Česká rozvojová agentura

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Č.j.: 281094/2024-CRA

Dodatek č. 1 Zápisu

k projektu ET-2023-006-RO-43040 s názvem „Zlepšení kvality života zajištěním dostupnosti a udržitelným nakládáním s vodními zdroji v regionu Sidama a zónách Gamo a Gofa, Etiopie“

Objednatel:	**Česká republika – Česká rozvojová agentura**
Zastoupená:	Ing. Michalem Minčevem MBA, ředitelem
Sídlem:	Nerudova 3, 118 50 Praha 1
Kontaktní osoba:	Mgr. Martin Šefr
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IČO:	75123924
Bankovní spojení:	
Číslo účtu:	

(dále jen „ČRA“)

a

Realizátor:	**Česká geologická služba**
Zastoupená:	Mgr. Zdeňkem Venerou, Ph.D.
Sídlem:	Klárov 3, 118 21 Praha 1
Kontaktní osoba:	RNDr. Kryštof Verner, Ph.D.
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Bankovní spojení:	
Číslo účtu:	

(dále jen „Realizátor“)

Článek 1

Předmět dodatku

I.1. Předmětem tohoto Dodatku č. 1 je úprava zápisu k projektu s názvem **„Zlepšení kvality života zajištěním dostupnosti a udržitelným nakládáním s vodními zdroji v regionu Sidama a zónách Gamo a Gofa, Etiopie“**, uzavřeného dne 7. 3. 2023 (dále jen „Zápis“).

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Z důvodu částečně bezplatného poskytnutí ubytování účastníkům zahajovacího workshopu v Praze nebyla v roce 2023 dočerpána částka ve výši 20 638 Kč. Tato částka bude převedena zpět na účet Realizátora z účtu jeho zřizující instituce a následně využita na realizaci obdobné aktivity v rámci řešení Projektu v roce 2024.

Na základě vzájemné dohody ČRA a realizátora (viz dopis ze dne 2.4.2024), bude původně alokovaná částka na řešení projektu v roce 2024 ponížena o částku 1 000 000 Kč, přičemž dojde k navrácení této částky do rozpočtu realizátora v roce 2025. S ohledem na tuto skutečnost bude ekvivalentním způsobem ponížen rozsah prací v místě realizace v roce 2024 (aktivita 1.2 a 1.4) a to ve prospěch první poloviny roku 2025, kdy tyto práce budou doplněny.

Projektový dokument byl rozšířen o aktivitu *1.5 „Detailed groundwater and soil environment investigation in the Zala Woreda, Gofa Zone, SNNPR"*. Na řešení této aktivity byly vyčleněny finanční prostředky ve výši 900.000 Kč, jejichž vyplacení se předpokládá v roce 2026.

I.2. Smluvní strany se dohodly na následujícím doplnění odst. 2.1 Zápisu, přičemž znění tohoto odstavce se doplňuje následovně:

Částka, kterou ČRA zaplatí Realizátorovi za jeho plnění dle tohoto zápisu v roce 2024, činí ***12 129 500,- Kč (slovy: dvanáct milionů sto dvacet devět tisíc pět set korun českých)*** *včetně DPH. Celková částka, kterou Realizátor využije na realizaci Projektu v roce 2024, včetně nedočerpaných prostředků na realizaci Projektu v roce 2023 ve výši 20 638,- Kč, činí* ***12 150 138,- Kč*** *(slovy: dvanáct milionů sto padesát tisíc sto třicet osm korun českých). Tento finanční limit je akceptován oběma stranami jako nepřekročitelný.*

I.3. Smluvní strany se zároveň dohodly na úpravě znění těchto původních příloh Zápisu:

Příloha č. 1: Projektový dokument

Příloha č. 2: Matice logického rámce

Příloha č. 3: Strukturovaný Rozpočet

Příloha č. 4: Časový harmonogram

Příloha č. 5: Plán aktivit pro příslušný rok realizace

Veškeré úpravy příloh jsou prováděny na základě vypořádání a schválení roční zprávy za rok 2023.

I.4. Ostatní články a body Zápisu zůstávají beze změny. Celková cena Projektu se nemění.

I.5. Tento Dodatek č. 1 je vyhotoven ve čtyřech stejnopisech s platností originálu, z nichž každá strana obdrží dva.

I.6. Tento Dodatek č. 1 nabývá platnosti a účinnosti dnem podpisu oprávněnými zástupci smluvních stran.

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I.7. Součástí tohoto Dodatku jsou tyto přílohy:

Příloha č. 1: Projektový dokument
Příloha č. 2: Strukturovaný rozpočet
Příloha č. 3: Časový harmonogram
Příloha č. 4: Matice logického rámce
Příloha č. 5: Plán aktivit pro příslušný rok realizace

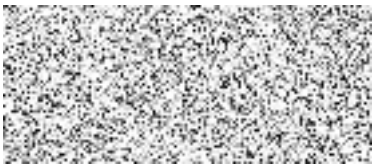
V Praze dne: 

……

za objednatele:

Ing. Michal Minčev MBA

ředitel České rozvojové agentury

V Praze dne: 

.....

za realizátora:

Mgr. Zdeněk Venera, Ph.D.

ředitel České geologické služby

CZECH REPUBLIC

CZECH DEVELOPMENT AGENCY

CZECH GEOLOGICAL SURVEY

INTERNATIONAL DEVELOPMENT COOPERATION PROJECT

BETWEEN

THE CZECH REPUBLIC

AND

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Improving the quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofa zones (Ethiopia)

07/2023 – 12/2026

Compiled by:

Assoc. Prof. Dr. Kryštof Verner, Ph.D
Mgr. Karel Martínek, Ph.D
Leta Megerssa, MSc., Ph.D
Dr. Jiří Šíma

with a great contribution of partner institutions

CZECH REPUBLIC
DEVELOPMENT COOPERATION

Title: Improving the quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofazones (Ethiopia)	**Project No.:**
Partner Country: The Federal Democratic Republic of Ethiopia(FDRE)	**Location of Project Implementation:** Sidama Region, Gamo and Gofa zones of the South Nations, Nationalities, and People's Region with the possibility of practical use of the methodical approach in the entire territory of Ethiopia
Sector Project Orientation: Agriculture and Rural Development	
Date of project commencement: July 2023	**Estimated date of project completion:** December 2026
Total funding related to the Project from The Czech Republic's Development Cooperation (in USD and CZK): **1 751 945,43 USD / 39 173 500 CZK** (exchange rate 22,36 CZK/USD)	**Total funding related to the Project including co-financing (in USD):** **2 062 365,83 USD / 46 114 500 Kč** (exchange rate 22,36CZK/USD) **Institutional in-kind contribution (15%)** **310 420 USD / 6 941 000 Kč** (exchange rate 22,36CZK/USD)

Responsible Project Implementer:

Czech Geological Survey
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Responsible Implementer: Assoc. Prof. Dr. Kryštof Verner, Ph.D. / Leta Megerssa, Ph.D
Tel.: ;
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Partner Institutions in the Country of Project Implementation:

Ministry of Water and Energy
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Contact: Muhuddin Abdela
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Water Resources Research Centre, Arba Minch University, Arba Minch, Ethiopia.
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Project proposal

Improving the quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamoand Gofa zones (Ethiopia)

List of Abbreviations:

AFS - All for Soil
AfDB – African Development Bank
AI - Artifical intelligence system
AMU - Arba Minch University
AMU WTI - Arba Minch University Water Technology Institute
CzDA - Czech Development Agency
CDF – Community Development FundCGS – Czech Geological Survey
C-RASC - Center for Resilient and Sustainable Communities
DAG – Development Assistance Group Ethiopia
EATA - Ethiopian Agricultural Transformation Agency
ECRE – Embassy of the Czech Republic in Ethiopia
EGRAP – Ethiopian Groundwater Resources Assessment Program
FDRE – Federal Democratic Republic of Ethiopia
EEPA - Ethiopian Environmental Protection Agency
ERA – Ethiopian Roads Authority
GMA - Global MapAid
GMU - George Mason University
GTP – Growth and Transformation Plan
HDI – Human Development Index
IDA – International Development Association
IDP - Integrated Development Plan
JICA – Japan International Cooperation Agency
MDGs – Millennium Goals
MODL - Modelling Optimal Drilling Locations
NIWRMP - National Integrated Water Resources Management Program
ODA – Official Development Assistance
One WASH – Water, Sanitation and Hygiene National Program
PASDEP – A Plan for Accelerated and Sustained Development to End Poverty
PIN - People in Need
RWMEB – Regional Water, Mines and Energy Bureau
SDGs – Sustainable Development Goals
SNNPR – Southern Nation, Nationalities and People Region
UNDP – United Nation Development Program
UNICEF – United Nations Children's Fund
VI - Vita Ireland in Ethiopia
CZDA – Czech Development Assistance
ZWMED – Zone Water, Mines and Energy Department

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1. PROJECT SUMMARY

In Ethiopia, the vast natural resources are underutilized and poorly allocated to the appropriate development sectors. Moreover, with the emergence of rapid population expansion, the problem becomes ever more pressing following the sharpincrease in public demand for means of production, not to mention the adverse increase in vulnerable areas to natural disasters, further aggravating the livelihoods of the population.

To help solve such problems, the first step is to bring multidisciplinary scientific knowledge and data into a viable working model that can alter the vicious cycle of poverty due to poor productivity. Natural resources are generally non-renewable and finite, requiring complex optimization and quantification for adequate utilization. One of the root causes of poverty in agrarian economic countries such as Ethiopia is dependence on traditional farming of centuries-old principles that do not match the exponential growth of demand along with technology and population growth. At the root of this backward farming system is dependence on rain-feed agriculture, which is unpredictable and unstable, and increasingly so given the effects of climate change. Finding optimal ways to utilize an alternative source of dependable water resources will go a long way toward solving this generational problem of subsistence farming practices. Small-scale farming families make up 72% of the total population and 74% of Ethiopia's farmers, but 67% of them live below the national poverty line.[1]

This project proposes aspects of bringing pertinent data and developing a versatile tool for visualization, planning, and assessment groundwater resources for decision-makers and development workers. This would be especially useful for workers developing shallow irrigation which has the potential to double crop yields and improve the year-on-year consistency of yields for small-scale farmers.

While this project builds on the previous projects involving the compilation of various geoscientific maps for large areas in southern Ethiopia, the aim is to evaluate optimal shallow aquifers (water-bearing horizons) for use as shallow groundwater reserves for irrigation and drinking. The project, hence, aims to use the existing hydrogeological and hydrochemical maps at various scales and generate quantitative models of groundwater availability in a selected watershed system. The project will be implemented through the long-standing cooperation of the promoting institutes, the Czech Geological Survey (CGS), Charles University and SG Geotechnika a.s., together with partner institutes from abroad, including the Center for Resilient and Sustainable Communities (CRSC) of George Mason University, Fairfax, VA, USA and Global MapAid, Buckinghamshire, United Kingdom. Local institutes from Ethiopia include the Arba Minch University, Water Technology Institute and the Ministry of Water and Energy of Ethiopia. Regional authorities will also be part of the important partners in the project, including the Southern Nations Nationalities and Peoples Region (SNNPR) and the Sidama Regions Water, Mines, and Energy Development Bureaus all located in Hawassa.

[1] FAO (2018) Small Family Farms Country Factsheet https://www.fao.org/3/i8911en/I8911EN.pdf

The overall cost of the project is estimated to 46 114 500 Kč (2 062 365,83 USD; exchange rate 22,36 Kč/USD, where 85% is to be covered through a grant from the Czech Development Agency (CzDA) means 39 173 500 Kč (1 751 945,43 USD; exchange rate 22,36 Kč/USD) while the remaining 15% (means 6 941 000 Kč / 310 420 USD) will be covered by the government of Ethiopia (7%) and by responsible project implementer Czech Geological Survey (8%) in the form of in-kind contributions through the local partner institutes, such as the provision of available data, arrangement of logistics and office space, partial provision of of available field vehicles, salary of participating counter-part experts as well as local administrative supports.

2. DESCRIPTION OF THE INITIAL STATUS

Economic and social situation in the country and development strategy

Ethiopia is the second most populous country in Sub-Saharan Africa. It currently has over 100 million people, of which only 17.8% live in cities while others live in rural areas[2]. With an annual increase of 2.6% of the population, Ethiopia is expected to reach 130 million in 2025 and be among the ten most populous countries by 2050[3]. The country is characterized by great variability in both topography and the prevailing climatic conditions. Most of the population (85%) lives in temperate zones within mountainous areas, while the population density of tropical and arid regions is significantly lower[4]. The territory of Ethiopia, covering an area of 1.13 million km^2, is divided into two self-governing urban areas and 11 Regional states, which are further divided into Zones and 'Woredas' which refer to districts. There are more than eight thousand 'Woredas' and these are further divided into 18 thousand Kebeles, which form the basic administrative units of the country. Ethiopia is one of the countries that have made the most progress in meeting the Millennium Development Goals (MDGs). The country has successfully achieved 6 outof 8 goals. Ethiopia did not meet the third and fifth objectives of promoting gender equality and women's empowerment and improving maternal health by the end of 2015, but it was close to meeting them[5]. Yet, according to the Human Development Index (HDI), Ethiopia ranked 184th out of 188 countries in 2014, and its current gross national income per capita (purchasing power parity of US $ 1,428 for 2014) makes Ethiopia one of the world's poorest countries[6]. In addition to poverty, Ethiopia's population is facing inadequate infrastructure, high illiteracy over of 50% (of which 58.9% for women and 42.8% for men in 2015)[7] and, above all, very poor access to drinking water (in 2014-2015, 58% of Ethiopian residents had access to safe water resources)[8].

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[2] UNDP, 2015: Human Development Report.
http://hdr.undp.org/sites/default/files/2015_human_development_report_1.pdf [ref 2016-03-31] [3]
The World Bank (2014): Project Apraisal Document. Dostupné z: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/03/06/000333037_20140306113645/Rendered/PDF/PAD6390P133591010Box382156B00OUO090.pdf [ref. 2016-03-30]

[4] The World Bank (2013): Ethiopia. http://data.worldbank.org/country/ethiopia [ref. 2016-03-]

[5] UNDP (2015): MDG Progress – Africa. http://www.undp.org/content/undp/en/home/librarypage/mdg/mdg-reports/africa-collection.html [ref. 2016-03]

[6] UNDP, 2015: Human Development Report.
http://hdr.undp.org/sites/default/files/2015_human_development_report_1.pdf [ref. 2016-03-31]

[7] UNESCO (2014): Integrated Functional Adult Education: http://www.unesco.org/uil/litbase/?menu=4&programme=195 [ref. 2016-03-30]

Despite these indicators, Ethiopia occupies an important geopolitical and economic position in the Horn of Africa and this economic strength has resulted in Ethiopia becoming a regional center. The Ethiopian economy is one of the fastest growing in the world. GDP last declined in 2009, and since then its economy has grown by 10.8% each year[9]. Ethiopia is doing extremely well compared to other countries in the region, which are averaging 5% growth[10]. Ethiopia's economic growth has also had a direct impact on population poverty. While 38.7% of Ethiopians lived in extreme poverty in 2004-2005, in 2012-2013, it was almost 13% less (26%)[11]. Significant strengthening of the country's economy was achieved mainly thanks to ongoing reforms and investments in sectors such as agriculture, education, health and infrastructure. Despite an increasing share of services and industry, agriculture is the largest contributor to economic growth (42% of total GDP in 2014)[12], which is also an important sector for local manufacturing and export. Although the bulk of agricultural production is of a subsistence nature[13], agriculture can play another vital role in reducing the country's poverty, as in Ethiopia almost 80% of the population[14] works in this sector accounting for 95% of the GDP[15]. However, local farmers face market instability, soil degradation, adverse natural disasters, and depend on unpredictable and limiting rainfall for agriculture and domestic use; this unpredictability is aggravated by climate change. In order to improve the population's standard of living, the Ethiopian Government has adopted several strategic documents. The Ethiopian Government defined its current development priorities, namely economic development and poverty reduction, in the Growth and Transformation Plan (GTP II) the strategic document valid for 2015/16-2019/20. GTP II builds on the previous 2010/11-2014/15 Growth and Transformation Plan and other development documents such as the Plan for Accelerated and Sustained Development to End poverty, hereinafter referred to as PASDEP I). Through this strategy paper, the Government aims to achieve average annual GDP growth of 11%, a stable macroeconomic environment, rapid industrialization of the country, and its structural transformation. Increasing the quality and efficiency of productivity and building critical infrastructure should contribute to strengthening competitiveness. Building out telecommunications, water, and infrastructure networks will also assist the nation draw new investors. Ethiopia also wants to actively address the increasing urbanization, human development and dissemination of democratic values, as well as the creation and strengthening of organic farming.

