COSTEA "REUSE - WASTEWATER REUSE IN AGRICULTURE" INITIATIVE

DELIVRABLE 2: SYNTHESIS OF COUNTRIES' SYNTHESIS

APRIL 2022

2.3 INTERMEDIARY CONCLUSION

❖ ALGERIA:

Algeria is facing **increasing water stress**. Algeria loses an average of 20% of these renewable water resources every year (filling rate of dams in operation across the national territory falling). An alarming finding, knowing that urban and agricultural water consumption is constantly increasing. This situation has recently prompted the public authorities to think about alternative solutions, in particular to reconsider the question of the reuse of non-conventional water.

In this sense, the Minister of Water Resources, recently pleaded for the **reuse of wastewater**, and the **desalination of seawater**. According to him, unconventional resources are currently "palliative resources" in the water stress facing Algeria.

In 2017, the annual volume of wastewater generated by the Algerian population was 1.6 billion ^{m3}/year; distributed across the country's 1,541 municipalities, of which 1.2 billion ^{m3} were collected in 1,125 municipalities managed by ONA.

As for treatment and purification facilities, Algeria has made significant progress in terms of basic infrastructure. The **number of wastewater treatment plants** has increased from 28 WWTPs for a treatment capacity of 98 million ^{m3}/year in 1999 to 177 in 2016 to reach **200 in operation in 2021** for a treatment capacity reaching 1 000 M^{m3}. Production is now 400 M^{m3}.

Of the 200 WWTPs in operation in 2021, **17 WWTPs** (10 of the aerated lagoon type and 7 activated sludge) are **subject to REUSE for irrigation purposes**. In 2020, a volume of 18 million ^{m3} of treated water was used for agricultural purposes for the irrigation of 11,500 hectares, in particular fruit trees (date palms, olive trees, etc.) and some cereals such as barley, wheat and oats.

Informal reuse of treated wastewater remains significant, although poorly documented

TWW REUSE for irrigation takes the form of a concession and requires close coordination between the various stakeholders involved at all levels, and framed by the regulations.

The technical control, the management of the irrigated perimeters and the sanitary control as well as the quality of the purified water and the agricultural products are ensured by the territorial directions of each wilaya under the supervision of **various ministries**: water resources, agriculture, health, environment. and trade.

The **REUSE governance** process includes three interconnected stages, namely the concession study, health control and water use. Each step involves a number of actors.

In **rural areas** not connected to the public sanitation network, i.e. 20% of the total population in 2015, the inhabitants mainly use the autonomous sanitation technique through septic tanks. In the Ghardaïa region, unplanned REUSE initiatives are carried out by local actors such as farmers and civil society.

At present, Algeria does not have a regulatory text relating to the management of **sewage sludge**. However, quality values for sludge and sludge compost have been established by the Ministry of Water Resources and have been classified as national standards by IANOR.

❖ BOLIVIA:

The recent Political Constitution of the State (CPE) approved in February 2009, determines **access to water** as a fundamental human right for life, being a strategic resource of State control.

Although **Bolivia does not have a specific regulatory framework for water reuse**. It has a regulatory framework for the conservation, protection and use of water resources. The regulatory framework for the planning, management and use of water resources in the country is very scattered. The current regulations of the Environmental Law 1333 are very restrictive in terms of quality standards, which represents a real difficulty for the promotion of reuse.

Each sector has its own regulations in this area, which does not allow for global water planning in the territories.

In recent years, some policy tools and regulations have been proposed that consider reuse in the country as an alternative to increase agricultural production under irrigation.

With regard to wastewater treatment, **only 22% of the more than 200 existing WWTPs are in good condition**. Most wastewater is not treated at all and sanitation coverage is only 30%, which is significantly lower than drinking water coverage which is 90%. Natural systems (lagooning) and anaerobic technologies are the most used for wastewater treatment in the country. 275 M^{m3} of wastewater are annually treated.

The sustainability of WWTPs is threatened by the connection of **industrial effluents** to sanitation networks (untreated micropollutants) and by the amount of the sanitation fee, which, in most cases, does not cover operating and maintenance costs. 'maintenance.

