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MIGRATION AND WATER RESOURCES: EXISTING CONCERNS AND PROPOSED SOLUTIONS

Kholoud Al-Ajarma
Department of Islamic and Middle Eastern Studies, University of Edinburgh

Ines Gasmi
Department of rural engineering, Water, and Forest National Agronomic Institute of Tunisia

Amr Madi
Electrical Engineering, Mathematics & Computer Science (EEMCS), University of Twente

Stefano Basso
Department of Catchment Hydrology, Helmholtz Centre for Environmental Research, UFZ, Halle (Saale)

Introduction

Environmental degradation and hazards, water stress, population growth, and economic and social instability have become major concerns of governments and people in the Southern and Eastern Mediterranean in the past few decades (IPPC, 2021; Castro & Ribera, 2020; Adamo & Al-Ansari, 2018). In countries like Jordan and Lebanon, water supply has become insufficient for drinking, sanitation, agriculture and industry demands (Zeitoun et al., 2011; Hussein et al., 2020; Adamo & Al-Ansari, 2018). Despite their own environment already being in a precarious state, Jordan and Lebanon host large numbers of refugees from neighbouring countries (Hussein et al., 2020). The strategies developed to deal with refugees' needs in the two countries seem to have a short timeframe rather than considering long-term concerns related to water consumption, waste production or food security (Gomez & Christensen, 2021). Moreover, the urgency of the humanitarian response following the influx of refugees makes the environmental footprint of these population flows less noticeable despite increased demand on natural resources (Al-Ajarma et al., 2018). Several studies, for instance, argue that the influx of migrants or refugees might cause damaging environmental practices, such as forest depletion, exhaustion of water and energy resources, waste production, sanitation problems, and land, air and water pollution (Gomez & Christensen, 2021; Fajth et al., 2019; Martin, 2005; FAO, 2019). The International Organization for Migration (IOM) predicts that the numbers of migrants will continue to rise due to the environmental effects of climate change, leading to more pressure on host countries (Brown, 2008).

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Taking into consideration the existing concerns of water stress and human migration, as well as their spiralling impacts on agriculture, water consumption and infrastructure, this policy brief examines environmental problems in Jordan and Lebanon, the world's highest per capita refugee hosting countries (UNHCR, 2017). The research team, comprising of an anthropologist, two hydrologists and an environmental engineer, used secondary resources (including government statements, news, and non-governmental organization [NGO] reports) to discuss environmental concerns in both countries, including those existing before the latest influx of refugees, those related to settlement conditions, and those claimed to be caused by refugees and migrants. They also conducted primary observation and interviews with Jordanian nationals and migrants, and conversations with researchers and water professionals in both Jordan and Lebanon. They also looked into some of the plans, projects and initiatives that have been implemented in both countries since the beginning of the arrival of Syrian refugees. Building on those findings, the team suggests some practical practices to manage the combined effects of migrant fluxes and climate change on hosting communities. These practices include introducing a settlement intervention, which is referred to here as "eco-camp model", in addition to policy recommendations that could be adopted in collaboration with governments and the international community to prioritise interventions for environmental mitigation.

Water stress in migration contexts

Jordan and Lebanon are two countries with a long history as hosts of migrants and refugees, including Palestinians, Iraqis and Syrians (Arsan, 2018; Klaus, 2003). During the Syrian refugee crisis, the two countries combined hosted more than two million "registered" refugees. The majority of refugees (registered and unregistered) have been living in urban and rural areas and mostly have access to similar services granted to local communities (Shteiwi & Ruisi, 2016). Around 16% of Syrian refugees in Jordan live in refugee camps (Shteiwi & Ruisi, 2016), whereas in Lebanon they reside in communities and Palestinian camps across the country (Makdisi, 2015), where construction of new camps was not allowed.

