For: World Summit AI – AI for Good and Bad…

MapAid

Mission: Drinking Water, Irrigation & Food Supply, in Ethiopia… at Lower Cost !

Method: Using AI to Detect Groundwater for Small Farmers !

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Irrigation improves crop yields x2 or x3 - increasing employment, building peace

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The problem:

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- 620 million youth are Not in Education Employment or Training across the world *. This is dangerous.
- In the developing world, Ethiopia has 27% youth unemployment and 25% undernourishment at national scale.
- In Ethiopia 50% to 70% of well drilling is unsuccessful. Traditional geophysics to detect groundwater is too expensive.

*World Bank, Fergusson & Yeates, 2013

The solution:

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- In the developing world, 80% of employment is farming - and mostly small farms that rely on rain.
- Ethiopia has 60,000 -120,000 Km Square of *shallow* irrigable land, for small farmers*, but 94.3% is not irrigated, while drill failings through "educated guesswork" makes irrigation more expensive. (*"Shallow" means 30meters*.)
- Groundwater mapping, using AI systems, using large databases, has potential to increase drill success from 50% to 75% or more, and promote aquifer sustainability.

*Mengistu et al, (2019) Groundwater resource potential...Hydrogeol J.27
Worqlul et al (2017) Assessing potential land.. Applied Geo. Vol.85

Why mapping is integral

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> “The needs and solutions of climate change and global poverty both urgently need to be mapped”

— **MapAid patron emeritus**

Nobel Peace Prize Winner

Archbishop Emeritus Desmond Tutu

Our solution:

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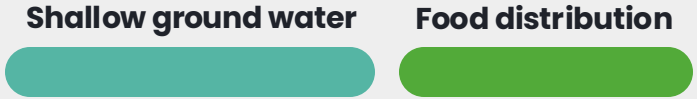
We make maps for:

- **Visualizing** gaps in opportunity, e.g:



- **Pinpointing** where people need aid most, e.g:

- It is about providing **quantitative guidance** at **locations**
- Maps to **benefit policymakers, international donors,** and **development NGOs,** where to direct their limited resources

Our ‘UN mandate’: UN SDG 6 ”WASH”

UN SDG 6
underpins x 9 SDGs

1: Zero poverty
2:Zero hunger
3:Good health & well being
4:Quality education
5:Gender equality
8:Decent work & economic
9:Industry, innovation
13: Climate action
16: Peace, justice, institutions

Ethiopia 1. AI system

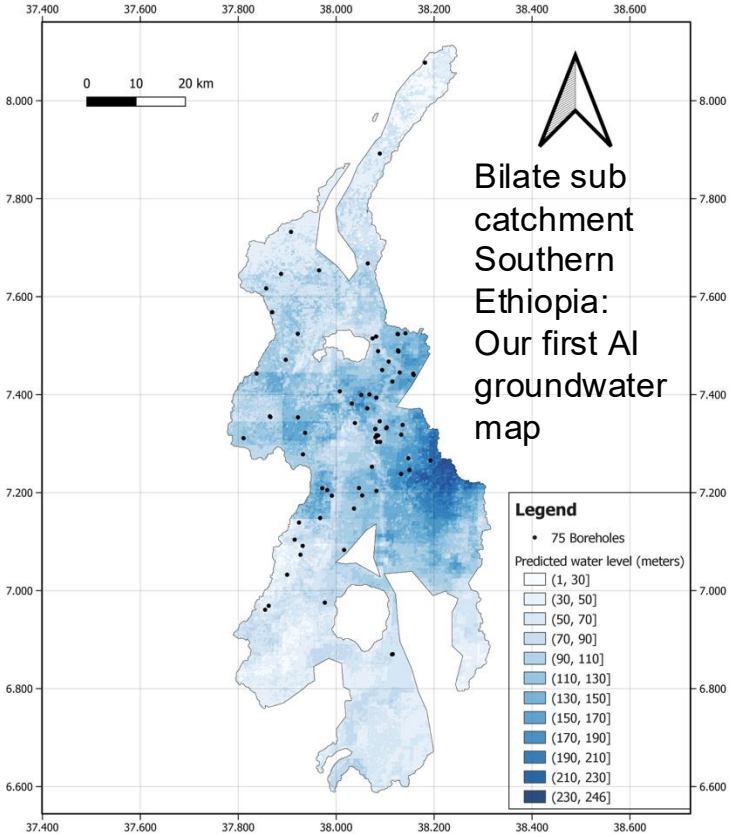
Ethiopia has 60,000 to 120,000 Km Square suitable for shallow irrigation, but 97.3% is not used !

