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Hill irrigation in Valais (Swiss Alps). Recent evolution of common-property corporations.

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ABSTRACT

Hill irrigation in the Swiss Alps has a long tradition of more than 700 years, especially in the Rhone Valley (the Canton of Valais) where a network of more than 1400 km of channels was created. Until the 19th century, irrigation was generally limited to the meadows. In the 19th century, it was extended to vineyards and orchards. Since the first decades of the 20th century, in relation to the decrease of mountain agriculture, irrigation has been in regression. Recently, the channels, called locally *bisses*, were integrated into the tourist industry as paths for hiking. This paper aims to analyse the recent evolution (the last 50 years) of irrigation in the Valais and the correlated transformations of common-property irrigation corporations called *consortages*. The analytical framework of the Institutional Resource Regime (IRR), that combines property regimes and public policies analysis, is used. The analysis shows that the social and economic framework has drastically evolved (winter mass tourism, tertiarisation of society, new water uses, especially hydropower production) and that mountain agriculture is in regression. Adaptation of the consortages to the new conditions is very different from case to case. Collective management is globally in regression and new actors (from the tourist sector) are emerging. The interest of tourist circles for the traditional channels has generally stopped their regression. Recently, Switzerland has shown a greater ecological focus for its water and agricultural policies. The correlated new instruments (direct ecological payments) are not always adapted for conserving traditional irrigation practices; explicit protection of the channels is needed and performed through territorial planning policy. The conclusive question is to know if the robustness of irrigation corporations in the Valais observed by various scholars is dependent on the property regime (common-property) or if it is not the result of a long period characterised by rural conditions, agricultural society, weak competition between various water uses and high competition between farmers for irrigation.

1. INTRODUCTION

The Swiss Canton of Valais (fig. 1) is situated in the central part of the Alps. It is drained by the Rhone River, that flows from East to West 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 (fig. 1). On the southern facing lateral valleys, the dry climatic conditions are accentuated by high insulation and evaporation.

