

**WATER MANAGEMENT: COLLECTIVE ORGANIZATION, LOCAL
DEMANDS AND WATER AVAILABILITY. A REVIEW**Christian Franco-Crespo^{1*} and José María Sumpsi²^{1,2} Centre of Studies and Research for Agriculture and Environmental Risk (CEIGRAM), Technical University of Madrid, Madrid, 28040

Abstract — This paper propose an overview for collective water management, the analysis of the global and local demands and influence into water availability. This review some social aspects of water management of Andean communities in Latin-America. Urban and industrial water demand has a relative pressure over local demand. On the other hand, collective practices have an “effective process” to conserve water resources and guarantee the future availability. Nevertheless, in this paper is highlight the negative effect of external water demand on traditional practices for water conservation. In this case, we propose the management regulation with attention to institutional policies that allocate water and reduce social conflicts.

Keywords- Collective management; Common goods; Andean communities; Water policy; Water governance.

I. INTRODUCTION

Water is essential for life. The estimated water storage amount exceeds 1.3 MM km³ [1]. Only 2.5% represents the amount available and 70% is in the form of ice. Besides, the natural reserves of the planet is about 2,000 km³, while extraction exceeds 3,800 km³ /year, equivalent to 10% of the available reserves [2], [3]. Water is integrated into ecological, economic, food and health activities of people [4]. Its importance is related to the society welfare and promoting integral development in the territory [5]. For this reason, the future water availability is one of the constant concerns of scientists and policy makers to ensure the minimum amount of water demand, to meet the requirements of the population that improve their capabilities. Thus, for future scenarios, different strategies are considered, which demands the formulation of public policies to reduce effects due to the lack of availability of water [2]. Furthermore, calculations of water availability are proposed based on four elements that pressure on the current availability: (1) population growth, (2) climate change, (3) resources constraint, and (4) increased food demand [6]. The effects of these factors can increase the water deficit in 10% by 2020 and 19% by 2050 [5],[6].

Agricultural is the major consumer with more than two-thirds of the water available globally [9]. Furthermore, population growth demands solutions to the agriculture to supply enough food [10]. The estimates of food demand by 2050 will increase by 17% (See Table 1). Moreover, the competition for water between: industrial, domestic and agricultural sectors is increasing every year. In fact, industrial consumption in developed countries such as Germany requires 70% of water available [11].

Table 1. Population growth and estimated food demand (2016 -2050).

Region	Population growth	Food demand
Africa	118%	2. 3%
Americas	2. 3%	17%
Asia	19%	19%
Europe	-5%	2%
Oceania	46%	6%

Source: FAOStat (2016)

Elaborated by the Author

The efforts assumed to reduce the adverse effects of water lack comprise a set of policies and actions from various sectors. This determines that all efforts should be aimed to conserve the quantity and quality of water to improve socioeconomic needs of the people [12]. Policy makers have the responsibility of strengthen the water management instruments. In fact, some postulates have been promulgated in order to determine parameters proposed to water efficiency, without disassociating the economic, technical, environmental and capital factors [13]. Water management, therefore, is not about limiting consumption, but about reducing waste and improving efficiency of use [14]. In fact, several mechanisms have been proposed to reduce the water consumption, such as: incentives to improve productivity, substitution of high-consumption practices or management improvements [15].

Ward [16], demonstrates that increasing the cost of applied water may be a more effective policy than subsidizing the cost of efficiency techniques [17]. Thus, these subsidies also reward irrigators who adopt water conservation practices and reduce water applications [18]. However, some results show that in the case of Wyoming, Texas, the water reserve was reduced by 15-75%, as a result of subsidies given to farmers [19].

II. COLLECTIVE WATER MAGAMENT

Efficient management requires the articulation between the policy instruments and stakeholders participation [20]. In fact, it requires a policy configuration by the social and productive characteristics. Moreover, the economic approach to water management proposes overcoming the scarcity problems, improving the management [21]. Nevertheless, is essential to consider collective participation into water management, even more if they have a political and cultural value, such as is present in peasant communities in the Andean countries [22], [23]. The management of water resources, in this sense, is presented as an axis to promote the welfare, economic and social development, which faces the pressures given by factors of low efficiency and water wastage. This process, in addition to conducting water management from an economic point of view, is considered as a strategy to guarantee equity, efficiency and sustainability of water resources [24].

The analysis developed above regards the economic rationality of the water management. Therefore, institutions and policies instruments play an important role in management [25]. In this sense, it is important to establish the "game rules" for stakeholders [26]. Thus, the implementation of a policy requires significant government intervention in cases where regulation by the market is inefficient [27]. Additionally, collective relations influence on water management efficiency, especially in situations where water is at the axis of these social confluence [28].