Since January 2020, MapAid and partners built an AI system "WellMapr" to map **where shallow boreholes for irrigation** could be **more accurately placed**, helping **food & water security decision makers** plan drill locations with lower risks & costs... enabling better food supply and many other benefits.

Our partners are the **Arba Minch Water Technology Institute** and **George Mason University C-RASC** and the **Czech Geological Survey.**

Why?
Ethiopia has been facing probably the worst drought in 30 years. A group of over 7 million people are surviving on aid based feeding schemes – with 700,000 more starving. This is especially problematic as agriculture employs 80% of the workforce; the majority being small farmers.

Ethiopia 1. AI system "WellMapr™"



We estimated the depth to water table according to the following approach:

- **Step1:** Construct a machine learning model based on data from existing boreholes, climate and geology information in a study area.
- **Step 2:** Use the model to predict the depth to water table for parts of our study areas that are without boreholes.

Step 3:

- Create a predicted depth to water table map of the study area as guidance for where to drill boreholes for drinking water and irrigation.

We called this "WellMapr©"

WellMapr™'s Machine Learning Process

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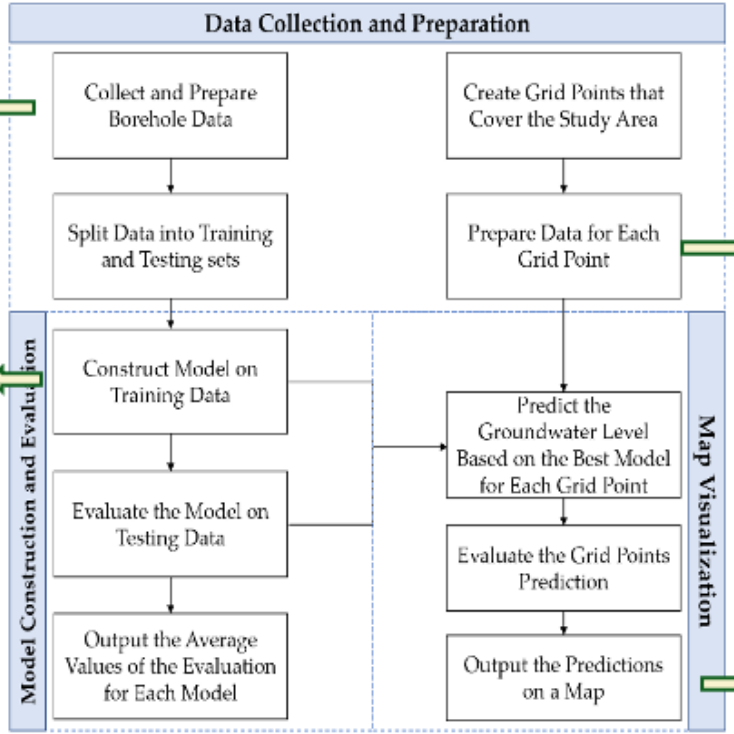
75 borehole points:

20 predictor variables (hydrogeology, climate)
Known static water level

Machine Learning:

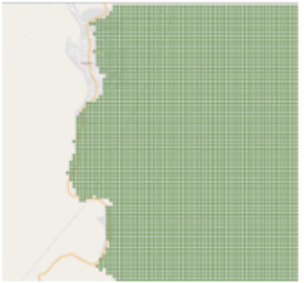
1.Multiple Linear Regression (MLR)
2. Multivariate Adaptive Regression Spline (MARS)
3. Artificial Neural networks (ANN)
4. Random Forest Regression(RFR)
5. Gradient Boosting Regression (GBR)



400k grid points:

20 predictor variables (hydrogeology, climate)
Unknown static water level **to be predicted**