[8] The Federal Democratic Republic of Ethiopia (2015): The Second Growth and Transformation Plan (GTP II).:https://www.africaintelligence.com/c/dc/LOI/1415/GTP-II.pdf [ref. 2016-03-30]

[9] The World Bank (2014): GDP per capita.://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries/ET?display=graph [ref. 2016-03-30]

[10] The World Bank (2015): Ethiopia: Overview.://www.worldbank.org/en/country/ethiopia/overview [ref. 2016-03-30]

[11] UNDP (2015): National Human Development Network Ethiopia 2014. http://hdr.undp.org/sites/default/files/nhdr2015-ethiopia-en.pdf

[12] The World Bank (2014): Agriculture, value added. http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS [ref. 2016-03-30]

[13] EU, 2013: EUROPEAN UNION, JOINT COOPERATION STRATEGY FOR ETHIOPIA: http://www.entwicklung.at/uploads/media/ EU_Joint_Cooperation_Strategy_01.pdf [cit. 2016-03-31]

[14] UNDP, 2015: Human Development Report.: http://hdr.undp.org/sites/default/files/2015_human_development_report_1.pdf [ref 2016-03-31]

[15] The World Bank, 2011: Additional Financing for the Ethiopia – Agricultural Growth Program.: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/10/24/000104615_20111025112543/Rendered/PDF/AGP0GAFSP0AF0PID0Sep02011.pdf [ref. 2016-03-31]

Farmers depend mostly on unreliable rain for agriculture in Ethiopia, and small farmers especially lack knowledge of developing and utilizing more reliable groundwater for irrigation. Well irrigation for crop production is practically never used by smallholder farmers. So far, there has been very little attempt at these irrigation practices. As a result, crop productivity has not increased as needed, and the food deficit is severe. Increasing productivity through irrigated agriculture is one of the best alternatives still available. In parallel, Ethiopia faces a large population explosion, decreased productivity, and land exhaustion from decades of production, sustainable agriculture that cares for the land has to be encouraged and developed, and it must optimize water use, which means it is underpinned by a solid understanding of underground water resources that development workers will find easy to use. Groundwater potential investigation is an indispensable approach to ensure the sustainable use of groundwater in the nation for various demands, including domestic, agricultural and industrial purposes. However, there is very limited and varying information available regarding the groundwater resources of the nation. This is mainly attributed to less understanding of the geologic set-up of the nation coupled with scanty hydro-geological data. Currently, the whole territory of Ethiopia is covered by separate geological and hydrogeological maps, although with less consistent and harmonious discrimination of groundwater resources available for usage. This gap in heterogeneous information on groundwater resources has been the focus of a recently started project being implemented that harmonizes basic geological mapping and hydrogeological mapping, which is a process crucial for such replicable discrimination of areas with potential as groundwater resources.

2.1 Context and topic origin, problem analysis

Ethiopia has a wealth of water resources, both surface water, and groundwater. Groundwater is mainly used for domestic and industrial purposes. The latest estimate of groundwater resources ranges between 12 and 47.9 km^3/year, where the higher number is based on remote sensing data. A preliminary estimate of renewable groundwater reserves was around 2,600 million m^3 per year, but recent studies show much greater potential[16]. Groundwater is usually of high quality due to its natural filtration, it is clean, free of staining and microbial contamination, and does not require further treatment. In addition, due to prolonged contact with rock sediments, it is rich in dissolved minerals, the volume of which depends on various factors (e.g. the mineral composition of a particular aquifer or the duration of water retention in a given aquifer). The problem may be a high salinity and high concentration of fluoride, whose concentration, especially in the Somali region and in the East African Rift Valley, exceeds the drinking water limit set by the World Health Organization, as well as by Ethiopian standards.

[16] Ministry of Water, Irrigation and Energy.: http://www.mowr.gov.et/index.php?pagenum=2.2 [ref. 2016-06-30]

The water supply limits set by the Ethiopian Government under the One WASH Program (Water, Sanitation and Hygiene National Program) are at least 20 l/person/day for urban and 15 l/person/day for the rural population. However, these limits are due to a significant rise in population as well as industrial and agricultural demands; nonetheless, the gap between demand and capacity is not filled by the limited financial resources available. In Ethiopia, less than 60% of the population has access to safe drinking water[17]. To meet the needs of all the population of the country by 2030 and to strengthen the social and economic development of all its regions, it is necessary to provide sufficient surface and groundwater resources. Surface water is not suitable for drinking without proper treatment and poses a health risk for the whole population, especially infants, since more than 80% of infectious diseases originate in contaminated water. In particular, the rural population obtains water from a variety of sources, such as shallow springs, watercourses, small rainwater storage reservoirs, and unprotected hand-dug wells, and it is, therefore, desirable to further strengthen the infrastructure to supply residents with safe groundwater from greater depths. Polluted surface water should gradually be reserved only for commercial purposes, irrigation and possibly for domestic animals, but preferably after analysis.

Groundwater resources in Ethiopia are under increasing pressure from the continuous growth in demand for sufficient quantities of good quality water for all purposes. Therefore, there is an actual need for action to protect groundwater resources from qualitative as well as quantitative points of view. Groundwater resources are, in principle, renewable natural resources; in particular, ensuring a good state of groundwater requires early action and stable, long-term planning of protective measures, owing to the natural time lag in its formation and renewal. Such a time lag for improvement should be considered in timetables when establishing measures aimed at achieving a good quantitative and qualitative state of groundwater and reversing any significant and sustained upward trend in the concentration of any pollutant in groundwater or a downward trend in groundwater levels.

A delineation of hydrogeological zones is needed in order to coordinate efforts to improve the protection of groundwater environment in terms of quantity and quality, promote sustainable water use, contribute to the control of transboundary water problems, protect aquatic and terrestrial ecosystems and wetlands directly dependent upon them, and to safeguard and develop the potential uses of community waters. Good water quality will contribute to securing the drinking water supply for the population.

[17] The official United Nations site for Millennium Development Goals indicators.: http://mdgs.un.org/unsd/mdg/Data.aspx [ref. 2016-07-21]

The Geological Survey of Ethiopia compiled a hydrogeological map of Ethiopia at a scale of 1:2,000,000, which was compiled in the late 1980s by Tesfaye Chernet and later on published with an explanatory report (Chernet, 1988). Regional hydrogeological investigation of Northern Ethiopia at a scale of 1:1,000,000 was also part of the various endeavors (Asfaw 2003). However, the existing Ethiopian Water Resources Master Plan is about 20 years old and there is no integrated information about existing groundwater resources for the entire Ethiopian territory that collates new data and information for the purpose of planning, developing, and protecting existing groundwater resources.

The National Integrated Water Resources Management Program (NIWRMP) was compiled in August 2018[18]. Basin plans are also relatively old, and there is a lot of new data and information from regional geological and hydrogeological mapping and drilling of various exploratory wells:

- ✓ DHV: Tekeze River Basin Integrated Development Master Plan Project, Interim Report (Nedeco 1997).
- ✓ BCEOM French Engineering Consultants in association with BRGM and ISL: Abbay River Basin Integrated Development Master Plan Project (Ministry of Water Resources 1998).
- ✓ Halcrow Group Limited and Generation Integrated Rural Development (GIRD) Consultants: Rift Valley Lakes Basin Integrated Resources Development Master Plan Study Project (Halcrow 2010).
- ✓ JICA: The Study on Groundwater Resources Assessment in the Rift Valley Lakes Basin (JICA 2012).
- ✓ WWDSE in association with MCE and WAPCOS: Wabi Shebelle River Basin Integrated Development Master Plan Study Project (Ministry of Water Resources 2003).
- ✓ Lahmeyer International GmbH: Genale-Dawa River Basin Integrated Resources Development Master Plan Study (Lahmeyer International and Yeshi-Ber Consult 2007).
- ✓ Richard Woodroofe and Associates: Omo-Gibe River Basin Master Plan Study (Woodroofe 1996)
- ✓ Soyuz Giprovodkhoz Institute, USSR, Moscow: Baro-Akobo master plan of study of water and land resources of the Gambela Plain (EVDSA 1990).
- ✓ TAMS-ULG: Report of the Baro-Akobo River Basin Integrated Development Master Plan Study (TAMS-ULG 1996).
- ✓ Halcrow, Sir William and Partners Ltd.: Master Plan for the Development of Surface Water Resources in the Awash Basin (Halcrow 1989).

[18] FDRE, 2018. National Integrated Water Resources Management Program

Despite all the efforts, a significant gap remains between the demand and current availability of clean and sufficient water supply, generating an acute and urgent need for intervention to alleviate the prevailing adverse conditions. In addition, the aspect that has not yet gained much attention is related to ensuring a sustainable water source for the economic welfare, mainly for the agriculture-based economy in rural Ethiopia, where over 85 % of the population resides. Small plots of land are often over-utilized under very risky conditions. A rapidly growing population is in acute need of accelerated improvement in agricultural productivity, which is highly dependent on efficient and economical utilization of water, which in turn is currently not receiving the attention it needs.

One of the main negative factors affecting agricultural production is the increasingly diminishing soil fertility and unpredictable seasonal weather conditions, partly in close connection with ongoing climatic changes. With the increasing changes in the global climatic conditions resulting in extreme flooding and prolonged dry spells, rain-fed agriculture involving the cultivation of crops as well as animal husbandry has become ever more challenging. The climatic variability, the recurrent drought and malnutrition affect the vast majority of the population. Since there is a chance for change in this situation, it is essential to consider how to best use smart, sustainable, and efficient groundwater resources. This can help overcome the challenge of rain-dependent farming by shifting it to irrigated systems using the reserve of untapped subsurface water resources.

Groundwater resource is the main source of water supply in many towns and villages in Ethiopia in general and in the proposed study regions in particular. However, there is a huge lack of data and information regarding the groundwater reserves in the study areas, which is attributed to limited subsurface data acquisition, storage, and availability. Studies concerned with the groundwater reserve in many parts of Ethiopia are scant, and thus there are very few research studies recommending proper utilization and management for the decision-makers. Groundwater use for irrigation purposes is also minimal. Therefore, there is a need for a better understanding of the available groundwater reserves in the study regions for sustainable use and management of the resources.

2.2 Project broader context

As Ethiopia executes GTP II and moves into GTP III, integrating a market-driven and integrated approach, which considers lessons learned from past national and international experiences, it is critical to ensure that all sectors can drive commercialization and growth. Improved and climate-resilient packages in natural resources management have not been fully developed and implemented. Climate- resilient and gender-sensitive technologies are not fully demonstrated and established either. Further, businesses related to natural resource development and the promotion of business groups, in various sectors, are not fully developed. There is no Integrated Development Plan (IDP) yet, including capacity improvement programs in the country including the Sidama Region and the Gamo and Gofa zones in SNNP Region. The Sidama Region was established in 2020 and is the eleventh region of Ethiopia. IDP makes it possible to implement the most important intervention by CzDA, which is the export of, particularly, agricultural products. This also set the platform for cooperation of interventions between the Czech Governmental and Non-governmental organizations as well as profit-making organizations and other international donors and development funds.

Southern Ethiopia (the Sidama and SNNP regions) has been a priority for the Czech development cooperation for the past 25 years, where impressive data on the geological, hydrogeological, and agrophysical aspects of the region have been gathered and can be

combined with other available data to create the Integrated Development Plan. Available infrastructure and facilities (programs) that have the potential to be integrated into the plan to improve their function and effectiveness are: (a) Hawassa industrial zone – agricultural equipment and geochemistry (potential for investment – export); (b) Agricultural clusters program (Agricultural Transformation Agency) - Sidama horticulture cluster in Dale and Shabedino woredas; and (c) Existence of Agro-industrial park in Yirga Alem - food processing and storage facilities (potential for investment – export).

The geological environment pertaining to this part of Ethiopia (Sidama Region and Gamo and Gofa zones of SNNP Region) ranges from mostly volcanic and volcaniclastic rocks to partly crystalline metamorphic hard rocks. The project intervention areas particularly the Sidama Region and most of the Gamo and Gofa Zones are accordingly endowed with great potential for agricultural development and increased living standards (new and diverse agricultural products – fruits, wine, flowers, etc.). Measures implemented by CzDA are decreasing destructive erosion and water shortage. These include newly proposed plans for afforestation and the development of integrated anti-erosional measures, including a map of natural hazards concentration and plans for retention of water in the landscape (e.g., the current governmental interest in the construction of micro dams). Further, shallow groundwater for household irrigation has been mapped in cooperation with the Agricultural Transformation Agency in recent years ("drilling of several boreholes to use shallow groundwater for irrigation – less affected by dry periods including drilling of irrigation wells operated using solar energy and drip irrigation systems"). Information systems in water management ("information systems about natural resources of the region – systems established for agricultural, water and soil/rock systems") were developed by People In Need (PIN).

The overarching reach of the project is complimentary to the "Sustainable Development Goals (SDGs)" defined by United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. In particular the goals defined as SDGs 6 under the titles "Clean water and sanitation" (chapters 6.1, 6.4, 6.6), SDGs 9 under the title "Industry, innovation and infrastructure" (chapters 9.1, 9.2), and SDGs 15 under the title "Life on land" (chapters 15.1, 15.2, 15.3) will be addressed.

2.3 Complementarity with the activities of other donors

Government policy and donor activities in the sector

A large number of bilateral and multilateral donors are involved in Ethiopia. Ethiopia is one of the largest beneficiaries of development aid in Africa, but at the same time, it is still much lower than the average for sub-Saharan Africa[19]. The largest bilateral donors in the area of development policy are the United States of America, the United Kingdom, the European Union as a whole, Japan, and Canada[20], and among the multilateral donors in particular, the International Development Association (IDA) and the African Development Bank (AfDB)[17].

In general, there has been a recent trendtowards a gradual increase in the effectiveness of development cooperation in Ethiopia, in which donors are leaving too busy sectors and reducing the number of sectors in which are engaged. At the same time, there is a reduction in the number of individual development projects and their congregation into larger units/programs.

In line with the Paris Declaration on Aid Effectiveness, the Czech Republic coordinates its activities with other donors. Within the framework of donor cooperation, the Development Assistance Group Ethiopia (hereinafter referred to asthe DAG) is a coordinating group in Ethiopia. In February 2011, upon request, the Czech Republic received observer status in the DAG working groups on education, water, rural economic development, and food security, whose activities correspond to the sectoral focus of Czech development cooperation in Ethiopia. The Czech Republic will work toward achieving full DAG membership in the upcoming phases of its development partnership with Ethiopia.

Many international organizations working in Ethiopia focus on water resources in their strategies because of its interdependence with other sectors - health, agriculture, education, industry, etc. These organizations are part of a coordinating body, the so-called water, sanitation, and hygiene (WASH) cluster. The head of the cluster is UNICEF, tasked with coordinating all activities in the sector, providing information to implementing agencies, and avoiding duplication of activities. UNICEF is also one of the largest donors in the water and sanitation sector in Ethiopia.

In developing economic infrastructure, the provision of drinking water to urban andrural areas is crucial. The availability of safe water resources is also an important starting point for development in other areas and economic growth. In 2014/15, drinking water was accessible to 58% of the territory (59% in the countryside, 51% in cities)[21]. The Government had planned to achieve an average of 83% coverage (by2019/2020, aiming at 85% in the countryside and 75% in cities)[18]. The Governmentalso wants to reduce the cost of building drinking water supply systems while providing adequate financial and technical support for their further construction. Its goal is primarily to create better conditions for collecting potable groundwater through well drilling and extraction. In addition to improving the availability of drinking water, improving sanitation and monitoring the quality and quantity of water resources are also crucial to the government. Other objectives set in the water and sanitation sector include mitigating the negative consequences of floods and surface water use and increasing the use of groundwater presently provided from aquifers[22]. Aquifers are locations of water accumulation in the rock environment in the interstitial pores or fractures in them and constitute about 90 percent of industrial water supply, highlighting the importance of groundwater versus the usage of surface water resources, such as dams which are less reliable and offer relatively lower storage capacity.

