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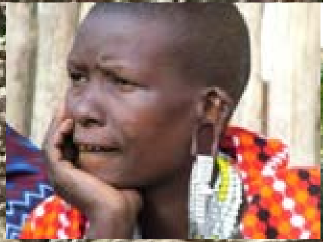


Scarsità o scarsa conoscenza delle risorse idriche sotterranee? Esperienze scientifiche in aree aride e semi-aride del Mediterraneo e dell'Africa Subsahariana.

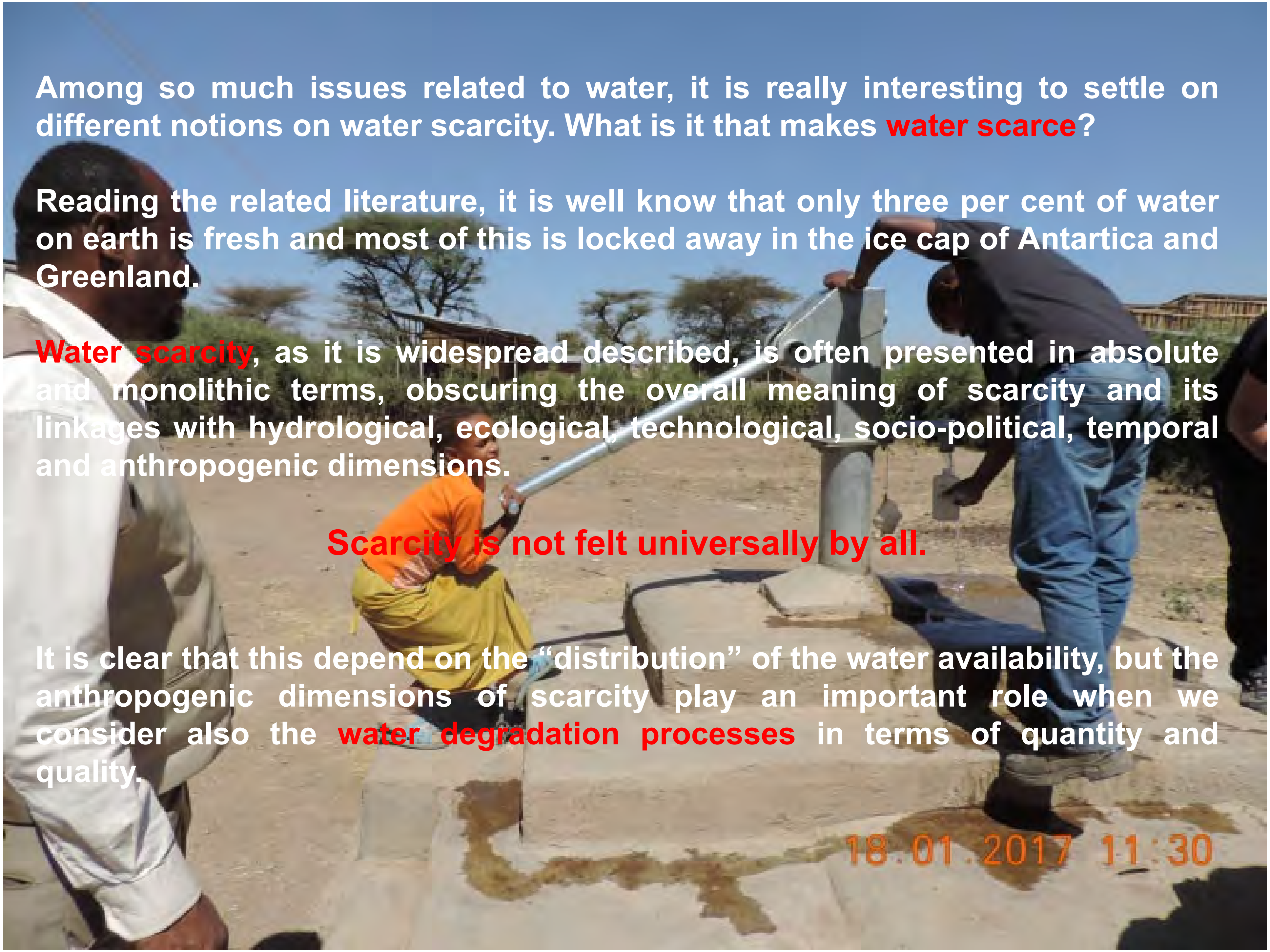
Prof. Giorgio GHIGLIERI:
Dipartimento di Scienze Chimiche e Geologiche
Università degli Studi di Cagliari - e-mail: ghiglieri@unica.it

“Thousands have lived without love, not one without water,”

so W.H. Auden finished his poem “First Things First.”

IL CONSUMO D’ACQUA NEI PAESI INDUSTRIALIZZATI E’ DI CIRCA 250-300 litri/giorno per abitante

IL CONSUMO D’ACQUA NEI PAESI DEL TERZO MONDO E’ DI CIRCA 10-20 litri/giorno per abitante



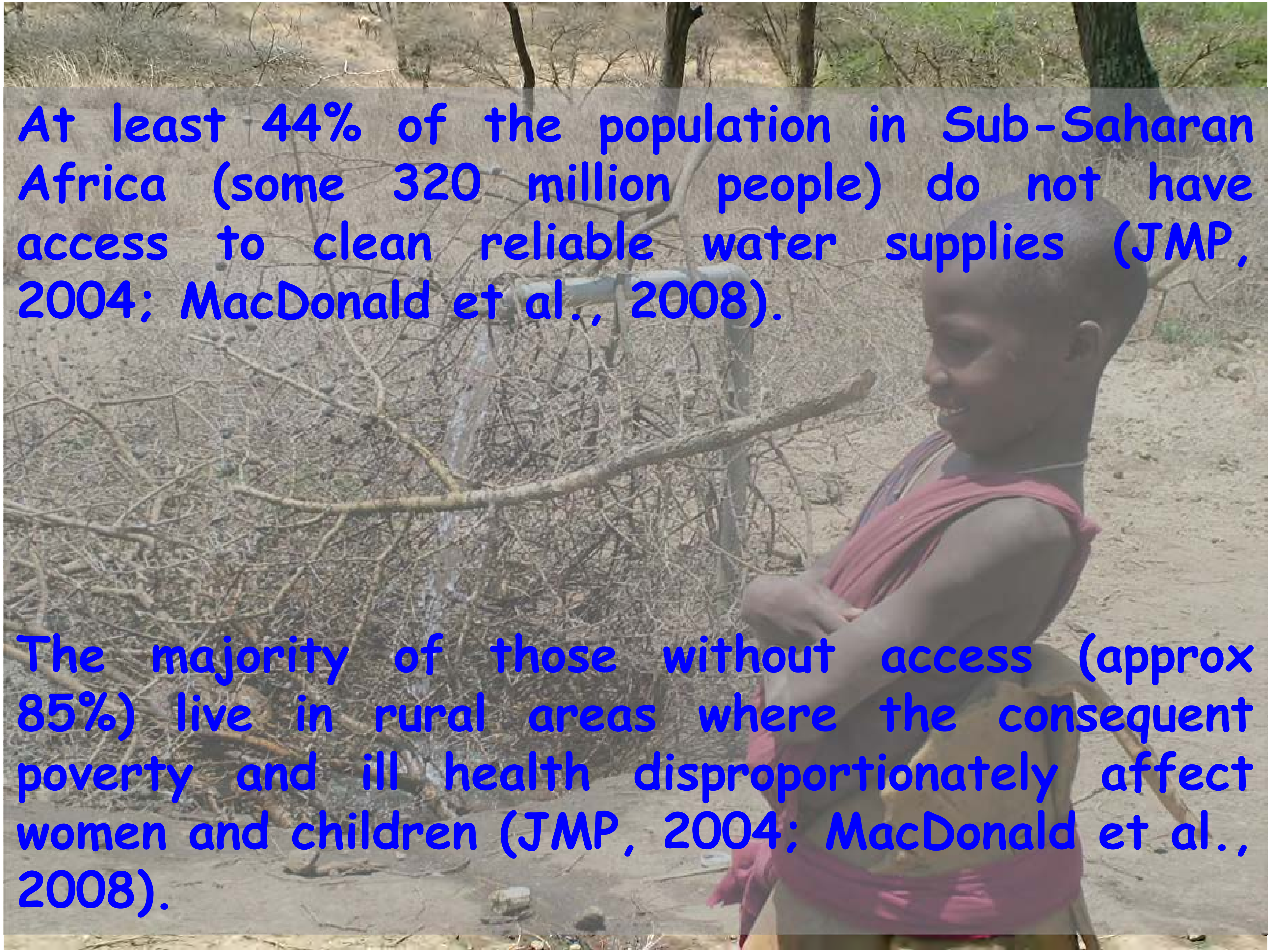
Among so much issues related to water, it is really interesting to settle on different notions on water scarcity. What is it that makes **water scarce**?

Reading the related literature, it is well know that only three per cent of water on earth is fresh and most of this is locked away in the ice cap of Antartica and Greenland.

Water scarcity, as it is widespread described, is often presented in absolute and monolithic terms, obscuring the overall meaning of scarcity and its linkages with hydrological, ecological, technological, socio-political, temporal and anthropogenic dimensions.

Scarcity is not felt universally by all.

It is clear that this depend on the "distribution" of the water availability, but the anthropogenic dimensions of scarcity play an important role when we consider also the **water degradation processes** in terms of quantity and quality.



At least 44% of the population in Sub-Saharan Africa (some 320 million people) do not have access to clean reliable water supplies (JMP, 2004; MacDonald et al., 2008).

The majority of those without access (approx 85%) live in rural areas where the consequent poverty and ill health disproportionately affect women and children (JMP, 2004; MacDonald et al., 2008).

In response, the international community has set the Millennium Development Goals (MDGs) which commit the UN membership to halve the proportion of people who are unable to reach, or afford, safe drinking water by the year 2015 (United Nations, 2000).

The most important international Organisations, like the WHO (World Health Organization) and the United Nations General Assembly (UN), declared the period 2005-2015 as the International Decade for the Action "Water for Life" aiming at supplying almost of 15-20 daily/litre/inhabitants to developing countries populations.

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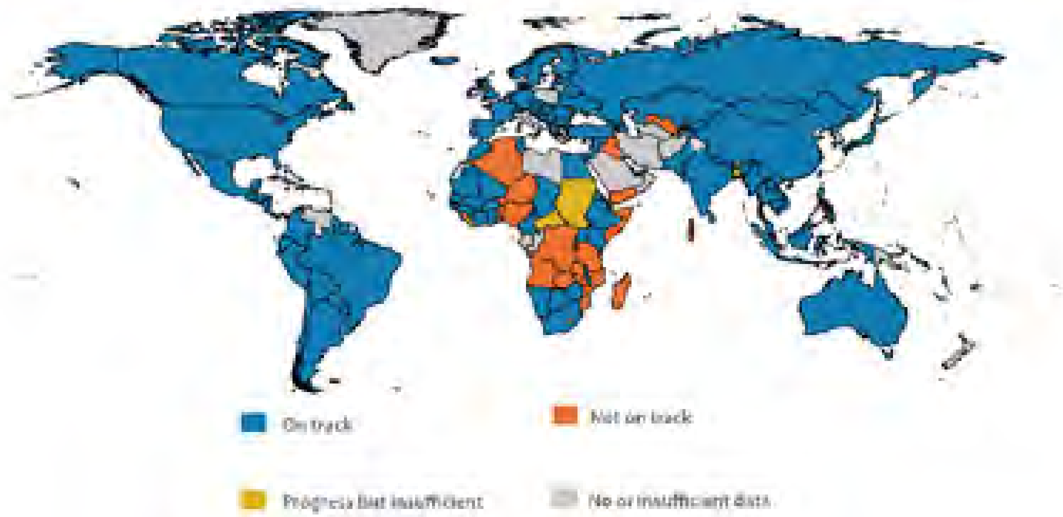
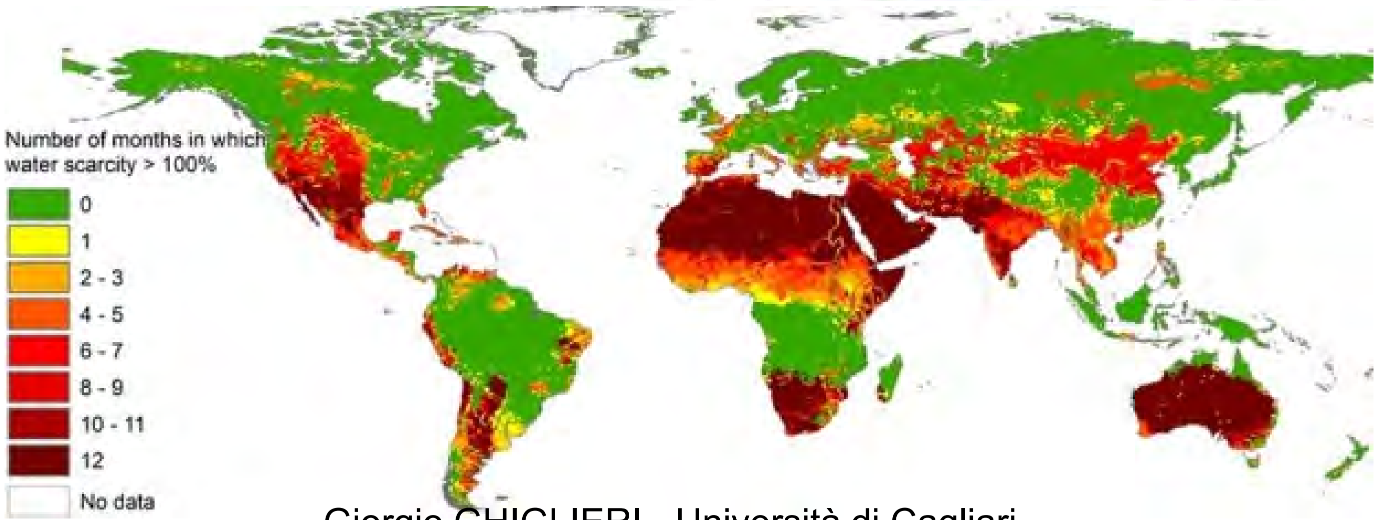
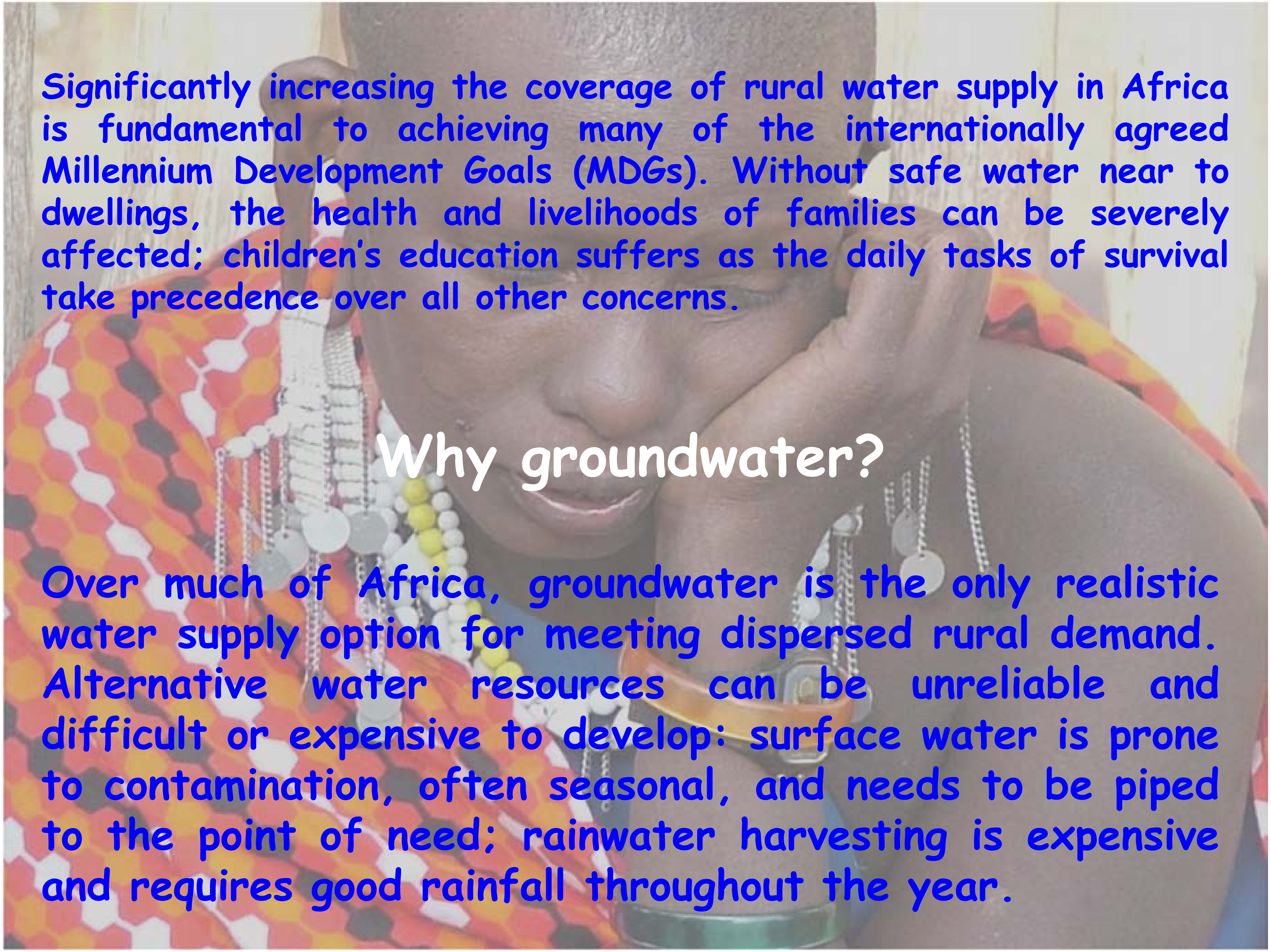
Some progress for drinking water:
If the current trend continues, sub-Saharan Africa will not reach MDG water target



Progress towards the MDG drinking water target, 2006
UNICEF/WHO JMP '08





Significantly increasing the coverage of rural water supply in Africa is fundamental to achieving many of the internationally agreed Millennium Development Goals (MDGs). Without safe water near to dwellings, the health and livelihoods of families can be severely affected; children's education suffers as the daily tasks of survival take precedence over all other concerns.

