CRANS-MONTANA: WATER RESOURCES MANAGEMENT IN AN ALPINE TOURIST RESORT

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Abstract: Water is a key element of services supplied by Crans-Montana. It is part of the landscape and is the physical base for sport activities in its various forms (water, snow, ice). Because of the high concentration of tourist activities at this Swiss alpine resort during certain seasons—and the multiple uses of water in tourism—problems of supply sometimes emerge. When this is the case, the uses of this resource for tourism enter into competition with other types of water uses (drinking water for the resident population, irrigation, and hydroelectric production). Recent studies show that current water problems in the Crans-Montana resort are not due to water scarcity per se, but are the result of dysfunctional management. Decision makers are increasingly conscious of the need to better manage this resource. The challenge is to find how to connect "traditional" knowledge with "modern" techniques about water use and management.

Keywords: tourist uses of water, water policy, water management

1. INTRODUCTION

In spite of its particularities, the case of Crans-Montana is similar to many other situations one can find in the tourist areas of the Alps. This article details the kinds of problems that can arise in alpine tourist resorts regarding water supply and water management.[1]

[1] Data for this chapter come from two main sources: Reynard (2000a) and Clivaz (1995).

E. Wiegandt (ed.), Mountains: Sources of Water, Sources of Knowledge, 103–119.

After presenting the main characteristics and history of tourist development in Crans-Montana, we will discuss successively the tourist uses of water, the increasing competition between rival uses, the institutional regulation of water management, and the characteristics of current management of water in the resort. In conclusion, we will propose new models for improving water management that are currently being tested in the resort.

2. CRANS-MONTANA: FROM SOME "MAYENS"[2] TO A MOUNTAIN TOWN

2.1. History

Crans-Montana is a tourist resort located in the French speaking part of the canton of Valais, in south-western Switzerland (cf. Figure 1). Located on a plateau 1,500 m a.s.l.,[3] it offers an exceptional view over some of the most beautiful 4,000 m summits of the Alps, in particular the Matterhorn and Mont-Blanc. It also has an excellent climate compared to other alpine regions (good sunshine, low rainfall, and mild temperatures), which helps explain the rise in tourism there. Although today 40,000 tourists spend Christmas and New Year holidays in this famous resort, there were not any permanent inhabitants until 1892, when the first hotel was built. During the past century, the tourist development of Crans-Montana has been impressive.

Historically, golfing and skiing have been the main activities that contributed to the development of the Swiss High Plateau. In 1908, Crans-Montana inaugurated the highest 18-hole golf course in the world; three years later, one of the first genuine downhill events in the history of skiing, the Earl Robert of Kandahar Challenge Cup, was held. In 1939, the First Swiss Golf Open took place in the resort, which later became the European Masters of Golf. In 1987, Crans-Montana also hosted the World Alpine Ski Championships. Apart from these sport activities, the development of Crans-Montana was also marked by health tourism (notably for convalescence and treatment). Since the 1960s and the discovery of a cure for tuberculosis, the importance of health tourism quickly decreased, although

[2] The "mayens" are the huts and agricultural buildings located in the alpine pastures used in the Valais region for spring and autumn grazing.

[3] This geographical location explains why Crans-Montana is also called the "High Plateau."

it still exists to a limited extent today. In the 1970s, a new ski resort, Aminona, was built in the eastern part of the Plateau (Figure 1).

The growth of the resort of Crans-Montana, which accelerated after World War II with the rapid development of the ski industry, enabled the local population to find employment and wages without leaving their homes. However, it also generated serious problems, the effects of which are still felt today. Examples include dispersed buildings that lack architectural unity (Coppey et al. 1986; Antonietti 1993); a completely saturated road network at peak hours; air and noise pollution; social tensions between hosts and inhabitants; reduction in the profitability of the investments; and, most important for this book, water pollution and frequent water crises due to shortages (Reynard 2000b, pp. 71–72). The problems that arise from the daily activities of a mountain resort put the survival of the tourist system itself in danger. The environment has not only been damaged in its visible aspect (destruction of the landscape), but also in terms of its ability to supply natural resources, such as water, necessary to the resort (Clivaz 1995, p. 34).

