Tourism effects on water management in mountain areas. The case of an Italian Alpine Valley.

Giacomelli P, Brambilla M, Carboni V, Rossetti A.

Università degli Studi di Milano (Italy) – Department of Agricultural, Food and Environmental Economics and Policy

Abstract: The paper analyses the effects of tourism on the Adda River basin, one of the most representatives in northern Italy. In recent years tourism activities in the area have experienced a great growth, which has given rise to emerging problem of drought. To face this critical situation, the incoming and the output flows from the lake are carefully regulated. The management of volumes need to take into account all the components of the demand, in order to maintain the current development of local economy.

Key words: tourism pressure, water regulation, water management

Introduction

Tourism plays a very important role in the economy of Alpine areas. Nevertheless, in the last ten years it is becoming an intensive and overexploiting activity on the environment and on water resources. This work is part of RICLIC project (Regional Impact of Climatic Change in Lombardy Water Resources: Modelling and applications), funded by Lombardy Region to develop a scientific methodology to assess climatic impacts on water resources. The project is focusing on the Adda River basin, one of the most representatives in northern Italy, either for his extension and for his socio-economic role. Within this watershed, water flows are sharply regulated, thanks to the presence of alpine reservoirs for hydroelectric power generation and floodgates that control the hydrometric levels of Lake Como. This regulation system provides the water supply to the lower sectors of the basin, where Adda flows through Padana Plain. This part of the watershed is highly populated and characterized by the presence of intensive agriculture and industrial activities, which produce a great demand of water. Tourist activities can be considered the leading forces of local economy, as Lake Como and Valtellina mountains

generate great attraction in different periods of the year. The two areas are analyzed separately, in order to characterize tourist flows and the problems related to water management. The presence of several tourist facilities causes a great water consumption (estimated to be twofold of the residential consumption) which may lead to situations of stress on the water supply system of both the valley and the lake. Moreover, during summer, the coincidence of irrigation activities in Padana Plain with the rise in temperature causes an important increase in external water demand. To face this critical situation, the system of floodgates on the lake is employed to regulate the incoming and the output flows, to satisfy the overall demand of water. If the management of volumes doesn't take into account all the components of the demand, the water in the lake might reach not suitable levels for navigation and leisure purposes, leading to public health problems and shores instability.

Study area

The study area is the Adda River basin, the greatest in Lombardy and the fourth in Italy for surface. In the upper part of the basin the river flows through a glacial alpine valley, Valtellina, which is entirely included into Sondrio Province. In the centre of the basin Adda flows into Lake Como, one of deepest lakes in Europe. The lake area is ruled by two different provinces: the Lecco Province on the right side, and the Como Province on the left side. Then, in Olginate, Adda flows out from Como Lake, going across Padana Plain until the confluence with Po River.

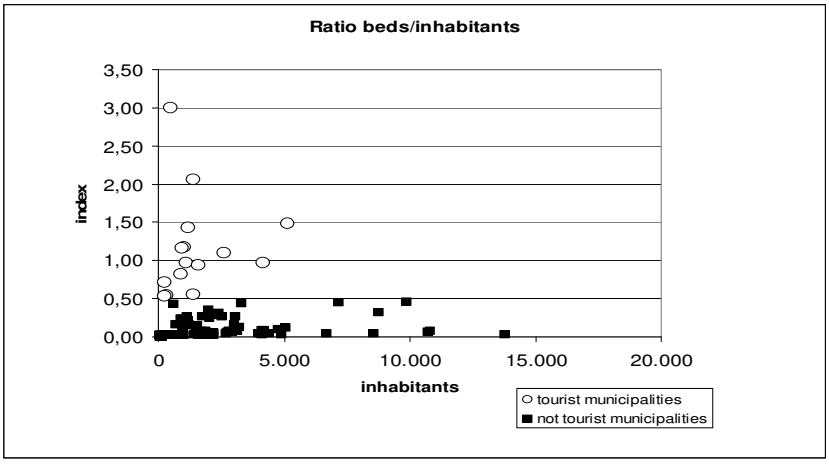

Fig 1:Ratio beds/inhabitants index.Own elaboration, based on ISTAT data, 2001

Tourist characterization

The annual overall tourist presence has been estimated around 2 millions units for Valtellina and 2,3 million units for the lake area, which is almost ten fold the resident population. An index that express the ratio between accommodation and the dimension of population has been used to identify, among all, which municipalities can be addressed as “tourism oriented” (Rasulo, 2007). This method states that, if the ratio exceeds 0.5, it is possible to say that tourism is the economic driving force for the municipality (Figure 1). Applying this index on the study area, a first selction among the municipalities has been made. The results show that, for the 18% of the municipalities of the whole area, tourism is the most important economic driver, and the ratio grows till 40%, as regards only to the municipalities belonging to Lecco Province.