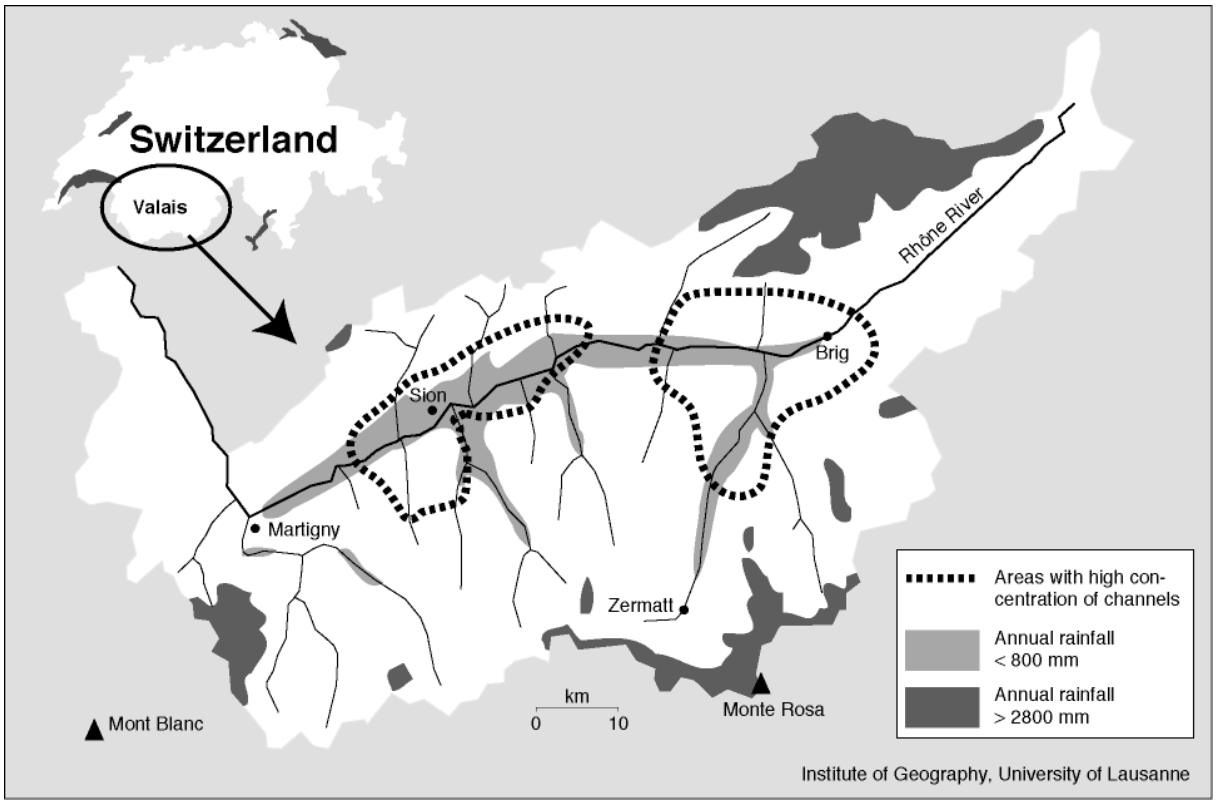

Figure 1 Situation of Valais and principal areas with high concentration of channels.

Because of these climatic conditions, irrigation has been carried out almost since the 13th century (Mariétan 1948, Ammann 1995, Reynard D. 2002). A network of mountain channels that transport water from nival or glacial rivers to cultivated fields was gradually constructed. These channels are called *Bisses* or *Rayes* in the French- speaking part of the valley and *Suonen* in the German-speaking part (Casanova 1995). In this paper, we use the term "bisse" in a generic form. The channels are normally 5 to 10 kilometers long and the longest one is 32 kilometers long. The smaller ones are not more than one kilometer long. The principal channels derive water to secondary and tertiary channels. Sometimes, the channels transport water to small artificial lakes that allow the water to be stocked during the night or on Sundays. The channels are normally cut directly into the valley side (fig. 2); in some sectors, because of the presence of high rock cliffs, wood channels (fig. 2) were constructed along the cliffs (Högl 1995, Bratt 1995). These wood channels are emblematic of the Valais irrigation system, but they are no longer in use and are replaced by galleries. Until the 19th century, irrigation was limited mainly to the meadows. In the 19th century, it was extended to vineyards and orchards. Meadows are irrigated by aspersion or gravitational techniques; only aspersion is used to irrigate orchards and vineyards (Reynard 1995). Micro-irrigation is quite limited. In the main valley (the Rhone alluvial plain), irrigation is carried out by pumping from the phreatic nappe. Since the first decades of the 20th century, in relation with the decrease of mountain agriculture, channel irrigation has been in regression. The bisses network is currently about 600 kilometers long (SAT 1993). It was more than 1400 kilometers long at the end of the 19th century (Rauchenstein 1908:11, Lehmann 1913:43, Papilloud 1999:28). Recently, the channels were integrated into the tourist industry as paths for hiking.

In this paper, we study the recent evolution (the last 50 years) of irrigation in the Valais and the correlated transformations of infrastructures and management institutions. We also analyse the impacts of public policy change, especially agricultural policy, on such evolution. In the next section, the analysis framework is presented. The property rights system of irrigation is analysed in the third part. In the following section, we analyse the recent transformations of social and economic conditions in Valais. The fifth part is dedicated to the analysis of major changes of public policies concerning *bisse* management. We then study the impacts of social and economic change and policy change on *bisse* management institutions. In the last section, a synthesis and some perspectives are elaborated.

Figure 2 Channel cut into the valley side, the Bisse of Ayent (left), and wood channel, the former Bisse of Savièse (right).

2. ANALYTICAL FRAMEWORK: THE INSTITUTIONAL RESOURCE REGIMES

The comprehension of the management organisation of an irrigation system is necessary in order to evaluate its degree of sustainability. Our framework analysis is based on Elinor Ostrom's works on common-pool resource management (Ostrom 1990). In this section, we recall the problem of Tragedy of the Commons. We then present the concept of institutional resource regime (IR).

