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Governance of Farmer Managed Irrigation Corporations in the Swiss and Italian Alps: Issues and Perspectives

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1. INTRODUCTION

Farmer Managed Irrigation Systems (FMIS) represent “*the decentralised natural resource management by the local community [...] that has developed its own organisation system, norms and values governing the management of water resource, resource mobilisation based on obligations and right to use the natural resource*” (Pradhan 2001). But, FMIS are not closed systems. They are to be considered as one of the multiple water resource management subsystems integrated within larger systems, as the agricultural system and the water management system (fig. 1). They are also connected with other economic systems and natural systems. For example, we may think of the tourism system, as in the Alps, where irrigation channels are also used as hiking paths (Reynard 2003), and of the geomorphological system, that has a large influence on the building techniques, as is shown by the development of wood channels along the cliffs of the lateral sides of the glacial Rhone Valley (Reynard 2002).

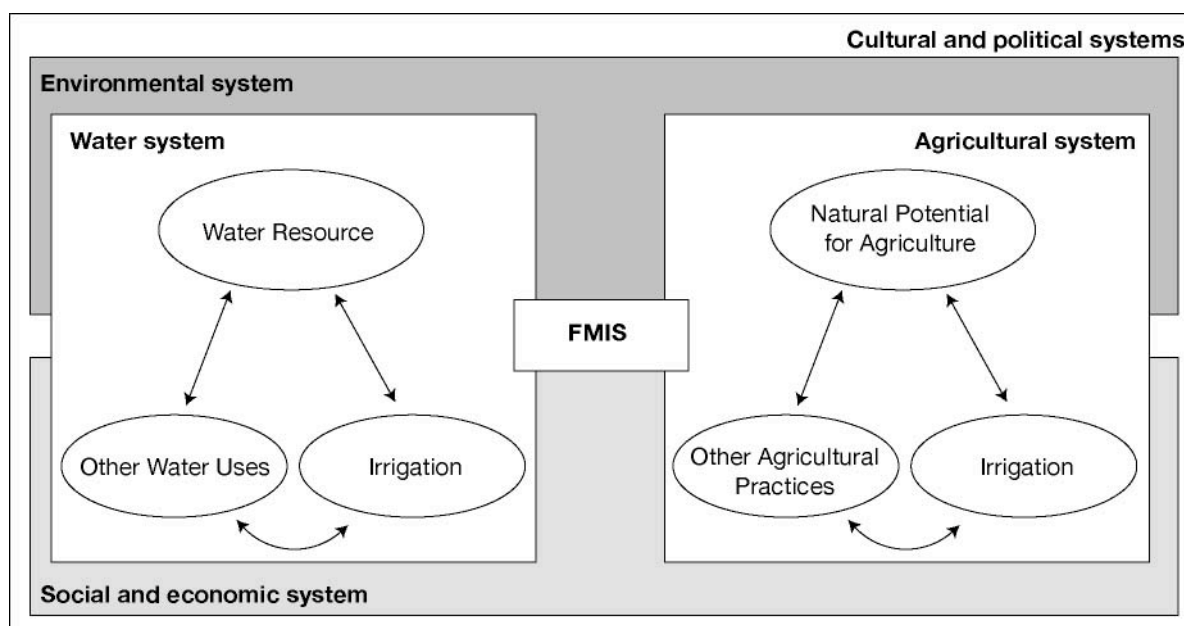


Figure 1 Integration and interactions of Farmer Managed Irrigation Systems with other natural and economic systems.

All these interactions need to be regulated by a large palette of rules, which can be classified into two types, the public policies and the property rights (Reynard 2002), and which we proposed to group within the generic denomination of Institutional Resource Regime (IRR) (Varone et al. 2002, Reynard 2002). Both types of rules concern the internal functioning of the irrigation system, as well as the regulation of the relationships between irrigation and other systems. It is what I propose to call **the internal and the external governance** of irrigation systems.

Because of the rapidly changing world, FMIS face several challenges that concern technical aspects, internal organisational features, as well as integration and interaction with larger systems. In her key-note speech to the First International Seminar on FMIS held in Kathmandu in 2000, Linden Vincent addressed a series of issues concerning FMIS in a changing world (Vincent 2001, 18). Two of them are related to governance challenges:

“What are the links of FMIS with wider civil society? How are FMIS transforming in the face of wider agrarian, political and environmental change?”

Why, and how, have the policies and programs for FMIS evolved over time and how does this shape the opportunities for FMIS to evolve?”

More precisely, in terms of governance, I think that three issues are of great interest to be studied more in detail:

How the national governing system – centralised or federal –, and how the regional and national policies regulating agriculture and water management influence the functioning of FMIS?

