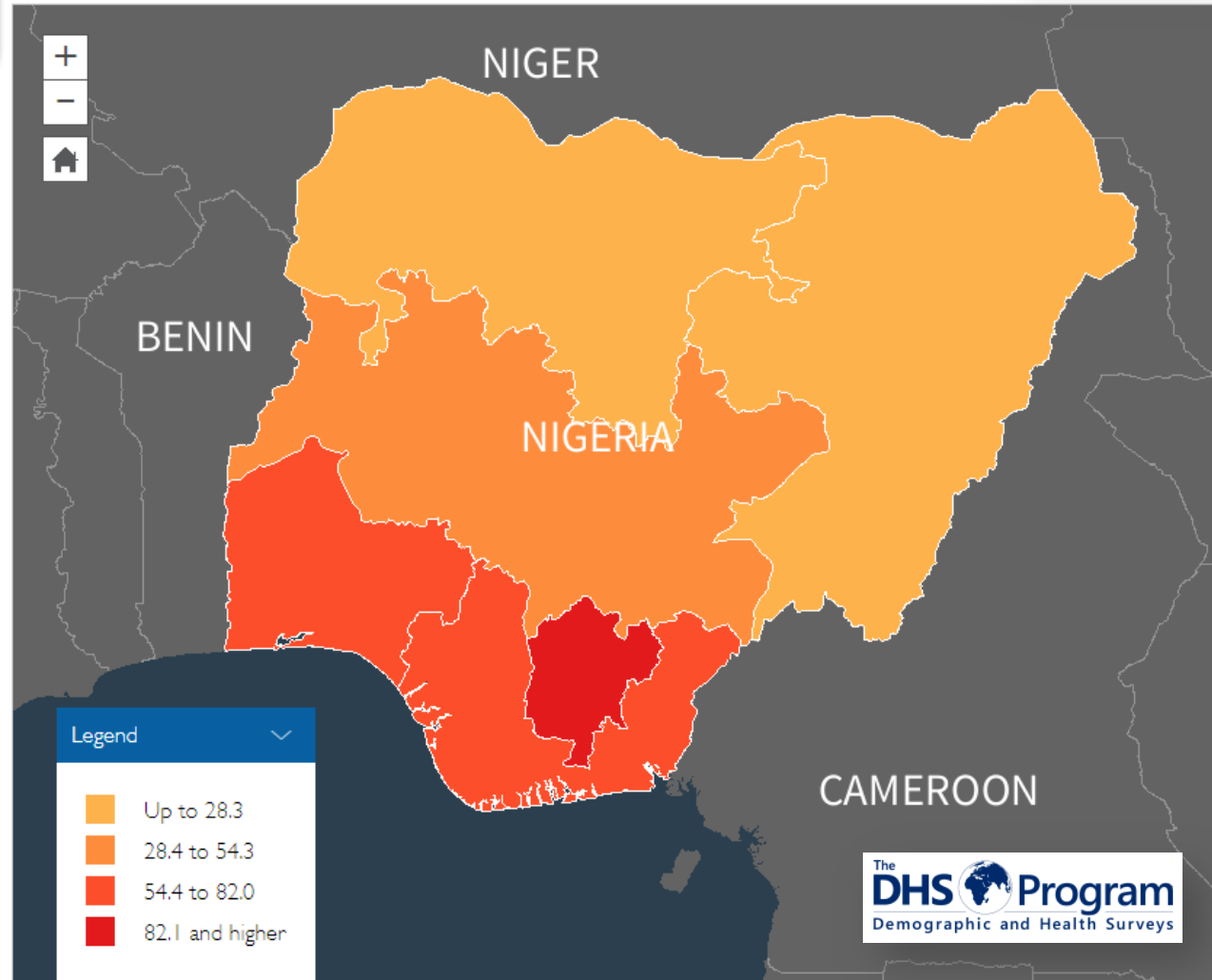
Aggregate,
national level
indicators hide
important local
differences