[19] The World Bank (2013): Net ODA receiver per capita.: http://data.worldbank.org/indicator/DT.ODA.ODAT.PC.ZS/countries/1W-ET-ZF?display=graph [ref. 2016-03-31] [20] DAG (2012/13): ODA to Ethiopia.: http://dagethiopia.org/new/oda-to-ethiopia[ref. 2016-03-31]

[21] The Federal Democratic Republic of Ethiopia (2015): The Second Growth and Transformation Plan (GTP II).:https://www.africaintelligence.com/c/dc/LOI/1415/GTP-II.pdf [ref. 2016-03-31]

The Water, Sanitation, and Hygiene National Program (One WASH) is a significant initiative to improve the current situation. Five Ethiopian ministries have agreed to support this program and fully address the needs of individuals, communities, schools, and healthcare facilities by signing a Memorandum of Understanding. These ministries are the Ministry of Water and Energy, Ministry of Health, Ministry of Education, Ministry of Finance and Economic Development and recently the Ministry of Irrigation and Lowlands. An important point about the One WASH program, which is implemented in two phases, 07/2013 - 06/2015 and 07/2015 - 06/2020, is the harmonization of donors and all inputs of financial support. Key donors favored support for the One WASH program, which allows for more flexible and efficient project planning and financial management over other programs that differ in terms of time and geography. The core of the program remains the level of coherence between all stakeholders, i.e., donors, communities, implementers, partners, etc. - One WASH strives to work together to achieve the set goals.

In the context of identifying groundwater resources, mention should be made of the Ethiopian Groundwater Resources Assessment Program (EGRAP) that started in 2000. The aim of this program was to map and explore all groundwater resources throughout Ethiopia and is implemented by the Ministry of Water Resources, closely cooperating with the then Geological Survey of Ethiopia (now renamed as Ethiopian Institute of Geological Survey). EGRAP was designed to address the urgent need to improve knowledge of groundwater resources and to make this information available for the sustainable development and management of groundwater resources.

Governmental strategies and methodologies such as the Climate Resilient Green Economy, Nutrition Sensitive Agriculture, or Community Based Participatory Watershed Development are some of the notable indications with regard to the government's efforts towards natural environmental management in recent years. Parallel to this, the government has prioritized agricultural development strategies that emphasize production intensification to boost plant yields (such as those of maize, teff, wheat, and enset) through the use of mineral fertilizers or extensive tillage. The promotion of such inputs is surely vital, requiring comprehensive and contiguous information for the development sector and farmers. The other strategic focus of the government of Ethiopia is in areas of natural resources and land management, as seen in the Natural Resources Management campaigns on communal spaces. Increased exposure to natural disasters has put increasing stress on the well-being and safety of various communities, which costs the government the loss of a stable and productive workforce and money associated with rehabilitation and property losses. Landslides, frequent flooding, and deforestation are some of the problems at large. An independent entity called the Disaster Risk Management and Food Security. This sector has been established as one of the important sectors under the Ministry of Agriculture to tackle the impact of natural disasters, highlighting the emphasis given to the problem by the government of Ethiopia. The current strategy is focused on a new approach to disaster management shifting the focus from crisis management in the past decades to that of risk management.

[22] S. Kebede, 2013. Groundwater in Ethiopia: Features, numbers and opportunities. Berlin Heidelberg: Springer

Several donors have worked to aid the various strategies of the government in different locations in the country, including the African Development Bank, the European Commission, the Czech Development Agency, the Rift-Valley Fund Organization, andthe Global Environment Fund via the Ethiopian Environmental Protection Agency (EPA).

All uses of natural resources, whether they involve valuable minerals, groundwater, or soil, necessitate prior understanding of the region's geological structure and characteristics. Such information is readily made available for decision-makers and beneficiaries through various maps and the explanatory texts attached to the maps. This main task has been entrusted to the Geological Survey of Ethiopia, which has been operating under different names since 1968, when the last proclamation (Proclamation No. 194/2000) established its current structure.

Fostering sustainable development is crucial for enhancing Ethiopia's infrastructure and accessibility. However, due to geological factors regarding landslides in particular areas of the country, infrastructure development has proven difficult. The Japan International Cooperation Agency (JICA) implemented a capacity development project for countermeasures against landslides in cooperation with the Ethiopian RoadAuthority (ERA) and the former Geological Survey of Ethiopia (GSE) from 2010 to 2012. Due to limited knowledge in managing hazards related to landslides in Ethiopia, the project was established to build capacity in the country. The stakeholders GSE and ERA directly took part in implementing the project.

The government of Ethiopia has recently given more attention to preparing inventoryof natural resources through various stakeholder organizations. For instance, the GSE recently began preparing a geochemical catalogue covering the entire nation that is being implemented following the international standard. Currently, new detail of geological mapping at a scale of 1:100 000 has been started in western and southern Ethiopia to upgrade the geological information system for exploration and infrastructure as well as natural resources utilization. In addition, the Geological Survey has increasing the coverage of the geohazards assessment maps for the nationat scale of 1:250,000 by many folds, which, so far, has reached about 50% in termsof coverage.

In an effort to enhance the skills of young geologists, Ethiopia has been one of the hosting partners to train young professionals from all over Africa through the initiative of the European Commission support to African Geologists implemented byEuroGeoSurvey in the years 2018 to 2019.

Context of cooperation from the Czech development cooperation in Ethiopia

The long-term goals of the Czech development cooperation in Ethiopia are given by the Strategy of International Development Cooperation of the Czech Republic for the period 2018 - 2030[23]. In accordance with this Concept, Ethiopia is a priority partner country of the Czech Republic with a cooperation program. This position is based on the development needs of the partner country and reflects good interrelations and the results of previous development cooperation.

The Program of Bilateral Development Cooperation between the Czech Republic and Ethiopia for the period 2018-2023 (hereinafter referred to as the Program) defines two priority areas in which bilateral development projects will be implemented in the given years. Specifically, this concerns the sustainable management of natural resources, in particular, water, agriculture, and rural development[24].

Most of the Czech development projects in Ethiopia have so far been implemented in the area of SNNPR/Sidama. Given the size of the SNNPR and the funds available, the Czech Republic targets its activities in accordance with the Program primarily, for the Sidama (currently Sidama Region), Gamo and Gofa zones identified together with the Ethiopian authorities. Furthermore, in the current programming period, 2018-2023, the Czech Republic will concentrate a large part of development cooperation in the SNNP region, using the already established contacts with local authorities and the relatively good knowledge of local conditions (in comparison with other regions). However, parts of the interventions can also be implemented in other regions of the country as well as at the federal level.

Better access to quality water resources and sanitation are not only among the main objectives set by GTP II, but also the main objective of interventions within the water and sanitation sector of the Cooperation Program between the Czech Republic and Ethiopia. This Program has focused an equally important sector at its inception is the disaster prevention and preparedness sector, which aims, inter alia, to strengthen the GSE's capacity in hydrogeology and geology with a focus on geodynamic risk management. The disaster prevention and preparedness sector were gradually merged with the water and sanitation sector during the implementation of the Program.

The project thus builds on the Program's previous and existing activities within the above-mentioned sectors. The projects "Capacity development in the field of environmental geology – mapping geo-risks including hydrogeological conditions in the areas of Dilla and Hosaina, Ethiopia" (2012-2014), "Capacity development in the field of engineering geology and hydrogeology in Ethiopia "(2010-2012), and "Analysis of natural risks affecting agricultural production in selected areas of Southern Nations Nationalities and People's Region (SNNPR), Ethiopia" (2015-2018) are among the recently completed outputs in this context. Moreover, the activities of the Development Cooperation Program in Ethiopia, "Increasing the capacities of experts working in geological fields for EFDR authorities" (2016-2018) as well as a complex project called "Finalization of hydrogeological and hydrochemical mapping of the entire Ethiopian territory at a scale of 1:250,000" (2016-2019) have continued from the long-standing program.[25]

[23] Strategie zahraniční rozvojové spolupráce České republiky pro roky 2018-2030: http://www.czda.cz/editor/filestore/File/Koncepce.pdf

[24] MZV ČR (2018): Program dvoustranné rozvojové spolupráce České republiky a Etiopie 2018-2023.

[25] http://gis.gse.gov.et/hg_maps/index.html

The recommendation came from the Report from the Comprehensive Evaluation of Czech Development Cooperation in the Water and Sanitation Sector in Ethiopia (Ministry of Foreign Affairs of the Czech Republic, November 2014) concerning the Czech Development Cooperation Program and Continuation and was addressed to the Czech Development Agency.

Several collaborations and humanitarian assistance from the Czech Republic are also gaining momentum in Ethiopia. Mendel University has continued research in irrigated agriculture, forest development and the extraction of medicinal ingredients from indigenous trees (for example Moringa tree). A vast implementation of water and sanitation programs have been pursued with the support of People in Need (PIN) in various parts of southern Ethiopia. Support through setting up a soil testing laboratory and pilot farms and training the local youth and women for improved skills to earn income using handcrafts are among the various efforts of PIN. In addition, the assistance provided by PIN through humanitarian assistance to displaced communities following the recent clashes between ethnic groups is also noteworthy.

3. STAKEHOLDERS

Ethiopia's umbrella organization for foreign development cooperation is the Ministry of Finance and Economic Cooperation (MoFEC), with whom the MoU is signed for all projects supported by the CzDA.

The primary stakeholders are local authorities of Regional, Zonal, and Woreda level Agriculture and Natural Resources Management Bureaus. The representatives of the inhabitants in the smallest administrative units (cabinets of Kebeles) are also very important stakeholders with a deep understanding of the local practices and knowledge of the various socio-economic activities in their respective constituencies. Apart from the direct end-users (e.g. local communities, Woredas, Kebeles), key stakeholders will be Federal Authorities and Universities that will identify the resources and ways of utilizing the resources in an optimum way. Such institutes will aid by providing the scientific and technical know- how as well as regulatory and statutory frameworks for the implementation in future expansion, and initial project implementation in the natural resource management related to sustainable agricultural practices.

The Ethiopian Agricultural Transformation Institute (ATI), which is a section within the Ministry of Agriculture, is designated to fast-track change. ATI directly reports to the prime minister. Its mandate is to rapidly improve the agriculture sector by ensuring that efforts are aligned, activities are coordinated, and an enabling environment is created for farmers to benefit from adopting proven technologies.

The list of specific major stakeholders is as follows:

- ✓ Administration of the Sidama Region and Gamo and Gofa zones of the SNNP Region
- ✓ Regional Bureau of Agriculture and Livestock Resources, Industry, Trade, Water and Mines, etc.
- ✓ Ministry of Water and Energy
- ✓ Ministry of Irrigation and Lowlands
- ✓ Ministry of Agriculture
- ✓ Ethiopia Commodity Exchange

- ✓ Federal Cooperative Agency
- ✓ Integrated Agro-Industrial Park
- ✓ Central Statistical Office
- ✓ National Steering Committee
- ✓ Regional Transformation Councils
- ✓ Value Chain Alliances
- ✓ Ethiopian Agricultural Transformation Agency (Institute)

Indirect beneficiaries are rural Savings and Credit Associations (RUSACOs), Regional Research Centers (focused on Climate Change Adaptation and Mitigation, Gender, Nutrition, Targeted Livelihood Support, and Biodiversity) programs/projects.

3.1 Direct target groups

Direct beneficiaries are the local administrations of the Sidama Region and the Gamoand Gofa zones of the South Nations, Nationalities and Peoples Region. The various government institutes in both regions that directly benefit from the project outputs are regional, zonal and Woreda offices of the Water, Agriculture and natural resources sectors. Furthermore, the Agricultural Commercialization Clusters (ACC) Unit for theTransformation Agenda and the ACC program management office (PMO), Irrigation Water Users Associations (IWUA) will have profound use of the project outputs.

3.2 Project final recipients

The final beneficiaries are small-holder farmers and rural families across the Sidama Region and Gofa and Gamo zones (SNNP Region) who will gain access to water, improved food security and better income. All ages of society will benefit from the intervention. The water well and other subsurface water extraction will require considerable labor, staffing, and specific technical skill. This will enable job creation for the young and vocationally trained men and women, and it will also prevent internal displacement. Since there would be enough water for domestic use, the burden of carrying water from far-off locations, which mostly exposes women to adverse conditions, will be greatly alleviated. The intervention will also help to carry out subsidiary activities (e.g. irrigation for agriculture, drinking water supply, groundwater resources protection and sanitation) required to keep the water supply system running, bringing additional income for inhabitants. The awareness created in terms of self-help by local enterprises based on the technique and information gathered from the intervention project will initiate a way out of ordinary practices and look for new frontiers in the various problems encountered in the community's livelihood. Also, it will alleviate the risk of adverse health conditions due to the unclean open water source normally used for domestic purposes. It also entails to the local community the practice of leading their enterprise by plans and introduces the importance of quantitative evaluation of resources in terms of expenditures and savings. The most important benefit will be detangling from the traditional farming practice of years of relying on unpredictable and ever-worsening climatic conditions in rain-fed agriculture. Multiple harvesting cycles will also benefit from sustainable subsurface water resource utilization by avoiding the idle times spent between the rain seasons.

4. PROJECT INTERVENTION LOGIC

4.1 Project development intent – impacts

The main intent of the project is to fulfil the "Sustainable Development Goals (SDGs)" defined by United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. These include mainly SDGs 6. "Clean water and sanitation" (chapters 6.1, 6.4, 6.6; SDGs 9. "Industry, innovation and infrastructure" (chapters 9.1, 9.2), and SDGs 15,"Life on land" (chapters 15.1, 15.2, 15.3). The matrix of the Project's logical framework forms Attachment 1. And the comprehensive description of the intervention logic is given in this chapter.

4.2 Project goals

The main aims in solving the above raised problems will have the following Goals:

- ✓ To characterize, improve, develop and protect groundwater resources in the Sidama Region and the Gamo and Gofa zones of the SNNP Region using novel geostatistical and artificial intelligence methods.
- ✓ To integrate the knowledge and collected hydrogeological and geological data from previous individual projects into a comprehensive system for the use in further socio-economic development in Ethiopia.

The comprehensive 3D geological and hydrogeological models including calculation of groundwater reserves (balance model) through quantitative evaluation will be carried out. The main implementers will be Czech Geological Survey, Charles University, C- RASC, George Mason University, Fairfax, VA, USA, Global MapAid, with the close collaboration of Arba Minch University, Aquacon Engineering Ltd. and SG Geotechnika a.s. These models will be processed based on a wide range of geological and hydrogeological data that have been obtained by the past and present development intervention projects of the Czech Geological Survey (including 3D geological modelling) and the new methodological approach being developed by researchers at George Mason University, Fairfax, VA (USA) with co-partners. These models will combine pertinent hydrological factors to create an optimum utilisation scheme of groundwater resources in an area by employing artificial intelligence. Based on the results of the hydrogeological and geological modelling, three sites will be selected for drilling of 2 shallow and 1 deep groundwater wells in collaboration with the regional offices (the Sidama Region and the Gamo and Gofa zones of the SNNP Region). The number of hydrogeological water-wells (3) fully corresponds to the necessary needs of the project and it is equal to budget. After completion of the drilling work, the wells are proposed to be handed over to respective local authorities for further usage and maintenance. Detailed designs of water supply schemes could be further developed and proposed as new construction projects to the Water Resource Development Fund to ensure further funding. Small holder farmers will benefit from the project through increased income and sustainable means of farming, stability of families, increased income and safety, reduced dependence on rainfall and climate change effects and lastly improved food security. Local Administrative sector offices (water bureaus, natural resources management and agriculture bureaus) would have robust source of groundwater database/information for basing decisions on planning and prioritizing of local development. Federal Institutes would profoundly benefit from the potential impact of the project outputs in supporting the effort to increase access to clean water and improvement of agricultural

productivity by providing alternative to dependence onrainfall. Aid Workers would have access to the means for helping decision on optimum location of wells sites for groundwater extraction as well as an improved method of shallow water well drilling and underground storage would be essential. Academic Institutes would get the chance to train their experts through long-term and short-term training programs which will motivate them to involve in the project implementation.

