COLLOQUIA

Ecosystem Services in Floodplains

edited by
Dario Canzian and Elisabetta Novello

PADOVA UP
PADOVA UNIVERSITY PRESS

Published with financial support from the University of Padua project
"Ecosystem services nella bassa pianura dell'Adige e del Bacchiglione
dal medioevo all'età contemporanea"

First edition 2019, Padova University Press
Original title *Ecosystem Services in Floodplains*

Università degli Studi di Padova
via 8 Febbraio 2, Padova

www.padovauniversitypress.it
Graphic Design Padova University Press

ISBN 978-88-6938-183-6

Cover image *Texture* di Davide Scek Osman

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Introduction

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This volume is a collection of essays by European environmental scholars on the ecosystem services theme. The Millennium Ecosystem Assessment (MEA), carried out between 2001 and 2005 at the behest of the United Nations General Assembly, was designed to assess the consequences of the changes which have taken place in the environment on human wellbeing as well as to improve conservation and the sustainable use of ecosystems by identifying the contributions these made to economic and social progress over the course of the centuries. Scholars have been conducting research on the ecosystem services-human wellbeing interaction for some years now, but no long-term historical study of this topic – from the Middle Ages to the present day – has yet been attempted, and we believe this to be a fertile field of enquiry. In particular, this volume deals with the relationship between ecosystems and the well-being of the people living in a certain area in the widest sense, focusing on *ecosystemic services*. These latter are the services available to a community on the strength of an appropriate management of ecosystems which, in turn, can be chararacterised by more or less intensive human activity (undisturbed ecosystems such as natural forests do exist, as do other considerably modified ones, such as agricultural land and urban areas).

Ecosystemic services can be categorised as follows: *provisioning services* (food, water, timber, fuel, etc.); *regulating services* (effects of human activity on the climate, provisioning regulations, health and safety standards, waste management, water quality checks, hydro-geological framework monitoring); *cultural services* (services offering recreational, aesthetic and educational benefits, etc.) and *supporting services* (soil formation, maintenance of the chemical composition of the atmosphere, the nutritional cycle underlying growth and production, etc.).

From a long-term historical perspective it is interesting to assess the way environmental transformations have impacted on human wellbeing both in the past and today. This wellbeing is made up of a range of components:

- basic material for a good life (safe and adequate means of subsistence, sufficient food at all times and in all situations, shelters/huts/houses, clothing, access to goods);
- health (including a physical environment perceived to be healthy);
- good social relations (social cohesion, reciprocal respect, ability to provide for the more vulnerable and unproductive social elements);
- security (safe access to natural or non-natural resources, personal safety, protection from natural or man-made disasters).

In our opinion, historical-environmental studies designed to study in depth the relationships between ecosystemic services and the dominant economic and social factors in the various communities can make a crucial contribution to the development of a new interpretation of the process whereby environmental resources are used and economic development choices made over the years.

Environmental historians are unlikely to have much to offer in the *supporting services* field, but feel more at home in dealing with provisioning services. This is the sphere which encompasses themes linked to the production of economic goods, primarily foodstuffs, water provisioning, raw material management (timber, salt, sand and clay) and the production and/or management of energy resources (water, peat, timber, carbon and natural gas).

Regulating services provide an opportunity for environmental historians to analyse all aspects of anthropisation and regulation of water and other energy resources. The settlement distribution network is also to be assessed diachronically: was there a hierarchy (administrative, economic, residential)? And what relationships were there between the various elements in this network? Were resources regulated locally and supra-locally? Were residential and rural settlement operations co-ordinated by the authorities – lordships, citizens, statutes? What were the communication routes?

Lastly, the *cultural services* sphere is a matter of recreational, aesthetic and educational benefits by definition. This category encompasses research focusing on the artistic representation of the area and its landscape (paintings, photographs, literary descriptions, cartography). For the Middle Ages identifying this type of services would appear, in the context of reference, not to be immediate but still possible. It should not, for example, be forgotten that activities such as hunting were the wealthy classes' primary pastime, with hunting and tournaments being seen as a peacetime opportunity to retain one's skills in what was considered the aristocratic pursuit *par excellence* – war. As to the contemporary age, considerations on the tourist and recreational use of the area are also essential.The essays in this volume attempt to identify the various direct or indirect drivers of change which have long influenced the human species-ecosystem interaction, opening up new avenues of research in the field of environmental history.

The *indirect drivers* of change category encompasses demographic, economic (markets, commerce, globalisation, political framework), scientific, technological and cultural factors. *Direct drivers* of change include changes in land use, the introduction of new animal and plant species or their extinction, technology adaptations and use, external input (use of fertilisers, pesticides, drainage and irrigation systems), consumption of resources, climate change and natural, physical and biological change factors.

It was decided to limit the spatial scope of this volume to floodplains, and case studies, whilst mainly Italian, also cover other European and non-European contexts. The reconstruction of specific historical circumstances which are directly related to the subject of floodplains was guided by the ecosystem services analysis model, despite the fact that this was developed only recently to analyse the contemporary era.

Contributions follow a classic chronological approach because this seems to be the criterion best able to highlight continuity and discontinuity in the phenomena analysed.

Thus a first nucleus of work examines the Middle Ages. This section begins with an analysis of safety – and food provisioning – related services, the two primary forms of medieval wellbeing protection in the context of the Veneto flood plain, with insights into settlement forms and foodstuffs distribution in the towns and countryside of the lower plains. Villages, castles and towns, roads and waterways: the infrastructure network was conceived for medieval man's *bonum statum,* on which subject a great deal of research remains to be done (Canzian).

In relation to the Costa di Rovigo site, Remy Simonetti illustrates an extremely significant ecosystem services production laboratory linked to an amphibious environmental context. Fallow land resources, hunting and fishing, timber exploitation, use of the waters of River Adigetto, a branch of the River Adige, as a vital artery for the local community's multiplicity of activities: these are highlighted on the strength of an analysis of previously unseen documents examined for the occasion. The Adige River basin is also the subject of Francesco Tognana's paper, as regards the vocationally semi-urban area of Este, fulcrum of the marquisate which took its name from the town. Este's commercial potential bound up with its river network is highlighted here. This was reinforced in the late Middle Ages in work involving digging canals sponsored by the Padua commune for the purposes of improving river flood containment in the plains and, at the same time, maintaining water levels sufficient to ensure navigation and economic use.

With Alexei Kraikovski and Margarita Dadykina's work we move outside Italy to Northern Russia, the region bordering on the White Sea. Here, from the

15th century onwards, some monastic communities made use of local resources, first and foremost water, promoting agriculture and livestock farming and also salt production and fishing. Monastic intervention favoured the area's urbanisation and modified its environment, for example via the digging of canals which are still drawing in tourists today to the Solovkie islands.

In the Early Modern Era community access to ecosystemic resources was transformed alongside renewal of the forms of political power and changes in the social equilibrium. In this respect Raphaël Morera enquires into the relationship between political and social change on one hand, and uses relating to the exploitation of wetlands on the other. In an approximately three century long overview of the whole Ancien Régime period, Morera shows that, however unevenly, in the 16th and 17th centuries the French wetlands were progressively incorporated into the capitalist market and economy, thanks to the action first of locally powerful groups supported by the monarchy and then the king's most trusted men. The monarchy saw reclamation and farming of fallow land, both wetlands and otherwise, as a means of affirming central power. The wetlands, after their transformation, thus ended up offering political services above all. From a different starting point – sustainability as the ability to use resources without imbalances and degradation of the productive structures or destructuring the communities involved, in the pre-industrial age – Matteo di Tullio and Claudio Lorenzini's analysis encompasses an examination of the relationships between new forms of political power and local customs. Two case studies are examined here: the plains between Milan and Brescia and Carnia, as regards the management of water and forests and the conflicts deriving from it. In this respect, in the 16th and 17th centuries, consolidating state bureaucracies tended to compete with local institutions for the management of environmental resources. The increasing awareness of the importance of water in the Early Modern Age also brought about the adoption of measures designed to contain damage done by rivers bursting their banks. Paolo Buonora focuses on the cultural and ideological horizons of those seeking explanations for such catastrophes and solutions to them. Nature and culture, theology and science, luck and virtue interwove in the considerations of decision-makers, engineers and intellectuals until the 19th century. Today, the author believes, a scientific approach combined with historical analysis would enable an adequate database to be created for the Tiber River for the purposes of generating effective environmental disaster prevention systems.

The last section of this volume deals with the contemporary era, encompassing global geographical horizons. Silvia Piovan and Michael Hodgson focus on a specific ecosystemic function of water, namely its use in war. A rapid overview illustrates some examples covering the period from 1938 to the end of World

War Two, in reference to the Möhne and Eder Rivers in Northern Germany and the Yellow River in China and the Pacific Ocean. The authors also focus on a fortunately non-implemented plan to flood a large section of the lower Veneto plains, along the Mincio-Po and Adige-Gorzone axes, as an extreme response to a hypothetical in-depth Austrian penetration of Italian territory in the wake of the Italian defeat at Caporetto in 1917.

With Armel Sambo's contribution we shift our attention to Lake Chad, an extremely important lake as far as ecosystemic services to those living on its shores in Chad, Cameroon, Nigeria and Niger are concerned and under great environmental stress in recent decades due to the effects of climate change aggravated by increases in demic pressure. For this reason, the author argues, multilateral co-ordination of the lake's ecosystemic services is desirable, both those linked to the past (fishing, livestock, irrigation) and those bound up with new services such as tourism.

Tourism is also the focus of Elisa Tizzoni's contribution, which concentrates not on the flood plains but the Tuscan-Emilian Apennines (Abetone and Colle Cerreto). In this case the author highlights a sort of collective raised awareness of the ecosystemic sustainability principle amongst all those co-operating in tourist promotion in these two sites, as regards the exploitation of environmental, cultural and landscape resources in these middle mountain sites. It is clearly a model transferable to other areas in which local and international tourism can be a valid alternative to super-exploitation in local resource production terms (primary or secondary).

Elisabetta Novello's essay focuses on direct and indirect drivers of change. By examining the various phases in the evolution of the notion of "land reclamation" and providing an analysis of the contributions of the state and private financial sector to environmental improvement work from Unification to the Fascist age, the essay highlights the way in which ecosystemic services offered in marginal areas are frequently subject to diverse interpretation in the long term. The attention of lawmakers shifted from analysing the more strictly financial factors to technological and scientific and then social factors. The lawmakers' readings both influenced, and were influenced by, the construction of 'artificial lands', within which new economies, new power relationships and new identities gradually took shape.

This volume, which includes contributions on the services offered by water ecosystems, intends to break down academic and disciplinary barriers as far as possible, and therefore relies on the co-operation of specialists from a wide range of sectors.

We are very grateful to all those who agreed to work on this project and hope that this co-operation will continue in the future.

Studying the environmental history of Medieval Veneto: elements for an eco-systemic assessment (12th-13th centuries)

Dario Canzian

1. Wellbeing in the Middle Ages

First and foremost, I must clarify that the intention of this paper is to pose questions and report issues rather than to supply answers. And one of these questions must be posed right at the outset: can medieval environmental history be approached from an eco-systemic perspective? The basis of this question is the fact that I believe that this model of historical enquiry has not yet been used. The eco-systemic services issue is, in fact, a paradigm which emerged at the outset of the new millennium as a research initiative fostered by the United Nations for the purposes of supplying new analysis tools and proposing sustainable solutions to problems of development and co-existence in human societies. The basis of this is the holistic principle which considers the environment, its resources and man as an interrelated system capable, if its infinite variants are well managed, of guaranteeing reasonable wellbeing expectations for the collectivity.

It is, thus, not a matter of a methodology of historiographical enquiry as such but rather that this analysis model can constitute an important and novel sphere of debate for historians.

In actual fact, considering the vicissitudes of medieval societies from an eco-systemic perspective has already been attempted by historians, although in a rather 'un-self-conscious' way. In very recent times, in 2009 for example, a late Middle Ages conference held in Pistoia focused on *La ricerca del benessere individuale e sociale. Ingredienti materiali e immateriali* – The Search for Individual and Social Wellbeing – Material and Immaterial Ingredients (AA.VV 2011). In her introduction to the conference papers Gabriella Piccinni concisely summarised the following question: what is wellbeing and, in particular, what

was wellbeing for medieval man (Piccinni 2011, 1)? That is – translated into eco-systemic language – what does the expression 'wellbeing' mean as applied to medieval man? Piccinni's answer to this question is rightly complex and encompasses both material elements such as the supply system, forms of harvest distribution, protection from external risks and from labour and illness related problems, public health supervision and so on, as well as elements of a spiritual and psychological order such as good religious and civic practices, art, religious and carnival rituals, social peace and peaceful co-existence in towns and cities.

Attempting to reinterpret these elements in eco-systemic terms might involve noting that medieval man survived via recourse to a series of more or less efficient provisioning, regulating and cultural services. Awareness of this fact, which takes very diverse forms today but is, all the same, at the heart of the academic and socio-political debates, was then very different. It was certainly not absent: the ability to guarantee regular food and drinking water supplies and safeguard public health and citizens' very lives in the face of the era's natural calamities and endemic violence were important credentials for those holding public office, at least in the image they put forward of their role. The famous late 1330s images of the effects of good and bad government in Siena's Palazzo Pubblico illustrate this clearly.

However, the pursuit of the 'bonum statum' so frequently evoked in medieval public sources and so close to the concept of 'wellbeing' expressed in ecosystem services literature comes across as a insubstantial goal in the Middle Ages. The very concept of 'system' was weak: the planetary vision of today's globalised world is a very long way away from what we might call the localism of the Middle Ages. On the other hand, the human will for positive intervention, via government action for example, was limited by socio-political and environmental factors which condemned people to a precariousness which was never entirely absent even at the most favourable economic and political junctures and can perhaps be paralleled with that of the world's less developed areas. It is a situation which was well summarised in the observations made by Gabriella Piccinni in the final part of her introduction: "all the rest may lose meaning, even the fact that you are legally free while your grandfather was a serf, if you do not have enough to eat or keep warm. But similarly there was nothing so wonderful about wellbeing if you were an exile, if you could not love, if you were besieged within a gilded world, if your home could be destroyed for political motives, if your children could be torn from your arms and decapitated for vendetta, if your image could be daubed on the walls to defame you (…)" (Piccinni 2011, 23). The perfect combination of material and immaterial elements in determining wellbeing was thus extremely rare and probably remained so for some considerable time after the end of the Middle Ages and this is perhaps true even today.

In this paper I will focus on the nexus between forms of anthropic organisation and environmental transformations limited to two types of services which we might consider of fundamental importance to the medieval era: protection – which is, I believe, to be considered to all intents and purposes one of the era's eco-systemic services to the extent that it was strongly bound up with environmental and settlement factors – and food supply. From an eco-systemic perspective these aspects are to be considered resources supplied by the territory directly or via human intervention. Political and institutional laws will subsequently be considered as superstructures as will the event data.

2. Curtine*, castles, batlements: security services*

In 1242 the village of Montagnana, now an attractive lower Padua province town with perfectly preserved fourteenth century town walls, was attacked by Ezzelino da Romano, Frederick II of Swabia's main ally in the Marca Trevigiana[1]. The Marquis of Este, Azzo VII, the head of the region's most important aristocratic family and a bitter rival of the da Romano lordship, present at the castle of the same name at the time, around 16 km away from Montagnana, saw the fire lit by Ezzelino and went to the assistance of the besieged town. Then, according to chronicler Rolandino da Padova, he returned to his Este fortress

> «taking with him men, women and children in the great quantities his goodness enabled him to take to safety. This derived, in fact, from his great benevolence because this noble lord could do no other than help the weak, protect the vulnerable and defend the humble» (Rolandino 2010, 233).

This certainly eulogistic tale brings out, all the same, the value of this service to the *inermes* which the Marquis felt was his duty as an aristocrat. His was a security service of fundamental importance in the Middle Ages, above all if we consider eco-systemic services as oriented towards human wellbeing. The Marquis of Este was, in fact, making a protective structure, the family castle, available to the refugees, as the poor inhabitants of Montagnana had been violently deprived of their homes and their lives were at risk. Certain ambiguous elements bound up with this type of situation come across. The apparently charitable marquis himself contributed to the fire before leaving Montagnana, according to this source, probably in order to make it unusable by his enemy and perhaps also to oblige its people to place themselves under his protection. We are effectively talking about the same man who, as a 19 year old in 1224,

[1] In this paper Marca Trevigiana is understood as the area between the Adige river to the west and the Livenza river to the east, essentially corresponding to modern day Veneto, with the exception of Venice, Polesine di Rovigo and the Alpine area.

attacked Fratta castle near Ferrara with a large army as it was harbouring some of the allies of his rival Salinguerra Torelli and, having accepted their surrender, killed all its inhabitants including the children and leaving those who had attempted to escape to drown in the moat (Rolandino 2010, 87).