When Garrett Hardin published his famous paper on the tragedy of the Commons (1968), he argued that his model of unsustainable management could explain management of common-property natural resources such as oceans, air, forests, water, etc. The rapid degradation of this type of resource is due, according to Hardin, to their property characteristics that allow each user to access the resource and to use it freely. Hardin concluded that collective management of such natural resources was not possible and that only privatisation or State control could preserve the resource from degradation. Several scholars, like Netting (1981), Berkes et al. (1989), Feeny et al. (1990), Ostrom (1990), Stevenson (1991) and Becker & Ostrom (1995), then criticised Hardin's model and showed, from multiple case studies, that renewable natural resources like forests, water, meadows, etc. are managed sustainably by endogenic collective self-organised management structures. Numerous irrigation systems in various parts of the world are studied and presented as cases of the robustness of management structures (e.g. Boelens & Dávila 1998, Bruns & Meinzen-Dick 2000, Shivakoti & Ostrom 2002). Swiss mountain irrigation is sometimes presented as an example of a success-story of local management (Netting 1974), as well as alpine meadows management (Netting 1981, Stevenson 1991).

In this type of study on common-pool resources management, it is presupposed that property regime is the main explicative factor of sustainable or unsustainable management. Only the "local scene" is analysed, independently of the general political framework (State political structures, federalist or centralised state, for example), macro-economic tendencies (e.g. globalisation, global markets, etc.) or social changes (modernisation, tertiarisation of society, etc.). Moreover, only one type of resource use (e.g. irrigation) is analysed, independently of the other

complementary or competitive uses of the same resource. For these different reasons, we propose here a larger framework analysis, that we have called Institutional Resource Regime (IRR) (Kissling-Näf &Varone 2000, Knoepfel et al. 2001, Varone et al. 2002).

The IRR concept considers that a renewable natural resource is generally exploited by more than one type of use. Forests are for example used for various wood exploitation (e.g. fire, construction), other material exploitation (e.g. mushrooms, litter, leaves), protection (e.g. against rockslides and avalanches), leisure (e.g. walking) and biodiversity conservation. Water is used for consumption, irrigation, industrial production, energy production, pollutant absorption, support for navigation, fishing or gravel extraction, recreation (e.g. water landscapes such as lakes, glaciers, waterfalls or sport activities), medical uses (mineral and thermal waters), religious uses, reserve against fire and biodiversity conservation (Reynard et al. 2001). Natural resources are therefore defined as the components of the natural system that are used by societies to satisfy their needs (Siebert 1983:2) and it can be considered that they create goods and services for the society. Renewable natural resources are formed by two components: the stock, that is auto-reproduced (e.g. in the case of water, the reproduction is made by the water cycle), and the fruits that are produced by the stock (Ostrom 1990:30f). Goods and services are produced by the stock as well as by the yield (Kissling-Näf & Varone 2000 and fig. 3). Management of such high heterogeneous resource use systems needs efficient institutional regulations and we postulate that sustainability of resource management highly depends on institutional framework. The IRR concept allows the analysis of all the components of such institutional conditions.