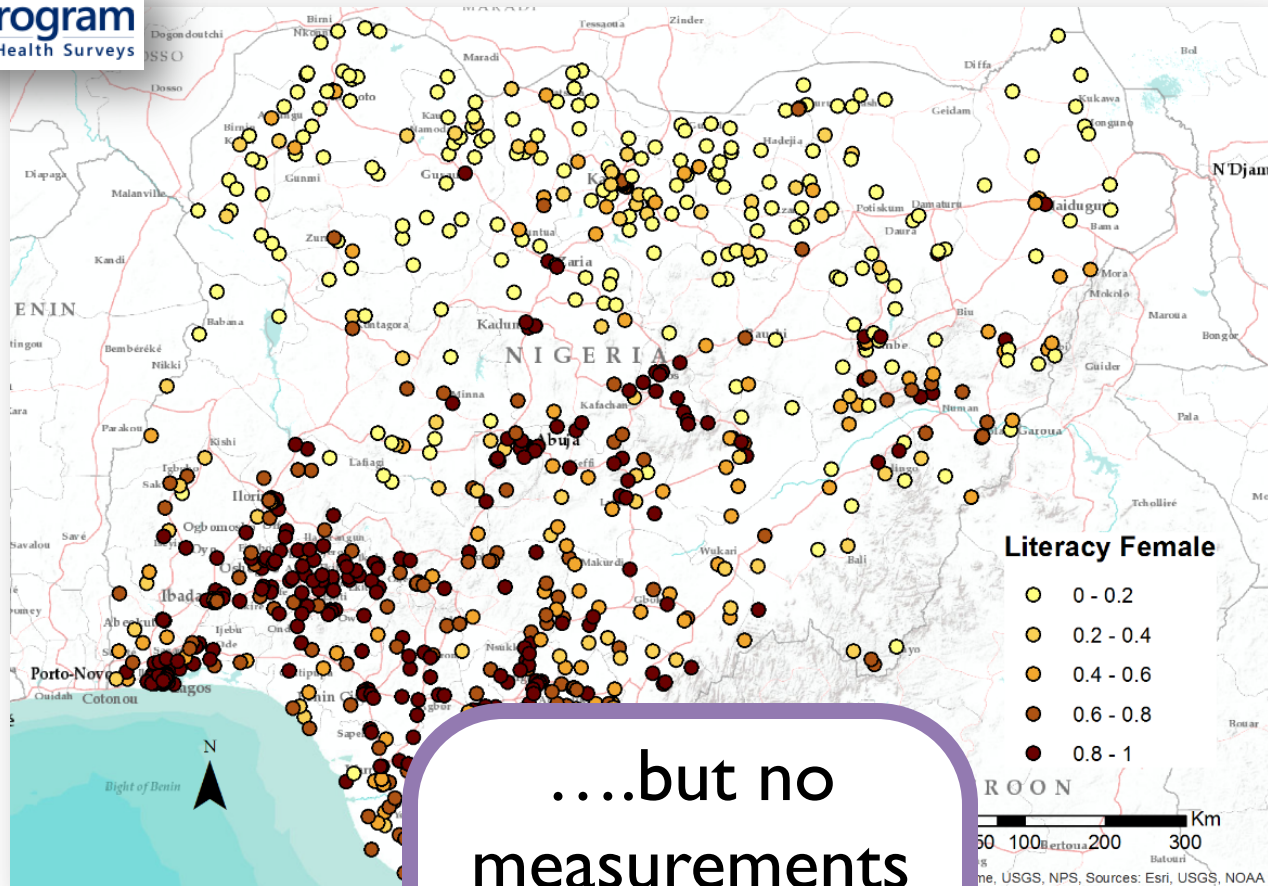




Household
surveys


Subnational
data are
available, but at
very coarse
scales





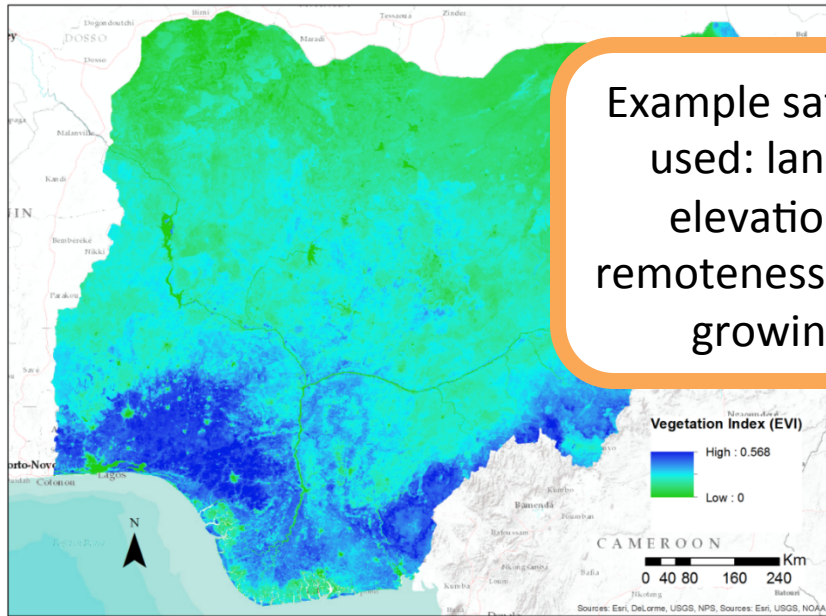
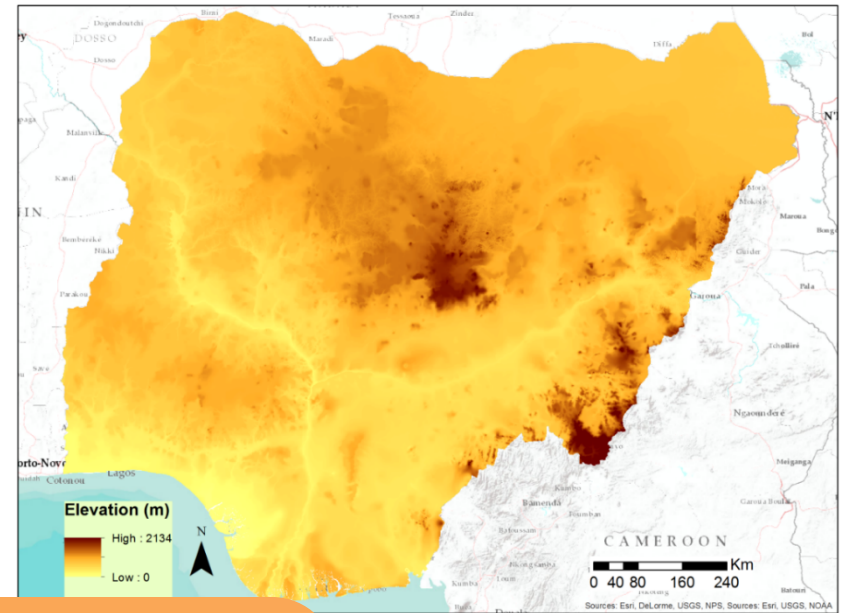
Increasingly
survey cluster
location data
are available to
provide
relevant
detail...

...but no
measurements
in the
unsampled
locations –
what can we
do?

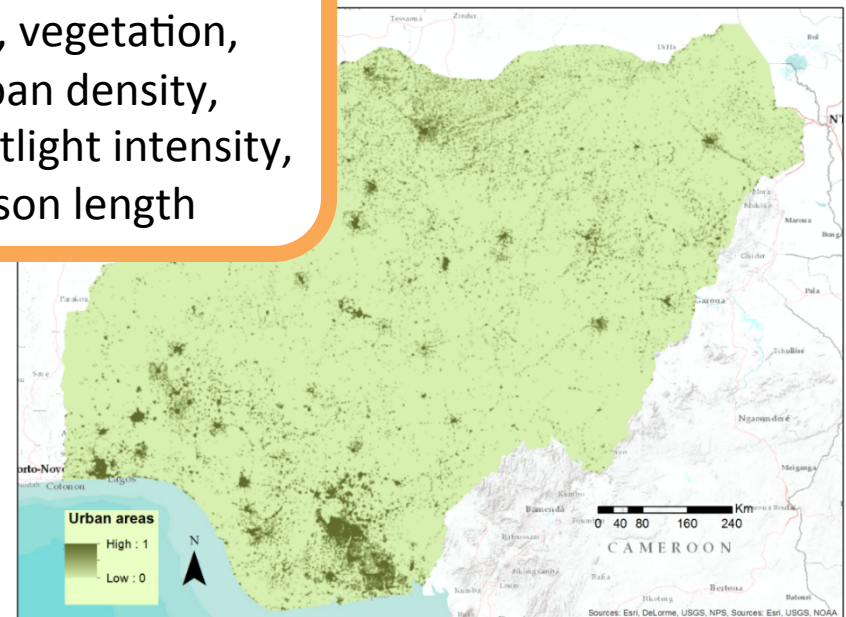
A satellite image of a mountainous region, likely the Himalayas, showing a river valley. The terrain is rugged with brown and tan colors, and the river valley is green. A white text box with a green border is overlaid on the left side of the image.

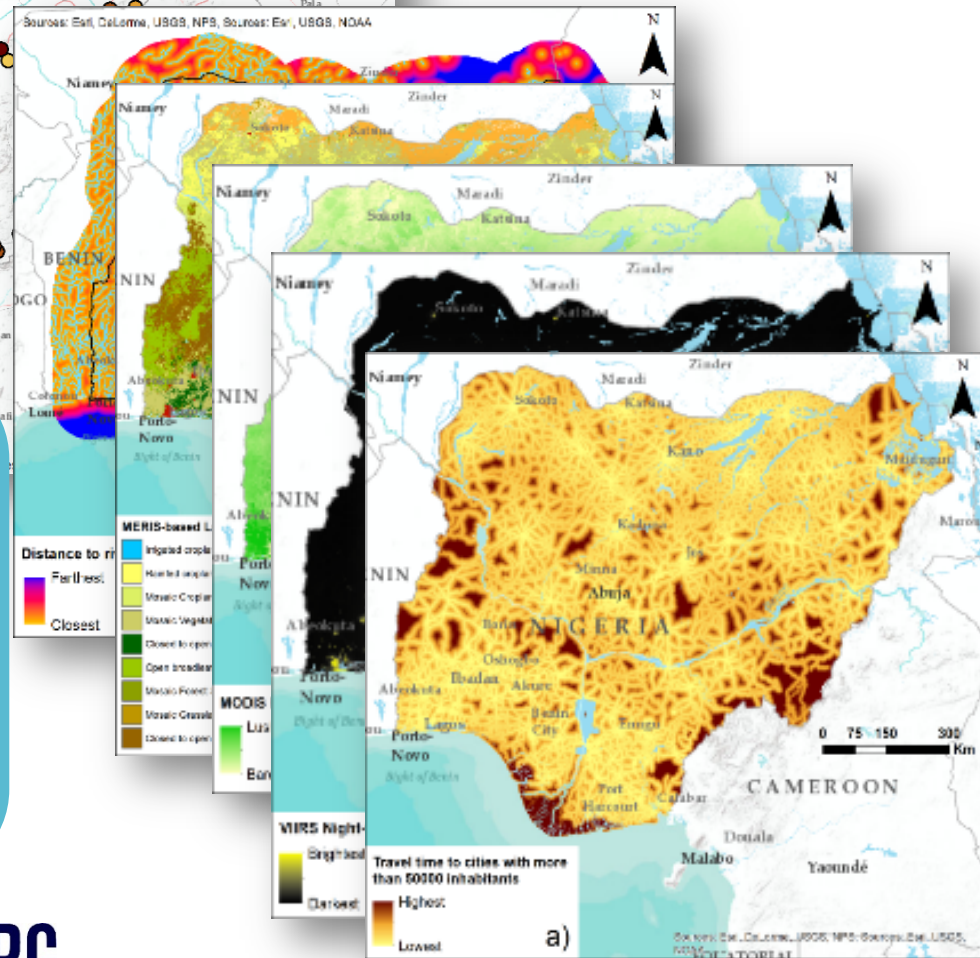
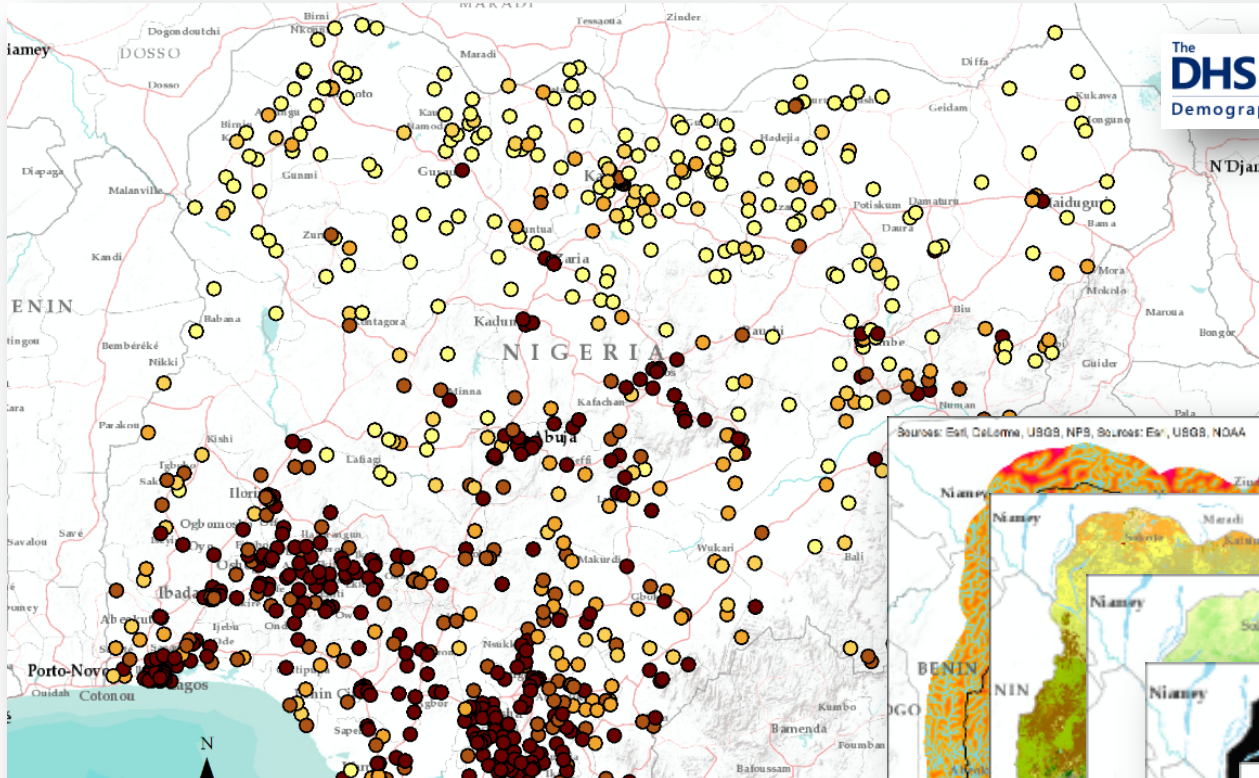
Satellite imagery
can be processed
to map factors
known to
correlated with
human welfare