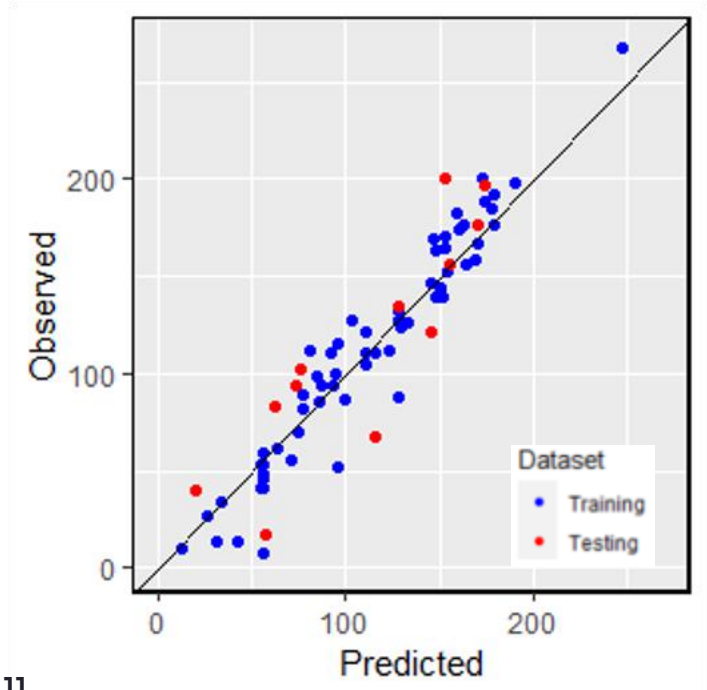
Each grid has a resolution
100m * 100m



Output:

High-resolution predicted groundwater level map

WellMapr™ Evaluation



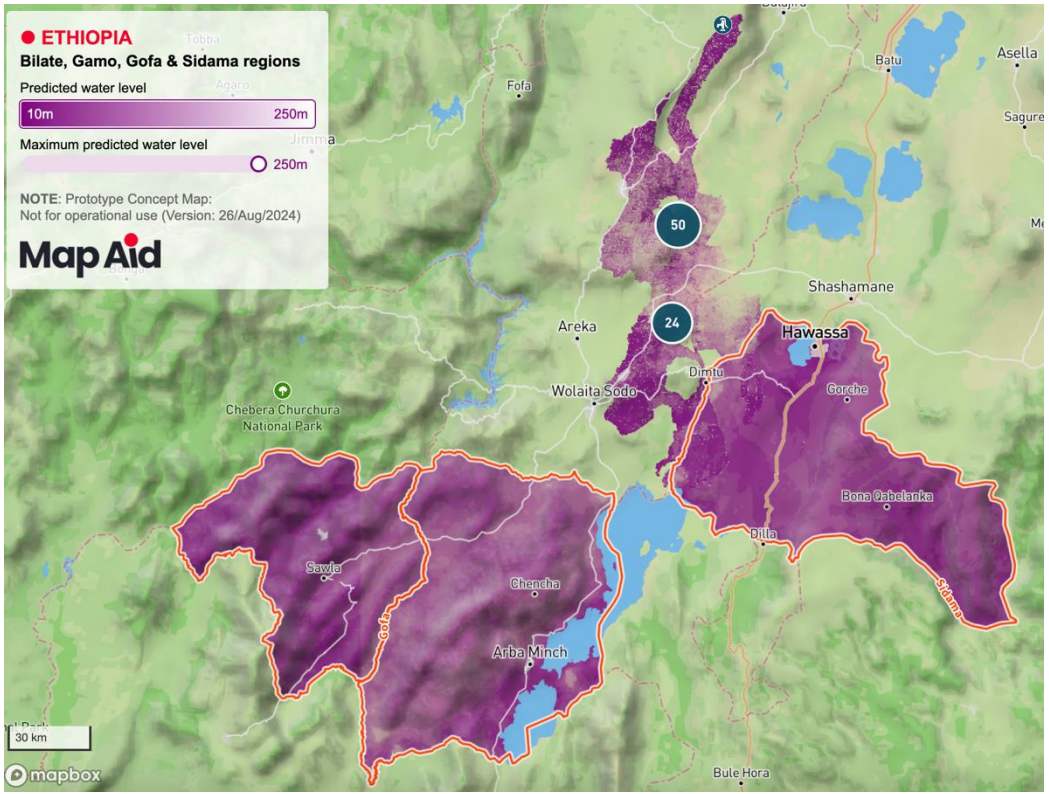
Graph shows observed and predicted depths

- If predictions were perfect, all the points would lie on the black diagonal line
- If the algorithm had no ability to predict, the dots would be scattered all about with no pattern
- Relationship is good but not perfect

Median prediction error on testing data is about 19 m

We are working to improve our predictions

Ethiopia 1.AI system build



The purple areas are Gamo, Gofa, and Sidema Zones, in southern Ethiopia.

