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### INTRODUCTION

Although rain is usually greeted with great jubilation in most Middle Eastern countries, Lebanon is blessed by Levantine standards as far as water resources are concerned. However, only 17% of the country's water resources are used, more than half of the rainwater is wasted to the sea and about 40% is unaccounted for due to the lack of maintenance of the water supply networks [1]. Experts agree that Lebanon will be the first country in the Middle East to be affected by climate change [2]. Indeed, the distribution of the rains has changed, the density of snow is decreasing and the forest fires are multiplying leading to a decrease in infiltration and groundwater recharge. In rural South Lebanon, the development of agriculture required good practices for the conservation of water resources. Rural communities in the region have survived around water sources where multiple forms of oral customary arrangements have co-existed since and have historically adapted to the characteristic water scarcity by harvesting and storing rainwater. Customs and practices of water use have brought together a set of procedures and rules that have organized land and water management for the local societies. How can we effectively prepare rural communities for the impacts of future water management problems, and what can be done to strengthen traditional social water arrangements?

“Open-air reservoirs (Arabic: *Birket*) collect Pluvial Waters in communal pools, located on *Musha' Lands*, for public use.”

**Birket:** open-air communal irrigation pools located in the middle of the villages

**Pluvial Waters:** In Lebanese water law, collected rainwater are owned by the landlord and not the government

**Musha' Lands:** Musha' is a collective and communal land tenure where the land is owned by all the villagers (Forest, pasture, grasslands, birket,...)

### METHODS

In the context of this study, research focused on the role of indigenous water arrangements, customary law and inherited practices in developing the water sector in Lebanon. Legislative texts reforms in Lebanon were researched from a sustainable and adaptive, community-based, bottom-up approach. Indigenous water practices are the result of palimpsests of legislative and administrative water competence and are better shaped to face climate change because of their tested adaptive capacities. What is the role of reclaiming indigenous hydrological competences in rural South Lebanon, such as the communal pools, at enhancing sustainable development?

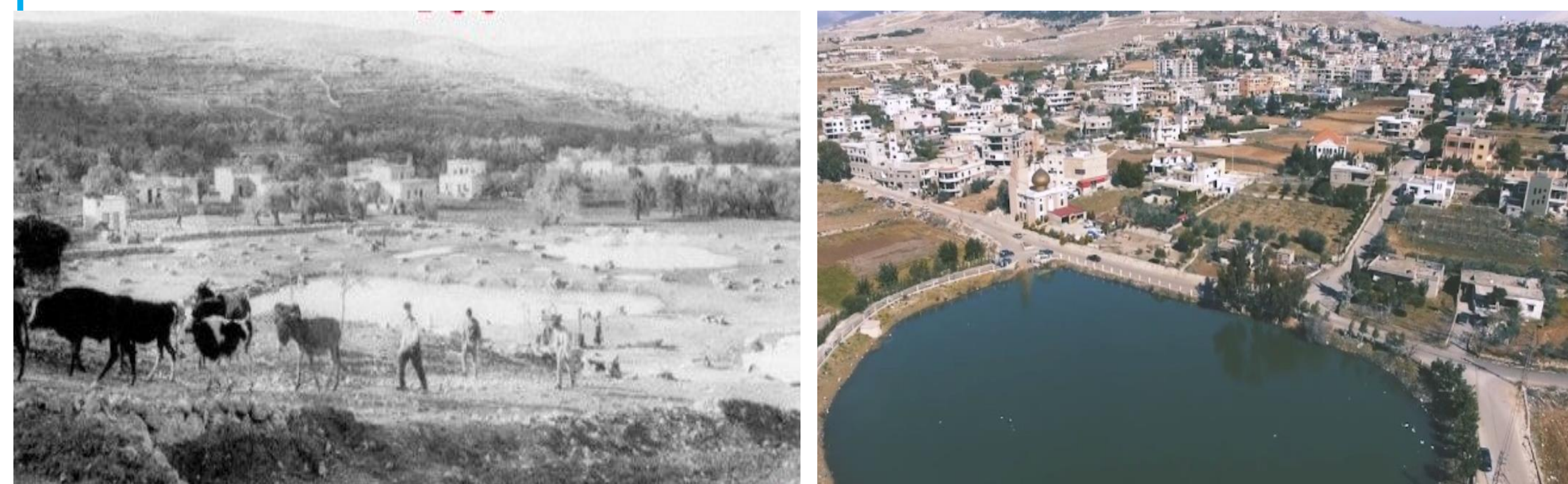
This correlational work researches the influences and effects of strengthening customary, locally-developed water arrangements on the empowerment of resilience and sustainable development. Therefore, it is based on understanding social water arrangements in rural areas of Lebanon, exploring their future potential in the management of water, and reclaiming local autonomy. For this purpose, an appraisal of all ancestral social water arrangements that were developed in the region for the conservation of property and for the periodic distribution of water between interested parties was conducted through field visits to the rural areas of the countries and discussion with villagers and water users. Oral history was here the most important method of data collection as well as literature review of old books from Levantine poets or orientalist travellers. Then, a survey of all the ancestral birket-s of South Lebanon were identified using very old maps dating back to the year 1881 [3], GIS maps, and land cover maps [4], and their status assessed using comparison with modern aerial images, and field verification.