Why groundwater?

Over much of Africa, groundwater is the only realistic water supply option for meeting dispersed rural demand. Alternative water resources can be unreliable and difficult or expensive to develop: surface water is prone to contamination, often seasonal, and needs to be piped to the point of need; rainwater harvesting is expensive and requires good rainfall throughout the year.

Why groundwater?

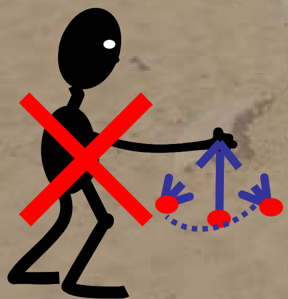
The characteristics of groundwater make it well suited to the more demand responsive and participatory approaches of rural water and sanitation programmes:

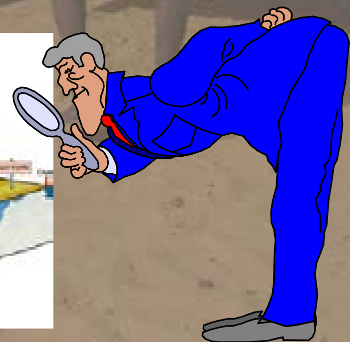
• Groundwater resources are often resistant to drought.
• Groundwater can generally be found close to the point of demand (if you look hard enough with appropriate expertise).
• Groundwater is generally of excellent natural quality and requires no prior treatment.
• Groundwater can be developed incrementally, and often accessed cheaply.
• Technology is often amenable to community operation and management.
• Groundwater is naturally protected from contamination.

Knowledge and Data are not readily available
Critical (Research) Gaps

Frequently, many rural water supply projects suffer from very little hydrogeological input. Instead, they are seen only in terms of engineering problems: e.g. drilling, pump installation, tanks and taps (Davies, 2008).

There are some risks inherent in proceeding with large increases in groundwater use without a scientific approach and sustainable management to groundwater development (Davies, 2008).



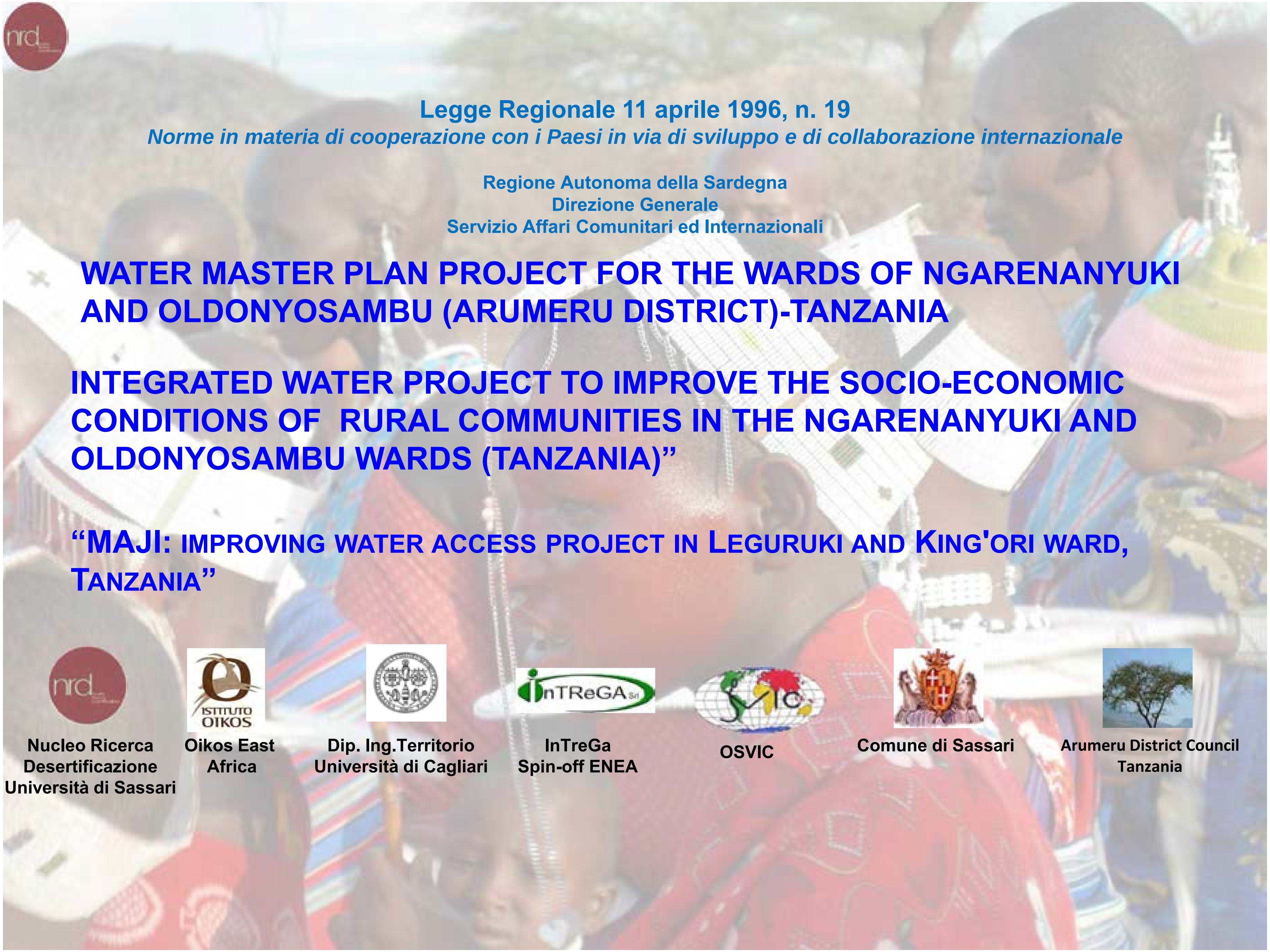


Water Shortages: A Driver of Conflicts?

"Ten years ago – even five years ago – few people paid much attention to the arid regions of western Sudan. Not many noticed when fighting broke out between farmers and herders, after the rains failed and water became scarce."

"We can change the names in this sad story. Somalia. Chad. Israel. The occupied Palestinian territories. Nigeria. Sri Lanka. Haiti. Colombia. Kazakhstan. All are places where shortages of water contribute to poverty."

Ban Ki-moon, UN Secretary-General, 2008



Legge Regionale 11 aprile 1996, n. 19

Norme in materia di cooperazione con i Paesi in via di sviluppo e di collaborazione internazionale

Regione Autonoma della Sardegna
Direzione Generale
Servizio Affari Comunitari ed Internazionali

WATER MASTER PLAN PROJECT FOR THE WARDS OF NGARENANYUKI AND OLDONYOSAMBU (ARUMERU DISTRICT)-TANZANIA

INTEGRATED WATER PROJECT TO IMPROVE THE SOCIO-ECONOMIC CONDITIONS OF RURAL COMMUNITIES IN THE NGARENANYUKI AND OLDONYOSAMBU WARDS (TANZANIA)"

"MAJI: IMPROVING WATER ACCESS PROJECT IN LEGURUKI AND KING'ORI WARD, TANZANIA"

Nucleo Ricerca Desertificazione Università di Sassari

Oikos East Africa

Dip. Ing.Territorio Università di Cagliari

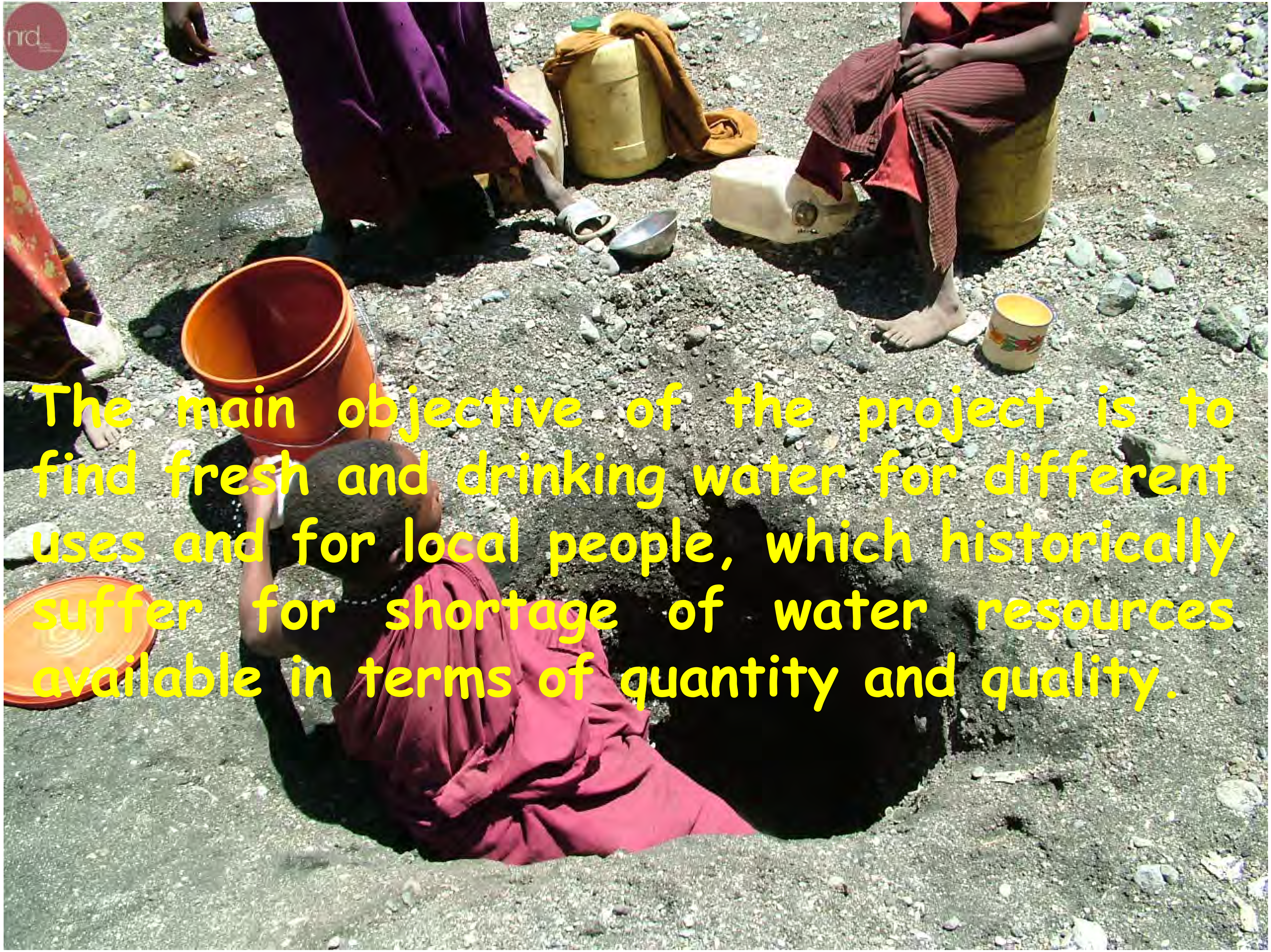
InTreGa Spin-off ENEA

OSVIC

Comune di Sassari

Arumeru District Council Tanzania

Giorgio GHIGLIERI - Università di Cagliari


The main objective of the project is to find fresh and drinking water for different uses and for local people, which historically suffer for shortage of water resources available in terms of quantity and quality.

WMP FOR THE WARDS OF NGARENANYUKI AND OLDONYOSAMBU (ARUMERU DISTRICT) – TANZANIA HYDROGEOLOGICAL AND GEOPHYSICAL RESEARCHES

REGIONE AUTONOMA DELLA SARDEGNA
ITALY

- poverty level;
- enviromental degradation;
- impoverishment of pasture lands;
- **quantitative** and **qualitative** *(High fluoride content)* degradation of water resources;

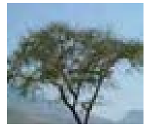
PARTNERSHIP:

ISTITUTO OIKOS

Oikos East Africa

University of Sassari (ITALY)

Fa Test (ITALY)



...cil

Concentrazione (mg/l)	*Effetti sulla salute*
0.0	Crescita limitata
0.0-0.5	Carie dentarie
0.5-1.5	Previene l'indebolimento dei denti con effetti benefici sulla loro salute
1.5-4.0	Fluorosi dentaria (chiazzatura dei denti)
4.0-10.0	Fluorosi dentaria. Fluorosi scheletrica (dolori alla schiena e alle ossa del collo)
>10.0	Fluorosi deformante

The standard quality of domestic water (recomanded fluoride concentration):

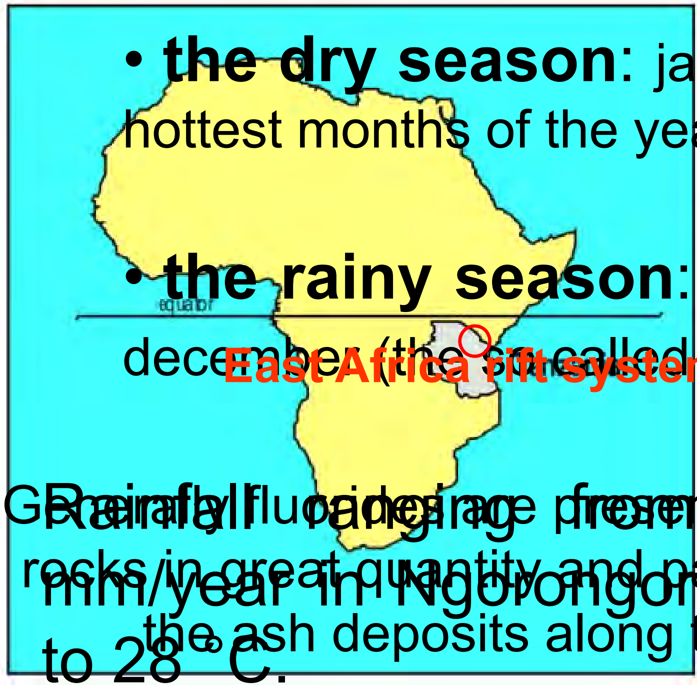
•WHO Guideline **1,5mg/l**

•Tanzania Standard for rural and domestic water **8,0mg/l**

STUDY AREA

Approximately 440 km^2, located in the northern part of the Arumeru district, is bounded by the M.Meru (4565 m a.s.l.) and the Arusha National Park. Includes 9 villages belonging to the Oldonyo Sambu and Ngarenanyuki Wards

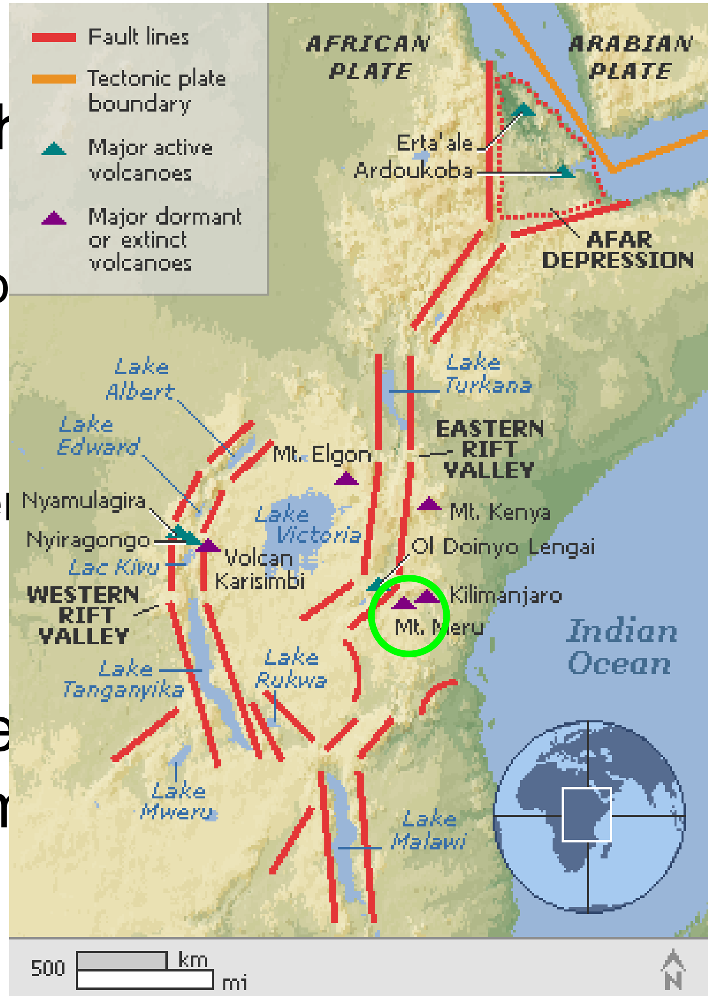
Climate is generally semi-arid, with … **:**



- **the dry season**: january, septemeb… …e hottest months of the year;
- **the rainy season**: rains are concen… …d december (the so called *small rains*) and …

Rainfall ranging from 400 mm/ye… …0 mm/year in Ngorongoro. Annual tem… …0 to 28 °C.

