An exemple of irrigation adapted to the land, allowing a varied ecosystem but relying only on rains, an uncertain source of water because of climate change.

SUSTAINABLE IRRIGATION:

A Multi-dimensional Approach to Freshwater Management in Agriculture

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POLICY BRIEF

To the Food & Agriculture Organization (FAO) whose aim is to achieve food security worldwide and to use and manage water sustainably. Both issues - food security and water use - are tightly linked and therefore require a particular attention to the way water sustains agriculture. Being a precious resource, water needs to be managed internationally to allow everyone an equitable and sustainable access to water.

A non-efficient way of watering a crop, but still a way of growing edible plants in arid lands where an irrigation system is lacking.

EXECUTIVE SUMMARY

As the World's population is growing at a rate of 1.1% per year (1), the demand for water - the precondition of our existence - is increasing quickly and putting more and more pressure on ecosystems. Although the 'direct' consumption of water (drink, sanitation) uses a fair amount of water, it is very little compared to the agriculture which counts as 70% of our freshwater consumption (2). Water utilization in agriculture must thus be managed to be used efficiently, because although the population grow, the amount of water on Earth does not. The water issue underpins sustainability; indeed, with hydric stress and poor water management, many sectors would be affected and the realisation of the Sustainable Development Goals (SDG) would be at risk - without an equal and effective distribution of water, it would be even harder to achieve a good life on land, below water, zero hunger, no poverty and good health... Few measures implemented by institutions had a real effect.

Managing water efficiently would require effective technologies to increase water productivity but also need a change in the agriculture system and the management of water sources. Moreover, the demand for food has to shift towards less water-intensive diets and require international cooperation to trade virtual food and rebalance the geological differences to allow a more equal access to freshwater worldwide.