Even before the Syrian refugee crisis, the environmental situation in both countries was already precarious (Yahya et al., 2018; Makdisi, 2015). Jordan, for example, is under water scarcity pressure, which has increased over the years due to rapid population growth, poorly planned urbanisation, unsustainable agricultural practices, and inadequate waste management (Breulmann et al., 2021). The annual average water use in Jordan is 103 m3/capita (Waternet, 2021). While Lebanon has more water resources than Jordan, the country's per capita renewable resources were 656.5 m3 in 2018, which is below the threshold of water poverty set at 1,000 m3/capita per year. The situation is further worsened in Lebanon as a result of inadequate water policies and dire economic and political conditions (Jaafar et al., 2020). Shortage of fuel and supplies has affected water pumping, limiting people's access to water (UNICEF, 2021).

Although these threats on water availability and access were ever present, they have become more alarming in the past few years due to increased demand (Hussein et al., 2020). Existing water stress meant insufficient supply for migrants, especially those living in Jordan's northern governorates (MoPIC, 2019; Achili et al., 2017). Furthermore, in refugee camps established by the Jordanian government and the UN Refugee Agency (UNHCR), refugees have limited water supply, which is usually delivered by tanker truck. In a study conducted by the Helmholtz Centre for Environmental Research and the Ministry of Water and Irrigation in Jordan, housing, education, health and water were the leading areas that municipal authorities need to manage in order to provide for the influx of refugees (Breulmann et al., 2021). The study also refers to a survey that assessed that 60% of Syrians are likely to be severely vulnerable in terms of water, sanitation and hygiene services. According to the Jordanian Ministry of Planning and

International Cooperation, 70% of Jordanian and Syrian refugees receive less than the national standards, which is 100 litres per person per day (MOPIC, 2015). Lebanon's regions of Baalbek-Hermel and Bekaa, which host at least 40% of Syrian refugee populations, face serious water shortages, and over 71% of people risk losing access to water according to a report published by the United Nations Children's Fund (UNICEF) in July 2021. Migrants are also often housed without adequate consideration of the infrastructures' capacity to meet the increased demand in water and wastewater (Bakchan et al., 2021), which makes delivery of sufficient amounts of water and provision of proper sanitation facilities difficult (Farishta, 2014).

Significant growth in water demand placed enormous pressures on the water and wastewater networks and treatment plants, which were not built to support the current increase of the population (Breulmann et al., 2020; Alshoubaki & Harris, 2018). For example, a study by the Jordanian Ministry of Water and Irrigation has shown that the country's sewerage network has been overflowing and subsequently leaking because of the population increase, in addition to poor planning of infrastructure (Breulmann et al., 2021). The overall water infrastructure and piping networks are largely outdated with more than 50% of water lost as a result of leakages, weak infrastructure, and illegal consumption (Riachi, 2014; Hussein et al., 2020). Lebanon faces similar issues in addition to limited desalination (Hussein et al., 2020). In the Lebanese case, reports have discussed the effects of increased population density on wastewater and sanitation even before the "refugee crisis" (Jaafar et al., 2020). With the continuous population growth and unequal distribution of resources, Zeitoun et al. (2011) estimated that the country will not be able to support its population with freshwater by 2030. Additionally, water stress affects food production, especially in the absence of appropriate farming practices (Jaafar et al., 2020; Hussein et al., 2020). Since the use of modern production and irrigation technologies depends largely on financial abilities, it is beyond the capacity of local farmers, despite them being in favour of promoting water management (Zeitoun et al., 2012).

Furthermore, the existing water and sanitation conditions in Jordan and Lebanon in addition to the effects of migration have led to politically driven discourses that often link the dysfunctional water sector to the influx of refugees (Hussein et al., 2020). For instance, refugees have been repeatedly portrayed on television, in newspapers, and in political parties' speeches and conferences as the cause of deteriorating water problems, instability and unemployment (Makdisi et al., 2018; Hussein et al., 2020). These discourses build on existing pressures and discontent in host communities and lead to hostility towards migrants (Wildman & Brady, 2013). Such hostilities also result from short-term humanitarian responses that do not consider the conditions of host communities. For example, whilst water gets trucked to Jordan's Za'atari camp daily, Jordanians in surrounding communities complain about water shortages since piped water is pumped once every 10 days. These comparisons voiced by local community members make it necessary to re-evaluate existing interventions and propose solutions that take into consideration both groups.