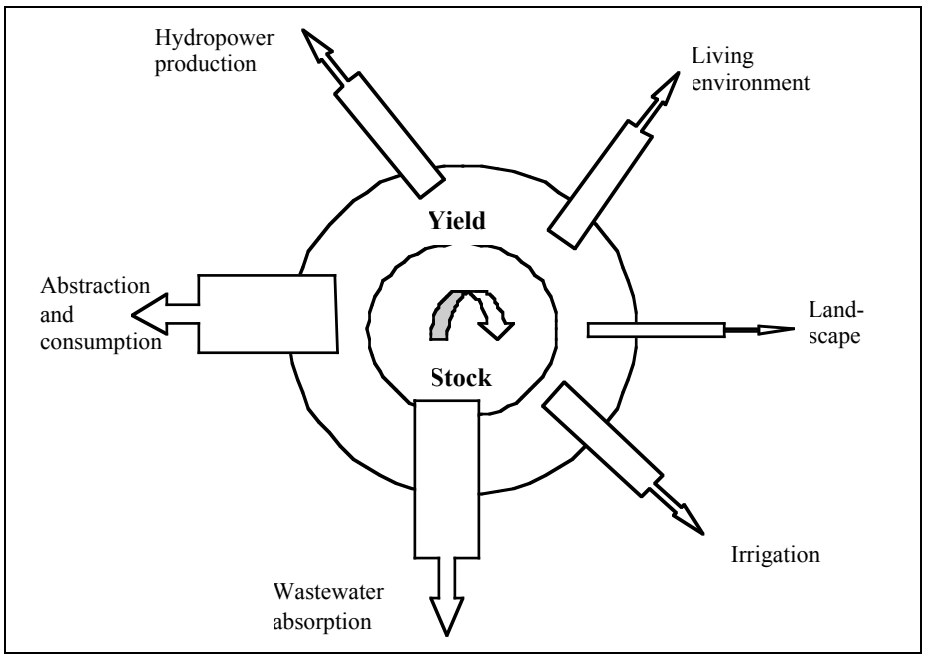

Figure 3 Examples of goods and services produced by the water resource.

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. 2001:35f, 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. Evaluation of public policies is made through the analysis of various components (objectives, causality model, target groups, instruments and actors) of the policy design of such policies (Bussmann et al. 1998). Two complementary dimensions are also considered: the extent and the coherence. The extent describes the numbers of goods and services explicitly regulated by the IRR. The coherence concerns the degree of co-ordination of the actors' network. The IRR are then classified into four regime types: no regime, simple regime, complex regime and integrated regime (Knoepfel et al. 2001:38f). In this paper, the IRR analysis framework is partially used in order to analyse the transformation of the irrigation management institutions in the Valais.

3. PROPERTY REGIME

In Switzerland, water rights are currently regulated by the Swiss Civil Code (SCC) in use since 1912. Property rights on water are based on two principles: the principle of accession (art. 667 SCC), which considers that underground property is linked to soil property (springs and underground water property are therefore linked to soil property) and the principle of state sovereignty, which restricts private property for predominant public interest. The Swiss Civil Code considers therefore that surface water (rivers, lakes, glaciers) are public water (art. 664 SCC) and underground water bodies and springs are private water (art. 704 SCC). In fact, large phreatic water bodies are now considered public water as well. It has to be noted that the civil code did not cancel all the former historical rights and there still exist now several cases of private property of rivers or glaciers, especially in the Alps.

The public property of surface water means that the State can dispose of the water and give concessions (e.g. for energy production), authorisations (e.g. for sport activities), licenses (e.g. for fishing) to users or user groups. Some uses, like bathing, are free. Because of the federalist structure of the Swiss political system, public property is organised on 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 land Lords, 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). Very few channels use spring water. The duration of these use rights is generally unlimited (the so-called *droits perpétuels* in French) and most of these rights were preserved and reallocated when the rivers of Valais began to be used for the production of electricity (end of the 19th century - beginning of the 20th century). Because of the high costs of construction and maintenance, there are nearly no private *bisses*. The channels were therefore constructed by the entire local community or by corporations of farmers called *consortages*. In a same village, various specialised corporations could be created for managing a specific resource (e.g. alpine meadows, forests, dairies, fountains, etc.). Even now, new *consortages* are emerging, for example for irrigating lawns in villa allotments. The relationships between the entire community (the so-called *comunitas*) and the economic corporations during the Middle Age is not well documented. It seems that corporations were created and managed by the richest people of the community (Reynard D. 2002). Irrigation systems could also have been constructed by the local community and more recently by the local administration (municipality). Transfers from common systems to public systems are also documented.

The *consortage* is an example of common-property regime. The members of the association are common owners of the infrastructure and they benefit from rights on the use of the resource (ex. water rights) or on the products of the association (e.g. wood, cheese). In the case of irrigation, the water division and allocation is normally organised into the form of a cycle (the so-called *tour d'eau*). Netting (1974) showed that the allocation was not always equitable. In Valais, 52.5 % of the channels now in use are managed by farmer associations and 42.5 % by local municipalities (state property), and the last 5 % are private *bisses* (Reynard 1995:58). In the case of public management, the municipality is responsible for the capture, the transport and the distribution of water, and for the maintenance of the infrastructures. The farmers are responsible for the maintenance of the networks on their fields and pay a tax for the water allocation, generally based on the surfaces they irrigate. Their decision power is indirect by electing the municipal council and by participating in the local legislative assemblies. In the case of common management by a *consortage*, all the rights and obligations are in the hands of the association's members. The maintaining 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 irrigate. 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 maintaining works, etc.