Ostrom [29] determines that collective management strengthens consumers capacities, to achieve a sustainable management [21]. Thus, this discussion is marked by a "good governance" to promote efficiency and enhance sustainability [30]. The public policy, therefore, requires to involve the actors who participate in it [31], in this way, we try to correct the deficiencies in the management caused by the non-participatory policy [32]. On the other hand, this framework requires heterogeneous policies adapted to the social conditions [33]. A special characteristic is immersed in a flow of limited resources that influence in the people development. Therefore, it is through this objective that it has been possible to implement incentives adapted to local specificities in order to promote the well-being.

The proposed advances to improve the policy are shaping towards the adoption of new forms of inclusion in the management with institutions, non-governmental organizations, groups and users for decision making [33]. Thus, it is considered within the mechanisms of regulation the participation of actors recognized by the State that are in charge of water management, many of which are present at the level of peasant communities and organizations [34].

2.1. Water Governance

The water governance definition suggests the application of a complex system to link political, social, economic and administrative between the different levels of articulation of society [35]. According to Mayorga [36], governance is the possibility of agreeing for orderly consolidation and guarantee of stability. Since this conceptualization, institutions have had changed the way of planning the resources management, while the society matured in the awareness of inefficient use, with clear negative effects observable in the present [37].

Governance, therefore, is made in co-responsibility with policy makers, to position users' needs and problems on a vertical scale [31]. (See Fig. 1). This is not to say that local governance represents the only solution, but one of the solutions to minimize the failures of institutional management on a global scale. Indeed, current policies adopt parts of governance within the decision making of lower / executing institutions to settle supranational agreements along the path of sustainability, modernization, and efficiency of water use [38].

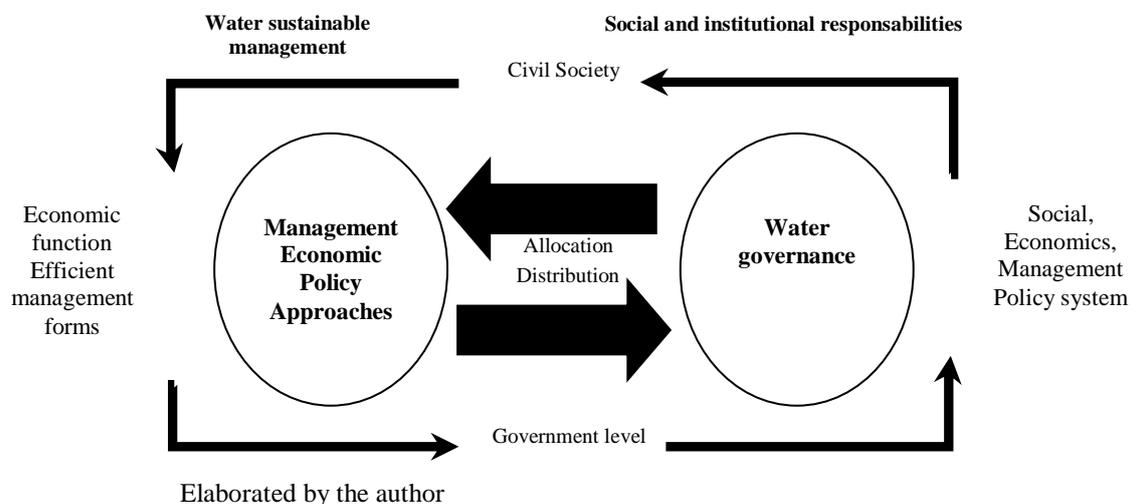


Fig. 1. Policy management and governance scheme.

Water governance is presented in a practical sense as an instrument for the management of water resources [39]. The way analyzed by Ostrom [40] show the conformation of different levels of government with planning capacity, for public participation and technological development, as well as innovation. Therefore, mechanisms are proposed for efficient management with an economic value. On the other hand, governance is conformed the implementation of social,