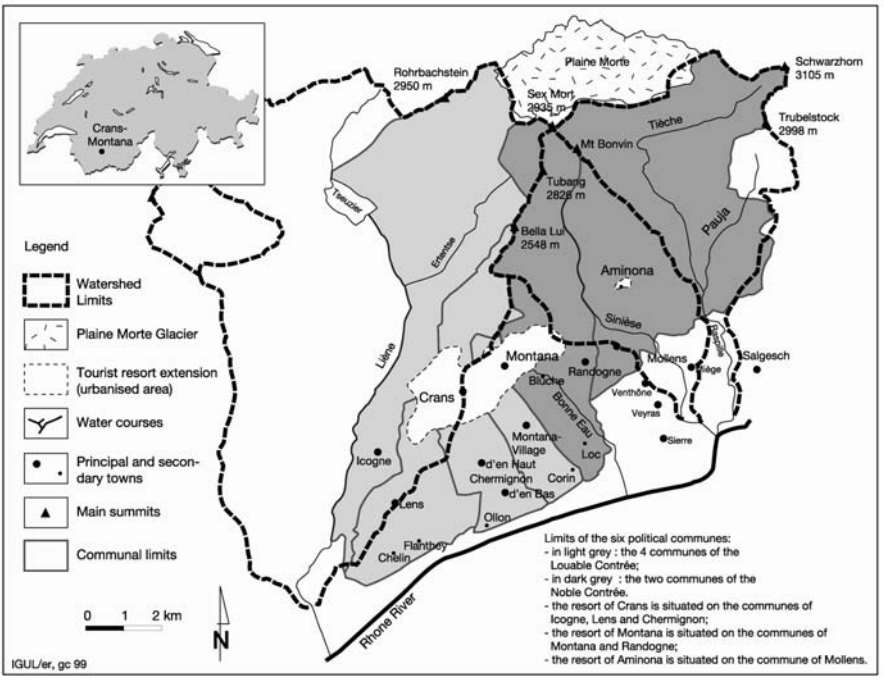

Figure 1: Location of Crans-Montana and Political Division of the Area in Six Municipalities.

To these observations, which could easily be applied to other tourist areas (see Cognat 1973), one can add a specific characteristic, which concerns Crans-Montana: the extension of the resort over six different municipalities, stretching from lowland areas (500 m a.s.l.) to the mountains (3,000 m a.s.l.) (Figure 1). Currently the resident population of these municipalities (Icogne, Lens, Chermignon, Montana, Randogne, and Mollens) is about 13,000 inhabitants, with one half living directly in the resort, and the other half in the surrounding villages on the slope. Following the development of the resort, the population of the six municipalities quadrupled in one century. The fact that there are six municipalities for one resort inevitably brings problems of coordination among the municipalities and complications in development planning, from the economic, social, and environmental points of view (Clivaz 1995, p. 35). Economic stratification is also a problem, with agriculture and industrial activities concentrated mainly in the villages situated below 1,200 m, and tourism located in the high mountainous areas. This stratification has created political tensions between the tourist area and the surrounding villages since the beginning of tourist development.

2.2. Tourism Supply and Demand

When speaking about the tourism industry, we sometimes forget to speak about the original sources of attraction, which include many factors that have no direct relationship with tourism, but which become tourist objects because of their force of attraction (Müller et al. 1993, p. 104). Among these factors, one can distinguish (Clivaz 2001, p. 105):

- *natural factors*: these factors (climate, landscape, fauna, flora, air, water), which often constitute the basic capital of tourism, are characterized by the fact that they are not created by man and that the latter can generally at best only preserve them;
- *cultural factors*: all that is included in the notion of "culture" (traditions, habits, mentality, hospitality) as well as the constructed heritage play a significant role in the attraction of a tourist area;
- *general infrastructure*: this groups together the facilities that enable the development of multiple socioeconomic activities, namely the infrastructure for transport (public and private), supplies (water,

energy, telecommunication), disposal (waste water, refuse), as well as the installations required to meet daily needs (stores, hospitals, etc.).

In the Alps, natural factors are fundamental to tourist development. This is particularly true for Crans-Montana. As mentioned earlier, this resort, in comparison to other tourist areas, enjoys an above-average amount of sunshine and a beautiful panoramic view over the Penninic Alps. The fact that Crans-Montana is located on a plateau also greatly facilitated the construction of the tourist buildings, as there were practically no physical obstacles to the multiplication of the latter. As part of the natural factors, water is a key element of the original supply. We will see in the next section that numerous tourist uses of water developed in Crans-Montana during the twentieth century.