Generally fluorides are present in volcanic rocks in great quantity and particularly in the ash deposits along the rift.



OBJECTIVES

In this context, this research was aimed at finding fresh and safe groundwater easily deliverable to the Wards that suffer water shortage...

...recognition of homogeneous sub-areas suitable by well drilling or for improving of the springs catchment, or with a combination of both.

This general aim has been pur

action consisting of geological

geophysical and hydrological s

THE RESEARCH ACTIVITIES:

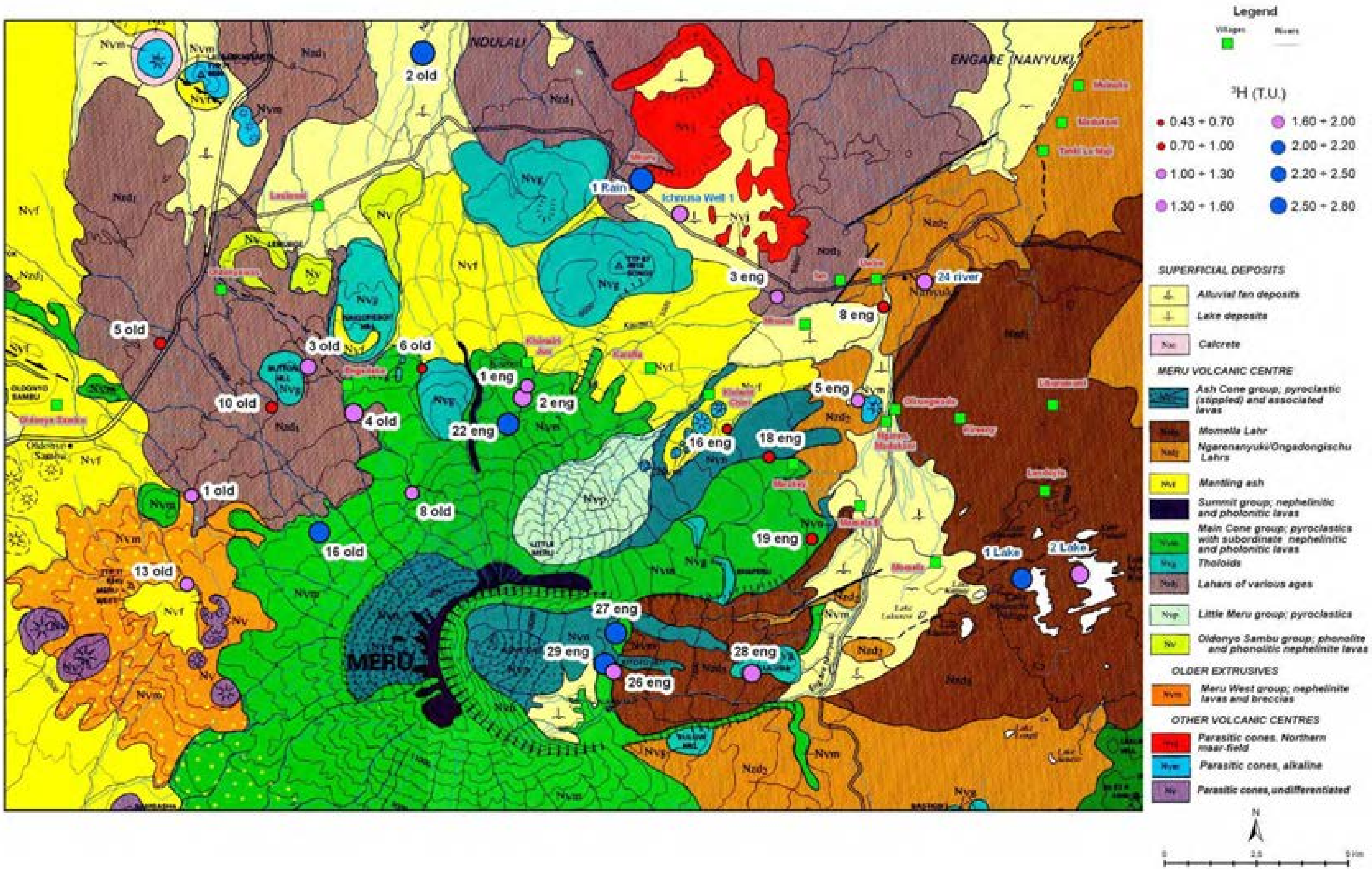
- **Definition of the geological, hy**
setting;

- **Geological and hydrogeologic**

- **Groundwater circulation and r**

RESULTS

SPATIAL DISTRIBUTION OF THE ³H IN WATER SAMPLES



RESULTS

Groundwater circulation and recharge

Shallow groundwater circulation system:
referred to as local systems because of their limited occurrence (sandy river beds)

Recharge occurs by:

- direct infiltration (rainfall);
- infiltration following runoff (volcanic uplands in correspondence of slope changes);
- through lateral systems (aquifer hosted in the weathered and scoriaceous basalts, as in the Mkuru area, at a depth of about 40-60 m below g. l.).

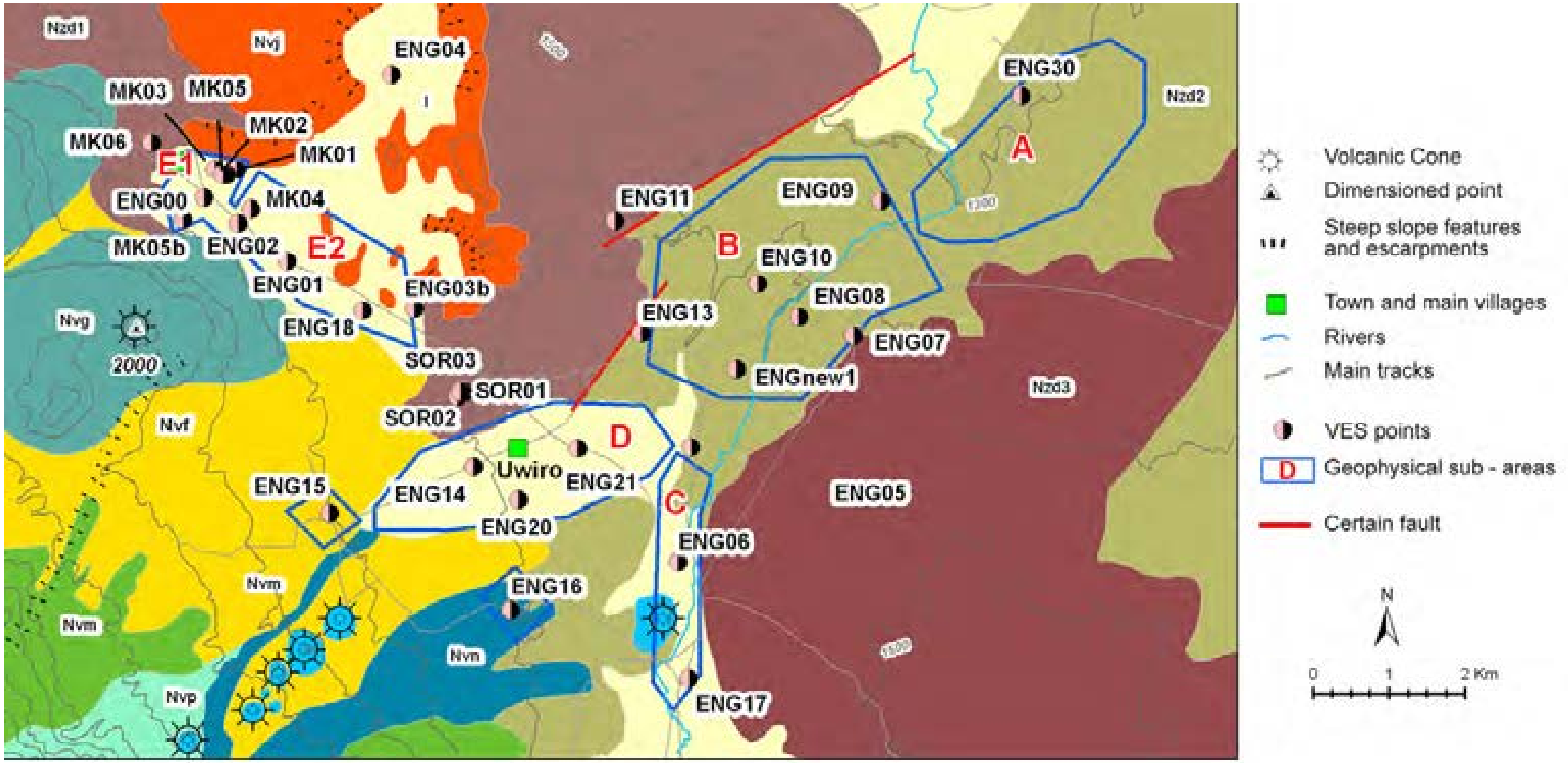
Intermediate and deep groundwater circulation systems:

- by permeability of the aquifers and elevation difference between recharge and discharge areas;
- fracturing and faulting affect brittle rocks over wide areas (e.g. Main cone group complex Nvm)

The groundwater regional flow system, is generally controlled by the morphology and involves a multidirectional flow with the dominant pattern from the higher elevation area in the south, towards the area of lower elevation in the north.

RESULTS

Operative synthesis of the survey results



Ward	Sub-area	Drilling suitability (0 - 5)	Maximum drilling depth (m)
Ngarenanyuki	A	1	40
	B	2	100
	C	1	80
	D	3	80
	E1	2	50
	E2	5	100

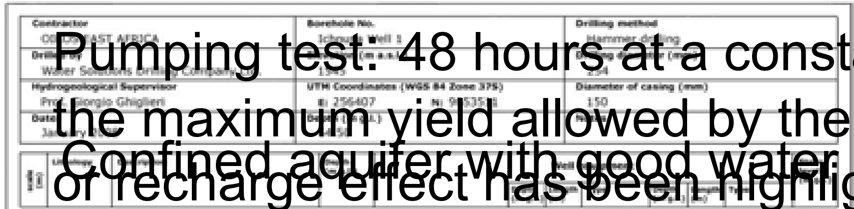
Columns 3 and 4 show, respectively, drilling suitability and a suggested maximum drilling depth. The former is scaled from 0-5, where "0" = do not drill at all, and "5" = area particularly suitable for drilling. The sub-areas in the second column are shown in Figure

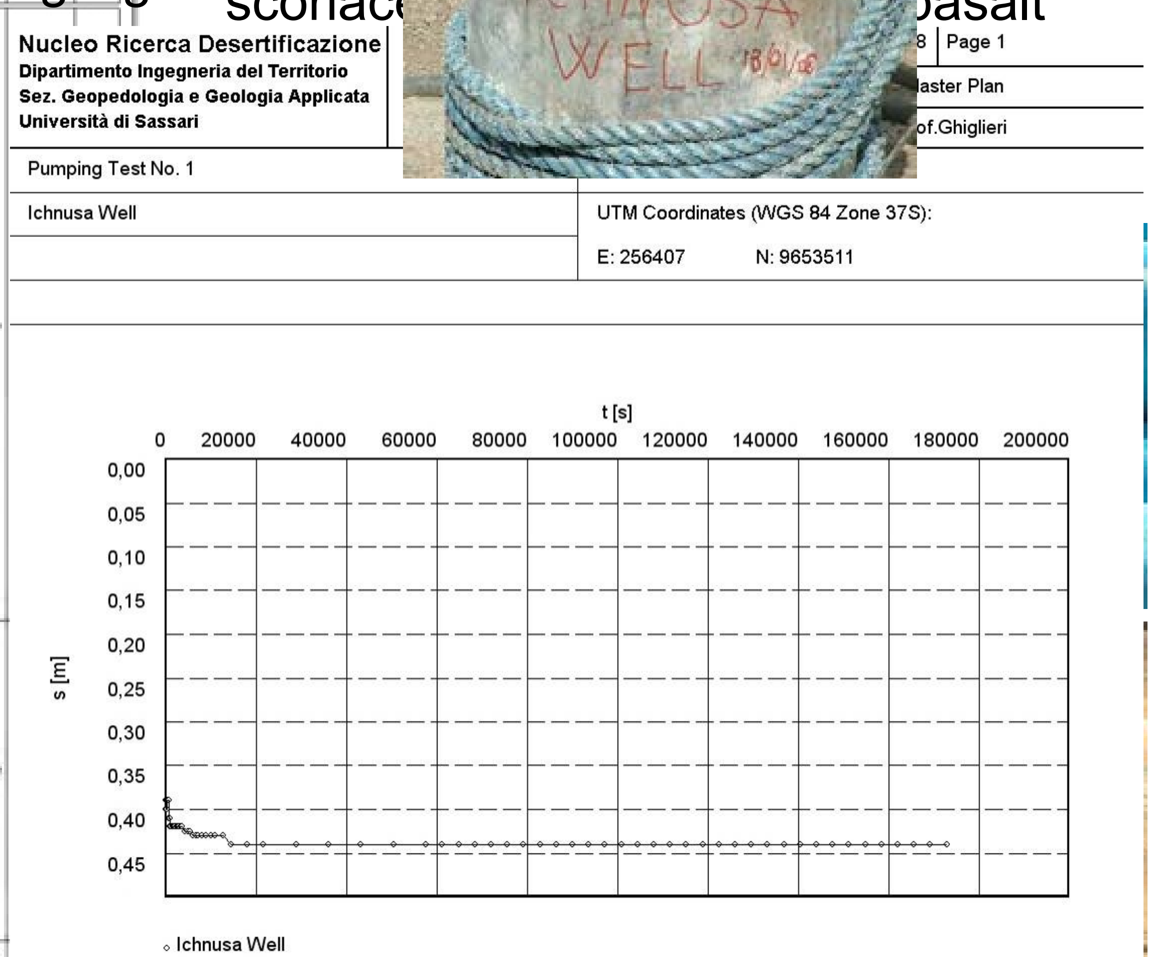
RESULTS: Construction of the borehole Ichnusa Well at Mkuru

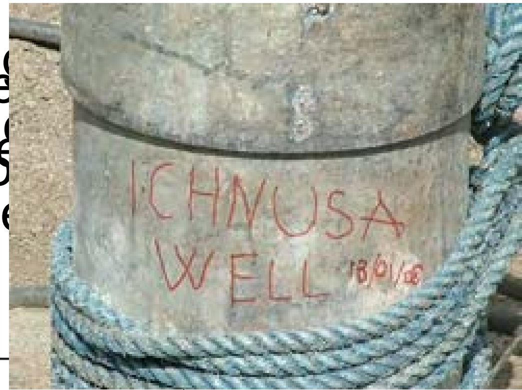
Pumping test: 48 hours at a constant pumping ... was
the maximum yield allowed by the pumping d...
or recharge effect has been highlighted

