



DISCUSSION

LEGAL MECHANISMS FOR THE PROTECTION OF FOGGARA IN ALGERIAN LEGISLATION

By

REZIG R.

PhD, Abbas Laghrour University of Khenchela, Algeria

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Discussor

KHEBIZI H.

Water Resources mobilization and evaluation laboratory, The National Higher School
of Hydraulics, Blida, 09000, Algeria

h.khebizi@ensh.dz

This discussion focuses on the legal aspect highlighted by the author in his considered article entitled: Legal mechanisms for the protection of Foggara in Algerian legislation. The author debates the different legal mechanisms that protect Foggara and ensure its sustainability as a cultural heritage of socio-economic role. In addition, he mentions the various natural and anthropogenic constraints that negatively affect the sustainability of this ingenious system of capturing, sharing water, and irrigating gardens.

In this discussion, it seems useful to present a general overview of traditional water management systems nationwide and worldwide. In addition, the in-depth study of Foggara aims to highlight the interest of mathematical calculation used for water sharing (Remini, 2018; 2020a). For this, the discussion highlights the carefully described technical aspect, to highlight this knowledge, which constitutes a source of inspiration for water resources management according to the current demands of modern life. The technique has perfectly met the needs of the inhabitants of the Touat and Tidékelt for centuries. In this perspective, recommendations have been proposed to highlight the primordial role played by the mathematical calculation for sharing water quantities and the necessity to state regulation texts that discuss and value the Foggara calculation method and other ancestral intelligent systems, notably the Ghout hydroagrarian alarm

system, while encouraging teaching these techniques in academic institutions to ensure their sustainability.

Foggara's history worldwide

The Saharan population’s stability is linked to the availability of water resources, which has required, since antiquity, a profound knowledge of geography. The people of the Sahara have proven a philosophy of survival and a mode of civilization, giving an example of wisdom, art, solidarity, and a history of a cultivated society (Remini, 2020b; 2020c). For this, it seems useful to discuss the old systems of water resource management worldwide, where the Foggara is the most well-known worldwide under different names since the 11th century. Foggara is called Kanjering in China (Hu et al., 2012), Karez in Afghanistan and Pakistan (Azami et al., 2025), Kanat in Iran (Branduin et al., 2021), Al-Maya'aen in Yemen (Baquhaizel and Saeed, 2011), Falaj in Oman (Al-Kaabi et al, 2023), Qanat Romani in Jordan and Syria (Lightfoot, 2000). Subsequently, this technique was developed in the Mediterranean basin thanks to Arab expansion, hence the name of Foggara in Touat-Tidekelt, Algeria (Remini and Achour, 2008; 2017), Khettarra in Morocco (Beraaouz et al., 2021), and Galerías in Spain (Martínez-Medina et al., 2018). Finally, this technique was developed in America after the Spanish colonization (Miller, 2009 in Taghavi-Jeloudar et al., 2013) (Fig.1).

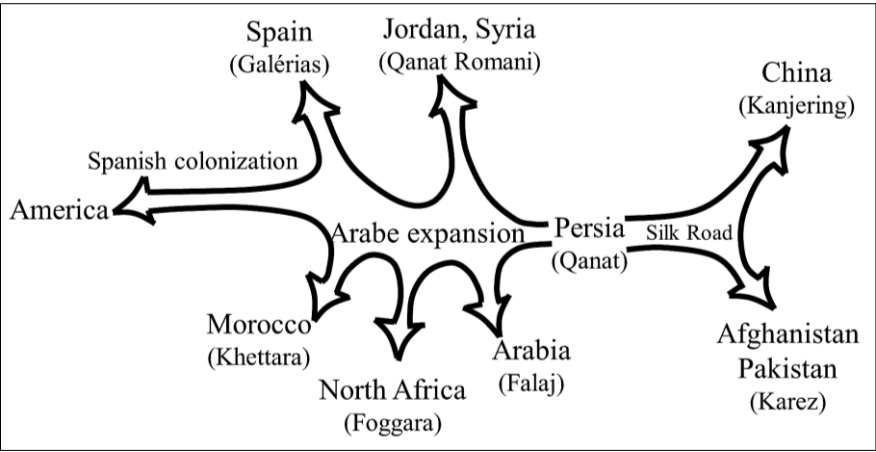


Figure 1: Foggara in the world (Source: Miller, 2009 in Taghavi-Jeloudar et al., 2013)