To the original features that attract tourists we must add the derived supply, which is composed of all the facilities and services set up with the specific aim of satisfying tourists.[4] This includes 46 hotels (totaling 3,600 beds), 7,000 chalets and apartments (totaling 34,600 beds, of which only one third are rented beds), three international schools, 28 ski lifts, three golf courses (one 18-hole course and two 9-hole courses), many other sports facilities for walking, cross-country skiing, tobogganing, ice-skating, curling, mountain biking, running, tennis, swimming, etc. The derived supply also requires water for a great quantity of uses (golf course irrigation, artificial snowmaking, ice production for skating, etc.).

Tourist demand can be measured in terms of the number of overnight stays, which is about 1.5 million a year. Swiss people are the main clientele of the resort (54.7 percent) followed by French (9.5 percent), Italian (8.7 percent), German (7.5 percent), Dutch (5.3 percent), Belgian (4.6 percent), British (3 percent), and people from other countries (6.7 percent) (Crans-Montana Tourism 2004: 25). As shown in Figure 2, most of the overnight stays concern the chalets and apartments sector (56.6 percent) and only 23.5 percent concern the hotel sector, which can easily be explained by the fact that there are 10 times more beds in the first sector than in the second one. It is worth noting that Crans-Montana also counts on an important number of overnight stays at the international schools and the convalescence homes and clinics.

[4] To have a comprehensive view of the derived supply in Crans-Montana, see the website http://www.crans-montana.ch.

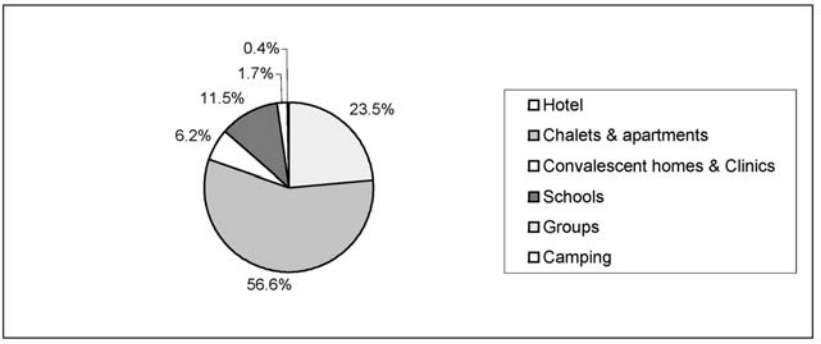

Figure 2: Distribution of Overnight Stays by Accommodation Type (2003) (Crans-Montana Tourisme 2004, p. 25).

If we look at the evolution of the overnight stays in the resort during the last decade (Figure 3), we observe a rapid decrease in the middle of the 1990s (a loss of 270,000 overnight stays between 1993 and 1996, or a decrease of 16 percent) and then a period of stagnation in demand. This means that the High Plateau today is facing the challenge of finding a way of restoring the level of overnight stays it had 10 years ago. Various measures regarding issues like destination management, the use of information and communication technologies for reservations, and better collaboration between the tourist partners were taken recently.

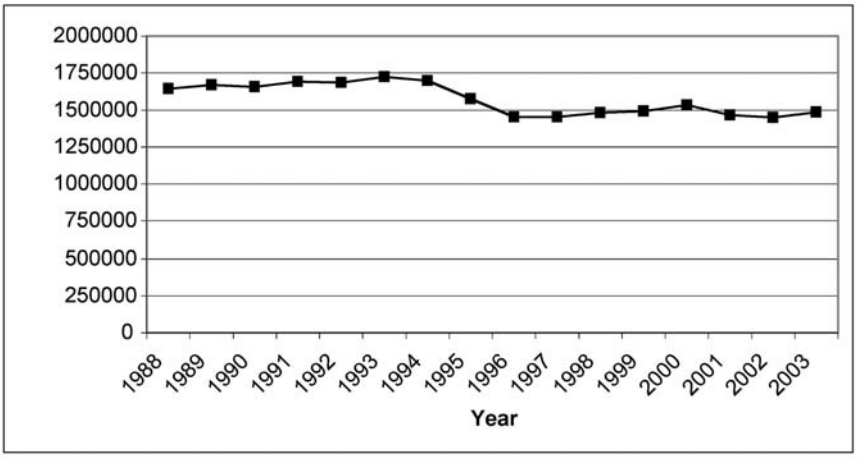

Figure 3: Evolution of the Number of Overnight Stays in the Last 15 Years (Crans-Montana Tourism 2004, p. 25).