### DISCUSSION

*Birket*-s are one type of depression irrigation and watering pools that are communally owned and collectively managed, from construction to operations and maintenance. All of the ancestral *birket*-s located within the villages perimeters have been built on communally owned lands – *musha'*. As such, their construction and later on their management is vested upon all the community, males and females, young and adults.

With public network coverage reaching 85% of the houses of South Lebanon, the traditional usages of the *birket*, such as cleaning and washing, almost vanished. Moreover, the decline in numbers of herds and cattle, and their gradual distancing from urban centers, rendered unusable the *birket* for drinking. However, other new activities emerged around the *birket*-s that survived the course of time, such as using water for construction and water tankers business, and utilize it for recreational activities (opening restaurants and cafes facing the pool, creating a sidewalk promenade around the perimeter, or developing sports activities – jet ski, pedal boat, fishing). The only activity that remained steady and travelled over time is irrigation.



#### Case studies:

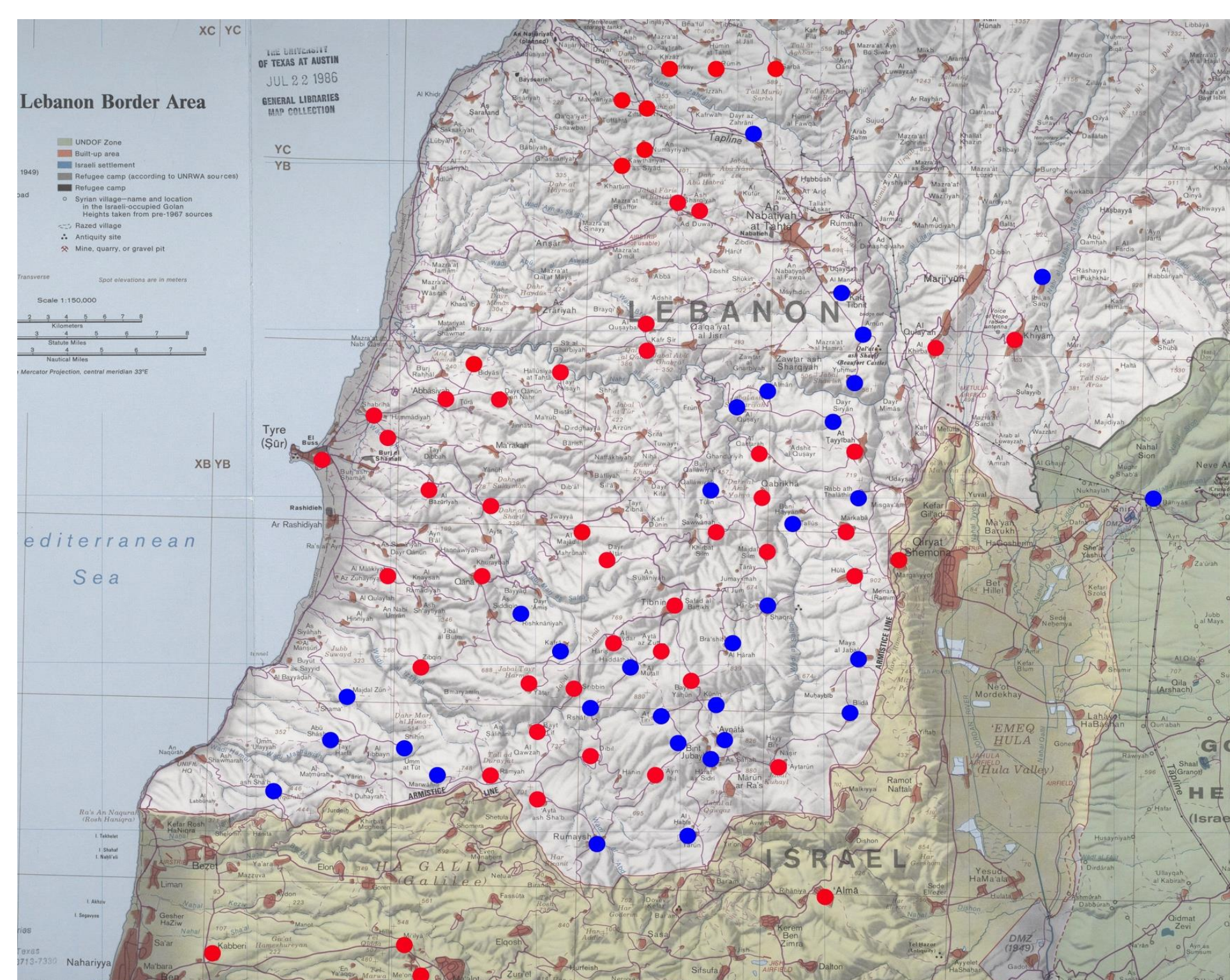
In this research, two case studies were elaborated in depth: the *birket*-s of Dirdara and Marwaheen. The Dirdara *birket* in Marjeyoun area have been uncontrolled for more than twenty-five years and this resulted in a total chaotic situation in the Marjeyoun plain. The reclamation of the waters of this *birket* (illegal wells forbidden, shaft pumps removed, irrigation pipes installed, etc.), and the restoration of its irrigation network has impacted positively the agricultural productivity in the region. Undeniably, the strong willingness of participation demonstrated by the farmers and water right holders is a key point in the success of the restoration of the Dirdara [5]. Farmer-managed irrigation systems have demonstrated the potential for improvements in system efficiency through active participation of users in system operation, maintenance, and financing [6]. Similarly, the intangible results from the restoration of the *birket* of Marwaheen are many. These include the re-instilling pride in traditional means of water conservation such as rainwater-harvesting, an opportunity for increased income from vegetable farming in place of fixed-income tobacco farming, strengthening the bond to the rural community by providing viable means of survival in the village setting, and providing a model for other communities in the south [7]. The project model can be easily replicated in several other villages in the south and other parts of the country as it is based on traditional practices with low technology and maintenance needs or costs, resulting in prolonged project sustainability [7]. The analysis of these two *birket*-s showed a positive impact on the water management process and acknowledges that the reclamation of the waters and restoration of the pools. Such irrigation networks may potentially play a role in achieving water security for towns in southern Lebanon.