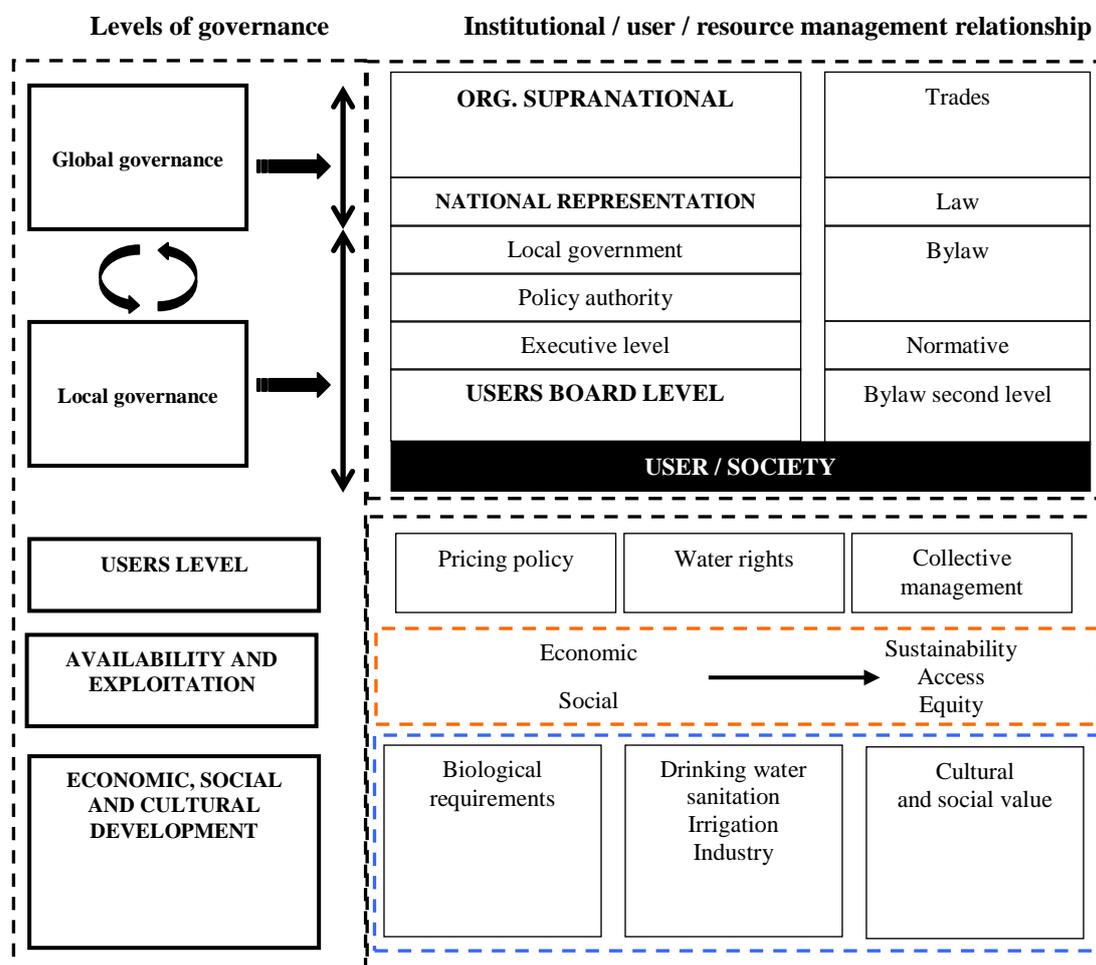
economic and administrative policies, and civil society and government institutions participation. This system, described in the previous figure, proposes the reduction of bureaucratic interventions and implies an interactive guide on appropriate perceptions, interests and specific agendas among local actors [41]. Thus, there are two sector linked by allocation and distribution of responsibilities aimed at the sustainable management of water.

In a theoretical frame, the management of natural resources are articulate with “theory of commons” developed by Ostrom [31]. In fact, “common space” redefines many aspects of the relationship between actors and resources against property rights, externalities and access to resources within an economic framework [25]. Vásquez [42] uses this term to specify the level of management over water: municipal, private and collective in conjunction with the necessary legislation for its execution. On the other hand, Moretto [43] determines that governance has been used like a totem to invoke the development in situations in which the institutions did not give solution to the over exploitation of resources.

Collective management is focused in conserve natural resources, giving the responsibility to the users. Indeed, participation of the actors evidences the problems in the management by the deficiencies in the use of the water, as well as the environmental externalities. Therefore, governance within public policies stimulate the sustainable management of water resources [44] and propose the solution of conflicts on a local scale [45]. Moreover, local management problems interferes with the allocation of water on a global scale, although it is difficult to solve the conflicts of shared tributaries, and the allocation of water sources [46].

According to Valdés-Pineda et al. [47], collective management recompenses the efficiency of public policies. This proposal try to relieve the pressure on water demand in local scenarios. In fact, innovation in policies is influenced by the demand of users who participate directly in the policy design [48]. To achieve this, the collective effort of the different levels of consumers is required [31]. In this sense, governance has greater weight in the general interest that conceives of water as a collective heritage, which encourages society to participate in decision-making. (See Figure 2).