Project Outputs:

- ✓ The database of hydrogeological parameters (including chemical composition of groundwater) for the Sidama Region,Gamo and Gofa Zone (SNNPR);
- ✓ The geological and hydrogeological maps at a scale of 1:100,000 and accompanying explanatory booklets for the Gofa Zone (SNNPR);
- ✓ 3D geological models for all the target areas (Sidama Region,Gamo and Gofa Zone (SNNPR) using the MOVE software tools;
- ✓ The book describing the hydrogeological environment of all target areas (Sidama Region, Gamo and Gofa Zone (SNNPR) published in a minimum edition of 100 pieces, freely accessible for download on the Internet and at least two scientific publications with IF;
- ✓ Predictive models of groundwater level estimation and yield by employing conventional hydrogeological approaches, ultimately providing an estimation of groundwater reserve in the study areas. An App will be also be developed to address the need to provide the future amounts;
- ✓ Geostatistical modelling of groundwater availability and artificial intelligence tools for modeling of optimal drilling locations;
- ✓ Identification of prospective (promising) drilling sites for shallow groundwater extraction in close cooperation with local administration entities and drilling of three water-wells for the purpose of domestic use and community house hold irrigation service;
- ✓ Interactive, on-line information system of groundwater resources for the Sidama Region and the Gamo and Gofa zones of the SNNP Region. Increased outreach to growing demand of the community by providing resources for the local administrations to base decisions on natural resources management;
- ✓ Capacity building for local experts in the form of workshops and trainings.

The final outputs, in the form of interactive mathematical models and maps will be demonstrated and handed over to the federal, regional as well as local authorities and communities for scaling up as well as implementation. The outputs of the project will be also valuable for other international entities implementing development activities in Ethiopia in the field of geosciences.

The objectively verifiable indicator of this Project having a positive impact will be a real grasp of the trends in the quantitative and qualitative status of groundwater resources.

The project will be open to other NGOs, donors, policymakers, agro-agencies and all related projects through the website providing relevant information and the training module mentioned above.

Output indicators:

- ✓ Current state of knowledge of geological and hydrogeological environment and set of geological and hydrogeological maps at a scale of 1:100,000 and text explanations of the Gofa Zone of the SNNP Region;
- ✓ 3D geological model of the studied area with interactive means to extract pertinent geological information for groundwater potential evaluation in any part of the study area;
- ✓ Computer simulations and groundwater parameters/metrics (total reserve, optimum extraction rate, recharge rate, depth variability, quality);
- ✓ Geostatistical and artificial intelligence (AI) based models that predict the success of striking groundwater in any of the studies area by considering both the natural and socio-economic conditions (needs of local people, farmers, etc.);
- ✓ Identified prospective areas for sustainable water well drilling in overpopulated areas based on developed conventional, geostatistical and AI models;
- ✓ List of constrained sites proposed for optimum water well drilling in the studied area intended for house hold irrigation;
- ✓ Two shallow wells and one deep well for monitoring groundwater dynamics. Domestic water supply and house-hold irrigation (driven by solar energy and adopting drip irrigation systems);
- ✓ Development of interactive on-line information system on groundwater resource along with explanatory text;
- ✓ Interactive simple to use apps that can be installed on mobiles/tablets that use input parameters and predict optimum location, depth and yield of groundwater well sites using the developed AI;
- ✓ Increase in new recruits of graduates from University directly for the purpose of household irrigation/small-scale farmers';
- ✓ Establishing a training module on water drilling optimization at the premises of Arba Minch University and also elsewhere in Ethiopia, which will be available for all water well drilling NGOs and experts from local administration offices;
- ✓ A comprehensive manual demonstrating the steps in shallow well drilling that can serve as a training manual.

4.3 Overview of outcomes and activities – efficiency

Technical specifications of the project

Project outputs conform to acceptable level of verification for accuracy and relevance such as accuracy of the developed 3D geological model, the groundwater parameters (e.g. depth, yield, location, quality) predicted by the developed AI models by comparing with available data from existing wells. Project outputs are also intelligible to the studied area's primary language (both in the apps and model outputs) or at least in the lingua franca of Ethiopia (or in the respective local language of Sidama for the case of the Sidama Region and in the Gamo and Gofa dialects for the case of Gamo and Gofa Zones respectively). Moreover, project outputs have broader impact (at least across a watershed or zonal administrative extents).

In selection of the study area for the project, areas with acute shortage of water for agriculture are be prioritized. The scope of the project is limited to small scale farmers' critical problems and needs and must resonate with the improvement of agricultural productivity and income.

The project has aspects that promote the direct role and benefit for women and children. The project solution is sustainable in terms of replicability, scale, continuity and utilization of affordable technology in the local context.

The following activities leading to the implementation of the outputs have been established:

Output 1. Complex assessment of groundwater resources for the Sidama Region, Gamo and Gofa Zones (SNNPR)

Activity 1.1 - Geological, hydrogeological and surface data review and re-interpretation.

This activity involves the collection of pre-existing data relevant to the compilation of necessary geological and hydrogeological maps and data-bases sources for processing of 3D models (activities 1.2, 1.3, 1.4). As sources of existing information all the relevant and available hydrological data, socio-economic data, satellite data, climatic data, geomorphological and land-cover data (including remote sensing data and digital elevation model (DEM) from all target areas will be used. The current average precipitation data obtained by combining the data from observation network with satellite rainfall estimates will be incorporated as an input for groundwater recharge estimates. In addition, a consolidation of database of water points and drilling reports will be conducted including update of hydrogeological data and information based on recent studies. This necessary information will be collected as priority and further processed by the working team.

Processed by: Czech Geological Survey / Aquacon / Geotechnika / Arba Minch Uni / MWE / Charles University
Responsibility: Leta Megerssa

Activity 1.2 – Geological and hydrogeological mapping of Gofa Zone at a scale 1:100,000

This activity represents the acquisition of new field and analytical geological and hydrogeological data obtained by mapping of Gofa Zone (4,548 km^2) using the methodological approach by Hanžl and Verner (2018). By synthesis of the field and laboratory data a set of geological and hydrogeological maps on a 1:100,000 scale will be finalized, including the final processing using the ArcGIS software environment. In addition, the text explanatory booklet representing a comprehensive description of geological and hydrogeological environment will be compiled. This text output will be intended for the wider professional public, state administration institutions and private entities with activities in geoscience fields. The map outputs will be created in a form that will enable their incorporation into African or global information systems on natural resources. A minimum of 100 sets of printed geosciences maps will be printed for each target area for all defined target areas. Map outputs will be also published online and available for free download.

Processed by: Czech Geological Survey / Charles Uni / Aquacon / Geotechnika / AFS /MWE
Responsibility: Kryštof Verner

Activity 1.3 - 3D geological modelling (preparatory phase for hydrogeological modelling)

Based on the existing sets of geological data from the Sidama Region and the Gamo Zone of the SNNP Region (outputs of previous development project), new data acquired from planned geological and hydrogeological mapping of the Gofa Zone of the SNNP Region (see Activity 1.2) and archive data from drilling reports, the 3D geological models will be created in the MOVE software – Petex (Fig. 1). Two principal techniques will be used for the model creation: (a) interpolation in case of sufficient amount and homogeneity of the input geoscientific data, and (b) manual construction when lower amount of input data combined with higher complexity of geological architecture will be encountered. The geological models will be composed of meshes, that represent: (a) boundaries of lithostratigraphic units ("rocks"), (b) major tectonic zones and (c) ground water table estimated based on interpolation of available data.

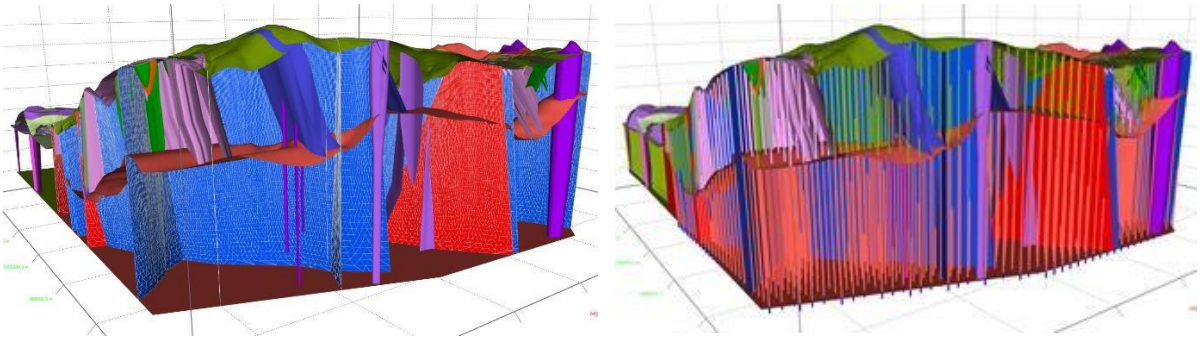

Fig. 1. Examples of a geological 3D model showing lithological bodies and main fault zones in the MOVE software (left) and the derived network of virtual vertical boreholes plotted intothis model (right).

The 3D models will be the basic input for the processing of groundwater spatial variability (activity 2.1). In the next stage the geological 3D model will be transformed to virtual vertical boreholes in a regular network, whereas the geological pattern is extracted to the virtual boreholes and virtual borehole database is used to transfer the geometry of geological objects to the groundwater flow models.

Processed by: Czech Geological Survey, Geotechnika
Responsibility: Jan Franěk

Activity 1.4 - Geochemical and hydrochemical assessment of groundwater environment

Since the Sidama Region, Gamo and Gofa zones (SNNPR) are located in contrasting geological and hydrogeological environment (the rift valley vs. highland) the groundwater quantity and quality assessment is quite essential for sustainable and efficient domestic and agricultural uses. Based on (a) an archival set of hydrogeological data for areas of interest (output of activity 1.1); (b) newly acquired hydrogeological and hydrochemical data from all target areas including sampling of groundwater, chemical analysis including isotopic composition and tracers determining groundwater age and source areas) and (c) results of ongoing monitoring of existing hydrogeological wells which will characterize the hydrogeological environment, including assessment of drinking water quality, possibilities of effective irrigation or industrial usage based on expected water quality and yields. These data will serve as necessary input element for the implementation of activities within Output 2.

Processed by: Charles University / MWE / Aquacon / Geotechnika

Responsibility: Jiří Bruthans

Activity 1.5 - Detailed groundwater and soil environment investigation in the Zala Woreda, Gofa Zone, SNNPR

This activity will enable the highly desirable analysis of groundwater potential to build resilient and sustainable agriculture in drought prone area to ensure food security using the groundwater irrigation agriculture in the Zala area (eastern Gofa Zone), which covers ca. 14,000 hectares. The fundamental problem in the target area is sever scarcity of surface water due to erratic rainfall in light of climatic change, despite the rich fertile land for agriculture which is essential for the livelihood of tens of thousands of local residents. In frame of this activity the detailed set of hydrogeological, geological, geophysical and soil data (at a scale of 1:10,000 and 1:25,000) as well as land use/cover data in combination with monitoring of existing medium depth test groundwater boreholes will be acquired. The main output of this activity will be necessary scheme for construction of production water wells and irrigation system.

Processed by: CGS / AMU / Charles University / MWE / Geotechnika
Responsibility: Kryštof Verner

Output 2. Identification of groundwater levels using conventional hydrogeological methods, geostatistics and artificial intelligence

Activity 2.1 - Groundwater level estimation and possible yield identified by conventional hydrogeological methods

This activity will include (a) compilation of shallow groundwater hydrogeological map at scale 1 : 50 000 of perspective area for irrigation and water supply and (b) compilation of recharge maps using “water balance models” (Bilan or alternatively WetSpass) and base flow separation. In order to capture whole complexity of water cycle in the area of interest, gaps will be filled in channel runoff gauging by identifying hydrologically important sites that do not have sufficient runoff data available. For precise base flow measurement, a modern acoustic Doppler velocity meter will be introduced for local beneficiary. Practical on-site trainings (activity 3.2) will be provided for end users with benefit ofcollecting runoff data directly applicable within this project.

Processed by: Geotechnika / Czech Geological Survey
Responsibility: Jiří Šíma

Activity 2.2 - Geostatistical groundwater spatial distribution modelling

This activity includes: (a) Advanced processing of the data acquired at the previous stages (Activity 1.1, 2.1), e.g. hydrological modelling and topographic wetness index calculations (TWI), evapotranspiration modelling and other relevant derived variables calculations; (b) Geostatistical modelling using all available primary field and satellite data and also derived variables focused on identification of areas rich in groundwater.

Models will be first calibrated and later independently tested using existing wells where available. The project expert team will be incorporated in model parameters adjustments for best results. Geostatistical analysis is very effective for processing of complex spatially oriented datasets; tens of parameters characterizing geomorphology, hydrology, precipitation,

land-cover, hydrogeology and geology will be evaluated. Input data are also of very different reliability (e.g. ground station precipitation measurements vs. precipitation derived from satellite data) and varying homogeneity (e.g. ground station precipitation measurements are lacking temporally continuous data, there are many significant gaps in the record). Considering complexity and inhomogeneity of input data geostatistical methods using also multivariate statistics will help to understand water cycle. Using artificial intelligence tools in following Activity 2.3, which are being widely used for analysis of complex and inhomogeneous datasets, will provide deeper insight.

Processed by: Charles University / Czech Geological Survey / Geotechnika
Responsibility: Karel Martínek

Activity 2.3 – Artificial intelligence (AI) tools

The AI task will be employed to interpolate heterogeneous data points of known pertinent information for estimating groundwater parameters (depth-to-water table, yield, etc.), throughout the area that will be modelled in order to generate a continuous probability surface of the parameters. For this, the parameters from known locations will be interpolated using robust methods (AI) to cover the entire study area. These parameters will be extracted from both the available point data (borehole) wherever available and partly from the constructed 3D geological model such as stratification of the aquifers, the orientation of geological structures, etc. Once the regular distribution of the parameters are obtained, the AI model will be run to identify the optimum location of well sites optimized with respect to the cost and the sustainable yield. Further, the AI will be employed for the purpose of quantifying future scenarios of the groundwater resource by inputting climatic factors relevant for recharge based on data from satellites, ground measuring stations, etc.

To summarize, the activities include:

- ✓ Processing of the obtained data for AI models (the list below is a possible data list);
- ✓ Constructing machine learning models to predict the depth-to-water table, water yield and groundwater recharge throughout the areas;
- ✓ Mapping out the areas that are more favorable for sustainable groundwater development and areas that are vulnerable to groundwater utilization;
- ✓ Constructing and solving optimization models for identifying the optimal drilling locations;
- ✓ Developing an App to incorporate results of the AI system into a decision support system to visualize results and automate collection of well completion reports. These activities will help to provide guidance for decision making on drilling boreholes for sustainable irrigation purpose.

Lists of parameters to be considered for GW distribution estimation: (a) Soil parameters such as hydraulic parameters, granular composition (2D maps); (b) Lithological pattern (based on 2D maps and 3D model); (c) Tectonic features such as orientation of main lithological boundaries and regional fault structures (based on 2D maps and 3D model); (d) Stream/ river proximity (based on 2D maps); (e) Topography (based on DEM); (f) Geophysical data (2D map and 2D profiles); (f) Land cover, land use and climate data; (g) Population density (data from Central statistical Agency of Ethiopia) and (h) Water use (estimation according to purpose of use from the population socioeconomic characteristics).

Processed by: George Mason University / Charles Uni / Geotechnika / Global Map Aid
Responsibility: Kathryn Laskey

Activity 2.4 – Artificial intelligence APP with (AI) tools

Out of the AI will come an App innovation as a decision support tool to be used by drillers/diggers, hydrogeologists, and donors, to support decisions on where to drill or dig shallow (< 30 meters) wells, for sustainable small holder farmers irrigation system. The App will employ an artificial intelligence (AI) system that generates a shallow ground water level estimation map. The map will enable rapid identification of appropriate locations for shallow wells and contribute to improved food security (a) supporting social stability and (b) violence reduction. The App can also be used to enter well completion reports in a consistent format, thus facilitating datamanagement for small farm irrigation.