Ostrom (1990) showed numerous cases of natural resources sustainably managed by this type of common-property system. The reason Hardin's "tragedy of the Commons" is avoided is the presence of precise use rights that allow the exclusion of non-members, strict and precise internal regulations that organise access to the resource and high mutual control that limits practices of free-riding (Ostrom 1990:45, Feeny et al. 1990:11). Numerous case studies of irrigation *consortages* in the Valais show evidence of these features and the long history of these associations. The robustness of the self-organised associations and the sustainability of irrigation water management by farmer corporations and common-property systems is therefore well documented in Valais.

4. SOCIAL AND ECONOMIC TENDENCIES

As outlined above, more than half of the total length of irrigation channels have been abandoned during the 20th century, especially during the period 1920-1970. Moreover, most of the remaining channels were transformed and modernised (replacement of wood channels by galleries, replacement of traditional open channels by concrete tubes, etc.). The reasons for such an evolution are multiple (Reynard & Baud 2002). First of all new engineering techniques (e.g. use of explosives) allowed tunnels to be built to replace dangerous sectors along cliffs. The rapid modernisation of agriculture after the 1950s (increasing productivity needing more water, aspersion needing "pure" water, not charged with sediments, use of chemical fertilisers replacing the natural fertilisation by sediments transported by water) induced use of concrete in order to reduce infiltration and sediment transport. The concurrence of lowland agriculture and the general tendency of farmers to leave agriculture for secondary (chemical and metallurgic industries since the end of the 19th century) and tertiary (tourism and administration since the 1950s) activities provoked a rapid decrease of mountain agriculture and rearing. Intensive building of hydropower dams during the 1940s-1970s also reduced farming activities in the high valleys by reducing labour for agriculture. Entire sectors formerly farmed as meadows are therefore now being replaced by forests. Numerous agricultural surfaces are also replaced by the extension of urbanised areas, especially in the valleys where mass winter tourism is developed. Water needs for irrigation are therefore highly reduced in respect to the last decades of the 19th century. A lot of former water rights of *consortages* members are no longer in use because the owners of these rights do not practice agriculture any more or because the former farmed surfaces are now forested or urbanised.

If water needs for irrigation rapidly decreased during the 20th century, general water exploitation of the watersheds highly increased (Reynard et al. 2001). Domestic water uses increased until the beginning of the 1970s before stabilising. Since the end of the 19th century, nearly all the major watersheds, and especially the ones highly covered in glaciers, were progressively exploited by the electrical industry. Several private companies obtained concessions from the communes (generally for a duration of 80 years) for the exploitation of hydropower. Natural discharge of the rivers was therefore highly reduced (frequently in the order of more than 80 %). More recently, since the 1980s, water is also used for artificial snowmaking. At the same time, the tourist industry, formerly oriented mainly to winter activities (skiing), is now trying to diversify the offer, principally by proposing estate tourism based on walking and "green" natural activities. Demand for preserved natural landscapes, for example " hydrologic" landscapes like natural lakes, rivers with high discharge, waterfalls, etc., is increasing. There is therefore now a high competition between different water uses that can provoke conflicts, especially in tourist areas (e.g. Reynard 2000, 2001) and in watersheds with a high range of goods and services produced by the water resource (Reynard et al. 2001).