Foggara's history nationwide

In addition to the valuable explanation provided by the author about the definition of Foggara, it seems useful to add a detail of paramount importance concerning the three main components of the Foggara traditional system in the Touat-Tidikelt region. It is about (1) water; (2) soil; and (3) sharing, well known thanks to the knowledge of holders still using this system of capturing, sharing water, and irrigating gardens. The first

component ensures the survival of the population; the second is part of a space, which brings together inhabitants confronting the same natural constraints of the arid Saharan zone, while the third ensures a stable, sustainable socio-economic life for all categories of society. In Adrar, nearly two hundred Ksars exist, many of which are in ruins, attesting to the long-standing occupation of this area. Each Ksar contains a community made up of extended families who gather around the mosque and the mausoleum of the universally recognized ancestor. In each Ksar, families of varying social status, notably farmers (Harratin), families of Zenata or formerly settled nomads, Mrabtin, and families of Chorfas live, hence the reason for making the space a determinant component that should take into account the entire sociological Foggara dimension. The Foggara space ensures water supply to the Ksour and the palm groves where oasis dwellers cultivate gardens. The Foggara elements begin by Ayn El Foggara or Ras El Foggara in its upstream part, passing through Aghûsrû and arriving downstream at the Qas'ri and Mecht'a, whose principle is to share the water that flows permanently. This technique consists of digging wells up to about twenty meters deep. An underground canal that allows the circulation of water from the groundwater connects these wells. Once it reaches the surface, the water is measured by Kiyalin el-Ma. Finally, the water flows into channels called "Séguias," which carry it to the gardens.

Kiyalin El Ma or water measurers

The Foggara technique is subject to great precision and is determined by a measurer called locally "Keyal El ma" to ensure the share of water for the inhabitants. Nevertheless, this meticulous technique based mainly on a mathematical calculation becomes a knowledge to be transmitted from one generation to another, which makes it an intangible heritage. The main functions of Kiyal El Ma are to:

- Calculate the water volume of the Foggara,
- Calculate the water shares of each owner,
- Drill the openings in the distribution combs that allow each person's water volume to pass through,
- Repeat these operations as many times as necessary throughout the year.

Calculations are based on data passed down from generation to generation by a master measurer to his apprentices. The unit of measurement is the "Habba," which corresponds to a defined volume of water (one drop). The main sub-measures are the "Qirat" (1/24th of a habba) and the "Qirat al-Qirat" (1/24th of a qirat).

The work of water measurers is linked to the existence of water in the Foggaras. In recent decades, a decline in the water table static level has been noted in all the oases of Touat. It is somewhat less pronounced in the oases of Tidikelt, but in Touat, it will have repercussions on irrigation, on the existence of traditionally cultivated gardens, and therefore on the existence of water measurers.

Other practices worldwide

Other practices different from Foggara have been inherited notably in Africa. These intelligent systems are developed and adapted to the climate and the soil nature, as well as Zaï in Burkina Faso (Sawadogo et al., 2008), in Kenya (Kimaru-Muchai et al., 2021), in Ghana (Danso-Abbeam et al., 2019). This technique is called Tassa in Niger (Bouzou-Moussa and Nomao, 2004), and Towalen in Mali. Other techniques exist, notably the ancient irrigation system at Engaruka in Tanzania (Caretta, 2018).

