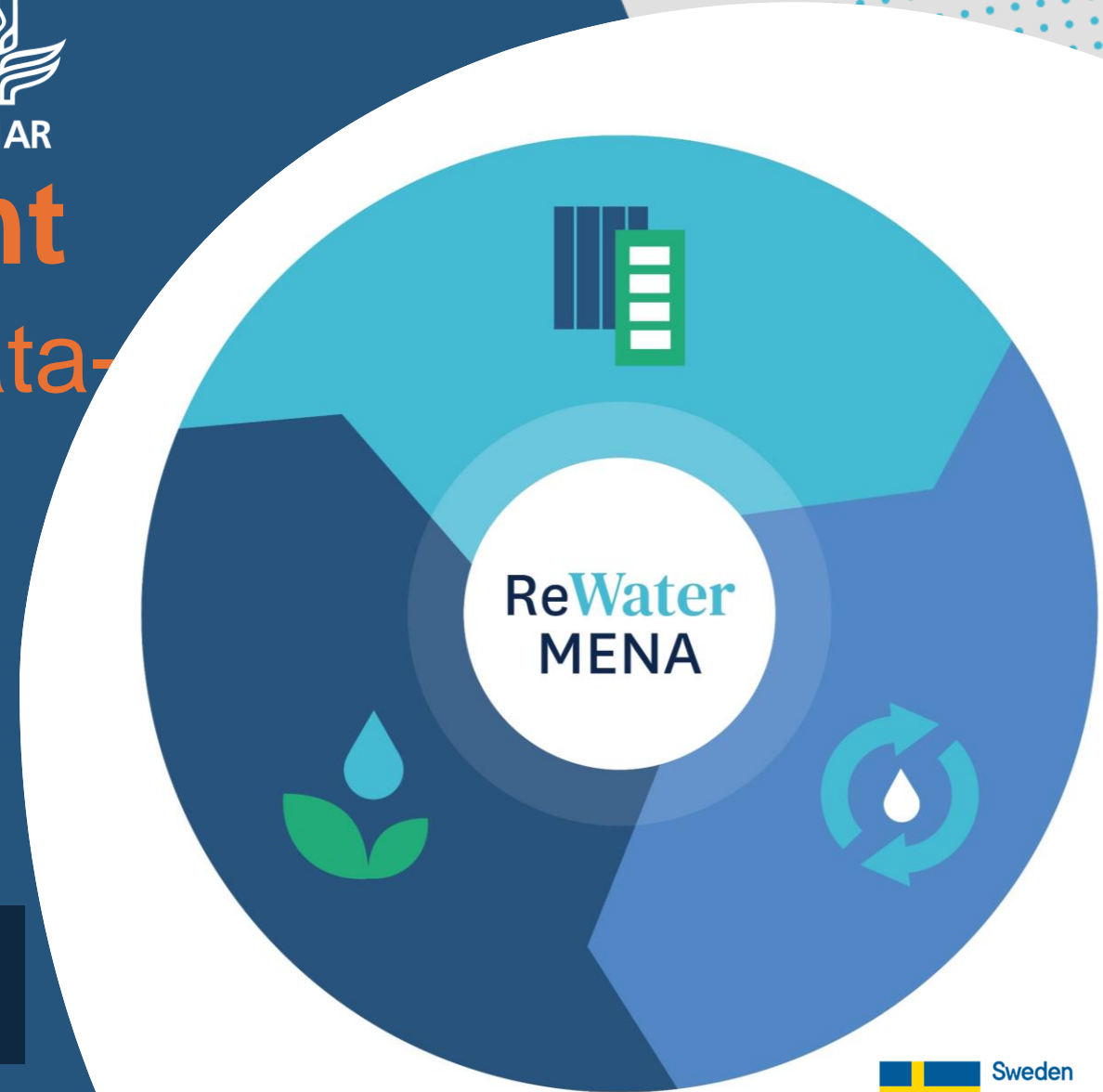


Wastewater Treatment & Reuse in MENA: Data- related Challenges and breakthroughs

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- Senior researcher and coordinator-Water Quality -IWMI



IWMI

International Water
Management Institute



Sweden
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Food and Agriculture
Organization of the
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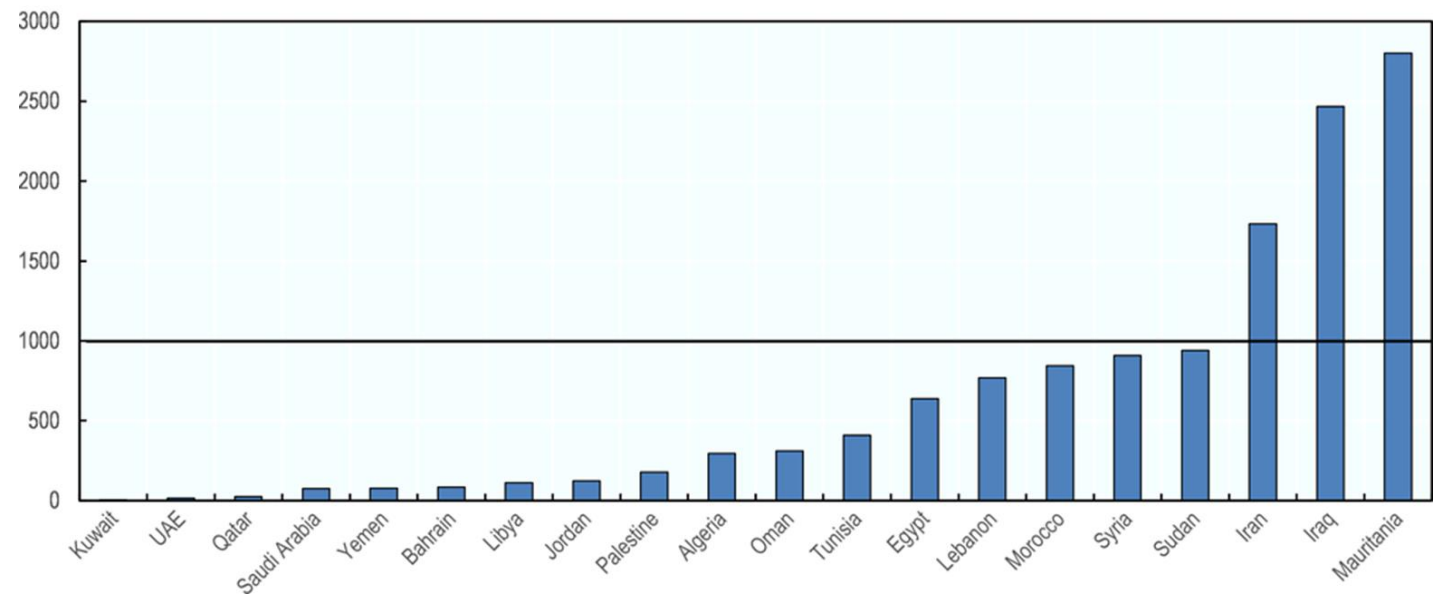
مركز الأبحاث العلمية الزراعية
L.A.R.I.



ICARDA



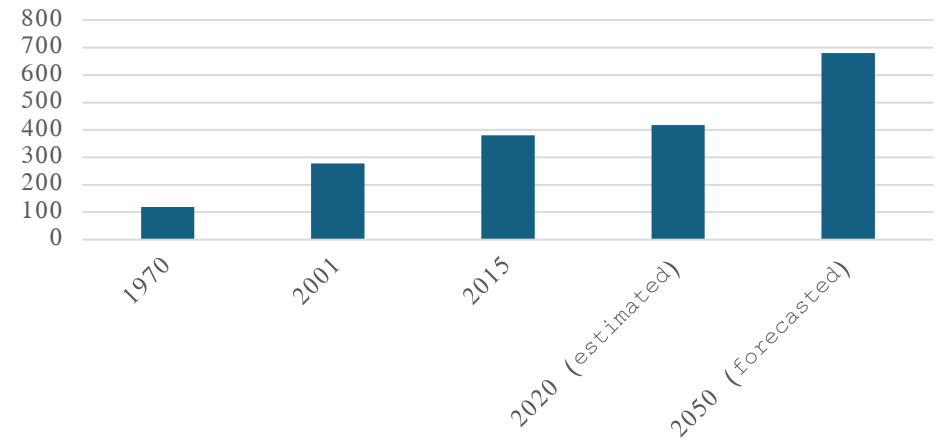
Cubic meters per capita



Source: FAO (2018).