Many satellite-derived measures such have been shown individually to correlate with human welfare indicators

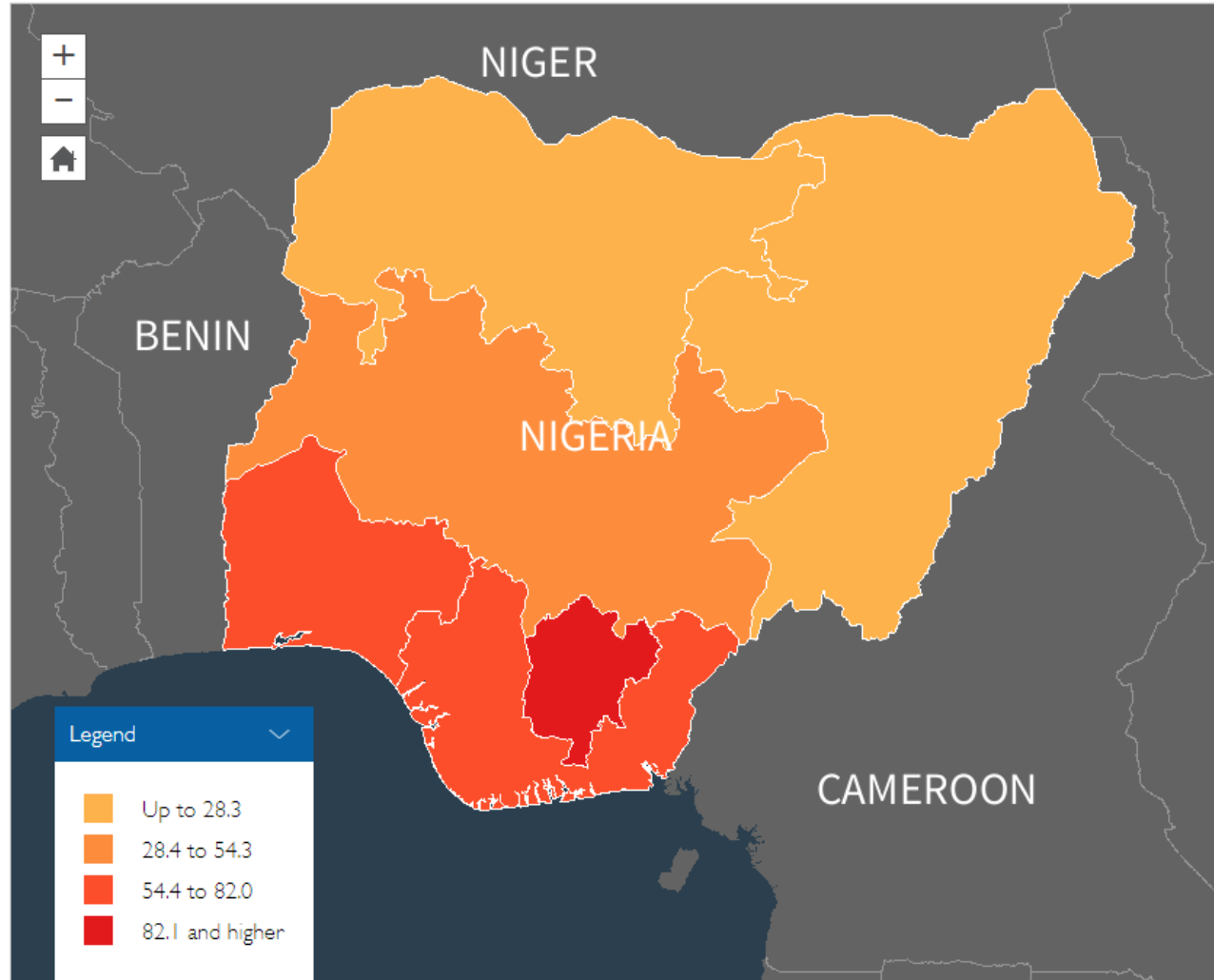


Example satellite-derived maps used: land use, vegetation, elevation, urban density, remoteness, nightlight intensity, growing season length



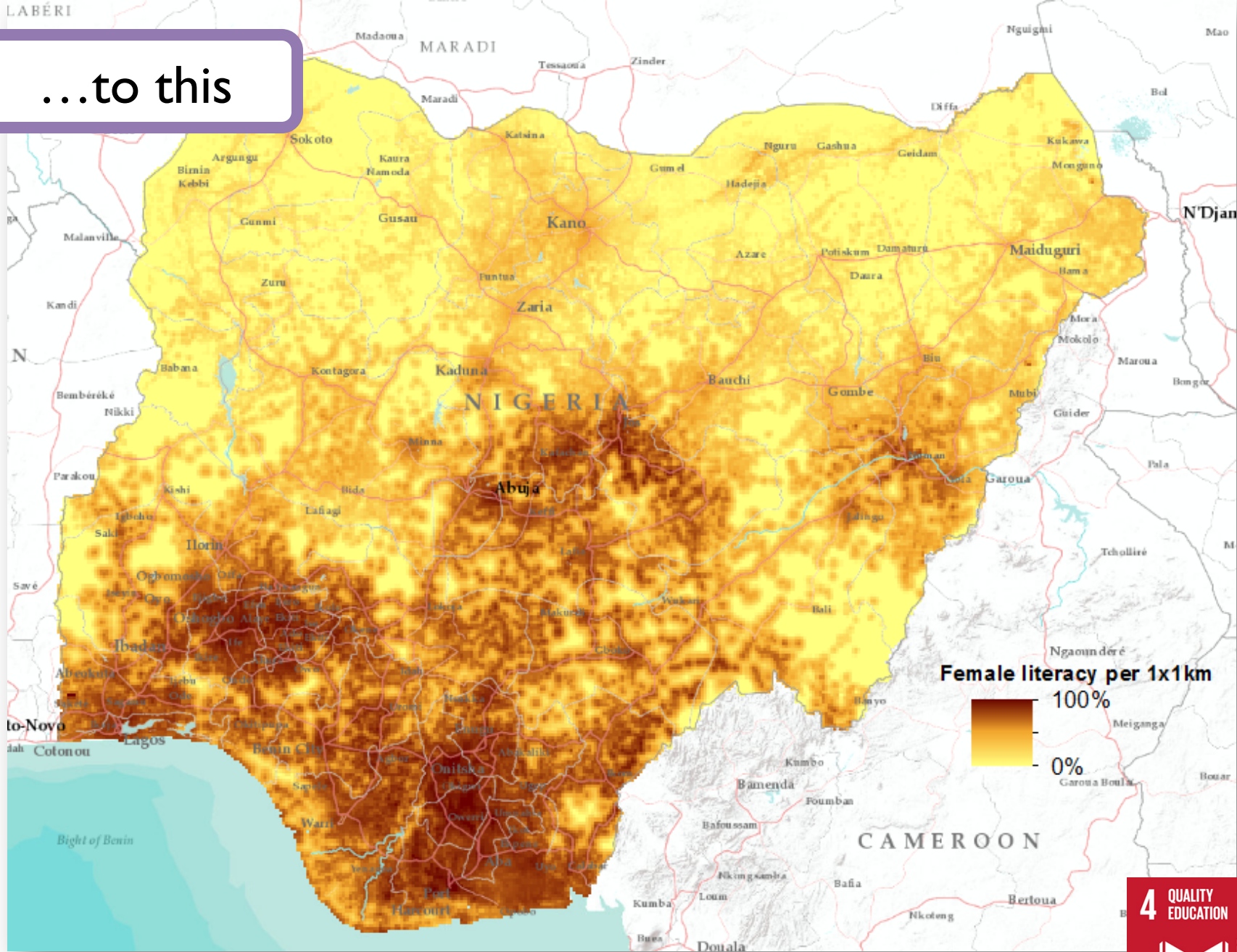


Combining the satellite maps with the survey cluster data in a statistical model enables predictions to be made in unsampled locations with high levels of accuracy



So we can move from this, which hides local heterogeneities and those left behind....