The case of the Decentralized Sustainable Sanitation (DSSN) Knowledge Node (2009-2015), an initiative that worked to promote knowledge and implementation of **alternative decentralized sustainable sanitation** (DSS) systems in Bolivia (Semi-decentralized WWTP and dry toilets).

When it comes to wastewater reuse in the country, most of it is used for agricultural purposes. It is estimated that more than 7,000 ha, or the equivalent of 2% of the country's irrigated production area, come from the direct and indirect reuse of wastewater. About 78% of agricultural reuse is concentrated in Cochabamba and La Paz. Around 40% of the wastewater treatment plants in the country are **reused indirectly**, the effluents being mixed with natural waterways and reused downstream. The direct reuse of effluents is practiced in 8% of WWTPs. In only 14% of WWTPs does the discharged water undergo some degree of additional treatment for REUSE.

As with treatment, the question of **tariffs for reuse** is not developed. These REUSE systems are self-managed, which means that the infrastructure, water rights, organization, operation and maintenance are provided by the farmers themselves. Therefore, payments or contributions in kind or labor for the operation and maintenance of irrigation systems are contributions focused solely on repair and corrective maintenance and are not considered tariffs.

Regarding the quality of water for reuse, as mentioned above, no specific regulation exists. On the other hand, liquid discharges from WWTPs must respect the admissible limits of 25 parameters. In addition, the classification of watercourses and water bodies according to their quality and suitability for use (and reuse)

The lack of regulatory text relating to the agricultural use of sludge has led to the orientation of nearly 60% of the residual sludge generated by urban WWTPs towards landfilling and 15% in storage; according to the ONA, only 25% of the 250,000 tonnes of sludge produced in 2012 was recycled in agriculture.

According to the surveys carried out by the MRE between 2018 and 2020, the areas likely to be irrigated by WUEs are 45,000 hectares from 81 purification systems (activated sludge and lagoons) in operation and under construction.

For example, SEAAL and ONID have developed a joint strategy to respond to the current emergency in the **Mitidja plain**. This strategy constitutes an **institutional innovation** in response to a difficult water context: in irrigated agricultural sectors, substitute agricultural withdrawals from dam water with REUT to exclusively direct the small volume of water available in dams towards drinking water. .

❖ MOROCCO :

Morocco has been involved in **water planning and mobilization** since 1960. The institutional framework is based on the management of water resources at the scale of hydrographic basins by specialized agencies (the ABHs), and the general legislative framework is constituted by law 10-95 of August 16, 1995 updated by the new law on water 36-15 of August 10, 2016 for "integrated, decentralized and participatory management of water resources". In the context of climate change, Morocco has anticipated a number of adaptation measures (water saving, efficiency of use, flood control, etc.).

Significant efforts are being made to **mobilize groundwater and surface water resources**. **Major hydraulic infrastructures** have been put in place at a sustained pace, in particular inter-basin water transfer systems, to meet sectoral needs, mainly that of agriculture.

The **2020-2027 priority** program targets two vital sectors, highly threatened by climate change: securing the drinking **water supply in rural areas** and meeting **irrigation needs**. In particular, it advocates saving water through localized irrigation and increasing supply through the **use of non-conventional water**, including treated wastewater.

The **current situation of the liquid sanitation sector** has seen a significant change in recent years: (i) a connection rate to the network of around 76% in 2019 against 70% in 2005; and (ii) a treatment rate of 66% with marine outfalls and 55% without outfalls in 2019 against 7% recorded in 2005. 79 WWTPs are under construction. The volume of treated wastewater is approximately **400 M^{m3}** (excluding outfalls).

According to the 2019 PNAM dashboard, the **intensity of treatments is progressing**: between 2014 and 2019 the percentage of primary treatments fell from 17% to 6%, secondary treatments from 42 to 51% and tertiary treatments (including lagooning complete) from 41 to 43%.

Despite a strong national desire to develop agricultural REUSE (many National Plans), the latter is struggling to develop: no large-scale project has yet emerged on Moroccan territory. Only **small pilot projects** (400 to 1,000 ^{m3}/day for a maximum area of approximately 1.5 ha) have been carried out and have made it possible to develop technical reference systems and to strengthen scientific skills which are fairly well documented.