Water conservation responsibility is a task that include to the entire social collective. Indeed, water is an axis for social, economic and political congruence [31]. Since the local approach, this process contributes to equity and develop capacities for use efficiency. In this sense, Trawick [49] attributes to water the ability to link people. Therefore, water is a common thread between collective and economic development.



Elaborated by the author

Fig. 2. Scheme for water governance from the global to the local.

The fig. 2 show the connection between local and global demand. Indeed, inequity water access is limited by the individual interest, even with a major interference than the water market allocation [50]. The public interference and its subsequent derivations, therefore, execute an exercise of failures adjustment, in the face of the scarcity resources problems. Thus, the intervention in the social behavior of "laissez faire, laissez" require some policy instruments to reduce the individual demand and its impact on local-global allocation of water. Therefore, the resources allocation must coincide a holistic analysis, and especially, the recognition of the collective organization in water management.

2.2. Collective water management process

In the past, irrigation water was administered by the traditional Andean hacienda and this rule determined that the community does not deal with the management of irrigation water. The dispute over access to water caused a change in the production structure, leaving behind sectors made-up of limited resources by sharing boundaries with land-owners dominance over land and water with smallholdings [51].

According to Ostrom [31], local communities, in both developed and developing countries, have not only been able to self-govern natural resources but also to implement, maintain and modify institutional arrangements in specific contexts. In this way, community systems stand out for their ability to manage water through reordering strategies and planning of irrigation systems. Boelens [52] determines that there is a diversity of local regulations governing community water use. These forms obstruct the work of policy planners, by the social relationship that occurs around water. Undoubtedly, this centrality arises from the "chaos" in which was the regulation and management of water resources. On the other hand, Piñeiro [53] mentions that it is a question of decentralizing public policies to improve management.

Several forms are applied to obtain water legitimacy, taken since local traditions at local level [54], [55]. Thus, certain collective organizations maintain an internal structure that re-circulates experiences for the management of resources. These organizational processes have been extensively analyzed by Boelens [56] and Boelens [57]. The transmitted experience feeds the decision of the whole community that goes hand in hand with respect for nature.

According to Vörösmarty [37], there is a persuasion in the relation of resources access, which is manifested from the local-global relationship, forming processes of solution to problems at local level to influence global forces. In fact, the conformation of community organization, as an exercise in the collective management of peasants and indigenous peoples, is being consolidated through the demand for access to water [58]. The continuous exercise of collective work allowed that the lack of strong institutional presence is not a limitation in the access to irrigation water. Thus, everyone who has participated and contributed in the construction of the system has the right to water. The members of the systems have an equal distribution of tasks, all work equally in construction (responsibilities) and all receive water according their requirements.

The relation State-users-consumers faces new challenges, especially for institutions in charge of protecting natural resources. This is because the analysis of community management has been raised on the cultural and organizational characteristics of communities, as well as the deficiencies of policies that seek to strengthen their development. However, it is important to recognize the importance of the interrelationships that occur within the economic sphere where the urban sector increases its demand for resources and competes with the rural sector. Meanwhile, in the same relationship, farmers demand access to markets and urban services [59]. In addition, there is a weakening within the collective structure of organizations related to the progress of individual behavior, as a product of the growth of inequality in rural areas. Thus, competition for resources, from outside to the communities and at the same time an internal demand, requires an analysis to guide public policy to allocate water.

In that sense, Casal [60] concludes that indigenous organizations have kept in perfect condition their resources under their rules and regulations. On the other hand, Trawick [61] concludes that there are several cases of communities that failed to conserve their resources, because the low commitment in the agreements on their needs altogether. This approach considers Hardin [62], by the problems that humanity is faced by its exponential growth against a finite amount of resources.

III. RESULTS

Community water management is based on the principle of subsidiarity, which establishes a priority of the social core of the community against the use of water. Hardin [62] determines the use of natural resources based on their limited availability and the unconscious order that prevails within a group of people who demand resources to their individual profit. Moreover, in economic terms, the distribution of the profit that comes from the use of resources, by the group of consumers who do not have a quota allocated, varies according to individual needs. The intrinsic conditions that promote the consumption of this set, are altered according to their spatial location. The social behavior to identify the amount of resources that each individual requires is the factor that distorts the collective norms and application of a regulation.