...to this

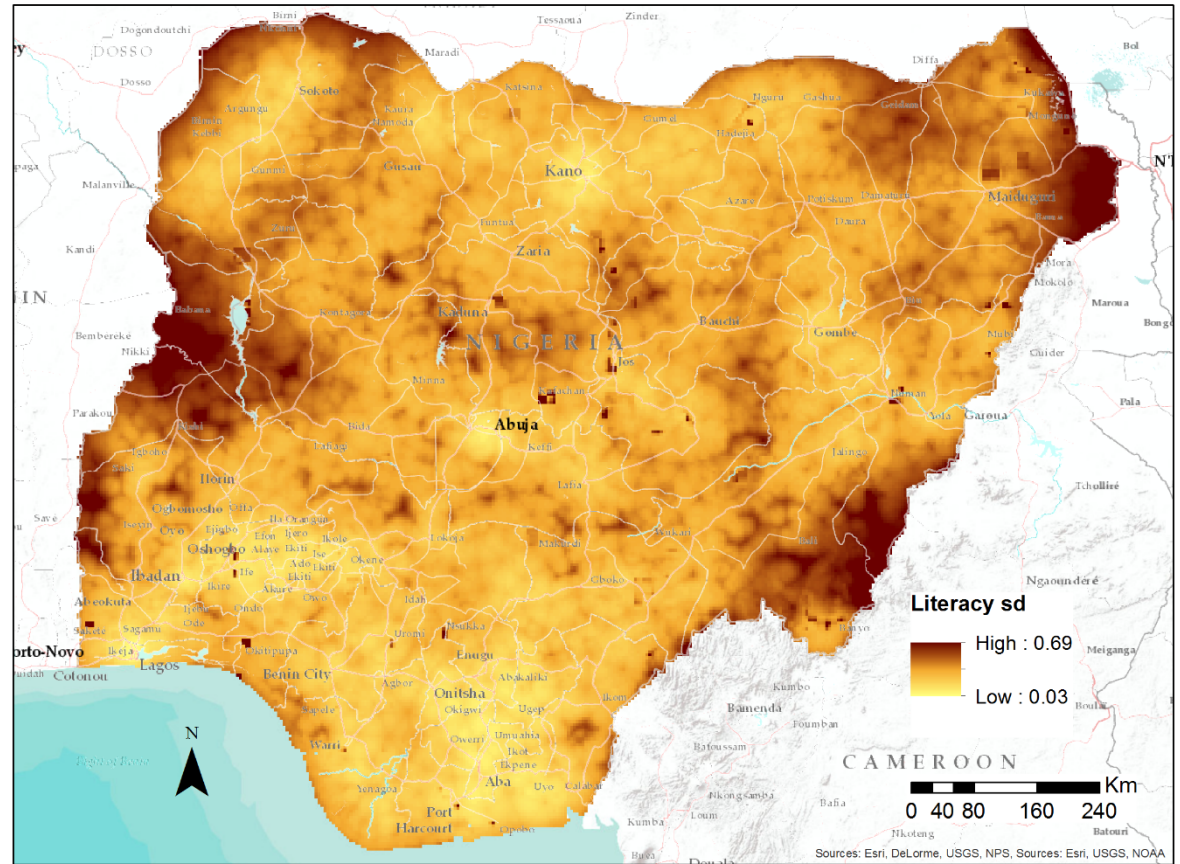
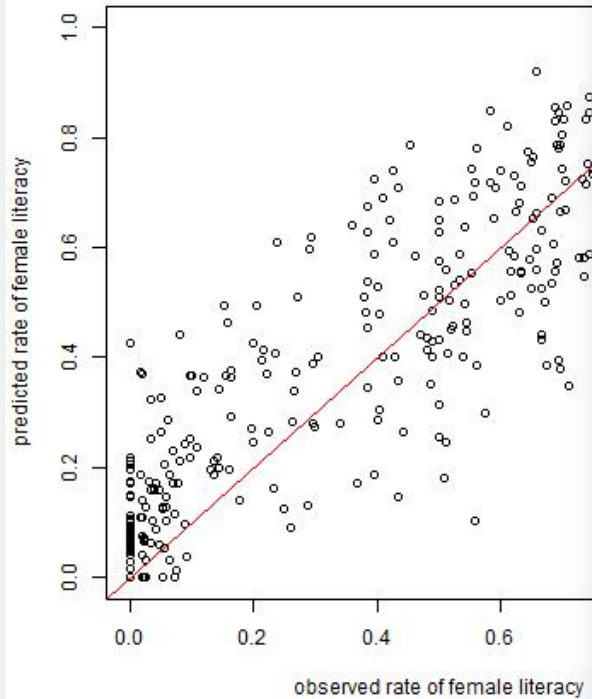


Female literacy per 1x1km
100%
0%

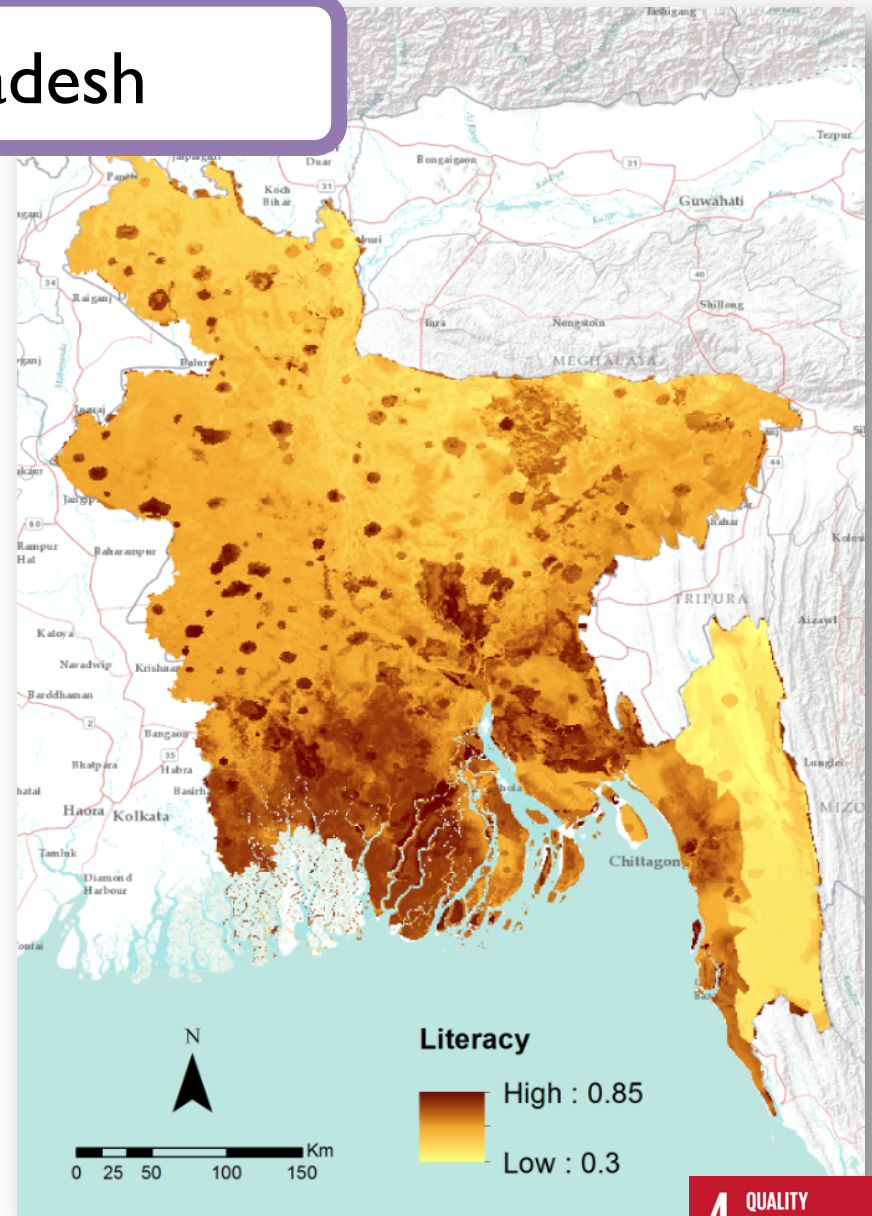
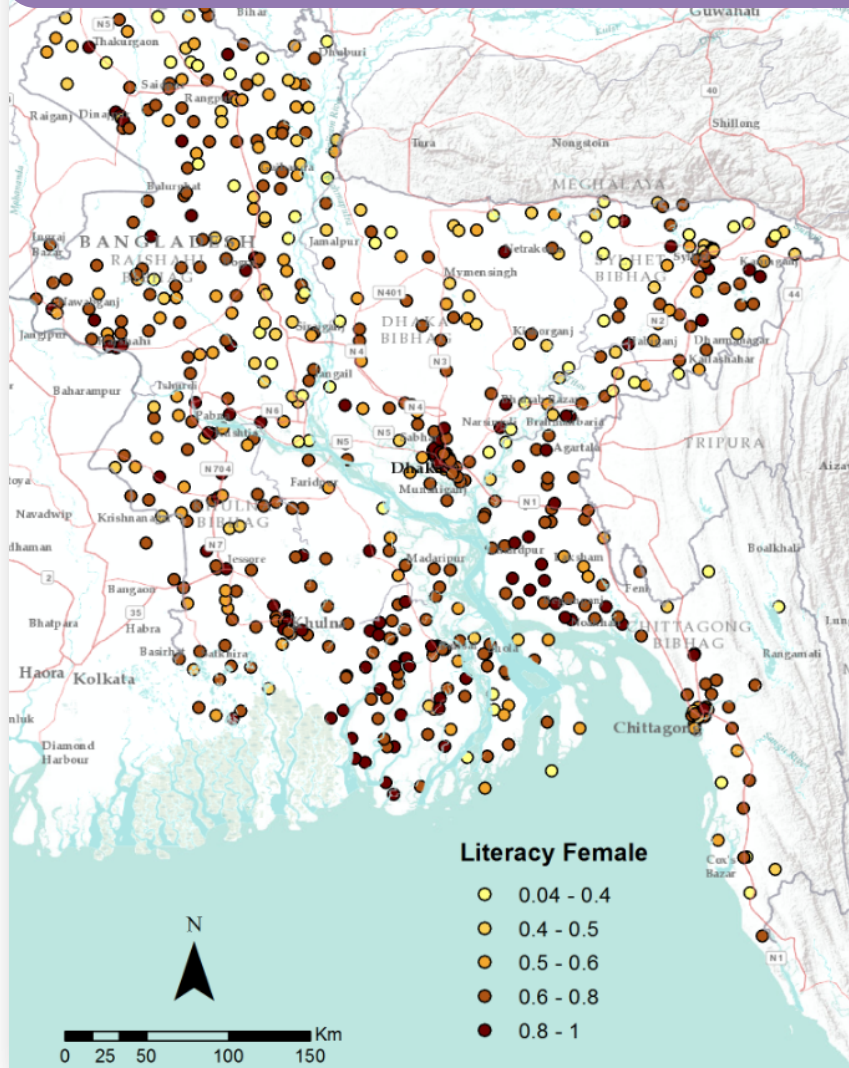


