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SALA CONVEGNI

PALAZZO DU MESNIL

TECH-2

DATA SCARCITY AND LOCAL CAPACITY GAPS: ISSUES, PROBLEMS AND SOLUTIONS

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CONTRIBUTI

HydroVjosa: NaturAlbania pilot action for water monitoring through open science and community of practice

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Estimating hospital solid waste produced in a low-income urban context: the case of Beira and Nampula in Mozambique

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Climate change water challenges: a case study of precision irrigation in a data-scarce rural area of Lebanon

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An integrated GIS approach for the identification of suitable sites for traditional pokhari water harvesting in rural Nepal

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Developing a structured groundwater database for hydrogeological interpretation as a tool for sustainable groundwater management in Guinea-Bissau (W Africa)

A. Marcolla, Dipartimento di Geoscienze, Università degli Studi di Padova; F. Fussi, Departamento de Geodinámica, Estratigrafía y Paleontología, Facultad de Ciencias Geológicas, Complutense University; F. Asplund, Department of Water and Sanitation, UNICEF; N. Dalla Libera, P. Fabbri, Dipartimento di Geoscienze, Università degli Studi di Padova; R. Sousa, Department of International Development, TESE - Associação para o Desenvolvimento; M. Rotiroti, T. Bonomi, Dipartimento di Scienze Ambientali e della Terra, Università degli Studi di Milano-Bicocca

Data acquisition and facility management in critical contexts. A three year long experimental activity in Bethlehem through innovation and capacity building

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QGIS tools to support remote data collection and modeling in Solid Waste Management in low-income countries

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ABSTRACTS

HYDROVJOSA: NATURALBANIA PILOT ACTION FOR WATER MONITORING THROUGH OPEN SCIENCE AND COMMUNITY OF PRACTICE

G. Besio, Università degli Studi di Genova; A. Carboni, VIS Albania; M. Castelletti, CELIM Albania; M. Crivellaro, Università degli Studi di Trento; F. De Leo, Università degli Studi di Genova; G. Ponti, CESVI Albania; M. Stagnaro, Università degli Studi di Genova; G. Timillero, AICS Tirana; G. Zolezzi, Università degli Studi di Trento

Functional water resources management is an essential component of socio-economic security and sustainable development. This is even more crucial with the increasing global population and climate change impacts on water resources. Over the past decades, several challenges have been addressed by governmental and non-governmental organizations, advisory bodies, resource-management institutions, and the scientific community. Among others, the need to ensure secure water supply for drinking and sanitation, irrigated agriculture, aquatic ecosystems, and economic development; the development and maintenance of infrastructures to manage risks associated with floods, droughts, pollution events; intersectoral and transboundary collaboration;

public awareness and understanding of the resource limitations. Adequate management is grounded on the knowledge of present water quantity and quality, as well as their spatio-temporal variability in both past and future climate scenarios, yet the number of weather and gauging stations has reduced worldwide over the recent years (1,2). In addition, although some improvements have been done in the direction of open data in the hydrologic sector, advocacy for common data access standards must be further enhanced. Such background allows introducing Albania case study: there, the abrupt socio-economic changes triggered by the fall of the communist regime in the 90s undermined the previous institutional framework, together with the efficiency and reliability of the water resources monitoring system. While the network of gauging stations over the country has not been updated over the past decades, a widespread lack of coordination characterizes today's data collection, still manually done by operators, and many water staff got damaged with time. Finally, administrative and management responsibilities are fragmented among several national agencies, making the European Union Water framework Directive alignment process laborious. In this context, the Italian Agency for Development Cooperation (AICS) is supporting local institutions, promoting their capacity building to improve water resources management and conservation. Within the NaturAlbania project, AICS Tirana is funding a pilot action for open-source hydrometric monitoring within the Vjosa river watershed. Specifically, through a joint effort of the Universities of Trento (UNITRENTO) and Genoa (UNIGE) an ultrasonic sensor was installed at a water pump station in the Narta lagoon (crds lon/lat:19.45424/40.51952; RS WGS84). Such device, named Microsonic, measures distances within the 30mm–8 m range with variable resolutions depending on the detection range, though always <1 mm. The sensor was moored to a concrete wall standing on the water and calibrated with coterminous measurements of the bottom depth. It was next connected to a local computer, sheltered by a hard plastic box hooked into the external wall of the station and equipped with a SIM card for internet connection. The whole system was then plugged into the power grid of the station and put into operation. The sensor measures the water level every 30 minutes over a minute long sampling duration; in this interval, it detects both mean and variance of the water level, allowing for a thorough data quality check. However, time setscan be easily changed from remote as needed. Measures are updated and stored on a NAS system daily, and stored data are finally uploaded on a web server and freely accessible for download. A similar system is planned to be installed soon in Permet along the Vjosa river. The system described above can be easily replicated in other contexts characterized by lack of data since it only requires power supply availability and costs for the single components sum up to ≈800 €, a price that would be reasonably low for most development projects. Besides providing water gauging stations and open-source data, the project partners are working ensure a proper transfer of knowledge to local authorities and encourage their engagement to guarantee long-term sustainability. To this purpose, a roundtable has been established to follow and adapt project implementation, including the most relevant stakeholders involved in the project, such as the donor, local NGOs partners in project implementation (VIS Albania, CELIM Albania, CESVIAlbania), scientific referents (UNIGE and UNITRENTO) and local authorities and institutions (University Polytechnic of Tirana, National Agency for Protected Areas-NAPA, National Agency for