This latter episode also makes clear that, in the Middle Ages, protection against violence was undoubtedly at the apex of the services required by the community because the wellbeing threshold was lower than it is today, although even medieval man was probably not content with mere survival. The proliferation of castles from the 10th to the 12th centuries, a much studied phenomenon which cannot be examined here, is the clearest material expression of this need. The environmental impact of castle building was imperative. For the region which is the subject of my studies, the Veneto area, a thoroughgoing castle balance sheet is still lacking but a survey of a 62 km long portion of the Treviso area along the Piave river has demonstrated the existence, from the 11th to the 13th centuries, of more than 60 castles, towers and fortified sites belonging to religious bodies, local lords, city notables, aristocratic consortia and village communities (Cagnin 2013, 92-113). This means a site fortified kilometre by kilometre, although fortifications were not evenly distributed across this area. Whilst we do not have equally accurate surveys on castle 'distribution lines', which frequently coincided with the rivers on the Po plains, and whilst the Piave is a border river (separating the Treviso diocese from that of Ceneda and, for a certain period, also their respective civic districts), it can be reasonably argued on the basis of the available data that the density of 12th and 13th century fortifications was to all intents and purposes the principal anthropic marker and probably the service most in demand of the people of the day or imposed on them by their lords.

A necessarily approximate estimate done a few years ago by Sante Bortolami calculated a hundred or so castles in the Vicenza area's 223 villages in 1262 and estimated that around one third of the Padua area's 400 villages had a fortification of some sort. Bortolami thus concludes that there could not have been fewer than 500 castles in the area corresponding to the modern Veneto (Bortolami 2005, 31). Linking up this high castle density with the presence of a dense water network in the lower Veneto plains is less banal than might be supposed. There is certainly an indissoluble link between water and castles because, in addition to its defensive function, water is essential to the survival and health of all human beings. And the Veneto plains, especially south of the underground springs line in the late Middle Ages, was a maze of ditches, artificial canals, large rivers, marshes and internal lakes which it is almost impossible to number but certainly fostered the proliferation of fortifications. It certainly cannot be said that it was water which generated the castles but there is no

doubt that the widespread availability of this must have accentuated a density which, as we have seen, was extremely high in the Vicenza, Padua and Treviso areas. Certainly, anything more definite would require a geo-referenced survey on a regional scale.

As far as the types of fortifications built are concerned, an approximate hierarchy can be identified. At the bottom – what we might call the 'zero level' in defensive terms – were the *curtine*, i.e. fortified enclosures which were very common in the Veneto and Friuli countryside in the 12th and 13th centuries. These are often to be found around churches or monasteries and were used as storage spaces. Probably, these *curtine* were originally ordinary houses abandoned by their residents when they moved outside the villages into the countryside. It is, in fact, well-known that during the centuries of full medieval development, from 1150 to 1300, the housing centralising process which had been such a feature of earlier centuries was reversed. Peasants increasingly moved out of the residential nucleus. A survey is lacking for these fortifications, too. In research done ten years ago I identified 15 of these in the area of the historic Céneda diocese in what is now Vittorio Veneto (in Treviso province), in an area of around 1400 square kilometres. But it is reasonable to suppose that systematic analysis might bring many more to light (Canzian 2005, 183; Bortolami 2005).

Now, if these *curtine* were the most basic level of collective protection, the walls of the larger rural centres, the quasi or real towns, had highly sophisticated defensive systems, as is well known. In the 12th and 13th centuries no form of collective life existed without defensive structures – if not walls then at least wooden enclosures and towers and ditches – with the exception of small country villages whose inhabitants could count on shelter at nearby castles or the towns in the event of need. The threat was not only human: wild animals (wolves, for example; Ortalli 1997, 68-72), floods, extraordinary weather events and fires (these, however, much more dangerous and frequent in the towns than outside them; Benucci 2016) obliged people to build barriers between settlements and what was to be found outside them. It is a huge subject and one which can certainly not be fully explored in this paper. It is, moreover, a widely studied subject and one to which little can be added here. I will simply note that this need was simultaneously rulers' duty and a collective responsibility and it was effectively this very duty, this sense of reciprocal responsibility, which forged feelings of community allegiance and thus identity.

Naturally, the eco-systemic effect of the dissemination of defensive structures remains to be analysed and it is a much more complex matter than simply surveying these: how many men were employed in building and maintaining castles and town walls and how much time was taken up? How much energy was diverted from other activities such as agricultural or professional work?

What were the economic and environmental effects of this building work as regards, for example, sourcing materials, preparing them for building – cutting out clay, firing bricks, finding iron to link up walls and floors[2]?

There are currently no answers to many of these questions but hypotheses can be formulated for some of them. For example, as regards building materials. Perhaps it is not accidental that there were so many fortifications along the Piave river. The Piave river bed was (and is) an open air rock and stone quarry almost throughout its course, including on its large stretch of plains. It is an environmental characteristic of Alpine rivers, like the Adige, Brenta and Tagliamento rivers (rather than spring rivers such as the Bacchiglione, Sile and Livenza). This fact cannot have been irrelevant to the transition from earth and wood to masonry castles which was an overall feature of the 12th centuries (Settia 2017, 73-80). And the same is true of the availability of clay in the lower plain flood lands which facilitated the substitution of earth, wood and stones with bricks at a later date. In this latter respect, the existence of the Camino / Camin toponym in many places in the Po plains, and always in the immediate vicinity of rivers, would appear to be significant[3] because these correspond to the historic presence of brick, lime and masonry kilns. The fortunes of at least one great rural family, precisely the da Camino – who were lords of Treviso at the apex of their success – may have drawn on a bond with this sort of infrastructure.

The political implications of the potential to control building material supply by dominant families or public bodies in the late Middle Ages have probably been underestimated in the documents, in which rulers' rights or patrimonial ownership comes out to a greater extent. But we know that building quality reflected the power hierarchy as it had developed in the process during which the rural lords came to the fore, in a way which contemporaries perceived directly. In the countryside the only brick buildings with tiled roofs, apart from ecclesiastical buildings, were castles and fortified houses and peasants were normally still living in wooden houses with straw roofs ('casoni') in the 14th century and also for some time afterwards (Rao 2015, 73). [4]

In conclusion, the hydro-geological framework, availability of raw materials, need for collective security, settlement patterns and the territorial order in human government nuclei were all faces of the same prism which should be studied as far as possible in parallel. If historical facts are examined from the

[2] See Pinto's case study 1996b, 65-76.

[3] In the plains the following, as a minimum, can be cited: Camino on the Tagliamento near Udine, Camino on the Monticano (Treviso), Camin on the Brenta (Padua), and lastly, Camino on the Po (Alessandria).

[4] In this respect see the illustrative example of the masonry motte and 12 *cassi domorum* with straw roofs described in minute detail in a Treviso document dating to 1231 (Canzian 2013, p. 151).

perspective of subjecting them to the eco-systemic services filter, an *a fortiori* total history model is recovered, the resource and the environment common denominator notwithstanding. Of these, the production of resources for food consumption naturally takes precedence, i.e. agriculture, and it is this which we will turn to now.

3. Provisioning services: agricultural production and food supplies

3.1 Supplying the towns

The great economic and demographic growth which took place from the 10th to the 13th centuries required especially intense efforts to co-ordinate the exploitation of the available resources in the countryside and the towns. In the Veneto the best known case is in Verona, namely the 1199 reclamation of the Zevio marshes. The declaration of intent at the beginning of *Liber de divisionibus paludis communis Verone*, written on this occasion by notary Enverardo (Castagnetti 1974), expressly states that as wheat was lacking in the town of Verona and as there was (in Zevio) an "infructuosa et sterilis" marsh choked by mud and reeds, the town's commune had decided to drain it for the use of the inhabitants and neighbouring villages. The reclaimed area was 4000 Veronese *campi,* i.e. around 12 square kilometres.

What most interests us here about this declaration is its specific reference to the need to supply Verona, the most populous town in the plains east of Lake Garda. In the rest of the Veneto area reclamation work for agricultural purposes is underlined by a series of accounts which historians have highlighted patchily, almost always in relation to individual episodes. These are certainly useful indications to trace the general lines referring to quantitative trends, wich however are less and less defined as you widen the scale through which you look at these phenomena. But certain overall tendencies can be identified.

Gerard Rippe has noted that, a few decades after the Peace of Constance (1183), the Padua district saw massive intervention by city institutions and aristocratic consortia also linked to the city commune designed to undertake large scale hydro-geological and canal building work in the plains (Rippe 2003, 519). As can be seen, this time frame broadly corresponds with the Veronese reclamation work cited above. Once again as regards the Padua area Remy Simonetti has undertaken highly detailed research work into the draining and farming reclamation phases of the marshlands near the Venetian lagoon (which lasted for over two centuries, at least from the mid-12th century to the second half of the 14th century) over which the Venetians also claimed jurisdictional rights (Simonetti 2012, 61-81). It should not be forgotten, in this regard, that,

with its 100,000 inhabitants, Venice was north eastern Italy's most important consumption centre and that it did not have a dependent hinterland apart from a very narrow strip of land on the internal edge of the lagoon from Grado to Cavarzere. Thus the competition for the exploitation of the margins of the mainland, on the coast, where Venetian jurisdiction risked overlapping with that of Treviso and Padua, was extremely intense.

These regional dynamics should be carefully noted with the *raison d'etre* of each semi-urban or rural consumption centre being mixed up with the interests of the great cities and the greatest city of all, Venice[5]. The measures adopted by the Padua commune against exporting food to Venice in the 1220s testifies to this as do the commercial constraints adopted by Venice against Padua, such as the ban on selling the wine arriving at Venice markets in the Padua district (Cessi 1950, 30; Rösch 1985, 232-234), a measure which was rare in the panorama of restrictions on supply (Pinto 1996a, 85).

Venice's pacts with Verona for the circulation of goods along the Adige river contrasted with this commercial conflict with Padua. These early 12th century pacts were studied by Andrea Castagnetti who effectively identified the complementary nature of Venetian and Veronese interests at Padua's expense whose elites were strongly oriented towards profits from the land (Castagnetti 1990, 141-171). Venice could exploit the resources of the fertile Padua area all the same via the large land holdings of its monasteries (Pozza 1995) but without facilitating Padua's economic growth because this latter would have threatened Venetian possessions on the continental side of the lagoon.

It is important to underline that almost all the Po valley city statutes encompassed measures limiting food exports which were jealously guarded by individual communities. And this was not only true of the cities. Conegliano castle, a consortia of nobles holding jurisdiction over 58 villages between the Piave and Livenza rivers, went as far as to double its communal seats to this end and there was a building in the castle on the hill, which was the seat of the *Consilium* in which the city's elites took political decisions, and a second *domus communis*, constituting a sort of 'fondaco' – namely a storage area used by the community for the sale and distribution of wheat and salt exclusively for those living within the Conegliano district. It was here that the late 13th century council adopted a ban on wheat exports and sale to the town district across the border (Canzian 2000, 101).

The picture emerging here is thus characterised by the prevalence of local interests in a context of political fragmentation. The food resources were subjected to rigid bureaucratic controls which responded not only to the supply needs of the main towns but also to political strategies. During wartime these

[5] On the era from the end of the Middle Ages to the Early Modern era, see Faugeron 2014.

strategies were even clearer as one of the main techniques used to wear down the enemy was less destroying crops and blocking water supplies rather than battle. As an example it should be noted that, from the second half of the 13th century until 1314, Padua dug the still extant Brentella canal joining the Brenta up to the Bacchiglione for the purposes of guaranteeing constant water supplies to the city – the Bacchiglione worked the city's mills – including when, for strategic reasons, the river would be diverted upstream (Grandis 1999, 115-119).

Fear of war and famine, localism and the powerful demand for food products in the urban and semi-urban centres was closely bound up with a large number of diverse and frequently conflicting variables. But, even at the most prosperous times, supplies to the community were never free of constraints imposed by need and urgency. This insecurity was an instrument of political control and, occasionally, a tool for military pressure.

Studies of provisioning services in the medieval Veneto does not, then, seem to have been independent of institutional transformations and political-military events. And, in effect, this observation is confirmed by Silvana Collodo's findings in an essay published a few decades ago, a pioneering study of the way Veneto mainland cities managed their supplying issues in the 12th and 13th centuries. Collodo carefully assessed the tax burden imposed by the urban lordships in the 14th century on the food market, a veritable forest of rights and taxes imposed on products. Collodo concluded that the city's control over primary products was, in all likelihood, not designed primarily to guarantee the survival of its citizens. The logic was different: supplies and their consumption were a tax opportunity designed to fulfil the needs of the public purse and reinforce the lords' managerial control. This means, consequently, that agricultural production was conceived primarily as "a state asset" while "the issue of supplying the civil population in the cities was an element of secondary importance in food supply policies" (Collodo 1999, 57, 62). The urban population's wellbeing was thus, from this perspective, not the primary goal of the urban institutions and this was especially true in the era of the lordships (14th century).

3.2 Supplying in the countryside

If cities are objects of primary interest in the eyes of historians for the reasons cited above, the countryside, with its large population scattered across a myriad of villages consisting of a few dozen or a few hundred people and its medium sized towns with populations of several thousand (such as Conegliano, Monselice and Bassano), should not be ignored. What supply network served these areas?

On this matter we must return to the issue of the dissemination of fortified village enclosures located near churches, the *curtine*, structured into *canipe*, small rural warehouses designed to store harvests. This is a subject on which the documents have little to say but in any case throw a little light on the methods used in the management of agricultural produce, settlement patterns and villages' social relationships. In fact the presence of the *curtine* presupposes a desire to collectivise storage – of a lordly or community matrix – probably to foster protection and concentrate production in view of its more straightforward distribution on the commercial circuits (Collodo 1980, 18; Settia 1984, 455).

The castle warehouses were a step up, in social and structural terms, from those described above. Much is known of these, largely as a result of the work of Aldo Settia. Castle warehouses were tools for the affirmation of lordly power because the owners of such buildings could oblige peasants to store their *biade* – wheat, spelt, millet, sorgum and oats – legumes, wine and even bread in these warehouses ('incanevare' or 'incanipare', i.e. place in the cellar) and pay rents for it. But it was, at the same time, a service offered by the lords because in this way supplies were kept safe in reliable buildings in both military and conservation terms. In the Veneto area there were many of these: in historic Treviso province there were at least seven – Sernaglia, Montebelluna, Camino, Oderzo, Scorzé, Trebaseleghe, Orgnano; in Padua district – San Giorgio delle Pertiche, Pernumia, Agna; in Vicenza district – Quinto Vicentino, Lonigo, Bassano, Costozza (Settia 1984, pp. 443-452; Canzian 2013, 152, note 26; Rippe 2003, 415). These were castle centres owned by secular and ecclesiastical lords. They were thus buildings serving medieval landowning interests which, at times of economic growth, such as the 10th to the 13th centuries, were of considerable importance perhaps also given the potential for speculating on product availability in large grain production areas in a way which is not dissimilar from today's mechanisms although its proportions were certainly very different.

A significant example of this is, I believe, *Cavoça* motte, a no longer extant settlement located along the lower course of the Sile river and owned, in the early decades of the 13th century, by a Treviso merchant (Canzian 2013, 151). This building, a 13 metre high brick tower, was the linchpin in a land estate focused on defensive structures and services ('barbacane', 'fracta', 'burgus'), and a space divided up into plots with peasants' houses on them ("cassos domorum copertos pallee", i.e. essentially large rooms with no floor and a straw roof). There was a village in the vicinity of this motte, called San Marino, which also disappeared in the 13th century where a 1240 source notes that a rural market generally took place ("ubi consuetum facere forum Sancti Marini", Canzian 2013, 152). I would thus not rule out that there was a functional relationship between this motte and market.

The great monastic land estates also had storage structures. The Cistercian monastery of Follina, for example, owned two granges, one in Santa Lucia di Piave and the other in Stabiuzzo, always along the lower course of the river. The great Benedictine abbey of S. Giustina di Padova owned important courtyards – which are still in a good state of conservation – in Legnaro, Correzzola and Maserà, but there is evidence of at least one 'smaller' storage site (*canipa*) separate from its satellite estates, at Ronchi, near Maserà (Bortolami 2008, p. 45).