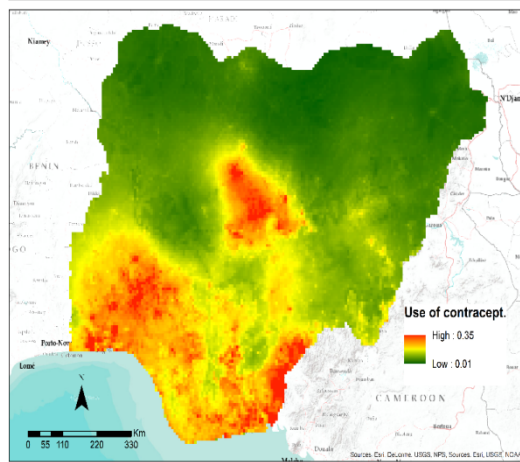
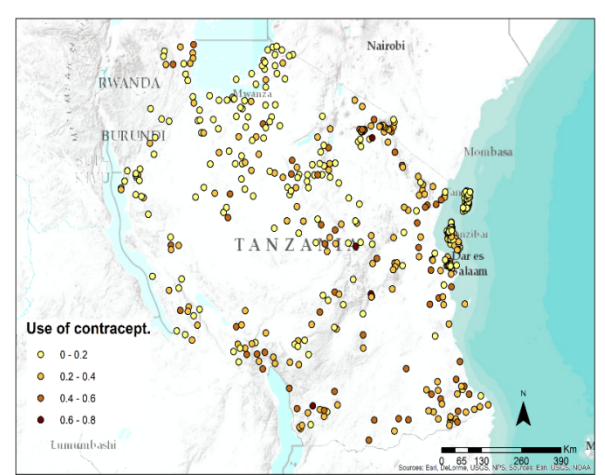
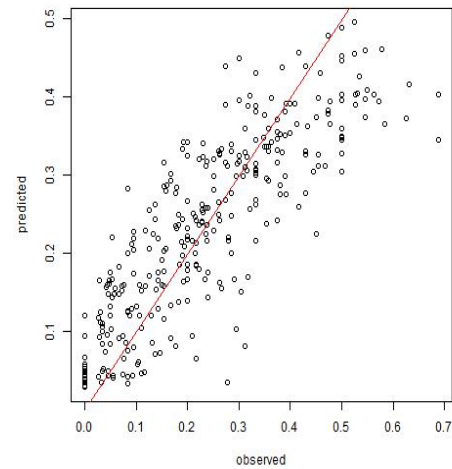
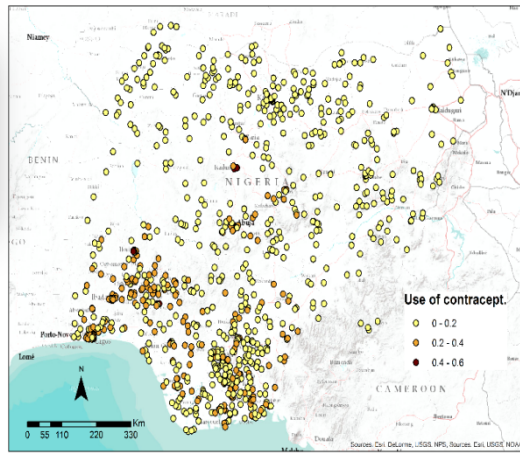


Cross-validation, mapping uncertainty

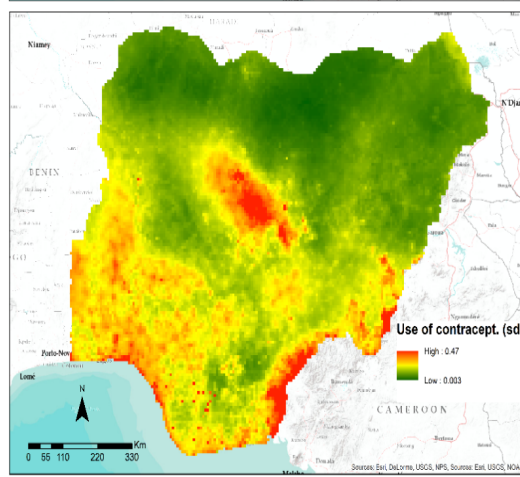
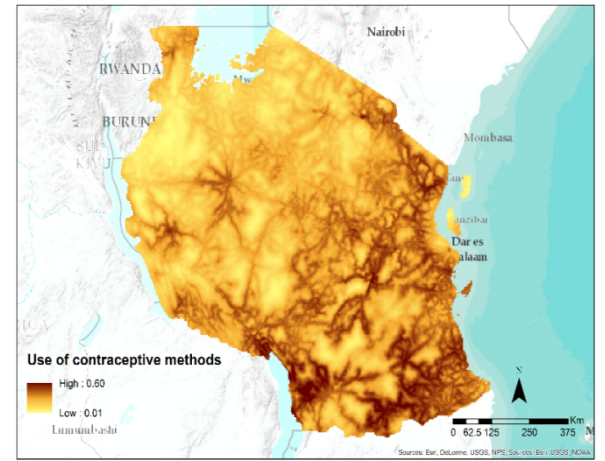


