Management and Conservation Water Techniques for and by Farmers: when the water management is a risk shared by the community. Case of fragile ecosystems in Algeria

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Abstract— *Algeria is situated in a region where the lack of water is frequent. Indeed, the period of drought is long even for zones classified in wet bioclimatic floors. This period of drought spreads out generally May until mid October for the wet said zones and all year long for the dry and desert zones. Rains are irregular and unevenly distributed. The recourse use to the techniques of collection of rainwaters, management and preservation for traditional processes is a current practice which tends to be neglected in favour of "modern" techniques of irrigation.*

Our contribution has double objective:

Rehabilitation of certain techniques of collections of rainwaters (valats, poach stones, impluvium) where it is used mainly for the olive tree and the fig tree (Mounts of Kabylia, Beni Snous), and,

A study of the management techniques and preservation of the water where the risk is shared by all the community (foggara,…)

Moreover, we underline that certain areas to fragile ecology are rich in sources of water, which in spite of the institution of the social rules which make the unanimity regarding sharing and regarding distribution; the farmers cannot manage to satisfy the water requirements of their cultures, only revenue stream for some of them.

This requires a renovation of the traditional system of water delivery to the plot of land without disrupting the already established social rules, where from the necessity of a participative work, where the farmers are actively involved. The methods of water sharing are based on equity, rigor, solidarity and mutual aid through the organization of the tour of water according to the size of the plot of land, the moment of intervention, the timing and the cultures to be irrigated.

We underline that the maintenance of the network is made prior to the beginning of the campaign (countryside) of irrigation in the form of "touisa" and financial resources have never been a means of access to water. The water source is considered as a benefit of the community regardless of its location.

Keywords— community, participation, preservation, fragile ecosystem, Algeria.

I. INTRODUCTION

Given Algeria's geographical location, in an area characterized by arid climate trend, wherein drought is spread over a long period, even for regions known as "wetlands". This jeopardizes the regularity of its agricultural production in rainfed. Geographical location and xerothermic climate make irrigation as an imperative and indispensable technique [7], to cope with the water deficit, to increase and stabilize the production. The economic spin-offs of irrigation are undeniable [8].In fact, irrigated areas have played a prominent role, as true "centres" of agriculture and rural development. However, water resources have limited potentials, especially in semi-arid, arid and mountainous areas. Water mobilization using technological facilities remains relatively low, despite the efforts made in this area.

Our ancestors, who settled and prospered in these areas, have had to deal with water scarcity [2], its uneven and irregular distribution and division. In this unfavorable context, farmers have developed a set of rules, social values and techniques to ensure the storage, preservation, protection of water resources and their equitable sharing and where appropriate, supply of

households in the countryside and villages. They were really smart, and yet they could not read. They set up an accurate and sophisticated system of water sharing [1] through traditional methods which represent today tangible and non-tangible cultural assets to enhance and preserve, upon water is becoming a rare and precious commodity.

The Making of basins, valats, impluvium, sed, the majen, the Ghout, the foggara demonstrate the ingenuity of these management techniques, water and soil conservation over the years, and with outstanding know-how. The tangible and intangible heritage has allowed people to settle in hostile environments, which were also the first home of the selection and conservation of local seeds and/or acclimated [9].

Our contribution is twofold:

- Rehabilitation of certain techniques of rainwater collection (making valats, stone pockets, impluvium, ...) where it is conducted mostly for the olive and the fig tree (Kabylia Mountains, Beni Snous), and
- A study of management and saving water techniques where the risk is shared by the entire community (foggara ....)

II. MATERIALS AND METHODS

To demonstrate the relevance of the study, we have proceeded to a territorial diagnostic analysis, based essentially on semi-direct interviews with resources people, primary and secondary data and observations on the ground to understand better the system of functioning of the peasant arrangements regarding preservation of waters and grounds.

The central question which we have to answer is the following one:

What is the logic of interventions of the farmers in the fragile ecosystems and which is the common denominator of these interventions?

III. RESULTS AND DISCUSSIONS

There are, according to regions, farmers' strategies and social organization mode, structures and manuals intended for the conservation of water and soil (WCS) or techniques and systems for harvesting, mobilization, supply and the equitable sharing of water for watering gardens. In mountain ecosystems, the focus is usually on fruit farming and food crops to ensure (benefits or annuity) and food self-sufficiency in fruits and vegetables. Farmers who colonized the mountains had to deal with the fragility and hostility of those inadequate environments yet offering significant perspectives.

The mountains in the north, are often full of water sources captured by farmers using processes and traditional manuals that have demonstrated their usefulness until our days, sometimes the water is fed through the seguias to gardens, sometimes these structures are simply enable the direct irrigation of trees or community use. Thus, making circular or half moon basins, valats, the impluvium, sed, the Aguellal (Fig. 1) demonstrate the ingenuity of these management techniques, the water and soil conservation over the years.

FIGURE 1. GENERAL VIEW OF AGUELLAL (BÉJAIA)

The tangible and intangible heritage has allowed people to settle in hostile environments, share risks related to water scarcity. To protect the land and provide the water supply of fruit trees, including olive trees, terraces are the oldest mountain culture method [4]. Its development is done individually or with the participation of the community. The fragmentation of land parcels which, over the years, become a tiny waist, encourages the mutual support to protect the soil capitals. Technique of circular or half-moon basins is a peasant technique frequently used. It occurs in the mountains of Beni Snous [2] in Kabylia, in the same plain. By cons, basins built into half moons have a strip down reinforced by a dry stone wall (fig. 2). This technique is less expensive to install, easier to maintain and less risk of rupture in the event of downpour.