What are the respective roles of public policies and property rights in the functioning of FMIS? Are common-property associations susceptible to be developed in all contexts or, at the contrary, are there some regulative conditions necessary for FMIS to function well?

How can FMIS influence the development of water policies at a regional or national scale? Are these small-scale systems able to be heard by the regional and national administration? Are they able to play a role in the evolution of water management at the regional and national scale?

These preoccupations are well addressed by the recent book edited by Boelens & Hoogendam (2002) concerning irrigation in the Andes: *“To find the starting points for strengthening users’ organisations, it is fundamental to understand the dynamics of water rights and indigenous normative systems. It is therefore necessary as well to understand their interaction with other normative frameworks and with the different institutions that make up the institutional context”*.

In this paper, I will first propose an analytical model for studying governance of FMIS. After briefly presenting irrigation in the Rhone and the Aosta valleys, I will analyse two regional cases. They concern the evolution of the internal governance of FMIS in a context of rapid changes in agricultural and economic frameworks. The *Ru Neuf*, in the Aosta valley, is the last irrigation corporation in the Aosta Region, where all the other farmer managed irrigation systems have been integrated in larger agricultural corporations highly supported by the Regional Administration. The *Bisse du Torrent-Neuf*, in the Rhone Valley, is a case where the irrigation corporation continues to exist only because of high financial and organisational support by the local administration. In the area, new corporations are created in suburban zones for irrigating private residential properties.

2. INSTITUTIONAL MANAGEMENT OF WATER RESOURCES AND IRRIGATION

The Institutional Resource Regime (IRR) concept was developed for analysing the institutional management of natural resource in a systemic way (Kissling-Näf & Varone 2000, Knoepfel et al. 2001, Varone et al. 2002). The focus is on the natural resource and not on a specific use. The model considers that a renewable natural resource is generally exploited by more than one type of use (e.g. water for consumption, irrigation, industrial production, energy production, pollutant absorption, support for navigation, fishing or gravel extraction, recreation, medical uses, religious uses, reserve against fire and biodiversity conservation (Reynard et al. 2001)). It can be considered therefore that natural resources create goods and services for the society. One of these goods is water for irrigation.

An institutional resource regime is defined as the combination of the property regime and public policies that regulate the natural resource management (Knoepfel et al. 2001, Varone et al. 2002). The property regime is analysed through three types of property rights (formal property titles, disposition rights and use rights) and two categories of public policies are considered: exploitation and protection policies.

In every process of resource exploitation, the *stock* of the resource and the *yield* are distinguished (Ostrom 1990). In the case of water, the stock is the quantity of water involved in the natural water cycle of a watershed. The yield is the amount of water that is available to humans for satisfying their needs for consumption, irrigation, industrial production, etc (fig. 2). When the total amount of water uses is higher than the yield, there is overexploitation.

Water uses result in a range of actions made from the water resource by three types of actors: the *owners*, the *managers* and the *users*. All three types may be in the hands of a same actor. This is the case when a spring owner uses and manages the spring for his own uses. Although, in most of the cases, the owners, the managers and the users are composed of different actors, this requires institutional regulation. Such an institutional regulation may be very different from one case to another. Differentiation depends of various types of property and use rights, public policies, political institutions, and cultural norms and values (fig. 2).

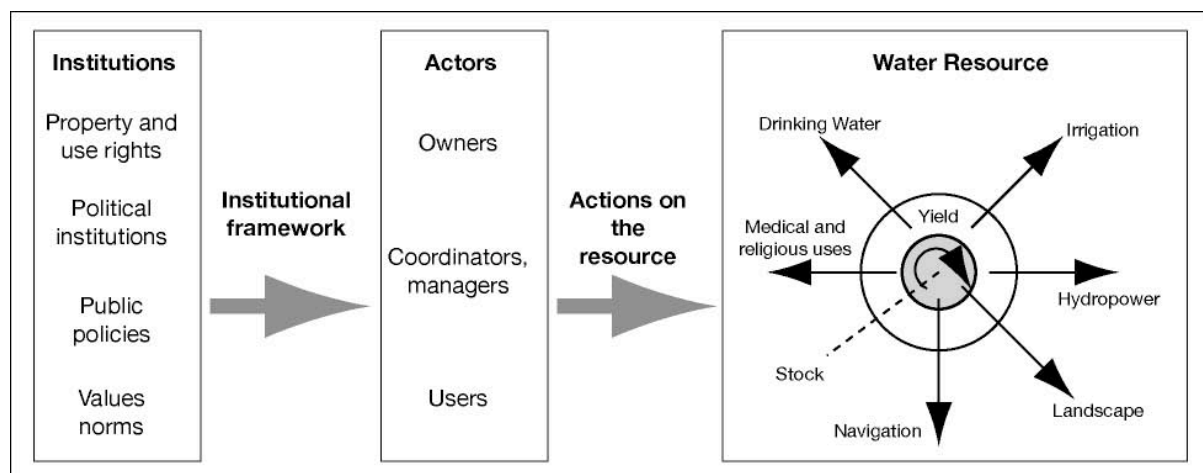


Figure 2 Conceptual model describing the relationships between institutions, actors and water resources.