Tab. 1 Tourist municipalities in the study area. Own elaboration, based on ISTAT data, 2001.

	Province	Nr. of municipalities	Nr. of tourist municipalities	%
LAKE	COMO	36	5	14%
LAKE	LECCO	25	10	40%
VALTELLINA	SONDRIO	78	10	13%
Overall		**139**	**25**	**18%**

Valtellina

Valtellina is a wide glacial valley that runs from east to west in the northern part of Lombardy region. The area involved 78 municipalities, the whole Sondrio Province. The resident population is estimated around 174.000 people (2001, ISTAT). The area is divided in some ski-areas: Valchiavenna, Alta Valtellina, Valgerola, Valmalenco and Tirano and there are 139 ski runs for more than 430 km. For more than the half of the ski runs there is the possibility to program artificial snowing.

Valtellina economy

Valtellina economy is mainly based on agriculture and tourism. Agriculture holds a very important role, with the production of some high quality products (DOC wines and DOP cheeses and meets). Tourism represents more than one third of the overall added value produced (3.836 million euros in 2004; source UNIONCAMERE). The service sector generates the 69,1% of the overall

province income, and in Valtellina is tourism oriented. Every year Valtellina receives on their territory a great number of tourists: in 2001 arrivals were more than 422.350 and presences about 1.871.590. It is possible to characterize tourist trend in Valtellina: it shows two peaks corresponding to the two tourist seasons. Summer tourist season lasts from June to September; the number of presences grows from the beginning of summer and reaches its peak in August. In winter, tourist arrivals and presences reach their maximum during the ski season.

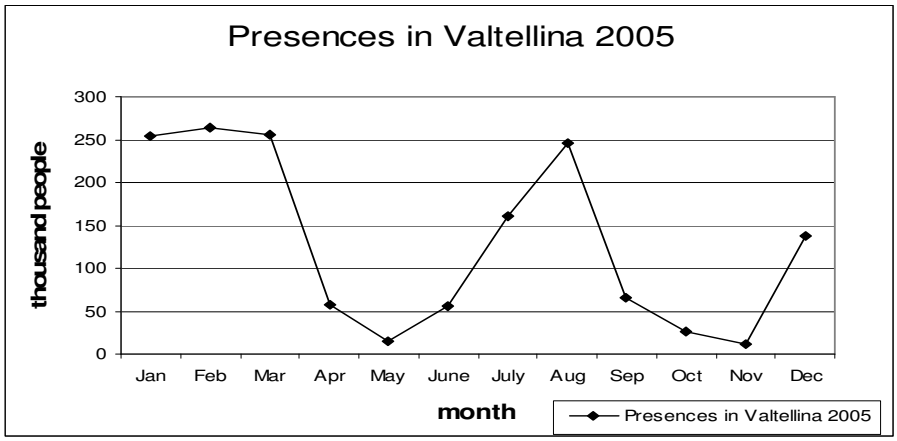

Fig. 2 Valtellina monthly tourist presences trend. Own elaboration on APT data, 2005.

It's possible to determine how much tourism influences the territory using an index of "stress": this index expresses monthly tourist pressure on every 1.000 inhabitants. It has been calculated as follow:

(presences * days per month * 1.000)/ inhabitants

The results for tourist municipalities, considering only the months of the tourist seasons, are shown in the graph in Fig.3.

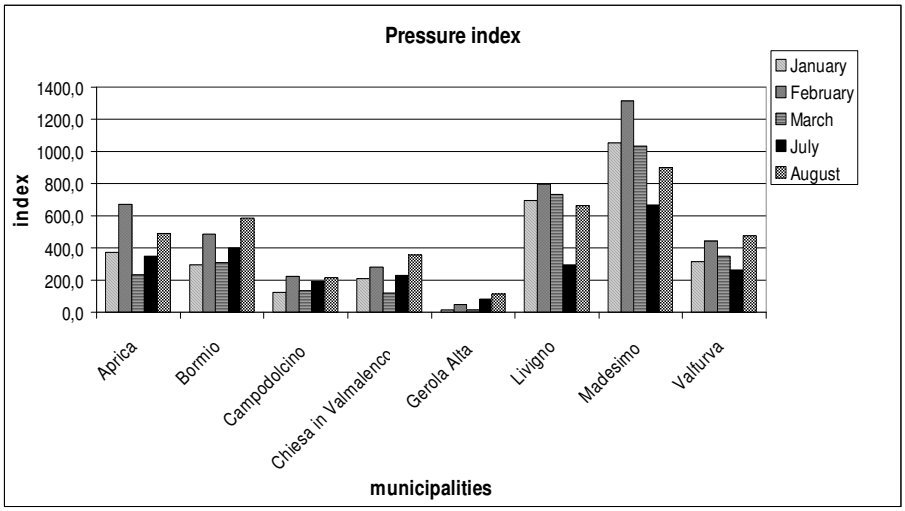

Fig. 3 Pressure index on the tourist municipalities. Own elaboration on APT (2005) and ISTAT (2001) data.