WaterManagement-AMBU). Such a roundtable represents the primary means to enhance the community of practice and set the basis for the delineation of a pivotal path for the sustainable handover of project outputs, be it material (gauging stations) or non-material (know-how for monitoring and management, the community of practice). The possibility to integrate different backgrounds in the NaturAlbaniaproject implementation is assuring the legitimacy, and long-term sustainability of the HydroVjosa action, which encompasses high-valuable technical, institutional, and networking tools and solutions for sustainable development.

ESTIMATING HOSPITAL SOLID WASTE PRODUCED IN A LOW-INCOME URBAN CONTEXT: THE CASE OF BEIRA AND NAMPULA IN MOZAMBIQUE

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In a low-income context, national and municipal governments often have insufficient capacity or funding to meet the growing demand for solid waste management services. Although Beira and Nampula are, after the capital Maputo, the two most important cities in Mozambique in terms of population and economy, the hospital solid waste management is precarious, both because of a deep crisis in the health sector and because of a deficiency in risk perception. Limpamos MOZambique Project, coordinated by Progettomondo and CAM¹, aims to strengthen Municipal Solid Waste Management in Beira and Nampula and involves Italian and Mozambican actors from public, private and nonprofit sectors. The DICAM² of the University of Trento is Partner of the Project for the supervision of technical and scientific aspects, contributing also to the collection and processing of technical data. One of the objectives of Limpamos Project is to strengthen the proper management, segregation, and disposal of hospital waste in two urban Health Centres, one in Beira and one in Nampula. The two interventions carried out differ slightly, but the common actions are mainly these: (i) visits, meetings and interviews with the administrative coordinators and technicians of the departments to understand the current waste management system and the primary needs, (ii) weighing of the types of waste produced daily to estimate suitable numbers and volumes of bins, (iii) construction of a temporary storage building for sorted waste, (iv) staff training and accompaniment. However, good segregation and temporary storage might risk being incomplete without improvements in the whole waste management chain. In Beira, the centralised management system for biomedical waste from most urban health units is based on a critical municipal collection and transport service and an obsolete, high-impact and dangerous incinerator in the Central Hospital, which will soon be joined and gradually replaced by a new electric steriliser from another parallel project. Biomedical waste is treated in the incinerator, common waste is transported to landfill. The Health Centre in Nampula, by contrast, was not included in a collection route, and the intervention had to be completed with another parallel project to build a septic tank for anatomical waste and an incinerator for infectious and sharps waste inside the Centre. For common waste,

arrangements were made with the local municipal company that collects and transports municipal solid waste. The new challenge is to understand which additional solutions can improve the entire urban hospital waste management. First step is to analyse waste streams, differentiating data according to different types that may require different treatments. The absence of quantitative and qualitative data and the impossibility of carrying out product analyses in all health centres means that alternative methods must be found to estimate waste streams. At Beira Central Hospital, weighing biomedical waste transported to the incinerator was a good starting point for obtaining an initial estimate of the quantities, broken down by type but not by origin as they were mixed during transport. The weighing, however, lasted only two weeks and the Central Hospital did not continue this data collection. In second phase, therefore, interviews and needs assessment surveys were conducted in seven other Health Centres in Beira. A good knowledge of the average per diem patient admissions by wards would make it possible to refine the classic literature data on per capita daily generation, readjusting it according to the local waste segregation and the type of services and treatments present in the health unit. Comparison with the two weighings carried out in the two Health Centres will also be very useful in improving the estimates. However, many Health Centres report that they do not possess historical series of patient attendance data because they send them monthly to the District Health Service. However, this Service provided incomplete average attendance data compared to what was verified by the field interviews (e.g. no count of many wards). This fact, together with the lack of clarity of the data collection methods (e.g. repeated data, wrong averages) makes it necessary to deepen part of the interviews or to collaborate more with the District Health Service for a better management of the incoming data. The difficulties that emerged in Beira, however, will be useful in repeating and improving the experience of the interviews in Nampula. In conclusion, new methodologies for collecting, organising, and obtaining data are essential to properly assess best and worst management solutions and related project choice for hospital waste management the different health units of Beira and Nampula. At the same time, the excellent feedback from the interventions in the Health Centres and the interest shown by Beira Central Hospital in the weighing activities are positive signs of a good involvement of the local partners, which give hope for continuity and greater depth in the collection of information.