Thickne... 38 and
69 m be... undary

Confined aquifer with good water quality (fluo... .1 mg/l);
scoriace... basalt








OIKOS
East Africa
REGIONE AUTONOMA DELLA SARDEGNA
ITALY
DISTRICT COUNCIL
MRADI HUU WA MAJI MKURU-UWIRO
UNATEKELEZWA KWA HISANI YA SHIRIKA
LA OIKOS EAST AFRICA KWA KUSHIRIKIANA
NA JAMII YA MKURU MWAKA 2008/09
UMEZINDULIWA LEO TAREHE 10/10/2008
NA MHE..JEREMIA SUMARI(MB) NAIBU WAZIRI
WA FEDHA NA UCHUMI
Ichnusa Well 1

Azioni di sensibilizzazione sul corretto uso dell'acqua scuola di Uwiro (Tanzania)


MZUNGUKO WA TONE LA MAJI
THE WATER CYCLE
Ninaitwa Tone la Maji, niko hapa kukata kiu ya mimea, wanyama na wewe mwenyewe
My name is Tone la Maji. I'm here to quench your crops, other plants, your animal and yourself.
Ona! Unafurahia huduma zangu. Ukima mwema kwangu, mimi ni mwema sana kwako.
Look how now you are enjoying my services. If you are good with me, I can be VERY good for you
KAMA ULINITUMIA VIBAYA, UTAPATA MADHARA!
IF YOU MISSTREAT ME ANYHOW YOU WILL SUFFER THE CONSEQUENCES
Asante kwa kunitumia salama na hukunichafua. Sasa niko tayari kwenda mawinguni kuanza safari upya.
Thank you for using me safely and for never have polluted me. Now I'm ready to come back in the sky, become cloud again, and ready for another cycle.
OIKOS
East Africa
Comune di Sassari
University of Sassari (ITALY)
REGIONE AUTONOMA DELLA SARDEGNA

Project financed by Sardinia Region

REGIONE AUTONOMA DELLA SARDEGNA
ITALY

(L.R. n°26/96 A.F. 2001)

2002 Responsabile scientifico del progetto ***Formazione sull'utilizzo dei Sistemi Informativi Geografici (GIS) per i ricercatori del Department of Geology and Geophysics, Faculty of Science, Addis Ababa University. Un caso pratico: il GIS delle risorse idriche sotterranee dell'area di Makale (Ethiopia nord-orientale).*** Dipartimento di Ingegneria del Territorio dell'Università degli Studi di Sassari. Progetti di mobilità e formazione in favore dei Paesi in via di Sviluppo

L.R. 19/96 es. 2003

L.R. 19/96 es. 2004

2004-2006 Responsabile del progetto dal titolo ***"Approvvigionamento idrico di due comunità agricole nell'area di Shenkora (Etiopia centrale): indagini idrogeologiche e pedologiche di dettaglio per l'individuazione dei siti più idonei per la realizzazione di pozzi di captazione e per la caratterizzazione dei suoli in funzione della risposta produttiva alle pratiche irrigue" I Anno***, in collaborazione con Department of Geology and Geophysics, Faculty of Science, Addis Ababa University - Dipartimento di Ingegneria del Territorio dell'Università degli Studi di Sassari. *Progetti di cooperazione in favore dei Paesi in via di sviluppo*

L.R. 19/96 es. 2005

2006-2007 Responsabile scientifico per la componente idrogeologica del progetto dal titolo ***"Ottimizzazione e studio dell'uso delle risorse idriche del bacino di Sekota (ETIOPIA)- Messa in esercizio di un pozzo e implementazione della rete idrica cittadina finalizzata al servizio di distribuzione dell'ospedale di Sekota"***, in collaborazione con Hydrocontrol S.p.A., COOPI Italia Dipartimento di Ingegneria del Territorio dell'Università degli Studi di Sassari. *Progetti di cooperazione in favore dei Paesi in via di sviluppo*

L.R. 19/96 es. 2006

2008-2009 Responsabile scientifico ***Integrated water project to improve the socio-economic conditions of rural communities in the Ngarenanyuki and Oldonyosambu Wards (Tanzania)"*** in collaborazione Dipartimento di Ingegneria del Territorio dell'Università degli Studi di Cagliari, Oikos East Africa, Fatest, Comune di sassari. *Progetti di cooperazione in favore dei Paesi in via di sviluppo*

Università di Cagliari

FLOWERED

de - FLuoridation technologies for imprOving quality of WatEr and agRo - animal products along the East African Rift Valley in the context of aDaptation to climate change

www.floweredproject.org

FLOWERED PROJECT

conceptual structure, objectives, operational approach, synergies

Giorgio GHIGLIERI

Department of Chemical and Geological Science - University of Cagliari, Italy

ghiglieri@unica.it

H2020

The FLOWERED Project has received funding from the European Union's Horizon 2020. Grant agreement no. 690378 (Topic: WATER-5c-2015 Type of action: RIA)

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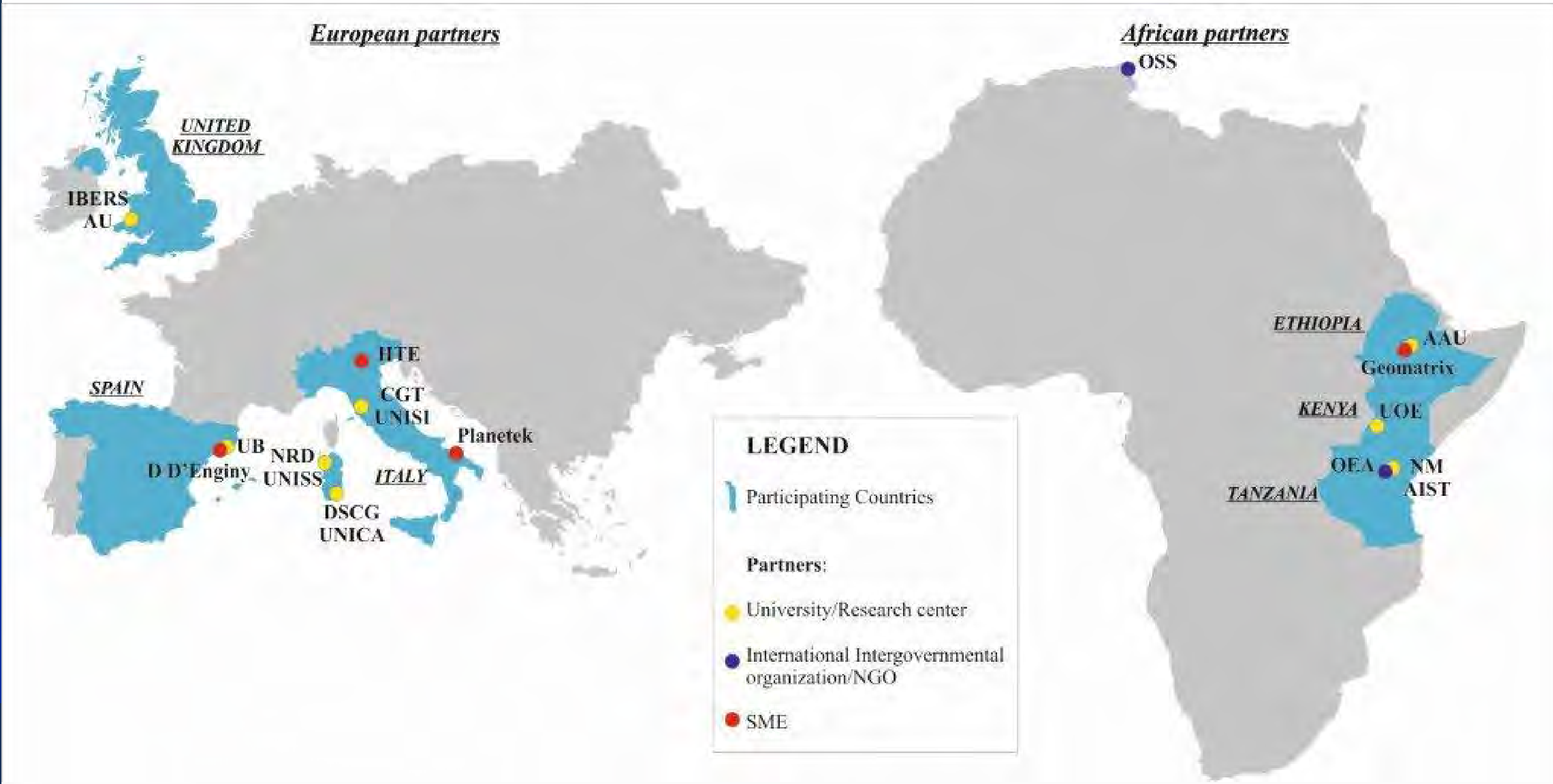
Consortium as a whole

FLOWERED



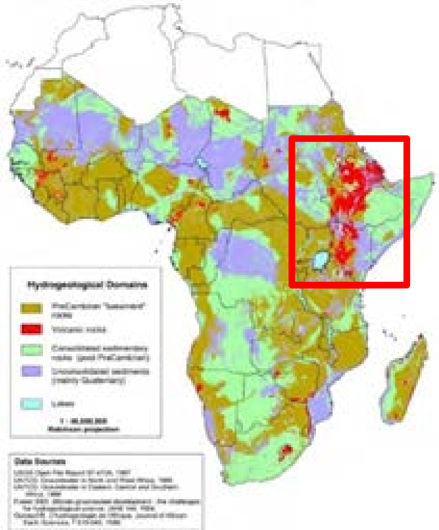
H2020

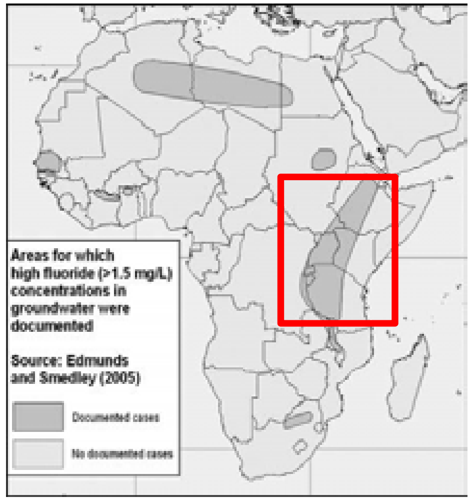
Università di Cagliari

H2020

FRAMEWORK

Fluoride in groundwater of the East African Rift System (EARS)





WHO limits for fluoride in drinking water 1,5 mg/L
High fluoride concentrations have been detected in surface and groundwater within East Africa:

•Ethiopia <u>1.3–300 mg/L</u> (Gizaw, 1996; Alemayehu et al., 2006, Tekle-Haimanot et al., 2006, Ayenew, 2008)

•Kenya up to <u>180 mg/L</u> (Nair et al., 1984; Gaciri and Davies, 1993),

•N Tanzania up to <u>70 mg/L</u> (Ghiglieri et al. 2010, 2012); <u>437 mg/L</u> (Kilham and Hecky, 1973) and <u>12–690 mg/L</u> (Nanyaro et al., 1984)

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de - FLuoridation technologies for imprOving quality of WatEr and agRo - animal products along the East African Rift Valley in the context of aDaptation to climate change

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Consortium as a whole

Università di Cagliari

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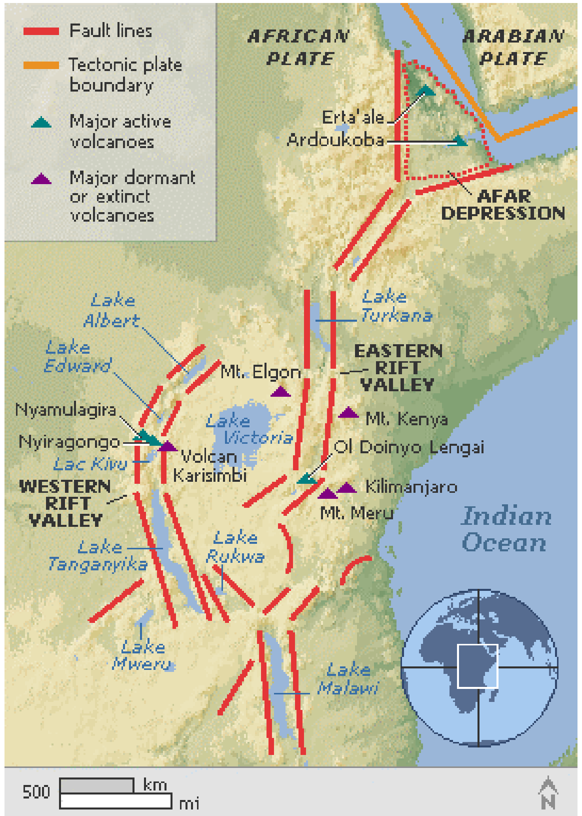
EXCELLENCE

The overall objective of the project is to contribute to the development of a sustainable water management system in areas affected by fluoride contamination in water, soils and food with the aim of improving the living standards of local population.

Call "WATER-5-2014/2015: strengthening international R&I cooperation in the field of water", namely to the topic "WATER 5c) [2015] Development of water supply and sanitation technology, systems and tools, and/or methodologies".



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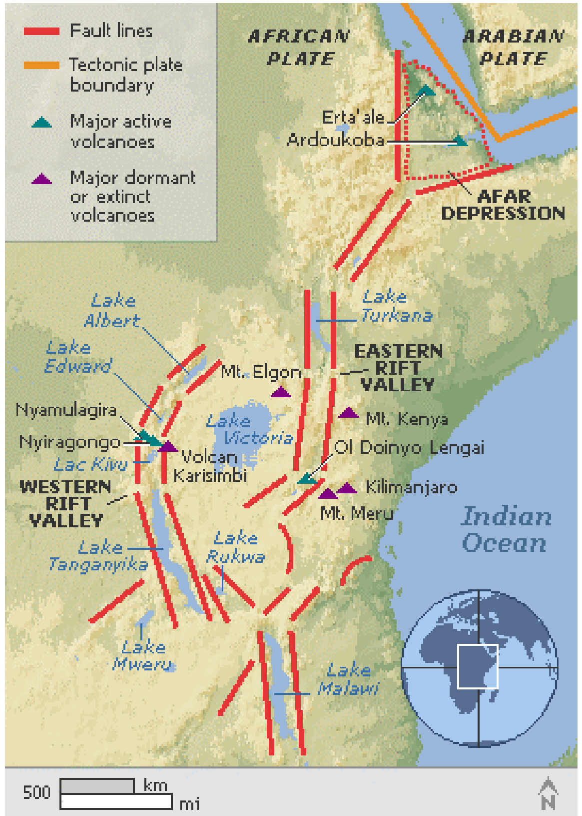
H2020

www.floweredproject.org

EXCELLENCE

Particularly, FLOWERED addresses environmental and health (human and animal) issues related to the fluoride contamination in the African Rift Valley. It will improve the current scientific knowledge on the presence of fluoride in surface water and groundwater as a consequence of water-rock interaction processes, and on its impact on soils and agro-animals products (food security). The project will also investigate the relationships between fluoride contamination of irrigation water and agricultural soils and animal health.



www.floweredproject.org

EXCELLENCE

FLOWERED aims to test innovative defluoridation technologies for drinking water operating mainly at small village scale and to develop an integrated, sustainable and participative water and agriculture management.

Also the optimization of locally used defluoridators, in terms of efficiency, duration, health security, ease of use, production and operating costs, will be pursued.

Integration of advanced scientific research with local knowledge and experiences is expected to provide opportunity to generate new know-how for both scientists and stakeholders, enhance decision making and facilitate the rising of innovative ideas for EU and African enterprises.