Female literacy in Bangladesh

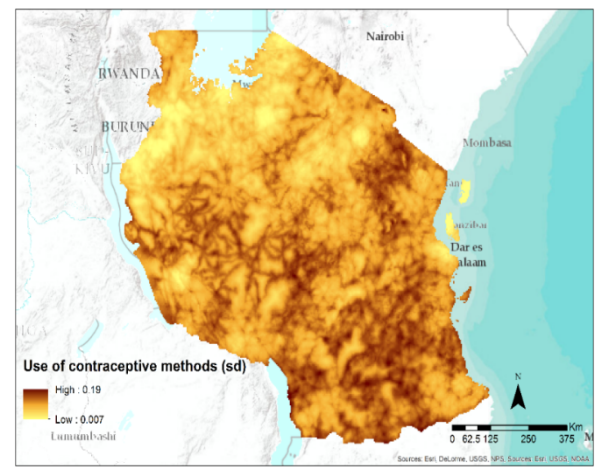




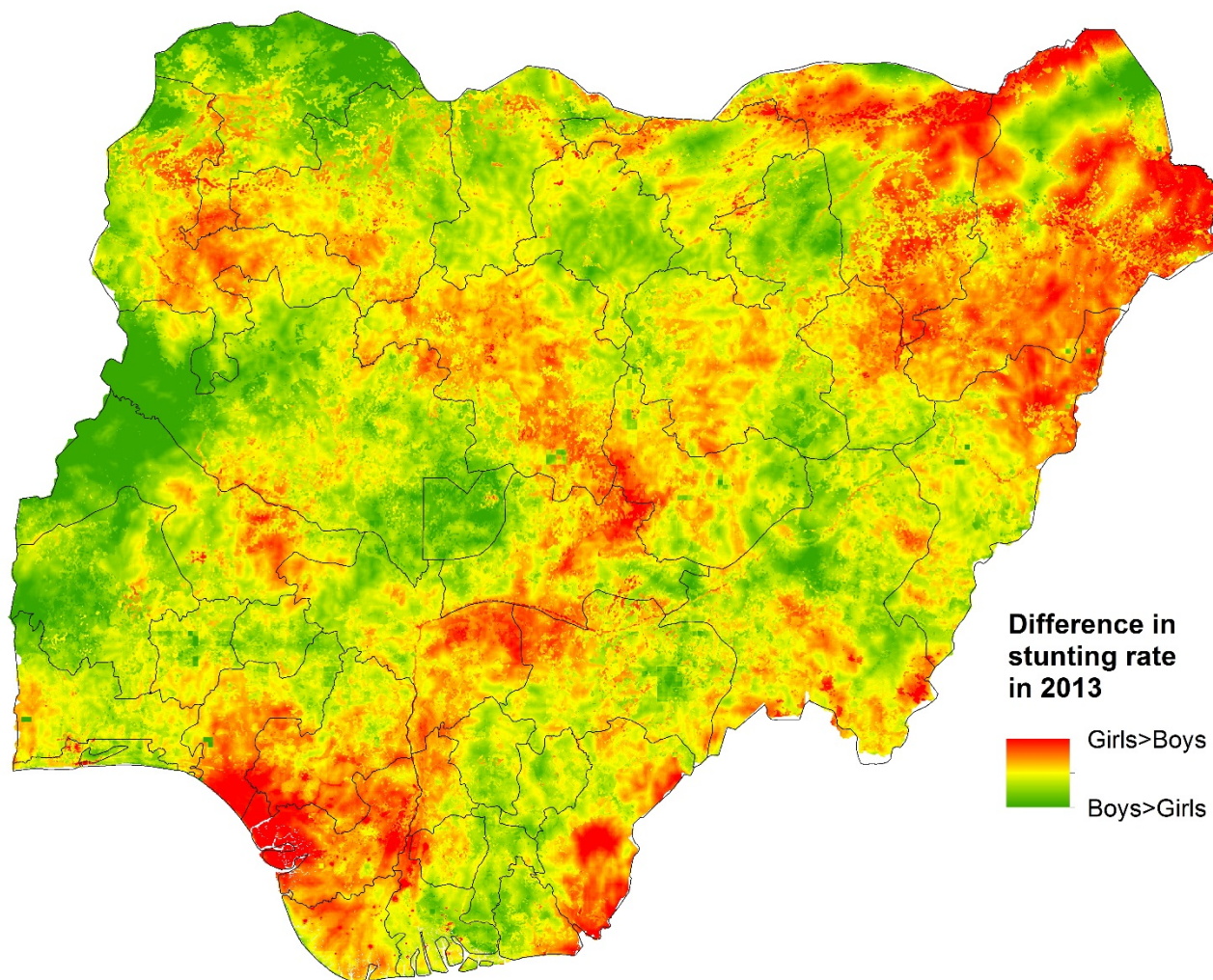
Percentage of women of reproductive age using modern contraceptive methods