EMPIRICAL ANALYSIS

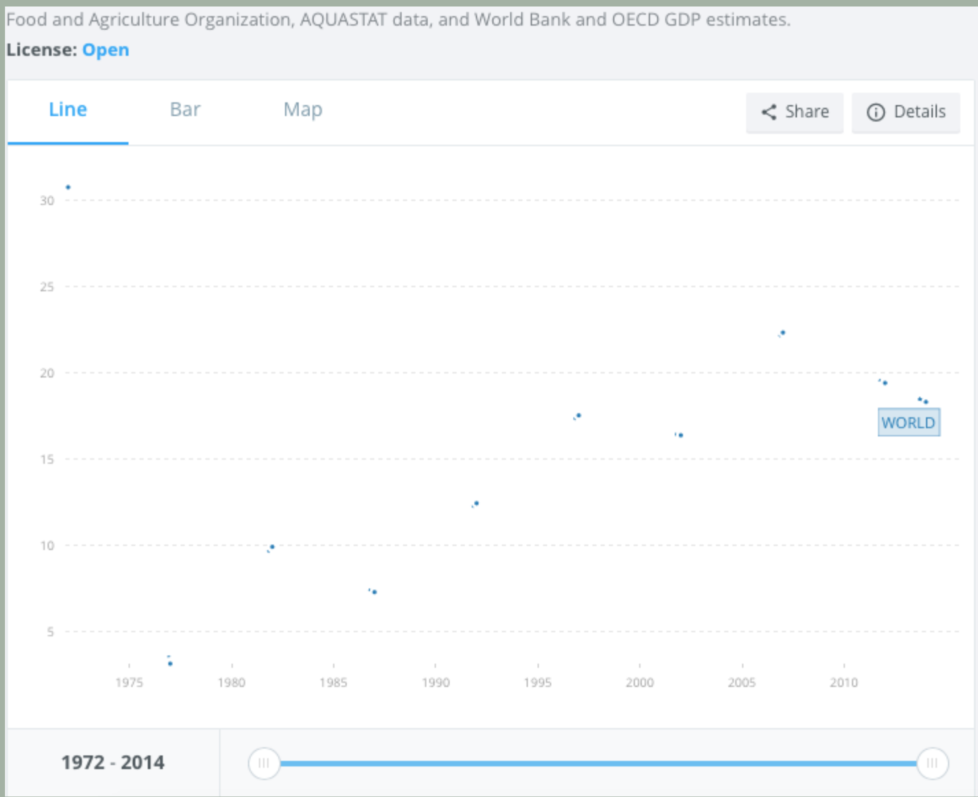
Water management stake

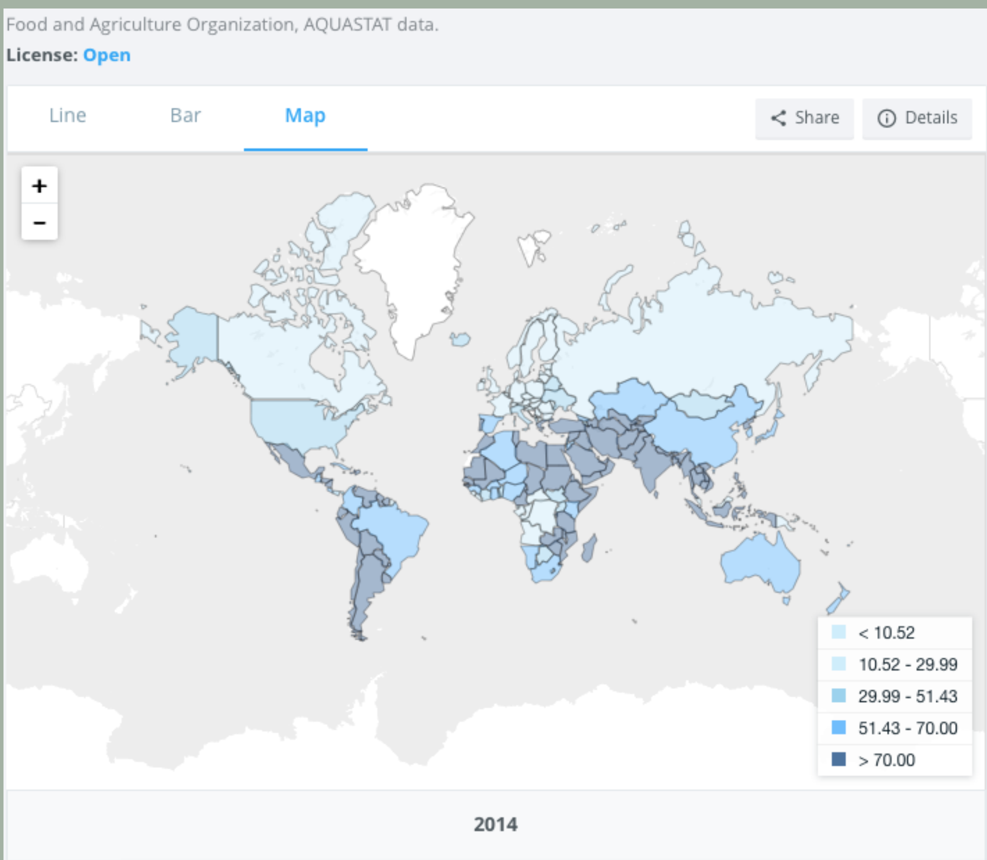
Our Blue Planet deserve its surname with its 1,386,000,000 km3 of water (4). However, of its millions of millions of litres, around only 2.5% is freshwater and a small percentage of it solely is accessible to humans (4). It is still enough for humankind to live correctly if water was correctly managed, but humans may soon face problems concerning the lack of freshwater worldwide if they continue on the trend of to their ever increasing demand for this precious but inexpensive resource (5). Soon, climate will also more dramatically modify the water cycle and its already unequal distribution. Global environmental degradation has reached a critical level with major ecosystems approaching thresholds that could trigger a massive collapse (5). By 2050, the human need for food will increase by 60% worldwide, while global freshwater consumption cannot grow as much. Agriculture management is a key sector for sustainability. Not only is agriculture indispensable to feed humanity but it is also the sector that consumes the more freshwater - 70% of the World's consumption - leading to changes in natural ecosystems (5-9). Although water productivity is increasing *(see Graph 1)*, it is evolving irregularly and not quickly enough. Moreover, the poorer countries from the Global South, in particular, suffer the most from the lack of water and its withdrawal worldwide *(see Graph 2)* can lead to environmental degradation, added to the fact that the poorest countries cannot afford to fix it (10, 11).