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H2020

APPROACH

FLOWERED has a strong interdisciplinary research approach because it implies knowledge of geology, hydrogeology, mineralogy, geochemistry, agronomy, crop and animal sciences, engineering, technological sciences, data management and software design, economics and communication. During 36 months, FLOWERED will be de

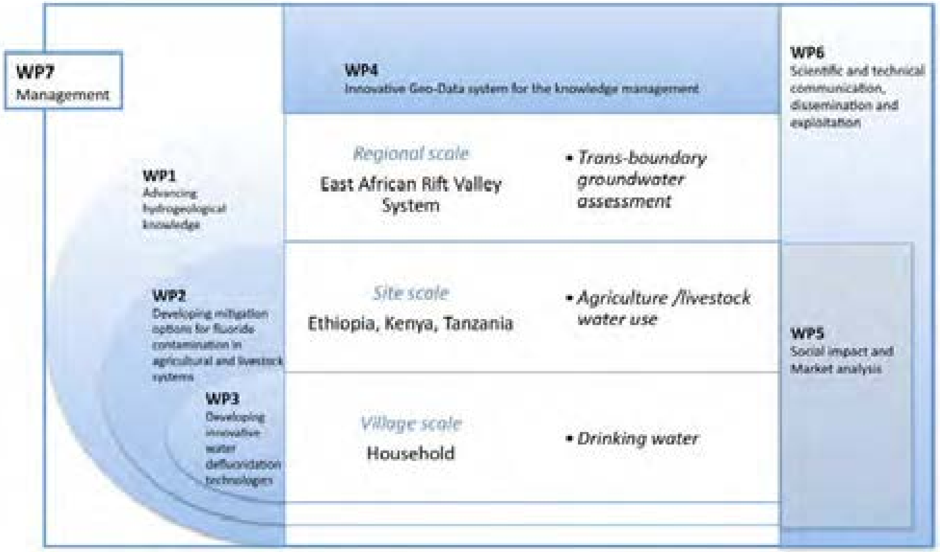

Figure 1.2 FLOWERED is organized in three main activities (WP1, WP2, WP3) supported by a detailed, innovative and shared Geo-data system for the knowledge management (WP4). Specific actions will be dedicated to the market analysis (WP5). The activities of communication, dissemination and exploitation (WP6) will attend the whole project from the beginning as well as those of coordination and management (WP7) that will be organized to guarantee the high scientific and innovative level of the results.

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H2020

APPROACH

FLOWERED has a strong interdisciplinary research approach

- advancing in the geological hydrogeochemical knowledge on the processes associated to the occurrence of fluoride in water bodies, up to the development of a water-body monitoring network (WP1);

- developing mitigation strategies for fluoride contamination in cropping systems, soils and livestock systems (WP2);

- developing innovative, low-cost and sustainable water defluoridation technologies (WP3).

Their activities are constantly supported by a detailed, innovative and shared Geo-data system for knowledge management (WP4).

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H2020

APPROACH

FLOWERED has a strong interdisciplinary research approach

- **The WP5 is devoted to the evaluation of the potential markets for the studied and developed technologies, and to value the social cost and benefits from the project interventions.**

- **A variety of strategic activities (WP6) ensure the successful promotion of the project, dissemination of the scientific knowledge acquired, technology transfer and capacity building, and exploitation of results, and will act as springboard for the upscaling of the proposed techniques and practices from the studied areas in the East African Rift Valley to other countries worldwide.**

- **All along the Project, coordination and management activities (WP7) will guarantee the accomplishment of the objectives and the work plan.**

METHODOLOGY

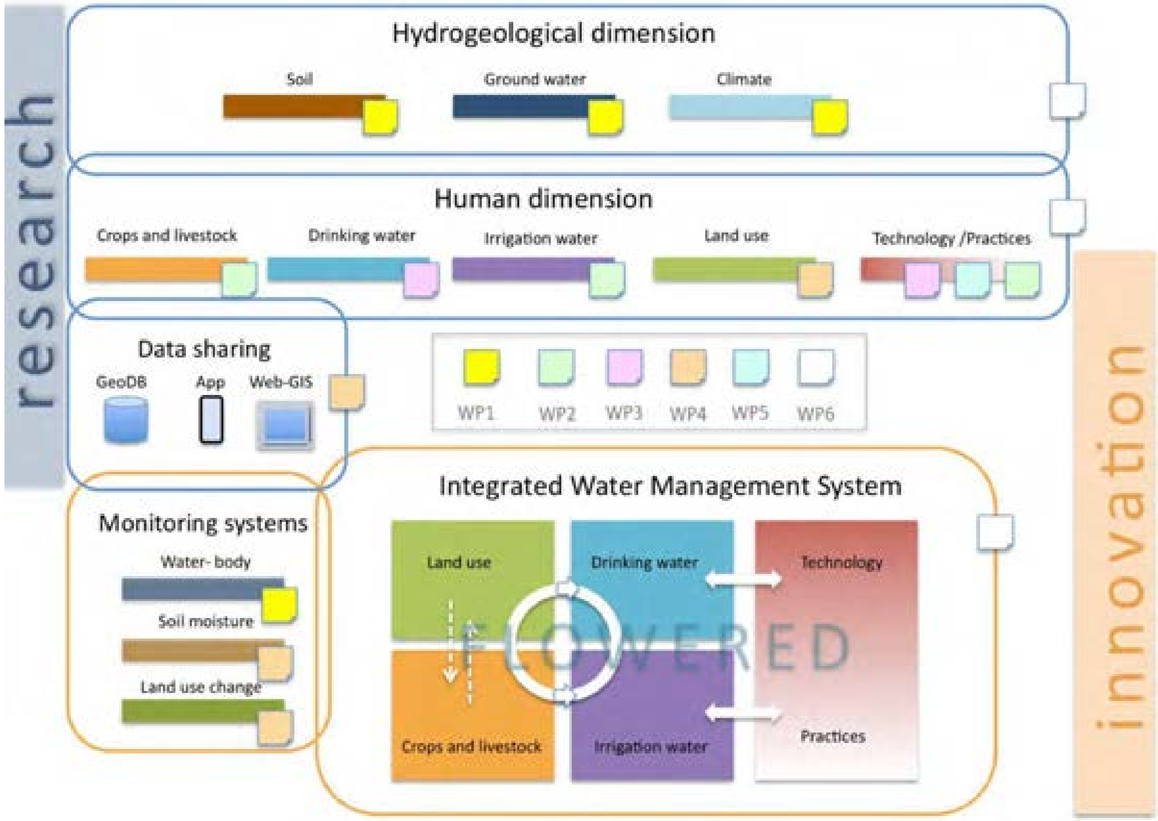


Figure 1.3 FLOWERED methodology is planned to answer to the need to achieve an Integrated Water Management System based on the deep knowledge of the natural and human dimension of the study areas: research (blu boxes) and innovation (orange boxes) activities are overlapped to demonstrate the relationship between them.

Università di Cagliari

FLOWERED

Three main pillars

The structure of FLOWERED work plan is based on three main pillars.

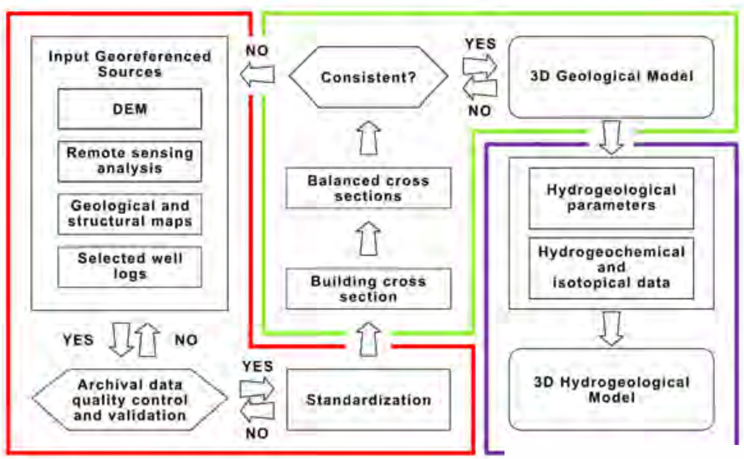
Beyond the state-of-the-art

Improve technology

Address public engagement and social challenges

FLOWERED approach seeks to combine integrative science-based procedures with stakeholder knowledge.

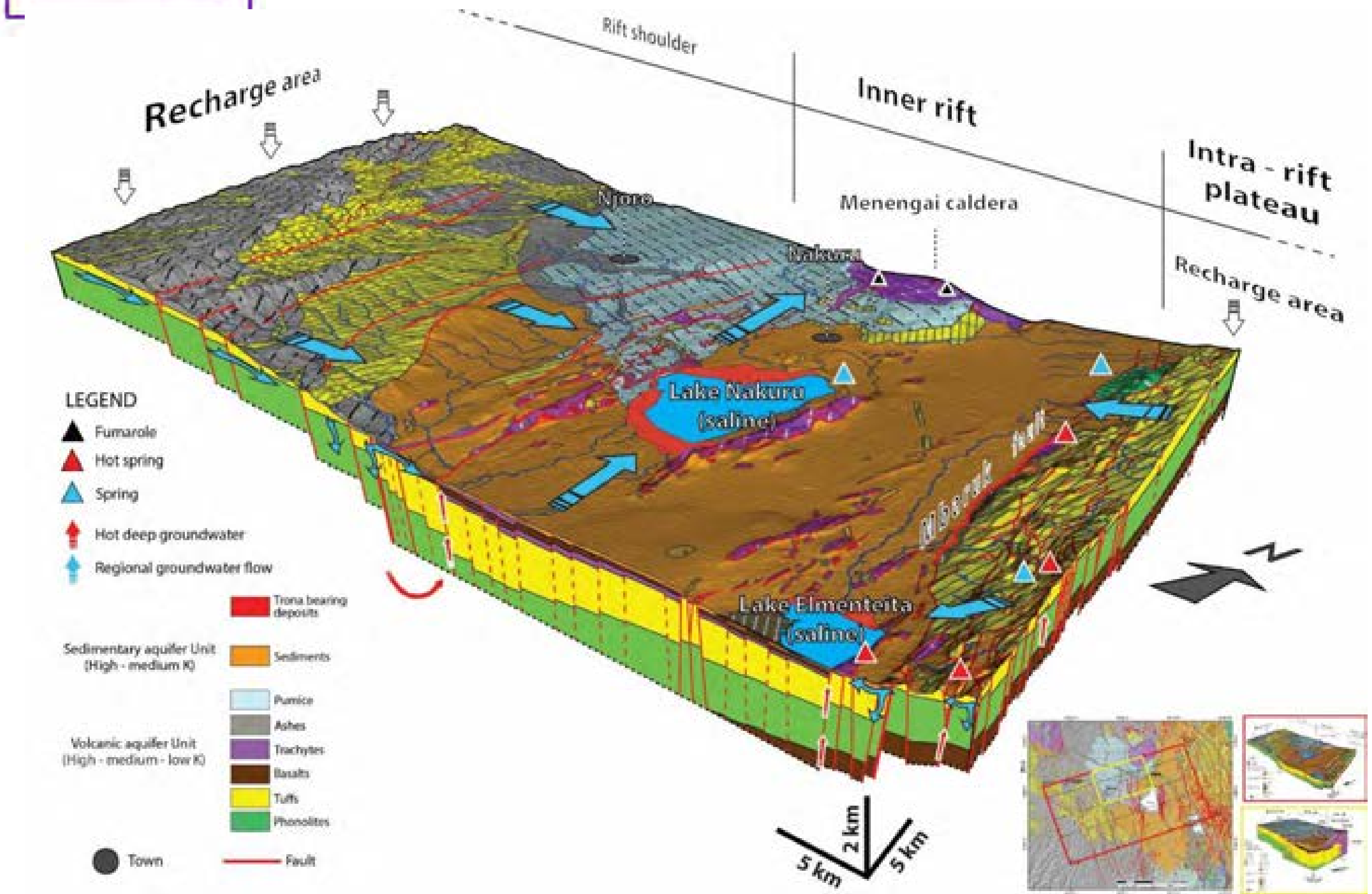
WP1 Integrated approach



Geological and Hydrogeological assessment and Groundwater model of the target areas

FLOWERED

The regional 3D hydrogeological conceptual model
Nakuru Area - Kenya



Giorgio GHIGLIERI - Università di Cagliari

Università di Cagliari

H2020

EXPECTED OUTPUTS

The main project's outputs will consist of:

(i) identification and mapping of the specific geological-hydrogeological and geochemical conditions of water contamination in relation to different land uses,

(ii) development of mitigation options for fluoride contamination in agricultural and livestock systems,

(iii) identification and testing of innovative water defluoridation technologies,

(iv) development of an innovative Geo-Data system for the knowledge management with a web platform for data sharing and a mobile app for the collection of data.

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EXPECTED IMPACTS

FLOWERED is in line with the expected impacts of the work programme concerning the creation of market opportunities for European water innovations outside Europe (WP3 and WP5) with a specific action performed by SME addressed to the evaluation of the possible market opportunities for the analysed innovative technologies

FLOWERED will provide support across the innovation chain from research, to development, to proof of concept, piloting, demonstration projects and is expected to have strong impacts on:

(i) Innovation capacity of water managers and agricultural actors, (ii) Competitiveness, (iii) Environment, (iv) Policy and (v) Science.

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H2020

EXPECTED IMPACTS

Impacts of FLOWERED on Sustainable Development Goals. FLOWERED is consistent with priorities identified in United Nations Convention to Combat Desertification National Action Programme (UNCCD NAP) of East Africa that emphasize community participation and public awareness raising, promotion of applied research and integration with indigenous knowledge, institutional framework and planning systems, and strengthening of regional and international collaboration for exchange of experience and best practices.

FLOWERED

de - FLuoridation technologies for imprOving quality of WatEr and agRo - animal products along the East African Rift Valley in the context of aDaptation to climate change

Università di Cagliari

FLOWERED

FLOWERED Contact Point
Department of Chemical and Geological Sciences
University of Cagliari
Via Trentino 51
09127 Cagliari, Italy
floweredsecretariat@unica.it

Project Coordinator
Giorgio Ghiglieri
ghiglieri@unica.it

www.floweredproject.org

Project Funded by the
European Union

Sustainable Water Integrated Management (SWIM)
Demonstration Project

WADIS-MAR

Water harvesting and Agricultural techniques in Dry lands: an Integrated and Sustainable model in MAghreb Regions

The WADIS-MAR PROJECT:

conceptual structure, objectives, operational approach, synergies.

Prof. Giorgio GHIGLIERI

Department of Chemical and Geological Sciences – University of Cagliari

Desertification Research Group (NRD) - University of Sassari - Italy

Implemented by

UNIVERSITAT DE BARCELONA

OSS

ANRH

Project website:
www.wadismar.eu

WHY WADIS-MAR?

North Africa arid land of Maghreb, suffer under scarce water conditions. Erratic behaviour of rainfall events over brief intervals often produce short and intense floods events which converge into ephemeral wadis beds.

Most part of the available superficial waters is thus lost, providing scarce benefits for households living in villages of such semi-desertic areas.

IWRM IN ARID AND SEMI-ARID REGIONS

Soil and water resources of arid and semi-arid regions are limited. Particularly, surface water supplies are normally critically unreliable, poorly distributed and subject to high evaporation losses.

IWRM IN ARID AND SEMI-ARID REGIONS

Despite or because of these problems, the optimum course of action for sustainable water resources management in arid and semi-arid areas will, in most case, be a combination of surface and groundwater use, with a range of storage options (Cosgrove & Rijsberman 2000).

Reliable water resources data are a prerequisite for rational development, though these are generally sparse in arid and semi-arid regions (Simmers 2003).

IWRM IN ARID AND SEMI-ARID REGIONS

On a smaller scale, <u>water harvesting techniques</u> might catch water during rainfall events in order to recharge an aquifer, thus impeding the quick runoff out of a catchment area.
This is particularly important for people living in semi- arid regions characterized by erratic rainfall and prolonged periods of drought, where…

…every drop of water counts.

IWRM IN ARID AND SEMI-ARID REGIONS

In arid and semi-arid regions surface and sub-surface flows are intermittent and some form of storage is essential (contour terracing, graded and field bounding, strip cropping, check dams, ponds, micro-dams, etc).

An alternative or supplementary activity to water harvesting is:

Aquifer Artificial Recharge

…every drop of water counts

WHAT IS AQUIFER ARTIFICIAL RECHARGE?

It is a process of induced groundwater replenishment

The concept:

STORE WATER UNDERGROUND WHEN AVAILABLE AND RECOVER IT WHEN NEEDED

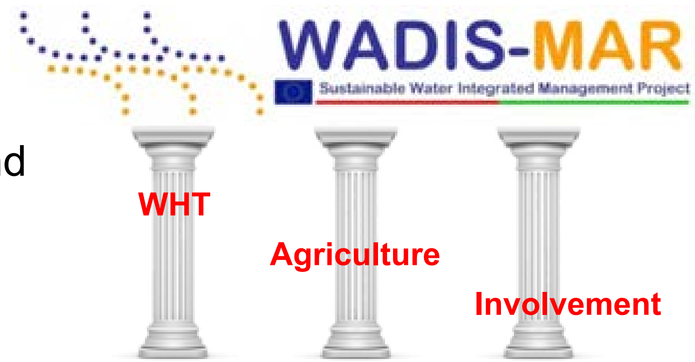
STORES WATER FOR DROUGHT AND

WADIS-MAR: objectives

Overall Objective

- Improve living standards of the rural population in arid and semi-arid areas of Maghreb region in which an increasing of water scarcity contributes ongoing desertification processes.