3. IRRIGATION IN THE ALPS

The Alps are considered as the water tower of Europe (Viviroli et al. 2003). Because of their geographical position at the contact of Northern Europe and Mediterranean climatic systems, the mountain chain has a relatively high amount of precipitations. Because of the absence of a dry season, irrigation is generally not necessary in large parts of the mountain massif. Nevertheless, some dry islands exist, due principally to rain shadow effect and to geological characteristics (karstic areas), in several parts of the Alps. Irrigation has therefore been developed at large scales since the Middle Ages in the French Alps (Briançonnais, Lubéron), in the Swiss Alps (Rhone Valley, Graubünden Alps), and in the Italian Alps (Aosta Valley, Piemonte, Venosta Valley) (SHVR 1995, Aubriot & Jolly 2002, Vauterin 2003a). Most of these systems, which were principally managed by irrigation corporations, have been abandoned or have drastically evolved during the 20th century (Aubriot & Jolly 2002, Vauterin 2003a). The examples presented in this paper are all located in the Rhone and the Aosta valleys.

The Rhone Valley is situated in the South-Western part of Switzerland, and is boarded by two high mountain ranges: the Penninic Alps in the South and the Bernese Alps in the North. Because of rain shadow effects, the climate is relatively dry and annual rainfall is not more than 600 mm at 500 m ASL and 800 mm at 1600 m ASL. On the southern facing lateral valleys, the dry climatic conditions are accentuated by high insulation and evaporation. Because of these climatic conditions, irrigation has been carried out almost since the 13th century (Mariétan 1948, Ammann 1995, Reynard D. 2002). The irrigation channels are called *Bisses*. Most of them were cut directly into the valley side, but in some sectors, because of the presence of high rock cliffs, wood channels were also constructed along the cliffs. Until the 19th century, irrigation was limited mainly to the meadows. In the 19th century, it was extended to vineyards and orchards. Gravitational techniques tend to be replaced by aspersion irrigation. Micro-irrigation is very limited. Since the first decades of the 20th century, in relation to the decrease of mountain agriculture, channel irrigation has been in regression. The *bisses* network, that represented

more than 1400 kilometres of principal channels at the end of the 19th century, is currently about 600 kilometres long. Recently, the channels were integrated into the tourist industry as paths for hiking (Reynard 2003).

The Aosta Valley is a relatively isolated region of North-Western Italy, boarded by the Penninic Alps in the North and the Grand Paradiso massif in the South. The double rain shadow effect provokes a reduction of annual rainfall to about 650 mm in the bottom of the valley (550 m ASL), and not more than 900 mm in more elevated sites (1500-2000 m ASL). Because of the relatively high mean altitude (2100 m), the principal farming activity is livestock production. Vineyards are also cultivated at low elevations. Both are irrigated (Gerboire 2003, 16). Irrigation channels are called *Rus*. The majority of them were built during the climatic optimum of the 13th – 14th centuries (Gerboire 1995, 2003). Internal water right distribution was fixed in documents called *Egances* (Gerboire 1995). During the 17th century, several of them were abandoned because of the Plague in the 1630's and/or climate cooling of the Little Ice Age (1600-1850 AD). The abandoned *rus* were not reconstructed, and now their number is estimated to be about hundred. No statistics exist on their length because no systematic inventory was carried out and most of the channels were transformed into underground channels (Filipponi 2003). Since the mid-1970s, due to the regional policy, gravitational irrigation has been progressively replaced by aspersion (Vauterin 2003c). Like in Valais, because water is sufficient, micro-irrigation is poorly diffused.