Uncertainty maps: standard deviation

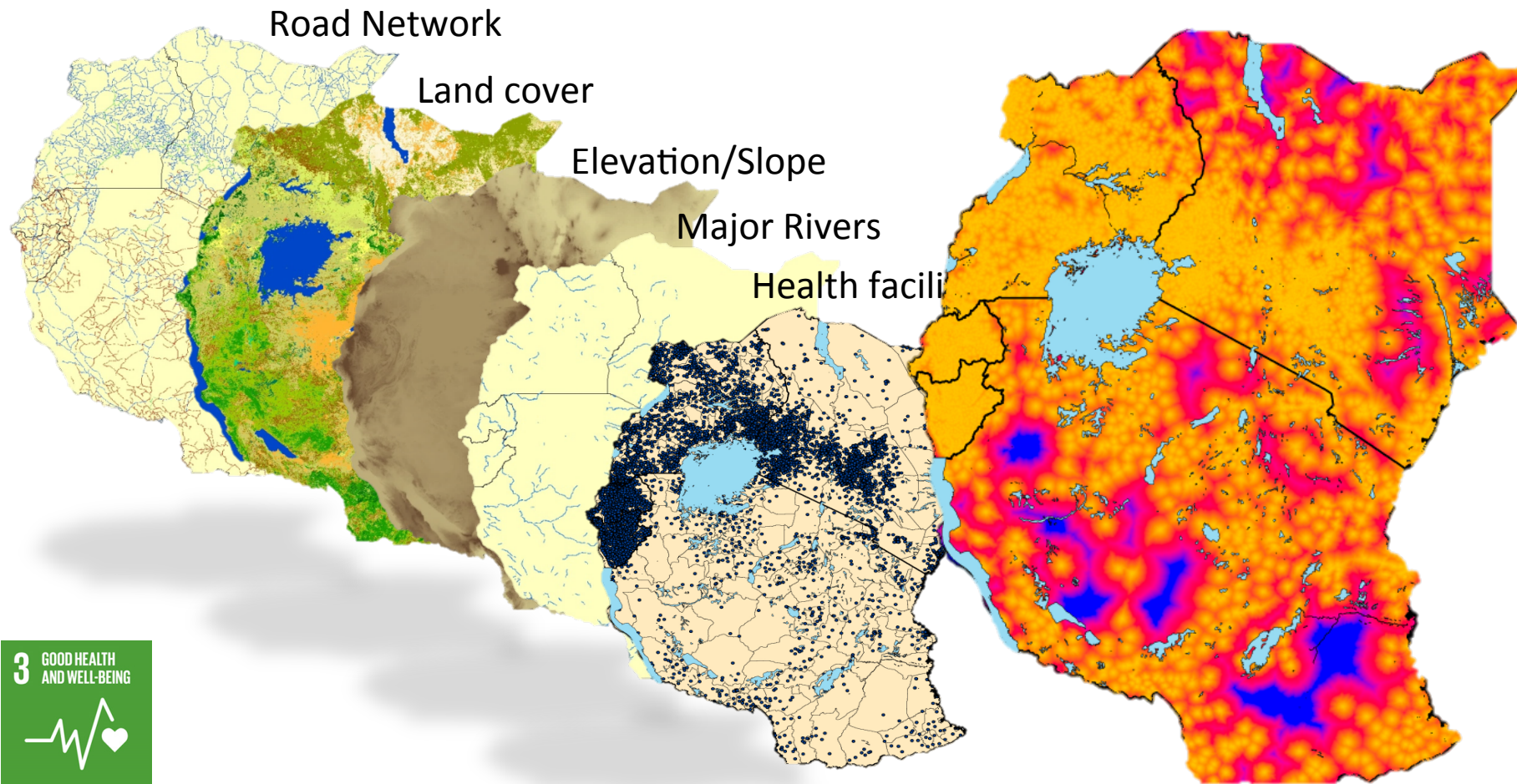


Highlighting gender differences



Utilisation of maternal healthcare

Travel time to nearest facility



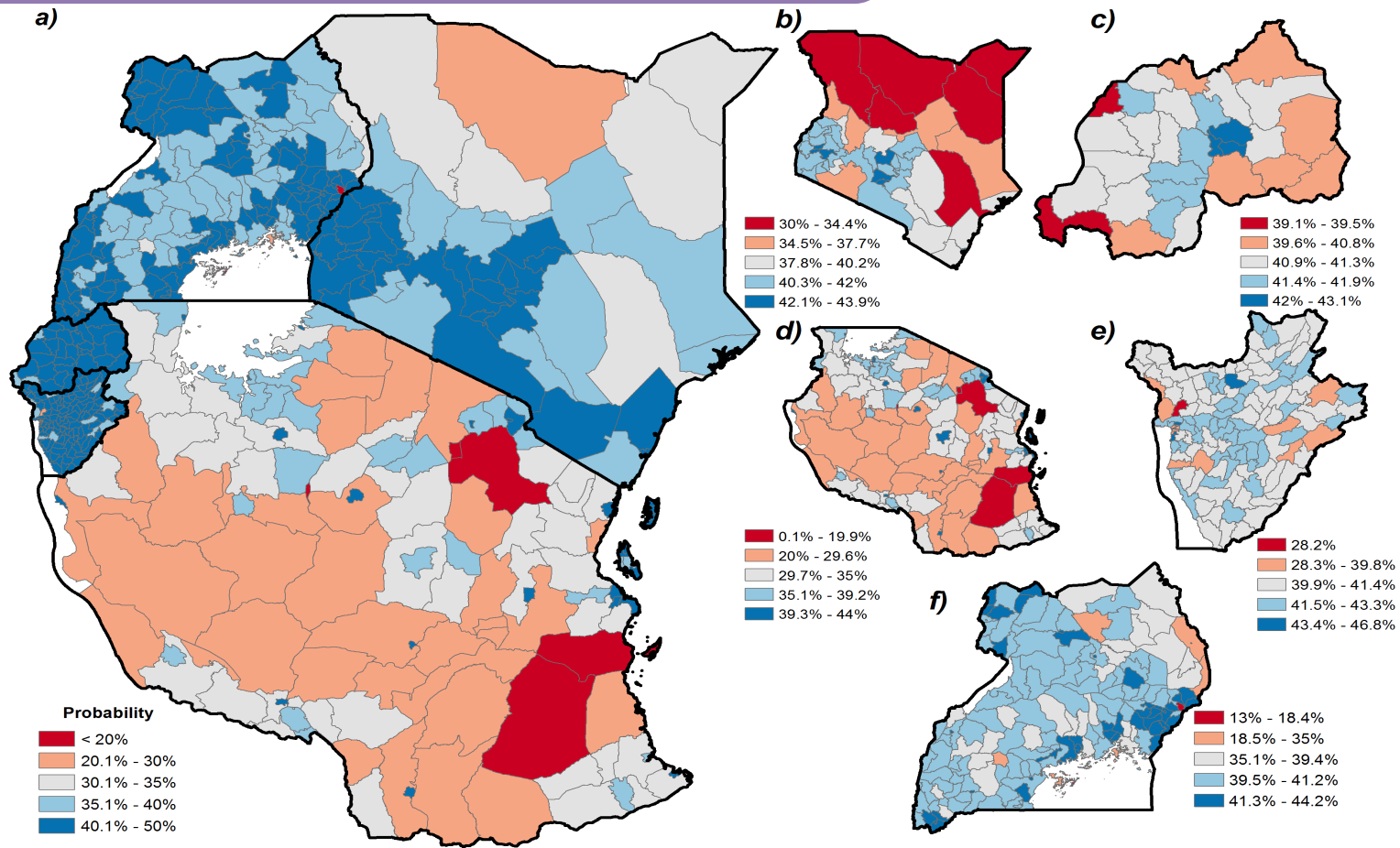
Open Health Initiative

world pop



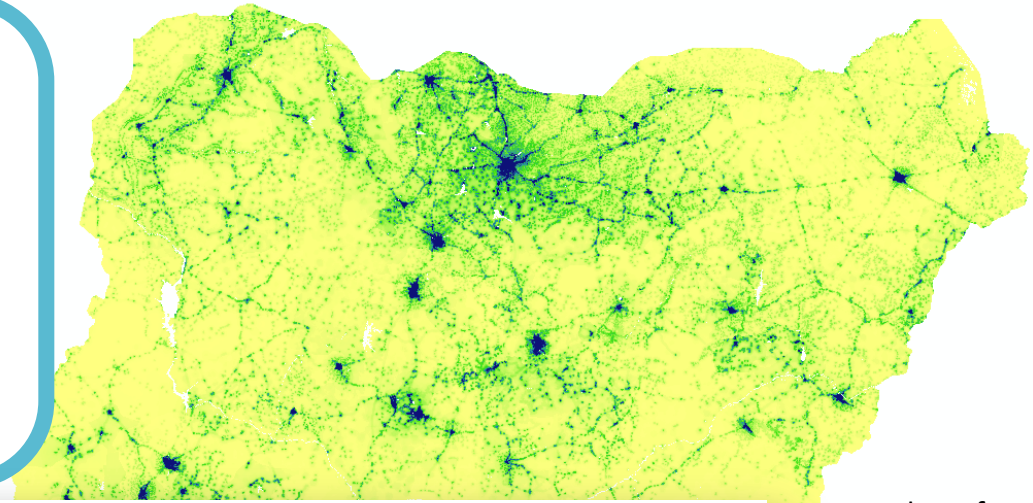
FLOWMINDER.ORG

Utilisation of maternal healthcare

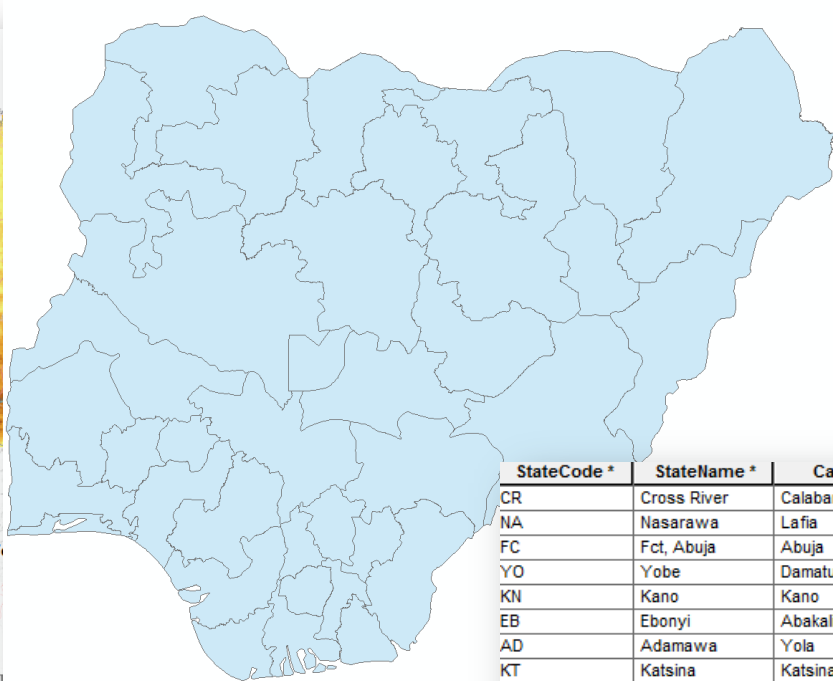
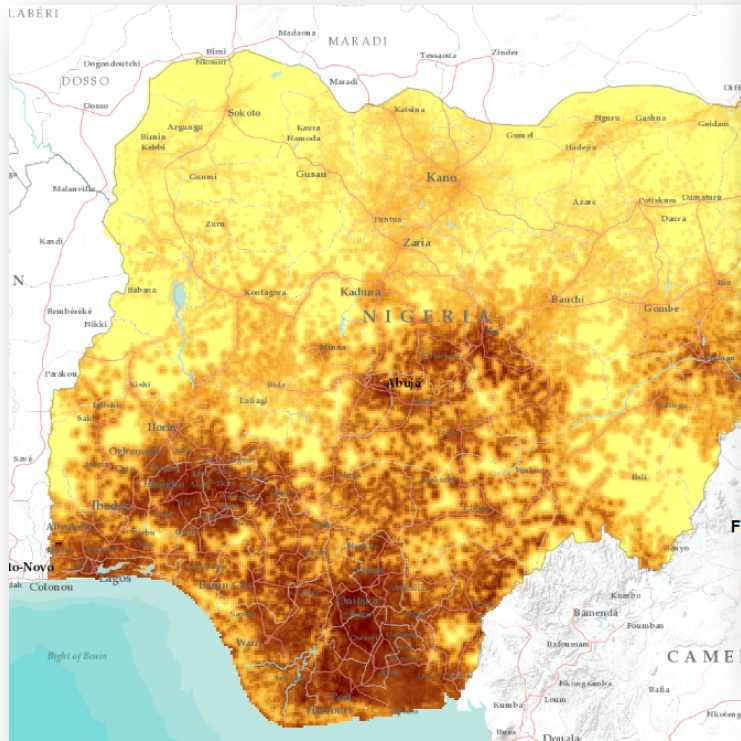
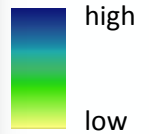


Probability of delivery with no **skilled birth attendant** present, in **a) East Africa, b) Kenya, c) Rwanda, d) Tanzania, e) Burundi, and f) Uganda.**

Overlaying these maps with population count maps from WorldPop enables translation from prevalences to counts (e.g. number of literate women per 1km grid square, or per state)