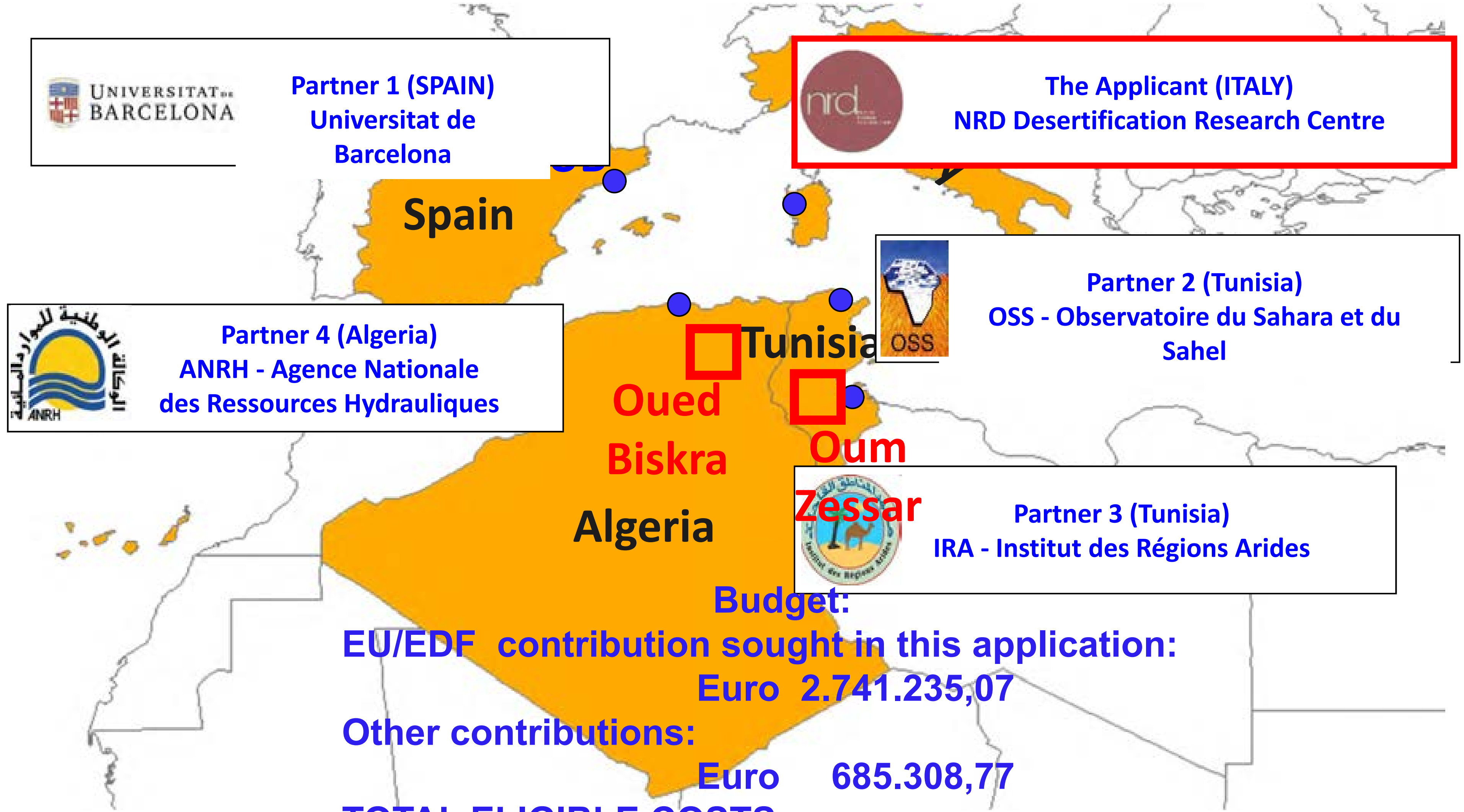
- **Specific objectives**
  - To achieve an integrated, sustainable and participative water harvesting & water and agriculture management in the watershed Oued Briska in Algeria and Oum Zessar in Tunisia for adaptation to climate change condition and drought
  - to increase water availability through Managed Aquifer Recharge (MAR) (artificial aquifer recharge) and evapotranspiration reduction
  - to enhance water quality by reducing pollution
  - to promote water efficient farming systems and the use of more stress-tolerant crops
  - To promote best agricultural practices
- **Strategic Approach**
  - To apply “soft” modern rehabilitation interventions and promote the use of modern techniques through a bottom-up approach



WADIS-MAR Partnership, pilot area and duration of the project

2012 | 2013 | 2014 | 2015 | 2016

18 months extension



Partner 1 (SPAIN)
Universitat de Barcelona

The Applicant (ITALY)
NRD Desertification Research Centre

Partner 2 (Tunisia)
OSS - Observatoire du Sahara et du Sahel

Partner 4 (Algeria)
ANRH - Agence Nationale des Ressources Hydrauliques

Partner 3 (Tunisia)
IRA - Institut des Régions Arides

Budget:

EU/EDF contribution sought in this application:
Euro 2.741.235,07

Other contributions:
Euro 685.308,77

TOTAL ELIGIBLE COSTS:
Euro 3.426.543,836

WADIS-MAR: MAIN RESULTS

Result 1
Sustainable water harvest integrated (upstream-downstream) systems based also on managed aquifer recharge (MAR) techniques

e.g.

Jessours systems have irrigation structures rehabilitated at Ksar El Hallouf and at Cheebet El Anz, etc. i.e. Koutine site: 6000 m^3 tabias/jessour; 45 m^3 spillways Boughrara site : 30 ha; 20 tabias (olive trees plantations)

Hydrogeological and hydro-chemical setting of pilot areas, Hydrologic and groundwater models improved.

1 executive artificial aquifer recharge designed-plan realized in Tunisia. This plan foresee the construction of: 10 recharge well systems; 6 piezometers for efficiency evaluation; 5 piezometers (depth<150m) . Q (m^3 an^{-1}*) tot 1,171,830

1 executive artificial aquifer recharge designed-plan realized in Algeria. This plan foresee the construction of 4 dry star wells (incl. drainage pipes); 3 recharge trenches; 4 or more temporary barriers; 2 dry recharge wells;
Q (m^3 an^{-1}*) tot 1,665,771

Result 2
Agricultural practices and rational irrigation techniques

e.g.

Percentage of crops irrigation requirements satisfied	**100%**
Percentage of yield increase using SWB (soil water balance) 100	e.g. Potato:37% ; carrot: 24%; green bean: 20%;
Number of farmers with less than 5 ha of land involved; Percentage of increased productions in each watershed (expected 25 %)	Tunisia 13 farmers are selected (+15 news) 11 (over 13) farmers have their land extension less than 5 ha Algeria 4 farmers are selected and 6 sites no farmer (over 4 selected) have their land extension of less than 5ha in Algeria
Percentage of water productivity increase (Tunisia)	Barley: 50%; Green bean: 63%; Potato: 55%; carrot: 64%; Dry red pepper: 47%

Result 3
Capacity building and awareness in local and national institutions

e.g.

Representatives of a farmer association involved in a participation workshop held in January 2012; 19 Tunisian and Algerian farmers and 8 experts trained on the irrigation management aspects with saline water, during the South-South cooperation and experience exchange in December 2014.

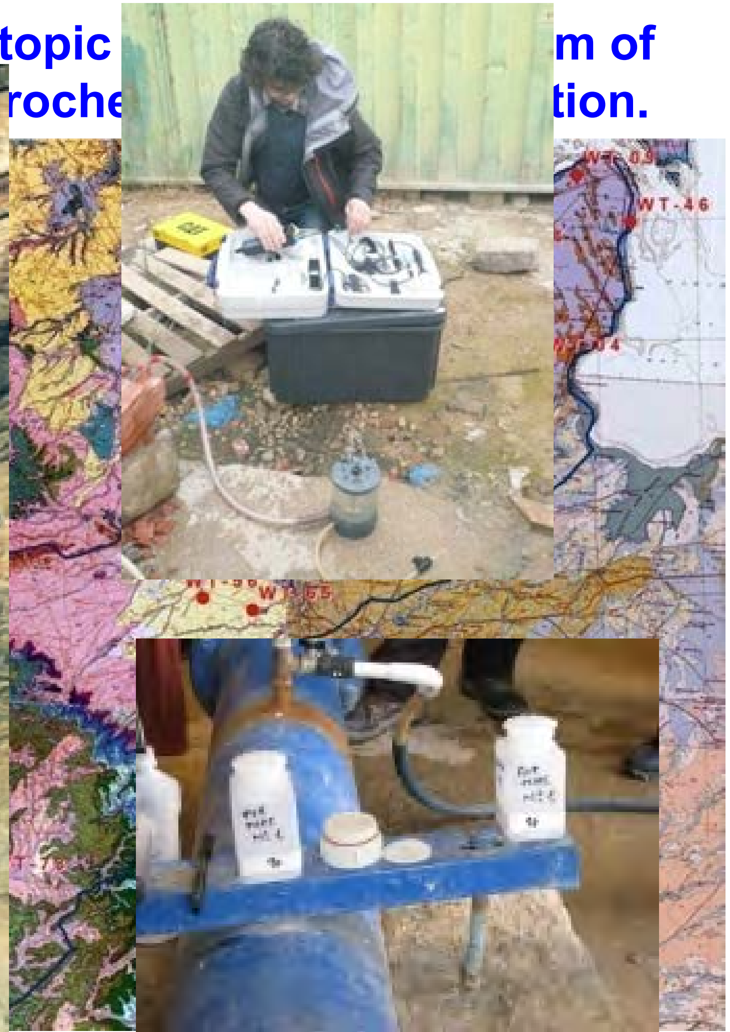
40 smallholder farmers for each demonstration area (Oued Biskra and Oum Zessar) involved in the compilation of a questionnaire on water and agriculture management;

Around 250 among technicians, researcher, students were trained thanks to the following course: Agrometeorology, Geophysics and geoelectrical resistivity method, Spectoradiometric, RDBMS and 3D hydrogeological Modeling

23 Capacity Building training session organized: at least 25 different institutions and organizations at local and national level involved.

Activity: Field data survey and training

- **Hydrogeological, hydrogeochemical and isotopic ... m of ... roche... tion.**



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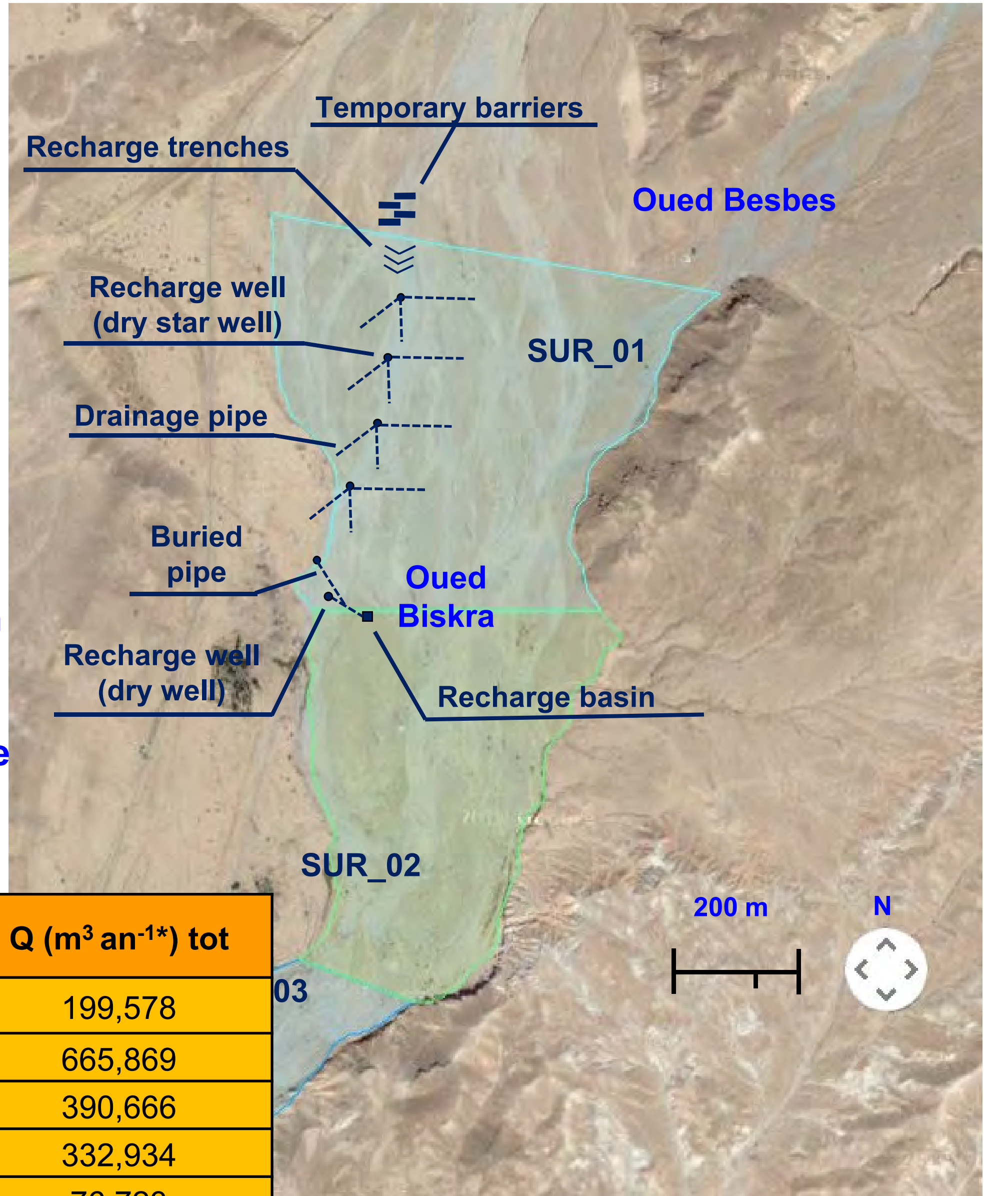
Activity: MAR System design

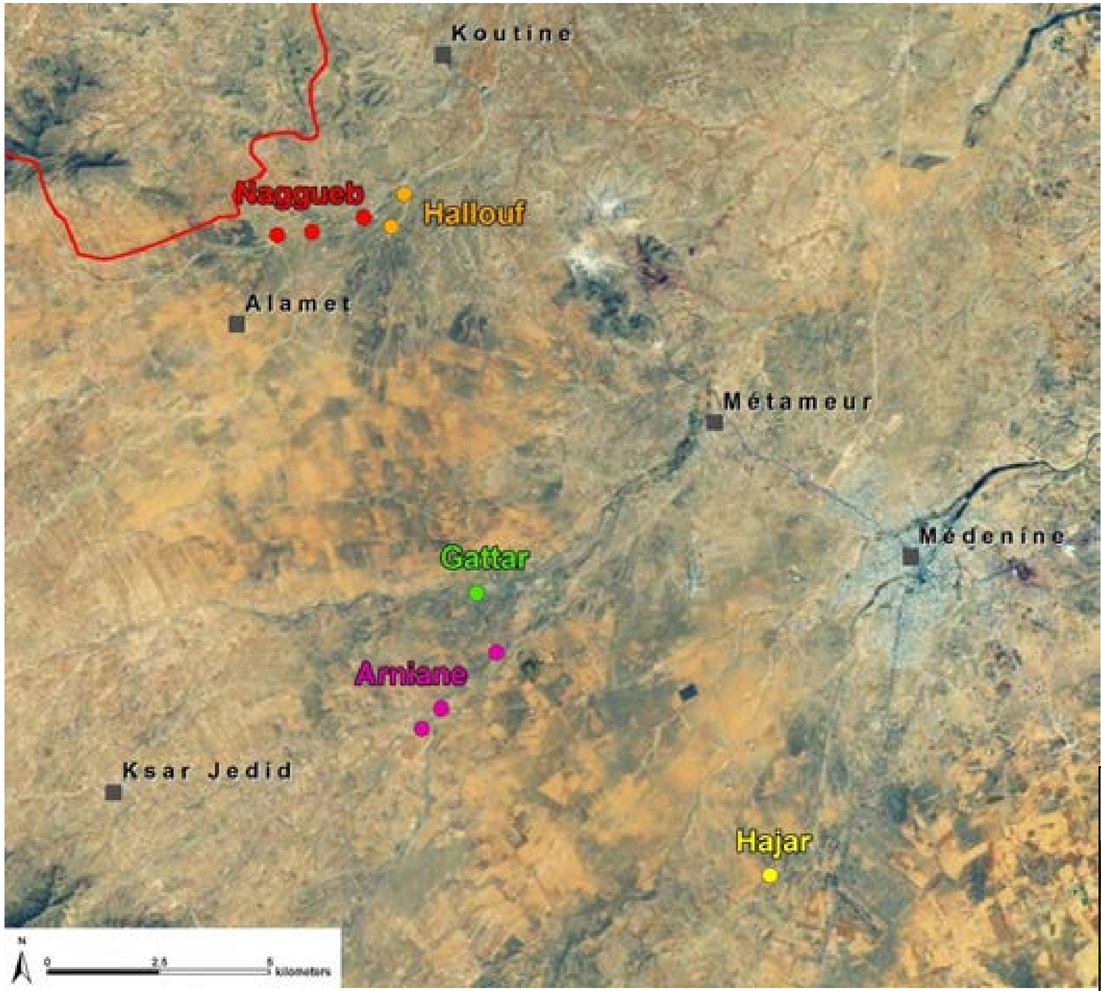
- ✓ ***Dry star wells* – Recharge wells equipped with a recharge chamber and three buried drainage pipes aiming at improving the efficiency of recharge.**
- ✓ ***Recharge trenches* – It are arranged perpendicular to the flow direction, disposed in cascade in a v-shape manner, to capture the surface water flow.**
- ✓ ***Temporary barriers* – Weirs made of local stone, placed perpendicular to the flow direction.**
- ✓ ***Dry wells* – This system consists of coupled recharge wells, type dry well, equipped with a recharge chamber, which are connected through buried pipes to an infiltration basin.**
- ✓ ***Recharge basin* – It allows the infiltration of excess water channeled by buried pipes from the recharge wells.**



Recharge systems	Q (m^3 an^{-1}*) per unit	Q (m^3 an^{-1}*) tot
Recharge trenches	66,526	199,578
Recharge wells (dry star well)	166,467	665,869
Drainage pipes	97,667	390,666
Recharge wells (dry well)	166,467	332,934
Recharge basin	76,723	76,723
	TOT	1,665,771

Activity: MAR System design

Tunisia: 5 intervention sites selected to recharge the Triassic aquifer



The design of the managed aquifer recharge system consist of 10 *recharge wells*, equipped with recharge chambers, placed in the centre of the wadi upstream of existing gabion check dams which usually retains the flooding water during rainy events. We estimate overall an average of 1.2 Mm^3/year.