On the other hand, the economic pressure that is presented on the communities must be recognized. The need to get involved in the development process promotes a series of needs for goods and services, some of which are fundamental, such as education, health and food. This pressure on the availability of water comes in two forms, on the one hand the population that is found around the community and also the growing population of the community.

The spatial analysis of interrelationship shows how different individuals participate in resources, in competition over a finite space. In fact, the market economy that is most clearly undertaken in urban centers is associated with rural space. The export flow of raw material contributes to the demand of external populations. Thus, there is another flow of input

and output of raw material that allows nature to fulfill its natural cycle, being renewed with a limited capacity compared to the current extraction. Thus, in the environment where all individuals who have access to resources participate, in the face of external pressure and the need to satisfy their family, there is an exchange of resources, in conditions of inequality in distribution by competencies. (See Fig. 3).

The tasks presented, the social groups face the economic and environmental pressure that develops within the same territory. The interactions of the territories described above are sometimes aggravated by factors such as poverty, unemployment, land productivity reduction, sub-parceling, and urban expansion. In fact, many of these problems go hand in hand with the lack of planning during the growth of cities, especially in developing countries which have seen the rural population decline by 20% in the last 25 years and 2050 will become between 25% and 30% [63].

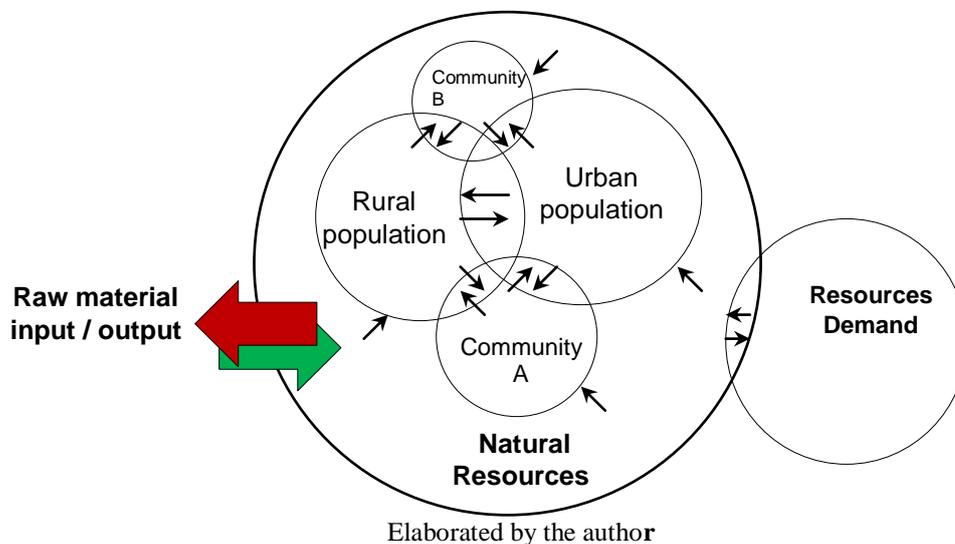


Fig. 3. Representation of community resources demand and the global relationship of exchange

Boelens [64] argue that in many cases, the economic vision of water use efficiency is a threat to the most vulnerable groups in agriculture. Indeed, Boelens and Vos (2012) consider that peasant management systems have the capacities to efficiently manage resources. Those characteristics of collective organization face effects of scarcity, pollution, competition with other farms and urban demand. In this sense, the land, in possession of collectives groups have problems of erosion and deficit in the access of irrigation water. This consequences require that the water resources regulation take the implementation of a regulatory institutionality to reduce the impact of differences between de local and global demand.

Additionally, the collective organization is the strength of the community. In fact, individual relationships are very narrow where systemic eco-relationships and social structures are the union. On the other hand, agricultural tasks are shared with some members, especially those requiring more work. In this way, the community strengthens its political representation and defense of the fundamental resources for its development, being a practice for the social and ideological cohesion at the peasant level.

IV. CONCLUSION

This paper review the collective water management and the effects of local and global water demand. This perspective is based on the theory of commons linked to the exchange of raw material between the local and global scenarios. In this sense, the collective organization has a weakening by the individual behavior. On the other hand, urban water demand, situated in the global scenario take more water from the territories where communities develop. This study, therefore, concludes that collective organization has traditional practices and systems of knowledge subject to change and continuous political contestation. Thus, the development of these organizations has been involved in a climate of confrontation with State policies. Therefore, the reassignment and distribution of resources is maintained within the political and social approaches. Moreover, this research can determine that the management of natural resources is a complex structure of physical, technical and social aspects that are intertwined by internal agreements, external challenges and the limits that mark conflicts.

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