EMPIRICAL ANALYSIS

Graph I: Water productivity, total (constant 2010 US$ GDP per cubic meter of total freshwater withdrawal)

(12)





Graph 2: Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal)

(13)

Box: Aral Sea ecosystem

(14, 15)

The level of water in the Aral Sea has dramatically decreased since 1990. The whole ecosystem (plants, algae, birds, fish, molluscs) has nearly entirely died. This also has had repercussions on the inhabitants nearby who have lost a precious source of water and food. Solutions are being implemented to bring back water and keep it: it is working but extremely slowly.

1 liter of water = 1 calorie of food supply

Existing arrangements

"Donor agencies and international institutions have advocated a host of panaceas—water pricing, water markets, farmer management of irrigation systems, drip irrigation" (5). The United Nations (UN) have created the action "*Water for life*" during a decade, from 2005 to 2015, based on cooperation to fulfil commitments that had been made on water. They have brought attention to water that became a SDG in 2015 (6, 7, 9). Some governments have national regulations concerning water use inside their borders including for agriculture, particularly countries from the Global North. The European Union, in particular, has taken action such as in its *Strategy for Water Scarcity and Droughts Will* (16), and has identified policy options such as a better allocation of fund for water, "improving drought management", "fostering water efficient technologies and practices"...

UN helps by supplying water

ASSESSMENT

International institutions have worked on water management but their efforts have been largely ignored because there are not adapted locally (5). The UN have taken steps in the right direction to bring water to the attention of international organisation and have worked to improve access to water in many poor countries. However, concerning agriculture, they made some recommendations but have not taken direct, big-scale actions (7).

In Europe, their measures have not been very efficient yet as severe droughts have happened since, it show that much work is still needed to compensate the effects of climate change and allow a normal growth of crops even with a lack of rain. Crops have been destroyed (17, 18). However, the EU's Will was then still a very recent one and did not have enough time to be correctly implemented.

RECOMMENDATIONS

The aim is to implement as many recommendations as possible. However, when not possible, it is advised to implement at least one recommendation from each category to support freshwater management in different areas, and therefore to make it more likely to succeed.

RECOMMENDATIONS

Technical solutions

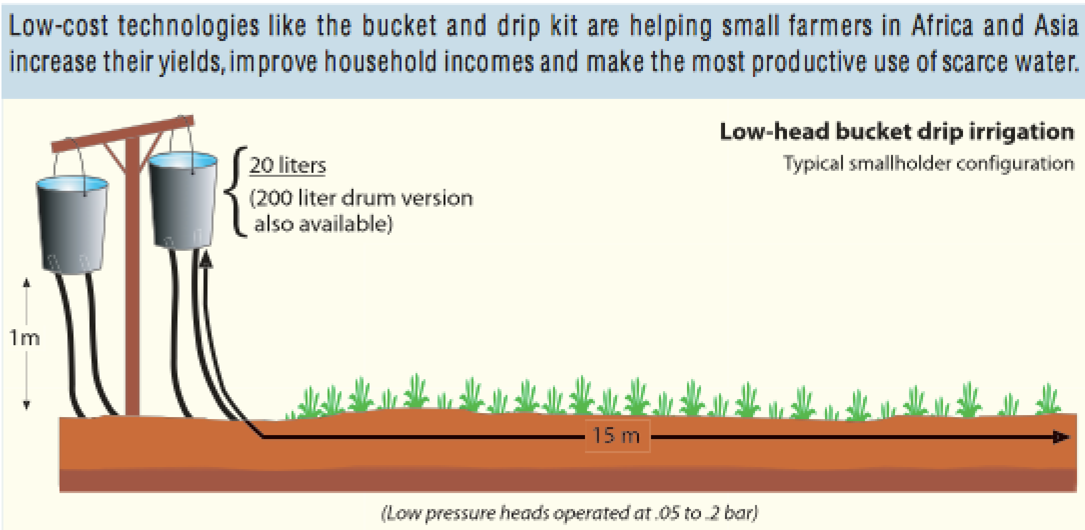
I) Increase water productivity (more 'crop per drop') and other productivity-enhancing measures

Concept

"Gaining more yield and value from less water can reduce future demand for water, limiting environmental degradation and easing competition for water"(21), we should invest in technologies (such as the "drip watering system") to save as much water as possible and help farmers to buy and use these technologies (20-22).