One specific case study on this subject is the mainland land estates of Venetian religious bodies. The land estates of these monasteries were truly huge to the extent that they constituted, in Sante Bortolami 's words, Venice's invisible *contado* (Bortolami 1992). The Cluni monastery of S. Cipriano di Murano, for example, had, since 1208, owned an enclosed area in Pianiga, near Padua, where it had a *caneva* and a porticoed *domus* – here a monastic steward collected the food supplies owned by the monastery and had them sent by river boat to Murano (Bolzonella 2012, 341). A further example: S. Cipriano in 1154 collected wine, grain and linen at Lova, near the Venice lagoon, and a "navis dominicalis", i.e. one of the mother house's boats, came to pick these up and take them to Murano. For Gerard Rippe the Venetian monasteries "entretiennent un trafic périodique de bateaux qui viennent se charger de l'enlèvement des produits des tenures" (Rippe 2003, 423, note 63; Simonetti 2009, 110, for other cases). In general it should be underlined that these river deposits were temporary storage sites in the expectation that supplies were to be transported to the mother house and were thus excluded from local trade. All the same they constituted key locations on the country transit and storage networks and allow us to sketch out a foodstuffs distribution map if nothing else.

The large landowner resource management picture is thus filled up with a range of variables which do not make for a unitary view. And if this is the case of storage, the redistribution picture is even more complex. What we need in this respect is to be able to quantify the harvest shares which remained available to farmers and those which were passed on to owners and in both cases how much of these shares was consumed within the family and how much went to the urban and rural markets. Difficulties in assessing this are partly due to the fact that the rural markets are especially difficult to survey as the relevant sources are extremely incomplete on the subject (Settia 1993, 218, 225-227). To my knowledge, the evidence cited above – the San Marino di Cavozza market – is extremely rare. In the Treviso area, however, at least one further centre can be added, the previously cited village of Stabiuzzo on the middle course of the Piave river where we know that, at least until 1233, a market was held on the St John and St Mary Ciriale feastdays and at Christmas (markets which were

transferred that year to the new bridge built over the river in the area still today called Ponte di Piave; Liberali 1951). For the Padua area there is evidence of a rural market owned by Marquis Almerico in Agna ("in prato de Conca"; Cona? Concadalbero?) in 954. Here the landlord levied the *ripatico* (namely a mooring tax), *teloneo* (tax on trade) and taxed fishing and pasture rights (Rippe 2003, 410). It was thus the place at which the lord's privileges were applied. But we know nothing of who attended this market and with what frequency.

It is clear that these are documentary fragments which do not allow wider reaching conclusions to be drawn. Common features are visible in these three cases, however, which might indicate a research avenue. The first of these is the parallel between the market and the great landed estate owned by aristocratic functionaries or the bodies which took over from them. In the case of San Marino the landed complex was made up of the estate whose centre was the Cavozza motte, which was located in an area which saw the significant presence of the Treviso counts in land ownership since at least the 10th century (Canzian 2012, 23). As far as Stabiuzzo is concerned it should be noted that this was the site of one of the Follina Cistercian abbey granges but the Follina-owned Stabiuzzo estate was very probably originally a jurisdictional and land ownership enclave of the Aquileia patriarchate (Canzian 1995, 13). As regards Agna, as we have seen, in the mid-10th century the market was part of a land estate owned by Marquis Almerico and "produit d'un démembrement suivi d'une recomposition dont la logique interne n'apparaît pas directement, sinon que le nouvel ensemble est établi sur un unique terroir, celui d'Agna" (Rippe 2003, 409-410). Furthermore, all three centres were near water courses: Agna was on the Adige, Stabiuzzo on the Piave and San Marino-Cavozza on the lower Sile, a river which was a much used communications artery between Treviso and Venice. Lastly, the third shared element was the presence *in loco* of ancient consular roads. This is certain for Stabiuzzo which, as we have seen, was on the Postumia and for Agna whose name is a phonetic deformation of 'Annia', the road which led from Adria to the ultimate Aquileia destination. San Marino-Cavozza was also probably on this road, in its section north east of the lagoon, to the south of Musestre (Canzian 2012, p. 22).

Blanket enquiries into the documentation might certainly supply a map of the production and distribution of primary goods, something which would make a great contribution to our understanding of rural living standards, especially if supplemented by a systematic and diachronic survey of other production facilities, such as mills.

4. Conclusions

In conclusion, our initial question remains valid: what did being in "bonum statum" mean to a farmer or town dweller in the Veneto plains and how many people had access to this privileged state? A great deal remains to be explored. In particular, I believe that it is above all in the field of evaluation of the available resources in proportion to population that there is still space to improve our knowledge. In this respect what is needed is quantitative research into the unpublished documentation (and a revision of the published documentation, too, naturally). We need to get to the point of a regional database at least: what needs surveying is mills, types of production and environmental intervention such as canal digging and road building: we also need a clear understanding, as far as possible, of meteorological trends and good and bad harvest patterns with the latter by no means uncommon in centuries normally considered periods 'of growth', such as the 12th and 13th centuries.

The eco-systemic services perspective can guide us in this research, contributing to avoiding reducing the period's human history to power dynamics alone.

Figure 1 - The waterways that run through the Veneto territory from the mainland to the coast (from Bonetto, Jacopo. 2009. *Archeologia delle Regioni d'Italia.* Roma: Istituto poligrafico dello Stato).

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Environnement et services écosystémiques dans le *Polesine*. Le cas d'étude de Costa di Rovigo (XIIe-XVIe siècles)

Remy Simonetti

1. Introduction

Dans cet article je présente certains résultats d'une recherche que j'ai mené dans le cadre du Projet de Recherche de l'Université de Padoue «Ecosystem services *nella bassa pianura dell'Adige e del Bacchiglione dal medioevo all'età contemporanea*» coordonné par Dario Canzian. Tout d'abord il est nécessaire de préciser que, comme l'ont bien souligné Karsten Grunewald et Olaf Bastian, «despite, or perhaps because of the wide distribution and almost inflationary use of the Ecosystem Services term, there is no question that a clear and uncontroversial, universally accepted definition does not exist» (Grunewald et Bastian 2015, 14). En fait une discussion et une reconstruction de l'évolution de ce concept nous entraînerait trop loin de notre objectif, je ne m'arrêterai donc pas sur le débat qui a passionné les savants au cours des dernières années. J'ai donc décidé d'utiliser ici la définition qui m'a paru la plus équilibrée et celle qui à présent jouit du plus grand accord parmi les savants, c'est à dire la définition donnée par Robert Costanza et ses collègues dans le célèbre article *The value of the world's ecosystem services and natural capital* paru dans la revue *Nature* en 1997.

Cette classification comporte, comme on le sait, 4 typologies de services écosystémiques que je rappelle ici très rapidement :

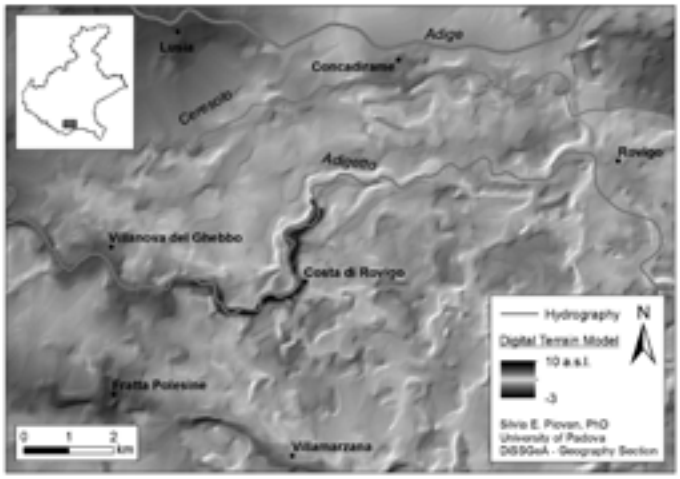
1. *Provisioning services* : c'est-à-dire la nourriture, l'eau potable, le bois, les matériaux bruts etc.[1]
2. *Regulating services* : par exemple la protection contre les crues, le

[1] «Nature provides food and water for our daily existence, the raw materials for handicrafts and industry and medicinal plants for healthcare», Grunewald et Bastian 2015, v.

contrôle de la pollution de l'air etc.[2]

3. *Cultural services* : les services récréatifs etc.[3]
4. *Supporting services* : à savoir tous les processus qui assurent les préconditions nécessaires pour l'existence des écosystèmes.

Le cas d'étude que j'ai choisi pour cette communication est celui du petit village médiéval de *Costa*, l'actuel *Costa di Rovigo*.



Tout d'abord une première question : pourquoi *Costa di Rovigo* ? J'ai choisi ce village parce qu'il se trouve dans une région particulièrement intéressante du point de vue géomorphologique. En fait il s'agit d'une région, le *Polesine*, caractérisée par une altimétrie modeste, comme on le voit clairement dans ce modèle numérique du terrain (DTM) réalisé par Silvia Piovan. L'image montre bien que les points les plus élevés, correspondants probablement aux bourrelets alluviaux, c'est-à-dire aux traces laissées sur le terrain par les anciens parcours de l'*Adig*e, du Pô et des cours d'eau mineurs tels que l'*Adigetto*, se trouvent à une dizaine de mètres au dessus du niveau de la mer, alors que la majorité du territoire se trouve à 0, voire même deux ou trois mètres au-dessous du niveau de la mer. La région présente en outre une hydrographie très complexe, qui, au fil des siècles, a obligé les résidents à effectuer un travail constant d'aménagement, ce qui permet à l'historien de voir comment l'homme a relevé le défi d'aménager le territoire afin de le rendre habitable, exploitable et économiquement rentable. Ensuite je signale l'existence à l'Archive de l'État de

[2] «Forests not only supply us with wood, berries, mushrooms and wild game, but also protect us against soil erosion and flooding, create the oxygen we breathe and bind greenhouse gases that endanger our climate», ibidem.

[3] «People find spiritual inspiration and fulfillment in nature together with an aesthetic pleasure, rest and recreation», ibidem.

Venise, dans le fond *Mensa Patriarcale*, de documents concernant les propriétés foncières de l'abbaye de *San Cipriano di Murano* dans le *Polesine* et notamment dans la portion de plaine alluviale comprise entre les cours actuels de l'*Adige* et du *Canal Bianco*. Il s'agit d'environ 800 parchemins et de quelques registres qui permettent de suivre l'évolution socio-économique du village ainsi que l'évolution de l'environnement sur la longue période du XI^e^ siècle jusqu'à la chute de la République Vénitienne à la fin du XVIII^e^ siècle.[4]

2. Les sources utilisées

Cette remarque sur les documents nous permet d'aborder un sujet central pour un historien, un médiéviste en l'occurrence, qui s'approche à l'étude de l'histoire environnementale d'une région donnée, c'est-à-dire le rôle des sources écrites. Or, en ce qui concerne la situation des sources de l'époque médiévale dans les archives italiennes, il est bien connu que, jusqu'au XII^e^ siècle au moins, la grande majorité des documents arrivés jusqu'à nous provient des grands établissements religieux (évêchés, monastères, églises paroissiales etc.), ce qui a permis à Paolo Cammarosano de parler d'une véritable hégémonie de la tradition ecclésiastique dans le domaine de la production et de la conservation des documents pendant le haut moyen âge (Cammarosano 1992, 39-111). L'état des choses change entre XII^e^ et XIII^e^ siècles, avec la naissance et le développement des autonomies urbaines, les *Comuni*. À partir de cette époque les sources écrites se multiplient, se diversifient, en effet aux actes notariés et aux diplômes des rois et des empereurs s'ajoutent les statuts des villes, les casiers judiciaires etc. À partir de la fin du XII^e^ siècles on voit paraître des lois «environnementales» avant la lettre, c'est-à-dire des lois visant à la protection de certaines ressources naturelles ou, pour citer notre projet de recherche, certains services écosystémiques, perçus comme importants pour la communauté, comme par exemple les zones boisées, les biens communs tels que les marais, les zones humides, les terrains en pâture etc. (Simonetti 2009, 100). En ce qui concerne plus particulièrement les bois Vito Fumagalli a souligné que «la tutela severa del bosco, ormai, si imponeva quasi ovunque nella pianura padana, insieme con la limitazione della caccia e della pesca, nel tentativo di contenere entro limiti sopportabili la dissoluzione progressiva dell'economia silvopastorale, per molti versi e per molto tempo ancora, sotto vari aspetti, non sostituibile» (Fumagalli 1990, 43; Castagnetti 1977, 58). Malheureusement ces

[4] Archivio di Stato di Venezia, (dorenavant ASVe) Mensa Patriarcale, b. 136 (1115-1733). Rubrica "Beni sotto la podesteria di Rovigo"; b. 137 (1313-1356). Rubrica "Beni sotto la podesteria di Rovigo"; b. 138 (1356-1423); b. 139 (1146-1710), Contiene un Libro L, "Catastico delle investiture del monastero dalla Costa"; b. 140 (1105-1729); b. 141 (1157-1589).

sources, et notamment les sources législatives, bien qu'en mesure de fournir à l'historien quelques indices concernant le territoire, ont des limites liées à leur propre nature, en fait elles sont soit très générales, c'est-à-dire qu'elles concernent l'ensemble du territoire ou des cours d'eau, soit très ponctuelles, c'est-à-dire qu'elles concernent une intervention sur un cours d'eau, un pont, un marais, un bois etc.

C'est pourquoi les sources que j'utilise le plus souvent au cours de mes recherches dans le domaine de l'histoire environnementale sont les censiers ou terriers, et les contrats agraires. Alors, pourquoi ces sources sont-elles si importantes? L'importance de ces sources vient tout simplement du fait que les grands propriétaires, ecclésiastiques pour la plupart mais aussi laïcs, afin d'avoir un cadre précis de leurs possessions, font dresser des inventaires fonciers, souvent en ayant recours à des intermédiaires, maires, doyens etc., (Verpeaux 2011) implantés localement et qui connaissent donc très bien les lieux, les usages locaux, les familles etc. Dans ces terriers sont détaillés les rentes et les tenanciers, ainsi que les biens exploités par ceux-ci, avec parfois un réel luxe de détails topographiques ou toponymiques (Glomot 2011). Dans le cas des contrats agraires, qu'il s'agisse de vente, de loyer à court terme, ou de *livello*, les parcelles sont mesurées, parfois même nommées, localisées par leurs confins ou leur position dans le terroir, en fonction des chemins, des routes, des arbres, qui sont souvent utilisés comme repaire, des cours d'eau ou des zones humides, des bâtiments etc. (Glomot 2011, 44). Là encore, avec une grande richesse de détails, on sait ce qui y pousse, qui y travaille et comment, ce que l'on en perçoit comme loyer, s'il s'agit de terre de bonne qualité ou de *mala terra* etc. Dans ce cadre de gestion des biens fonciers la localisation précise des parcelles est un élément très important et très délicat et en effet les rédacteurs de ces documents, ainsi que les arpenteurs, procèdent par approximations successives, du général au ponctuel, jusqu'aux éléments les plus menus du paysage (un arbre, une maison, un chemin, une pierre, etc.). À ce sujet j'ai pu recenser au moins quatre niveaux progressivement de plus en plus précis de localisation.

Le premier niveau, le plus général, concerne la circonscription administrative ou religieuse, le *comitatus* ou *districtus* et le diocèse de la ville chef-lieu. Dans le cas du village de *Costa di Rovigo* il s'agit du *comitatus Rodigii* et du diocèse de Adria.

Le deuxième niveau est celui de la circonscription *plebana*, c'est-à-dire la circonscription paroissiale.

Le troisième niveau est celui qui prend comme référence les implantations humaines, les villages, les hameux, *vicus* ou *villa* dans les sources, parfois *fundus* ou *pertinentiae*.

Le quatrième niveau est celui du paysage agraire, du *locus dictus*, le lieux-dit,

ou parfois la parcelle. On peut facilement imaginer qu'il s'agit du niveau le plus intéressant pour ce type de recherche, parce que là le chercheur est vraiment plongé dans l'objet de la recherche. C'est là que la description du paysage fourmille de détails, tous ces détails qui permettaient aux contemporains, compte tenu de l'absence de cadastres, de situer le bien objet de la transaction dans l'espace, dans un lieux précis et univoque. Niveau le plus intéressant certainement, mais également le plus difficile à apprécier pour le chercheur parce que, ce qui était évident pour l'arpenteur qui a mesuré la parcelle et pour le notaire qui a rédigé le document, n'est plus vraiment évident pour le chercheur qui étudie ce document après huit siècles. Ce sont quand même des indices très utiles qui permettent d'isoler certains éléments du paysage et de se faire une idée de son évolution.