3. TOURISM AND WATER MANAGEMENT

3.1. Tourist Uses of Water and Competition with Other Uses

This short overview shows that almost all tourist-related facilities need water in one way or another in order to function. Water is thus not only a key element of the original supply as part of the landscape or drinking water, but also a key element of the derived supply, above all as a physical base for sports activities in its various forms (water, snow, ice). Water was part of the summer tourist supply since the beginning of the tourist development in Crans-Montana and became a central element of the winter supply with the advent of skiing. Other types of tourist activities or infrastructures based on water also appeared, such as swimming pools and skating rinks, installations of artificial snowmaking, and the use of the paths along the "bisses"[5] for hiking. Additional projects of valorization of water are currently under way in the field of hydrotherapy.

While, on the whole, the tourist uses of water on the High Plateau are not very different from the ones existing in other alpine resorts, the Crans-Montana area also includes a unique atmosphere due to the presence of many lakes inside the resort itself. In this sense, the image of Crans-Montana used for tourist promotion is closely linked not only with mountains and snow, but also with lakes and water.[6]

At the same time, tourist uses of water are also linked to environmental problems, whether they are found in the High Plateau or more generally in the tourist resorts of the Alps (Clivaz 2001, pp. 115–116). Tourism contributes to an amplification of water pollution, which constitutes a difficult problem in the alpine areas where the sources are very sensitive and the capacity of regeneration of polluted water particularly weak. Moreover, this alpine water pollution has repercussions for the whole irrigation basin, thereby affecting most of the European continent. In a more specific way, the leveling or clearings undertaken in the skiing areas also have harmful consequences for the hydrological regime by supporting increased flows and an increase in erosion (Département fédéral de l'intérieur 1991, p. 25). As in other urban areas, soils are

[5] The "bisses" are mountain channels that transport water from nival or glacial rivers to cultivated fields (Société d'histoire du Valais romand, SHVR 1995).

[6] For instance, the cover page of the annual report 2001 of Crans-Montana Tourism represents a lake (Crans-Montana Tourisme 2002).

becoming much more impervious because of rapid urbanization linked to tourist development. Such imperviousness may create floods during periods of intense precipitation or during the snow melting period. These are only a few examples of the concrete implications of tourist development for water resources.

But tourism can also have other consequences for water use, particularly in the form of competition with other uses. As in the Alps in general, water is relatively plentiful in Crans-Montana (Reynard 2000a, pp. 119–179). Mean annual rainfall is about 1,000 mm at 1,500 m and 2,500–3,000 mm at 3,000 m. Evapotranspiration is about 500 mm at 1,500 m, and the available water resource is estimated to be about 100 million m^3 (Reynard 2000a, p. 148). However, because of the concentration of tourist activities in space and time and the multiple uses of water in tourism, problems of supply sometimes appear (Reynard 2000a, p. 3). When this is the case, the uses of this resource for tourism enter in competition with other types of water uses, in particular the supply of drinking water for the resident population, irrigation, and hydroelectric production. For example, during the European Masters Golf tournament, some lakes cannot be used for irrigation because they need to remain full for visual reasons. At the beginning of winter, intensive use of water for artificial snowmaking can be in competition with the drinking water supply, thereby drastically reducing the natural flow of some small water streams.

3.2. Institutional Regulation of Water Management

The Swiss political system, characterized by direct democracy and a federalist structure, imposes a three tier natural resource management structure, particularly for water management: the Confederation, the cantons, and the local municipalities (Varone et al. 2002, p. 86). Due to the historical development of the country, state affairs mostly remained in the hands of cantons until the end of the nineteenth century. Since then, tasks have been increasingly concentrated at the federal level, but the application of most public policies regulated by the Confederation is assigned to the cantons, often with considerable room for maneuver (Varone et al. 2002, p. 86). In the canton of Valais, local municipalities also have great independence.

Since the adoption of the Swiss Civil Code (SCC) in 1912, surface water, including lakes, rivers, and glaciers, are property of the state and ground water and springs are private property (Reynard et al. 2001). In Valais, the state property of water is in the hands of the local municipalities, except the Rhone River, which is the property of the canton. Many

municipalities are also private owners of springs. That means that at the local level most of the water has assigned property rights and, as such, is managed by local municipalities.