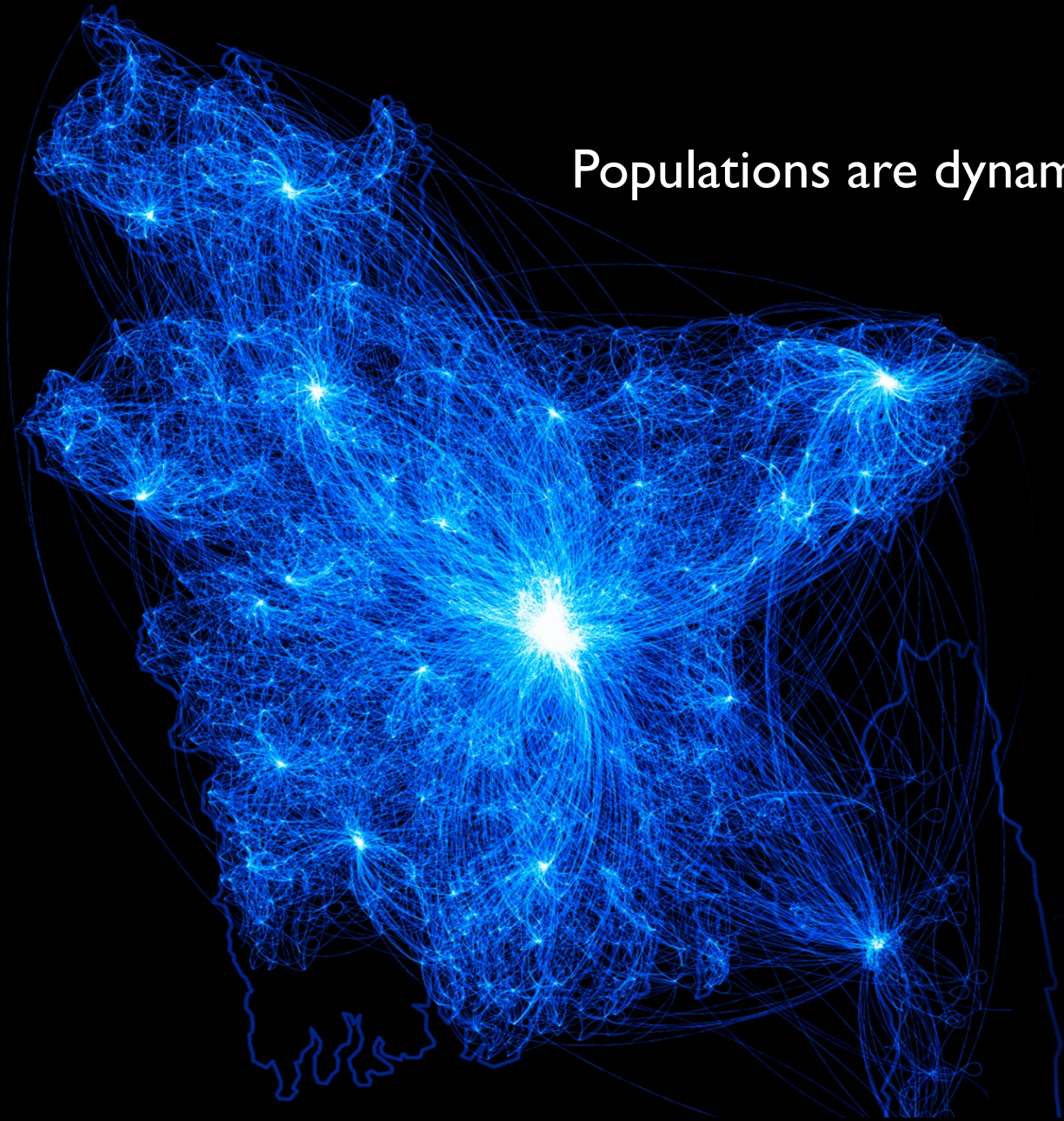


Number of women per 1x1km grid cell

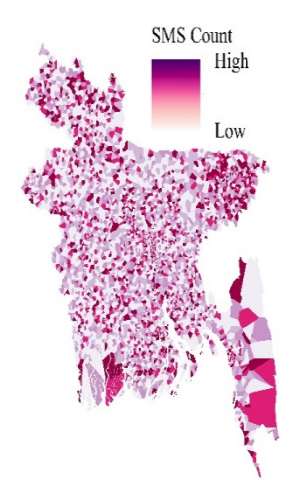
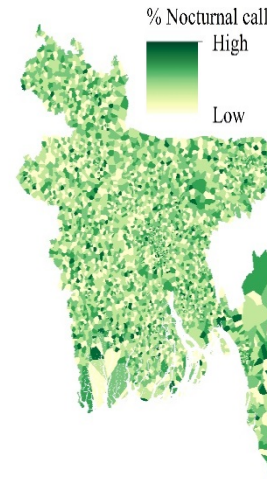
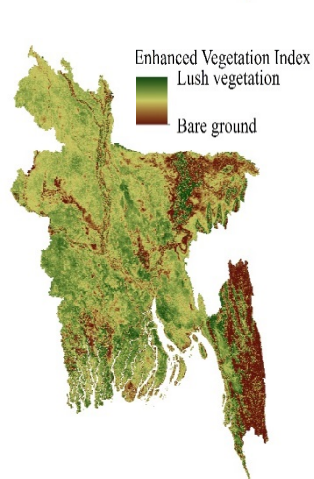
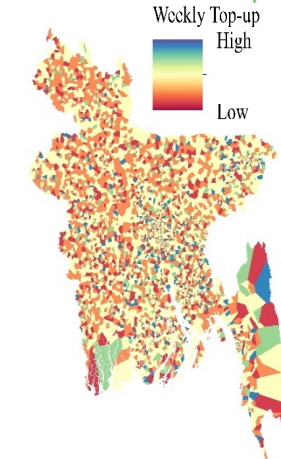
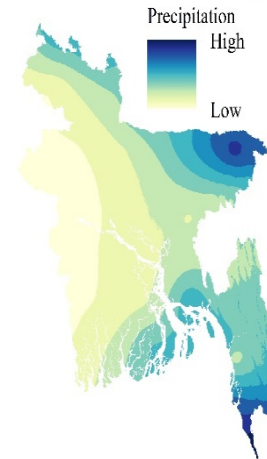
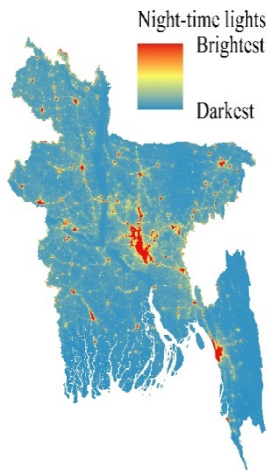
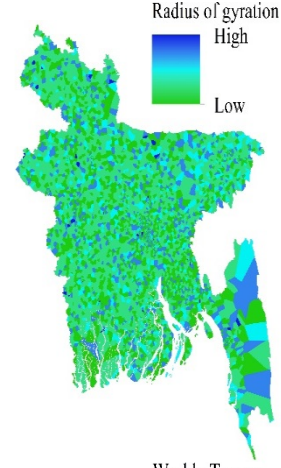
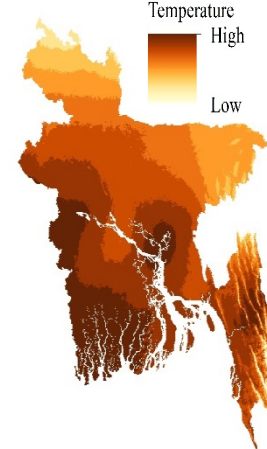
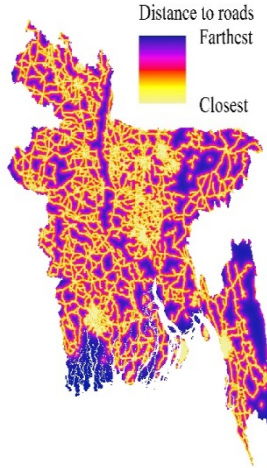
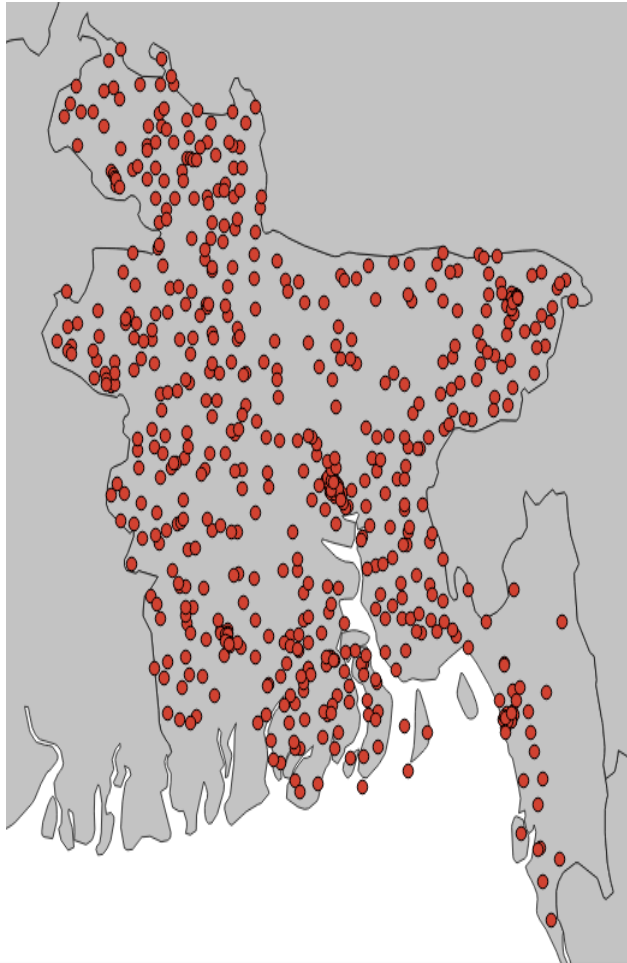


StateCode *	StateName *	CapCity	Source	Ti
CR	Cross River	Calabar	WHO	26/02/20
NA	Nasarawa	Lafia	eHA-Tosin	05/03/20
FC	Fct, Abuja	Abuja	WHO	26/02/20
YO	Yobe	Damaturu	EHA-MICHAEL	21/08/20
KN	Kano	Kano	EHA-TOSIN	15/08/20
EB	Ebonyi	Abakaliki	WHO	26/02/20
AD	Adamawa	Yola	EHA-TOSIN	10/07/20
KT	Katsina	Katsina	EHA-TOSIN	15/08/20
BE	Benue	Makurdi	WHO	26/02/20
OS	Osun	Oshogbo	WHO	26/02/20
EN	Enugu	Enugu	WHO	26/02/20
IM	Imo	Owerri	WHO	26/02/20
DE	Delta	Asaba	WHO	26/02/20
NI	Niger	Minna	eHA-Tosin	14/04/20
AB	Abia	Umuahia	WHO	26/02/20

Populations are dynamic....



Integrating mobile network data to improve gender-disaggregated mapping



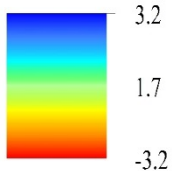
GPS-located survey cluster data



- 2017-18 Data2x-Nepal CBS collaboration
- Dynamic mapping and phone surveys: literacy, stunting, education, school enrollment, employment, attitudes to domestic violence, women's control over household resources
- Aiming to make Nepal CBS one of the World's most advanced in the use of new data forms for national statistics

Cellphone and satellite data are collected 24/7 = Potential for ongoing monitoring

DHS Wealth Index



Training, building expertise



-GIS, remote sensing skills and capacity are increasing everywhere

-Open data and software are accelerating uptake

-Making full use of existing traditional data and complimenting it with 'new' dataset integration is likely to be more cost-effective than new data collection

-Local ownership and analysis are key to sustainable implementation

Further information



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