Population in MENA (millions of inhabitants)





Increased water scarcity is forecasted to make GDP drop down between 6 to 14% by 2050 and reduce labor demand by up to 12% (WB 2018, Taheripour et al. 2020).

REFLECTIO

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Q1. How can Data help in **understanding** the current and

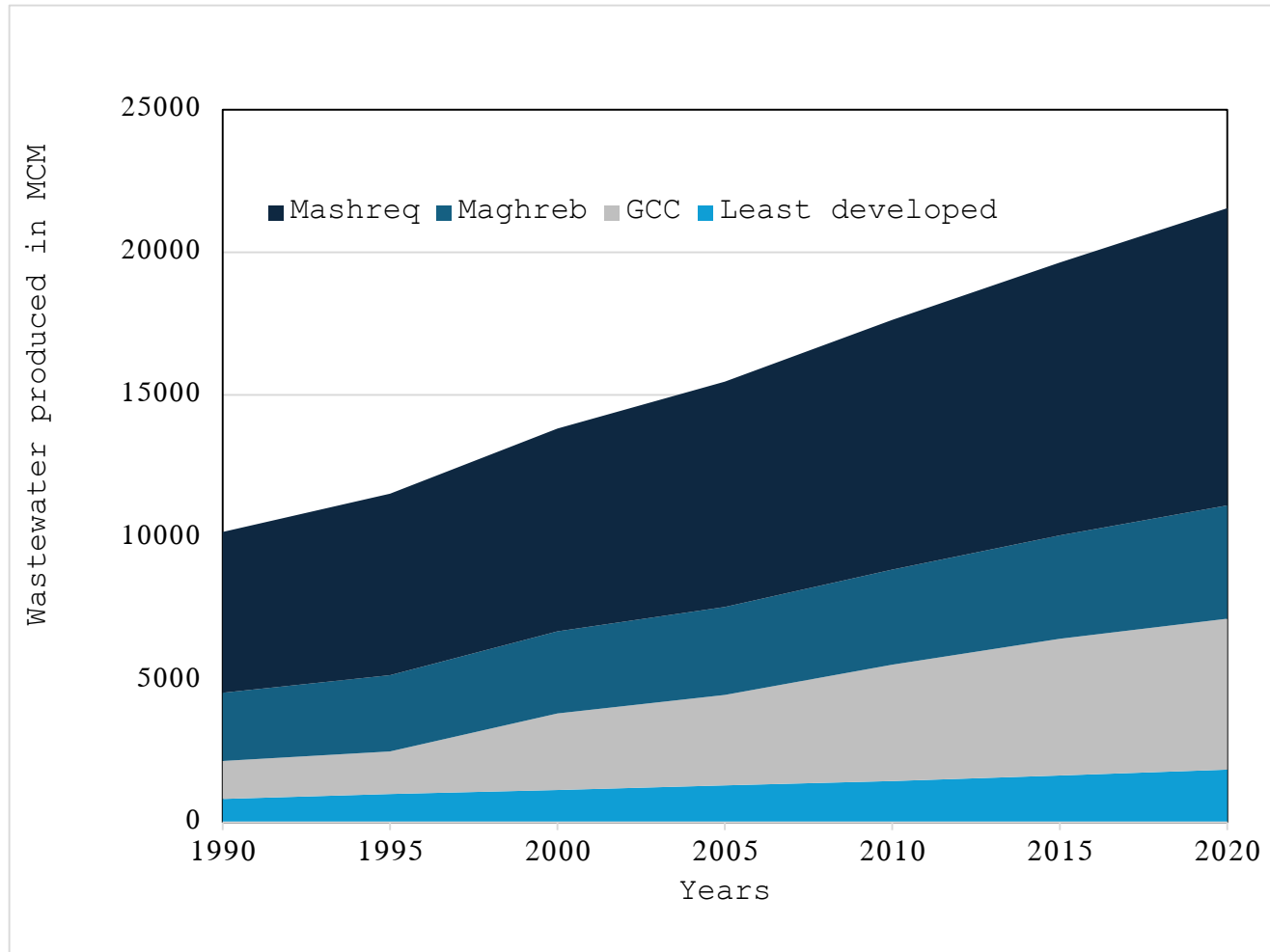
future **competition** between

Q2. How can Data help in **positioning** treated wastewater **sectors on water** to inform water allocation and to **alleviate this competition**?

2-Wastewater is part of the problem and part of the solution

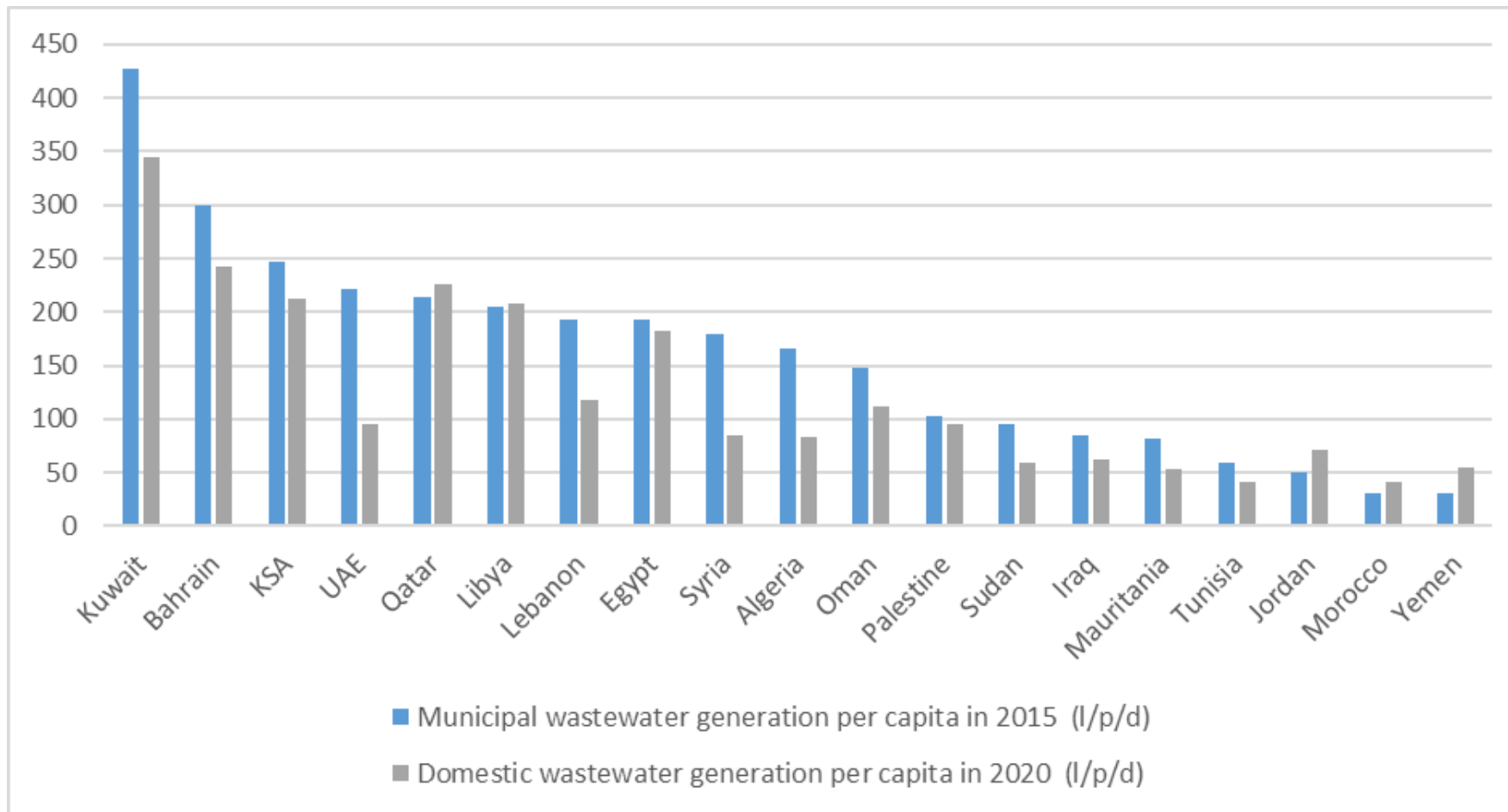


Wastewater production grows as population, urbanization and income per capita grow