This is a non-operational example of our prototype mapping, to guide well drilling and digging.

With field development we can make this more accurate !

Online here.

Our goal – Small farm soil moisture conservation

Conservation Agriculture is founded on three key principles:

1. Disturb the soil as little as possible (i.e. no ploughing, digging and hoeing)
2. Keep the soil covered as much as possible (i.e. cover crops and mulches - no burning and no grazing of felds)
3. Mix and rotate crops (i.e. leguminous cover crops)

A shallow well (at 30 meters) costs USD$ 2,000.
A deep well (150 meters) costs USD$ 100,000.

Accurate low-cost groundwater mapping, will improve successful and sustainable drilling that saves money on dud drills.
Money saved could be spent on farmer training in Conservation Agriculture, anywhere

Our goal – Small farmer irrigation

Abu Resu is a small farmer, on c.0.7Ha.

She works the land with her husband. **She has a shallow well.** Therefore, she **'wins'** some cash crops. **They can indeed support 4 children.**

She lives near Arba Minch, in a highland area.

In Ethiopia, c.70 million people out of 120 million total population, are small farmers.

Ethiopia 2.Prototype Project

Some small farmers and development workers

Why ? Development workers, and small famers, and donors **can use groundwater maps to plan suitable locations** to put shallow wells, that **help build in peace.** Since January 2020, MapAid has been working with partners to develop our prototype AI system for groundwater mapping: WellMapr©.

Next, a 2.5 year multi-disciplinary development project starts in Gamo, Gofa and Sidema Zones, to put our prototype AI system "WellMapr©" into local hands . **Arba Minch University Water Technology Institute** and the **Czech Geological Survey** and **George Mason University C-RASC** are our esteemed partners.