Implementation

Creation of a wide scheme of R&D involving scientists, farmers and engineers from different countries to develop technologies adapted to different situations, climates, landform, etc, and reduce the costs of the machines as much as possible. Institutions must then inform farmers of the existence of technology, help them invest in it, teach them how to use it, plus give them sufficient compensations and incentives to encourage them (20-21).



"Low cost technologies like the bucket and drip kit are helping small farmers in Africa and Asia increase their yields, improve household incomes and make the most of scarce water." (23)

Downside

It is a costly project, it needs wide cooperation, it is a huge-scale project, and involve the help of the governments. There is a risk of leaving some categories of people outside of this scheme (minorities, women). This recommendation would also need the infrastructures necessary to implement and make it work (such as roads and a market in the poorest countries). However, simpler versions of it can be created (20-22).

RECOMMENDATIONS

Technical solutions

2) Harvesting rainwater from urban areas

Concept

Diverting water from roads and rooftops into storage rather than letting it go into sewers or soil where it is not needed (5, 21, 23) .

Implementation

A very basic and cheap system can be created: the harvesting system is composed of a tank, with a system to harvest water from the rooftops (e.g. gutter), a pump and a mean of redistribution of water such as pipes (23) *(see photo below)*. Local organisations can easily promote this system and help to finance it as it is inexpensive.

RECOMMENDATIONS

Environmental evolutions

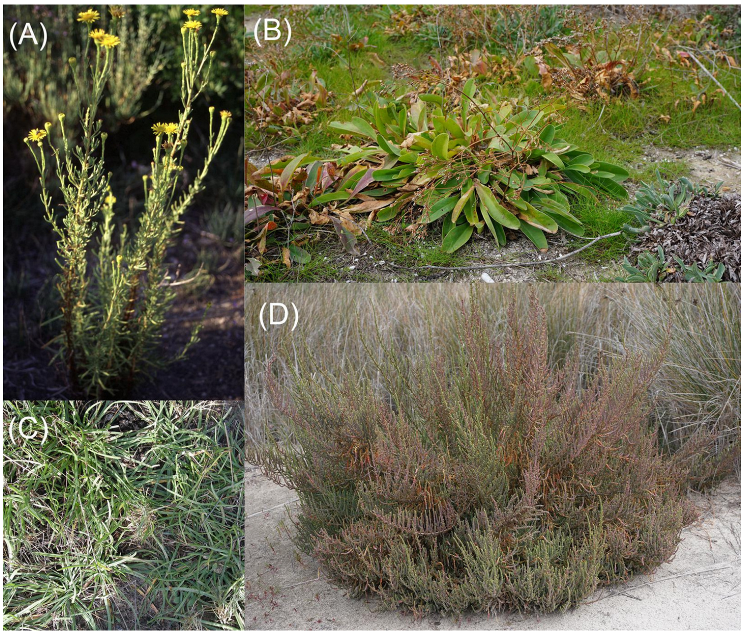
3) Switch to drought-tolerant/water-efficient/ low-transpiration crops/food that can grow with saline or alkaline water

Concept

"Producing crops that can yield more with less water, withstand water-scarce conditions, and thrive on low- quality (saline/alkaline) water" (24). Anyway, many arable lands are becoming more and more saline (around 20% to 50% of arable land) (5), it would save good freshwater for humans and use water of poorer quality for agriculture.

Implementation

It needs a huge investment in R&D of "conventional and molecular breeding techniques" (24) such as rice, maize, wheat, barley, lentil, sweet potato (food that the poorest population usually eat).