CLIMATE CHANGE WATER CHALLENGES: A CASE STUDY OF PRECISION IRRIGATION IN A DATA-SCARCE RURAL AREA OF LEBANON

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Agriculture is the world biggest freshwater consumer, with an amount of 70% of the total use (FAO, 2016). In order to guarantee water and food security to the world's population it is essential to enforce a smart water management system. The project "Saving Water Growing Crops" funded by the European Union aims at coping with water and energy related problems in the rural municipality of Mrusti in Lebanon through the introduction of efficient irrigation solutions, i.e. (i) the installation of a precise automated irrigation system, and (ii) the rehabilitation of Rainwater Harvesting ponds. The project is one of the "Demonstration Project On Efficient Use of Water" of the SWIM/Horizon Programme in the framework of the ENI1. The project implemented by Istituto OIKOS in partnership with CS2, University of Trento and ACE3 and the affiliation of FEM4 and Nadir. The context is a mountain environment (1300 m a.s.l.), the average yearly cumulative rainfall is about 1100 mm and the mean recorded temperature is around 14°C. The available local GIS and meteorological data are in general sparse, characterized by limited spatio-temporal resolution, and of poor quality or unknown accuracy, compromising the representation and detailed understanding of the territory. The project area covers 15 ha of orchard-cultivated land in the Mrusti Municipality in addition to 9 ha in the Municipality of Ammiq, in the Beqaa valley, to monitor and evaluate the performance of the solution. A first monitoring analysis of the agricultural practices conducted in 2020 revealed that, on average, the actual irrigation system covers only the 29% of the theoretical water demand of the plants, thus affecting the productivity and the health of the plants, which suffered water scarcity stress condition for more than two months. An increase in the efficiency of the system will reduce the losses, thus increasing the net irrigation water and shortening the stress period. The rehabilitation of the Water-Harvesting Ponds will imply less pumping water demand, therefore reducing the impact on groundwater and fuel consumption. Some critical aspects were identified in the water management of the community of Mrusti: (i) the absence of monitoring tools implies that the water tariffs are not proportional to the volumes withdrawn, (ii) many connections to the irrigation system are illegal and (iii) the water availability in the area depends mostly on the plots position due to the different outlet pressures, with consequent inequalities and system inefficiency. Furthermore, the absence of monitoring and partial gaps in the technical background of local professional staff in water management might lead to difficulties in optimizing the system. The designed irrigation system may provide relevant benefits both in terms of productivity and environmental aspects. The Key challenge will be the acceptance of the innovative technology by the local community in a rural and traditional context. A Well-structured cooperation between the PMU5 and the beneficiaries is essential for the achievement of the target results. A special effort will therefore be directed to the Capacity-Building of the beneficiaries both on management and technical aspects. The objective is the establishment of a committee of trained farmers responsible for the management of the system. A maintenance plan will be developed to define specific tasks and responsibilities for the project follow-up. As aforementioned, a crucial aspect for the success of the project is the collection and use of reliable data. For this reason, the University of Trento collaborated in the realization of M&E 6 plan and framework to collect robust data that are necessary to (i) assess the system's performances, (ii) support effective decision-making, and (iii) identify opportunities for

improvement. Data collection is a complex operation, as information from multiple sources needs to be combined, i.e. from the beneficiaries, local water management responsible people, direct observation, in-situ measurements and sensors. The issue of information reliability will be partially solved with the introduction of sensors that will provide high frequency, specific and objective data that could provide a robust data-set useful for the ongoing and future projects in the area. In particular, soil humidity sensors, weather stations, flowmeter and water level sensors will be installed to enhance the local water management, tailoring the technical solution to the environmental specificity of the context and for the monitoring and evaluation of the project. In conclusion, the present project can significantly improve efficiency in water consumption for agriculture in the Mrusti Municipality. However, several challenging issues need to be faced, related to technical aspects, management, and data scarcity. For this reason, a holistic action that involves, motivates, and trains the local community has been initiated by the PMU in cooperation with the University of Trento, which has assumed a leading role in environmental monitoring and evaluation, results dissemination, data collection and analysis, knowledge sharing, capacity-building, and decision-making support.

AN INTEGRATED GIS APPROACH FOR THE IDENTIFICATION OF SUITABLE SITES FOR TRADITIONAL POKHARI WATER HARVESTING IN RURAL NEPAL

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Storing water during monsoon season in Nepalese hills of Kaski district is crucial to have enough water resource to cope with the dry season, especially now that climate change is influencing rainfall intensity and pattern. Traditional Nepalese ponds, called pokhara, are used since centuries store runoff mainly for cattle rearing and for rice fields supplementary irrigation, which are the main subsistence activities in the area. The Socio-cultural value and ecosystem services provided by these ponds are also widely acknowledged by local communities, who are interested in restoring existing pokhari and building new ones to improve their economical and living conditions. However, despite the importance of selecting most suitable locations for these structures is crucial for their success, very few information is available for new pokhari sites selection. Sometimes they are dug in a given point considering only the proximity to the area where pond water is needed. The comprehensive analysis of multiple relevant parameters for traditional ponds most suitable sites can lead to more efficient water collection and provide a useful tool for water resources management. In this work, we propose a methodology for pokhari best siting analysis, based on Geographical Information Systems (GIS), Multi Criteria Decision Making (MCDM) and in-field participatory research. To our knowledge,