Concerning the regulation of water uses and water problems, there is no general law governing water resources in Switzerland. Three general responsibilities have guided development of Swiss water-related policies (Reynard et al. 2001, pp. 118–126; Varone et al. 2002, pp. 89–90): the protection against water hazards, water exploitation (for hydroelectric production), and protection of water. The policies regulating protection against floods and erosion are very old (Federal Law on the Hydraulic Engineering Police of 1877) and the regulation is centralized at the federal level. The Federal Law on the Use of Water Power was adopted in 1916 in order to improve electricity production and supply. Hydroelectricity production is based on the system of "water concessions," which means that the owners of surface water give a concession to a hydropower company for a period—generally 80 years—against the payment of an annual fee (hydraulic fee). In Valais, most of the lateral rivers were therefore conceded to hydropower companies.

Such was the case of the Liène River in the 1940s: the concession was given by the communes of Ayent and Icogne to the Lienne SA company, which built the Tseuzier dam (capacity 50 million m^3) between 1952 and 1957. The concession will remain in force until 2037. At the time when the concession's act was signed, the main use of river water was for irrigation by communities, which had had use rights since the Middle Ages (Reynard 2002). These ancient water rights were therefore preserved. On the other hand, water used for drinking water at the time came only from spring water. For this reason, no right for the use of drinking water was written into the concession acts. Two decades later, because of the rapid development of the tourist resort, spring water was no longer sufficient to cover all the needs, especially during peak use in winter and summer. Some municipalities were reduced to buying a part of water ceded to the hydropower companies at a price much higher than the hydraulic fee (Reynard 2000a, p. 287).

The third group of water policies in Switzerland concerns the protection of the hydrosystem. Since the 1950s, the Confederation has developed a large number of technical regulations aimed at improving protection against pollution. Implementation of the Federal Laws is the responsibility of the cantons. Because of the large communal autonomy and the low financial capacity of the canton, the Canton of Valais had many difficulties in applying the federal legislation. More than 30 years after the adoption of the Federal Law against Pollution (1971), which introduced the obligation to connect the entire population to water

treatment plants, several communities continue to eject effluents directly in the ecosystems without any treatment. That is not the case in Crans-Montana, where the whole population is connected to two treatment plants in the Rhone Valley, a thousand meters below. This solution resolves problems related to the rapid and seasonal population changes and to altitude (low productivity of treatment plants).

Drinking water supply is not regulated at the federal or the cantonal level. It is the task of the local municipalities to supply the entire population, including tourists and permanent residents, with sufficient water of good quality. For climatic reasons, irrigation is not, contrary to other countries, a major user of water in Switzerland; water use for irrigation is therefore very poorly regulated at the federal level. The only region where an irrigation system was developed is in the Valais because of the relative dryness of the climate (SHVR 1995). Here, irrigation networks, which gradually developed since the Middle Ages, are managed by local municipalities or by user communities, called locally "consortages," which have perpetual water rights on some rivers.

3.3. Current Water Management in the Resort

Current water management in the area is highly influenced by the institutional framework (water rights, water policies, Swiss political system) and by local factors (natural factors, political division in six municipalities, history of the region, and low cooperation between local actors).

Federal and cantonal regulations principally concern the use of water for hydroelectric production, the fight against water pollution and the management of hydrologic dangers. Drinking water supply and irrigation, on the other hand, are mainly regulated by decisions taken by the municipalities or by irrigators' associations. As most of the current water problems concern the drinking water supply, we concentrate our analysis on this use.

Drinking water is supplied independently by the six municipalities. The organization of the water network is influenced by the historical development of these communities. Since the Middle Ages, the four communities of the western part of the region were organized in a "Great Bourgeoisie" group called "Grand Lens" or "Louable Contrée" (Figure 1), which can be viewed as a federation of communities. Each section had some powers but there was no overarching central power. In 1802, the new Republic of Valais imposed a centralized power structure, which gave rise to conflicts between the four sections. In 1851, with the adoption of the

cantonal law on the communal regime, a distinction was introduced between the municipal commune (or municipality) and the burger commune (run by the "bourgeoisie"). The former is composed of all the residents of the commune, whereas the latter is composed only of people that have their family origin in the commune. With this political transformation, the four sections were fused into one municipality. In 1904, after half a century of political tension, the commune was divided into the four current municipalities. With the division, some collective resources remained undivided, especially alpine meadows, forests, and some springs and water infrastructures. This explains why some springs are currently the property of the four municipalities and that the annual flows are divided with complex repartition schemes. On the eastern side of the plateau, the communes of Randogne and Mollens were also part, along with other communities, of a bourgeoisie group ("Grande Bourgeoisie de la Noble Contrée"). That might explain why most of the springs, which are property of Randogne, are situated on the territorial perimeter of Mollens (Putz 2003).