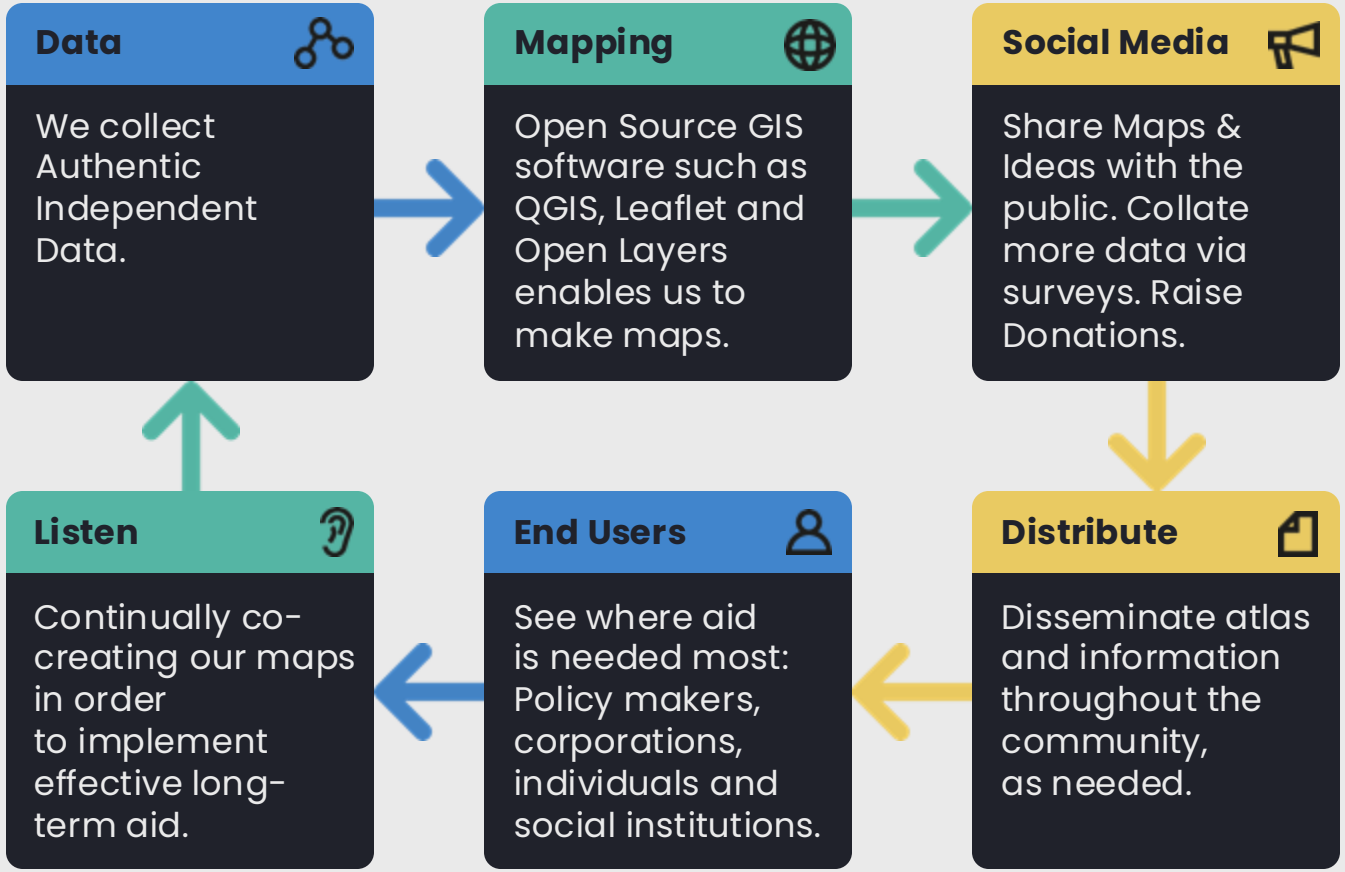
Our goal – Small farmers irrigation

Here the MapAid team is taking a look at Abu Resus' simple hand pump, for shallow water.

Locally made, easy & cheap to maintain, it supplies her domestic and farm water. Instead of walking an hour each day to get water, she has more time to focus on her family. It's also hard to over-use the aquifer, as hand pumping is worthwhile, but hard work !

This pump was originally installed by a partner NGO, Vita Ireland.

Our process



Key:

- **Create**
- **Capture**
- **Share**

Our volunteers







MapAid brings together volunteers from across the globe, offering diverse specialisms, including:

GIS Mapping Systems
Automated Data Collection
Data Analysis
Artificial Intelligence
Employment
Irrigation
Conservation
Fundraising / Marketing





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Our associates

MapAid

Non-Government Organisations

christian aid
MERCY CORPS
Vita
Fighting hunger and climate change in Africa
World Vision
poda PAKISTAN
CED CHRISTIAN ENGINEERS IN DEVELOPMENT
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CSR Donors

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KLL Kathmandu Living Labs
TransGlobal
NORTH SOUTH CONSULTING
MDC

Country Associates

VISTA Volunteers in Service to America
NSET Earthquake Safe Communities in Nepal

International Government Organisations

IFRC
THE WORLD BANK
OSCE
UNIFOR
UNHCR The UN Refugee Agency
UK

Government Agencies

ESSTI
American Red Cross
UK SPACE AGENCY
Department for International Development