Existing interventions and proposed solutions

Developing effective, balanced and sustainable responses to the growing demand on water and other resources requires action on multiple fronts. Some initiatives have been developed over the past few years to deal with environmental issues in Jordan and Lebanon, especially in response to the so-called refugee crisis (Ministry of Environment, 2017; UNEP, 2018; UNHCR, 2019). For example, both the Jordanian and Lebanese governments have developed response plans in partnership with the United Nations (UN) where access to water and sanitation facilities is highly emphasised (MoPIC, 2015; Government of Lebanon & UN, 2017). The plans include provisions to strengthen the base capacities in the health, water and sanitation sectors (Shteiwi & Ruisi, 2016). Likewise, both plans envision increasing access to sufficient safe water for drinking and domestic use. The plans, nonetheless, do not specify the required interventions or their environmental impacts. However, several initiatives by international organisations aim to address these issues. For example, Lebanon was involved in a three-country project launched in 2018 by UN Environment in collaboration with the IOM and the Office for the Coordination of Humanitarian Affairs (UN OCHA) and aimed at "strengthening national capacity to address the environmental impacts of humanitarian responses to population displacement" (UNEP, 2018). In 2018, UNHCR presented in its Regional Refugee and Resilience Plan a humanitarian and resilience response to the situation of refugees and host communities (UNHCR, 2018). In 2020, the Yarmouk Water Company and World Waternet started a three-year peer-to-peer programme in Jordan to exchange practical knowledge and skills in wastewater management, operations improvement, and energy saving. In Zaatari refugee camp, UNICEF and other humanitarian partners constructed communal water taps and sanitation and hygiene points with the aim of connecting households to water and sewerage networks (Van der Helm, 2017). There are also examples of water management initiatives in the agricultural field, such as the Jordan Hydroponics Agriculture and Employment Development Project, funded by the Netherlands Ministry of Foreign Affairs, which aims to advance agriculture through the adoption of hydroponic techniques.[1] These initiatives reflect awareness of the need to improve water productivity and the technical and management means to achieve this.

Despite the importance of these interventions, many of them come in the form of short-term humanitarian response to "crisis" rather than long-term development strategies that would benefit both host and migrant communities (Tan, 2015). Moreover, there is a lack of communication between different governmental bodies when implementing projects for both host and migrant communities. In the case of UNHCR's environmental guidelines when working with refugees, no specific guidelines to reduce the environmental impact of settlement sites are provided despite acknowledging their impact on environmental resources (UNHCR, 2014). The existing plans lack infrastructure to implement long-term water solutions for the growing population.