### RESULTS

During this research, we were able to identify several ancestral social water arrangements that were developed in the region for the conservation of property and for the periodic distribution of water between interested parties, that allowed for the mediation of disagreements between users and assured each of the equitable allocation of water to match needs. These include: *Urf*: Customs and Habits in the Islamic world // *Hima*: Ancestral Charter for the Protection of Nature // *Mushaa*: Communal land tenure // *Sabil*: water endowment for religious *waqf* // *Birket*: Ancestral communal rainwater harvesting // *Mastaba*: Indigenous water conservation and soil protection agricultural practices // *Aouna*: Rural mutual aid // *Sulha*: Traditional Arab tribal dispute resolution // *Mudaraba*: Profit and loss sharing system in landlord-farmer partnership // *Chaoui*: informal water users' associations. Following the application of a series of criteria relevant to resilience and sustainable development (e.g.: democracy, equity, equality, fairness, spontaneity, transparency, participatory, replicability, adaptability, flexibility, efficiency, effectiveness), particular focus was made on communal pools (*Birket*).

105 *birket*-s were identified across 85 villages and cities in 3 administrative regions and 9 sub-regions. Studies found that 33 of these pools are currently filled, 15 have been transformed into buildings (mainly municipal buildings), 6 asphalted into parking, 2 transformed into sports facilities, and 7 transformed into parks and gardens. The rest have either disappeared altogether or are empty.

Functioning *birket*-s are in blue



### CONCLUSIONS

Rainwater harvesting and storing has long been a traditional approach to water management in South Lebanon. This is done in cisterns beneath the surface of the ground and in reservoirs above ground. Moreover, location, form and capacity of traditional water reservoirs embody sophisticated and complex knowledge inherited over hundreds of years. They are located in the center of the villages and built on *mushaa* lands. Formerly, their usage included: drinking, irrigating, swimming, and washing (clothes, wool, grains, kitchenware, house ware, car...), whereas their modern usage is limited to irrigation, tourism (coffee shops, restaurants, promenade), water for construction, and for use by water tankers. In light of the recent threats on water security in Lebanon, understanding social water arrangements in rural areas of Lebanon, exploring their future potential in the management of water, and reclaiming local autonomy will definitely have a positive impact on community resilience and adaptation to climate change. In many countries, the number and intensity of extreme weather events such as hurricanes, floods and droughts is increasing, and the sea level is rising, threatening territories, economic and social development as well as the environment. In this context, there is a growing interest for a range of solutions inspired by local knowledge and indigenous practices that have proven to protect and sustainably manage water resources effectively and adaptively, and simultaneously increase the resilience of the territories to future water problems and climate risks.

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