The graph evidences that on the most tourist municipalities (Aprica, Bormio, Campodolcino, Gerola Alta, Livigno, Madesimo, Valfurva and Valmalenco), the maximum values of the pressure index are always shown in January and February, coinciding with the peak of ski season. In summer season, only the values of pressure index for the month of August are meaningful, in some cases, the pressure index is even bigger than in February. It is important to underline that this analysis has considered only data about hotel accommodation, because there are not available data on turist presence in private houses.

Water consumption

Table 2 shows the different uses of water in Valtellina and the characterization of water sources.

In Valtellina water for productive uses derives from water diversion from Adda River, while for civil uses, the water comes from springs. This elaboration has not considered the use of water for hydropower production; in fact, it is considered a “non consumptive” use of water, even if the volumes involved are significant. The presence of tourist significantly increases the municipal water demand. For exemple, considering tourist data for the municipality of Madesimo (about 600 inhabitants, 2001 ISTAT), in February 2005 presences reached 23.660 units (2005, APT); in Livigno (about 5.100 inhabitants, 2001 ISTAT), in March 2005, the presences reached 126.170 units (2005, APT). Water

consumption for each inhabitant is estimated about 200 l/day, while tourism produces a demand of water equal to 530 l/day per person (European Environment Agency, 2005). Table 3 shows the monthly estimation of volumes of water demand for the main tourist municipalities of Valtellina.

Tab.2 Water rights in Valtellina from different supply sources. Own elaboration on Lombardy data, 2003.

	V [Mm^3/yr]				
	FARMING, ANTI-FIRE	**HOUSEHOLD**	**INDUSTRY**	**IRRIGATION**	**FISH FARMING**
Spring	3,70	72,61	0,61	7,48	0,41
Well	9,31	4,96	24,69	2,18	12,52
Derivation	18,20	2,32	5,94	178,20	133,44

Tab.3 Estimated monthly water consumption by tourist in Valtellina main tourist municipalities (Aprica, Bormio, Livigno, Madesimo, Valfurva and Valmalenco).

water consumption		
2005	presences	Mmc/month
Jan	**254.884**	**4,19**
Feb	**263.432**	**3,91**
Mar	255.140	4,19
Apr	57.888	0,92
May	15.199	0,25
June	55.450	0,88
July	**161.407**	**2,65**
Aug	**246.651**	**4,05**
Sep	66.387	1,05
Oct	27.041	0,44
Nov	11.382	0,18
Dec	**137.131**	**2,25**
TOT	1.551.992	**24,96**

Only tourist water consumption in these municipalities, for the months of January, March and August exceeds 4 Mm^3, for an annual total amount of 25 Mm^3. The comparison with 1,2 Mm^3 estimated for the demand of water expressed by resident population in the same area (about 16.800 people, ISTAT 2001), gives the dimension of tourist impact on the area. Even the comparison with the total demand of water for Valtellina is remarkable: 12 Mm^3.

Lake Como

The pre-alpine zone includes the 61 municipalities around the lake, part under the authority of Como Province and part of Lecco Province; the resident population is estimated to be more than 267.340 people (2001, ISTAT). As compared with Valtellina, the density of population is seven fold bigger. Because of data availability, the study is focusing only on Lecco Province, which is also the branch of the lake with more tourist attractiveness.

Lake Como Economy

The economy in this area shows some differences between the two branches of the lake: in Lecco Province the economy is mainly based on industrial metallurgical activities, while in Como Province textile industry prevails. Moreover all along the shores economy is also influenced by tourism, which in the last years has been attracting a growing number of tourists. Both Italian and foreign people come every year on Lake Como (from more than 1.277.500 presences in 2000 to about 1.529.400 presences in 2006, APT), more than 70% of which coming from abroad (almost 1.129.400 foreign presences in 2006, APT).