Note: Mashreq includes: Iraq, Jordan, Lebanon, Palestine, Syria and Egypt; Maghreb includes: Algeria, Libya, Mauritania, Morocco and Tunisia; GCC (Gulf Cooperation Countries) includes: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates), Least developed countries include: Sudan and Yemen

Per capita wastewater generation in MENA



Source: AWC 2019, WHO 2021

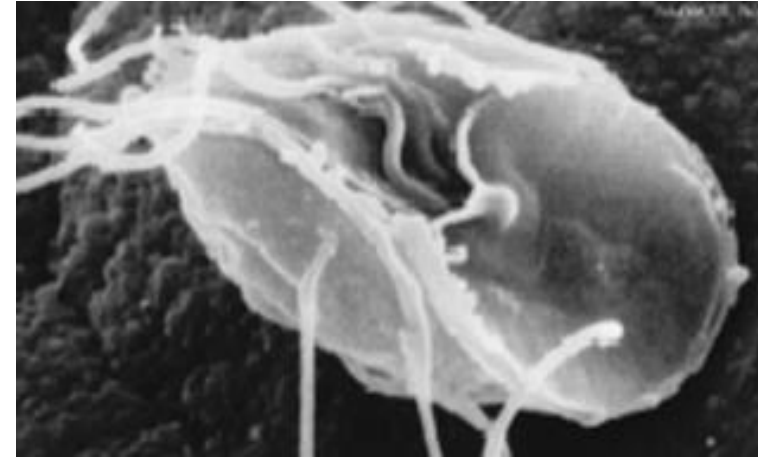
REFLECTION

Q3. What are (current & future) wastewater quantities to expect by period and location ?

Organic matter



Pathogens



Salts and sediments



Emerging pollutants



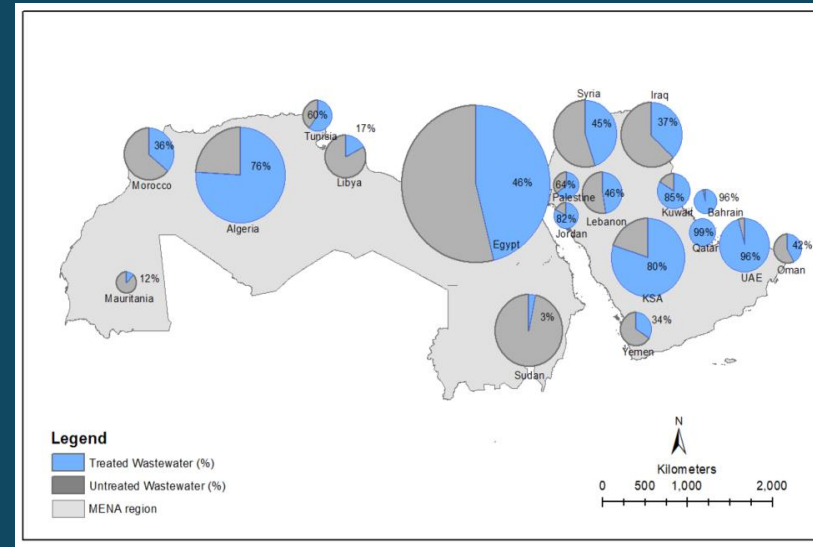
Composition raw wastewater

| Country | TSS | BOD | COD | T-N | T-P | F.C | EC | TDS | No of WWTPs |
|------------|------|------|------|-------|------|--------------|------|-------|-------------|
| | mg/l | mg/l | mg/l | mg/l | mg/l | CFU / 100 ml | dS/m | mg/l | |
| Algeria | 357 | 330 | 660 | 23.2 | 10.0 | 1.84E+08 | 2.4 | 1,642 | 20 |
| Bahrain | 179 | 219 | 410 | NA | NA | NA | NA | NA | 1 |
| Egypt | 243 | 209 | 391 | 40.2 | 6.4 | 1.43E+09 | 1.1 | 654 | 13 |
| Iraq | 230 | 214 | 395 | NA | NA | NA | 1.9 | 1,379 | 5 |
| Jordan | 628 | 624 | 1245 | 100.0 | 10.5 | 2.87E+07 | 1.4 | 978 | 22 |
| Kuwait | 250 | 234 | 431 | 31.5 | 21.8 | 3.41E+07 | 1.0 | 645 | 4 |
| Lebanon | 412 | 291 | 618 | 63.1 | 12.0 | 1.13E+06 | 1.3 | 962 | 15 |
| Libya | 216 | 298 | 431 | NA | 2.8 | NA | 2.8 | 1,664 | 5 |
| Mauritania | 658 | 535 | 1811 | NA | NA | NA | 2.1 | 1,506 | 1 |
| Morocco | 475 | 1354 | 907 | 82.7 | 11.3 | 7.83E+08 | 2.7 | 1,869 | 9 |
| Oman | 420 | 245 | 920 | 87.7 | 12.0 | 1.45E+08 | 1.7 | 944 | 7 |
| Palestine | 781 | 471 | 951 | 66.6 | 10.2 | 2.22E+06 | 2.9 | 2,268 | 10 |
| Qatar | 150 | 178 | 418 | 35.0 | 5.0 | 5.01E+06 | 2.0 | 1,329 | 2 |
| KSA | 321 | 213 | 413 | 25.6 | 13.2 | 2.54E+06 | 2.3 | 1,488 | 10 |
| Sudan | 447 | 411 | 1076 | NA | NA | NA | 1.2 | 709 | 3 |
| Syria | 539 | 355 | 542 | 46.8 | 2.5 | 3.90E+07 | 2.3 | 1,701 | 3 |
| Tunisia | 419 | 372 | 899 | 92.9 | 12.6 | 7.93E+06 | 3.2 | 2,477 | 23 |
| UAE | 277 | 258 | 589 | NA | 6.2 | NA | 3.8 | 2,108 | 8 |
| Yemen | 444 | 743 | 1307 | NA | 15.0 | 2.93E+06 | 2.6 | 1,899 | 5 |
| MENA | 326 | 335 | 522 | 55.2 | 12.2 | 5.15E+08 | 2.5 | 1,422 | 166 |

Still a long way to go in
wastewater treatment to catch up
with population growth

Municipal wastewater produced
21.5 km³

Safely treated
60%



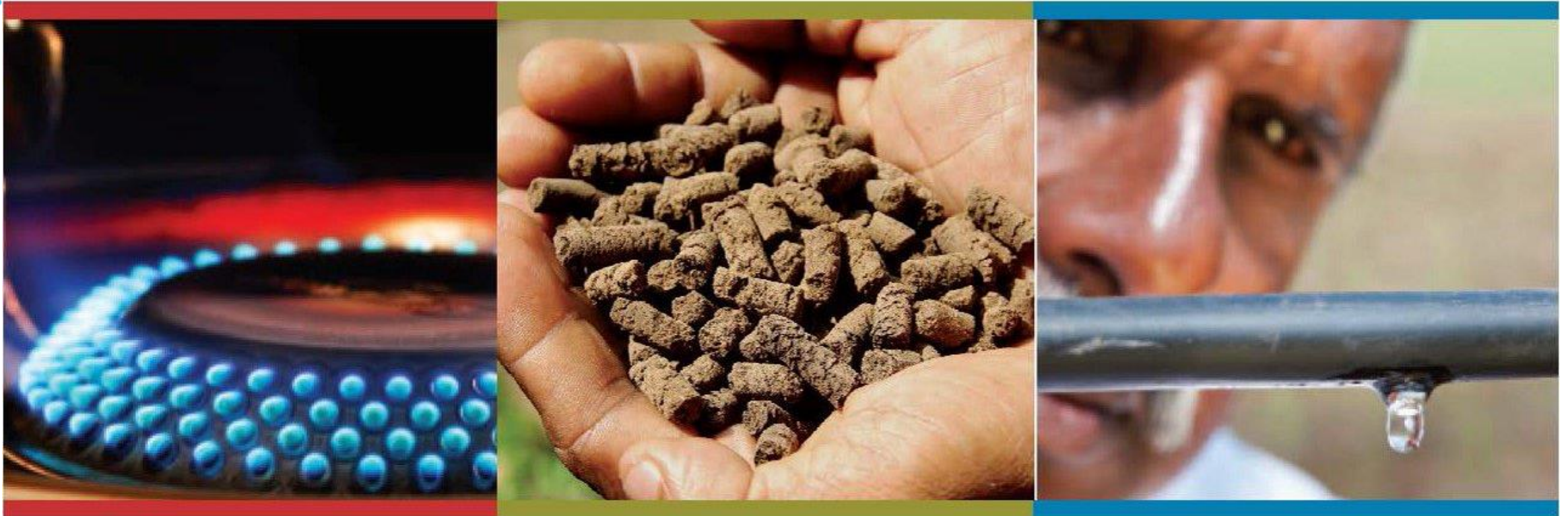
Source: AQUASTAT, AWC 2029, GWI, WHO 2021