Les documents du monastère de *San Cipriano di Murano* concernant les biens fonciers de *Costa* portent sur un territoire assez limité mais tout de même représentatif de la situation du *Polesine* à l'époque, ce qui pourrait permettre d'étendre la recherche à l'ensemble de la région.

3. Eau et services écosystémiques

Dans un article paru tout récemment (Simonetti 2017) j'ai essayé de reconstruire le cadre environnemental de cette région avec une attention particulière pour la gestion des ressources hydriques par rapport aux implantations humaines. Dans cet article je me concentrerai principalement sur les *provisioning services*, et notamment sur deux typologies : les services fournies par l'eau dans ses différentes formes (fleuves, rivières, marais, étangs et zones humides) et ceux fournis par ce que j'appellerai l'inculte productif et qu'autre fois Dario Canzian et moi-même avons appelé inculte géré, (bois, lisières, landes, prairies etc.; Canzian et Simonetti 2013).

En ce qui concerne l'eau, le DTM que l'on vient de voir ainsi que ce que je viens de dire sur l'hydrographie actuelle de la région, suggère immédiatement un rôle important des eaux dans les vicissitudes de la communauté qui, au fil des siècles, a colonisé et exploité Costa et les environs.

En fait ce rôle des eaux apparait clairement dès l'origine, c'est-à-dire dès 1115, lorsque le Marquis *Folco d'Este* donna au monastère de *S. Benedetto Polirone* une étendue de terrain, 36 *mansi*, sur laquelle au fil des années l'église de S. Jean Baptiste serait bâtie. Le terrain donné se trouvait «super fluvium Adesis… in loco ubi dicitur Costa, coerit ei ab uno latere fluvium Adesis, ab alio latere fosa que dicitur Gaibo, ab uno capite poleseno de supto de Ramedello, ab alio latere

albaro de plobegario».[5] Il est nécessaire de préciser que le fleuve qui apparait ici sous le nom *Adige* est en réalité l'*Adigetto*, c'est-à-dire une dérivation de l'*Adige* qui à l'époque était évidemment perçue par les habitants de la région comme le cours principal du grand fleuve. Les limites étaient donc d'un côté l'*Adigetto*, de l'autre côté le canal *Gaibo*, puis le *poleseno*, probablement un terrain surélevé par rapport à la campagne, une espèce de polder, et un arbre, notamment un peuplier.

En effet l'analyse des documents permet de dire que l'*Adigetto* a été le catalyseur du développement urbain de *Costa*, ainsi que le tournant de son développement économique et social. Une série de renouvellement d'investitures à *livello* de *casamenta casamentiva*, à savoir des parcelles habitables avec, en annexe, une partie cultivée, permet de voir que les maisons se trouvaient toutes près de l'*Adigetto*. Je signale par exemple la parcelle louée a *Bono fu Pietro de Orçano* en 1329, qui comprend «unum sedimen cum duabus domibus paleatis superpositis et clausura ac glara et salicibus super rippam Attecis», qui confine «a meridie quadam viatella monasterii predicti, a nulla hora flumen Attecis»,[6] et celle louée à Jean du feu Gérard, originaire de Bologne, qui comprend «unum sedimen cum duabus domibus palleatis positis superius, et cum clausura et cum glaria, et sallicibus super ripa Atticis … a nullora flumen Atticis».[7]

Cette rivière jouait probablement un rôle de premier plan comme source d'eau potable et pour l'irrigation des parcelles cultivées, mais aussi en tant que voie de communication. Une voie très importante notamment pour le transport à *Murano*, dans les *canipae* du monastère, des denrées copieuses produites dans la région. En fait j'ai trouvé de nombreuses attestations concernant l'obligation pour les locataires de «ad suam canipam in ipsa villa suis expensis conducere quartam partem et decimam omnium frugum»,[8] d'où elles étaient acheminées vers *Murano* grâce à un trafic périodique et régulier de bateaux qui, comme l'a bien souligné Gérard Rippe pour le *contado* padouan, «viennent se charger de l'enlèvement des produits des tenures» (Rippe 2003, 423; Simonetti 2009, 110).

L'importance de cette voie de communication est bien mise en évidence par une série de témoignages datant de 1171 et concernant quelques parcelles situées à *Costa*.[9] Les témoins précisent qu'une grande partie des parcelles étaient possédées *cum exitu ad Athesim*, à savoir avec le droit d'accéder directement au

[5] ASVe., Mensa Patriarcale, b. 136, doc. 1, 1115 juin 14.
[6] ASVe., Mensa Patriarcale, b. 137, doc. 154Z, 1329 janvier 27.
[7] ASVe., Mensa Patriarcale, b. 136, perg. 89, 1307 juin 5. En ce qui concerne le développement urbain de Costa il est intéressant de souligner qu'à l'Archive de l'Etat de Venise il y a une cartographie datant du seizième siècle qui montre très bien la structure de l'habitat, mais je n'ai malheureusement pas eu le temps de la reproduire.
[8] ASVe., Mensa Patriarcale, b. 136, doc. 56, 1267 juillet 27.
[9] ASVe., Mensa Patriarcale, b. 139, doc. 780, 1171 juillet.

cours de l'*Adigetto*. Grâce à de petits canaux de dérivation l'*Adigetto* fournissait également la force motrice permettant le fonctionnement de moulins et foulons qui étaient probablement concentrés dans une zone très proche de la rivière, comme en témoigne l'existence, au XIII[e] siècle, d'une *via molendini*, (voie du moulin) située « prope Attecim mediante via comunis », qui devient *via molendinorum*, au pluriel, en 1461[10] et qui est existait encore en 1518.[11]

Mais, comme je viens de le dire, ce n'est pas seulement l'eau de l'*Adigetto* et des cours mineurs qui segmente les campagnes de *Costa*. Dans les sources j'ai trouvé de nombreuses mentions de *valli*, ce mot qui peut indiquer soit des plans d'eau, spécifiquement aménagés pour la pisciculture et des viviers (Bottaro 2004, 13-31), soit des zones humides ou marécageuses ou des étangs.

Ces *valli* étaient souvent entourés par des saules, *cum sallicibus* dans les sources, cet arbre qui s'accommode très bien dans les zones humides, tout en contribuant à fortifier les levées. Les saules fournissaient également les ficelles utilisées pour lier les vignes, et parfois les vignes étaient même mariées aux saules (*viti maritate*) et devenaient alors une sorte de tuteur vivant. Or, ces zones humides sont en effet une importante source de services écosystémiques, et c'est pourquoi elles ont résisté à la vague d'assainissements qui avait pris une grande ampleur depuis le XII[e] siècle. En fait, comme l'a bien souligné Gérard Rippe, « on n'a pas à s'étonner de voir les marais survivre même à l'issue des opérations les plus spectaculaires. Il faut penser aux objectifs économiques liés à l'eau » (Rippe 2003, 534) et, l'on peut ajouter, aux services écosystémiques que les zones humides fournissaient.

Le premier service écosystémique qui vient à l'esprit est clairement la pèche, une pratique largement diffusée dans la région, comme en témoignent les nombreuses querelles qui ont opposé, au fil des siècles, les principales puissances de la région, à savoir le monastère de *S. Cipriano*, l'abbaye de *Pomposa*, la commune de *Rovigo*, les Marquis *d'Este* et les communautés villageoises pour les droits de pêche dans les rivières et les *valli* de *Costa*. Je propose seulement quelques exemples tirés d'un procès datant de 1171 qui montre bien l'enchevêtrement de ces droit : Guillaume *de Gregoro* dit « scio quod piscavi pro comuni Rodigii usque ad lacum de Roga »,[12] mais son collègue *Silvester* déclare que « scio quod vidi piscari in hac terra pro marchionibus »;[13] Pierre Butune, de son côté dit « scio quod capulum et pasculum atque piscationem habui pro

[10] ASVe., Mensa Patriarcale, b. 139, dossier sur parchemin marqué «Hoc est catasticum livellorum monahsterii sancti Cipriani de Muriano rerum et bonorum positorum in villa Coste inceptum sub MCCCCLXI», c. 34r., doc. 559Z, 1461 novembre 18.
[11] ASVe., Mensa Patriarcale, b. 139, dossier papier marqué «Armaro Z, Rinovazioni livellarie. Costa 1518. Libro H», c. 17 v., doc. 604, 1518 octobre 7 et c. 49v., doc. 642Z, 1518 octobre 14.
[12] ASVe., Mensa Patriarcale, b. 139, doc. 780, 1171 juillet.
[13] *Ibid.*

abbate pomposiano in loco qui dicitur Costa ».[14] Or, ces querelles duraient des années, voire des décennies, ce qui témoigne de l'importance économique de la pêche dans cette région.

Les espèces de poissons mentionnées dans les sources sont la carpe, le rotengle (*scardola*), la tanche (tinca), le *triotto* (*rutilus aurea*), le brochet et l'anguille, en plus des écrevisses. Il s'agit d'espèces qui aiment les eaux lentes voire même stagnantes, et riches en végétation, et qui s'accommodent bien dans un environnement pauvre en oxygène (Bottaro 2004, 47-48).

Une autre pratique liée aux zone humides et largement diffusée aux alentours de *Costa* était la chasse, et notamment la chasse aux oiseaux de passage qui trouvaient dans ces surfaces d'eau un lieu de halte et de de détente lors de la migration saisonnière.[15]

Ces *valli* étaient également une importante source de matériaux bruts comme les roseaux, les *canne* ou *cannelle*, utilisés par de nombreux paysans et sans doute par Jean fils de feu Gérard, de profession *cestarius*, vannier, pour réaliser corbeilles, paniers etc.[16]

Ces *canne* étaient également utilisées dans le domaine du bâtiment comme liant pour le ciment ou pour la couverture des maisons. En fait, aux douzième et treizième siècles la majorité des maisons étaient couvertes de *paleis*, mais il y en a également couvertes *de canella*, comme celles louées par « Bonus quondam Petro de Orçano » en 1353.[17]

Une autre source de services écosystémiques est, comme je le disais, l'inculte, à savoir bois, lisières, landes, prairies etc., ces écosystèmes que j'ai qualifié d'inculte productif ou géré. Les documents examinés donnent en effet l'image d'un environnement qui semble en grande partie échapper au contrôle de l'homme, un environnement dans lequel les parcelles cultivées demeurent très proches de l'*incultum*, représenté dans différents cas par des bois ou des parties de bois, des marais, des lisières ou des zones humides. En fait les mentions de parcelles, *sedimina*, constituées d'une partie cultivée en blé, orge ou autres céréales ou des vignobles, et d'une ou plusieurs parties de prés ou boisées, ou marécageuses sont très nombreuses. Par souci de brièveté je signale seulement quelque cas, datant de 1336, donc bien après la saison des grands assainissements, sur les dizaines que j'ai répertorié, en premier lieu celui de la « petia terre aratorie et prative et vallive cum salicibus, duorum camporum

[14] ASVe., Mensa Patriarcale, b. 139, doc. 783, 1173 janvier.
[15] ASVe., Mensa Patriarcale, b. 139, doc. 780, 1171 juillet.
[16] ASVe., Mensa Patriarcale, b. 137, dossier sur parchemin marqué B, f. 159z, 1331 avril 20.
[17] ASVe., Mensa Patriarcale, b. 137, dossier sur parchemin marqué B. Instrumentum livelorum de la Chosta, f. 13r., doc. n. 246z, 1353 avril 10.

vel circa iacens in dicto fundo in contrata Boschi » ;[18] ou celui de « una pecia terre partim aratorie et partim buschive camporum duorum iacente in territorio dicte ville Coste in contrata laci iuxta viam ».[19] À ce sujet, l'exemple le plus intéressant et celui qui explique au mieux la complexité du territoire de Costa est certes celui qui concerne les parcelles louées à Gérard du feu *Cavedonus de Costa*. Gérard devient locataire de cinq parcelles ainsi décrites par le notaire : « prima est una petia terre aratorie et prative et vallive cum salicibus duorum camporum vel circa, iacens in dicto fundo, in contrata Boschi…; secunda petia terre est aratoria circa quatuor camporum, iacet in dicto fundo,in dicta contrata Buschi; tertia petia terre est valiva circa sex camporum posita in dicto fundo; quarta petia terre est valliva circa trium camporum posita in dicto fundo in contrata de Dossadellis; quinta petia terre est buschiva dimidii campi posita in dicto fundo in contrata dicta I Boschi ubi dicitur Lagus ».[20]

Comme je le disais, les exemples pourraient se multiplier, en renforçant ainsi l'idée que les nombreuses parcelles boisées ou partiellement boisées ne sont pas de simples résidus de la grande saison des déboisements, cette entreprise titanique qui a amené à la création d'un mosaïque d'écosystèmes artificiels, en grande partie consacrés à la maximisation de la production céréalière (Burri 2016).

En fait les grands déboisements médiévaux ont laissé survivre des étendues plus ou moins importantes de bois, même près des grandes villes, et cela parce que leur importance était reconnue par les communautés en tant que sources de matériaux bruts, de combustible, de nourriture pour les hommes comme pour les animaux.

Voyons quelques exemples : il est bien connu que les bois étaient une source de nourriture pour certains animaux et notamment pour les porcs, à tel point qu'au moyen âge la dimension des forêts de chaines était souvent évaluée sur la base de la quantité des porcs qu'elles pouvaient nourrir. La pratique est très diffusée à *Costa*, et les droits de pâturage dans les bois ont fait l'objet de plusieurs querelles entre les paysans et le Marquis d'Este comme on l'apprend dans la déclaration de *Gondoaldo* qui, en 1171, dit « scio quod piscavi et venavi et capulavi in hac terra pro Marchione et suum ius de porcis ei dedi ».[21] Le bois était également important pour le pâturage des chèvres, des moutons et des brebis qui mangeaient les jeunes feuilles des branches les plus basses en

[18] ASVe, Mensa Patriarcale, b. 137, B. Instrumentum livelorum de la Chosta, dossier marqué D, doc. n. 243z, 1353 avril 9.
[19] ASVe., Mensa patriarcale, b. 137, B. Instrumentum livelorum de la Chosta, f. 7r., doc. n. 175z, 1336 octobre 15.
[20] ASVe., Mensa patriarcale, b. 137, B. Instrumentum livelorum de la Chosta, dossier marqué D, doc. n. 243z, 1353 avril 9.
[21] ASVe., Mensa patriarcale, b. 139, perg. n. 780, peu de temps après le 23 juillet 1171.

garantissant ainsi une sorte de gestion de la flore spontanée et par conséquent l'accessibilité du sous-bois.

Dans les bois, les habitants de *Costa* pouvaient cueillir des herbes comestibles, des champignons, des noix, etc., ils pouvaient chasser les oiseaux, les lièvres etc., ce qui permettait d'intégrer un régime alimentaire basé surtout sur le surplus de céréales obtenu des parcelles cultivées. La chasse au gibier de grosse taille, le sanglier par exemple, était évidemment réservée aux seigneurs.

Je viens de mentionner le *ius capulandi*, c'est-à-dire le droit de récolter du bois, habituellement de petite taille, dont jouissaient presque tous les habitants de *Costa*, qui pouvaient ainsi se chauffer, fabriquer des outils d'usage quotidien pour la maison ou pour les champs. Les arbres de grande taille, notamment les chênes, étaient l'apanage exclusif ou presque des « seigneurs », le Marquis, l'abbé etc., et étaient utilisés comme matériaux à bâtir ou pour la construction de bateaux. En ce qui concerne le bois, je souligne l'obligation, qui concerne presque la totalité des locataires, « de arboribus et salicibus plantare et plantatas allevare ».[22] Il est intéressant de souligner que l'obligation concerne aussi les saules qui ne fournissent un bois de valeur ni pour la construction ni pour le chauffage, mais, comme nous l'avons vu, leur usage est probablement lié à la viticulture. Ceci dit il n'est pas surprenant de constater que les loyers comportent le payement d'un quart ou d'un tiers du bois produit sur la parcelle. À cet égard, le contrat concernant *Paganino* « de Bruçigana qui doit redere et dare dicto monasterio ad festum omnium sanctorum unam bonam aucam pro campo et in racione campi que essent prata et nemora et pustillia de lignaminibus plantatis tam in ripis et iaris quam in nemoribus et pustillis » [23] est particulièrement clair.