We plan to test our prototype model in Bilate sub-catchment, with the population ca.690,000, which we estimate serves ca. 300 government development workers, followed by Gamo Zone with a population of ca 2,360,000 which is estimated to serve ca. 1,026 government development workers according to local sources.

Processed by: George Mason University / Global MapAid / Arba Minch University / Charles University / Aquacon

Responsibility: Kathryn Laskey

Activity 2.5 - Identification of prospective drilling sites and drilling of shallow water-wells

Identification of prospective areas for sustainable water well drilling in highly populated areas based on expert assessment of all the data acquired and application of geostatistical methods and AI modelling (activities 2.1 – 2.3). Specific preparation of sites will be located considering earlier results of models, earlier information on the geological conditions in the area, geophysical investigation, existing groundwater inventory data principles, documents water demand for domestic water supply and small holder irrigation. Drilling and completion of two shallow (30 m) and one deep (100 m) wells. The drilling of the wells also proceeds by installation of appropriate types of casing as per the encountered condition of the rock strata and also conducting pumping test to acquirethe storage coefficient, the specific yield, the hydraulic conductivity, and the transmissivity of the aquifer. The new water-wells will be handed over to local water administrative body including community members (for practical use - e.g. irrigation works, connection to existing water pipes).

Processed by: Aquacon / Geotechnika / MWE / Global Map Aid / Ircon
Responsibility: Jiří Šíma

Activity 2.6 Development of interactive on-line information system on groundwater resources

Formatting hydrogeological and geological data for information system (Geoportal). Identification of prospective areas for sustainable water well drilling in overpopulated areas based on expert assessment of all the data acquired and application of geostatistical methods and AI modelling (activities 2.1 – 2.3). Specific preparation of sites will be located considering earlier results of models, earlier information on the geological conditions in the area, geophysical investigation, existing groundwater inventory data principles, documents, water demand for domestic water supply and small holder irrigation.

Geoportal presenting online all-important project results will be developed on ArcGIS server hosted at Charles University. All data will be freely available to public and interconnected with online application. Map server will be also mirrored to relevant Ethiopian institution (Ministry of Water, Arba Minch University).

Processed by: Charles University / Czech Geological Survey / Geotechnika / Arba Minch University / Ministry of Water and Energy / Global MapAid

Responsibility: Karel Martínek

Output 3. Increasing the skill of Ethiopian experts

Activity 3.1 - Master's and doctoral studies of selected experts in the Czech Republic on the topic of the project

The activity covers the intramural study of hydrogeology of one PhD. student and one MSc. student at Charles University, Prague, Czech Republic. Both students will work on topics directly connected to the project (quantitative hydrogeology of basalt aquifers in study area; verification of the conceptual groundwater flow model by geochemical, isotopic and groundwater dating tools. Project will cover the standard time of study for both students (3 and 2 years, respectively) including fieldwork expenses for both students as required.

Processed by: Charles University
Responsibility: Jiří Bruthans

Activity 3.2 - Practical training of Ethiopian experts and local administration offices

Establishing a training module on water well drilling and groundwater abstraction (pumping) optimization (spacing, over-abstraction) ideally at the premises of Arba Minch University or elsewhere in Ethiopia, which will be available for all public serving water well drilling entities including None-Governmental Organizations (NGOs). Practical teaching of local administration workers / AM University – lectures / manual will also be a part of this activity. This activity will lead to the development of capacity for effective interventions in rural communities' access to sustainable water source and its management such as the operation and maintenance of groundwater supply infrastructure, understanding of water drilling optimization, formulation of monitoring, evaluation and promoting alternative views to traditional farming practices.

Processed by: Aquacon / Geotechnika/ Arba Minch University / Global Map Aid / MWE
Responsibility: Jiri Sima

Activity 3.3 - Training on the usage and dissemination of the project outputs

Periodical communication of the project progress will be consulted through various workshops that will be organized in the respective localities of the project implementation namely the Sidama Region and the Gamo and Gofa zones. These will be carried out at the beginning and at the end of major project output progress relevant for the stakeholder consultation. The results and outputs of the project will be disseminated in hard and soft copies. Freely accessible platform on the internet will be created for the interactive maps and APP for usage on android mobiles and tablets as well as desktop computers.

Processed by: Czech Geological Survey / Aquacon / Geotechnika / Global Map Aid
Responsibility: Kryštof Verner

4.4. Key assumptions and risks – external factors

The primary assumptions for a successful resolution of the Project include the lasting interest of the Government of Ethiopia as well as the partner institutions. The defined intervention incorporates capacity development activities to reinforce the implementing new government and federal agencies as well as the coordination between programs and associated implementing partners. The infrastructure supported by the program considers climate resilience and will have adaptation measures incorporated in the design and processes as part of the lending eligibility criteria and risk assessment.

Key assumptions are as follows:

- ✓ The Sidama regional administration and Federal government of Ethiopia continues to show strong support for the value chain and agro-processing initiatives.
- ✓ Budget allocations to the new government-led value chain development remain sufficient to achieve the expected outcomes and outputs.
- ✓ The Sidama Region has good security and stability.
- ✓ Relevant infrastructures needed for market linkages are present.
- ✓ Evaluation and strengthening policies for each project component

Risks:

Limited capacity of the new governmental offices to coordinate, manage and monitor defined intervention (M). Time constraints in commencement of the work - late signature of contract in the Czech Republic – field work and construction in Ethiopia cannot be performed during the main rainy season May – September (M). The effects of climate change may damage some parts of the program investments and affect the production base (M). Inadequate attention paid by end users to development and protection of natural resources (M).

Overview of relevant risks and assumptions:

Risk / risk area	**Possible influence**	**Strategy how to overcome adverseeffects / Mitigation**
The partner institution will no longer be willing to cooperate, fulfil its duties and support necessary and relevant documentation (particularly the declaredin-kind and expert contribution of the partner institute)	Significant	The disinterest of the local institutions and individual officers of the local administration will be tackled through the implementers working intensively with local experts, communities as well as local institutions. The implementer has great experience in this field; therefore, it is possible to assume that the Project could besolved by own means on the basis of compensation related to the stoppage of thein-kind cooperation.

A considerable change inthe exchange rate of the CZK against the ETB.	Significant	The change in exchange rate of the CZK against the ETB represents an unavoidable risk with regards to the recent developmentof this rate. The possible significant changes in this rate will be resolved by an agreement between the Czech DevelopmentAgency, the recipient and the Project implementer by changes in the scope of the Project and shortening/prolonging the period of the implementer's stay in Ethiopiaetc.

The Project will not be approved in time by the relevant Ethiopian authorities and the agreement with MoFED will not be signed	Medium	So far, the implementer has been successful in obtaining the necessary permissions in Ethiopia (including the signature of an agreement with MoFED) for the implementation of projects within the given territory (SNNP Region and Sidama Region) with no time prolongations.
The implementer will notbe granted the funding needed for the entire duration of the implementation of the Project	Significant	So far, the implementer has been able to obtain the necessary funding needed for theimplementation of projects within the particular territory. In the opposite case, it would be inevitable to reconsider the implementation of the Project.
Spreading of a pandemicand associated health / travel restrictions in theregion of interest (e.g. Covid-19 international aswell in between Ethiopian regions).	Medium (first part of the project) / Significant (second part of the project)	The first part of the project is mainly focused on processing the archived data. Incase of travel restrictions, it is mostly possible to work online in joint teams.

5. PROJECT QUALITY AND SUSTAINABILITY FACTORS

5.1. Ownership of the project topic by target groups

Small holder farmers will involve in the project through the provision of the labor force required in the activities of the project. This ensures acquiring the necessary skill and knowhow for the continuation of the introduced method and concept and its propagation to the wider community. The farmers will benefit fromthe project in the following manners:

- ✓ Increased income and sustainable means of farming
- ✓ Stability of families
- ✓ Increased food security and safety
- ✓ Reduced dependence on rain and climate change effects

Local Administrations

Concerned sectoral offices from the respective local administrative entities addressed in the project (Water bureau, Agriculture and natural resources Bureau of Sidama region, Gamo and Gofa zones of SNNP Region) will directly involve through assigned focal persons and experts. Furthermore, the local offices will provide Water Well drilling completion reports of previously drilled Wells and socio-economic data in their archive as well as expediting of permissions to access the localities needed to be visited by the project team. Smart solutions to lack of data and information on groundwater resources for development planning and management will motivate the local administration offices working on groundwater and related matters to take deeper interest in the project.

Federal Institutes

Ministries, in particular the Ministry of Water and Irrigation, the Ministry of Agriculture, and the Ministry of Irrigation and Arid Areas Development) would play crucial role by providing existing data on the national level for the utilization in the project. They also will involve by facilitating sending of water samples that need to be analyzed in foreign countries where the facility for advanced analysis are available. Relevant experts from these institutes will be assigned as a focal person to jointly carryout the project activity alongside the expatriate experts in the project. The Ministries will also undertake the responsibility to arrange necessary documents and permits for expatriate project teams to inter Ethiopia. The outputs of the project will have profound impact on the missions of the Federal Institutes and Ministries such as increasing outreach to clean water, agricultural productivity and reduced dependence on rainfall for agriculture.

Aid Workers

Various non-governmental Organizations will have important role for testing of the water well drilling decision support Application that will be developed based on AI models. The insights into the priority of the needs in the localities of the project implementation that can efficiently be communicated from the NGOs will also be an essential input for the project. These organizations will in return benefit from the guarantee for access to the AI based tools that will be developed in the project. This tool will complement the challenges faced by many Development Aid workers by providing objective decision support systems for optimal location of Water Well sites for groundwater extraction, improved methods of shallow water well drilling, and ways for underground water storage that will motivate their engagement in the successful implementation of the project.

Academic Institutes

Various institutes including research centers and Universities (Arba Minch University) would avail the necessary logistics at their disposal free of charge except consumable expenses for the usage in the project. This includes availing the infrastructure for hosting database servers and instruments for undertaking field surveys at areas that need further investigation at selected localities. Furthermore, the institutes would get the chance to train their experts through long-term and short-term training programs which will highly motivate them to involve in the project implementation and ensure its sustainability.

5.1. Practical and technological feasibility, innovativeness

The utilization of modern methodical procedures and a multidisciplinary approach during the resolution of the Project will allow the effective creation of all the defined outputs. Part

of the solutions for the Project is represented by training in and teaching about modern methodologies for Ethiopian professionals, who will carry out the processing on their own in the future. The know-how shared will benefit the participants of the project on the recipient's side.

Affordable and easy to use technologies will be adopted on the basis of cutting-edge Artificial Intelligence models. User friendly and freely accessible platforms will be utilized for broader impact and better outreach to the intended end users, the small- scale farmers.

To complement the use of conventional methods of field and laboratory-based research (e.g. geoscience mapping, methods of applied geophysics, remote sensing analysis, etc.) and the entire set of existing archive data the integration of innovative methods employing artificial intelligence (AI), the comprehensive hydrogeological model of groundwater resources will be created. These outputs will be used to help determine areas/sites where shallow water wells (<30m depth) can be effectively drilled for sustainable domestic as well as community – household irrigation purposes in the areas with high demand that lack such information.

AI has been successfully used in various drilling programs in the petroleum industry for optimization of drilling locations and modelling of various reservoir characteristics (Morooka et al. 2001, Ashena et al. 2021, Cayeux et al. 2021, Kuang et al. 2021). Despite the fact that hydrogeological research is dealing with similar reservoir issues as petroleum exploration, studies implementing AI in groundwater drilling programs are very rare (Pandley et al. 2020). Our team involves experts from the George Mason University Center for Resilient and Sustainable Communities (C-RASC), Global MapAid (GMA) and Arba Minch University Water Technology Institute (AMU AWTI), who have been successfully developing an AI based system for predicting groundwater levels since 2019 (see e.g., Wanru Li et al. 2021). This project is called MODL or "Modelling Optimal Drilling Locations" and will be soon embedded in an App and then field tested by government and NGO development workers via the AMU WTI, and Vita Ireland, in Gamo Zone which is adjacent to AMU WTI. The App will include a feature where users can input the data from wells they are drilling and therefore help improve accuracy and support availability of standardized data on groundwater. The developed application will form part of development workers course, on sustainable shallow irrigation, at AMU WTI.

5.2. Economic sustainability

The application that runs on Android will be developed that will have two-way interface by providing pertinent information on deciding location and depth of drilling a well in any place in the project area on the one hand and also gathering the information from new water well drillings that are to be entered on the App. This will aid to further improve the accuracy of the developed AI system ensuring its sustainability.

The implementation of the Project is financially dependent on the stability of financing from the sources of Foreign Development Cooperation of the Czech Republic and sufficient financial backing from the local partner institutions. The initiation of the Project reflects the long-term priorities of the Ethiopian policies in the areas of the water sector and the management of natural resources.

The implementation of the Project as well as its continuity from through maintenance, scale-up and replication to other regions will be guaranteed by the concerned Government entity. Given the declared priority of the measures, it is possible to predict a high probability of their maintenance and subsequent development.

5.3. Political and institutional sustainability, social and cultural factors

The project takes into consideration the local specifications within the region, customs and other relevant factors in order to minimize possible conflicts of interest. In the long term, the Project will contribute to improving the utilization and management of information on natural resources. It will also open opportunities into more research and development by local capacity. Furthermore, increased availability of household consumption will have an impact on curbing problems of malnutritionon children with increased productivity leading to improved income and cultivation.

Project support by the beneficiary country

The project was formulated on the basis of a request from the Ministry of Water and Energy of Ethiopia and Arba Minch University as the main partners. Both institutes pledge to provide all the necessary information and cooperation in processing individual project outputs, including direct participation in the implementation of individual activities and in-kind financial support for the project's success. The in- kind contribution includes providing the available infrastructure and appropriate manpower involved in project implementation, covering the salaries and other administrative expenses of their assigned local experts in the project as well as arranging local permits and logistics as well as follow up on the work progress.

An agreement between the promoter and the partner would be signed at the start of the project. The beneficiary country's partner institutes will hence:

- ✓ Provide offices, transport, and related facilities as the basic requirements for the project.
- ✓ Ensure obtaining the necessary permits and letters for the project implementer.
- ✓ Provide proprietary data, including archived map datasets.
- ✓ Ensure the selection of suitable experts for the joint working team and for training.
- ✓ Provide the premises and technical facilities for the planned training and output processing.
- ✓ Create conditions for publishing outputs on their website, including installing an application showing groundwater level fluctuation on the organization's website that will be accessible to public observers of the organization's data policy.
- ✓ Provide training in regions and other stakeholder organizations on how to results of groundwater resources monitoring.
- ✓ Plan for the future enlargement of a monitoring network and services in information about changes in groundwater resources for development planning, including abstraction permitting.

The above support items included in the project are approximately equal to 25% of the project budget funded by the CzDA. Capacity building for the beneficiary country's institutes will be performed in the form of developing the database, practical training in using the databases and its manipulation for professionals in the Beneficiary country's institutes and the regional Bureaus.

Recipients' participation and ownership of the projects

The Arba Minch University and Ministry of Water and Energy are the local leading partners for the implementation of the Project. The project proposal has been processed on the basis of the aforementioned institutes through "Letter of Interest" and the formulation of the concept note.

The exact definition of the requisite outputs and the comprehensive time schedule have been defined. The implementation of the Project will be carried out with the active participation of the local partners. All equipment obtained within the Project will be handed over to the relevant local partner institutes at the end of the Project.

5.4.Exit strategy, expected behavior change and possible multiplier effect

Apart from the direct project outputs, the lessons and developed intervention scheme are scalable and replicable with profound impact on the improvement of small-scale farmers' livelihood. The introduced technology and methodology will also open opportunities in terms of the norm of economic activity in the small-scale local farmers of the project area to consider a proactive approach to utilization of natural resources for betterment of their livelihood. Moreover, the project outputs will lead to alternative means for earning income for women and youth by curbing the high rate of unemployment.

6. CONSIDERATION OF CROSS-SECTION PRINCIPLES

6.1. Proper administration of public affairs

All communication between implementing country's stakeholders and authorities will be addressed through official letters from the Czech geological survey or the Ministry of Water and Energy as appropriate. Periodical dissemination of pamphletsand creation of a space on social media online with current global trends will be employed to further communicate the general information on the progress and findings of the project. Communication with other donor agencies operating in the country will be reached on workshops for feedback and consultation as well as promotion of the project benefits for the common cause of helping the targeted end users of the project, the same scale farmers in the Sidama Region, Gamo and Gofa zones of SNNP Region.