While the reuse of TWW for agricultural purposes is in a **mixed situation between the blockage and the start-up attempt** (20 M^{m3}/year in 2021), other uses, such as the watering of golf courses and green spaces (43 M^{m3}/year) and the washing of phosphates (industrial use piloted by OCP – 10.3 M^{m3}/year), have proven must be carried out in strict compliance with 80 parameters and their maximum values respective eligible. Furthermore, reuse is only considered for the production of high stem crops and not for the production of vegetables.

Regarding the management and reuse of **sludge**, the country's experience is still limited; there is no accounting for sludge production. Most of the sludge, after drying, is reused in agriculture, but without prior assessment of its quality and its pathogen content.

With regard to studies and documentation related to reuse in the country, the review shows that most of the documents generally deal with the **national situation of reuse** in the country, with information on regulations as well as technical tools for the environment and water resources.

❖ PALESTINE

Considering **water resources scarcity** and **loss of access to water** linked to the Israeli occupation, Palestine considers treated wastewater as one of the sources of water that can be used for different purposes such as Agriculture. Wastewater must be recognized as part of the total water cycle.

The Palestinian water authority (PWA) considers **REUSE** as **one of the five strategic objectives 2017-2021 (SO) for the water sector**. This was already the case in the previous strategic objectives 2012 - 2016.

Currently more than two thirds of the wastewater collected in the West Bank and Gaza is treated in sewage treatment plants (STEP). The total volume of wastewater generated in Palestine is 114 M^{m3}/year but only 47.9 M^{m3} of treated wastewater is produced each year by the 22 WWTPs in the country.

If all the wastewater generated were reused, it would be possible to save 14% of the gap between supply and demand. However, not all treated wastewater complies with the REUSE specifications and standards established between 2010 and 2012, in particular due to the faulty operation of certain treatment plants.

One of the main challenges for the 'Palestinian water authorities' is the management of "**transboundary water**" in the West Bank (15 M^{m3}/year): when there is no treatment plant, the Water can cross borders to Israel, where it will be treated (at the expense of the Palestinian government) and reused by Israeli farmers (Paris Agreement). There is a real challenge for Palestine in treating and reusing this flow of wastewater locally.

Donors (KFW, AFD, JICA, USAid) are very active in sanitation in general and REUSE in particular.

There are **already REUSE operations after tertiary treatment**, in Nablus (2 KFW and USAid pilots, agricultural use), in Jericho (informal REUSE, agricultural use), in Ramallah (green spaces), in Jenin (planned REUSE, on 500 ha) and Gaza (for less than 5% of wastewater). Most of the other major cities in Gaza and the West Bank also have their REUSE projects. There are also about fifteen small wastewater treatment plants that carry out REUSE, often after extensive treatment.

There is **no experience of sludge management on an operational scale**, all practices and projects are either at pilot level or research projects.

Scientific research in the water sector in general is mainly carried out by the water and environment departments of the main universities (Alquds, Birzeit, AnNajah, and to a lesser extent the University of Bethlehem and the University Arab American from Jenin). However, the **main researcher is Birzeit**

to be operational and remain candidates for development strongly supported by the Moroccan government.

Sludge management is not sufficiently integrated into the "water" sector, although initiatives have intensified over the last decade, encouraged by the National Shared Sanitation Program (PNAM). We can cite technical assistance by the AFD to establish good sludge management practices adapted to the purification systems and to the soil and agro-climatic context of the areas of intervention.

❖ SENEGAL :

The **state of sanitation is still precarious** in Senegal, even if the sanitation networks and treatment plants are under development. Non-collective sanitation by latrines and septic tanks is important, which generates faecal sludge rather than treated wastewater. Open air defecation still concerns 30% of the rural population.

The **informal REUSE began in 1970** following the rupture of a raw sewage pipe. It mainly concerns market gardening, with demonstrated negative health impacts on populations.

The country currently has a **legal and institutional framework for REUSE**.

However, only **two "pilot" cases of planned REUSE** have been identified, at pilot stage and supported by WHO and FAO. These sites are located in the northern outskirts of Dakar (Niayes de Patte d'Oie and Pikine sectors, flow rates concerned 1,000 ^{m3}/d for each). The use of water is mainly market gardening. Tertiary sand filtration treatments are implemented.