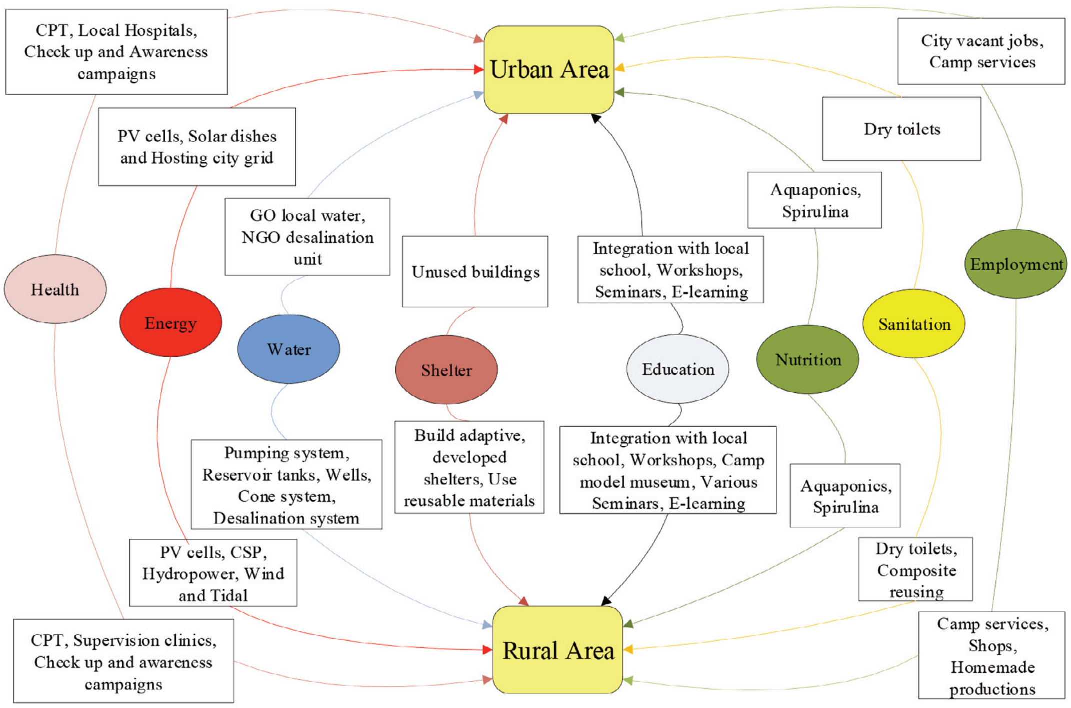
Therefore, there is a need for strategies that could ensure resilience of water and wastewater infrastructure systems for the use of both host and incoming populations and account for the baseline environmental situation prior to refugee influxes. The research team argues the need for a new and comprehensive approach that can ensure sustainability and environmental protection while considering all aspects affecting development in host countries in the context of population growth and increased demand on water and other natural resources. Such an approach is exemplified by the "eco-camp" model. An eco-camp is a settlement model where exemplary strategies and solutions for sustainable livelihood are implemented. The team identified eight interlinked aspects which should be taken into consideration for a sustainable development of an eco-camp: water, sanitation, energy, shelter, nutrition, health, education, and employment.

Although all eight aspects should be addressed to design a thoroughly sustainable eco-camp, water is the central concern of this paper, and exemplary solutions involving water resources are discussed hereafter. To alleviate water stress and conserve water, the team broadly proposes a system that increases water supply by increasing network efficiency and uses environmentally-smart technologies (see Figure 2). The model includes redundant water sources. River water, well water and cone system where night mist drops or rainfalls are collected. The incoming water from any of those three sources is purified using sun exposed tubes containing molten salt, which has the ability to store heat for several hours, thus using renewable energy to facilitate the process. The system also includes sensors that collect data on the inlet water nature and the impurities it possesses to identify the number of chemical additives and portions that need to be added when purifying it into drinking water. After the drinking water treatment is finished, outlet water is measured to ensure that it meets the drinking water regulations; otherwise it is drained to the inlet for

[1] HAED-Jo Jordan Hydroponic Agriculture and Employment Development Project (2021). Retrieved from https://www.haed-jo.org/home

reprocessing. Undrinkable water at the end of the process is transferred for other uses, such as agriculture and sanitation. The whole system is linked to sensors that provide feedback to the main station where all data is gathered. Based on the feedback, the main control station provides actions to the actuators and regulates the operation conditions to ensure the continuity of operation. The implementation of this or similar systems that take into consideration available water quantity and quality, and the use of renewable energy could improve water management and security for hosting countries, with the additional results of increasing the capability to deal with higher water and sanitation demands due to migrant influxes.