Comme je le disais, dans les sources examinées j'ai trouvé de nombreuses mentions de prés ou prairies, de terrains en pâture et de parcelles en partie pré et en partie bois. Il s'agit probablement des parcelles, ou parties de parcelles, moins adaptées à la céréaliculture sans doute parce qu'elles étaient trop humides (effectivement une grande partie de ces parcelles se trouve *in contrata Laci*, dans le lieu-dit Lac). Dans tous les cas même ces parcelles avaient une valeur pour les habitants de Costa, notamment car elles étaient considérées comme une source de foin et un espace de pâturage. Et pourtant, en dépit de la présence massive des prés dans les sources, les mentions explicites de la pratique de l'élevage bovin sont très peu nombreuses et dans la majorité des cas indirectes. Prenons par exemple l'arrêté d'un procès de 1173 concernant 36 *mansi* sur lesquels « debent homines predictorum monasteriorum… pasculare cum suis bestiis … salvis regulis comuniter factis » ; [24] un autre arrêté prévoit

[22] ASVe., Mensa patriarcale, b. 136, perg. n. 56, 1267 juillet 27; b. 136, perg. n. 39, 1356 janvier 22.
[23] ASVe., Mensa patriarcale, b. 136, perg. n. 56, 1267 juillet 27.
[24] ASVe., Mensa patriarcale, b. 136, perg. n. 4, 1173 janvier 4.

« quod homines monasterii et homines Marchionum habitantes in Costa pasculent invicem inter se sine dampno et salvis regulis in finibus Coste » ; [25] ou encore la mention, en 1267 d'une parcelle d'environ 36 champs (le champ à la mesure de *Rovigo* est d'environ 4400 m^2) « qua terra consueta erat stare in pascullo *bestiarum* ».[26] L'élevage, probablement bovin, (je rappelle qu'en patois le mot bestia, est utilisé exclusivement pour indiquer les vaches) était donc pratiqué, et il y avait même des règles à respecter pour l'utilisation des parcelle communes, mais aucune mention directe concernant l'achat, la vente ou des contrats de bail à cheptel, *soccida*, de bétail. Il n'y a également pas de traces de fumier, ce produit secondaire, si je peux m'exprimer ainsi, de l'élevage qui était la seule forme d'engrais dont les paysans médiévaux disposaient et qui était largement présent sur le marché. La seule mention de bovins que j'ai trouvé concerne les représailles faites par les « homines Rodigi qui venerunt et abstulerunt boves… pro comuni Rodigii ».[27] Aucune mention de chevaux non plus, sauf dans la toponymie. En fait il y a une attestation tardive, datant de 1536, d'un lieu-dit *Il prà dei Cavali*, le pré des Chevaux, qui était probablement consacré à l'élevage.[28] Il s'agit d'une situation très proche de celle que j'ai trouvé pour le territoire de Trévise. Aucune mention, ou presque, concernant l'élevage dans le large éventail de sources que j'ai pu étudier. (Simonetti 2018, 231-243).

Ce rapide aperçu nous a permis de voir que, au cours des siècles médiévaux, les communautés villageoises, ainsi que les collectivités citadines, profitaient largement des services écosystémiques fournies par l'environnement de la région étudiée et notamment des services fournis par les zones humides. Cet état de choses commence à changer entre la fin du quinzième siècles et le début du seizième, lorsque Venise étend sa domination sur le *Polesine* et lance une grande campagne d'assainissement, de mise en valeur de l'inculte, et de gestion des cours d'eau de la région, cette région qui, comme nous l'explique très bien un arrêté du Senat vénitien était « subiecta le aque ut est notorium non si possa mantenere se non con grandissima spesa per la confectione de essi arzeri et similibus attendendo alla grandissima summa de essi argeri che ha mantenir ditta iurisdizione che è circa miglia cento », mais cela c'est un autre chapitre de cette histoire.[29]

[25] ASVe. Mensa patiarcale, b. 139, perg. n. 781, 1171 novembre 18.
[26] ASVe., Mensa patriarcale, b. 136, perg. n. 56, 1267 juillet 27.
[27] ASVe, Mensa patriarcale, b. 139. perg. n. 780, peu de temps après le 23 juillet 1171.
[28] ASVe, Mensa patriarcale, b. 139, Libro L, «Catastico delle investiture del monasterio dalla Costa, anno MDXXXVI», c. 1r., doc. n. 690Z. 1536 septembre 19.
[29] ASVe, Mensa patriarcale, b. 140, doc. 822Z, petit dossier papier contenant des copies de *ducali*, 1489.

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Landscape planning and integrated economy in Medieval Italy: the case study of the Adige plain and the Este marketplace

Francesco Tognana

This work is the first step towards major research on the relationship between people and the environment in the Italian region between the River Adige and the Venetian lagoon during the Middle Ages. The aquatic landscape of the area contributed to the success of Este – a city not far from Padua – as a marketplace, thanks to an integrated economic system. This work looks closely at the role of waterways in the geopolitical development of that plain. It deals with the ecosystem services, paying particular attention to the evolution of territorial management, regulation of water flows, and the impact of human activities on the environment.

To begin with, I would like to give some geopolitical information. I'm referring to the lands on the left side of the flow of the River Adige. Today this is a "dry" plain because of the restless land reclamation carried out in the last centuries. In Medieval times the area was largely occupied by lakes and marshes fed by the Adige maggiore (*Athesis maior* in the 10th Century records) and its distributaries. The Adige maggiore came out the River Adige near Bonavigo, a village not far from Bevilacqua in the countryside of Verona. Once the Adige maggiore passed Bevilacqua, it entered the Paduan district flowing through Montagnana and Saletto until reaching the base of the Euganean Hills, the castles of Este and Monselice, and finally the Lagoon of Venice (Collodo 2014). According to the latest studies, the Adige maggiore was an important trade route among the North of Italy, the Transalpine region and the commercial hub of Venice during the Middle Ages (Tognana 2017).

The Adige maggiore was also a very important waterway in the political structure of the North East of Italy during the Middle Ages, as it linked the Western to the Eastern part of what was once the Roman Empire through the rising and then ripe medieval emporium of Venice. For instance, the establishment of Monselice as a *comitatus* before the early 10th Century is related to the control of the southern Adige reservoir by the public authority.

Such a political project was probably inspired by a previous plan drawn up during the Lombard rule as the repetition of the word "sculdascia" in the area. Indeed, the word stands for a district under the control of a Lombard official named "sculdascio" (Tognana 2017a, Vigato 2018).

For sure, once the German region became the core of the Western Empire in the second half of the 10th Century, the reason of the establishment of Padua as a *comitatus* – at the expense of Monselice – lies in the jurisdictional homogeneity to be ensured to the region framed by the Rivers Adige, Bacchiglione and Brenta. This was due to the proximity of their riverbeds in the mountain region as well as near the mouth next to the Ventian Lagoon. *Ex post* evidence of such a plan are the improvement of the connections of the Bacchiglione and the ancient riverbed of the Brenta to form the water ring of Padua before the half of the 11th Century and the numerous laws regarding water management issued by the comune of Padua, which, since the early 12th Century, overlapped and then replaced the *comitatus* (Collodo 1990, Grandis 2008, Tognana 2017a).

The geopolitical framework I outlined well explains the commitment to find balanced solutions and to achieve the maximum possible benefit in such a peculiar environment during the Middle Ages. In regard to water excess, Dante Alighieri himself remembers indirectly the bulk of the problem and the hard work of the locals to solve it, when he compares the Paduan experience with the well-known commitment of Dutchmen to similar endeavours (Collodo 2015).

The first records date back to the early 9th Century and refer to the dispute between the inhabitants of Verona and Monselice for the boundaries that were muddled or even deleted by the floods of the Adige maggiore in the countryside of Bevilacqua, where the river swelled due to the supply of its tributaries. Such a floodplain explains the etymology of Bevilacqua, that means "absorbing water"! Management of the wetlands was in the local agenda for a long time, seen that the sources mention that the canal named *Fossa alta* – which means deep pit – was dug by the inhabitants some years before. Such a canal was used for land reclamation as well as for conveying goods and people, like the *Fossa Carolina*, built some decades before, by the emperor Charles the Great, in order to connect the Rivers Rhein Main and Danube. The dispute was an important issue, as revealed by the interference of high-ranking imperial servants in order to settle the matter (Tognana 2017b).

The environmental context, outlined before, shows also the need to protect the wetlands due to their importance, for instance, in flax and hemp breeding. These natural fibres were used for the manufacture of tissues, ropes, fishing nets and gears but also for cooking and producing paper. Related to this topic is the case-study of Tillida, a village close to Bevilacqua which is mentioned in the 10th Century. The etymology of the place-name refers to the word tĭlia – linden

or its fibre – whose manufacture required retteries. Although not mentioned at the time, retteries should have been existing due to the environmental characteristics of the area, that are similar to those where we track down the place-name Maserà, a village south from Padua mentioned since the early 10th Century, whose name refers to rettery. It's important to specify that the proper word for rettery in medieval Latin is *vadum*, which also means ford! (Tognana 2017b)

Other local place-names are *Terracium, Vimenario, Saletum*. The last two ones, named after *salix viminalis* – to say osier (willow) – provide information on the different systems adopted in the Medieval times – and still in use – to support the riverbanks, otherwise subject to erosion. I'm referring to osier palisade and terracing, respectively *viminata* and *terracium* in medieval Latin. However, the medieval comune of Padua decreed that osiers used in such water engineering were to be removed if they occupied the riverbed. Moreover, the local statute prescribed to maintain the breaches if they were useful for the irrigation of the fields but also, on the contrary, it prescribed to strengthen the riverbanks as foot-routes. In that case the threats were infiltrations and sand accumulation obstructing the flow, due to the low ground inclination and the thick brush along the riverside. Other ones were the erosion and the resulting mud heap due to the building of hydropower plants along the riverside. I'm referring to water, paper or textile-mills. Also, the statute of Padua forbade free planting along the *restara* – that is the riverside set aside for the horse-drawn boats. Moreover, it forbade digging holes or building into the holms since they could be the cause of the ground and riverbank collapse. It must also be said that the routine maintenance of pits provided the materials for the reinforcement of the riverbanks while ground surplus was thrown into the surrounding fields to make them unbroken and fertile (Tognana 2017b).

With regard to local environment, there are hydronyms and place-names referring to fish such as Bisato, Anguillara, Scardovara, that are respectively the eel and the scardina. They confirm the amount of wetlands, the slow flowing and once again the commitment to achieve balanced solutions that supplied, for instance, the fishing industry. According to the latest studies, the Este marketplace hosted a *domus mata*, a space devoted to fish trade as reminded by the case-study of the Ravenna *schola piscatorum* and its *casa matha* (Tognana 2017a,Tognana 2017b).

Finally we arrive onto the subject of settlements and marketplaces. The sources mention a *domus paludis Montagnane* at the end of the 12th Century and a *villanova*, a new settlement south from Este in the next one. Both records remind us the commitment of the local authorities to optimize the land reclamation efforts with its colonization. In this regard, it's important to

remember the hydraulic network that ensured the healthiness of the city centre since the market square had spaces devoted to slaughtering, as it happened in Este. The availability of running water in such a polluted urban environment was undoubtedly the reason of a law banning the dumping of waste into the river, as stated by the Paduan authorities in the 13th Century. The statute was meant to not worsen the already unhealthy life conditions and wanted to guarantee the activity along the waterways as well (Tognana 2017b).

Really, it would be useful to deepen the topic of the drainage system within the cities and the nearby areas, as the case-studies of Montagnana and Este suggest.

The statute of Padua once again is very interesting in that respect.

A double canal was excavated near Montagnana within the late 13th Century to contain the Fiumenuovo from flooding and to feed the Adige maggiore at the same time. The excavation of a canal in the surroundings of Este planned by Paduan authority before the 13th Century had the same purpose, because the area collected the water excess of the tributaries of the Adige maggiore. Such a wetland was named *villa Zota*, which means 'lame' in the local dialect and it refers to an ustable equilibrium. Also, the plan was probably aimed at strengthening the connections between the Este and Venice marketplaces, due to the fact that Este was at the core of the regional urban system developed along the River Adige (Tognana 2017b).

As far as river's navigability is concerned, the topic is very important due to the fact that in the Middle Ages the rivers were the most important trade routes, thus inland ports were built along them. A manuscript of the late 13th Century mentions the buildings belonging to boatmen along the Este riverside, according to a settlement pattern typical of the inland port. For sure the major hub was set up at Ponte della Torre not far from the city centre. This was a fortified place surrounded by canals, where foodstuffs had to be lodged and duty had to be paid. The Venetian chronicler Marin Sanudo the Younger wrote that the Restara Canal flowed to Este and not the reverse, well into the 15th Century. The statement confirms indirectly the role of Este as a commercial hub. Besides, the same source clearly remind us that *da tute le bande de Este se fa esser aqua et si naviga* (Tognana 2017a).

No wonder the medieval comune of Padua stated the full navigability of the Adige maggiore through special acts.

However, water stagnation and slow flowing were in some way preserved. The topic concerns the use of fords for human, military and horse mobility. There were many along the last stretch of the current River Adige, which was called *Flumen Vetus* due to its inactivity in the Medieval Times. It's obvious that

the public authorities maintained fords and wetlands because of their strategic role.

Finally, I agree with Silvana Collodo on the medieval economy in the Adige floodplain. She states that the integrated system between dry land and running water had to be ensured due to its effectiveness for the economic success of the region. The environmental renewal of the area in the Middle Ages was both the reason and the result of the development of an integrated economic system too. In effect, the development of agriculture, hunting, fishing and trade is the key to understand the revival of the roman city of Este in the Middle Ages and its success as a commercial hub in the Adriatic hinterland. Obviously, the level of such a success has to be valued analyzing the real extent of land reclamation and the agricultural production, which are topics closely linked with the soil exploitation strategies and ecosystem services in the Middle Ages (Collodo 2015). Investigations into this subject are already under way .

Note: Special thanks to Daniel Zilio, beloved friend, for supervising the translation of the text.

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Monks, management and God's mercy: the Russian monasteries and the environment of the Russian north in the early modern age (16th – 18th centuries)

Alexei Kraikovski and Margarita Dadykina

1. Introduction

The Russian monasteries sprung up in the late 10th – early 11th centuries, after the adoption of Orthodox Christianity (Shepard 2007). The monastic tradition came to Russia via Byzantium and we would argue that the differences between the Orthodox and Catholic monastic traditions are of some significance for our theme.

Unlike the Western world, pluralistic attitudes towards monastic life are absent in Russia. The Russian church imposed uniform principles of monastic organization across the country and there were thus no monastic orders in Orthodox monasticism. Throughout the late 14th to early 16th centuries, most Russian monasteries[1] were reorganized as coenobiums, closed communities united around strict codes of discipline. When the debate between the adherents of the idea of the poor church, known as "non-possessors", and the idea of the rich and powerful church, known as "Josephites" after their leader Joseph of Volokolamsk, came to an end with the latter emerging victorious after obtaining the support of the secular authorities, the Russian monasteries finally became important economic centers (Letiche 1964, 104 – 122). This result of the religious debate was of decisive importance to the issue of the monastic economy and, therefore, of the use of natural resources, too.

The environment of the Russian North is another center stage player in the story. The vast territory from the town of Vologda in the south to the Barents Sea in the north, with the White Sea as the core space and the great rivers of the

[1] We do not consider Russian monasteries in this article, which long remained osobnozhitelstvo (idioritm).

Dvina and the Onega as links to central Russia, had gradually been colonized by Slavs and then Russians since at least the 11th or 12th centuries. Initially the area was incorporated into the Novgorod Republic, and then, in the 15th century, into Muscovy (since the middle of the 17th century, the Russian state). By the 17th century the Russian North was quite a specific part of the Russian state with a strong local identity and culture (Lajus 2011).

The territory provided several major resources for the economic development of both monasteries and rural settlements. The harsh climate made grain production problematic and thus local agriculture put special emphasis on cattle breeding.[2] The abundance of underground brine and fuel timber became the basis for the salt producing industry (Kraikovski 2002). Local minerals were available and used for various local industries such as mica mining and iron production. Marine mammals from the White Sea and the Arctic Ocean provided skins and blubber. Fish deserves some special attention. The rivers and the sea were rich with fish, including prized species like salmon and cod. The local economy included salmon fisheries, with Atlantic salmon being caught by weirs during spawning migrations and seasonal fishing expeditions to the Barents Sea coast of the Kola peninsula for cod and halibut (Kraikovski 2015).

In a word, the region was good for industry and trade and by the late 16th century it had become one of Russia's most advanced and developed regions, incorporating the port of Archangelsk – the major gateway for Russian commerce with Europe. The role of the monasteries in governing this region was a crucial one. In the following paragraphs we will consider the multifaceted interrelationship between the monks and the water environment of the region in more detail. We will start from landscape management considerations related to the foundation of the monastery itself, proceed to the control of the water environment in the monastery's everyday life and lastly analyze the role water control played in monastic economic power.