3. PROPERTY RIGHTS AND WATER POLICIES IN THE RHONE AND AOSTA VALLEY

3.1 Rhone Valley (Canton of Valais)

In Switzerland, surface water bodies (rivers, lakes and glaciers) are public waters (art. 664 Swiss Civil Code) and underground water bodies and springs are private waters (art. 704 SCC). The Swiss Civil Code, adopted in 1912, did not cancel all the former historical rights and even now there still exists several cases of private property of rivers or glaciers, especially in the Alps. The public property of rivers means that the State can dispose of the water and give concessions for water use, e.g. for irrigation or hydropower production. Because of the federal structure of the Swiss political system, public property is organised at three levels: the Confederation (central State), the Cantons (26 regional, relatively autonomous states) and the Communes (local municipalities). In the Canton of Valais, the principal river, the Rhone, is property of the Canton, whereas the other rivers are property of the Communes. During the Middle Ages, the period when most of the current *bisses* were constructed, surface waters were property of Landlords, principally the Duke of Savoy and the Bishop of Sion (Reynard D. 2002). Irrigation systems benefit from *access or use rights* ("concessions") to river water accorded by the Lords (Middle Ages and Ancient Regime) or by the Communes (in more recent times). The duration of these use rights is generally unlimited (the so-called *droits perpétuels* in French). Because of the high costs of construction and maintenance, the channels were constructed by the entire local community or by corporations of farmers called *consortages* (Reynard D. 2002).

The *consortage* is an example of a common-property corporation (Reynard 2002, Reynard & Baud 2002). The maintenance is carried out by the members themselves in the form of workdays (the so-called *corvées*). Rights and obligations are generally calculated according to the surfaces to be irrigated. Sometimes water rights are independent of surface (personal rights). The members, called *consorts*, elect their own committee and people for various specialised functions like the allocation of water, the control, the responsibility of maintenance work, etc.

The *water policy* in Valais depends on the water policy at the national level and of specific cantonal laws. The Swiss water policy is regulated by several laws, resulting from a long and complex evolution concerning three principal domains: protection against floods, hydropower production, and protection of quantitative, qualitative and dynamic natural features of water resources (Reynard et al. 2001). Due to the small geographic extension of irrigation, which concerns only the canton of Valais, no specific regulation on irrigation was developed at the national level. In the canton of Valais, a decree in 1924 fixes the period of irrigation from 15th April to 1st October. The cantonal legislation on hydropower production (three successive acts adopted respectively in 1898, 1957 and 1990) protects the former use rights, as irrigation rights, when new hydroelectric concessions are accorded. The Swiss agricultural policy (1951) introduced subsidies for the so-called *améliorations foncières*, that means all the technical innovations aiming to improve agricultural productivity, especially allotment reshuffling. In the Valais, where irrigated agriculture had a strategic importance, this type of subsidy was introduced in 1924 already, to improve the *bisses* productivity by replacing wood channels by tunnels or concrete channels. With the new agricultural policy (1999), subsidies are now redirected to the ecological functions of agriculture. The main instruments are the ecological direct payments that aim to pay the indirect services offered by the farmers to the whole society (landscape and nature management). They are normally

calculated on the basis of the surfaces that are farmed with respect of natural processes (e.g. few entrants). No subsidies however are provided to linear infrastructures like traditional *bisses* or stone walls that still play an important function in rural landscapes and nature conservation. The *bisses* are also concerned by the tourist policy because of their use as hiking paths.

3.2 Aosta Valley (Autonomous Region Aosta Valley)¹

Since 1948, because of the cultural exception (French language), the Aosta Valley has a status of autonomy that provides specific financial incomes and the possibility of regulating all the political domains at the regional level.

In the Aosta Valley, the rivers were property of the Duke of Savoy until 1773, when the feudal system was partly abolished and the Communes were forced to buy the waters from the Lords (Rio 2001, 45; Gerbore 1992, 293; Vauterin 2003b, 18). Since the 1910s, in the context of development of the hydroelectricity industry, the Central State has tried to appropriate the surface water of the Aosta Valley with the objective of receiving the water use fees (see Rio 2001). Finally, the Autonomous Region received a concession on all the waters for 99 years in 1948, date of the creation of the status of autonomy (Rio 2001, 55). The Region can give subconcessions on these waters to various users like hydropower companies and irrigation corporations. A subconcession is given against the payment of a fee, except for irrigation and drinking water uses. In 1994, a new law, called the *Galli Act* (L. 36/1994, *Legge Galli*), was adopted at the national level, which considers that all the surface waters are property of the Central State. However, the 1948 concession to the Regional government was not abolished because of the status of autonomy of the Aosta Valley.