this work is the first large-scale best siting analysis of traditional ponds carried out with these approaches in Nepal: in contrast to traditional method used to select locations where to build pokharis, our methodology allows a time-effective selection of suitable zones for multiple areas contemporaneously. Using physical and socio-economic criteria in GIS environment combined with traditional criteria, suitable areas for pokhari sand infiltration ponds are identified. These structures share the same construction criteria, with the difference that pokharis' bottoms are lined with red clay to store water, while infiltration ponds are not lined to allow water infiltration in soil. The combined use of these structures can further foster climate change resilience in Nepal. Our results were validated on the field, observing the location of 20 existing traditional ponds within the study area, all of which fell in the highest suitability quartile. Around 0.423 km², corresponding to 3.47% of the study area, were classified as highly suitable for pokhari sand infiltration ponds. Despite the low data resolution, which requires a further field inspection for the final site selection, our results provide a reliable guidance for large-scale suitability of pokhari sand infiltration ponds, supporting drought-resilience projects in the area. Further developments of this work may concern the inclusion of erosion data among the best siting criteria and the application of the same methodology in other areas with similar characteristics. This work was carried out in the framework of the project "Rain Communities" carried out by the Swiss NGO International Rainwater Harvesting Alliance (IRHA) with its Nepalese partner NGO Kanchan Nepal.

DEVELOPING A STRUCTURED GROUNDWATER DATABASE FOR HYDROLOGICAL INTERPRETATION AS A TOOL FOR SUSTAINABLE GROUNDWATER MANAGEMENT IN GUINEA-BISSAU (W AFRICA)

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Guinea-Bissau is a small West African Country characterized by a tropical savannah climate and an almost flat morphology. Although the yearly rainfall is high (around 2000 mm in Bissau), about 30% of the total population has no access to safe water (2015) and several villages are not reached by mechanized drilling programs. Exploitation of groundwater is fundamental to improve this situation, but the scarcity of information and the low quality of the data limit the hydrogeological knowledge of the territory by technicians and scientists. The research has been developed through a positive collaboration between University of Milano-Bicocca, University of Padova, UNICEF Bissau and the national water authority (DGRH-Direção Geral dos Recursos Hídricos). Our purpose is to

support DGRH in the systematic organization of the large amount of information available and in the efficient management of a well-structured groundwater database. Borehole-log data have been processed with specifically designed software (i.e. TANGAFRIC and spMC) that allow the extraction of hydrogeological parameters from the logs and the spatialization of the textural characteristics. The collaboration UNICEF-DGRH started in 2016, with the introduction of a new database structure and procedure for data collection and organization. This method is based on the web platform mWaterPortal (portal.mWater.co) which allows to manage a Water, Sanitation and Hygiene (WASH) information system at national scale, with the possibility to display and monitor the inventory of waterpoints. With the technical support of the Italian Universities, a clean dataset of about 800 litho-logs has been extracted. The stratigraphic description is standardized and organized in such a way that TANGAFRIC could process the data automatically. Through this software a limited number of standard categories, describing the lithological characteristics of each log, were assigned meter by meter. This allows the automated extraction of different textural parameters and the estimation of hydraulic conductivity at log level. In the following step TANGAFRIC's output have been integrated into the spMC package which allows the spatial simulation and prediction needed for the lithological reconstruction of subsurface. In particular, we are looking for possible correlation between the water quality and the lithological bodies geometry and trend, focusing on the Catiò Sector (SW Guinea-Bissau), where groundwater is affected by salt intrusion and high iron concentration. The research is demonstrating the potentiality of a properly organized groundwater database, developed from the information available in a low income African Country. The integration of specific tools for data collection and organization, together with software for hydrogeological interpretation has made possible to improve the knowledge of the hydrogeological context at national level. The proposed procedure is simple, innovative and easily replicable in other African Countries where an adequate strategy for groundwater exploitation and management could contribute to improve living conditions.

DATA ACQUISITION AND FACILITY MANAGEMENT IN CRITICAL CONTEXT. A THREE YEAR LONG EXPERIMENTAL ACTIVITY IN BETHLEHEM THROUGH INNOVATION AND CAPACITY BUILDING

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The paper shows the results of a three years long research financed by AICS, titled "3D Bethlehem—Management and control of urban growth for the development of heritage and improvement of life in the city of Bethlehem". This international cooperation project aimed to promote the strengthening of the management and territorial governance system of the Municipality of Bethlehem through the transfer of cognitive experiences and methodological practices for the