Figure 1. Central aspects and building blocks of an integrated eco-camp applied to migration contexts



Source: Elaborated by the authors

The proposed "eco-camp" model also supports using aquaponics for agriculture. In this combined system, nutrient-rich water from fish tanks constitutes a natural fertiliser for plants, which in return help purify water for the fish. Aquaponics thus produces high quality, organic food with no use of pesticides, herbicides or chemical fertilisers. Since it is usually made in greenhouses, contamination from nearby farms and adverse weather conditions are avoided. Although relatively new as a nutrition model, experimental use of aquaponics has proved this model's efficacy.[2] Aquaponics uses 10% less water than conventional agriculture, thus reducing freshwater depletion associated with irrigation (Goddek et al., 2015). Additionally, water losses by evaporation and plant transpiration can be compensated by capturing water from air humidity. Solar energy should be used to run air conditioning systems required to maintain the desired environmental variables in greenhouses. Alternatively, low energy greenhouses could be

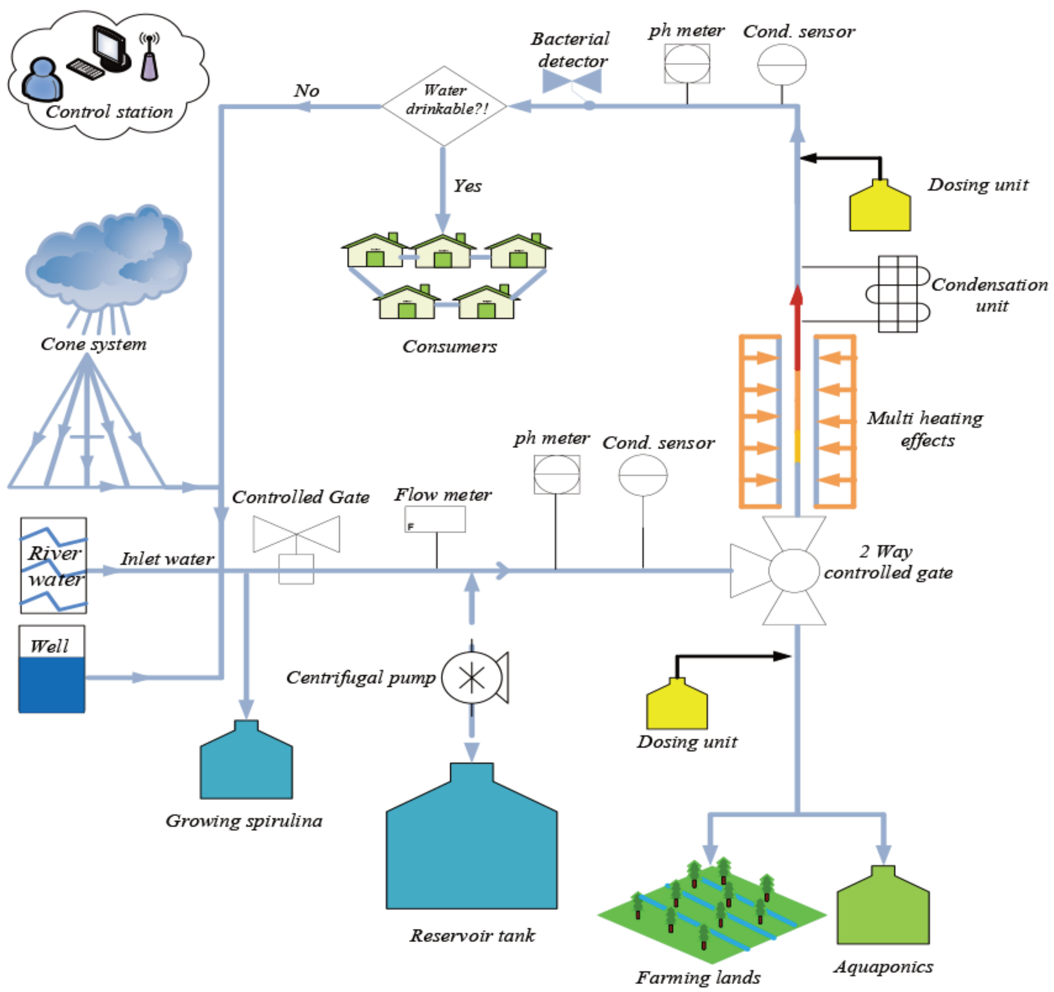
[2] Surveys mapping aquaponics around the world (e.g., Villarroel, 2016; Love et al., 2014) revealed that these systems are mainly used in the United States (US), Canada, Australia, Europe and South Africa. However, pilot plants exist in other places such as Caribbean islands and other tropical regions where freshwater is scarce or level farmland is limited (Rakocy, 1994), Bangladesh (Azad and al., 2016), India (Shafeena, 2016), and the Sultanate of Oman (Nagayo, 2017).