Until World War II, only spring water was used for water supply. With the rapid extension of the resort during the 1950s and 1960s, the groundwater resources were no longer sufficient and, in 1969, the municipalities of Lens and Randogne faced a severe water crisis. Both municipalities took urgent measures. Lens constructed a pipe several kilometers long for transporting water from the Tseuzier dam to the resort through a tunnel built in 1946 for irrigation purposes. Randogne also constructed a long pipeline from the Raspille River to the eastern part of the resort. Because of the peculiar distribution of property rights on this river, the result of a Bishop's decision made in 1490 and still in use, water use depends on the consent of all other territorial communities of the watershed (Reynard 2000b, p. 72). In this instance, the municipality faced the opposition of the community of Salquenen, situated at the confluence of the river with the Rhone river, and was forced to pay an annual fee of CHF 30,000 (indexed to the living costs) (Figure 4). This is just one example of the recurrent conflicts over water rights and water allocation that have confronted several municipalities over the last 40 years (Reynard 2000a).

Reliance on surface water to meet increased demand required the construction of drinking-water treatment plants by both municipalities. Some years later, the communes of Montana and Chermignon also faced water scarcity and had to build their own water treatment plants, as they were not allowed access to the Randogne and Lens constructions. The evolution of new water needs and the absence of planning and cooperation among the various municipalities help explain the presence of four treatment plants in a small area. In 2001, the municipality of Lens renewed its 30-year-old plant and asked, without success, for the financial

participation of the other municipalities in order to build a new collective plant. In the summer of 2002, the community of Chermignon renewed its own plant, situated less than 1 km from the Lens plant. This example is emblematic of the absence of global planning related to the construction of water infrastructures. It also highlights the absence of cooperation between the local municipalities, even though an intercommunal commission for water problems had been instituted in 1989. This commission does not play a key role in water-supply planning or water-use coordination, and all the important political decisions are taken at the communal level (Reynard 2000b, p. 71).

The absence of cooperation among local municipalities is illustrated by the "water market" that exists between the various political entities of the region (Figure 4). In fact, the distribution of water resources in the region is very heterogeneous (Figure 1). From a hydrological point of view, the High Plateau is divided into two main watersheds: the two main rivers, the Liène (in the west), and the Raspille (in the east). These are separated by a small catchment with very poor water resources that is the location of most of the tourist resorts and urbanized areas. This natural division explains why the municipalities rich in water resources are the communes of Icogne and Mollens, situated respectively in the Liène and Raspille watersheds at both extremities of the resort. The four most populated communes in the central part of the resort, which also face great peaks of demand during the high season, have fewer available resources. This explains the water market that developed between the various municipalities in a region that, by and large, had not faced any problem of water scarcity until recently.

These are some of the numerous cases of water competition, relative water scarcity, and water conflicts that were analyzed in the area (Reynard 2000a). Water problems in the Crans-Montana resort can be classified into three categories (Reynard 2000b, pp. 76–78; Reynard 2001a, pp. 13–14): sectoral problems that affect one type of water use (e.g., the absence of infrastructure planning for drinking water supply), intersectoral problems that affect the coordination between two or more water uses (e.g., coordination of the supply for artificial snowmaking and drinking water in early winter), and territorial problems, which are due to the absence of cooperation between the various municipalities.

In conclusion, it appears that current water problems in the Crans-Montana resort are not due to water scarcity, but are the result of dysfunctional management. This mainly includes the absence of cooperation among local municipalities, absence of planning, absence of an integrated local water policy, poor knowledge of water resource availability and water needs, and absence of cooperation between the various actors of

water management in the area. The result is that water "management" is much more of an accumulation of various unconnected actions than it is a coordinated management plan. As such, water management in the High Plateau cannot be considered to be either integrated or sustainable (Reynard 2001a, p. 81). Thus, new models of water management need to be explored.