management and control of urban growth for development heritage and improving the quality of life in the city of Bethlehem. The project implemented a technological process of analyzing the urban form in order to manage and plan the future city. The paper focuses in particular on the aspects related to the creation of databases aimed at the sustainable management of existing buildings and capacity building actions structured to allow the implementation and autonomous use of these tools information from local authorities. The collection, cataloguing and aggregation of data characterizing the urban structure of the central nucleus of Bethlehem, was a necessary tool for the knowledge of the system, and aimed at supporting the definition of possible enhancement actions. Any conscious and effective strategy of intervention on the existing patrimony needs a solid and organic knowledge of the state of fact and its main characteristics and connotations. If the object of the study is not a single building, or a simple urban block, but on the contrary a significant portion of fabric, especially if characterized by the almost inextricable complexity of millennial historical stratifications characteristic of the Holy Land, the selection and structured classification of information is definitely necessary. It is a vast amount of, photographic, metric and quantitative data, based on a system of objective cataloguing, with limited elements of judgement or subjective evaluation. Given the vastness of the heritage to be mapped, a data collection interface has been defined, based on objective compilation criteria to ensure the greatest possible uniformity in the collection of the data. This was also necessary considering the high number of players involved in the acquisition phase, consisting not only of university staff, but also of local technicians. Operational uniformity must also be ensured in order to guarantee that information system may be regularly updated by local operators, in accordance with standardized and homogeneous methods and criteria. For this purpose, guidelines have been drawn up for the compilation of the data sheets, providing a detailed description of required fields. At the end of the three-year project, a 30-hour training course was also organized for the technical staff of the municipality of Bethlehem, which was also involved in the mapping procedures, with exercises to learn how to master and autonomously manage the information system. It was then studied, tested and subsequently applied an inventory file articulated on two levels of investigation: one devoted to building units and one to urban fronts. The technological survey of building units provides for the collection and cataloguing of information related to two macro-categories: i) the urban location and the description of the perimeter of the unit; ii) a set of general information at an architectural and volumetric level. The latter constitutes the main part of the datasheet, and integrates morphological, historical, technological and structural information. The overall purpose of the cataloguing is not only the acquisition of structured and geo-referenced information, but the ability to extract from the files with thematic readings and specific queries for individual items or aggregations of these. The system is in fact designed to be interrogated or extracting a summary information of quantitative type for each indicator or sets of indicators, both showing the eventualities on a three-dimensional model. It is a multi-scale dynamic tool to read the state of fact, which in addition to an intrinsic value as a wealth of structured and searchable knowledge, may have a relevant role in defining possible strategies for urban enhancement. In the case of the research to which these notes refer, for example, a total of over 2,300 data sheets have

been compiled, relating to 671 buildings, to form a database for Building Unit consisting of 48,321 completable elements. This is a significant amount of information, which certainly places the current experience in the perspective of the broader scope of the acquisition and management of big data in the field of construction and urban. The information system structured in the research is based, in its current conformation, on the integration of a building scale database integrated with a three-dimensional geometric model. The tool is operational and in operation, and now allows a wide range of activities of interrogation and analysis scale of building, aggregate and neighborhood. The current model allows, however, a significant number of further implementations, with the integration of numerous additional sets of information, which hopefully could be implemented at stage of further research development. Further layers of knowledge could be integrated into the existing model, transforming it into a multidimensional model, which includes both the temporal dimension and the periodic updating of the completed forms, and the economic one with the integration of the costs related to the works carried out.

QGIS TOOLS TO SUPPORT REMOTE DATA COLLECTION AND MODELING IN SOLID WASTE MANAGEMENT IN LOW-INCOME COUNTRIES

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Solid waste management (SWM) in low and middle-low income countries represents a big issue, which can seriously affect both the environment and the human health. A big burden to the improvement of solid waste management systems, in many cases, can be the lack of funds. Waste collection and transport is one of the most expensive stages of a SWM system in terms of money and environmental impacts (considering both fuel consumption and atmospheric pollution). Consequently, strategies for the optimization of this and other stages of SWM are important.

Nonetheless, the development of such strategies may encounter a lack of information as a first obstacle. In fact, especially in low and middle-low income countries, authorities devoted to SWM are not always able to perform data collection, and existing data can suffer from accessibility and reliability issues (Domini et al., 2017). Field collection is an important stage of every research, but projects do not always include a feasibility study before the preparation of a proposal; moreover, data collection may require long time, and in some cases it should go together with the implementation of a project. Thus, efforts are required to obtain an acceptable, even though approximate, assessment of the situation – which should be obviously validated on the field, as soon as possible.

This presentation has the purpose of sharing a new strategy for the integration of data collection and spatial analysis to provide a practical support for solid waste management (SWM). This strategy aims to be as simple and fast as possible, and takes advantage from freely available information. A computerized "package" of procedures, to be applied in cascade, has been consequently developed.

Free open source software (FOSS) geographical information system (GIS) has been used. Chalkias and Lasaridi (2011), among other authors, explained the importance of the use of GIS in the optimization of the SWM system. FOSS has been identified as a tool which can be easily accessed, with no costs, and with the capability to be modified to fit the needs of the local context. The potential of FOSS, which does not only refer to be free of charge, has been widely discussed in literature, together with its points of weakness (Câmara and Fonseca, 2006). The last years have seen a considerable improvement in the potential and usability of FOSS GIS, which should be acknowledged.