Recharge systems	Q (m^3 an^{-1}*) per unit	Q (m^3 an^{-1}*) tot
Recharge wells (injection well)	97,667	976,670
Recharge chambres	19,516	195,160
	TOT	1,171,830

Activity: MAR System implementation

Activities: Implementation of best agricultural practices

Pilot site Bedoui: Evaluation of on-farm irrigation scheduling of drip irrigated vegetable crops under arid conditions of Tunisia (saline water (4.7 g/l) from a shallow well).

Irrigation scheduling methods

Two irrigation treatments based on the use SWB to estimate irrigation amounts and timing were compared to traditional farmer practice.

- **SWB methods consist in replacement of cumulated ETc when readily available water is depleted with levels of 100% (FI100) and 70% (DI70)**
- **Farmer method (FM) consists in giving fixed amounts of irrigation water with fixed intervals from planting till harvest**

Activities: Implementation of best agricultural practices

Activities: Evaluation of infrastructure performances

WADIS-MAR

Pilot site Megarine, Médenine: Improved water productivity by deficit irrigation and irrigation scheduling: Implications for saving water in orange orchards.

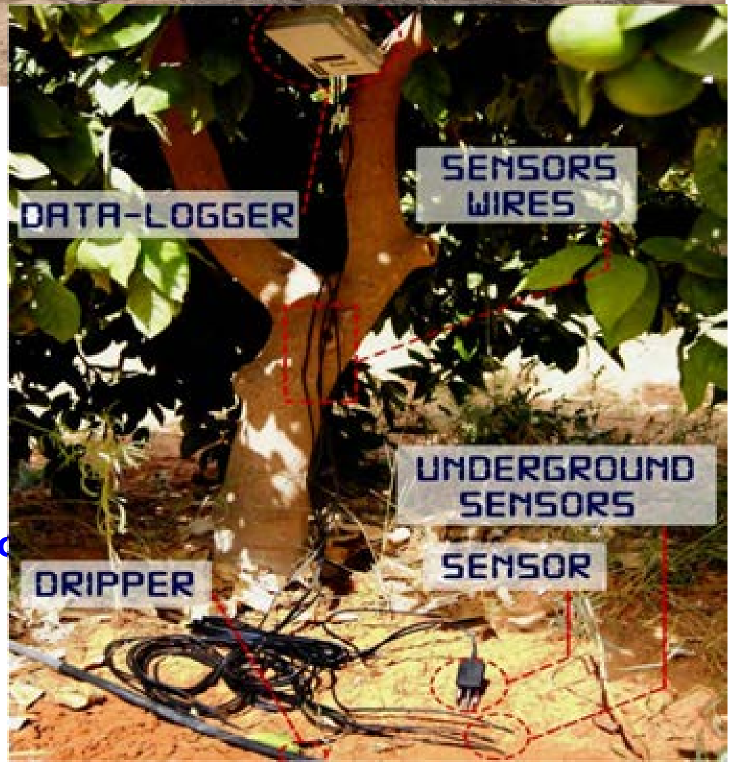
Irrigation strategies were evaluated according to their impact on:

- amount of irrigation water saving
- stomatal conductance
- yield, fruit size, juice content, total soluble solids TSS (°Brix), equatorial diameter (ED) and polar diameter (PD) with a digital calliper
- water productivity

-soil water content (gravimetric method / Sensors)

- Soil salinity and water content
- Ground canopy cover, stomatal conductance
- Yield and its components for all crops were determined fo physiological maturity
- Water supplies (I+R) (using water meter and rain gauge)
- Water productivity (WP)

WP (kg/m3) = Yield (kg/ha) / irrigation water (m3/ha)



Awareness raising and capacity building

Regional Training Workshop

- (Database and Modelling, field data acquisition, etc.)

Interchange experience and South-South transfer results.

- Several national/governmental institutions where contacted and involved within project activities (i.e. CRDA in TN, ITDAS in DZ, ARPAS in Italy)

Capacity building and awareness in local and national institutions

Module 1: Integrated agriculture and water resources management in arid and semi-arid areas and “best practices experiences”.

- 1.1 LAND REMOTE SENSING (48h)
- 1.2 GEO-STATISTICAL ANALYSIS and Advanced in GEOPHYSICAL PROSPECTION WITH GEORESISTIVIMETER (48)
- 1.3 AGROMETEOROLOGY, WATER SAVING AND AGRONOMIC MANAGEMENT (48)
- 1.4 AGRONOMIC MODELING (24h)
- 1.5 MANAGED AQUIFER RECHARGE SYSTEMS AND WATER HARVESTING TECHNIQUES (48h)
- 1.6 HYDRO-GEOCHEMICAL and ISOTOPIC INTERPRETATION, WATER FOR DRINKING PURPOSES (48h)
- 1.7 SWAT MODEL AND GROUNDWATER MODELING (48h)
- 1.8 ECONOMIC ANALYSIS OF WATER SUPPLY PROJECT (24h)

Module 2: Design and management of demonstrative actions within international cooperation p rojects for development

- 1.9 PROJECT DESIGN AND IMPLEMENTATION PROCESS (24h)
- 1.10 FINANCIAL PLAN AND MANAGEMENT (24h)
- 1.11 ENHANCE LOCAL PEOPLE CAPACITY - CAPACITY BUILDING PROCESS (24h)

357 APPLICATIONS RECEIVED (60% MEN, 40% WOMEN)

- 132 From Algerian Institutions
- 221 from Tunisian Institutions
- 1 from Cameroun
- 1 from Morocco
- 1 from Mauritania
- 1 from Central Africa

In the 17 sessions, an average of 13 participants per session was reached. About 220 applicants were trained : 50 % MEN and 50% WOMEN.

WADIS-MAR

Water harvesting and Agricultural techniques in Dry lands: an Integrated and Sustainable model in MAghreb Regions

Medenine Dec. 2014 Interchange experiences South South

WADIS-MAR

Participated to several national and international scientific events
Scientific Paper in ISI International Journals
WADIS-MAR leaflets, document folders
Undergraduate/graduate thesis, PhD research programs activated in Italy, Spain and TN
Synergy/Interaction with other relevant international projects focusing in water governance issues (i.e. CADWAGO; MARSOL)

WADIS-MAR: STRENGTHS

Replication potential of the project in other SWIM beneficiary countries

- ➢ Technical approach
- ➢ Capacities Building
- ➢ Improving national legal framework/policy/strategy
- ➢ Water policy management
- ➢ Sustainable and successful irrigation management practices

……but also

- **Problems**
  - **Internal i.e.**
    - **Inception phase too long (almost a year)**
    - **Difficulty of partner’s administration to manage the allocated budget (mission travel, tender management, works realization) (impact: almost 1 year of delay; status: solved)**
    - **Non eligibility of TVA (impact: almost 1 year of delay; status: solved)**
    - **The administrative/technical capacity of project partners lacks**
      - **technical planning has been made through the applicant's internal technical and scientific capacity**
      - **Partner’s administrative procedures should always be verified carefully**
    - **Applicant’s administration had a lot of constrain concerning the administrative lack of experiences of local Partners and the complexity of bourocratic decision making chain**
    - **Lack of interest and trust in the public tender offers shown by the local companies**
  - **External i.e.**
    - **Political transition (i.e. in Tunisia)**
    - **VISA issuing (i.e. in Algeria: short term visas to be reissued every 3 months)**
    - **Logistics in Algeria: field activities carried out with armed escort**
  - **EU-related**
    - **. difficulty to comply EU rules/procedures for tender procurements**
      - **6 unsuccessful tenders (in Tunisia), not possible to be applied in Algeria.**
    - **Partners do not have direct commitment with the EC → they are not directly empowered**
      - **EC regulations appear very “far” and cumbersome**
      - **Impact: difficulty in management of budget**


WADIS-MAR
Sadok KCHIH
a
Temporary barriers
Recharge trenches
Oued Besbes
Recharge well
(dry star well)
SUR_01
Drainage pipe
Buried
pipe
Oued
Biskra
echarge well
(dry well)
Recharge basin
SUR_02
200 m
N
SUR_03
WADIS-MAR
Ahmed LOUHICHI
Bedoui
Maraichage et céréales irrigués
à l'eau salée
08 04 2014 08 24

Observatoire du Sahara et du Sahel

IRA

ANRH

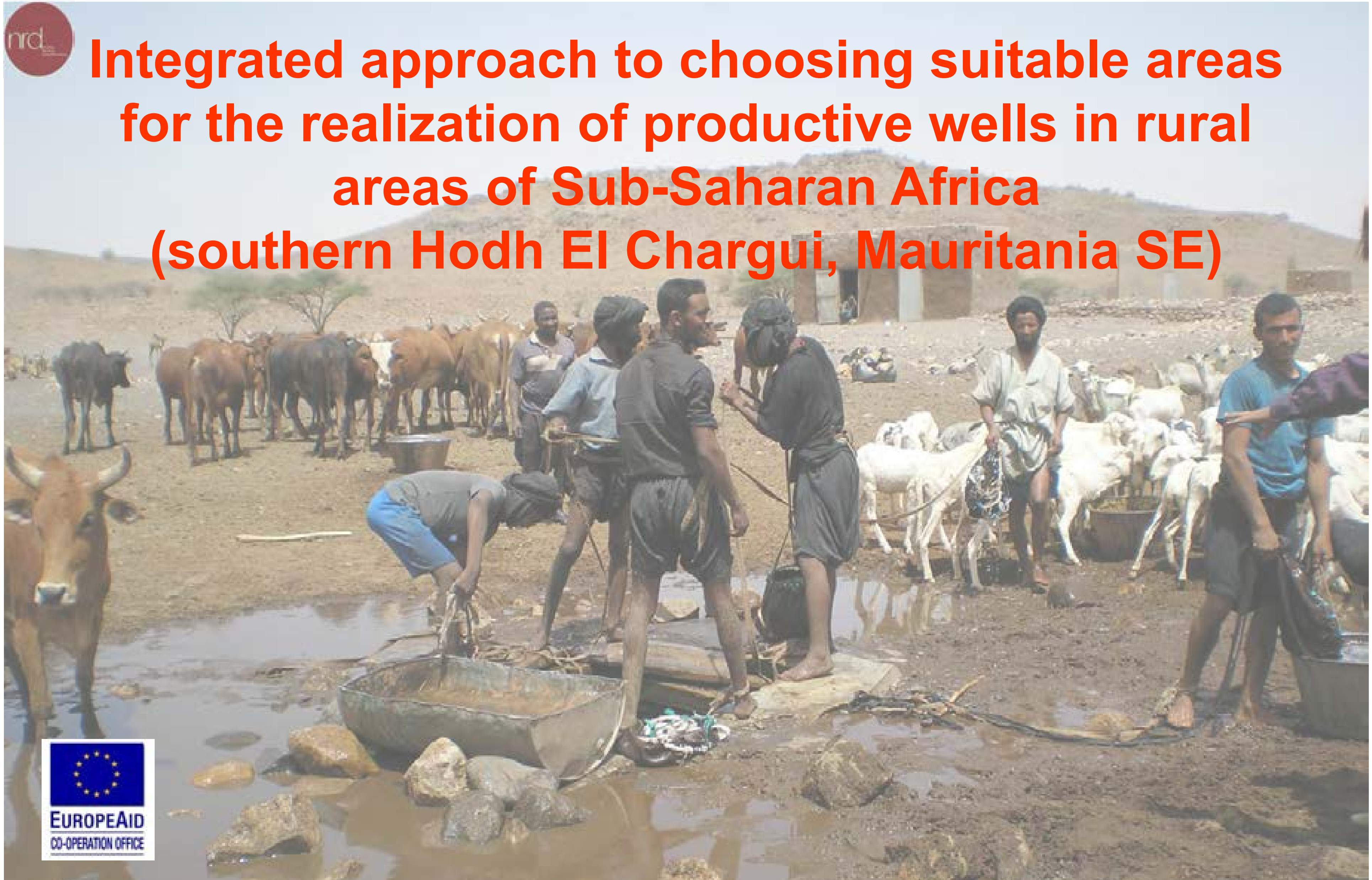
For additional information please contact:

wadismar@wadismar.eu ; ghiglieri@unica.it

or visit www.wadismar.eu

WadisMar The mouse and the mountain ENG subtitles - YouTube

Integrated approach to choosing suitable areas for the realization of productive wells in rural areas of Sub-Saharan Africa (southern Hodh El Chargui, Mauritania SE)



EUROPEAID
CO-OPERATION OFFICE

This work was carried out within the Water Facility Programme HEFEM Project (http://www.projet-hefem.org:8080/servlet/ae5Mau) with ACP-EU financial contributions

Partnership

TIMESIS s.r.l.

Istituto OIKOS Onlus

Terre Solidaire ONG

Terre Solidali Italia ONG

GRAIA s.r.l.

Nucleo Ricerca Desertificazione UNISS

Comune San Giuliano Terme (PI)

Objectives

The general objective was to guarantee easier access to water to the inhabitants of 13 rural municipalities of the provinces of Nema and Timbedgha, in the South of Hodh El Chargui (Mauritania SE).

A multicriteria approach in studying hydrogeology was used in the project area.

In order to identify some main areas in which to carry out pilot interventions, water accessibility and availability, and hydrogeological and water quality criteria were considered.

Furthermore, during the project, it was possible to transfer know-how and hand over responsibilities.

The guidelines of WHO (World Health Organization) (WHO, 2006) define minimum standards for water quality by establishing concentration level limits for a set of organic and inorganic chemical parameters.

Moreover, the guidelines contain a classification based on accessibility, expressed in terms of time and distance to be covered to reach the nearest water supply point, and on the quantity of water being distributed or used (Table 1).

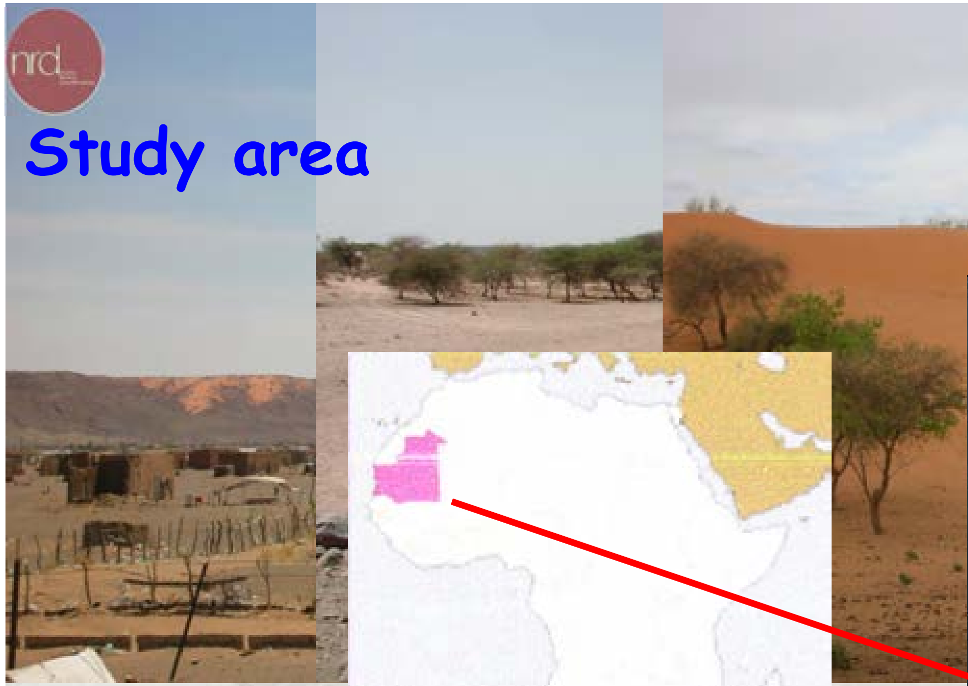
With regard to this last point, the minimum standard that has to be guaranteed in the developing countries corresponds to the *basic access* category (distance within 1 km and water availability of 20 litres per day per person).