A third tendency has been observed since the beginning of the 1980s: the tourist use of the irrigation channels (Reynard 1998, Reynard & Baud 2002). Numerous paths boarding the bisses for their maintenance are now used for hiking and integrated in the official walking paths network managed by the communes and the Canton. Various sectors with former wood channels are also renovated (e.g. Bisse d'Ayent, Reynard 2002a). Some channels no longer in use are reconstructed and refilled with water, sometimes only for tourist purposes. In several places, pedagogic boards are installed along the channels and numerous guides and booklets are edited by tourist offices or other organisations. In the inventory of the Cantonal Territorial Survey Office (SAT 1993), 50 % of the 190 listed channels have only an agricultural function, 37 % have an agricultural and tourist function, 8 % have only a tourist function and 5 % have no function any more (Reynard 1995:58). The local population also seems to be rediscovering the patrimonial value of the network and local conferences on the theme of bisses always attract a large public. The bisses may therefore not only be considered as pure agricultural infrastructures but as multi-functional objects at the interface of agriculture, culture and tourism (Reynard 1997). It is to be noted that this tendency towards the multi-functionality of the channels does not exist in other channel-irrigated regions of the Alps, like the Aosta Valley (Italy) or the French Alps.

5. PUBLIC POLICIES

The current multi-functionality of the *bisses* induces that the management of the channels is now concerned with three groups of public policies: water policy, agricultural policy, and tourist, nature conservation and territorial management policies. In this section, we rapidly analyse the recent transformations of these three groups of policies and their impacts on the channel management.

There is not one water act in Switzerland but numerous legislative texts, which are the result of a complex legislative history that began at the end of the 19th century and that can be summarised in four stages (Reynard et al. 2001:118f) : (1) the last decades of the 19th century developed a policy of protection against floods provoked by large deforestation in the mountainous watersheds of the country; (2) since 1908, the central State has been regulating the hydropower production (Law on the Use of Water Power, 1916); (3) since the 1950s, a sophisticated policy has been developed to fight against water pollution; (4) in 1991 a new Water Protection Act was adopted, that aims to protect the quantitative, qualitative and dynamic natural features of water resources. The main innovation of this law is the adoption of the principle of residual minimal flows in rivers exploited by hydropower industry or irrigation. In 1991 as well, a new River Act was adopted, that introduced the principle of revitalisation of rivers in order to reconstruct the natural hydrological processes.

The agricultural policy changed its objectives at the beginning of the 1990s, as well. From World War II, agricultural policy has followed three main objectives (Sciarini & Von Holzen 1995) : (1) insuring the food security for the country (strategic function), (2) producing in the interest of the national economy (economic function) and (3) insuring a decentralised occupation of the country by maintaining the rural population in the campaigns (social function) (Agricultural Act, 1951). The 7th Report on the Agriculture (1992) is a turning point in the agricultural policy development in Switzerland and introduces a new objective for Swiss agriculture : the protection of nature and landscape. The objectives of the agricultural policy are now the insurance of food security (strategic function), the production in relation to the market demands (economic function), the conservation and sustainable use of natural resources (ecological function), the management of rural landscapes (tourist and landscape function) and the decentralised occupation of the Swiss territory (social function) (Agricultural Act, 1999). The main instruments of the new policy are the ecological direct payments, that aim to pay the indirect services offered by the farmers to the whole society (landscape and nature management) and therefore to complete the direct revenues coming from food production. These direct payments are provided by the Confederation and by the Cantons and 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 (terrace cultures) that still play an important function in rural landscapes and nature conservation. The Canton of Valais policies are now trying to develop direct ecological payments for this type of infrastructure as well. A traditional instrument that was introduced by the agricultural policy in 1951 is the 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 galleries or concrete channels. Until the 1980s the policies of the agricultural cantonal administration was to improve the productivity of the bisses without any consideration for tourist or patrimonial aspects. Since then, technical improvements that respect historical and natural features of the infrastructures are used.

The *bisses* are also concerned by the tourist policy because of their use as hiking paths. The bisses can also obtain subsidies in relation with the cantonal Nature and Landscape Conservation Act (1998) for their patrimonial and historical interest. In the same order, they are considered in the cantonal Territorial Management Act (1987) as object to being preserved.

The recent transformations of the social and economic framework, shown in chapter 4, and the new ecological objectives of various public policies, presented in this section, have great impacts on the functioning of the irrigation corporations and on the structure of the actors' networks interested with the bisses management and conservation. These impacts are analysed in the next chapter.

6. OLD AND NEW ACTORS OF BISSES MANAGEMENT

Irrigation *consortages* are highly concerned by social, economic and policy change. As these changes are spatially differenciated, *consortage* transformations are differenciated as well. The aim of this chapter is to analyse how the *consortages* react to outside impacts and how their internal characteristics transform. The analysis is based on the results of various case studies (Crettol 1998, Reynard 2000, Reynard & Baud 2002, Reynard 2002a).