Universities

GEORGE MASON UNIVERSITY
Stanford University

Our partners

Map Aid

Digital sovereigns – Local leaders

Rotary in Ethiopia

Honourable technologists

Rotary Addis Ababa West

THE MAGIC OF ROTARY

Map Aid

GEORGE MASON UNIVERSITY

Center for Resilient and Sustainable Communities

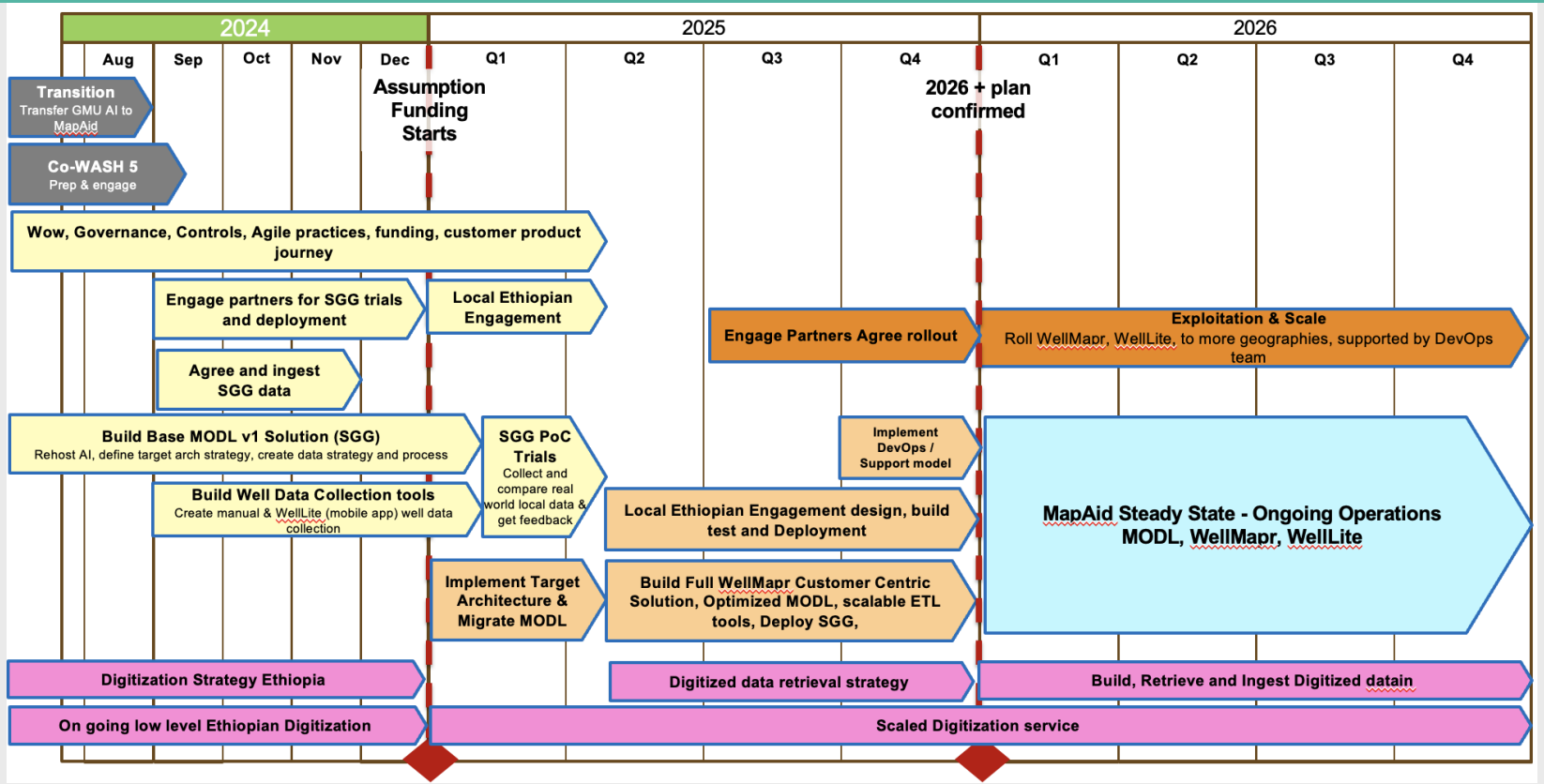
Since 2016

Arba Minch University

Ministry of Water & Electricity

1919 CZECH GEOLOGICAL SURVEY

Our plan – MODL/WellMapr/WellLite –L1 2.5 yr



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Three key takeaways:

- Shallow irrigation doubles yields, while sufficient food reduces fear and builds peace.
- Maps scientifically made, help show where investment in well digging are going to have the most impact, avoiding wastage and helping small farmers.
- Investment in WASH and UNSDG6 underpins nine (9) other UNSDGs.

Thank you: World Summit AI

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Mapping Ethiopian groundwater to put bread on the table for small farmers.

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Rupert Douglas-Bate, AI coach, Founder MapAid