At the end of the 18th century, following the acquisition of the river waters, the local municipalities also began to manage the irrigation channels until the beginning of the 20th century, when they were yielded to corporations, called *consorzi d'irrigazione* (Vauterin 2003b, 18). Only one channel, the *Ru Herbal*, continued to be managed by the local municipality. With the adoption of the Royal Decree 215/1933, the creation of large land reclamation consortia (*consorzi di miglioramento fondiario*) was possible. The difference between the irrigation corporations and the land reclamation consortia is that the former are created for managing the water used for irrigation in a specific channel, when the latter are geographical areas, in which all the terrain owners are involved in order to improve agricultural productivity. Progressively, the irrigation consortia were transformed in land reclamation consortia (Vauterin 2003b, 18). Currently, 170 land reclamation consortia are accounted for in the valley, when the *Ru Neuf* is the only irrigation corporation still in activity.

Italy is a relatively centralised country. The history of the Italian legislation on water has been characterised by a great deal of fragmentation across laws dealing with water use, water quality and hydraulic works (Goria & Lugaresi 2004). Concerning water uses, the first water law dates back to 1865 (L. 2248/1865), after the Italian unification, and defines a regime of water use authorisations. It was renewed in 1933 (L. 1775/1933). During the 1970's, some State functions were transferred to the Regions. That is the case of concessions for water use (through L.616/1977). In 1994, the *Galli Act* introduced the principle of integrated management in Optimal Territorial Area (not yet fully implemented), and finally in 1999 a new act (L. 152/1999) was developed for implementing the European Union Water Directive, that aims at the integration of environmental, health, economic and productive policies in the perspective of a global policy on water resources management. At the regional level², the Law 30/1984 on regional intervention on agriculture allows financial contributions for irrigation (art. 7): 95% of investments and 60% of management costs. The recent *Regional Law 3/2001* related to the organisation of land reclamation consortia reconstitutes the status of self-organisation of the consortia and their function of public interest. These consortia are considered to be one of the key-structures for implementing a sustainable rural development and their investments may be completely covered by the Region Aosta Valley. The current objectives of the regional administration are to re-organise the highly fragmented consortia into larger and much more rational entities.

¹ Partly according to an interview of Giovanni Vauterin, Office of Irrigation, Assessorate for Agriculture and Natural Resources.

² According to written documents by Tiziana Brix, Office of Consortia, Assessorate for Agriculture and Natural Resources and an interview with Giovanni Vauterin, Office of Irrigation, Assessorate for Agriculture and Natural Resources.

4. EXAMPLES

I have selected two examples to illustrate the evolution of internal and external governance of irrigation in the 20th century. For each example, I briefly present the system of irrigation and the current institutional situation. Then, I try to reconstruct the principal steps of evolution of the corporation.

4.1 The *Ru Neuf*³

The *Ru Neuf* is the last irrigation corporation still in activity in the Aosta Valley. It is situated in the Communes of Etroubles, Gignod and Aosta in the North-Western part of the Aosta Valley, near the main city of Aosta. It diverts the water of the Artanavaz River, at 1280 m ASL and is 12.850 km long. The total irrigated area is 424 ha, partly by traditional gravitational techniques, partly by aspersion. Some sectors of the main channel have been replaced by an underground pipe, but over most of the course, the channel is still an open-air channel.

The *Ru Neuf* received a concession for the derivation of water by the Lord of Savoy the 22 March 1401 (Glarey 2003, 106). In the 1770s, the feudal system was abandoned and in 1818, the Commune of Aosta approved the Rules regulating the utilisation of the *Ru Neuf*. These rules are still in use (Glarey 2003, 106), but have been partly adapted. In 1944 and in 1954, the water derivation in the Artanavaz River and the rules of the corporation were successively approved of by the President of the Republic. Recently, in 2004, the rules have been adapted to the Regional Law of 2001.

The irrigation system is divided into four zones, corresponding to the three communes (the Aosta section is divided into two sectors). In the upper part (Etroubles), irrigation is free in compensation for the land given by the inhabitants of Etroubles for the construction of the channel. In the lower zones, the irrigation is ruled by a 16 day long turn called *Journal*. Currently, the corporation is composed of 1786 users. The corporation is organised into an assembly of users and a directive council. In contrast to the majority of the consortia, where each member has one right, here the rights depend on the time of irrigation (one right for 2 hours, 2 rights for 6 hours, 3 rights for 10 hours, and 4 rights for members with more than 10 hours of irrigation per turn). The directive council is composed of 8 people (4 for the section of Gignod, 2 for the section of Exenex, and 2 for the section of Arpouilles).

Until 1948, all the investments were financed directly by the members. As in the other channels (Gerboire 1992), the maintenance was made directly by the users. Now, the heavy investments are financed by the regional administration. The current costs (guardian, secretary, minor work) are partly paid directly by the members. The annual fee is about 18 €/ha/year (with some variations because each year the distribution of the costs is calculated according to the duration of irrigation of each member), which has to be considered as very low. There is no fee for the use of water.