Even with wastewater treatment some pollutants are poorly removed

Average composition of raw and treated wastewater and associated removal in MENA

| | TSS | BOD | COD | T-N | T-P | F.C | EC | TDS | Ner of cases |
|------------|-----|-----|-----|------|------|----------|------|-------|--------------|
| Raw WW | 296 | 285 | 523 | 55.2 | 13.2 | 7.15E+08 | 2.46 | 1,490 | 166 |
| Treated WW | 38 | 32 | 84 | 21 | 8.32 | 8.04E+05 | 2.16 | 1,336 | 211 |
| Removal | 87% | 89% | 84% | 61% | 37% | 1-6 log | 12% | 10% | |

Opportunity: resources embedded in



Water and nutrients to irrigate and fertilize more than 2.6 million hectares.

Carbon to produce methane with a caloric value to provide electricity to 8 million households.

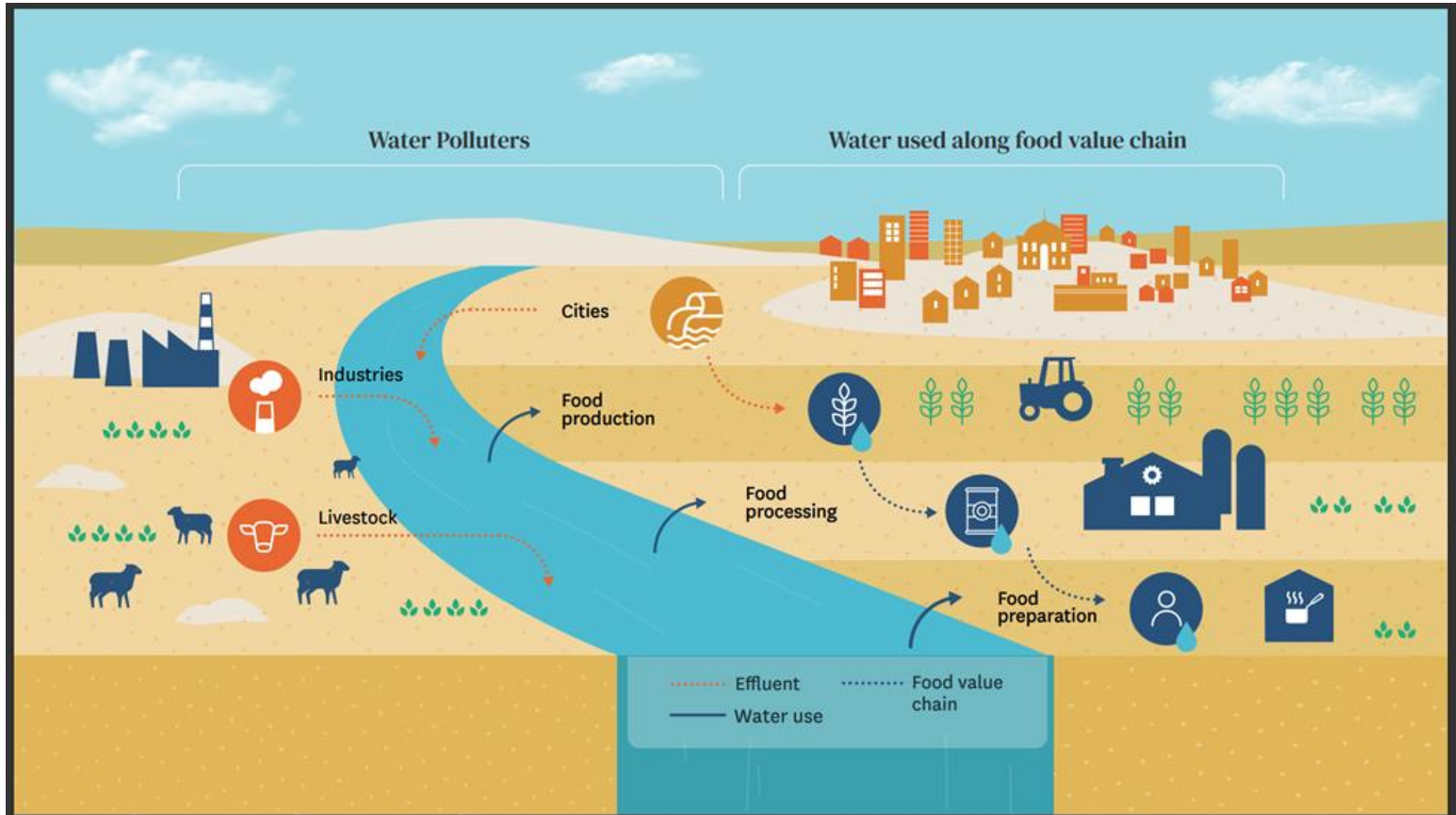
3-Indirect use of untreated wastewater is a common reality in MENA:

health
and mit.