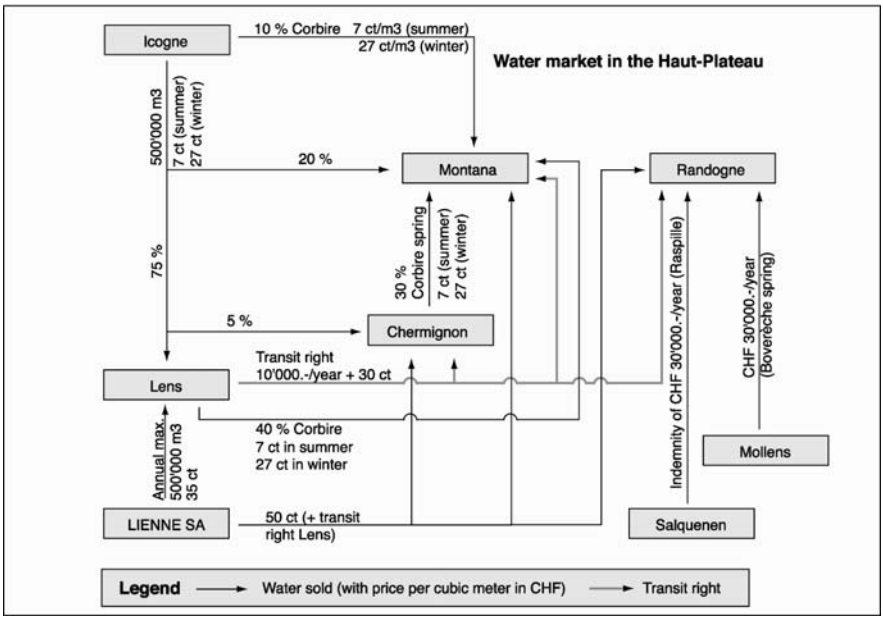

Figure 4: The Water Market between the Political Communes of the High Plateau (all prices are indexed to the living costs) (Reynard 2000a).

4. NEW MODELS OF WATER MANAGEMENT

4.1. Management Measures

In order to improve water management, we propose four types of measures (Reynard 2000a, pp. 343–356). First of all, future management should be organized at the watershed level, instead of the municipal level. However, this proposition faces natural constraints because all the populated areas in this part of the Rhone valley are situated between the rivers and not near the river banks, and political restrictions limit public activities—like transportation, urbanization, public infrastructures, and tourist infrastructures—making the logical area for political action not the watershed but

the political boundaries of the six municipalities. For these reasons, an integrated water management at the water basin scale is not feasible. One solution should be the creation of an intercommunal water service, which could include the six current water services, and other water related activities.

The second measure is the creation of a new institution of management that we call "water committee," whose aim is the coordination among the various water uses and the anticipation of intersectoral conflicts (Reynard 2001a, pp. 15–16). This type of structure was also recently proposed at the cantonal level (SAT 1998). Such forums for cooperation do not exist for the moment in Valais. They were developed with some success at the local river basin scale in France (Montginoul et al. 2000; Allain 2001). For the moment, there is no political incentive for this proposition at Crans-Montana.

One crucial problem highlighted by our research is the absence of planning of water infrastructure. Most actors (municipalities, private companies) manage their infrastructure alone, rather than collaborating with other actors. Middle-term and long-term planning is therefore of great importance, especially for financial and climatic reasons (possible transformation of water resource availability related to current climatic changes). Some local authorities of the region have accepted the principle of the creation of a Master Water Plan within the framework of the Environment and Health Action Plan (see next section).

The fourth measure is related to the management of information about water resources and water uses. One crucial problem revealed by our research is the absence of systematic statistics about water, the very heterogeneous management of data, and the relatively low quality of these data. We therefore propose the creation at the regional scale of a system for collecting, structuring, managing, and upgrading water-related information (Reynard 2000a, p. 355). The system should allow the creation of thematic statistics related to water that could help to create the Water Master Plan of the High Plateau. There is also a need to organize and manage the data within a Geographical Information System (GIS). The first steps for the implementation of Water GIS have been realized within the Environment and Health Action Plan. A first study concluded that the GIS should be organized in different interconnected sub-systems reflecting the various sub-systems concerning water management (resource, drinking water, irrigation, hydroelectricity, tourist uses, waste water, hydrological hazards) and collected and organized data related to water resource (climatic data, hydrological data) (Reynard 2001b). A second study created the module related to drinking water management within the GIS software ArcView (Putz 2003). It produced varied data concerning drinking water

infrastructures, characteristics of springs used for water consumption, and fountains. Local political authorities should now discuss the opportunity of continuing the implementation of other modules (see below).