6.2. Environment

The implementation of the Project will have a positive impact on the environment and its use, while contributing to meeting the targets of The United Nations Framework Convention on Climate Change (adaptation) and The United Nations Convention to the Combat Desertification. The creation of robust models of groundwater go hand in hand with the measures related to the more efficient use of groundwater, farmland, reduction of soil degradation as well as control of adverse water related environmental risks such as flooding, landslides, and deforestation.

6.3. Human rights and gender equality

The outputs of the project will have concrete recommendations and assessments as well as prioritization of the groundwater resource and its utilization that will alleviate the burden of many women in rural areas of the nation. The project will also contribute to increased availability of agricultural products that can offset the prevalent malnutrition in children. The available information will help to identify priorityareas needing immediate attention.

No.	Factor name according to OECDmethodics	principal objective	Significant objective	not targeted
1	Participatory Development / Good Governance		□	

2	Aid to environment		☐	
3	Biodiversity			☐
4	Climate change – mitigation	☐		
5	Climate change – adaptation	☐		
6	Desertification	☐		
7	Disaster Risk Reduction	☐		
8	Disability		☐	
9	Gender equality		☐	
10	Nutrition		☐	
11	Reproductive, maternal, newborn and child health		☐	

Table 2 – Selected OECD factors.

7. PROJECT MANAGEMENT

The Czech Geological Survey (CGS) and SG Geotechnika a.s. have a long-term experience of working in Ethiopia since 2010, through projects in the fields of natural resource management, education, water, development of agriculture and land protection. Cooperation with the partner institution of the Project is necessary for its successful implementation which will be provided by the establishment of mutual communication, joint inspection of task fulfilment and effective use of finances. The works within the Project will be managed by two subjects simultaneously – the leader of the Project nominated by the CGS and the counterpart nominated by the respective partner institutes.

The processing teams will be under these working leaders, where the Czech experts are under the Project leader nominated by the CGS, being responsible for the completion of map activities (work of the editor), while the partner institutes will be responsible for the assurance and implementation of the respective project outputs. Additional studies and expertise needed from outside of the main authors will be sought by outsourcing the particular task through individual contracts with the specifically defined scope such as geophysical data inversion, remote sensing data interpretation and digital cartographic and web map developments. The list of selected cooperating persons including their basic professional characteristics is given in table 4.

7.1. Responsibilities in the implementation team

The Czech Geological Survey (CGS) will be the principal investigator and implementation entity of the project outputs, including also full responsibility for the team management as well as effective cooperation with partner institutions and management of project funds (for summary see Table 3).

Activities proposed by the Czech Geological Survey, Prague, Czech Republic

- ✓ Managing the compilation of archive data and their final preparation for subsequent activities (activity 1.1);
- ✓ Geological mapping of the Gofa zone and processing of maps and text outputs (activity 1.2);
- ✓ Detailed groundwater investigation in the Zala Woreda, Gofa Zone in order to building the scheme for construction of production water wells and irrigation system (activity 1.5);
- ✓ Processing of 3D geological models in MOVE software (activity 1.3);
- ✓ Cooperation on groundwater level estimation and possible yield identified by conventional hydrogeological methods (activity 2.1)
- ✓ Cooperation on establishing of interactive on-line information system on groundwater resources (activity 2.6)
- ✓ Coordination of all stakeholders in the project;
- ✓ Management of the project activities and dissemination of outputs.

7.2. Responsibilities in partner organizations

Collaborating (partner) organizations will carry out the defined activities proportionally, as indicated below. They will be contractually obliged in relation to the principal investigator.

Activities proposed by the Charles University, Prague, Czech Republic

- ✓ Collaboration on the compilation of archival data (activity 1.1);

- ✓ Cooperation on geological mapping of the Gofa zone (activity 1.2);
- ✓ Hydrochemistry analysis, modelling and data interpretation (activity 1.4);
- ✓ Sampling and analysis of isotopic and dating tracers to verify the verification of the conceptual groundwater flow model (activity 1.4);
- ✓ Collaboration on detailed groundwater investigation in the Zala Woreda, Gofa Zone (geophysical survey) in order to building the scheme for construction of production water wells and irrigation system (activity 1.5);
- ✓ Cooperation on geostatistical groundwater spatial distribution modelling (activity 2.2);
- ✓ Cooperation on AI tools (activity 2.3; 2.4)
- ✓ Interactive online hydrogeological and geological map creation to the scale of the project outputs (activity 2.6);
- ✓ Teaching and training of Ph.D and MSc. students of hydrogeology (activity 3.1).

Activities proposed by Aquacon Plc, Ethiopia

- ✓ Collection of existing data, update of hydrogeological data and information based on recent studies (activity 1.1);
- ✓ Collection of new field and analytical and hydrogeological data obtained by mapping of Gofa Zone (activity 1.2);
- ✓ Collaboration on sampling, chemical analysis of groundwater (activity 1.4);
- ✓ Preparation of drilling documents and reports (activity 2.4);
- ✓ Drilling of two shallow (30 m) and one deep (100 m) wells (activity 2.4);
- ✓ Identification of prospective drilling sites and drilling of water-wells (activity 2.5)
- ✓ Collaboration on training activities (activity 3.2);
- ✓ Collaboration on dissemination of results (activity 3.3).

Activities proposed by Geotechnika Prague, Czech Republic

- ✓ Compilation of necessary hydrogeological maps, consolidation of database of water points and drilling reports (activity 1.1);
- ✓ Collaboration on processing of new field and analytical hydrogeological data obtained by mapping of Gofa Zone (activity 1.2);
- ✓ Preparation of geological and groundwater level data from the Sidama Region and Gamo and Gofa Zones (activity 1.3);
- ✓ Hydrogeological and hydrochemical data for areas of interest and monitoring results of of existing hydrogeological wells will characterize the hydrogeological environment of the target areas, including assessment of drinking water quality, irrigation or industrial usage based on expected water quality and yield (activity 1.4);
- ✓ Collaboration on detailed groundwater investigation in the Zala Woreda, Gofa Zone (hydrogeological assessment) in order to building the scheme for construction of production water wells and irrigation system (activity 1.5);
- ✓ Channel runoff gauging (activity 2.1);
- ✓ Hydrogeological conceptual models of target areas (activity 2.2);
- ✓ Interpolate heterogeneous data points – layer preparation (activity 2.3);
- ✓ Selection of drilling sites and preparation of drilling principles (activity 2.5);
- ✓ Formatting hydrogeological data for information system (activity 2.6);
- ✓ Preparation of training module on water drilling and groundwater lifting optimization (spacing, over-abstraction) (activity 3.2);

- ✓ Training on the usage and dissemination of the project outputs (activity 3.3).

Activities proposed by George Mason University, Washington, USA:

- ✓ Collect and process publicly available data for Artificial Intelligence (AI) models that predict optimized locations and depth of groundwater extraction wells to support drilling decisions (activity 2.3);
- ✓ Analyze the factors that are significant to the depth-to-water table, water yield,and groundwater recharge (activity 2.3);
- ✓ Develop AI models to predict the depth-to-water table, water yield, and groundwater recharge throughout the project areas and map the results (activity 2.3);
- ✓ Identify the optimal locations for potential water well drilling with regard to success of striking water table and keeping safe spacing to avoid over abstraction (activity 2.3);
- ✓ Develop an app to display results of the AI system, support drilling decisions,and collect well completion report data (activity 2.4).

Activities proposed by Global MapAid, United Kingdom:

- ✓ Collaborate on needs assessments to determine priority development areas;
- ✓ Consult the technical teams with Project Management in particular for the team working on innovative smart solutions including Apps that rely on AI methods to support decision making related to water well siting and drilling;
- ✓ Support development and testing of the proposed AI system to be developed;
- ✓ Assist in the creation of a donor sustainability program, with the Arba Minch University Water Technology Institute;
- ✓ Collaboration on AI models processing to predict the depth-to-water table, water yield, and groundwater recharge throughout the project areas and map the results;
- ✓ Participate on the hydrogeological data collection;
- ✓ Facilitate the creation of sustainable excellence center specialize in shallow groundwater extraction and storage technology in the Arba Minch University, premise;
- ✓ Offer encouragement and development consultancy for alternative strategies, for small farm water conservation, in the absence of shallow ground water, using mapping technologies.

Activities proposed by Arba Minch University (AAU):

- ✓ Conduct needs assessments to determine priority development areas and projects;
- ✓ Assess the existing GW infrastructure and rehabilitation options in the project areas;
- ✓ Processing of well completion and socio-economic data as an input to the appropriate formats for the project by inviting students in related field of study from Arba Minch University;
- ✓ Collaboration on detailed groundwater investigation in the Zala Woreda, Gofa Zone (geophysical survey and hydrogeological assessment) in order to building the scheme for construction of production water wells and irrigation system (activity 1.5);
- ✓ Collaboration on artificial intelligence (AI) tools (activity 2.3, 2.4)
- ✓ Provide sustainable infrastructure to house the project outputs to be stored on local server and available resource such as office space, appropriate staff and contact person to facilitate the smooth implementation of the project;
- ✓ Geophysical and hydrogeological surveys on selected project sites (activity 2.5);

- ✓ Designing of well field, distribution system, and storage systems for water supply (activity 2.5);
- ✓ Create a donor sustainability program, in Arba Minch University, Water Technology Institute (activity 2.6);
- ✓ Facilitate the creation of sustainable excellence center specialize in shallow groundwater extraction and storage technology in the Arba Minch University (activity 2.6, 3.1, 3.2)

Activities proposed by Ministry of Water and Energy, Addis Ababa, Ethiopia:

- ✓ Provision of archival data on groundwater from the project areas (activity 1.1);
- ✓ Provision of hydrological data for major rivers draining the project areas (activity 1.1);
- ✓ Support by providing available resources for logistics purpose such as cars and office space in Addis Ababa for the project team;
- ✓ Collaboration on detailed groundwater investigation in the Zala Woreda, Gofa Zone (administrative support) in order to building the scheme for construction of production water wells and irrigation system (activity 1.5);
- ✓ Cooperation on AI tools APP (activity 2.4);
- ✓ Facilitate sending of water samples for advance analysis such as (Isotopic analysis)
- ✓ Cooperation on establishing of interactive on-line information system on groundwater resources (activity 2.6);
- ✓ Act as focal institute to liaise in all aspects of the project implementation including requirements for arranging permissions to travel to Ethiopia as needed in the project and communicating with project stakeholders (activity 3.2).

Activities proposed by Ircon, Czech Republic

- ✓ Selection of drilling sites and preparation of drilling principles (activity 2.4);
- ✓ Preparation of water drilling and groundwater lifting optimization (spacing, over-abstraction) (activity 3.2).

Activities proposed by All For Soil (AFS), Czech Republic

- ✓ Collaboration on the compilation of archival data – soil (activity 1.1);
- ✓ Cooperation on geological mapping of the Gofa zone – assessment of soil environment (activity 1.2);

Name of the partner organization	Contribution (financial / in-kind)	Relevant activities/outputs
Czech Geological Survey	Provision of available data, the partial salary of participating experts, administrative expenses. From CDA: 14 233 500 Kč In-kind: 3 521 000 Kč (8%)	Coordination and administration of all activities by partner organizations and cooperation on following activities: Activity 1.1 Activity 1.2 Activity 1.3 Activity 1.5 Activity 2.1 Activity 2.6
Charles University, Prague, Czech Republic	Access to limited satellite data, coverage of web map services to host the project outputs. From CDA: 8 785 000,00 Kč In-kind: 0	Cooperation on following activities: Activity 1.1 Activity 1.2 Activity 1.4 Activity 1.5 Activity 2.2 Activity 2.3 Activity 2.4 Activity 2.6 Activity 3.1
Arba Minch University	Provision of available data, the salary of participating counter-part experts, logistical support through provision of capital goods at no cost other than consumable expenses such as Cars and Geophysical instruments at the disposal of the University during field work. From CDA: 1 500 000,00 Kč In-kind: 750 000 Kč	Cooperation on the following activities. Activity 1.1 Activity 1.5 Activity 2.4 Activity 2.6 Activity 3.2

Ministry of Water and Energy (MWE), Addis Ababa, Ethiopia	Provision of available data, arrangement of office space, salary of participating counter-part experts, administrative matters related to travel permits to enter Ethiopia and work in the localities of the project target areas, logistical support through provision of capital goods at no cost other than consumable expenses such as field cars at the disposal of the MoWEduring field work. From CDA: 1 500 000,00 Kč In-kind: 750 000 Kč	Responsible for communicating and facilitating permits and letters to Ethiopia and Regional as well as sectoraloffices. Oversee the smooth implementation of all project activities from the implementation country's (Ethiopia) side. Also key role in Activity 1.1 Activity 1.2 Activity 1.4 Activity 1.5 Activity 2.5 Activity 2.6 Activity 3.2

Aquacon, Ethiopia	Drilling at minimal rate of cost, adjust the drilling schedule to fit the project needs From CDA: 1 630 000,00 Kč In-kind: 0	Cooperation on the following activities: Activity 1.1 Activity 1.2 Activity 1.4 Activity 2.4 Activity 2.5 Activity 3.2 Activity 3.3
Geotechnika Prague, Czech Republic	Compilation of necessary hydrogeological maps, consolidation of database of water points and drilling reports, processing of new field and analytical hydrogeological data obtained by mapping of Gofa Zone, selection of drilling sites and preparation of drilling principles, etc. From CDA: 4 825 000,00 Kč In-kind: 0	Cooperation on the following activities: Activity 1.1 Activity 1.2 Activity 1.3 Activity 1.4 Activity 1.5 Activity 2.1 Activity 2.2 Activity 2.3 Activity 2.5 Activity 2.6 Activity 3.2 Activity 3.3

George Mason University, Washington, USA	Devote their already developed prototype AI model to aid the efficient deployment and customization to fit new demands and criteria of the project. From CDA: 3 960 000,00 Kč In-kind: 0	Responsibility for implementation of AI tools Activity 2.3 Activity 2.4
Global MapAid, United Kingdom	Create platform to communicate donors in Ethiopia that complement the project activities, mobilize higher level decision makers in the implementation Country (Ethiopia) to give due attention to the project implementation From CDA: 1 840 000,00 Kč In-kind: 0	Cooperate on the following activities. Activity 2.3 Activity 2.4 Activity 2.5 Activity 2.6 Activity 3.2 Activity 3.3
Ircon, s. r. o. Czech Republic	Collaboration on drilling and related infractucture building at minimal rate of cost. From CDA: 300 000 Kč In-kind: 0	Activity 2.4 Activity 3.2
All For Soil (AFS) Czech Republic	Collaboration on geoscience maps on 1:100,000 scale compilation From CDA: 600 000 Kč In-kind: 0	Acitivity 1.1 Activity 1.2

Table 3 – Overview of the partner organizations contributions to the project implementation.