Other practices nationwide

The Algerian Sahara, in addition to the Foggara system of Touat-Tidekelt, is endowed with other experiences of true water resources connoisseurs, whose methods are individualized according to the complexity of the natural context (Al-Khayri and Ain, 2015). These techniques are the pendulum wells in Touat and Ouargla (Senoussi, 1999), the Noryia or Saniya, in M'zab and Oued-Righ (Laradj-Benguergoura, 2014), and the Ghout in Oued Souf (Remini, 2006, 2019; Senoussi, 2012; Khebizi et al, 2023). The Ghout has been recently introduced as a hydroagrarian alarm system to better manage the water table in the Souf region, thanks to the introduction of the Beneia, known as the basic unit to build the Ghout, in the mathematical formula for calculating the drawdown of the water table static level (Khebizi et al., 2023).

Foggara's indication in the regulation of equitable distribution

The term equity has been associated in water resources management with outcome, distribution and share (Higgs et al., 2024). In modern water law, equity is associated with terms of access, use, utilization, process, participation, and management (Drobenko, 2004).

In Foggara, following the mathematical calculation reasoning used by Kiyalin El Ma, it seems that the Saharan man in Adrar, Tamanrasset, and In Salah has already thought about an equitable use of water to ensure a legal benefit according to well-defined needs of each inhabitant. The definition of rules for the equitable sharing of water resources was based on a good understanding of the population's needs, even though knowledge of the water potential was very limited, as the technique had not recorded any water drawdown problems for decades. This means that the regulatory framework introduced by Kiyalin El Ma for the management of Foggara has proven an excellent approach in terms of technical management of water resources, using Habba unit, Qirat, and Quirat al-Qirat to define the exact water share of each inhabitant without affecting their neighbour. Consequently, Kiyalin El Ma ensure a viability, shared respect, with an equitable use of water in the Ksour, and established a culture of legal benefit from water to avoid any conflict situation between the different social categories in the Ksour society.

Legal and institutional framework for protecting Foggara in Algerian legislation

As stated by the author, law No. 98-04 on the protection of cultural heritage is the fundamental legislative framework in Algeria for the protection of cultural property in all its forms, both tangible and intangible. Law No. 05-12 offers a legal framework for the use, sustainability, and management of water resources. Law No. 03-10 on environmental protection in the context of sustainable development. In addition, the Algerian constitutional legislator, through the 2020 constitutional amendment, notably article 21(2), guarantees the protection of national cultural heritage, both tangible and intangible; Article 64 makes it mandatory to maintain an ecological balance and preserve natural resources; Article 69 makes it mandatory to protect cultural and historical heritage.

The Culture Department of the Adrar wilaya requested in 2015 to register Foggara in the national database of intangible cultural heritage. Following this approach, Foggara has been well defined as an intangible heritage by the Algerian law and the international treaties and conventions, notably UNESCO Convention for the Safeguarding of Intangible Cultural Heritage. To preserve these heritages, regulatory and technical proposals are recommended.

Proposals

The importance of the Foggara and Ghout heritages encourages to ask the author for his opinion on the following proposals:

- 1- To recognize the knowledge and expertise of Keyalin El Ma and adapt the modern life needs according to the Foggara sharing system in the Touat-Tidekelt region.
- 2- To carry out actions to pass this knowledge on to younger generations and teach this technique in academic institutions.
- 3- To state a regulation that discusses both the mathematical calculation of sharing water in Foggara and the Ghout's new role of hydroagrarian alarm system as part of technical solutions allowing a better management of water resources in the Sahara.
- 4- To consider the Foggara and the Ghout system as scientific techniques of useful inspirations to adapt to the modern life needs according to the availability of water resources, for ensuring an equitable management and use of water resources in the Sahara.
- 5- To introduce the Foggara's water-sharing calculation into the regulations concerning this intangible heritage as an example of equity.
- 6- To consider mechanisms for addressing the problems of declining water table static level in the region, caused by increased pumping, for preserving Foggara and Ghout heritages in close relation with the water table.
- 7- To preserve the water table located at a depth varying between 10 and 60 meters, for ensuring the sustainability of these traditional irrigation systems, which can serve as natural indicator of hydrodynamic anomalies, particularly in the Ghout area.