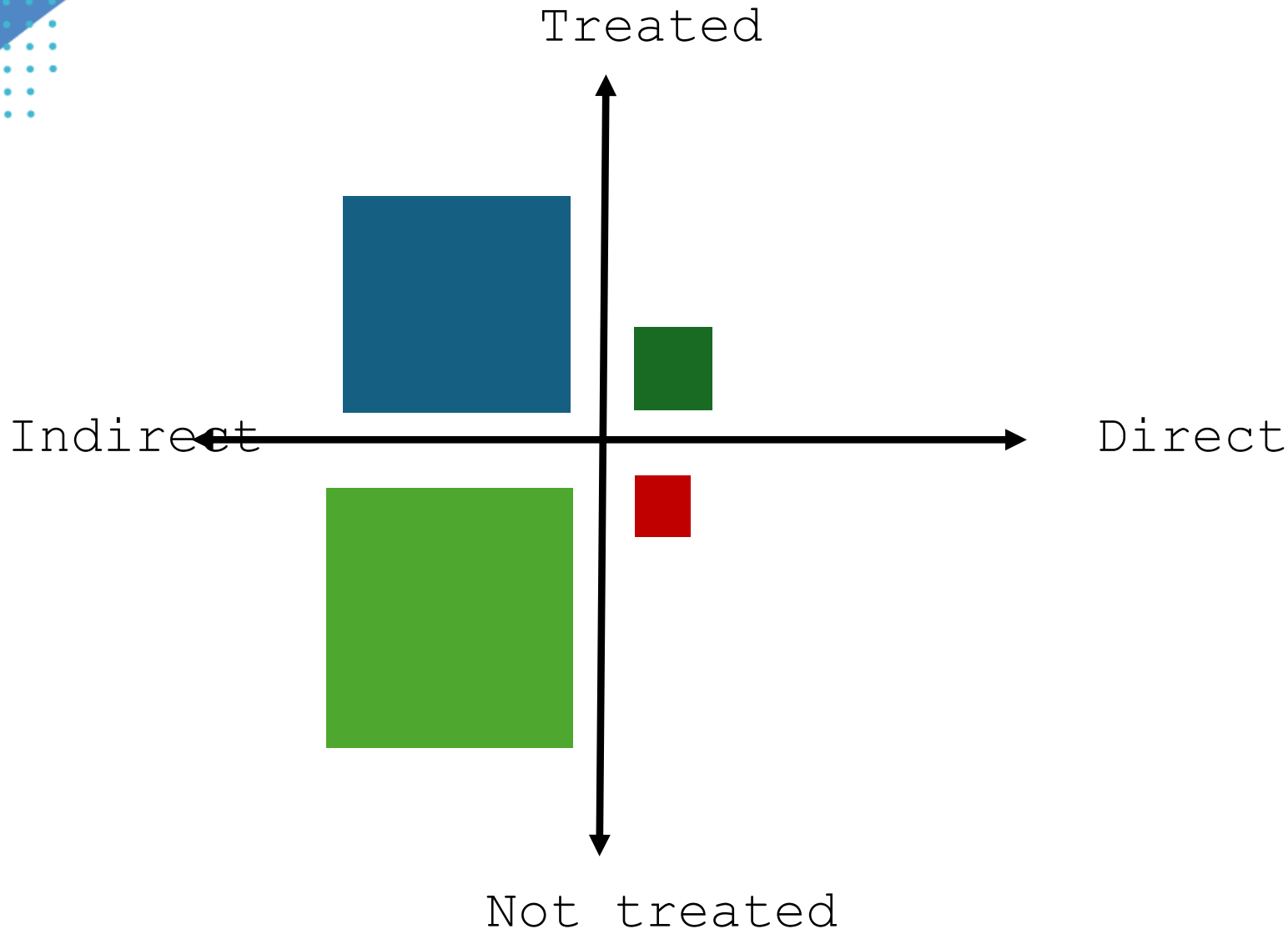
essed



Wastewater fate



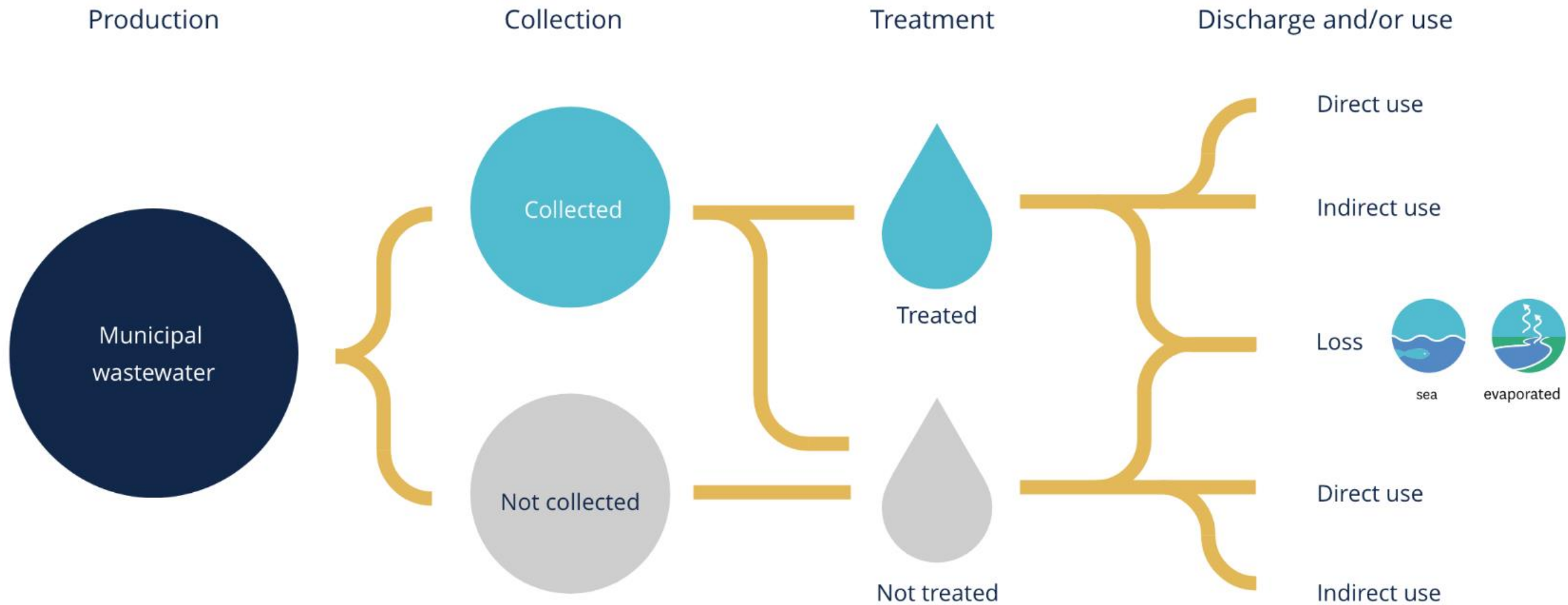
Surface irrigated with different type



4-Wastewater is only a waste if we decide to waste it:

The potential for resource recovery from municipal wastewater in MENA is still untapped