The project has enabled the annual supply of approximately 600,000 ^{m3}, half of which, from the Cambérène station, supplies the farmers of Patte d'Oie on approximately 35 ha. The other half, which comes from the Niayes station, supplies the farmers of Pikine on approximately 25 ha.

Farmers are interested in REUSE in order to cope with the **increasing cost of conventional water**, for which they compete with urban uses which are increasing due to demographic changes.

On the institutional, organizational and regulatory level, the **management of the REUSE is complex**, because it involves the hygiene service (Ministry of Health), the Department of Sanitation (Ministry of Hydraulics and Sanitation) , the Department of Horticulture (Ministry of Agriculture and Livestock), the Department of Town Planning (Ministry of Town Planning and Regional Planning), and finally the municipality. Because of this **multiplicity of actors** intervening in the sector, it is impossible to develop the sector sustainably without consultation to organize local governance.

On the technical level, the **management of sanitation works is ensured by ONAS**, even if there is a trend towards the delegation of public service to private companies. There is little agricultural technical support that would take into account the specificity of the irrigation source.

Currently, the main **reuse of sludge** concerns waste materials from non-collective or semi-collective sanitation (latrines). There is agricultural valorization after a summary treatment. It is in this context that there is currently a whole sector for the recovery of fecal sludge at the level of market gardening activities in the Niayes area, already studied for the informal REUSE and for the two pilot sites of Patte d'Oie and Pikine. .

The Gates Foundation is supporting a **heat treatment project for faecal sludge to disinfect it** and improve its use from a health point of view.

University. The research topics are the impact of REUSE on crops and soils, alternative treatments (e.g. planted filters).

Farmer acceptability of REUSE was also surveyed with 115 West Bank farmers, showing that 75% of them were willing to farm with EUTs, the main decision being the absence of a conventional resource.

❖ TUNISIA :

There are **122 wastewater treatment plants in 2020**. The fleet, the result of a massive equipment campaign in the 1990s, is now aging: 54 wastewater treatment plants are over 20 years old and twenty are over 30 years old. A major rehabilitation/extension program is being implemented by ONAS. 287 Mm^3 are annually treated.

The agricultural **REUSE began in 1965** in Tunisia. According to the latest report available on the REUSE, there are 31 irrigated perimeters with an irrigable area of 7 437 ha. This area has increased by 20% since 1998 (6200 ha).

During the **2018-2019** campaign, **only 22 irrigated perimeters** are operational with an area of 6387 ha (86%). The reasons explaining the non-functionality are: lack of interest in certain PIs located in the north of the country which is relatively endowed with rainwater, the quality of the EUTs, power cuts, non-functional networks and equipment.

The **REUSE regulatory framework** is in place, with a decree from 1989, an order from 1994, and a quality standard revised in March 2018. However, at present, if physicochemical analyses are carried out in the majority of irrigated perimeters, bacteriological analyses are less frequent. Sanitary measures (protective equipment for farmers, vaccination, prohibition of direct grazing) as defined in the REUSE specifications are often not respected. No monitoring of salinity or soil is ensured in the majority of the PI/EUT.

With regard to **sludge**, the Tunisian **regulatory framework** aims to protect public health and soils in the country's specific climatic conditions. Use restrictions apply for market garden crops. It is also forbidden to use liquid sludge as well as non-sanitized sludge.

Still on **sludge**, a first **general study** was carried out in 2006 in the form of an action plan which covered the various technical, financial and institutional aspects of the management of sludge from treatment plants. It was followed in 2015-2016 by four regional master plans (Greater Tunis, North, Center and South) which defined:

- he different treatment/recovery channels;
- planning of the necessary infrastructure by 2035;
- a priority investment program;
- and accompanying measures.

The sectors defined are the green sector (agricultural recovery), the red sector (energy recovery in cement works) and the black sector (landfill).

The lines of **research** in Tunisia around the REUSE, led by 6 main organizations, covered the following major themes:

- Techniques for improving the quality of EUTs prior to their reuse;

- Agricultural techniques and practices to optimize REUT in agriculture (irrigation systems, storage, fertilization, tillage, etc.);
- Environmental impacts;
- Health impacts for users and consumers;
- More marginally, aspects related to governance, including socio-economic, institutional and social aspects.