For such reasons, QGIS has been adopted for this research. Its embedded Model Builder allowed the creation of tools to perform the necessary analysis. The starting point for each analysis is freely accessible geographical information, such as Open Street Maps for urban features such as the road network, the Digital Terrain Models for the elevation, the satellite imagery for the interpretation of the urban characters. From these information, the distribution of waste generation is modeled, collection points are properly located through an automatic procedure which selects appropriate zones on the road network, and optimization of routes performed. In particular, network analysis is done taking into account the fuel consumption, which may vary substantially due to the gradient of the roads, especially for heavy duty vehicles usually operating the collection.

The procedure was applied for the first time to a Municipality in the South of Lebanon, a target village for a development cooperation project managed by a Non-Governmental Organization, INTERSOS. Validation of the tools was done, whether it was possible, thanks to data collected on the field in the first months of the projects, with the following results: the developed tools are found to be flexible, and appropriate to perform a first evaluation when approaching for the first time a case study; the module related to fuel consumption is found to be sensitive to the variation of vehicles and road conditions, and is ready to be validated with real world field data.

After the development of the package of tools, the idea was to evaluate the appropriateness of the tools in terms of accessibility and usability. The project included the training of local technicians on general aspects of solid waste management, operational management, financial and logistic aspects. For what regards GIS tools, the training was conceived according to the guidelines suggested by Fisher et al. (2017): 1) utilize free data 2) be contextualized to local Natural Resources Management issues, 3) result in data that meet local needs and central government reporting requirements and 4) be produced in appropriate languages. Due to COVID-19 restrictions, only the introduction to QGIS

and OpenStreetMap was done, providing three online sessions to nine municipalities, and sharing existing materials (such as the manual done by Ahmed et al., 2018) found to be suitable for this purpose.

DEFEATING DATA SCARCITY BY CONTEXTUAL REUSE

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The data and the information they brought are fundamental in every sphere of international cooperation, from research and social infrastructures to Industry 4.0. However, the information is only exploitable if both data resources and knowledge resources are recognized. Data resources are datasets containing the values collected observing the studied phenomena, while knowledge resources, modeled as ontologies, refers to the meaning those values have in a specific context.

These resources are often created according to the user requirements without considering further reuse. Without reuse, new projects are forced to produce new contextual, and hardly reusable, resources - a problem also underlying the well-known reproducibility crisis. In other words, resources are context-specific, i.e., exploitable in the same environment in which are produced. Users coming from different environments may not be able to exploit the same resources.

Therefore, places with scarce possibilities of producing resources remain irretrievably cut out of the game, often reiterating pre-existing mechanisms of economic inequality.

In this scenario, university's researchers, and the bodies of the third mission, can play a central role as actors of international cooperation. Universities can conduct research that drives development and innovation in infrastructures, technologies, and applications. While producing context-specific resources, universities can make them adaptable to other research and development projects, thus indirectly supporting resource scarcity contexts.

To support the difficult role of the researchers in this scenario, we propose a context-adaptive data collection and integration methodology centered on reuse. The methodology, called iTelos, aims to produce highly reusable resources, which have been designed to satisfy specific requirements, namely a purpose. iTelos builds its output by integrating already existing resources, called external, with resources collected to satisfy the purpose, called contextual. The methodology produces a Knowledge Graph (KG), namely a highly exploitable information structure that maintains both knowledge and data resources. iTelos doesn't design the KG top-down, considering only the purpose, neither bottom-up, considering only contextual resources. The KG is designed middle-out, helping the researcher to both integrate external and contextual resources and to tailor the outcome on her purpose. An additional feature is that the tools that support the methodology are selected and designed to interoperate with each other, thus reducing the effort of handling them separately.

iTelos is implemented within a four-phases process. (i) It starts formalizing the researcher purpose into a set of requirements from which derive the information elements later formalized as knowledge resources. (ii) Once formalized, the purpose leads the collection phase of both contextual and external resources. The contextual resources are collected through a citizen science application developed by the University of Trento (Italy), called iLog. iLog collects data both by asking context sensitive questions and from the smartphone sensors. On the other hand, external resources are fetched using the formalized purpose. To support the users in resource identification, iTelos offers a dedicated repository, where completed projects can be checked and their resources downloaded. In the further phases, the knowledge and data resources are managed. (iii) The knowledge resources are integrated, producing a single ontology that describes the information required in the purpose. Such ontology is obtained integrating the contextual knowledge resources, extracted from the formalized purpose, with the resource collected externally. (iv) In the last phase, the contextual and external data are integrated and merged with the ontology, in order to align the data with the purpose's interpretation.

The final outcome of the methodology is a highly shareable KG accompanied by the project documentation, that is stored in the iTelos repository to be available for reuse.

In a nutshell, the iTelos approach leads to the construction of KGs designed on contextual user requirements, by composing existing resources, often standardized, and well formed. For this reason, the KGs created are more shareable compared with other context-specific resource structures. Therefore, the outcome of the iTelos is both highly suitable and highly reusable, thus reducing the effort in KGs building and braking the production of non-recyclable resources.