Plants naturallary resistant to salinity

Downside

In the past, some trends (e.g. avocados, quinoa, palm) have damaged an equilibrium (society/environment). It can also lead to a loss of genetic diversity. Moreover, on top of isolating the right gene in plants, domestication of the latter is still often necessary (5, 24-29).

RECOMMENDATIONS

Environmental evolutions

4) Management of lakes, rivers and aquifers

Concept

“It is crucial to protect and restore natural ecosystems like wetlands, forests, rivers and lakes that provide important ecosystem services with regard to the quality and quantity of water”(6).

Implementation

With the monsoon, the water overflows from the river bed and fills in the aquifers around.

Management of basins of water combined with environmental preservation.The monsoon can recharge underwater aquifers; the water from the overflowing rivers are conducted through earthen canals to irrigate crops and recharge the aquifers underneath: they can then be pumped during the dry season. It thus reduces costs for irrigation and improves productivity (6,7, 30, 31).

Downside

Human-induced changes in natural areas must be done expertly so as not to permanently damage the environment nearby. Also, if rerouting a river, local governments should pay attention to the consequences downstream that could lead to conflicts.

RECOMMENDATIONS

Social changes

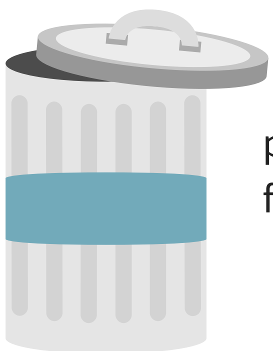
5) Change demand through dietary changes and reduce food waste

Concept

Encourage people to become consume less water-intensive food (idealy stopping the consumption of meat), change the type of food fed to animals, reduce waste to reduce food production because if the world, 30% of the food is wasted, which is water wasted (5).

Implementation

Making people aware of what their choices implies, give incentives to better grazing practices which respect the environment and the biodiversity, invest in aquaculture (thus removing pressure on freshwater). There is also a need for investment in “new” food (algae, insects). The economy has a role to play in it: Institutions would have to install a taxation/regulation system that would factor the environmental costs of food production. The negative externalities of the environmental degradation are then factored by the market (32). Likewise, city dwellers ought to compensate farming communities for the water they take away (5). Water access needs to be secure through the implementation of water rights (& need of investment in storage and delivery facilities). Food waste equals water waste, so it has to be reduced through the different stages: better techniques of harvesting, transport, distribution, storage, processing, evaluation, packaging and marketing, but also a change people's consumption of food, and recycling (compost, feeding animals…) (5-7, 33).



Downside

Changing a population mind is a hard and long process, it works mostly with incentives rather than prohibitions, we can hardly coerce people to change their culture.

RECOMMENDATIONS

Social changes

6) Trade food around the world

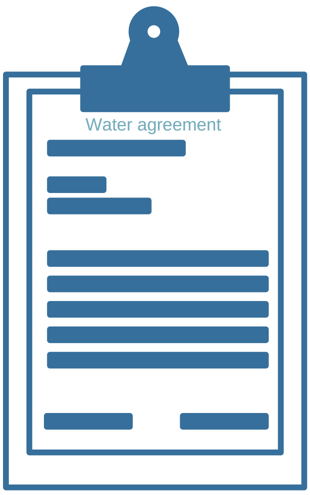
Concept

Importing food from countries that have more access to water ("trade in virtual water") to keep the equilibrium (countries have to produce what their land is naturally good at producing – globalisation make us grow food we shouldn't grow), countries should not strive for water efficiency (5, 16).

Implementation

There should be agreements between countries so there can be a mitigation of water scarcity and a reduction of environmental degradation and water-stress.

Downside



It can reduce poverty and improve the lives of people but governments have to be careful about the minorities and less empowered people (such as women). Very strong agreements and cooperation are essential between countries because depending on food/virtual water gives power to some countries (34). Another downside is that the richest/tertiary-sector-based countries would refuse to switch back to the primary sector even though they are often geographically inclined to do so.

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