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REPLY BY THE AUTHOR

I would like to express my sincere gratitude to the discussor for his interest in my article and for providing such a thoughtful and detailed analysis. The insights shared in the discussion are highly valuable and serve to further enhance the understanding of the research findings presented in my study. In response, I wish to offer the following clarifications and additional information to further enrich the discussion.

Introduction

The foggara system is one of the oldest and most important traditional irrigation systems in the desert regions of Algeria, combining technology, hydraulic engineering, and social and cultural dimensions, making it a water and cultural heritage of significant national and international value (Remini, 2018; 2024a; 2024b). The article "Legal Mechanisms for the Protection of Foggara in Algerian Legislation" analyzes the national and international legal frameworks ensuring the preservation of this heritage, highlighting issues of equity in water distribution and the role of traditional knowledge in local management.

The Dr Khebizi's discussion contributes significantly by emphasizing the technical and computational role of the "Keyal El Ma" and the traditional calculation methods used in the system, providing an important perspective for understanding foggara as a socio-water heritage.

Main themes for analysis of the discussion article

Appreciation of the Legal and Technical Merits in the Article's Approach

The original study highlights a strong link between:

- The comprehensive national legal framework, referencing key laws such as the Cultural Heritage Protection Law No 98-04, Water Law No 05-12, Environmental Law No 03-10, as well as the 2020 constitutional amendments that ensure rights to environmental and heritage protection (Water Law No. 05-12, 2005).
- The equitable aspect in water distribution through precise traditional measurement units (Habba, Qirat, and Qirat al-Qirat) supervised by the "Keyal El Ma," seen as a smart mechanism ensuring fair water distribution, as mentioned by the discussor, representing an advanced model of water justice under resource scarcity.
- System sustainability through integrating legal protection with environmental and social principles and involving local communities in management, supporting the resilience of foggaras against climate change and human pressures (Remini and Achour, 2017).

Constructive Critical Observations

It is essential, as the discussion points out, to distinguish between the legal frameworks governing the technical and environmental aspects of the foggara system (Water and Environmental Laws) and those relating to its protection as cultural heritage (Heritage Law and UNESCO Convention) (UNESCO, 2003). This distinction ensures clearer responsibilities and avoids implementation conflicts.

Moreover, integrating the role of "Keyal El Ma" within a formal legal and institutional framework through official local organization would enhance the sustainability of expertise under modern legal standards and preserve the balance between traditional knowledge and contemporary law (Idda et al., 2021; Ostrom, 1990).

Environmentally, the drop in groundwater levels caused by intensive exploitation of modern wells presents a critical threat to foggaras (Mohamed, Remini, 2017). This highlights the need to develop detailed legislation to tighten control over drilling activities and link governmental support with improved system maintenance and environmental protection, as recommended by the author in the original article.

Finally, caution must be exercised in generalizing comparisons with other traditional irrigation systems due to the specific desert geography of Algeria, characterized by extreme water scarcity and social conditions, which require careful contextualization of these differences (Remini, 2008).

Recommendations and Proposals

Ensuring the sustainability of foggaras requires:

- An integrated regulatory guide incorporating traditional water justice principles within modern legal standards for water share allocation, as recommended by the author in the original article.
- Activating the role of "Keyal El Ma" and local community institutions in water management through local legal and administrative frameworks, thereby reinforcing participatory governance (Idda et al., 2021).
- Conducting comparative studies of legal models from other traditional irrigation systems in desert regions to generalize best practices, as recommended by the discussor.
- Linking foggara protection programs to sustainable development goals, especially Goal 6 concerning clean water and sanitation and Goal 16 concerning governance and institutions (UN, 2025).

CONCLUSION

The protection of foggaras presents a complex challenge requiring a wise blend of legal analysis, technical management, and cultural heritage preservation. The high-level dialogue between the original article and the discussion underscores the need to build a comprehensive and diverse protection system that includes legislation, institutional governance, and traditional communities, along with effective environmental monitoring mechanisms.

The foggaras remain a living heritage reflecting the Saharan people's ability to utilize resources within a framework of justice and cooperation. Legislation and management must reflect this diversity to enable sustainability of both heritage and environmental elements in a changing desert environment.

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