Two tendencies can be shown. Some corporations conserve a high dynamism. Their internal structure (committee, specialised functions) is conserved and they finance their activities (maintaining, technical investments, tourist valorisation) without any problems. Part of the financial income sometimes comes from the hydropower industry that buys water no longer used for irrigation because of the decreasing agricultural needs

and that is preserved as former water rights in the hydropower concession acts. In the case of tourist investments, these corporations promote the valorisation themselves, like the Consortage d'Ayent (Reynard 2002a). Other corporations, often situated in tourist or suburban areas, have a lot of functioning difficulties. Because of agriculture reduction and urbanisation, the consorts do not participate in the consortages' activities any more. Very often, the committee is composed of old farmers that have difficulties being replaced by younger ones. The assemblies are sometimes patronised by less than ten members. There is also a reduction of the "official" functions in the consortage and sometimes the committee is composed of only one or two persons. Because of the effective water rights reduction, these corporations often have financial difficulties. Because of low dynamism of the committee, these consortages often do not ask for subsidies for patrimonial conservation. Some *consortages* are not associated with tourist or patrimonial projects. The maintenance of the infrastructures is also being reduced, which means that potential risks induced by channel breaking increase. This problem is even more acute where the channels cross urbanised areas. The consequence is a difficulty in taking out insurance (Crettol 1998) and the problem of the responsibility of the committee, and especially of the president, in case of flooding induced by channel degradation. Most of these *consortages* are now trying to be dissolved and to transfer their infrastructures to public administrations. This is clearly a tendency to a transfer from common-property management to public management.

Disposition rights on Swiss Alps rivers were highly transformed when the Hydropower Act (1916) precisely organised the concession of water to hydropower companies. Preservation of former water rights for irrigation was clearly mentioned. That means that in the concession acts, irrigation water rights are preserved, and generally quantitatively calculated. As irrigation needs are now lower than the discharge conserved for irrigation, some corporations sell the water surplus to the electrical companies (e.g. Bisse d'Ayent, Reynard 2002a) and therefore receive interesting financial incomes. Other consortages concede water free to the hydropower companies.

Because of a general decrease in mountain agriculture, the conflicts between consortages occupying the same watershed, that were very common in the past centuries (SHVR 1995), are now very scarce. Several scholars (e.g. Lehmann 1913, Mariétan 1948, Netting 1974, etc.) described very precisely the sophisticated internal regulations that organised water rights distribution between the members and the water allocation (irrigation cycles). These regulations are now often no longer in use. Water access is very often free. Exclusion of non-members is also beginning to disappear, and non-members can often use the channel water freely, as was shown in the Ayent area (Reynard 2002a). Selling water rights to non-members is possible, as well. In the past, such a practice was forbidden. In some valleys, irrigation water use is completely free (e.g. Bagnes Valley) and infrastructure maintenance is paid by the whole population (Reynard 2002b). The argument is that irrigation participates in the maintenance of meadows and indirectly to rural landscape conservation: it is therefore logical that this service is paid to the farmers by all of the inhabitants of the valley.

Patrimonial and tourist valorisation of the *bisses* induce an enlargement of the actors network (Reynard 1998). Until the 1970s, three groups of actors were concerned by the *bisses* management: the consortages, the local administration and the cantonal agriculture administration (for technical support and subsidies). The new interest for patrimonial conservation and tourist valorisation of the channels has enlarged the circles of actors interested by *bisse* management. At the local level, new actors are emerging from the tourist industry (e.g. tourist offices) or simply from society (e.g. associations for patrimonial conservation, association for the conservation of one particular *bisse*, etc.). Very often, these new circles are animated by one or two strong individualities that promote the conservation and valorisation of the channels. Sometimes, their actions are not co-ordinated with the *consortages* that manage the channels.