4.2. Water Management and Sustainable Development of the Resort: The Environment and Health Action Plan

Water management problems are also managed within the larger framework of sustainable development actions. As a response to the different problems, including water management, that Crans-Montana has to overcome, the resort has decided to take part in the Environment and Health Action Plan as a way of prolonging and strengthening the first actions taken in the framework of a Local Agenda 21 process. This Action Plan follows from the commitments taken by Switzerland during the Earth Summit in Rio in 1992. It is supervised by the Swiss Federal Office of Public Health. The main objective of this Action Plan is to encourage people to associate environment and health in their daily lives. To reach this goal, three domains were chosen: nature and well-being, mobility and well-being, and housing conditions and well-being.[7] Due to its numerous traffic problems, Crans-Montana was chosen as a pilot region for the mobility and well-being domaine.

Since the summer of 2001, the authorities as well as numerous people involved in different fields (tourism, education, agriculture, engineering, etc.) have worked on a new approach to mobility. More precisely, 14 projects—including, for example, the development of a mobility plan for the whole resort, discovery of the regional architectural heritage by walking tours, and the promotion of local food products—have been defined. The first concrete measures were executed during Winter 2002–2003.[8] Among these 14 projects, one directly concerns the water theme and is called "Crans-Montana along the Water" ("Crans-Montana au fil de l'eau"). The aims of this project are:

1. To make the population and visitors aware of the water problems according to its principal uses: drinking water, irrigation, hydroelectric production, and tourist use. One important point in this

[7] For more information, see the following website: http://www.paes.ch.

[8] More details concerning the Action Plan Environment & Health in Crans-Montana are available at http://www.paes-crans-montana.ch.

context is to highlight the modes of water consumption and the potential of economizing.
2. To take part in the development of an "inter-municipal" master plan for a concerted management of the hydrological and water use problems of Crans-Montana.

In order to reach the first goal, several events have been organized during tourist seasons: water photography competitions in summer 2001 and water information weekends with conferences, visits of infrastructures (irrigation network, drinking water treatment plants, hydropower production plants, artificial snowmaking infrastructures) and creation of a water tourist path (2003–2004). Workshops were also organized. In 2001, the conferences focused on drinking water management problems; in 2002, the main theme was the impacts of climatic warming on water resource conservation. In order to reach the second goal, a working group composed of people representing the local political authorities, water technicians, and scientific circles are organizing the collection of all the existing information regarding water in the High Plateau. This information should be integrated in a Geographical Information System (GIS) for the six municipalities. At the moment, the water planning process is included in a much larger process of territorial planning.

As we have noted, these aims and actions in the field of water seem particularly adapted to the water management problem described in the previous sections. What is currently needed is to determine if the local authorities and their various partners in water use will be able to realize these objectives and to implement them over the long term.

4.3. Conclusion: How to Link "Traditional" with "Modern" Knowledge

Largely because of various expert studies in the field of water resources and management (Reynard 2000a) as well as the Environment & Health Action Plan, the decision-makers of Crans-Montana are now conscious that water is an important resource that should be better managed in the upcoming years. The challenge in this context is to find how to connect "traditional" knowledge with "modern" knowledge about water use and management. "Traditional" knowledge typically concerns those mechanisms aimed at developing sustainable collective management of common-pool resources, thus allowing the conservation of the resource, economic efficiency, and social equity (see Ostrom 1990). The canton of Valais has a long tradition in this type of collective management of natural resources,

principally in the area of irrigation (Crook and Jones 1999) and alpine meadows.

"Modern" knowledge, on the other hand, aims to improve the management of water resources using technical and organizational solutions (such as GIS), and implementing harmonized planning (Master Water Plan) and management (local governance via Environment & Health Action Plan). The challenge is to invent new common-pool management structures (Lenhard and Rodewald 2000) that will be able to manage not only sector-based uses like irrigation, but also cross-sector problems like the coordination of various water uses.

Although we saw that the High Plateau has some specific features in terms of hydrological regime and institutional structure, we think that the challenge of connecting "traditional" and "modern" knowledge regarding water use and water management also concerns the majority of resorts in the Alps, and perhaps the majority of resorts in mountains areas of other developed countries.