Research team members	**Field of expertise and function**	**Practical experience**	**Responsibility for particular outputs**
Assoc. Prof. RNDr. Kryštof Verner, Ph.D. Czech Geological Survey; Charles University	Main coordinator of the Project. Expertise: Structural geology and geological mapping	19 years of experience in the fields of structural geology and geological mapping, 7 years of a leadership of Foreign Development Cooperation (FDC) project in Ethiopia.	Main project coordinator, geological mapping, tectonics
RNDr. Jiří Šíma Geotechnika a.s.	Deputy coordinator of the Project. Expertise: Hydrogeology	40 years of experience in the field of hydrogeology in Africa.	Hydrogeological parts of relevant outputs
Mgr. Jan Jelinek Geotechnika	Hydrogeology / information system	8 years of experience in hydrology, water protection management and contaminant hydrogeology, 4 years of experience in catastrophe modelling and data processing	Preparation of hydrogeological data for information system
Mgr. Zenaw Tessema Aquacon Engineering plc	Hydrogeology, procurement	38 years of experience in hydrogeology in Ethiopia	Collection of latest data, preparation of ToR for drilling, supervision of drilling
Leta A. Megressa, MSc., Ph.D Czech Geological Survey	Project Management. Expertise: Tectonics, engineering geology and geological hazards	Over 15 years of experience in the fields of engineering geology, structural geology and geological hazards. Currently an employee of the Czech Geological Survey	Geoscience mapping, Deputy project coordinator
Assoc. Prof. Jiří	Hydrogeology	Over 20 years of experience	Tutor of two Ethiopian

Bruthans, Ph.D Charles University		in the field of hydrogeology, namely environmental tracers, isotopic techniques, groundwater dating, field hydrogeology, estimation of recharge and base flow. Since 2002 teacher at CharlesUniversity and researcher at Czech Geological Survey. Field experiences from USA, Iran, Georgia, Jordan, South Africa, Germany etc.	PhD and MSc students at Chares University, working on topics closely connected to project. Evaluation of hydrochemical data from study area including geochemical modelling. Sampling and analysis on isotopic methods and groundwater dating.
Jan Valenta, Ph.D Charles University	Geophysics	14 years of experience in the field geophysical research	Geophysical data assessment
Jan Franěk, Ph.D Czech Geological Survey	Geological modelling	18 years of experience in tectonic and modelling in geological sciences	3D geological modelling
Karel Martínek, Ph.D. Charles University	Sedimentology, remote sensing, geoinformation systems. Geological mapping of sedimentary formations	24 years in the field of sedimentology, 18 years in the fields of remote sensing and geoinformation systems, FDC projects in Ethiopia, British Guyana and Afghanistan, other geological expeditions in Iran, Namibia and Argentina. 22 years of teaching experience at the Faculty of Science, Charles University in Prague.	Geostatistical modelling, web GIS map creation, publishing, web map application development, field mapping, other necessary field data acquisition.
Ondřej Noll, MSc. Czech Geological Survey	Hydrogeology	16 years of experience in hydrogeology and modelling 10 years of experience in Ethiopia and Peru	Water balance modelling

Tomas Vranek, MSc.	Hydrogeology	16 years of experience in hydrology monitoring 10 years of experience in Ethiopia, Georgia and Moldova	Acquisition and processing of field hydrogeological data
Mekuanent Muluneh, MSc University of Charles, Arba Minch University	Hydrosystem Modelling	8 years of experience in demand driven research in sustainable water resources management	Ph.D student at the Charles University in Prague.
Prof. Kathryn Blackmond Laskey George Mason University	AI System design & testing	Over 30 years' experience at the forefront of computer science.	AI tools
Wanru Li, Ph.D George Mason University	AI System design & testing	PhD student at George Mason University, with MODL as her research subject.	AI tools
Rupert Douglas-Bate MBA, MSc.	Project management	Over 20 years' experience in humanitarian & development work and sustainability.	Dissemination of the project outputs
Dr. Abdella Kemal, Ph.D AMU, Scientific Director of Arba Minch Water Technology	Water Resources Engineer	Over 13 years of experience in teaching and conducting demand research in water institutions. Participated in different water development and design projects.	Regional hydrogeological research

Dr. Samuel Dagalo, Ph.D AMU, Director of Water Resources Research Center	Irrigation Engineering and Water Resources Management	Over 13 years of field experience in water development (NGO) and over 15 years of teaching and research experience in the areasof Hydrology, IrrigationEngineering and management.	Regional hydrogeological research
Muhudin Abdela, MSc. Ministry of Water and Energy	Hydrogeology	Over 25 years of experience at various levels of practice and leadership in	Administrative coordinator (MoWE)

Table 4. – Key memgers of implementation team and their working experience

8. PRESENTATION OF DEVELOPMENT COOPERATION

The progress of the project and intermediate results will be communicated through pamphlets that will be periodically prepared. Further available means of print and state media as well as social media platforms will be established through which project activities will be posted in pictures, videos and explanatory texts. Outreach media is envisaged to be engaged at the beginning and end of the project to give due attention to the causes and needs of the project for the country's development effort. Workshops will be held to handover outputs and demonstrate the usage as well as continuation in sustainable manner. In the Czech Republic, the project outputs will be promoted on major newspapers which address relevant topics in their column.

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Wanru Li, Muluneh M, Laskey KB, Douglas-Bate R, and Houser P (2021). MODL Study Technical Report: Using Machine Learning to Predict Depth to Water Table.

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Struktura rozpočtu projektu *"název projektu"*

Příloha č. 2 k Zápisu č.j. 280829/2023-ČRA

Náklady projektu (celkem):	Jednotka	Počet jednotek	Jednotková cena (v CZK)	Celkové náklady projektu (v CZK)	Z prostředků ZRS ČR	in-kind (CGS)	in-kind (partner)
Prosíme před vyplněním pozorně přečíst list Instrukce k vyplnění							
1. Osobní náklady (mzdové náklady včetně zákonných odvodů na zdravotní a sociální pojištění nebo náklady na experty)							
1.1 Management							
1.1.1 Odborný garant projektu (Kryštof Verner)	den	34,29	3500,00	**120000,00**	60000,00	60000,00	0,00
1.1.2 Koordinátor projektu (Leta Megerssa)	den	29,71	3500,00	**104000,00**	52000,00	52000,00	0,00
1.1.3 Administrace projektu a účetnictví (Miroslava Konrádová)	den	30,00	3000,00	**90000,00**	45000,00	45000,00	0,00
1.2 Experti / konzultanti							
1.2.1 Oblast datové rešerše a správy	den	31,43	3500,00	**110000,00**	110000,00	0,00	0,00
1.2.2 Oblast geologické mapování a zpracování map	den	485,71	3500,00	**1700000,00**	850000,00	850000,00	0,00
1.2.3 Oblast 3D geologického modelování	den	51,43	3500,00	**180000,00**	180000,00	0,00	0,00
1.2.4 Oblast hydrogeologického mapování a 3D modelování	den	51,71	3500,00	**181000,00**	181000,00	0,00	0,00
1.2.5 Oblast geostatistických medod a AI	den	31,43	3500,00	**110000,00**	110000,00	0,00	0,00
1.2.6 Oblast budování kapacit a diseminace výstupů projektu	den	31,43	3500,00	**110000,00**	110000,00	0,00	0,00
1.2.7. DPP (externí experti)	den	15,00	1500,00	**22500,00**	22500,00	0,00	
1. Osobní náklady - mezisoučet	**den**	**792,14**		**2727500,00**	**1720500,00**	**1007000,00**	**0,00**
2. Cestovní náklady							
2.1 Cestovné							
2.1.1 Mezinárodní cestovné	zpát. let/jízda	5,00	25000,00	**125000,00**	125000,00	0,00	0,00
2.1.2 Pozemní doprava (místo realizace)	měsíc	1,00	25000,00	**25000,00**	25000,00	0,00	0,00
2.1.3 Letecká doprava (místo realizace)	zpát. let	4,00	5000,00	**20000,00**	20000,00	0,00	0,00
2.1.4 Doprava v ČR	cesta	1,00	25000,00	**25000,00**	25000,00	0,00	0,00
2.1.5 Náklady na provoz vlastního vozidla	km	1,00	25000,00	**25000,00**	25000,00	0,00	0,00
2.1.6 Víza	osoba	5,00	2000,00	**10000,00**	10000,00	0,00	0,00
2.1.7 Pojištění	osoba	5,00	5000,00	**25000,00**	25000,00	0,00	0,00
2.1.8 Ubytování	noc	150,00	1000,00	**150000,00**	150000,00	0,00	0,00
2.2 Zdravotní příprava							
2.2.1 Covid test	osoba	5,00	500,00	**2500,00**	2500,00	0,00	0,00
2.2.2 Očkování	osoba	5,00	2500,00	**12500,00**	12500,00	0,00	0,00
2.2.3 Léky	sada	5,00	1000,00	**5000,00**	5000,00	0,00	0,00
2.2.4 Bezpečnostní školení	osoba	0,00	0,00	**0,00**	0,00	0,00	0,00
2.3 Diety							
2.3.1 Mezinárodní	osobo/den	150,00	1400,00	**210000,00**	210000,00	0,00	0,00
2.3.2 Místní	osobo/den	0,00	0,00	**0,00**	0,00	0,00	0,00
2. Cestovní náklady - mezisoučet				**635000,00**	**635000,00**	**0,00**	**0,00**
3. Vybavení a dodávky zboží							
3.1 Dlouhodobý nehmotný majetek							
3.1.1 Software	lumpsum	1,00	100000,00	**100000,00**	50000,00	50000,00	0,00
3.1.2 Ocenitelná práva	lumpsum	0,00	0,00	**0,00**	0,00	0,00	0,00
3.1.3 Ostatní (*kancelářské potřeby*)	lumpsum	5,00	5000,00	**25000,00**	25000,00	0,00	0,00
3.2 Dlouhodobý hmotný majetek							
3.2.1 Pozemky, stavby (*specifikovat*)	m²	0,00	0,00	**0,00**	0,00	0,00	0,00
3.2.2 Výpočetní technika (*specifikovat*)	kus	5,00	10000,00	**50000,00**	50000,00	0,00	0,00
3.2.3 Ostatní (*specifikovat*)			0,00	**0,00**	0,00	0,00	0,00
3.3 Zásoby, stavební a spotřební materiál aj.							
3.3.1 Nářadí	sada	2,00	2000,00	**4000,00**	4000,00	0,00	0,00
3.3.2 Pohonné hmoty	nádrž	70,00	2000,00	**140000,00**	140000,00	0,00	0,00
3.3.3 Ostatní (*specifikovat*)		0,00	0,00	**0,00**	0,00	0,00	0,00
3. Vybavení a dodávky zboží - mezisoučet				**319000,00**	**269000,00**	**50000,00**	**0,00**
4. Přímé náklady v místě realizace							
4.1 Pronájem nemovitostí							
4.1.1 Kancelářské prostory (*konkrétní místo*)	měsíc	2,00	20000,00	**40000,00**	0,00	0,00	40000,00
4.1.2 Konferenční prostory (*místo/konkrétní aktivity*)	den	1,00	10000,00	**10000,00**	10000,00	0,00	0,00
4.1.3 Školicí prostory (*místo/konkrétní aktivity*)	den	1,00	10000,00	**10000,00**	0,00	0,00	10000,00
4.2 Služby související s pronájmem nemovitostí							
4.2.1 Poplatky za telefon/internet	měsíc	1,00	10000,00	**10000,00**	10000,00	0,00	0,00
4.2.2 Poplatky za energie (voda, plyn, elektřina)	měsíc	12,00	5000,00	**60000,00**	0,00	0,00	60000,00
4.2.3 Ostatní (*specifikovat*)	0	0,00	0,00	**0,00**	0,00	0,00	0,00
4.3 Drobný materiál a služby							
4.3.1 Kancelářské potřeby	kus	5,00	10000,00	**50000,00**	50000,00	0,00	0,00
4.3.2 Nájemné za movité věci (zařízení, stroje, náčiní aj.)	kus	0,00	0,00	**0,00**	0,00	0,00	0,00
4.3.3 Kopírování, skenování, tisk	stránka	150,00	1500,00	**225000,00**	125000,00	0,00	100000,00
4.3.4 Ostatní (*kurzové rozdíly*)	paušál	0,00	638,00	**638,00**	638,00	0,00	0,00
4. Přímé náklady v místě realizace - mezisoučet				**405638,00**	**195638,00**	**0,00**	**210000,00**
5. Subdodávky (služby plně zajištěné externí dodávkou)							
5.1 Průzkumné, stavební, montážní, servisní, aj. technické práce							
5.1.1 Geotechnika (datová rešerše, hydrogeologické mapování)	den	300,00	5000,00	**1500000,00**	1500000,00	0,00	0,00
5.1.2 Aquacon (datová podpora - Etiopie)	den	250,00	2000,00	**500000,00**	500000,00	0,00	0,00
5.2 Expertní služby (studie, technická dokumentace, výzkum aj.)							
5.2.1 PřFUK (hydrogeologický a geofyzikální průzkum)	výstup služby	1,00	2800000,00	**2900000,00**	2900000,00	0,00	0,00
5.2.2 George Mason University, USA (AI expertiza)	výstup služby	1,00	1200000,00	**1200000,00**	1200000,00	0,00	0,00
5.2.3 Global Map Aid, UK (výuka expertů v praktických dopadech)	výstup služby	1,00	560000,00	**560000,00**	560000,00	0,00	0,00
5.2.4 All For Soil (pedologie) / Ircon (vrty infrastruktura)	výstup služby	1,00	450000,00	**450000,00**	450000,00	0,00	0,00
5.3 Doprava materiálu a zboží (včetně cla a pojištění)							
5.3.1 *doprava vzorků do ČR*	materiál/zboží	1,00	15000,00	**15000,00**	15000,00	0,00	0,00
5.3.2 *pojištění - doprava*	materiál/zboží	1,00	5000,00	**5000,00**	5000,00	0,00	0,00
5.4 Služby jiného typu							
5.4.1 Půjčovné za osobní automobily	den	120,00	3000,00	**360000,00**	180000,00	0,00	180000,00
5.4.2 Překlady, tlumočení	den	1,00	15000,00	**15000,00**	15000,00	0,00	0,00
5.4.3 Finanční služby (bankovní poplatky apod.)	služba	1,00	5000,00	**5000,00**	5000,00	0,00	0,00
5.4.4 Organizační výpomoc (konference, semináře, školení)	den	30,00	10000,00	**300000,00**	50000,00	0,00	250000,00
5.4.5 Ostatní (*specifikovat*)	0	0,00	0,00	**0,00**	0,00	0,00	0,00
5. Subdodávky - mezisoučet				**7810000,00**	**7380000,00**	**0,00**	**430000,00**
6. Přímá podpora cílovým skupinám							
6.1 Podpora účastníkům školení, workshopů, studijních cest apod.							
6.1.1 Cestovné, stravné	osoba	2,00	80000,00	**160000,00**	160000,00	0,00	0,00
6.1.2 Ubytování	osoba	2,00	80000,00	**160000,00**	160000,00	0,00	0,00
6.1.3 Úhrada poplatků (stipendia, registrace aj.)	osoba	2,00	140000,00	**280000,00**	280000,00	0,00	0,00
6.2 Ostatní přímá podpora (specifikovat)							
6.2.1 Arba Minch University (podpora partnerské instituce)	suma	1,00	750000,00	**750000,00**	500000,00	0,00	250000,00
6.2.2 Ministry of Water and Energy (podpora partnerské instituce)	suma	1,00	750000,00	**750000,00**	500000,00	0,00	250000,00
6. Přímá podpora cílovým skupinám - mezisoučet				**2100000,00**	**1600000,00**	**0,00**	**500000,00**
7. Ostatní přímé náklady projektu							
7.1 Ostatní (*analytické práce - geochemie vod a hornin*)	suma	1,00	450000,00	**450000,00**	350000,00	100000,00	0,00
7. Ostatní přímé náklady projektu - mezisoučet				**450000,00**	**350000,00**	**100000,00**	**0,00**
8. Celkové přímé náklady projektu				**14447138,00**	**12150138,00**	**1157000,00**	**1140000,00**
				kofinanc:		**8%**	**8%**

Příloha č. 4 Zápisu č.j. 280829/2023-ČRA: Časový harmonogram

Časový harmonogram aktivit projektu "Zlepšení kvality života zajištěním dostupnosti a udržitelným nakládáním s vodními zdroji v regionu Sidama a zónách Gamo a Gofa, Etiopie"

Předpokládaný kalendářní měsíc / rok	**2023**												**2024**												**2025**												**2026**											
Aktivity/měsíce od zahájení projektu	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**;**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Řízení projektu							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Komplexní hodnocení zdrojů podzemních vod pro region Sidama, zóny Gamo a Gofa																																																
Aktivita 1.1 – Rešerše a reinterpretace geologických a hydrogeologických zájmových oblastí regionu Sidama, zóny Gamo a Gofa;							x	x	x	x	x	x	x	x	x	x	x	x																														
Aktivita 1.2 – Geologické, hydrogeologické a (půdní) mapování zóny Gofa v měřítku 1:100 000													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Aktivita 1.3 - 3D modelování geologické stavby (přípravná fáze pro hydrogeologické modelování);							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x										
Aktivita 1.4 - Geochemické a hydrochemické zhodnocení prostředí podzemních vod;													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Aktivita 1.5 – Podrobná analýza hydrogeologického a půdního prostředí v oblasti Zala;																			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Identifikace hladin podzemních vod pomocí konvenčních hydrogeologických metod, geostatistiky a umělé inteligence																																															
Aktivita 2.1 – Odhad hladiny podzemní vody a možné vydatnosti identifikované konvenčními hydrogeologickými metodami;																			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Aktivita 2.2 – Geostatistické modelování prostorového rozložení podzemních vod;													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Aktivita 2.3 – Aplikace nástrojů umělé inteligence (AI) pro analýzu prostorového rozložení podzemních vod;													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Aktivita 2.4 – Tvorba APP s nástroji umělé inteligence (AI).																															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Aktivita 2.5 – Identifikace potenciálních vrtných lokalit a vrtání mělkých hydrogeologických vrtů																									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
Aktivita 2.6 Vývoj interaktivního on-line informačního systému o zdrojích podzemních vod;																																					x	x	x	x	x	x	x	x	x	x	x	x
Zvyšování dovedností etiopských odborníků																																															
Aktivita 3.1 - Magisterské a doktorské studium vybraných odborníků v ČR na téma projektu;							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Aktivita 3.2 - Praktické školení etiopských expertů a místní správy ve všech parametrech projektu;							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Aktivita 3.3 – Školení o využití a šíření výstupů projektu.																																											x	x	x	x	x	x

Příloha č. 2 Zápisu č.j. 280829/2023-ČRA: Matice logického rámce

Matice logického rámce – Improving the quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofa zones (SNNP Region), Ethiopia.