Both iLog and iTelos have been tested over multiple use cases, within university courses and EU projects. For instance, in the WeNet project, iLog collected data about social habits of university students in eight countries across three continents (Europe, South America, Asia). The iLog data collection methodology has been taught in the Studies on Human Behavior (SHB) master course, where students collected data about their daily routines. On the other hand, iTelos methodology has been taught in the Knowledge and Data Integration (KDI) master course, held in Trento (Italy) and Jilin (China). Here, students produced KGs integrating external resources with the data collected by iLog, with the purpose of offering services for the university community.

These use cases shown how the research outcome can foster the creation of applied services.

WHY ARE NEGLECTED TROPICAL DISEASES (NTDs) PERSISTENT DESPITE THE SIGNIFICANT EFFORTS TO ERADICATE THEM: CASE OF SCHISTOSOMIASIS IN BURKINA FASO?

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Context: Despite a significant effort to eradicate Neglected Tropical Diseases (NTDs), they are still exacting on human communities a heavy burden estimated for the case of Schistosomiasis to 70 million Disability-Adjusted Life Years (DALYs). In order to achieve the SDG 3 related to NTDs by 2030, there is a necessity to figure out the factors governing this persistence of schistosomiasis, still endemic with high prevalence and high infection intensities, maintaining populations in poverty.

Objective: The purpose of this study is to identify the health determinants of schistosomiasis persistence.

Methods and Materials: Three factors have been evaluated: the treatment method, the sampling method and the diagnostic technic. As regard to treatment, we assessed the accuracy of the World Health Organization height gauge for drug doses estimation; the drug doses has been estimated according to each of involved 258 subjects' weight and their height and compared through Spearman ANOVA at 1% significance level. Regarding the current sampling method for prevalence estimation based on school-age children effectively attending schools, we compared using Fisher Exact test at 5% significance level, the prevalence from three groups of people: scholarized children, non-scholarized school age children and the overall population of Panamasso, the village where the study has been performed. As regard to the diagnostic technic, we compared the traditional parasitological technic of Kato-Katz for stools samples screening to a molecular biology technic especially Real-Time Polymerase Chain Reaction.

Results: a significant difference has been observed between the treatment adapted according to height and the normal one based on weight (p -value < 0.0001). It appeared from the analysis of height-based doses, 50 cases of overdoses (19.38%), 117 (45.35%) cases under the normal dose and 91 (35.27%) cases of normal doses. Besides, according to World Health Organization (WHO) criteria, 50.78% of acceptable doses (30-40mg/Kg), 97.29% of appropriate doses (30- 60mg/Kg), 46.51% of optimal doses (40-60mg/Kg) and 2.71% of inaccurate doses (< 30 mg/Kg) were noted. As for sampling method, we noted a significant difference between the prevalence (p -value = 0.307). As regard to the diagnostic technics comparison, the Kappa Indice of 0,634 indicated a relatively weak correspondence between the two methods; the PCR technic showed a sensitivity of 100% while the Kato-Katz technic showed a sensitivity of 57.14%.

Discussion: The significant differences identified in this study revealed a very relevant issue: the one of accurate data shortage. Indeed, development plans in health sector are established based on data and the necessity of getting accurate data is well known. Considering the treatment based on height that entails low doses administration, the low doses contribute to develop a parasite resistance to treatment. As of today, praziquantel is only medicine used to treat schistosomiasis and a resistance of parasite will be a big obstacle to the eradication of the disease. Also, high doses of drug that entail violent adverse events in body will lead to people reluctance or refusal to take part to the mass

treatment; another obstacle to disease eradication. As regard to the sampling method, the study revealed a significant difference between the reality and the data on which strategies are based. The sampling method based on scholarized children only does not allow getting the accurate disease profile that is the basis for health plans development. This is an important aspect to consider as the eradication of this debilitating disease relies on the ability to establish accurate disease profile. At last, the PCR technic showed that there is a high risk of not getting a real prevalence and then, influence the decision making on the solutions to apply to eradicate the disease.

Conclusion: the emergency of using suited methods and tools to get accurate profile for the disease is a stake of major concern. A strong collaboration between world universities and stakeholders intervening in the fields of NTDs is a high level priority.

MITIGATION OF THE SALINE INTRUSION IN THE MECUFI DISTRICT THANKS TO A WELL-DESIGNED COUNTERMEASURE

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Saline intrusion is the movement of saline water into freshwater aquifers. Saltwater is denser than freshwater and it intrudes inland under the less dense freshwater, creating an encroachment defined "salt wedge". The saline intrusion phenomenon is a global problem of the contemporary society that involves several socio-economic issues in the management of freshwater resources, agricultural productivity and on the preservation of coastal aquifers.

Despite its important socio-economic consequences, nowadays there are still difficulties in properly mitigating its effects, especially in international cooperation contexts.

Therefore, with this study we aim at conceiving an efficient countermeasure to mitigate the saline intrusion phenomenon in a specific case study area in the Mecúfi district (Mozambique).

Manipulation of rivers bed, irrigation systems, the increasing water demand and climate change are aggravating the saline intrusion phenomenon in the area. Saline intrusion penetrates for kilometres inland, contaminating aquifers and affecting soil, causing serious damage to the agricultural production and contributing to the loss of biodiversity.