2. The water environment and the establishment of the cloister

Monastic expansion in the Russian North started in the late 14th century when Sergius of Radonezh founded the Trinity monastery to the north-east of Moscow which soon became something of a model for Russian monasteries for centuries to come. His concept included a search for hardships which monks were to overcome in the name of God, as an inextricable part of the monastic spiritual experience on the path to the ideal Christian life and, eventually, the salvation of soul. With its harsh climate, poor population and enormous forests

[2] See the detailed analysis of the area's agricultural history in: Shapiro, 1978.

the Russian North seemed the perfect place for such a religious escape from the world. As a result St. Sergius of Radonezh's disciples began moving northwards, generation after generation, founding monasteries further and further from the center of Russia. This process known in Russian history as the monastic colonization of the Russian North can easily be tracked on a map (Benz 2017, 116 – 117).

Physically, monastic expansion meant the monks moving on foot in search of places in which to found new monasteries. Environment played an important role in this process. Monasteries could only be founded in places with specific characteristics and the banks of rivers, lakes or the sea, preferably islands, was very important to monastic location. To some extent it might be said that this was a quest for an imaginary environment existing in monastic culture. Descriptions of this imaginary environment are to be found in the texts of the lives of the founders of monasteries. For instance, Sergius of Radonezh traversed a great many forests before finally coming to the one solitary place in the woods, with a water source, that he was looking for[3]. St. Anthonius of Siya traveled for a long time from one place to another, looking for a wilderness situated near any kind of water (river or swamp) and eventually founded his monastery on an island surrounded by lake waters, considering this wild forest the ideal place for prayers. Another famous monk, St. Cyril of Beloozero (the White Lake) made the most important decision of his life after seeing a vision of the Virgin Mary, which indicated the shores of the White Lake as the ideal place for his monastery. Once again in the thickets of the forest, St. Cyrill's companion, Ferapontus chose a beautiful site for his monastery on the banks of a river. Zosima and German, the founders of the Solovki monastery on an archipelago in the White Sea, received a special sign from the angels confirming that the area had been specially set aside for the monks by God himself. Clearly, a suitable place for a monastery had to combine the good environmental conditions that was a necessary part of holiness with hardships which the monks could overcome for the glory of God and with His help. This sort of interaction with the environment is typical of monastic literature. The idea of Eden is the basis for these texts. The natural environment was considered a reflection of Eden or, perhaps, a potential Eden. Monasteries, on the other hand, had to become models of Eden and add an element of holiness to nature. In practical terms this sometimes meant quite significant intervention in the landscape, and this moves us onto the second link between the monastery and the environment, namely landscape management.

The monasteries, especially the larger ones, were constructed as impressive architectural complexes, including the walls that were to separate Eden or the

[3] On the subject of Sergius and the Trinity Sergius monastery, see: Kenworthy 2010, 10–15.

holy space inside the monastery from the secular world outside. The monks did not limit themselves to landscape management with monastic walls, however. Monasteries became the center of sometimes very impressive infrastructural systems. The Solovki monastery seen here is the best example of this kind. As undoubtedly the region's richest monastery, it influenced the environment of the entire White Sea archipelago.

The system of canals constructed in the 16th – 19th century on the larger Solovki Island to connect up its numerous lakes is perhaps the best example of such a large-scale monastic infrastructure. The canals provided transportation, delivered fresh water to the monastery and provided water currents in the lakes to ensure natural water purification. Moreover, by the late 19th century the monks had constructed an extremely sophisticated technological infrastructure designed to harness the power of running water, including a power station. The network of canals still exists as one of the island's most important tourist attractions.

3. Waterside environment and monastic economy

Moving on to monastic economic activities it should be remembered that the monasteries were the only feudal lordships existing in the region of the Russian North, where private noble land possessions had disappeared after the territory was incorporated into the Russian state in the late 15th century. The first monastic domains appeared in the North in the Novgorod era and existed until the 18th century. The monasteries acted as the region's cultural and administrative centers and enjoyed governmental support, including direct financial donations and tax privileges. The monastic authorities controlled numerous dependent peasants who we might call "instruments" for the use and transformation of the environment.

The monastic economy was rather complex with the situation varying from one monastery to another, depending on geographic location of its land possessions. However, monastic documents regularly refer to such activities as agriculture and cattle breeding. If the monks could not acquire control over arable lands, they normally took an active part in the grain trade, purchasing grain in central Russia and delivering it to the northern settlements.

Salt production was another fundamental part of the monastic economy and prosperity. The big monasteries possessed salt extraction enterprises across the region, sometimes an extremely long way away from the monastic cloisters. This was, for instance, the case of Solovki monastery which controlled the salt making industry on the banks of the White Sea. The Spaso-Prilutsky monastery, situated near Vologda, occupied an optimal position in the salt making region

along the Dvina River. In general no large monastery in the Russian North was not involved in this industry. Quite recently the outstanding role of the rivers in the formation and success of this branch of economy has been revealed and studied. Indeed, working in river and coastal areas, the monks used their profound knowledge of the environment to create and manage strong links between production grounds and markets. This can be conceptualized as space management in which the monasteries used the opportunities given them by God and eventually constructed a semi-artificial environment based on their religious ideas, on one hand, and quite traditional local managerial practices, on the other.[4]

The same was true of fishing and a little less where the hunting of marine mammals was concerned. All these activities were done quite often not by the monks themselves but by dependent peasants. The monks acted as managers and record-keepers. This role was a long way away from the ideal Christian life that was to include hard physical labor, not commerce or management. The monks considered this work service for the glory of God, however. Moreover, the monastic documents contain direct references to the fact that rather than working for themselves, these monastic managers were acting on orders from abbots and the brothers as a whole. In other words, the monks were seeking to combine commerce and holiness.

4. Conclusion

After the 1917 Revolution the old Russia was completely destroyed, and this was undoubtedly true of its religious life too. As far as the monasteries were concerned, their magnificent architectural complexes were partly destroyed or rebuilt. However, some famous masterpieces such as the Solovki monastery were eventually made part of the museum system. This meant the complete transformation of the meanings presented to visitors with the religious aspect of monastic life concealed behind secular ideas of beauty, art value and patriotism.[5] As a result, after the collapse of Communism in Russia, the historic monasteries have once again begun combining both religious and tourist functions and water still plays a significant role in monastic development. An observation of the narratives devoted to these famous monasteries, prepared during a research project on the transformation of heritage practices from the late Soviet period to today at the National Research University's Higher School of Economics in St. Petersburg, shows that the monastic waterscapes are presented to pilgrims

[4] See for details: Dadykina 2016.
[5] See, for instance: Takahashi 2009.

from the perspective of holiness, while tourists see it via the perspective of the historic role of their waterside locations in the lives of these monasteries and their inhabitants.[6] A special emphasis can be also put on the holy wells or springs that appeared or existed in these monasteries. However, these narratives normally do not even mention hydraulic technologies or water and coastal control as integral parts of monastic life, and we can thus conclude that the conceptualization of water and the waterside environment as a space with specific links to the monasteries is now part of the past.

Our conclusions are very simple at the moment, as our research is to a great extent still under way. Firstly, we would like to stress that no understanding of interrelations between the monasteries and the environment is possible without a special focus on their cultural and religious ideas and practices.

Secondly, it seems to us important that a complex approach to the phenomenon of the monasteries should be taken. The Russian research tradition is based on in-depth studies of separate cases (Solovki monastery, Kirillo-Belozersky monastery etc.) based on an assumption that all the monasteries in Russia were organized in more or less the same way. However, we would argue that this method requires some modification and the Russian monasteries must be placed within their broad historic context. Moreover, traditionally monasteries were considered either spiritual, or economic centers – and we believe that these facets of monastic life are inseparable.

Finally our conclusion is that the comparative perspective is highly promising. A comparison between the system of interrelations between the monks and environment developed in the Orthodox and Catholic worlds will undoubtedly open up new perspectives on this theme.

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[6] See, for instance: Andreev and Shumov 2007, 181.

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Économie, politique et services éco-systémiques des zones humides en France, XVIe-XVIIIe siècle. Éléments de synthèse

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En France, l'histoire des terres marécageuses a longtemps occulté la dimension environnementale et a été écrite sans grands égards pour les services écosystémiques qu'elles pouvaient rendre. Fondateur, l'ouvrage du comte de Dienne sur l'*Histoire des dessèchements en France avant la Révolution française*, publié en 1891, assimile l'histoire des drainages à l'histoire du progrès économique et social d'une part, et aux succès de l'État monarchique d'autre part (de Dienne 1891). Encore marqué par les crises frumentaires du XIXe siècle, les historiens postulaient que le destin des marais était d'être mis en culture. Cette historiographie dominante s'est imposée durablement, notamment relayée par l'ouvrage marquant de Karl Wittfogel (Wittfogel 1957). À l'image des changements observés dans les historiographies européennes, le regard sur les zones humides a progressivement évolué sous le double effet d'une prise de conscience environnementale, et de méthodes plus proches des terrains étudiés, via l'archéologie (Burnouf et Leveau 2004). Deux éléments principaux sont notamment apparus : le caractère changeant et anciennement aménagé, et la diversité des ressources mises à la disposition des sociétés dans les zones humides.

La question des services écosystémiques rendus par les zones humides s'est imposée dans le questionnement historiographique. La vision aménageuse et agrarienne de l'histoire des dessèchements a ainsi été enrichie d'une vision plus positive de l'état naturel des marais à leur état naturel. L'histoire des zones humides est désormais traversée par la question des usages. Au cours de l'Époque moderne, deux visions de la destination économique de ces territoires se rencontrent et parfois s'affrontent. Il est désormais acquis que les communautés villageoises riveraines des zones humides en tirent des profits substantiels en les exploitant de manière extensive : chasse, cueillette, pêche, pâturages offrent aux riverains des compléments de ressources tout à fait appréciés. Face à ces communautés, les pouvoirs politiques et économiques

voient dans ces territoires des terres cultivables potentiellement très rentables pour peu que des aménagements hydrauliques y soient réalisés. De manière schématique, l'histoire des zones humides s'apparente à celle d'un affrontement autour des services éco-systémiques qu'elles peuvent rendre aux sociétés.

Le fonctionnement des zones humides repose ainsi sur un équilibre entre le fonctionnement de la nature d'une part et les usages sociaux qui s'y développent d'autre part. Le devenir des zones humides dépend des évolutions de la société et de ses cadres politiques et économiques. De ce point de vue, l'histoire de France est marquée par un très grand dynamisme. Dès le XVIe siècle, la Monarchie a constamment soutenu les travaux de drainage et de mise en culture des zones humides en promouvant des acteurs intéressés. L'État et l'autorité politique mues par un puissant mouvement de structuration et de concentration ont joué un rôle décisif dans les mutations des usages des zones humides. Mais, au cours des trois siècles de l'Ancien Régime, les soutiens politiques et sociaux de l'État monarchique ont autant évolué que ses structures administratives et techniques. Le soutien continu apporté aux travaux d'assèchement s'est ainsi inscrit dans des contextes et dans des temporalités divers.

Cet article a donc pour objectif de dresser les grands traits d'une synthèse du processus d'intégration des zones humides au cœur de la politique économique du royaume de France. Il s'agira de s'interroger sur les interactions entre changement politique et social d'une part, et usages des zones humides d'autre part. Comment ces évolutions et changements très globaux ont-ils provoqué la mutation de la conception des services éco-systémiques rendus par les zones humides ? Après avoir mesuré à quel point les usages extensifs et locaux des zones humides dominaient à l'aube de l'époque moderne, nous verrons comment elles ont été transformées par l'action conjuguée de l'État monarchique et de ses élites économiques au XVIIe, puis de son administration au siècle des Lumières.

1. Un héritage d'exploitation extensive

Les zones humides sont des territoires labiles, mouvants et changeants. En fonds de vallée comme dans les zones deltaïques, elles vivent au gré des événements hydrologiques et climatiques. Crues et étiages rythment leur devenir. Dans la France médiévale, les sources sont finalement peu nombreuses pour comprendre ce fonctionnement. Le traité d'arpentage écrit par Bertrand Boysset, Arlésien du XIIIe siècle, décrit la nécessité pour les riverains des marais du bas Rhône de procéder régulièrement à de nouvelles mesures de terres, les bornes séparant les propriétés étant régulièrement déplacées par les importantes divagations du Rhône (Stouff et al. 1985; Portet 2004). Les temps de conquête

et de déprise sont également tributaires des dynamiques démographiques et institutionnelles. En Normandie, Guy Bois l'évoque en filigrane, les zones humides sont, en tant que terres marginales, les plus rapidement abandonnées en période de déprise en même temps qu'elles deviennent très convoitées par les établissements religieux aux revenus rongés par l'inflation (Bois 1981).

Mais, la croissance économique du Moyen Âge s'est en partie réalisée grâce à une intensification de la maîtrise de l'eau, pour la meunerie et la plupart des activités artisanales. Les zones humides ont été profondément affectées par la nécessaire mobilisation de l'énergie hydraulique. En lien avec l'élevage et l'agriculture, de nombreux programmes de dessèchements ont été conduits au cours du Moyen Âge. Le rôle des établissements religieux a été fondamental au cours des XIVe et XVe siècles. Dans le Languedoc, les marais arrière littoraux ont fait l'objet de travaux importants et exigeants sur le plan technique comme dans le cas de l'étang de Montady (Abbé 2006, 180 et suiv.). Ils résultent pour la plupart de l'initiative conjuguée des bourgeoisies urbaines et des établissements religieux (Abbé 2006, 117 et suiv.). Ces programmes prolongent en les systématisant les logiques d'aménagements portées par les moines s'installant de manière privilégiée en fonds de vallée et donc contraints de drainer leur environnement immédiat (Benoit et Pressouyre 1996).

Au XVIe, le poids des initiatives locales reste prédominant mais leurs modalités de mise en œuvre évoluent substantiellement. Le déclin des établissements religieux est perceptible dès la première moitié du siècle. Il se confirme par la suite et se traduit par l'abandon de terres jadis exploitées. Dans certains cas, les propriétaires locaux prennent le relais. À Arles, en Camargue, les propriétaires fonciers s'entendent pour creuser de larges canaux de drainage afin de gagner des terres cultivables[1]. Ils travaillent et financent en commun de puissantes réalisations et créent à cette fin des associations de gestion tout à fait originales. Regroupés autour de l'entretien d'un canal émissaire, les propriétaires fonciers s'organisent pour décider des travaux à réaliser et des financements alloués. Les procédures de décisions sont dépendantes d'un processus de délibération auquel les pouvoirs urbains et le représentant du roi sont conviés.

L'étendue du territoire arlésien y laisse coexister des pratiques s'inscrivant dans des logiques économiques très différentes. Aux côtés, des travaux de mise en culture, Émeline Roucaute a montré à quel point la pêche constitue l'activité dominante des marais. L'anguille apporte aux religieux de l'abbaye de Montmajour des revenus considérables (Roucaute 2004, 245-253). Pendant les assèchements du XVIIe siècle, les pêcheurs figurent encore parmi les plus vigoureux opposants aux travaux. Le droit de chasse accordé de manière assez

[1] Archives municipales d'Arles, Archives des associations territoriales, Corrèges.

libérale aux Arlésiens représente une spécificité régionale. Ne pouvant être affermé, il demeure un droit permettant aux plus modestes de bénéficier d'une alimentation carnée. La cueillette est également très présente. Sagnes et roseaux offrent des ressources importantes pour la vannerie, les toitures et parfois le chauffage. Enfin, les marais accueillent des prairies temporaires dans ses franges les plus sèches. Le cas arlésien est exemplaire par sa richesse documentaire, mais il illustre tous les types de ressources offertes par les marais au cours de la période sur la majeure partie du royaume de France. De fait, les oppositions qu'eurent à affronter les dessiccateurs du XVIIe siècle revendiquaient toutes ce type de droit (Penna 2003, 25 et suiv.).

Le cas d'Arles semble exceptionnel, notamment en raison de la richesse de la documentation. À l'aube de la modernité, les seigneuries dont les assises démographiques et foncières avaient subi frontalement les deux siècles de crise de la fin du Moyen Âge, ont renoncé à la mise en culture des zones humides. Le recul démographique a conduit à délaisser des terres qui pouvaient être, au moins ponctuellement, desséchées pour alimenter des bras plus nombreux, mais au prix d'un travail beaucoup plus intensif. La vigoureuse reprise du beau XVIe siècle engagea un mouvement de cette nature dans les régions les plus dynamiques du royaume. À la Varenne-sur-Seine, dans la vallée de la Seine, en aval de Paris, des fouilles archéologiques ont récemment montré comment une seigneurie s'était implantée précisément en milieu humide au cours du premier XVIe siècle alors que le site avait été ignoré, même au cours des périodes les plus prospères du Moyen-Âge central (Hurard et Cavanna 2015, 259-273). À une plus grande échelle, les travaux de Joséphine Rouillard ont montré un processus comparable à l'échelle du bassin de la Vanne, petite rivière s'écoulant en Bourgogne (Rouillard 2003). L'essor démographique contribue ainsi à changer le regard sur les marais.