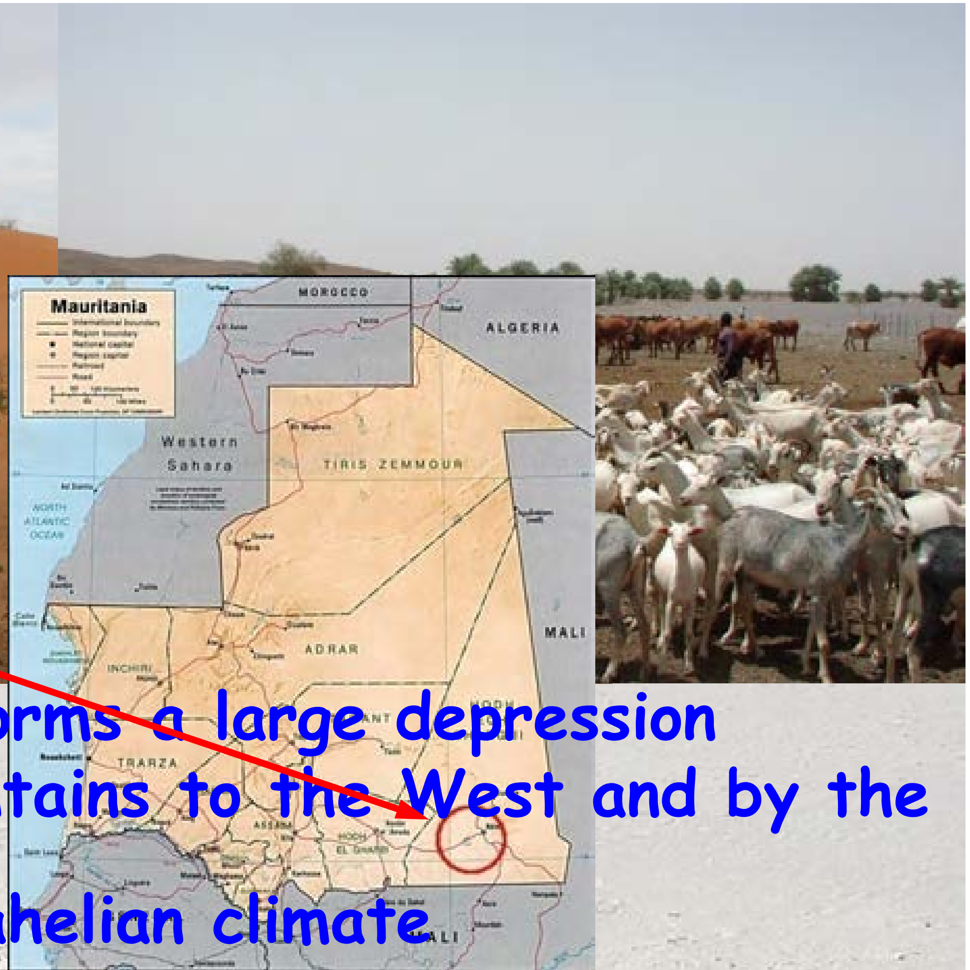
Service level	Access measure (distance or time)	Needs met	Level of health concern
No access – quantity collected often below 5 litres (L) per capita per day	More than 1,000 metres (m) or 30 minutes total collection time	Consumption cannot be assured Hygiene not possible (unless practised at the source)	Very high
Basic access – average quantity unlikely to exceed 20 L per capita per day	Between 100 and 1,000 m or 5 to 30 minutes total collection time	Consumption should be assured Handwashing and basic food hygiene possible; laundry and bathing difficult to assure unless carried out at source	High
Intermediate access – average quantity about 50 L per capita per day	Water delivered through one tap on plot or within 100 m or 5 minutes total collection time	Consumption assured All basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access – average quantity 100 L per capita per day	Water supplied through multiple taps continuously	Consumption: all needs met Hygiene: all needs should be met	Very low

Source: Howard and Bartram, 2003.

(Guidelines for drinking-water quality. First addendum to third edition. Vol.1 – Recommendations. WHO 2006)

Study area





The region of South Hodh forms a large depression delimited by the Afollé mountains to the West and by the cliffs of Dhar to the East.

The area shows a typical Sahelian climate

The study area corresponding to the Moughataa (Province) of Nema and Timbedra is situated in the South-East of Mauritania and lies entirely within the Wilaya (Region) of Hodh El Chargui.

Main activities are grazing and livestock farming, including sheep, goats, beef, and camels.

Area is about 22.000 Kmq with 86.000 inhabitans

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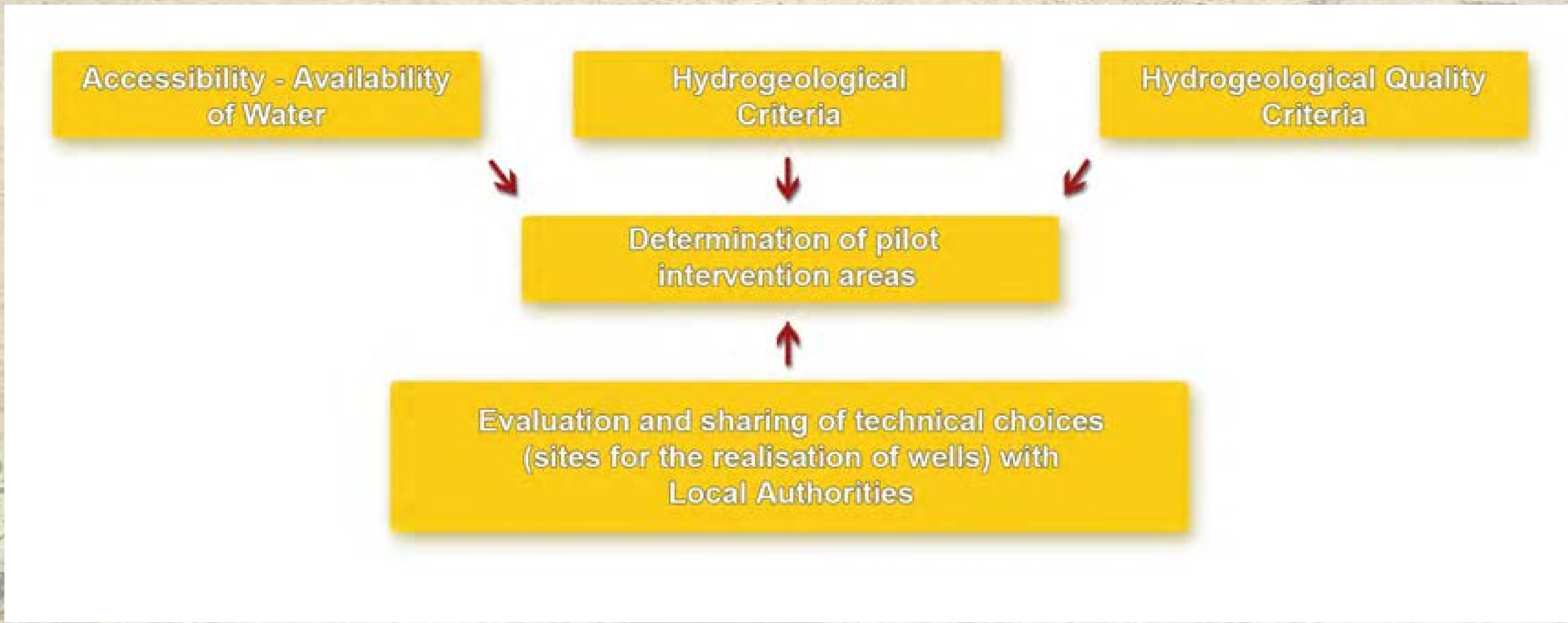
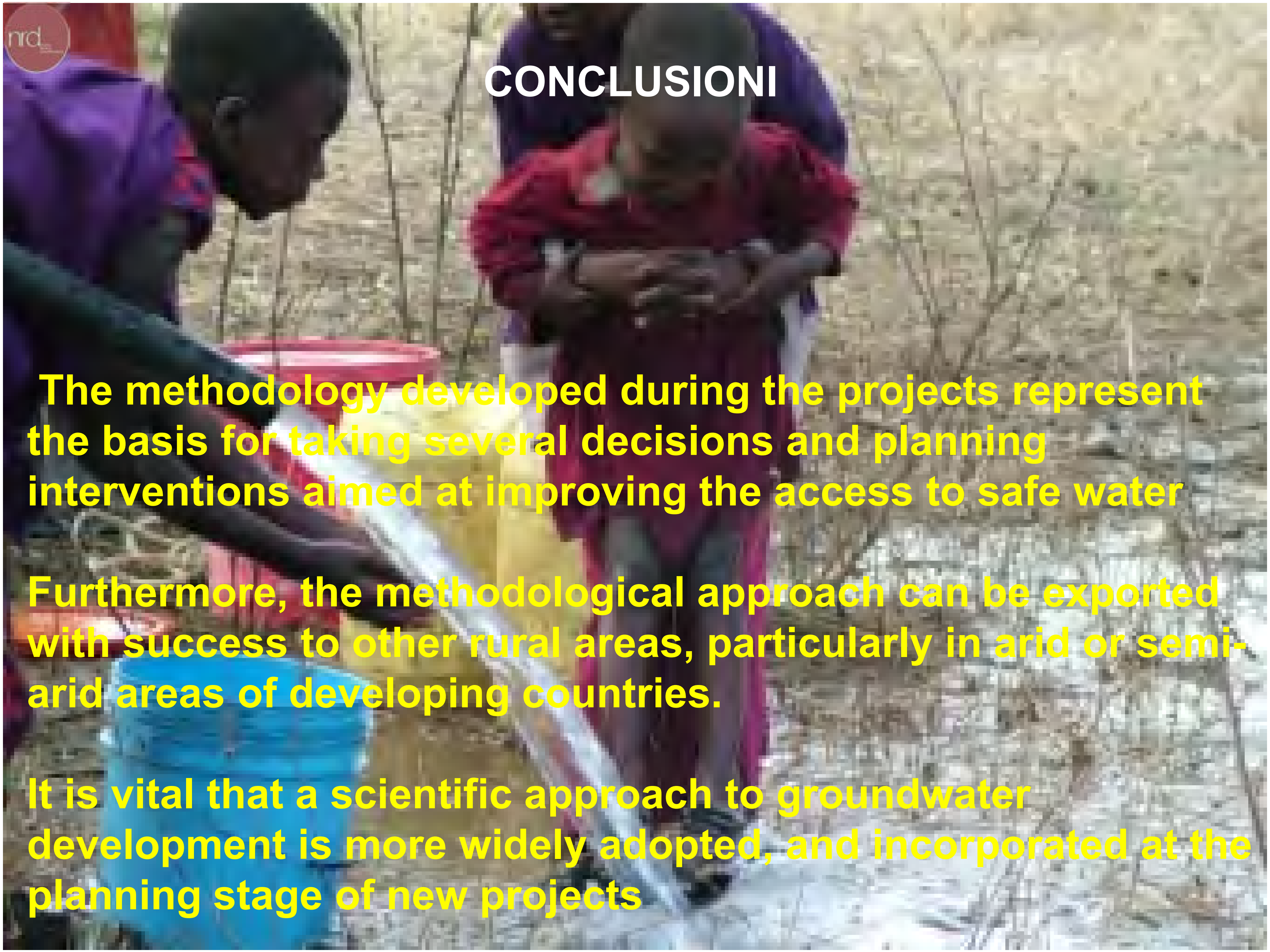
coordinates, piezometric level, hydrogeological
Noual
Mavnadech
HEFEM

Selection criteria of the suitable intervention areas: deciding which well site is best (Nema and Timbedgha - Hodh El Chargui, Mauritania SE).



Once the list of suitable areas was defined, it was submitted to the opinion of the Territorial Communities of Nema and Timbedgha and of the different Municipal Authorities, in order to reach a consensus.

In fact, in making the above-mentioned decisions and interventions, the technical results are not sufficient, since a relevant role is played by social and economical factors, of which the development plans had been already approved by local Authorities and by local people.

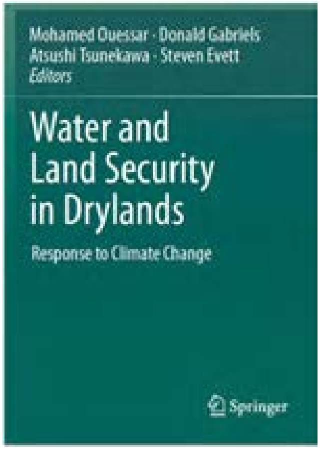


CONCLUSIONI

The methodology developed during the projects represent the basis for taking several decisions and planning interventions aimed at improving the access to safe water

Furthermore, the methodological approach can be exported with success to other rural areas, particularly in arid or semi-arid areas of developing countries.

It is vital that a scientific approach to groundwater development is more widely adopted, and incorporated at the planning stage of new projects



Hydrol. Earth Syst. Sci., 14, 1081–1091, 2010
www.hydrol-earth-syst-sci.net/14/1081/2010/
doi:10.5194/hess-14-1081-2010

Hydrology and Earth System Sciences

Prospecting for safe (low fluoride) groundwater in the Eastern African Rift: the Arumeru District (Northern Tanzania)

G. Ghiglieri[1], R. Balia[2], G. Oggiano[3], and D. Pittalis[1]

[1]Department of Territorial Engineering, Desertification Research Group (NRD), University of Sassari, Italy
[2]Department of Territorial Engineering, University of Cagliari, Italy
[3]Department of Botanical, Ecological and Geological Sciences, Desertification Research Group (NRD), University of Sassari, Italy

Received: 21 October 2009 – Published in Hydrol. Earth Syst. Sci. Discuss.: 27 November 2009
Revised: 7 June 2010 – Accepted: 9 June 2010 – Published: 28 June 2010

Hydrological Sciences Journal
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t911751996

Integrated approach to choosing suitable areas for the realization of productive wells in rural areas of sub-Saharan Africa

Giorgio Ghiglieri[a]; Alberto Carletti[b]
[a] Department of Territorial Engineering, Desertification Research Group (NRD), University of Sassari, Viale Italia, Sassari, Italy [b] Desertification Research Group (NRD), University of Sassari, Viale Italia, Sassari, Italy

Online publication date: 29 November 2010

Hydrol. Earth Syst. Sci., 16, 529–541, 2012
www.hydrol-earth-syst-sci.net/16/529/2012/
doi:10.5194/hess-16-529-2012

Hydrology and Earth System Sciences

Hydrogeology and hydrogeochemistry of an alkaline volcanic area: the NE Mt. Meru slope (East African Rift – Northern Tanzania)

G. Ghiglieri[1], D. Pittalis[2], G. Cerri[3], and G. Oggiano[3]

[1]Department of Earth Sciences, University of Cagliari, Italy, Desertification Research Group – NRD, University of Sassari, Italy
[2]Department of Territorial Engineering, Desertification Research Group – NRD, University of Sassari, Italy
[3]Department of Botanical, Ecological and Geological Sciences, Desertification Research Group – NRD, University of Sassari, Italy

Correspondence to: G. Ghiglieri (ghiglieri@unica.it)

Received: 22 July 2011 – Published in Hydrol. Earth Syst. Sci. Discuss.: 1 September 2011
Revised: 27 December 2011 – Accepted: 3 February 2012 – Published: 17 February 2012


Gestione sostenibile delle risorse idriche sotterranee per le zone aride
Esperienze e soluzioni per il Mediterraneo e l'Africa Sub Sahariana
Thank you
Prof. Giorgio GHIGLIERI
Department of Chemical and Geological Science Tel. 070-6757717 -e-mail: ghiglieri@unica.it