heated by passive solar energy (Gorjian et al., 2011). Training of camp residents and local population to operate aquaponics facilities is required.

Growing bio-spirulina is an additional activity that will be carried out in the eco-camp. Spirulina is a natural source of nutrients that provides essential amino acids, rare lipids, minerals and vitamins. The United Nations World Health Organization (WHO) has confirmed that spirulina is an interesting food that can be safely administered to children and should be used to fight malnutrition. The individual daily spirulina need is 10 g, and its production requires around 1 m2 (Matondo et al., 2016).[3]

The eco-camp model also fosters the adoption of ecological sanitation, which can be applied to both urban and rural areas and recognises human excreta and household sewage as renewable resources. Sanitation systems proposed in this context are easy to use, eco-friendly and more economic than conventional systems. They also enable recovery of nutrients and their reuse for agricultural purposes, thus helping to preserve soil fertility and safeguarding long-term food. The compost obtained from dry toilets can in fact be used as fertiliser for cultivated plots within the camp, whereas nutrient-rich household sewage can be employed in aquaponics systems for growing spirulina.

Figure 2. Eco-camp water cycle schematic



Source: Elaborated by the authors

[3] Spirulina is produced in a pool/container, which can be placed in a yard, balcony or roof, and must be protected from rain (which can change the pH level), dust, insects, and direct sunlight by means, for example, of a greenhouse.

The team does not underestimate ongoing efforts by host countries and institutions that work with migrants to develop infrastructure and action plans for water scarcity and drought management. Nonetheless, the research team advocates encompassing water-efficient technologies and practices that can help reduce water demand and pollution for both migrants and host communities. In general, more effective and long-term environmental planning in refugee camps is required.

As suggested by Zeitoun et al. (2012) and Barham (2012), there is a need to address power inequalities among stakeholders by encouraging shared decision-making involving civil society, public and private sectors, and NGOs. Improving decision-making structures, including communication and coordination, is central to water management. Moreover, the adoption of water-efficient plants and drought-resistant crops should be mainstreamed instead of continuing to grow water-guzzling crops in highly water-stressed areas.

Conclusions

The authors understand the ongoing debates about short-term planning of facilities for refugees. Nonetheless, migration flows and climate-induced migration will likely continue in the future. Therefore, there is a need for appropriate laws, policies and strategic planning beyond short-term responses. Accordingly, the team introduced the eco-camp model as an exemplary solution to tackle environmental degradation and water scarcity in host communities. The development and sustainability of the sectors entail coordination mechanisms based on a reliable database on water management and knowledge derived from professionals, policy-makers, farmers and other stakeholders to fill the existing gaps in current policies and interventions. Finally, further work is required to carry out a more thorough and systematic analysis of the policy and legislative landscape, analyse other environmental, economic and political concerns in the two countries, and investigate the implications of an eco-camp model, including the pros and cons of such a model in humanitarian and development interventions, which should ensure the dignity of both migrants and host communities alike.

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