3.3 COMMON POINTS AND SPECIFICITIES

Theme 1: Unplanned REUSE, rural sanitation, sludge management

➔ For this first theme, the countries can be roughly divided into two groups, depending on the purification capacities in place: a group equipped in a more or less exhaustive and functional manner with its main WWTPs (the 3 countries of the French-speaking Maghreb) a group of countries still under-equipped or failing (Bolivia and Senegal). The case of Paestine is intermediate: a large part of the main WWTPs are operational, the last ones under construction or in an advanced project.

➔ Unplanned or informal REUSE takes a contrasting position depending on the country. It is generally ignored and poorly documented.

➔ The first group displays an informal ban on REUSE, a ban which in fact is not complete except in Tunisia. They already have (in the Tunisian case) or are planning (Algeria, Morocco, Palestine) REUSE projects for most of their wastewater treatment plants.

➔ As for the second group, uncontrolled informal REUSE is the majority, which represents a significant health risk. It is difficult for the public authorities to intervene when habits are established, the reaction of user farmers can be strong. Note that after treatment and dilution in media, the health risk is reduced.

➔ More specifically, in Bolivia the high number of treatment plants hides malfunctions, low treatment efficiency, and discharge of poorly treated water of poor quality; there are 81 informal REUSE sites against 4. In Senegal, in the Niayes area, market gardening is developing from informal REUSE; we note there two experiments of complementary treatment to limit the risks accompanied by FAO and WHO.

➔ Note that Algeria seems to have switched from the second to the first group after an episode of cholera in 2018.

➔ Rural sanitation is in its infancy in the target countries, but there are some successes of "model" projects with an integrated REUSE component, in Morocco or Palestine. This will be discussed in step 3 (participatory workshops).

➔ With regard to sludge: the situation is similar in the countries of the first group, which overall are thinking about planning tools, but have not made any progress from an operational point of view. The deposit is there, some experiments have taken place but no systematic development. The subject inspires mistrust, the volumes stored are accumulating, landfilling is not sustainable, and it will be necessary to tackle the problem one day...

Theme 2: governance, communication, awareness

➔ Note that regulatory and governance issues will be the subject of a specific COSTEA REUSE deliverable (step 4).

➔ All countries benefit from official texts governing the REUSE. As for Theme 1, there are two groups of countries: for the 4 Mediterranean countries, the legal texts are accompanied by decrees, orders or application standards which detail them. For Bolivia and Senegal, the corpus is simpler (law only).

➔ The institutional stakeholder game is particularly complex in the 3 French-speaking Maghreb countries and in Senegal, with many Ministries involved, as well as local authorities and the agricultural profession. There are coordination bodies or mechanisms, but they are in fact not very operational.

➔ In the operations identified, user associations are generally responsible for the practical organization of irrigation (Senegal not yet)

➔ In some countries, there are models of agreements between actors that could serve as a model more widely (eg Morocco), even if these are not always implemented.

➔ There are national plans specific to REUSE in the 3 French-speaking Maghreb countries (that of Tunisia is being developed). For the other 3, the REUSE is integrated into broader planning documents, such as national water resource management plans.

➔ The REUSE issue is important in the Occupied Territories (West Bank = West Bank) because Israel charges for the rejection of EUTs in the valleys leading to its territory. In this scenario on the Palestinian side, water is not a resource but a source of costs.

➔ The acceptability by farmers is quite good in general, but contrasted according to the availability of conventional resources. Where there is a lack of water, there does not seem to be any cultural or religious blockage.

➔ Senegal offers the particularity of a valuation of water for its fertilizing elements, which are the main criterion justifying the use by WTEs by farmers.

➔ The support and awareness of farmers are implemented in Morocco and Tunisia by various departments of the Ministry of Agriculture (ONCA, ONSSA in Morocco, CTV in Tunisia)

➔ Tunisia has been the subject of public awareness initiatives on the use of treated wastewater.

➔ In the case of Senegal, non-collective or semi-collective sanitation is still the norm. Faecal sludge from septic tanks is still the norm, treatment units are being set up to condition it and reduce the health risk, but it is often bypassed and the sludge is marketed without treatment.

➔ Provided that the levels of trace elements are within the standards, and that a mixed organic substrate is available, the composting of sludge seems to be a very relevant solution, which would also allow the maintenance of the organic matter content of the soils, crucial in irrigated agriculture in hot climates (OM mineralization dynamics).