	Popis projektu (intervenční logika)	**Objektivně ověřitelné ukazatele** (indikátory)	**Zdroje ověření ukazatelů**	**Předpoklady a rizika** Viz kapitola 4.4 projektového dokumentu.
Záměr	Hlavním záměrem projektu je naplnit „Cíle udržitelného rozvoje (SDGs)“ definované členskými státy Organizace spojených národů v roce 2015 jako všeobecnou výzvu k akci k ukončení chudoby, ochraně planety a zajištění toho, aby všichni lidé do roku 2030 měli mír a prosperitu. Patří sem především SDGs 6. „Čistá voda a sanitace“ (kapitoly 6.1, 6.4, 6.6), SDGs 9. „Průmysl, inovace a infrastruktura“ (kapitoly 9.1, 9.2) a SDGs 15 „Život na souši“ (kapitoly 15,1, 15,2, 15,3).			
Cíle	1) Charakterizovat, zlepšovat, rozvíjet a chránit zdroje podzemních vod v regionu Sidama a v zónách Gamo a Gofa regionu SNNP pomocí nových geostatistických metod a metod umělé inteligence. 2) Integrace poznatků a shromážděných hydrogeologických a geologických dat do uceleného systému pro pokročilé využití v dalším socioekonomickém rozvoji Etiopie.			
Výstupy	1) Ucelená databáze současného stavu poznání v oblasti geologické stavby a hydrogeologického prostředí (databáze vrtného průzkumu, chemické složení podzemních vod atd.) regionu Sidama, zóně Gamo a Gofa.	1) Soubor geologických a hydrogeologických map v měřítku 1:100 000 a textové vysvětlivky zóny Gofa regionu SNNP; 2) 3D geologický model studovaného území s interaktivními prostředky pro extrakci	1) Výroční zprávy o řešení projektu a renomované statistiky 2) Webové stránky a on-line interaktivní aplikace s výstupy projektu	

	2) Soubor geologických a hydrogeologických map v měřítku 1:100 000 a doprovodná vysvětlující kniha pro zónu Gofa. 3) 3D geologické modely pro všechny cílové oblasti pomocí softwarových nástrojů MOVE 4) Souborná kniha popisující hydrogeologické prostředí všech cílových území. 5) Prediktivní modely odhadu hladiny podzemní vody a vydatnosti s využitím konvenčních hydrogeologických přístupů, které v konečném důsledku poskytují odhad zásoby podzemní vody ve studovaných oblastech. 6) Geostatisticky a nástroji umělé inteligence odhadované dostupnosti podzemních vod pro modelování optimálních míst vrtů. 7) Identifikace perspektivních vrtných míst pro mělkou těžbu podzemních vod. 8) Realizace 3 hydrogeologických vrtů pro monitorování hladiny podzemní vody a účely domácího použití a zavlažovací služby (dle dohody s MoWE a ČRA) 9) Interaktivní, webový informační systém zdrojů podzemních vod pro region Sidama a zóny Gamo a Gofa. 10) Zvýšení expertní znalosti místní správy, aby mohla rozhodovat o řízení přírodních zdrojů. 11) Detailní zhodnocení hydrogeologického prostředí v oblasti Zala (západní část zóny Gofa) za účelem tvorby prováděcí studie na výstavbu zavlažovacího systému.	relevantních geologických informací pro vyhodnocení potenciálu podzemních vod v jakékoli části studovaného území; 3) Počítačové simulace a parametry podzemních vod (celková zásoba, optimální intenzita jímání, rychlost doplňování, variabilita hloubky hladiny pod terénem, kvalita vody); 4) Charakteristika geochemických hydrochemických parametrů (složení) podzemních vod v zájmové oblasti. 5) Prediktivní modely založené na geostatistice a umělé inteligenci (AI), které předpovídají distribuci zásob podzemních vod v kterékoli oblasti studie s ohledem na přírodní i socioekonomické podmínky (potřeby místních lidí, farmářů atd.); 6) Identifikované potenciální oblasti pro udržitelné umístění vrtaných studní v přelidněných oblastech na základě vyvinutých konvenčních, geostatistických a AI modelů; 7) Přehled oblastí navržených pro optimální realizaci vrtů ve studované oblasti určené pro zavlažování; 8) Realizace tří vrtů pro monitoring dynamiky podzemní vody, případně zásobování domácností vodou a zavlažování domácností (poháněné solární energií); 9) Interaktivní webový informační systém o zdrojích podzemní vod spolu s vysvětlujícím textem; 10) Interaktivní, snadno použitelné aplikace, které lze nainstalovat do mobilních telefonů/tabletů využívajících vstupní parametry k predikci optimálního	3) Publikované mapové a textové výstupy / publikace dostupné ve vědeckých databázích / nakladatelstvích. 4) Prezenční listiny, výkazy o studiu, diplomové / disertační práce studentů, výsledky testů získaných znalostí.	

		umístění, hloubky a vydatnosti vrtů podzemní vody pomocí vyvinuté umělé inteligence; 11) Zvýšení počtu absolventů univerzity (AMU) v oboru hydrogeologie a hydrologie; 12) Zřízení školícího modulu o optimalizaci vrtů pro jímání podzemní vody v prostorách Arba Minch University (AMU) a také jinde v Etiopii, který bude k dispozici všem nevládním organizacím zabývajícím se vrtáním studní; 13) Komplexní příručka shrnující nezbytné kroky při vrtání mělkých studní. 14) Sestavní technické prováděcí studie na efektivní využití půdního fondu a výstavbu zavlažovacího systému v oblasti Zala (západní část zóny Gofa).		
Aktivity	Aktivita 1.1 – Rešerše a reinterpretace geologických a hydrogeologických zájmových oblastí regionu Sidama, zóny Gamo a Gofa; Aktivita 1.2 – Geologické, hydrogeologické a (půdní) mapování zóny Gofa v měřítku 1:100 000 Aktivita 1.3 - 3D modelování geologické stavby (přípravná fáze pro hydrogeologické modelování); Aktivita 1.4 - Geochemické a hydrochemické zhodnocení prostředí podzemních vod; Aktivita 1.5 – Podrobná analýza hydrogeologického a půdního prostředí v oblasti Zala; Aktivita 2.1 – Odhad hladiny podzemní vody a možné vydatnosti identifikované konvenčními hydrogeologickými metodami;	**Prostředky:** Specifikace prostředků k řešení projektu je uvedena v kapitole 7. „Management“ projektového dokumentu. Časový harmonogram je součástí přílohy projektového dokumentu.	**Rozpočet:** Celkové financování související s projektem včetně institucionálního příspěvku činí 2 062 365,83 USD / 46 114 500 CZK (směnný kurz 22,36 CZK/USD); Institucionální příspěvek na řešení projektu (domácí i partnerské instituce; v USD) činní 15,05% z celkové ceny řešení: 310 420 USD / 6 941 000 CZK (směnný kurz 22,36 CZK/USD); Celkové financování související s projektem ze strany ČRA činí 1 751 945,43 USD / 39 173 500 CZK (směnný kurz 22,36 CZK/USD);	

	Aktivita 2.2 – Geostatistické modelování prostorového rozložení podzemních vod; Aktivita 2.3 – Aplikace nástrojů umělé inteligence (AI) pro analýzu prostorového rozložení podzemních vod; Aktivita 2.4 – Tvorba APP s nástroji umělé inteligence (AI). Aktivita 2.5 – Identifikace potenciálních vrtných lokalit a vrtání mělkých hydrogeologických vrtů; Aktivita 2.6 Vývoj interaktivního on-line informačního systému o zdrojích podzemních vod; Aktivita 3.1 - Magisterské a doktorské studium vybraných odborníků v ČR na téma projektu; Aktivita 3.2 - Praktické školení etiopských expertů a místní správy ve všech parametrech projektu; Aktivita 3.3 – Školení o využití a šíření výstupů projektu.		Specifikace viz strukturovaný rozpočet.	
				Výchozí podmínky (vstupní předpoklady): Regionální správa zájmových oblastí a federální vláda Etiopie nadále vykazují silnou podporu

		iniciativám v oblasti tohoto typu rozvojové spolupráce. Partnerské organizace / instituce jsou připravené k úzké spolupráci na řešení projeku. Rozpočtové prostředky na zůstávají dostatečné k dosažení očekávaných výsledků a výstupů. Zájmové oblasti vykazují dobrou bezpečnost a stabilitu. Místní infrastruktura zůstává v uspokojivém stavu pro realizaci projektu.

Plán aktivit na období od 1.7.2023 do 31.12.2026

Název projektu: Improving the quality of life by ensuring availability and sustainable management of water resources in Sidama Region and Gamo and Gofa zones (SNNP Region), Ethiopia

Výstupy a aktivity	Popis aktivit a způsobů naplňování indikátorů	Zdroje ověření	Termín realizace
Řízení projektu	Zajištění realizace, organizačně-technické koordinace a návaznosti projektových aktivit tak, aby byly naplněny v souladu s nastaveným harmonogramem projektu a tímto plánem, včasná identifikace a zajištění náhradního řešení v případě omezení průběhu některých aktivit z důvodu aktuální epidemiologické situace	Výroční zprávy o řešení projektu, pololetní a roční projektové zprávy realizátora, řádně, vedené účetnictví, výstupy z monitoringů partnerských organizací v Etiopii, zprávy z monitorovacích misí ČRA a ZÚ.	Viz harmonogram projektu – příloha F05_5_MP17
Výstup 1			
Aktivita 1.1 – Rešerše a reinterpretace geologických a hydrogeologických dat zájmových oblastí regionu Sidama, zóny Gamo a Gofa; Aktivita 1.2 – Geologické, hydrogeologické a (půdní) mapování zóny Gofa v měřítku 1:100 000 Aktivita 1.3 - 3D modelování geologické stavby (přípravná fáze pro hydrogeologické modelování); Aktivita 1.4 - Geochemické a hydrochemické zhodnocení prostředí podzemních vod**;** Aktivita 1.5 – Podrobná analýza hydrogeologického a půdního prostředí v oblasti Zala;	Podrobný popis aktivit a metodiky realizace viz kapitola 4. projektového dokumentu. Mezi hlavní výstupy projektu patří: 1) Soubor geologických a hydrogeologických map v měřítku 1:100 000 a textové vysvětlivky zóny Gofa regionu SNNP; 2) 3D geologický model studovaného území s interaktivními prostředky pro extrakci relevantních geologických informací pro vyhodnocení potenciálu podzemních vod v jakékoli části studovaného území; 3) Charakteristika geochemických hydrochemických parametrů (složení) podzemních vod v zájmové oblasti. 4) Sestavní technické prováděcí studie na efektivní využití půdního fondu a výstavbu zavlažovacího systému v oblasti Zala (západní část zóny Gofa).	1) Výroční zprávy o řešení projektu a renomované statistiky 2) Webové stránky a on-line interaktivní aplikace s výstupy projektu (v anglickém jazyce s rozšířeným abstraktem v amharském jazyce. 3) Publikované mapové a textové výstupy / publikace dostupné ve vědeckých databázích / nakladatelstvích.	Viz harmonogram projektu – příloha F05_5_MP17
Výstup 2			
Aktivita 2.1 – Odhad hladiny podzemní vody a možné vydatnosti identifikované konvenčními hydrogeologickými metodami;	1) Počítačové simulace a parametry podzemních vod (celková zásoba, optimální intenzita jímání, rychlost doplňování, variabilita hloubky ,	1) Výroční zprávy o řešení projektu a renomované statistiky	Viz harmonogram projektu – příloha

Aktivita 2.2 – Geostatistické modelování prostorového rozložení podzemních vod; Aktivita 2.3 – Aplikace nástrojů umělé inteligence (AI) pro analýzu prostorového rozložení podzemních vod; Aktivita 2.4 – Tvorba APP s nástroji umělé inteligence (AI). Aktivita 2.5 – Identifikace potenciálních vrtných lokalit a vrtání 3 hydrogeologických vrtů (2 mělké, 1 hlubší) v úzké koordinaci s příslušným zonálním úřadem dle potřeb místních komunit. Po realizaci vrtů, osazení a monitoringu proběhne předání funkčních vrtů do správy místního úřadu/komunity k volnému užívání, a to včetně krátkého školení o užívání. Dle finančních možností úřadů a úrovně technického zázemí proběhne napojení vrtů na vodovodní síť (pokud existuje). Aktivita 2.6 Vývoj interaktivního on-line informačního systému o zdrojích podzemních vod;	kvalita); 2) Prediktivní modely založené na geostatistice a umělé inteligenci (AI), které předpovídají distribuci zásob podzemních vod v kterékoli oblasti studie s ohledem na přírodní i socioekonomické podmínky (potřeby místních lidí, farmářů atd.); 3) Identifikované potenciální oblasti pro udržitelné umístění vrtaných studní v přelidněných oblastech na základě vyvinutých konvenčních, geostatistických a AI modelů 4) Přehled oblastí navržených pro optimální realizaci vrtů ve studované oblasti určené pro zavlažování; 5) Realizace tří vrtů pro monitoring dynamiky podzemní vody, případně zásobování domácností vodou a zavlažování domácností (poháněné solární energií); 6) Interaktivní webový informační systém o zdrojích podzemní vod spolu s vysvětlujícím textem; 7) Interaktivní, snadno použitelné aplikace, které lze nainstalovat do mobilních telefonů/tabletů využívajících vstupní parametry k predikci optimálního umístění, hloubky a vydatnosti vrtů podzemní vody pomocí vyvinuté umělé inteligence; 8) Zvýšení počtu absolventů univerzity (AMU) v oboru hydrogeologie a hydrologie; 9) Zřízení školícího modulu o optimalizaci vrtů pro jímání podzemní vody v prostorách Arba Minch University (AMU) a také jinde v Etiopii, který bude k dispozici všem nevládním organizacím zabývajícím se vrtáním studní; 10) Komplexní příručka shrnující nezbytné kroky při vrtání mělkých studní.	2) Webové stránky a on-line interaktivní aplikace s výstupy projektu 3) Publikované mapové a textové výstupy / publikace dostupné ve vědeckých databázích / nakladatelstvích. 4) fotografie, předávací protokoly, záznamy ze školení, prezenční listiny	F05_5_MP17
Výstup 3			
Aktivita 3.1 - Magisterské a doktorské studium vybraných odborníků v ČR (na základě přijímacího řízení na UK) na téma projektu; Aktivita 3.2 - Praktická školení etiopských expertů a místní správy ve všech parametrech projektu;	1) Zvýšení znalostí místních expertů, pracovníků místních administrativ a představitelů komunit v základních parametrech a výstupech projetku.	Prezenční listiny, výkazy o studiu, diplomové / disertační práce studentů, výsledky testů získaných znalostí.	Viz harmonogram projektu – příloha F05_5_MP17

Aktivita 3.3 – Školení o využití a šíření výstupů projektu.			