This example shows the complexity of a self-organised corporation with a history of more than 600 hundred years long. The internal distribution of rights goes back to the Middle Ages. The feudal concession for the water derivation was recognised by the new unified state in the 1860s and by the Italian Republic after World War II. Because of their status of public interest, the activities of the corporation may be partly financed by the central state (since 1933 law), and by the regional administration (currently 100% of the investment costs). The administration has recognised the importance of the self-organised corporations for insuring the sustainable development of this rural region, and therefore massively subventions their activities. It has to be noted, however, that the *Ru Neuf* corporation is the last one to be dedicated only to irrigation, and that most of the rural development is now carried out by more integrated consortia.

4.2 The *Torrent Neuf* in Savièse⁴

Savièse is a Commune situated in the center of Valais, near the city of Sion, in the driest part of the Rhone valley. Until the middle of the 20th century, most of the population was composed of peasants practising a mixed agriculture (livestock, cereals, vineyards, orchards). Since the 1960s, as in most of the country, agriculture has decreased drastically. Livestock production is carried out by some tens of people, cereal production has almost completely disappeared, and people generally cultivate vineyards during their free time. The population has rapidly increased because of the vicinity with the main city of the Canton and large residential areas have been

³ According to an interview with Lino Grimod, Secretary of the *Ru Neuf* Corporation.

⁴ Partly according to an interview with Bernard Luyet, Chief of the Public Works Service, Municipality of Savièse, and Frédéric Varone, Civil Engineer, Technical Service, Municipality of Savièse.

built on former agricultural land during the last three decades. This has produced a complete transformation of the irrigation system.

Because of the position of Savièse, irrigation has been carried out in the meadows since the Middle Ages (Roten Dumoulin 1995; Reynard D. 2002, 2003). In 1430, the entire community built one of the most impressive channels of the Canton, called the *Torrent Neuf*. Contrary to other cases in Valais (Reynard D. 2002), the channel was managed by the whole community (Reynard D. 2003) and not by a specific irrigation corporation. The water rights of the community members were fixed in a document called *Ratement* and a local community statute of 1447 regulated the complex organisation of irrigation (Reynard D. 2002). During the 17th century, several new restrictive articles were added because of the demographic pressure on the water resources (Roten Dumoulin 1995). Finally, in 1810, the community transferred the management of the *bisse* to a corporation, still existing, the *Consortage du Torrent Neuf*.

Because of high costs of maintenance, a tunnel cut into the mountain replaced the wood channel in 1935. The municipality financed the costs of the project. A contract was therefore signed in 1929 between the municipality and the corporation. The new owner of the irrigation system was the municipality that would continue to provide water to the corporation during the irrigation season (10th April to 20th September). The corporation would pay the Commune 8360 Swiss Francs during 35 years to contribute towards the communal investment. In exchange, the maintenance and the payment of the guardian is the responsibility of the Commune. In 1952, the rules of the *consortage* were renewed, and in 1959, a hydropower concession was signed by the Commune of Savièse reconstituting the former rights of irrigation corporations.

These two events (replacement of the former channel by a gallery in 1935 and the hydropower concession given by the Commune in 1959) have drastically changed the organisation of irrigation in the area. The *consortage* is still in activity, but its rights and activities have been very much reduced. The water capture is undertaken by the hydropower company. The transport of water is the responsibility of the Commune as well as the distribution of water to irrigators. The corporation pays about 8000 Swiss Francs per year to the Commune for these services.

The *Torrent Neuf* corporation has the responsibility of the irrigation of meadows. Several small *consortages* also exist for the irrigation of vineyards. In 1974-1975, the municipality created an irrigation system by aspersion for the whole of the vineyard area. Several of these *consortages* disappeared at that time; others are still in activity, but do not work very well. One of the problems is that wine production in the area is mostly a part-time activity. During the last two decades, overproduction has provoked a lowering of prices and a large population of owners no longer work their domains. Most of the new wine workers do not know the irrigation system whose maintenance progressively diminishes. One solution should be the dissolution of these *consortages* and the replacement by a communal management, a solution that the Commune does not agree to because of the costs implied.

The last tendency concerns the urban extension of the Commune. Population has drastically increased during the two last decades and a shortage of drinking water is not uncommon. Most of the new population has built individual houses with lawns that require a high amount of water for irrigation. For this reason, the Commune proposed the creation of new "*urban*" irrigation corporations. Since this, more than ten *consortages* have been created. Payment of the infrastructures and management are the responsibility of the corporation members. The Commune proposes only its technical help for the planning phase.