New data are collected in the case study area, thanks to a local association activity, to integrate the lack of existing data. The collected data are then processed and analysed to recreate numerically the three dimensional case study area through the GMS processor and the Seawat model. GMS and Seawat are powerful and complex tools able to simulate numerically the saltwater intrusion phenomenon, solving coupled the flow and transport equations.

Different countermeasures are then implemented in the numerical domain to test their efficiency against the phenomenon. After the numerical analysis, the most efficient countermeasure is chosen and built physically in the Mecúfi district.

An appropriate quantitative data collection is extremely important for developing a realistic numerical domain and for conceiving a well-designed countermeasure.

A well-designed countermeasure, defined through data collection and the Seawat powerful numerical model, can properly mitigate the effects of the saline intrusion and can ensure a long-term technical solution, avoiding important negative socio-economic consequences in the area.

ESTIMATION OF GROUNDWATER POTENTIAL FOR MANUAL DRILLING USING A MACHINE LEARNING APPROACH AND A GROUNDWATER DATABASE IN SOUTH WESTERN DEMOCRATIC REPUBLIC OF CONGO (DRC)

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The interpretation of groundwater data is important for a correct groundwater management. But most of the countries they do not have an updated, completed and easily accessible groundwater database.

The aim of this research is to evaluate the contribution of automatic analysis of groundwater data with a specifically designed tool based on a machine learning approach to estimate the groundwater potential in low- income areas of Africa with limited direct hydrogeological information.

The study area is located in the South-western provinces of Democratic Republic of Congo (DRC). The region is covered by Quaternary alluvial deposits, with tertiary sandstone and small areas of Precambrian crystalline rocks. Morphology is almost flat or slightly undulated. The access to safe drinking water is low (less than 50% in most of the study area). Groundwater is exploited mainly with moderate shallow boreholes, generally manually drilled in the unconsolidated aquifer.

In order to estimate the potential for groundwater exploitation using manual drilling techniques at national level, a study focused to the identification of suitable zones has been carried out in 2018. In the meantime, a preliminary example of national groundwater database has been set up, using the methodology already applied in Guinea Bissau by UNICEF and the University of Milano Bicocca.

In this research the correlation between hydrogeological conditions, geological context and morphometric indicators have been analysed using different statistical procedures. Furthermore, the tool MlMapper, developed by the University Complutense of Madrid, has been applied to process

the data using a machine learning approach and estimate two indicators related to the groundwater potential of the unconsolidated aquifer: the expected yield of boreholes and the percentage of coarse texture in the saturated exploitable zone.

A series of GIS layers related to the geology, geomorphology and hydrography of the area have been generated. The Mlmapper plugin uses different algorithms to estimate the probability of drilling positive boreholes across the region, (according to threshold values for the two indicators defined taking into consideration water points for small-medium communities). This procedure is carried out automatically splitting the data set in a trial subset (used in the learning process of the algorithm) and a control subset (used to estimate the accuracy of the results).

The study demonstrates that setting up national groundwater database and processing the information with simple automatic tools could provide a strong support for the decision-making process in the implementation of sustainable groundwater development in Africa.

THE DEVELOPMENT OF THE FIRST SOLID WASTE SAFETY PLAN TO REDUCE HEALTH RISKS

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Inadequate solid waste management (SWM) can lead to environmental contamination and human health risks. SWM usually improves moving from low- to high-income countries. Health risks associated with SWM can also vary based on solid waste contents and management practices. Therefore, it is crucial to adequately understand the local situation to reduce health threats related to solid waste mismanagement. Unfortunately, specific information related to exposure and health risks is not available in many circumstances due to the isolation or inadequate resources in communities in many developing countries. The situation is often more challenging in rural areas.

To overcome such issues, evaluate the relative health risk level, and propose appropriate interventions, the first version of the Municipal Solid Waste Safety Plan (MSWSP) is discussed.

In particular, we developed risk assessment matrices specific to the SWM practices observed. We adopted a similar approach used in the Water Safety Plan and the Sanitation Safety Planning developed and promoted by WHO in the last two decades. However, in the field of solid waste, WHO has not fulfilled such a plan yet.

The proposed MSWSP starts with a health risk assessment matrix that is used to grade the level of risk of various SWM hazards related to factors such as leachate, waste combustion, free movement of people and animals around the waste site and spread of contaminants to the surrounding environment through different pathways. Then, control measures are proposed to mitigate the highest identified risks. Finally, a cost analysis is conducted, and it represents the main novelty with

respect to the previous safety plans used for water and sanitation. The cost analysis allowed us to evaluate the order of magnitude of the economic needs considering the concept of appropriate technologies.

Such a first version of MSWSP needs to be discussed at the international level and can be refined and improved from input from the SWM community. Nonetheless, it can be a useful tool to enable easier health risk assessment related to solid waste mismanagement in developing countries, prioritising the interventions associated with the highest risks. Furthermore, it represents the first step towards a solid waste safety plan that could be used worldwide.