L'extraction de la tourbe renforce d'autant l'intérêt de certains marais, notamment septentrionaux. En Normandie, le marais Vernier est aménagé depuis le Moyen Âge en fonction de l'exploitation de la tourbe. Les villageois sont autorisés à extraire de la terre du centre du marais pour pallier la subsidence des parcelles où la tourbe est exploitée. Au XVIe, dans un contexte de crise énergétique, la ville d'Amiens a recours à ses tourbières pour cuire les briques devant être employées pour la reconstruction de ses fortifications (Morera 2011a, 155-168)[2]. Un briquetier flamand est appelé pour mettre en œuvre les nouvelles techniques. Les tourbières environnant la ville d'Amiens, sur lesquelles s'étendent des jardins et des cultures maraîchères réputées, sont ainsi contraintes d'accueillir un nouvel usage, certes extensif, mais promis à se déployer dans la longue durée. En effet, les travaux du XVIe siècle marquent le

[2] Sur le maraîchage dans les zones humides péri-urbaines : Fournier 2011, 155-168.

début d'une pratique s'étant pérennisée jusqu'à la fin de l'Ancien régime.

La reprise d'exploitation des zones humides fut interrompue par les conséquences françaises de la réforme religieuse. À partir de 1550, le royaume entre dans une période de troubles graves ayant fortement perturbé la vie des campagnes. Dans la région parisienne, où les affrontements furent intenses, les Guerres de Religion, provoquèrent des saignées dans les villages. Partout, mais surtout dans les régions gagnées par la réforme, les monastères hydrauliciens furent durablement affaiblis. Dans le Poitou, des structures de drainage mises en place par les Cisterciens entre les XIIIe et XIVe siècle perdirent toute leur efficacité en raison de la crise monastique (Suire 2006, 23 et suiv.). La deuxième moitié du XVIe siècle fut ainsi marqué par une progression des zones humides, renforçant ainsi l'exploitation extensive des ressources offertes par les zones humides. En retour, le rétablissement d'une certaine stabilité politique à la faveur du règne d'Henri IV se matérialise rapidement dans les marais du royaume.

2. Des zones humides mises au service de l'État monarchique au XVIIe siècle

Dès le XVIe siècle, mais avec plus de vigueur au XVIIe siècle, les zones humides ont été progressivement, et de manière inégale, intégrées à l'économie marchande et capitaliste. En conséquence, la nature des services écosystémiques rendus a évolué de manière importante. D'espaces tampon, dont les usages extensifs offraient des ressources aux membres les plus démunis des communautés riveraines, elles ont été transformées en espaces de production agricole appropriés au bénéfice de groupes sociaux puissants, soutenus par l'État monarchique. La conquête des zones humides au service de l'économie agricole s'intègre dans un projet politique visant à étendre la domination territoriale et politique du souverain. Dans la tradition hippocratique, les marais et paluds sont considérés comme des zones insalubres peuplées d'animaux dangereux pour le développement humain (Hippocrate 2006, partie XV)[3]. Ces éléments de doctrine issus du corpus médical sont repris en termes plus politiques dans le cadre de la théorie du climat dès l'Antiquité : les qualités humaines sont en partie définies par le climat dans lequel il vit. Au XVIe siècle, les théoriciens de la monarchie puisent abondamment dans ce corpus intellectuel. Pour Jean Bodin, les populations habitant les marais sont jugées positivement précisément parce qu'elles parviennent à vivre dans un environnement hostile et, par conséquent, à le dominer (Bodin 1579, livre V). Mais, d'une manière générale, les

[3] Ces principes ont été repris par les agronomes romains (Varron, Colummelle) et Vitruve. On les retrouve chez Alberti 2004 [1485], 65.

zones humides sont assimilées à des espaces vides abandonnés accueillant des populations rétives à l'autorité monarchique. Les marais définissent un climat presque dissident au sein royaume. Au XVIIIe siècle, Montesquieu considère encore que les marais sont des lieux de résistance et d'anarchie (Montesquieu [1748], livre XVIII, chapitre 7).

Dans un contexte de déploiement du mercantilisme à l'échelle du royaume, le coup d'envoi de la conquête des marais est donné en 1599 par l'adoption de l'*Édit pour le dessèchement des marais*[4]. L'exposé des motifs s'inspire directement du cadre intellectuel défini par Bodin. Par le monopole qu'il accorde au Brabançon Humphrey Bradley, Henri IV entend mener une politique de peuplement et de conquête politique. Le dessèchement des marais est assez clairement assimilé à une extension du domaine royal et de son contrôle sur les hommes. En ce sens, à la suite de l'édit de 1599, les services écosystémiques rendus par les marais prennent une dimension symbolique : leur assèchement pour leur mise en valeur agricole témoigne du pouvoir détenu par le roi de France.

Bradley obtient un privilège lui permettant de dessécher et de mettre en culture l'ensemble des zones humides du royaume. Il lui appartient d'investir les montants nécessaires pour la conduite des travaux et il est, à cette fin, libre de s'associer avec des partenaires extérieurs. Les dessèchements lui permettent d'acquérir les deux tiers des terres conquise, l'autre tiers revenant de droit aux anciens propriétaires. L'octroi de parcelles desséchées aux anciens propriétaires vaut dédommagement et le dispense d'acheter les terres. Le soutien à la mise en culture des zones humides est tel qu'un mécanisme juridique implacable dissuade toute opposition. Le dispositif conçu en 1599 a par la suite été précisé et amélioré si bien que, malgré quelques éclipses, il a soutenu l'action de l'État à l'égard des zones humides jusqu'à la fin de l'Ancien Régime et inspiré celle des régimes suivants.

Bradley débute rapidement ses travaux, mais se heurte à l'insuffisance de ses moyens et à des difficultés d'ordre politique et institutionnel (Morera 2011b, 67 et suiv.). Pour les surmonter, il s'associe des membres de l'aristocratie financière et ministérielle d'une part, et des marchands originaires de Flandre d'autre part. En 1605, Bradley crée ainsi une forme de société de commandite avec de fidèles soutiens politiques et financiers d'Henri IV et de Sully : Jean de Fourcy, intendant des bâtiments du roi, et Nicolas de Harlay, ancien ambassadeur au service du roi de France. Ils furent rapidement rejoints par Antoine Ruzé d'Effiat, intendant de l'artillerie et futur maréchal de France. L'autre pilier de l'association était constitué des familles Comans et de la Planche : tapissiers venus de Flandre à l'invitation d'Henri IV. Grâce à ces associés, Bradley fut en capacité de réunir les

[4] Édit *pour le dessèchement des marais, portant commission à cet effet à un étranger,* Fontainebleau, 8 avril 1599.

capitaux nécessaires et d'obtenir des soutiens politiques cruciaux pour réaliser les travaux projetés. Cet attelage capitalistique et politique put réaliser sept assèchements d'envergure jusqu'aux années 1640.

La mainmise de Richelieu sur l'appareil d'État français se traduisit également dans le pilotage des opérations de drainage. À partir des années 1640, elles sont prises en main par deux de ses banquiers principaux : Jean Hoeufft et Barthélémy Hervart. Ils poursuivent la mise en œuvre de l'Edit de 1599, mais de manière encore plus centralisée et en adoptant une gestion plus rigoureuse et nettement tournée vers les profits commerciaux. Sous leur direction furent réalisés les assèchements d'Arles et du Marais Poitevin. Dans les deux cas, ils provoquèrent des changements environnementaux considérables et s'appuyèrent sur des transferts de population relativement importants. En revanche, les réactions des acteurs locaux furent très différentes. Les dessiccateurs ne rencontrèrent aucune opposition dans le Poitou mais furent confrontés à des procédures longues et couteuses dans le cas d'Arles.

À partir du règne d'Henri IV, le pouvoir central français a adopté une ligne politique constante à l'égard des zones humides : elles doivent intégrer le giron de l'économie agrarienne et commerciale qui fait la force de la richesse et la richesse du royaume. Par le drainage, conduit à différentes échelles, la vocation écosystémique des marais et des zones humides dans leur globalité a été bouleversée. Leurs usages ont été intensifiés par la voie d'une appropriation permise et soutenue par le pouvoir monarchique. Les potentialités des terres humides ont suscité la convoitise de seigneurs comme de détenteurs de capitaux désirant acquérir de vastes domaines. Avec les usages, ce sont aussi les acteurs qui ont été remplacés : les populations riveraines ont cédé la place à des acteurs extérieurs cherchant la rentabilité et le service du pouvoir. Enfin, en modifiant les écosystèmes par l'imposition de schémas de drainages imposants, les sociétés sont entrées dans une nouvelle relation avec la nature : le déploiement des activités humaines rend nécessaire des équipements, puis leur entretien et leur extension. Ces évolutions décisives en matière environnementale et économique ont été accompagnées, au cours de la période, par un aménagement de nombreux fonds de vallées afin de faciliter la navigation.

La mise en culture des terres est un objectif économique en soi. Dans certaines opérations, elle est également un moyen en vue d'une autre fin. Dès les premières années du XVIIe siècle, la monarchie française a soutenu le développement des voies navigables. Le canal de Briare, construit entre 1604 et les années 1650, lance un mouvement qui s'est poursuivi par d'autres constructions monumentales : le canal de Languedoc et le canal d'Orléans sous le règne de Louis XIV, les canaux de Bourgogne et du centre au XVIIIe siècle. En réalité, par le biais de la création d'administrations spécifiques, la navigation

intérieure est devenue une catégorie spécifique de l'action de la politique économique monarchique (Szulman 2014). Le fonctionnement technique des canaux suppose une alimentation régulière en eau (Pinon 1995, 95 et suiv.). La construction du canal de Briare s'est accompagnée du creusement de kilomètres de rigoles dans les forêts et de la mise en eau d'étangs de retenues d'eau massifs. Dans d'autres cas, le drainage et la mise en culture sont devenus des moyens de développer ces axes de navigation jugés fondamentaux. L'article premier de l'édit de 1644 accordant à Jacques Brun le droit de construire le canal de Languedoc est sans équivoque sur ce point :

> « Avons aussi permis & permettons audit Brun, & ses associez de faire dessécher tous & chacuns les étangs, Palus, marais, coustiers, & terres inondées du bas Languedoc que bon leur semblera, qui sont depuis la ville de Beaucaire, jusques audit Agde, tant par le moïen dudit Canal navigable, que par autres qu'ils pouroient faire, qui se déchargeront dans icelui, ou autement, soit que lesdits estangs, palus, marais & terres inondées nous appartiennent, ou aux Ecclesiastiques, communautez ou particuliers »[5]

La politique économique conduite au XVIIe siècle s'appuie sur une nouvelle conception du territoire et sur la promotion massive de nouveaux usages de l'eau au service de la puissance. Cet effort ne se limite pas au domaine économique et se concrétise logiquement dans le domaine militaire. La maîtrise de l'eau fait partie intégrante des stratégies défensives depuis le Moyen Âge. Un simple fossé de quelques mètres de profondeur devient, une fois rempli d'eau, un obstacle particulièrement gênant pour barrer la route à des assaillants, même nombreux. Les places fortes médiévales eurent massivement recours à ce procédé de mise en défense. Au XVIe siècle débute un vaste processus de « révolution » militaire notamment mise en lumière par Geoffrey Parker (Parker 1988). L'expression de révolution est à juste titre discutée, mais elle a le mérite de rendre compte de l'ampleur des changements politiques, institutionnels, techniques et économiques survenus afin de soutenir la croissance le développement des opérations militaires ayant marqué le continent européen jusqu'au XVIIIe siècle. Les sociétés ont été entièrement reconfigurées autour de la guerre et de ses nécessités (Lynn 1988).

D'un point de vue stratégique, le développement des voies de navigation et la mise en culture de terres nouvelles par le drainage participent directement de cet effort militaire (Le Bouëdec et Chappé 2010). Cependant l'eau a également été utilisée de manière beaucoup plus directe par les armées, et avec de fortes implications territoriales et paysagères. Du XVIe au XVIIIe siècle, la France se déploie géographiquement vers le Nord par l'acquisition de la Picardie puis des

[5] *Edit du roy pour la construction d'un nouveau canal navigable au Païs de Languedoc, & pour le dessechement des marais*, Paris, 1644.

Flandres, et à l'Est par la conquête de l'Alsace (Nordman 1998). De même, l'État monarchique affirme puissamment sa présence sur les littoraux atlantiques et méditerranéens. Ce mouvement d'expansion géographique participe d'une politique de puissance conduite de manière hostile à l'égard de ses voisins directs. Elle se traduit par l'édification puis l'entretien d'un appareil militaire gigantesque, notamment à partir des années 1660.

Vauban fut l'architecte de la politique de puissance territoriale de Louis XIV (Blanchard 1997). Grand ingénieur, il a inlassablement travaillé à la mise en défense du royaume par la fortification de ses frontières. Il a été particulièrement actif dans le Nord de la France où il mit en œuvre un pré carré, mais aussi en Alsace, en Bretagne et sur les frontières alpines. Théoricien de la défense des places, il se fixait pour objectif de donner à ses places fortes la capacité de tenir le plus longtemps possible, le temps de l'arrivée des secours. Dans ce schéma, l'eau a été mobilisée avec constance, par le biais des inondations défensives. En effet, l'utilisation de l'eau à des fins militaires permet de renforcer l'occupation territoriale, d'une part, et de réaliser des économies d'infrastructures substantielles, d'autre part.

Les principes théoriques essentiels des inondations défensives ont été posées par Simon Stevin, dans un ouvrage publié en néerlandais et rapidement traduit en français sous le titre *De la castramétation par écluses* dont Vauban possédait un exemplaire (Stevin 1618 ; Virol 2007). La méthode la plus couramment utilisée consistait à doter la ville à défendre d'un système permettant de bloquer le cours d'eau qui la traverse afin de faire gonfler le niveau de l'eau en amont. Si les fossés de la ville sont correctement remplis, une écluse disposée en aval de la ville permet de lâcher de l'eau afin de créer un effet de chasse en cas d'avancée ennemie qui remonterait la vallée. Vauban a très clairement décrit ce système pour la ville d'Oudenaarde, située en Flandre, mais il l'a également disposé dans bien d'autres lieux, et notamment Lille, Metz et Strasbourg (Morera 2008, 39-54). Dans le cadre d'un tel système défensif, les prés, jardins et terres cultivables sont maintenus en l'état de zone humide.

L'hydraulique défensive fut développée de manière particulièrement sophistiquée dans l'arrière-pays dunkerquois et dans l'ensemble de la Flandre maritime. À Bergues ou Saint-Omer, les marais jouxtant les villes sont volontairement maintenus en l'état afin de doubler l'effet des fortifications. Ils sont même équipés d'avant-postes élargissant le rayon d'action des fortifications. La vocation militaire des zones humides est si forte qu'elle contrarie leur éventuel usage agricole. Au Nord de Dunkerque, le vaste lac formé par les Moëres avait été desséché avant l'arrivée des Français à l'initiative de Wenceslas Cobergher. Dès leur installation, les Français encouragèrent son retour à l'état de lac tant cette vaste étendue d'eau constituait une barrière défensive, en définitive peu onéreuse.

Dans les années 1670 et 1680, l'intérêt stratégique de la Flandre et les nécessités de l'alimentation en eau du port de Dunkerque poussent les Français également à réorienter toute l'armature hydraulique de la région. Les alentours de Dunkerque devaient pouvoir être inondée en toute circonstance. À cette fin, le bras de l'Aa alimentant Dunkerque fut remanié afin de pourvoir à la défense du port. De même, des bastions furent disposés le long des canaux tout autant pour pouvoir faire jouer l'artillerie que pour rompre les levées bordant les canaux et inonder les terres à défendre.