6. DISCUSSION

These two relatively contrasted examples allow some general comments:

1. **Physical conditions of irrigation.** The two valleys are almost identical in respect to climate and topographic conditions. Agriculture practices are quite similar: although, in the Aosta Valley livestock production is the principal activity, in Valais livestock, vineyards and orchards are much more evenly distributed.

2. **History of Irrigation.** In both valleys, irrigation systems date from the Middle Ages. The conditions for their development seem to have been the same: concession of water for irrigation by Landlords, concentration of channel building during the 13-15th centuries. The reason for enlarging the irrigation system seems to have been the same in both valleys, that is a conjunction of dry climatic conditions and the development of cattle livestock due to urban demand in Northern Italy and Central Plateau of Switzerland. However, in Italy, the 1630 Plague seems to have produced a large decrease of the channel network, which is not the case in Valais.

3. **Corporations.** In both regions, irrigation corporations have existed since the Middle Ages and some of them have been in activity for more than 600 years. Nevertheless, the history of corporations is very complex and different models of evolution exist. It is therefore not possible to produce general conclusions by only analysing two cases. In the two regions, there has been a balancing out of management by corporations and by the local municipalities. A same observation was made by Ruf (2002a,b) in the Central Pyrenees (France) and in Ecuador. What is interesting to note is that there is no historic coincidence in the two areas (table 1). The current tendency seems also to be a decrease in the force and autonomy of the corporations in both regions.

	Aosta Valley – Ru Neuf	Rhone Valley – Torrent Neuf
15 th – 18 th century	Common-pool management (<i>Consorti</i>)	Public management (<i>Communautés</i>) or Common-pool management (<i>Consortages</i>) ⁵
19 th century	Public management (<i>Communes</i>)	Common-pool management (<i>Consortages</i>)
20 th century	Common-pool management (<i>consorzi</i>), and then, since 1933, integration in larger land corporations (<i>consorzi di miglioramento fondiario</i>). Exception: Ru Neuf.	Complex integration of the roles between the local municipalities and the corporations.

Table 1 Balance between public and corporate management of irrigation in the two studied regions.

4. **Property rights.** In both valleys, the rights on water were in the hands of Landlords during the Middle Ages. For financial reasons, they gave *perpetual* concessions to local communities or to corporations of irrigators with the obligation for them to build and manage irrigation systems. In the 18-19th centuries, the feudal system was progressively abolished in both countries and most of the rivers became public water bodies, generally in the hands of the local communities. In Italy, with the development of the hydropower industry, the central State tried to transform these public waters into State water with some success. That is the reason why in the Aosta Valley, the Region has a concession of the State on the waters. In Valais, the Communes are proprietors of the rivers except the Rhone river that is the property of the cantonal State. The development of hydropower industry shows the importance of property rights. In both countries, former irrigation rights were protected and these rights are generally written in the hydropower concession contracts.

5. **External Governance.** The Regional Government of the Aosta Valley has developed an active policy aiming to support the activities of irrigators. The current irrigation system is the result of thirty years of investments for developing a rational system. The national law of 1933 and the regional land policy have produced a progressive integration of irrigation corporations into more general land corporations. In contrast, in Valais, there is no specific policy for the development of irrigation. Nevertheless, the federal law on agriculture and the former cantonal rules (1924) have allowed the support of various irrigation projects. Because of the federal structure of Switzerland, the role of local municipalities is much higher than in Italy. For this reason, each irrigation corporation is quite specific. In the Aosta Valley, the role of the central State, especially in the fascist period, in the development of irrigation contributed to a much more centralised system than in Switzerland.

6. **Internal Governance.** One fact is that the corporations have drastically evolved during the 20th century, and especially during the last two decades. Most of them have disappeared, but not for the same reasons in the two regions: in the Aosta Valley, they have been integrated into the land corporations, whereas in Valais they have been replaced by municipal management (see also Reynard 2002). Because of the reduction of agricultural activity in the Alps, most of the very precise rules regulating the water distribution and the maintenance of the infrastructures are no longer in use and it is quite difficult to find people to participate in the management structures (presidency, secretary, guardians). In the Aosta Valley, the regional administration supports not only the investments, but also the management of the corporations, a situation that is of great interest for the future. But it must be highlighted, that all the corporations are not in crisis and as we noticed two years ago some of them are quite dynamic with good organisational and financing structures (Reynard 2002). The new *consortages* of Savièse, responding to new needs, are also a good example showing that FMIS is not limited to traditional agriculture.

⁵ In most cases a specific corporation was created; Savièse is perhaps an exception, even if the links between corporations and communities are difficult to evidence (Reynard D. 2002).