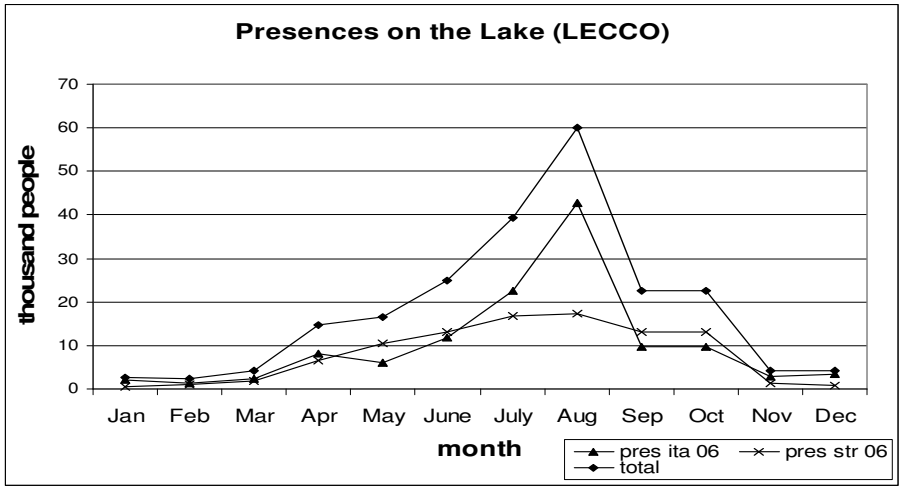

Fig.4 Monthly presences on the Lake, Lecco Province. Own elaboration on APT data, 2006.

As it is shown in Figure 4, the peak of presences is in August, both for Italian and for foreign tourists.

Water consumption

To maintain turist attractiveness on Como Lake, the level of water must not lower the minimum level of 40 cm under the hydrometric level. Under this level many problems arise for lake enjoinment: limitation of landing wharf availability, deterioration of water quality, that brings about limitation in bathing and in water derivation for civil uses; sewers appear over the surface, giving rise to problem of smell and unaesthetic conditions. It is possible to compare the resident water demand with tourist consumption. In the municipalities considered there are 30.700 inhabitants and their total consumption is estimated about 6,1 thousands m^3/year. On the other hand, the 218.000 tourists in 2006 determined a water consumption of about 115 thousands m^3/year. It is possibile to make a comparison between the situation in Valtellina and on the lake. As shown in Figure 5, tourist pression on the lake is much lower then in Valtellina, even in July and August, the two months with the maximum of the presences.

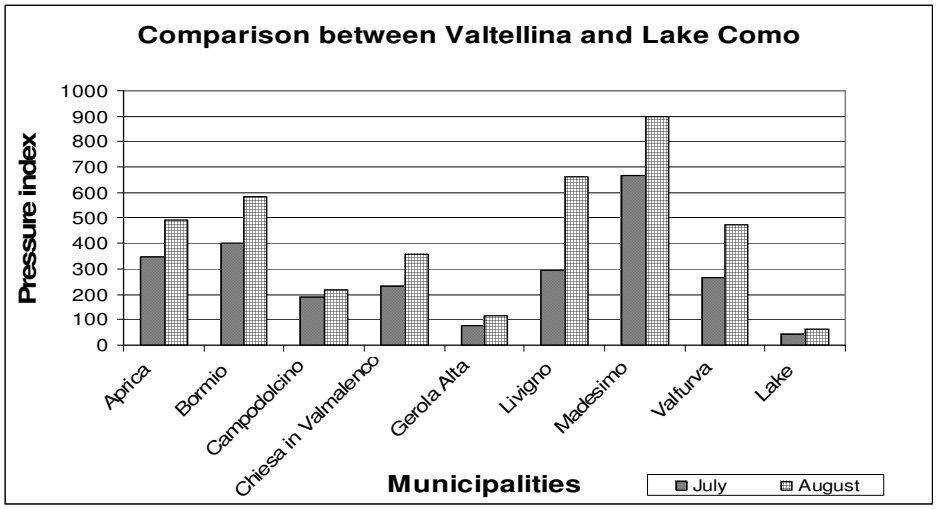

Fig. 5 Comparison between tourist pressure on Valtellina and on the lake. Own elaboration on APT (2006) and ISTAT (2001) data.

Conclusions

The paper has shown the importance of tourist activities on the area. In particular, the comparison between Valtellina and the Lake area has underlined some differences. Valtellina, also thanks to the development of ski tourism in the last twenty years, has reached a good development of its tourist potential. Tourism on lake area, instead, is going through a phase of growing. Moreover, data have shown that tourism in Valtellina represents not only the most important economic driver, but also an important impact factor for water consumption. Tourism on the lake doesn't carry on a strong impact on water resources, but the level of water in the lake has to be preserved in order to maintain it enjoyable by tourists.

Project description

This research is carried out in the framework of RICLIC project, funded by Università degli Studi di Milano Bicocca, Fondazione Lombardia per l'Ambiente (Lombardy Environment Foundation) and Regional Agency for Environmental Protection. This paper has been discussed by all the authors. Paolo Giacomelli

wrote the paragraph 5, Marta Brambilla wrote the paragraph 1, Valentina Carboni wrote the paragraphs 3, 4 and Andrea Rossetti wrote the paragraph 2.

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