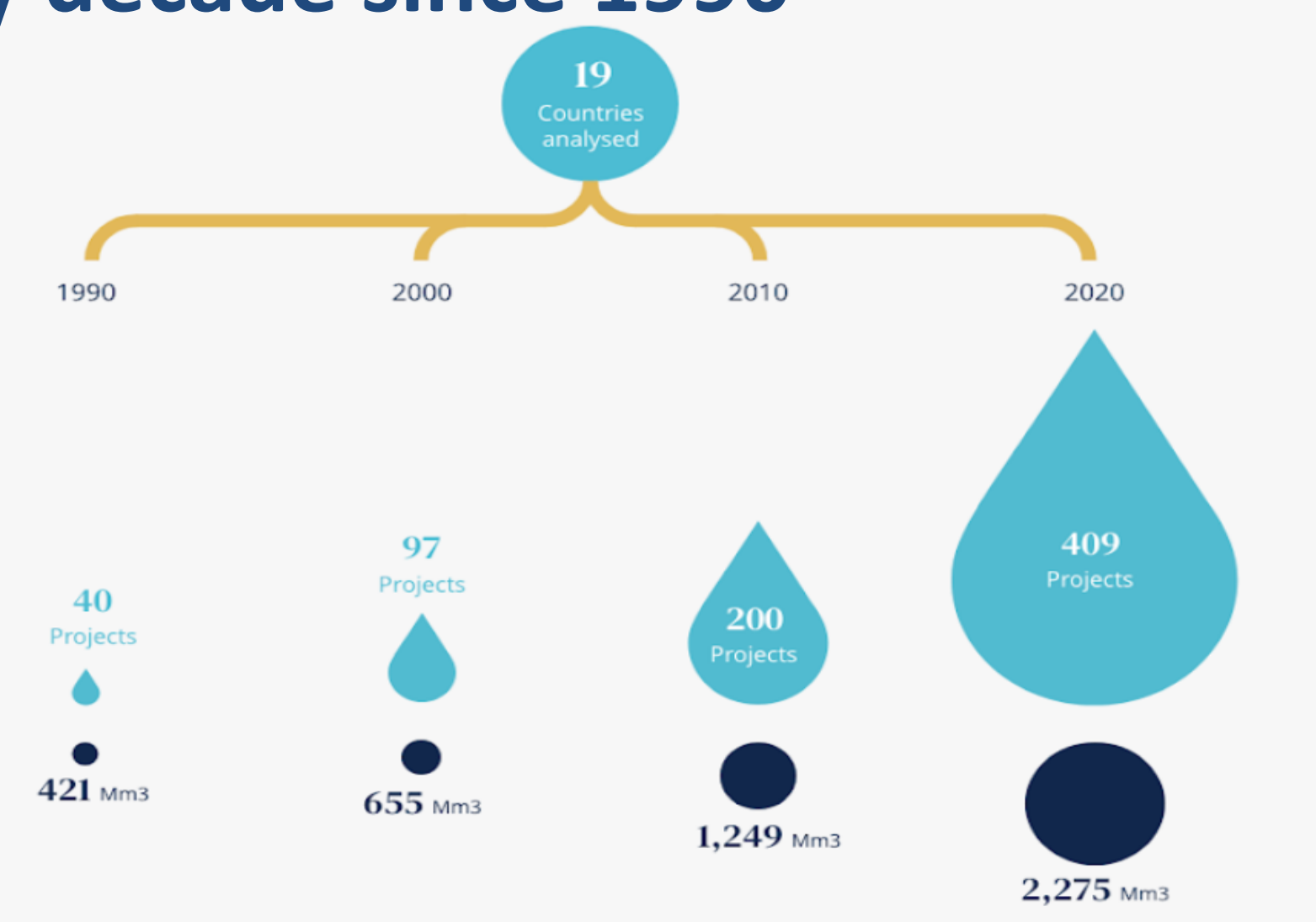
Wastewater fate



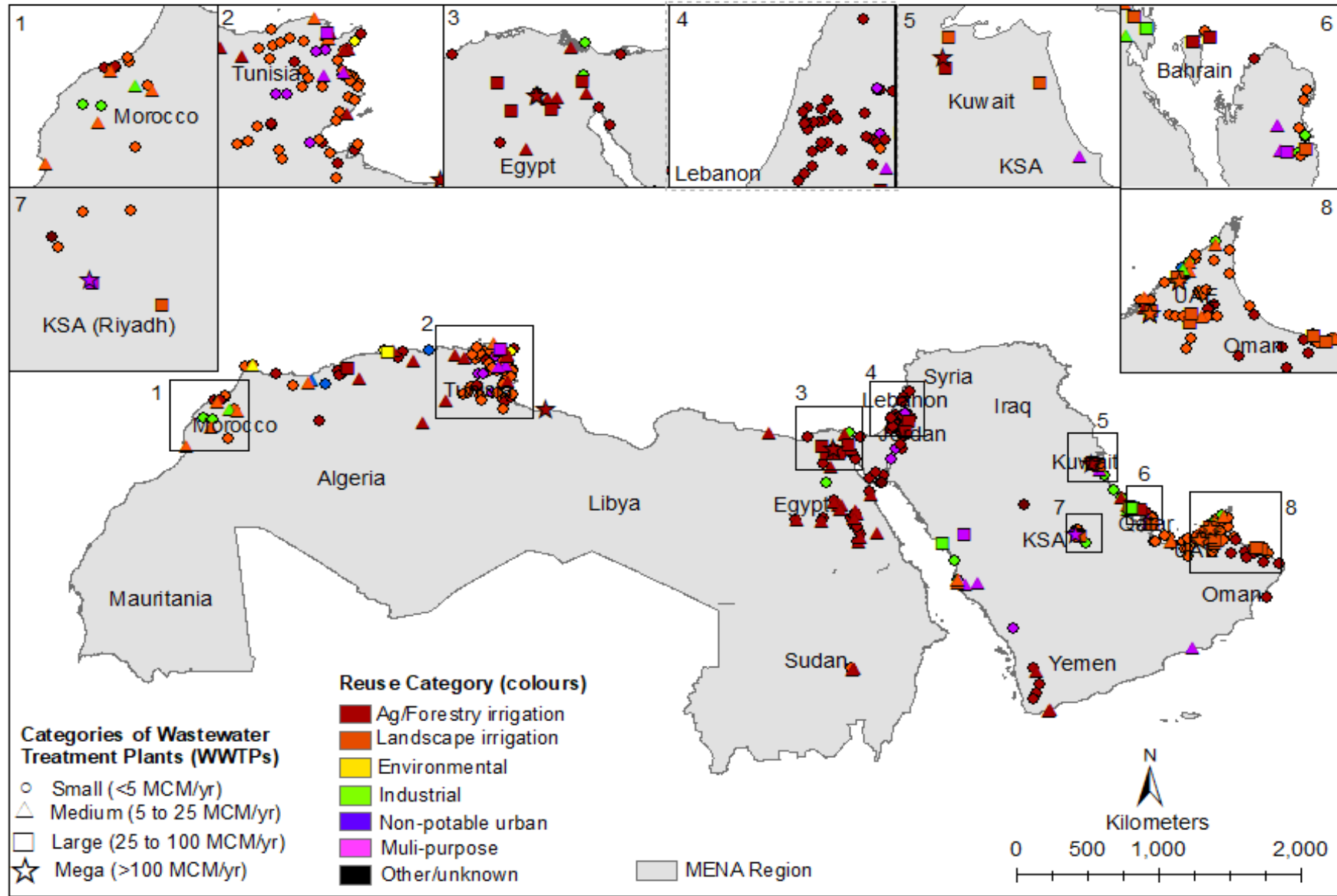
Water reuse projects in MENA

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
|----|-----|-------|--|------------------|------------------------------|-------------|--------------|------------------------------|-------------|-----------------------|-------------------------|-----------|-----------------|-------------|---------------|---------------|---------------------|---|--|----------------------------|-----------|-----------|
| 1 | No. | UID | Name and Location of Reuse Cases | | | | | Time and Status of operation | | System description | | | | | | | | | | Population served (capita) | Reference | |
| 2 | | | | | | | | | | Water reuse case name | Country | Location | Latitude(N) | Longitude E | Location type | Start-up year | Status of operation | Reuse Category and Specific application/Purpose | Wastewater input type (agroindustrial, domestic, etc.) | | | |
| 3 | | | Desgin Capacity | Average Capacity | | | | | | | | | | | | | | | | | | |
| 4 | 1 | ALG1 | Taghit Oasis Project | Algeria | sub-Saharan area, near the | 30.93687215 | 2.04137797 | Municipality | 2002 | Yes | Agricultural Irrigation | Municipal | Max Secondary | | 302,220 | | 0.00030 | 0.00027 | | 6900 | 254 | |
| 5 | 2 | ALG2 | Reuse in Mascara | Algeria | Mascara, North West Algeria | 35.38399692 | 0.143401442 | WWTP | before 2015 | Yes | Agricultural Irrigation | Domestic | Max Secondary | | 7,750,000 | 0.00775 | 0.00696 | 2580 | | 5 | | |
| 6 | 3 | ALG3 | Brezina pilot case Constructed wetland for | Algeria | Brezina, 85 km south of the | 33.09389 | 1.234278 | WWTP | 2012 | Yes | Agricultural Irrigation | Domestic | Max Secondary | 10,950 | 6,899 | 0.00001 | 0.00001 | 2.3 | | | 77 | |
| 7 | 4 | ALG4 | UHS Pilot for Waste water reuse (Mostaghanem WWTP) | Algeria | Mostaghanem, is located 350 | 35.93084706 | 0.090595174 | Municipality | 2016 | Yes | Agricultural Irrigation | Mixed | tertiary | 41,610,000 | 82,125 | 0.00000 | 0.00000 | 2180 | | xx | | |
| 8 | 5 | ALG5 | Tlemcen | Algeria | 12 km north of the Tlemcen, | 34.9227059 | 1.31428515 | WWTP | 2005 | Yes | Environmental Reuse | domestic | Max secondary | 10,950,000 | 8,470,000 | 0.00847 | 0.00761 | 912 | | | | |
| 9 | 6 | ALG6 | Ourgala WWTP | Algeria | Ourgala, Algerian | 31.995219 | 5.366084 | WWTP | 2008 | Yes | Environmental Reuse | domestic | Max tertiary | | 5,104,890 | 0.00510 | 0.00459 | 80 | | 189 | 190 | |
| 10 | 7 | ALG7 | El Kerma WWTP | Algeria | El Kerma, Oran province | 35.57944261 | 0.547475322 | WWTP | 2011 | yes | Agricultural Irrigation | domestic | Max secondary | 213,203,800 | 98,550,000 | 19,345,000 | 0.01935 | 0.01738 | 500 | | 191 | 285 & 286 |
| 11 | 8 | ALG8 | Ain Temouchent | Algeria | Ain Temouchent | 35.33406613 | -1.139056059 | WWTP | 2014 | Yes | Environmental Reuse | Municipal | Max secondary | | 3,500,000 | 0.00350 | 0.00314 | | | | 34 | |
| 12 | 9 | ALG9 | Boumerdes | Algeria | Boumerdes | 36.74764782 | 3.467556964 | WWTP | 2001 | yes | Agricultural Irrigation | Municipal | Max secondary | | 228,125 | 0.00023 | 0.00020 | 80 | | 47 | | |
| 13 | 10 | ALG10 | Baraki Algeria WWR Case | Algeria | Baraki, 15 km south of | 36.64702 | 3.089992 | WWTP | 1989 | Yes | Environmental Reuse | Municipal | Max secondary | 108,405,000 | 53,655,000 | 23,141,000 | 0.02314 | 0.02079 | | | 286 | |
| 14 | 11 | ALG11 | Beni Messous. Algeria WWR Case | Algeria | AinBenian, 15 km west of the | 36.782774 | 2.898829 | WWTP | 2007 | yes | Environmental Reuse | Municipal | Max secondary | 36,792,000 | 18,396,000 | 12,191,000 | 0.01219 | 0.01095 | | | 284 | |
| 15 | 12 | ALG12 | Jijel | Algeria | north-eastern coast of | 36.81964974 | 5.738853033 | WWTP | 2008 | yes | Non-potable Urban Reuse | Municipal | Max tertiary | 10,950,000 | 4,015,000 | | 0.00402 | 0.00361 | | 15000 | 192 | |
| 16 | 13 | ALG13 | Médéa | Algeria | Médéa | 36.26429137 | 2.75776886 | Municipality | 2007 | yes | Environmental Reuse | Municipal | Max tertiary | 9,490,000 | 3,913,895 | | 0.00391 | 0.00352 | | 162500 | 193 | |
| 17 | 14 | ALG14 | Hassi Messaoud New Refinery | Algeria | Hassi Messaoud, 80 | 30.97411391 | 5.764736406 | WWTP | 2121 | under constructi | Industrial Reuse | | Other | | 7,847,500 | | 0.00000 | 0.00000 | | 75000 | 194 | |
| 18 | 15 | ALG15 | Hassi R'mel solar thermal plant | Algeria | Hassi R'mel | 32.93624108 | 3.260236262 | Municipality | 2011 | yes | Industrial Reuse | | tripple barrier | | 575,605 | | 0.00058 | 0.00052 | | | | 564 |
| 19 | 16 | ALG16 | Reghaia Wastewater Treatment Plant | Algeria | Reghaia | 36.73856712 | 3.342083918 | Municipality | 2008 | yes | Agricultural Irrigation | Municipal | Max tertiary | 29,200,000 | 22,739,500 | | 0.02274 | 0.02043 | | | 286 | 287 |
| 20 | 17 | ALG17 | Oasis of Brézina FAO Pilot Project | Algeria | 85 Km south of the county | 33.538 | 1.1534 | Municipality | 2008 | yes | Agricultural Irrigation | Municipal | Max Secondary | | 10,950 | | 0.00001 | 0.00001 | 12000 | | 254 | 288 & 289 |
| 21 | 1 | BH1 | Tubli Reuse Case | Bahrain | East of Bahrain island | 26.19453936 | 50.55366329 | WWTP | 1980 | Yes | Agricultural Irrigation | Municipal | Max tertiary | 21,900,000 | 10,950,000 | | 0.01095 | 0.00581 | 722 | | | |
| 22 | 2 | BH2 | Muharraq WWTP | Bahrain | Muharraq | 26.22807768 | 50.70337956 | WWTP | 2014 | yes | Agricultural Irrigation | | Max tertiary | | 36,500,000 | | 0.03650 | 0.01935 | | | | |