FIGURE 2. BASINS STRENGTHENED IN DRY STONES (BENI SNOUS AND BÉJAIA)

These traditional techniques are adapted to local conditions. They are based on a slow acquisition of know-how, sometimes over several generations [10]. These processes are also in harmony with the conditions of climate, terrain, soil and water availability. They also depend on the kind of life of people, their history and their production system [4].

In Kabyle, the valats once made to collect spring rainwater to ensure water supply of the olive trees during the summer (dry), this technique was abandoned. This led us to the rehabilitation by making the implementation of a participatory manner, a process with potential for replicability [6], ensure the durability, and enables reproduction at a low cost and proven efficiency [3].

This process is called stone pockets that we have linked with irrigation by internal diffusion [5]. The first results on olive trees are convincing. Among the techniques that can improve water productivity, we tested the rainwater harvesting which consists of trapping the runoff waters in a given area by using simple and inexpensive methods, called impluvium. This allows triple or even quadruple the water amount received by the surface. The use of this technique on olive trees have an appreciable gain of water supply estimated at 120 mm at the end of cycle (mid-June) [11]; [13].

Spring control, construction of Sed (earth-fill or rock dams) and majen (basin) are techniques and structures for watering gardens located about 30 km, depending on flow rate. Each type of water source requires an appropriate apparatus of irrigation, a distinctive management approach and a specific sharing method.

In some areas, the water source is a community asset whatever its location (which is not the case of foggaras) and sharing is done by the Nuba depending on the size of the plot and the kind of cultivation to irrigate. This fair sharing enable to share risks even the little water in cases of severe droughts. Better yet, to save water, another method is used on a small scale, in order to improve productivity in rustic orchards by using irrigation "in jars" [7].

The objective of this technique is:

- this technique aim to ;
- improving the productivity of tree with less water
- Improve household incomes
- Enhance cottage industries (pottery)
- Highlighting local expertise (know-how)
- Develop agro-tourism

In arid areas, know-how has been developed to capture, channeling and sharing water by ensuring its conservation. If some country techniques are used for the water harvesting with a perennial irrigation on ground without channeling and sharing, other techniques require laborious work.

Indeed, ingenious systems have been developed in the northern Sahara, the Ghout and the Thlou'e. The Ghout is a Basin, a funnel or a hand-dug hole. It is a technique of date palm crops specific to Souf region. The palms are located in groups of 20 to 100 in the center of the artificial impoundment about 10 m of depth with a diameter of 80 to 200 m [15].

Thus, date palm is only 1 m of the water table and they have roots in water which removes irrigation, but requires ongoing maintenance work [16]. The fight against sand is an endless battle and the victory was always for the Sufis [16]. Unfortunately, today we are witnessing to the slow death of this system and we have a duty to save it.

The foggara which has been developed mainly in the regions of Gourara, Touat and Tidikelt, refer to an underground drainage gallery with ventilation and disposal wells of backfill, enabling the extraction and transport of groundwater in order to irrigate yards located at its outlet. This gallery of a gentle slope has been skilfully studied and provides the watering by gravity. Their major advantage is to ensure a continuous and regular supply.

In this system, because of the water scarcity and the almost total absence of rainfall, water is transmitted, inherited, sold and bought, which would suggest a pre-established organization of this market. This organization begins at the outlet, where Qasri or qasrîa is the social regulator (Fig. 3).

FIGURE 3. THE QASRÎ IN GOURARA

Qasri is the centerpiece of the social organization of the oasis; it is the heart [12]. We note that this technique, this mode of social organization, the tangible and intangible heritage is in sharp decline due to the use of modern techniques of water harvesting (drilling and center pivot irrigation).

This conflict has driven to a partial abandonment of foggara. The oasis communities which, as indicated, do not build and maintain properly foggaras. Leaving the system to its own, facing aggressive climatic conditions, several foggaras have been collapsed and others sanded up and deteriorated. On 1400 foggara at Adrar, 493 are dry [14].

In the Zab, to harvest rainwater, farmers have built runoff gullies on the hills and mountains sides surrounding the valley channeling their water into their gardens made on the riverbanks and in the beds of Wadis. To protect themselves from major floods, they carried out several dikes and dams of different sizes along the most important wadis of the M'Zab (Fig. 4), by providing ingenious and sophisticated systems of storage, piping and distribution (fig. 5), for their time and the rudimental means that they had both for work and more accurate calculations on the water management plan.

FIGURE 4. DAM IN M' ZAB

FIGURE 5. ALLEYS CHANNEL

IV. CONCLUSION

Communities have been able to create for centuries and, in extreme weather patterns and hostile environments, and with rudimentary means, a characteristic feature of fragile ecosystems, economically profitable, socially acceptable and environmentally sustainable.

Thanks to their know-how, they have prospected and trapped the surface and groundwater. They carried out hydraulic works still operational and have introduced legislation on the use of irrigation water suitable for dewatering methods (galleries, deep wells, superficial, dike, dam ....) and basis for their specific social organizations. Drawing on their experiences, the ingenuity of their techniques by making a thoughtful transfer, assimilated and adapted techniques and new technologies and through an equitable, rational and reasonable management of resources, including soil and water that we can create the successful conditions for the development of new homes land for a farming and a cultural in symbiosis able to bequeath to future generations as much if not more opportunities than we ourselves.

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