7. CONCLUSIONS AND PERSPECTIVES

This rapid presentation of the recent evolution of the *bisses consortages* of Valais show a very high diversity of situations. Some corporations are dynamic and their financial situation is good. They promote the irrigation improvements themselves and the tourist valorisation. Other associations are losing speed. Their internal structures are weak and they have an unhealthy financial situation. They often do not promote the tourist valorisation of their infrastructures and other specialised associations are emerging. The public policies concerning the *bisses* management have diversified. The general evolution of the social and economic framework is towards a decrease in mountain agriculture and to a tertiarisation of the society. The tourism sector is diversifying its offer, by promoting estate activities. The analysis showed however that *consortages* situated in tourist sectors and suburban areas have more difficulties than corporations acting in more rural regions, because

of progressive disinterest of their members for agricultural activities and progressive reduction of effective water rights. The principal transformations are presented in the table in figure 4.

Characteristics	**Situation in 1950**	**Situation in 2000**
Social and economic framework	Regression of mountain agriculture. Lowland agriculture (Rhone valley). Tendency towards a tertiarisation of society (emerging winter tourism). Construction of large hydropower dams.	High tertiarisation of society. Full-time agriculture occupied only by 3.5 % of the active population. Tourism is diversifying the estate offer. Political willingness to promote sustainable development of the Canton of Valais.
Irrigation infrastructures	Tendency to abandon or technical transformations (concrete tubes, galleries). New irrigation sectors in vineyards.	Conservation of traditional channels. New channels are very rare.
Irrigation	Transfer from gravitational techniques to aspersion, especially in vineyards and orchards.	Transfer from gravitational techniques to aspersion, in the meadows as well. Reduction of vineyard irrigation.
Institutions	*Consortages* and local administrations.	*Consortages* and local administrations. Tendency: transfers from consortages to local administrations.
Property regime	Corporations' water rights to rivers preserved in the concession acts for hydropower production. Strict internal regulation of the *consortages* is evolving. Regulated access to water (irrigation cycles).	Corporations' water rights still in use but not always effectively recognised. Internal regulation often weak or non-existent. Tendency to free access to water.
Public policies	Bisse management concerned by water and agricultural policies. Hydropower policy recognised the former water rights of the irrigation corporations. Agricultural policy: subsidies for technical improvements to irrigation systems.	Greater ecological focus in water and agricultural policies. Enlargement of public policies concerned by channel management. New subsidies for the preservation of patrimonial aspects of the channels and for their tourist valorisation. No subsidies for their landscape conservation function in the sense of agricultural policy.
Actors network	*Consortages*, local municipalities, cantonal agricultural office	Enlargement of the actors network: tourist industry, local society, other cantonal and federal administrations (tourism, environment).
Consortages	Corporations generally well organised. Some consortages no longer exist because of channel abandon.	Differenciated evolution of the consortages. Some conserve their dynamism; others are losing speed.

Figure 4 Principal transformations of irrigation and channels management in Valais (1950-2000)

The question is now to know if the robustness of the irrigation corporations of Valais, that are sometimes five to six centuries years old, is intrinsec to their common-property characteristic or if other reasons to their long-term activity have to be found. The answer is varied. Several *consortages* are very old and it is certainly a sign of a certain robustness or almost a capacity to adapt to changes. The consortages are also models of participation management (cf. Ostrom 1992). But, this paper shows that internal pressure (competition between irrigators, mutual control), that is one reason for the efficient functioning of such corporations (Ostrom 1992), is hardly decreasing. On the other hand, external pressure (increasing water demand for new uses like drinking water, hydropower production, artificial snowmaking) is increasing. The consequence is that several *consortages* are weakening and some have almost disappeared. One could therefore ask if *consortage* robustness is not intrinsec to the property regime, but a consequence of favourable external conditions like a non-globalised economic context, based on agricultural production, and the absence of interventionism of the central state. Current decrease of common-property management of irrigation in Valais would then be explained by new economic conditions, characterised by a high tertiarisation, globalisation of the food markets, transformation of agriculture objectives, transformations of the channel functions (new tourist uses) and apparition of new actor groups. Only the *consortages* that are situated in areas with high agricultural activity or the *consortages* that can adapt to the new economic conditions (new types of subventions for ecological agriculture, financing of tourist services, etc.) will survive.

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