The number of reuse project has doubled every decade since 1990



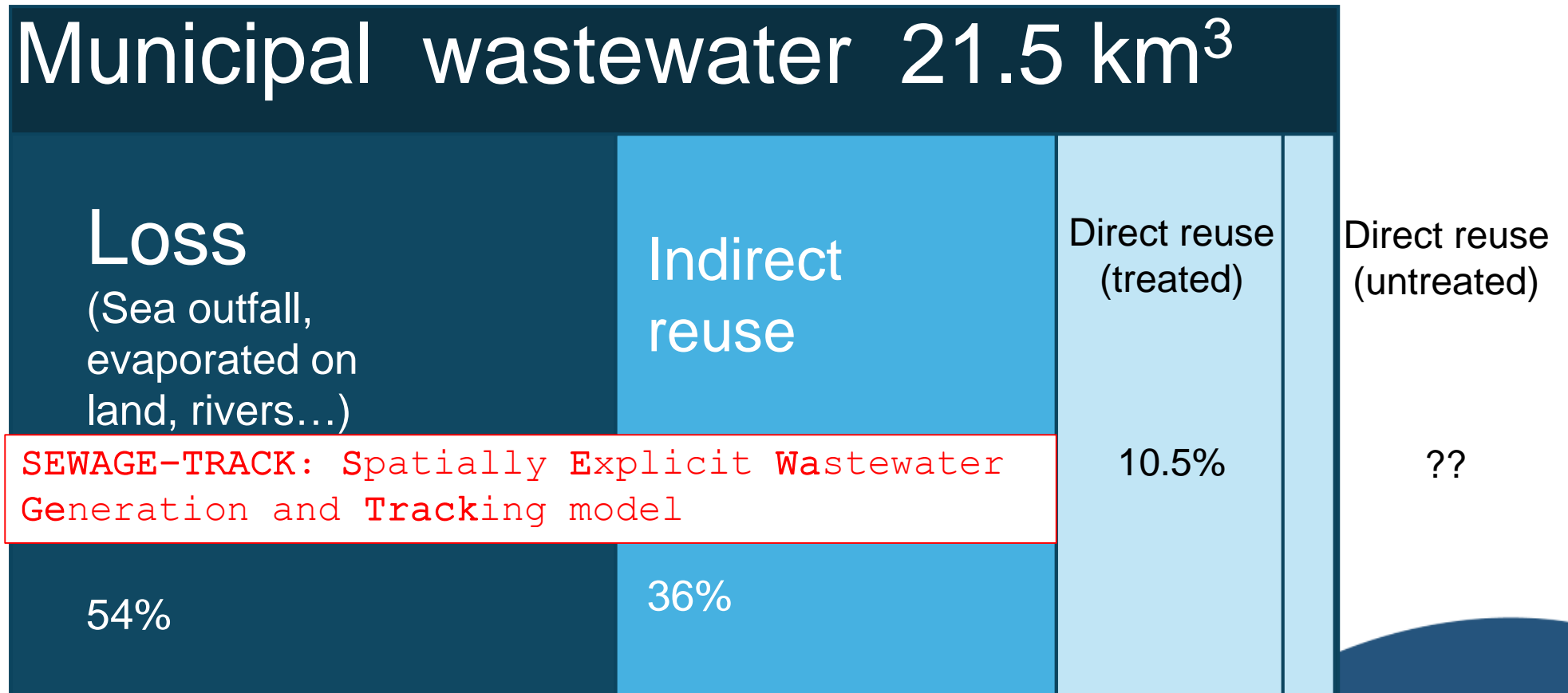
Water reuse projects in MENA as of 2020



Direct water reuse in 2020

| Country | Total municipal wastewater generated** | Municipal wastewater that is treated and directly reused | Directly reused from municipal wastewater | Number of projects where municipal wastewater is treated and directly reused |
|--------------|--|--|---|--|
| | (Mm3) | (Mm3) | (%) | (N) |
| Algeria | 2,649 | 100 | 3.8 | 22 |
| Bahrain | 1,86 | 45 | 24 | 4 |
| Egypt | 7,196 | 341 | 4.7 | 77 |
| Iraq | 1,232 | NA | NA | NA |
| Jordan | 187 | 71 | 37.9 | 25 |
| Kuwait | 666 | 271 | 40.7 | 6 |
| Lebanon | 481 | 2 | 0.4 | 4 |
| Libya | 514 | 40 | 7.8 | 1 |
| Mauritania | 138 | NA | NA | NA |
| Morocco | 415 | 76 | 18.3 | 22 |
| Oman | 275 | 79 | 28.6 | 30 |
| Palestine | 180 | 7 | 3.7 | 24 |
| Qatar | 225 | 165 | 73.6 | 17 |
| Saudi Arabia | 3,144 | 431* | 13.7 | 40 |
| Sudan | 1,533 | 29 | 1.9 | 3 |
| Syria | 1,147 | NA | NA | NA |
| Tunisia | 254 | 34 | 13.4 | 63 |
| UAE | 801 | 549 | 68.6 | 64 |
| Yemen | 326 | 36* | 11.1 | 7 |

Wastewater production and fate in MENA



Sources: IWMI 2022, Velpuri and Mateo-Sagasta 2022 forthcoming

Wastedwater Missed opportunities



REFLECTIO

^N
Q4. Quantity and location of productive/unproductive wastewater?