7. **Finance.** In comparison with the Valais, irrigation in the Aosta Valley Autonomous Region is much more centralised. Each corporation is composed of an assembly of members and a committee. The financing of the activities by the members is very low (US\$5-10 per year to US\$100 per year depending on the situation⁶). All the *consorzi d'irrigazione* and *consorzi di miglioramento fondiario* are therefore massively financed by the Regional State. Until the year 2000, 95% of the costs of an improvement project were financed for by the Regional State; the five remaining percent were paid by the local municipalities. Since then, all the costs are covered by the Regional State. In Valais, public support is much more reduced and limited to the costly investments.

8. **The Future.** Certainly that the tendency to a reduction of the number of corporations will continue, especially in Valais, where the system is very complex. I think that a sustainable management of the infrastructures, for example the traditional channels, will not be possible without financial support by the public sector. In this sense, in Switzerland, new modes of financing the services proposed to society by the *bisses* need to be paid by sectors other than agriculture, for example by the tourism industry (Reynard 2003). In the Aosta Valley, there is an active policy developed by the Region for supporting its agriculture that includes irrigation systems.

7. CONCLUSIVE THOUGHTS

It has been demonstrated that the good functioning of irrigation systems is not only dependant on the physical structures but also (and may be more) on social structures (Boelens & Davila 1998, Rivière-Honegger & Ruf 2000, Pradhan & Gautham 2002, Shivakoti & Ostrom 2002, Boelens & Hoogendam 2002, Aubriot 2003). Therefore, the *social capital*, that is all the formal and informal rules, the oral tradition, the symbolic views, the integration of irrigation practices into larger social rules, etc., is one of the key-factors for understanding sustainable functioning of irrigation systems. This social capital is certainly one of the elements that explain that Farmer Managed Irrigation Systems often have a better productivity than Agency Managed Irrigation Systems that are not really appropriated by the local population (Shivakoti & Ostrom 2002, Ostrom 2002).

Switzerland and Italy are to be considered as post-modern societies where agriculture occupies a very minor part of the population. The former social capital that was formed by all the irrigation practices, the knowledge of the complex organisation of irrigation at local scale, the knowledge of the territory, of the natural processes, etc. is quite reduced now. A lot of farmers no longer carry out their activity because they are too old and they have not passed down their traditional knowledge, which is not always perceived as knowledge by young generations. The less productive areas, for example in the Alps, have been given up due to the process of intensification of agriculture, and with them also the irrigation systems.

But this is not an irreversible tendency and several signs show that common-pool irrigation, and more generally common management of landscape and territory, may be an adequate tool for improving sustainable management in rural areas in the Alps. I have mentioned in this paper the creation of suburban common-property structures in Savièse. Other studies show the interest of developing common-property management of territory by creating new common institutions. Nevertheless, crafting new institutions may need the integration of new actors, not originally involved in the irrigation. That is the case where irrigation channels assume tourist functions. I have demonstrated that new actors, external to agriculture, are involved in the promotion of channels as tourist infrastructures (Reynard 2003). Certainly that in the future, irrigation corporations will include these new actors or will be included in more integrated territorial institutions. And certainly this tendency will transform the internal governance of FMIS.

All the studied cases show the importance of the links between the State and FMIS. In the framework of a global economy, where agriculture produces few economic incomes for farmers, especially in the Alps, it is necessary that the State finance part of the means that are used for improving productivity. I think not only to contribute to the infrastructures, but also to the social capital, for example in the domain of transferring traditional knowledge to younger generations. Such public aid has, for example, already been used with good success in Valais for developing management of traditional stone walls by using traditional practices.

There is currently, after decades of disinterest, a new interest for traditional and more ecological agriculture, and more generally for traditional ways of life, in the Alps. On one hand, this tendency is of great interest for irrigated agriculture because it should produce money transfers to the mountain areas. On the other hand, there is the risk of producing false models, especially regarding participation in or sustainable management of the common-property institutions. I think that currently a "romantic" view of the functioning of common-property

⁶ These charges are used for paying the secretary. The president usually works for free.

corporations is largely diffused in the “urban” circles, a view that no longer corresponds completely to the reality... and that we cannot demonstrate because research is too limited in this area.

In fact, because mountain irrigation is not a big issue in countries like Switzerland or Italy, precise research on the current (and former) functioning of FMIS institutions is not very well diffused in our countries as opposed to other parts of the world. Because the study of the social capital, management institutions or relationships between irrigation and other land management practices is of great importance in order to understand how sustainable rural development will be crafted in the Alps during the 21st Century, I hope that the important knowledge that has been developed in countries with a long irrigation tradition like in Asia, in Africa or in South-America, will be used more in our countries.

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