Theme 3: IWRM, economic aspects

➔ Integrated Water Resources Management (IWRM) is a relatively new concept, which is being implemented in Algeria, Morocco, Bolivia and Senegal, with the creation of Hydraulic Basin Agencies. However, there is a lack of resources for these structures, and a significant weight of the central (ministries).

➔ In display, the REUSE is generally integrated into the IWRM. For example, Algeria foresees in its IWRM 2035 plan the realization of 235 structuring projects, of which 32% concern the REUSE.

➔ The sale price of treated wastewater is generally low, and does not cover any tertiary treatment costs. In some cases (Algeria, Tunisia), an excessively low selling price is detrimental to the practice: the treated wastewater no longer has any value. The ordinary costs of the irrigated perimeter, in particular pumping costs and maintenance costs, are generally not covered.

➔ In Tunisia, a decree recently came to circumvent the fixing of the sale price which is too low, requiring the payment of energy costs.

➔ The situation is as follows: the selling price of treated wastewater must be lower than that of conventional water, which itself is subsidized. Special case of Algeria, very low conventional water tariff (0.02 €/m3) and identical to that of EUT. Higher in Morocco (0.05 to 0.1), and in Tunisia (0.06 to 0.25).

➔ La seule solution réside donc dans la subvention par l'État pour couvrir l'écart entre le coût réel et le prix payé par les usagers.

➔ Globalement il n'y a que peu de recul sur l'impact économique de la REUSE agricole dans ces pays.

➔ Une analyse coûts bénéfices réalisée en Palestine, sur 3 sites, ratio coûts / bénéfices varie entre 2 et 5 : les coûts dépassent systématiquement les bénéfices économiques. Il faut prendre en compte les externalités sociales (création d'emploi et économies d'engrais) et environnementales (préservation de la qualité des eaux superficielles et souterraines). L'étude démontre également l'intérêt du multi-usage, dans ce cas l'industrie cimentière, qui va consommer l'eau toute l'année.

➔ Le prix acceptable pour une eau usée traitée est en général de la moitié de celui d'une eau conventionnelle, à condition que le service soit correct (quantité).

➔ Le recouvrement des factures est compliqué en Palestine.

➔ La valorisation de l'eau est contrastée. Il existe notamment une réflexion sur des cultures à plus forte valeur ajoutée en Tunisie.

➔ Tunisian civil society is mobilizing more and more often on environmental issues, and in particular on the impact of waste water treatment, which is favorable to the REUSE.

Theme 4: REUSE on the plot, equipment, health and environmental risk management

➔ Tertiary disinfection treatments are among the first links in the health risk management chain. They are rare to date, but integrated into the new projects of the 4 Mediterranean countries. These are generally sand + UV filters.

➔ Morocco is thus pushing towards the generalization of tertiary filtration and disinfection treatments before agricultural REUSE, whatever the crop.

➔ In the event of a sudden deterioration in EUT quality, there is no warning system

➔ The methods of irrigation with treated wastewater are contrasted. Gravity in many cases to limit costs, such as Tunisia in an intercropping system of olive trees / fodder crops. Localized in the case of Palestine.

➔ There are restrictions on crops by regulation (eg ban on market gardening in Tunisia, ban on short-stemmed plants in Bolivia).

➔ The informal use of wastewater is widely present at least in Algeria, Bolivia, Morocco and Senegal. It leads to a lack of control and increased risk. Witness market gardening in Senegal.

➔ In Algeria surprising study result: vegetables irrigated by the REUT are less contaminated by metals than similar vegetables bought on different markets probably irrigated with other waters of mediocre quality.

➔ In the Tunisian example, irrigation with treated wastewater did not induce waterborne disease, unlike raw wastewater, or even conventional water which can be contaminated by discharges.

➔ An environmental and social impact study (ESIA) is required before the implementation of a REUT irrigated perimeter in Morocco and Tunisia. An Environmental and Social Management Plan (ESMP) is required. The monitoring of the quality of soils and groundwater, required in these studies and plans, is rarely carried out.

➔ Raising awareness and supporting farmers with regard to health risks are undertaken in Morocco and Tunisia.