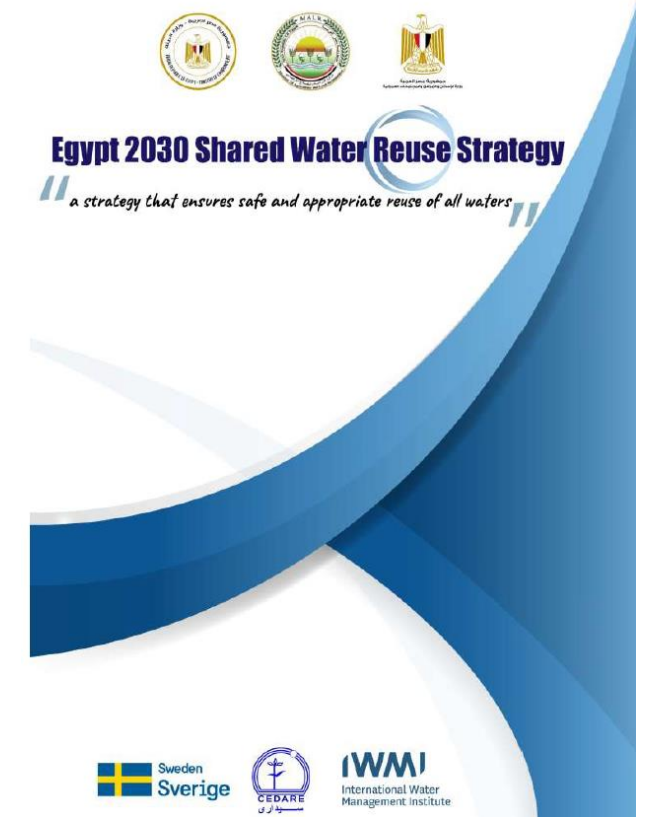
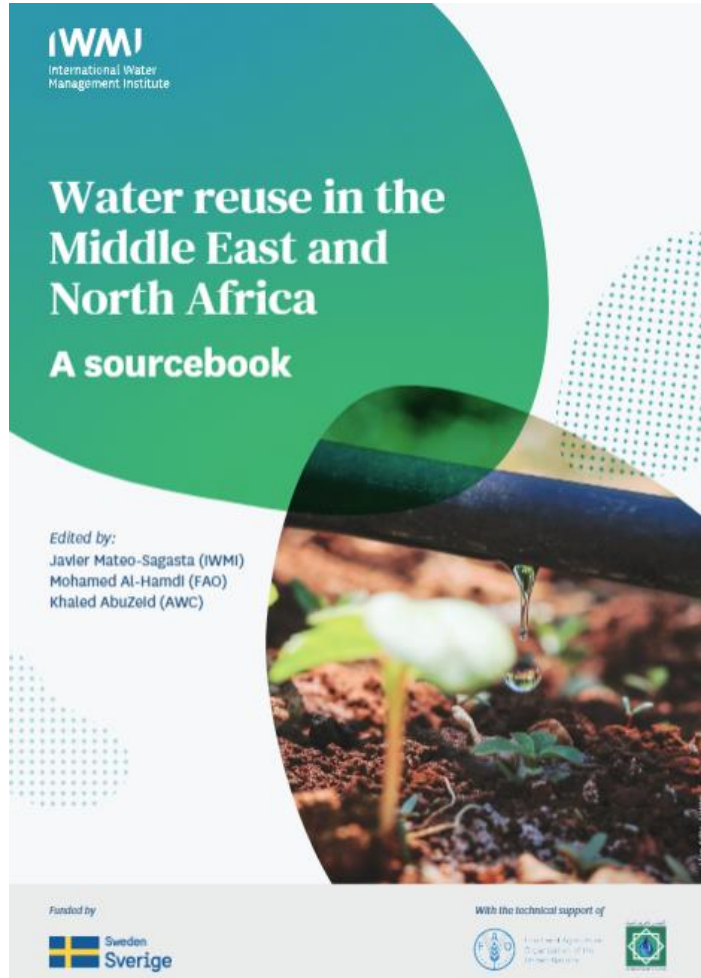
Q5. Expected expansion rate/locations of urban centres and irrigation schemes?

Q6. Quantities of emitted GHG from WWT?

Recap

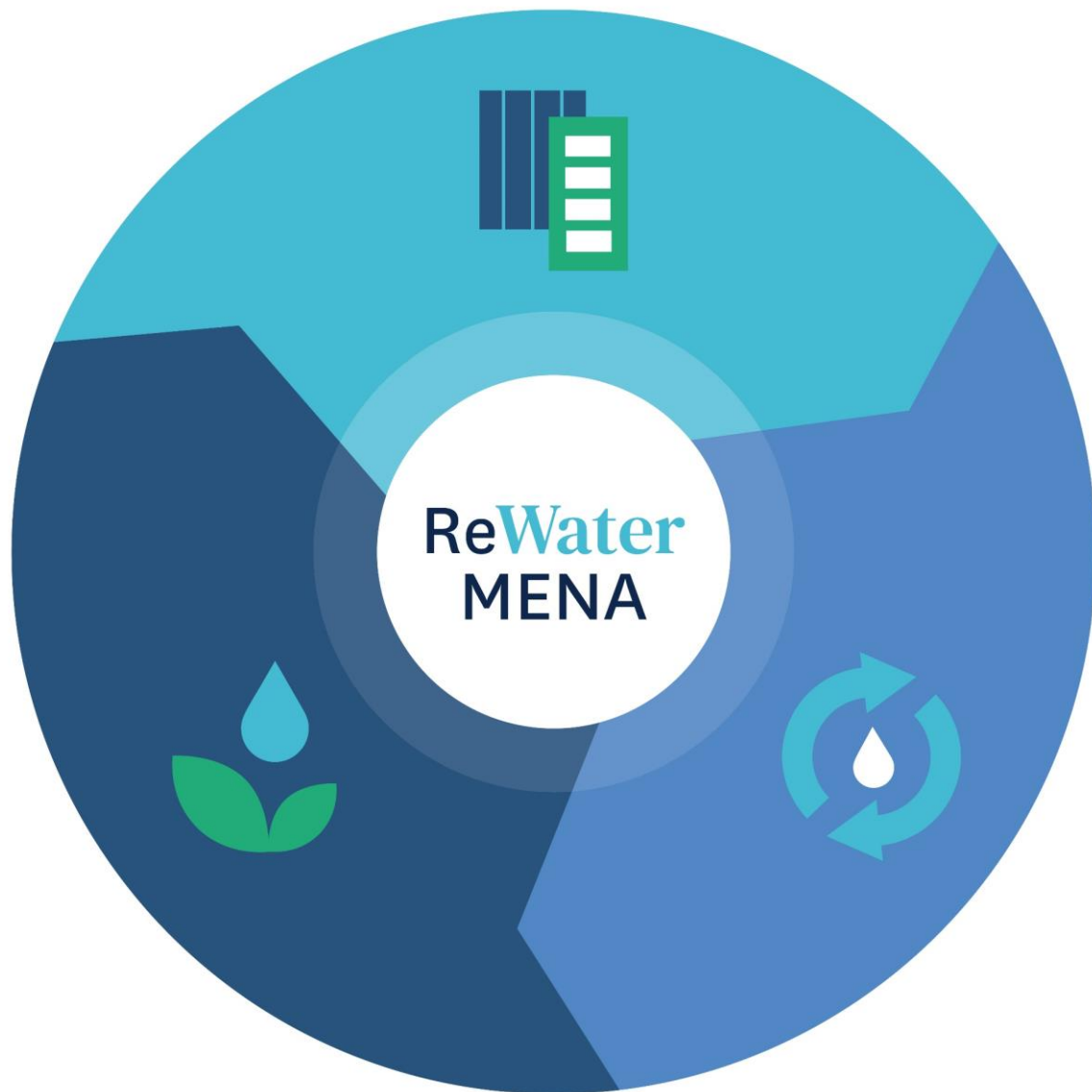
- 1-MENA faces a deep water crisis and we are not doing enough to solve it
- 2-Wastewater is part of the problem and part of the solution
- 3-Indirect use of untreated wastewater is a common reality in MENA: health risks need to be assessed and mitigated
- 4-Wastewater is only a waste if we decide to waste it: The potential for resource recovery from municipal wastewater in MENA is still untapped
- 5-MENA needs to accelerate to meet SDG6 (to recover and reuse loss wastewater and make reuse safer and more productive)
- 6- MENA needs to address the challenges that lock the potential: High costs and lack of cost recovery, cultural barriers and distrust, institutional fragmentation, improper regulations...
- 7- MENA needs to accelerate the replication of bright water reuse examples

KNOWLEDGE PRODUCTS



<https://rewater-mena.iwmi.org/resources/sourcebook/>

Thanks!



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For more information on the outcomes
of the **ReWaterMENA** project visit:
<https://rewater-mena.iwmi.org/>