Les objectifs militaires conduisent à limiter les usages agricoles des terres jouxtant les places à défendre, mais ils peuvent également motiver un meilleur contrôle des pratiques de drainage liées à l'hydraulique agricole. En Flandre, les wateringues sont des organisations en charge de la gestion de l'eau depuis le Moyen Âge : leur action est nécessaire au déploiement et à l'entretien des réseaux de drainage. Elles rassemblent les propriétaires, collectent les fonds et organisent les travaux à réaliser. À partir des années 1670, les wateringues sont pleinement intégrées au dessein militaire de la monarchie. En effet, l'alimentation des canaux servant aussi bien à la navigation qu'aux potentielles inondations supposent un drainage efficace de la région. De même, la monarchie française agit afin de s'installer durablement dans la région, ce qui ne peut être réalisé sans l'adhésion des populations locales. Le maintien de pratiques agricoles efficientes trouve donc une place naturelle dans ce dessein stratégique. Dès les années 1660, l'intendant confirme le rôle des wateringues et leur assigne des missions précises. Il leur enjoint notamment de produire des comptes réguliers et leur fixe un objectif de remise en culture des terres endommagées. Dans les années qui suivent, les wateringues sont étroitement contrôlées et voient leurs marges de manœuvre singulièrement limitées. De fait, la conquête française s'accompagne d'une reprise et d'une augmentation importante de la production archivistique des wateringues.

Le déploiement de l'État militaire agit ainsi de manière notable sur les services écosystémiques demandés aux zones humides. De fait, la vision stratégique déployée par Vauban s'est prolongée dans la longue durée. Elle est restée déterminante dans la formation des ingénieurs et dans l'action des militaires français au cours du XVIIIe siècle. Les quatre tomes de l'*Architecture hydraulique* de Bernard Forest de Bélidor illustrent la pérennité de cette conception militaire du territoire et des zones humides (de Bélidor 1733-1737). Les équipements réalisés par Vauban sont présentés, analysés et enseignés aux ingénieurs en formation.

Au cours du XVIIe siècle, le devenir des plus grandes zones humides du royaume se trouve ainsi étroitement associé à celui de la monarchie et elles sont mises au service de son renforcement. Les assèchements sont réalisés par des

soutiens essentiels au fonctionnement de l'État mis en place par les premiers Bourbons. Lorsque la France entame sa mue en puissance militaire continentale, elles sont intégrées au schéma stratégique mis en œuvre par Colbert, Louvois et Vauban. Les services écosystémiques rendus changent substantiellement : les marais sont désormais au service d'intérêts politique et financiers, via la mise en culture, d'une part, et la mise en défense du royaume d'autre part. Si l'empreinte politique demeure forte au XVIIIe siècle, elle change cependant de forme.

3. Les zones humides dans le jeu de la Monarchie administrative au XVIIIe siècle

Des années 1660 au tout début du XVIIIe siècle, la monarchie met en sommeil le soutien aux assèchements au profit d'initiatives économiques tournées vers la production manufacturée (Minard 1998). Quand la politique dessiccative reprend, elle s'inscrit toujours dans le cadre posé par l'édit de 1599, mais ses modalités évoluent substantiellement. Le roi ne procède désormais plus en soutenant des groupes de financiers en capacité d'agir sur l'ensemble du royaume. L'encouragement aux dessèchements compose désormais avec les conditions locales si bien que les projets rencontrent des fortunes diverses selon les régions. L'ambition n'est donc plus d'accorder un droit de drainer sur l'ensemble du royaume mais de soutenir des projets locaux de mise en valeur agricoles des zones humides. Au moins trois cas de figure peuvent être identifiés : le pouvoir soutient des initiatives locales, répond aux suppliques des populations ou le roi accède à la demande d'un Grand. Toutes présentent le point commun d'avoir bénéficié de l'intervention directe des services administratifs de la monarchie.

Par le don de vastes zones humides à des membres de la haute noblesse, Louis XIV renforce la dimension politique de la mise en valeur des zones humides. L'octroi d'un droit de dessèchement participe d'une économie de la libéralité par laquelle le roi donne une partie de son territoire dans le cadre de la politique de curialisation. Il ne s'agit plus de renforcer ses partisans par l'enrichissement comme au XVIIe siècle, mais plutôt d'acheter leur adhésion par la promesse de terres nouvelles. En 1705, Louis XIV accorde ainsi à son cousin, le duc de Noailles le droit d'assécher l'ensemble des marais du bas Languedoc[6]. Face aux résistances rencontrées par le duc de Noailles, le roi met en branle l'ensemble de l'appareil administratif. Dans les années 1730, l'intendant du Languedoc fait ainsi réaliser des études techniques et des enquêtes très poussées visant

[6] *Edit pour le dessèchement des étangs, palus & marais du bas Languedoc depuis la ville de Beaucaire jusqu'à celle d'Aigues Mortes & à l'étang de Parols, donné à Versailles au mois de janvier 1702,* Paris, 1702.

à lever les oppositions en rassurant les riverains craignant de perdre terres et droits[7]. Déterminés et soutenus par le clergé local, les opposants aux travaux de dessèchements développent une théorie originale selon laquelle le drainage risque d'accroître la présence de moustiques et de rendre la région invivable en inversant les conceptions généralement admises. Une opération similaire est réalisée dans les moëres de la région de Dunkerque. À la suite de l'annexion de la région, Louis XIV donne à Colbert et Louvois le grand lac intérieur situé dans l'arrière-pays de Dunkerque à des fins de défenses[8]. La guerre de Succession d'Espagne achevée, la Flandre se trouve pacifiée au point que le Régent reprend la politique favorable aux dessèchements. Des lettres patentes du mois d'avril 1716, donnent la vaste étendue d'eau à la « dame marquise de Maisons » et au sieur marquis de Canillac afin qu'ils les mettent en culture. En dépit des exemptions fiscales et des facilités juridiques accordées, les bénéficiaires de ce don ne furent jamais en mesure de mettre en œuvre leur projet[9]. Par conséquent, en 1757, le roi reprend la main sur la zone pour la donner au « Comte d'Hérouville de Claye, lieutenant général des armées de sa majesté, & inspecteur général de sa majesté »[10]. L'objectif agricole demeure inchangé et les conditions accordées restent très avantageuses. Dans ce contexte, l'opération est couronnée de succès dans les années qui suivent.

Dans les marais de Rochefort, défini au sens large, le soutien passe par le contrôle des associations en charge de la gestion de l'eau (Morera 2011b, 85-110). Les premiers programmes d'assèchement des marais entourant la ville de Rochefort remontent au XVIIe siècle et ont été largement couronnés de succès. Les projets reprennent au XVIIIe siècle à l'initiative de propriétaires locaux (Morera 2015). La juxtaposition des zones asséchées et l'usage commun des canaux émissaires posent rapidement la question de la coordination de l'action et du partage des frais entre associations[11]. Dans ce cadre, à l'intérieur de ces territoires et entre ces territoires surgissent des différends. Si bien que l'intervention des pouvoirs publics s'avère indispensable. Pour pacifier les relations entre acteurs, l'intendant impose des règles et procède à un contrôle sourcilleux des dépenses des différentes associations. La monarchie n'encadre donc pas, *a priori,* les travaux de dessèchements mais met à la disposition des acteurs locaux des outils de régulation de manière à les soutenir et à les

[7] Archives nationales, G[7] 1673.

[8] *Don des Moeres, en faveur des sieurs Colbert et de Louvois, donné à Saint Germain en Laye, au mois de juin 1669, registré au conseil souverain de Tournay, le 5 juillet 1669.*

[9] *Lettres patentes du roi, données à Paris le 23 février 1716. Portant don des Moëres en faveur de la dame Marquise de Maisons, & du sieur Marquis de Canillac,* Paris, 1716.

[10] *Arrest du conseil et lettres patentes, portant don des Moëres en faveur du sieur comte d'Hérouville de Claye, lieutenant général des armées de sa Majesté, & inspecteur général de son infanterie*, Paris, 1765

[11] Archives départementales de Charente-Maritime, C 19 ; C 24.

rendre possibles. S'il confie le territoire et son développement agricole aux propriétaires, l'État monarchique ne renonce ainsi nullement à agir par son pouvoir de contrôle et de sanction.

Le cas du littoral du Pas de Calais correspond à un troisième cas de figure du soutien aux dessèchements dans la France du XVIIIe siècle. Chroniquement plongé sous les eaux à partir des années 1710, en raison du désengagement des militaires, les marais littoraux jouxtant Calais mobilisent l'attention de l'intendant de Picardie qui lance à plusieurs reprises des enquêtes et des projets afin d'en rendre possible l'exploitation. Son action s'appuie notamment sur les plaintes des communautés locales qui, faute de curer régulièrement les canaux de drainage, sont dans l'incapacité d'exploiter durablement leurs terres. Dans les suppliques des communautés du Calaisis adressées à l'intendant, mais aussi au Contrôleur Général, les villageois reprennent l'argument essentiel de l'édit de 1599, tout en en inversant la portée puisqu'ils le mettent à leur propre service. Ils demandent ainsi l'appui du roi afin de peupler des terres, développer l'agriculture et, *in fine*, œuvrer pour bien commun. Bien relayés par l'intendant, les villageois obtiennent d'importantes exemptions fiscales et une meilleure implication de l'armée, très présente, dans la gestion des eaux. Les travaux débutent en 1738 mais, après avoir donné de résultats prometteurs, ne peuvent empêcher un retour des eaux stagnantes.

Le soutien aux dessèchements est constant tout au long du XVIIIe siècle. Les quelque exemples évoqués dans cet article suffisent à évoquer la diversité des cas de figure et des modalités pratiques de mise en œuvre : la monarchie fait du sur mesure pour chaque chantier et déploie sur le terrain ses relais les plus efficaces à travers les services des intendances. Mais, paradoxalement, les pratiques administratives limitent également les possibilités de dessèchement. À la faveur de la vague politique libérale, les moyens mis en œuvre pour soutenir les travaux de drainage évoluent notablement (Grenier 1996 ; Kaplan 1986 ; Kaplan 2017). En 1764, Louis XV promulgue une déclaration « qui permet à tous seigneurs & propriétaires de marais, palus et terres inondées, d'en faire les dessèchements, vérification préalablement faite de l'état et consistance desdits terrain » (*Déclaration* 1764). La déclaration dispose ainsi que le roi permet « à tous seigneurs et propriétaires de marais , palus et terres inondés, ensemble à tous ceux qui en ont ci-devant pris & prendront ci-après par baux emphithéotique ou à perpétuité, à droit de champart, de faire les desséchemens desdits marais, palus et terres inondés » (*Déclaration* 1764). Aux côtés des grandes opérations de drainage à dimension symbolique et politique, la monarchie élabore un cadre juridique minimaliste destiné à faciliter davantage la conquête des zones humides. Les seigneurs, propriétaires éminents, sont tout à la fois favorisés et mobilisés : une simple déclaration suffit pour obtenir le droit de dessécher des

marais convoités. Le statut des zones humides est de cette manière aligné sur celui de l'ensemble des terres vaines et vagues, laissées en friche. Si le cadre juridique et intellectuel évolue, l'objectif demeure identique : transformer les zones humides en espaces de production agricole.

La libéralisation des assèchements ne signifie cependant pas l'abandon des grandes opérations qui prennent également un tour nouveau. Ainsi qu'en témoigne, le don des Moëres flamandes à des fins de mise en culture, l'hydraulique militaire perd de son importance stratégique. Cette mutation engage une évolution tardive mais forte de l'attitude des armées à l'égard des marais. La vision des militaires se modifia lentement, à la faveur de la diffusion des thèses aéristes et néo-hippocratiques de plus en plus en vogue dans la France des Lumières (Fournier 2010, 9-24). En dépit d'assèchements réalisés au XVIIe siècle, les marais de Rochefort sont, pendant une grande partie du XVIIIe siècle, maintenus sous les eaux. Colbert souhaitant favoriser la défense du site, avait en effet encouragé l'abandon des dessèchements précédemment réalisés. Mais, la profusion des moustiques finit par devenir très préjudiciables à l'effort de guerre lui-même puisque les marins et les ouvriers sont décimés par les fièvres paludéennes. Si Rochefort compte 25000 habitants en 1752, ils ne sont plus que 10000 en 1782 (Bériet 2007, 27-42)[12]. Face à cet affaiblissement chronique, la Marine initie des enquêtes médicales afin de démontrer la nocivité des marais imparfaitement desséchés. En 1782, un programme d'assèchement des marais de Rochefort est en conséquence lancé avec, pour la première fois, un investissement budgétaire direct de l'État monarchique. La Marine dispose pour cela d'une troupe encore nombreuse et d'un magistère technique indéniable, mais le travail se trouva interrompu par la Révolution et ne fut finalement mené à son terme qu'au XIXe siècle.

Au XVIIIe siècle, ni les moyens techniques mis en œuvre, ni les services écosystémiques attendus des zones humides n'évoluent considérablement. Les principes économiques et politiques favorisant leur mise en culture au bénéfice des propriétaires terriens et des seigneurs demeurent les mêmes. En revanche, les modalités de mise œuvre de ces principes changent dans la mesure où elles participent d'une économie du don beaucoup plus nette qu'auparavant et qu'elles bénéficient de l'implication de l'appareil administratif de l'Etat désormais en mesure de contrôler les actions réalisées et d'apporter une expertise technique importante.

[12] *Arrêt du Conseil d'État portant règlement pour le dessèchement des marais de Rochefort,* Paris, 1782.

4. Conclusion

Envisager l'histoire des zones humides françaises au prisme de la notion de services écosystémiques au cours de l'Époque moderne met en lumière un long processus d'intégration des marais et fonds de vallée dans le circuit d'une économie agrarienne soucieuse d'accroître la production céréalière d'une part, et l'élevage d'autre part. Ce mouvement a été contrarié par une pluralité de facteurs : crises économiques et démographiques, crises et changements d'orientations politiques, difficultés techniques. De manière symétrique, il a perduré en raison des profits importants qu'il offrait à ses promoteurs. Porté par les maîtres de la terre, il accompagnait l'extension de vastes domaines fonciers. Par ce biais, les ambitions économiques et agrariennes de l'État monarchique recoupaient un programme politique et culturel. Drainer les marais signifiait étendre le domaine royal, accroître le nombre de ses sujets et affirmer sa puissance. Par divers véhicules juridiques et supports économiques et sociaux, la Monarchie française a poursuivi ces objectifs de manière constante.

D'espaces marginaux fournissant aux plus pauvres des moyens de subsistance ou mis en valeur localement, les marais ont fait l'objet d'une convoitise généralisée et de travaux très souvent couronnés de succès. Tout autant que les services rendus, ce sont les bénéficiaires de ces services qui ont profondément changé. Les acteurs locaux ont cédé leur place à des soutiens de la Monarchie ou des proches du roi. La mise en culture des marais constitue donc un miroir des modalités et temporalités de la construction et de l'affirmation de l'État central. Ces observations contribuent à enrichir la notion de service écosystémique elle-même. Tout au long de la période, les zones humides fournissent tout autant des ressources vivrières et des terres cultivables, qu'un support d'action politique. Leur conquête, légitimée par un discours savant puissant et expressif, donne à la monarchie un moyen d'en matérialiser les principes. En ce sens, les zones humides, en tant que réservoirs de nature sauvage à domestiquer, rendent un service éminemment politique. Au cours de la période moderne, l'intensification des usages économiques est ainsi couplée à un très fort investissement symbolique.

La mutation des services écosystémiques rendus par les zones humides s'inscrit ainsi dans un processus largement conditionné par les initiatives de l'État monarchique. La vision idéale d'une bonne zone humide se cristallise au cours du XVIe siècle et se déploie au cours des siècles suivants. Les éléments utilisés sont profondément inscrits dans la culture monarchique, mais l'alliance entre une forte dimension intellectuelle et des méthodes de gestion et d'exploitation a donné naissance à une tendance très forte qui s'est poursuivie bien au-delà de l'Ancien Régime. Au XXe siècle, l'assèchement est

très longtemps resté la norme d'usage dans les milieux conquis. De même, les tentatives de dépoldérisation et de remise en eau de certains marais se heurtent aujourd'hui à l'appropriation par les populations d'un discours construit pour servir les intérêts de la monarchie et de ses élites.

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Natural resources, conflict and sustainability in Northern Italy in the early modern period

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1. Introduction

This essay deals with management of water and other natural resources in pre-industrial societies, adopting a long-term perspective and focusing on some specific areas in northern Italy[1]. The centre stage issue here is sustainability, because this is the main object of our study and the subject of analysis is the practices and norms put in place by the communities examined for the purposes of sustainable use of local resources. The definition of sustainability used here is the ability to use natural resources – fundamental to the preindustrial livelihood (such as water) – for various economic activities without causing overexploitation and degradation of the resources themselves or of any infrastructure necessary for their usage, while also avoiding damage to the network of people using these resources. In this way, sustainability is seen as an essential practice to which all societies aspire, but which is inevitably subject to both external and internal forces. In the light of this, sustainability is analysed here from multiple points of view (economic, social and environmental), giving due consideration to the interrelation between nature and culture which underlies exchanges between the various components of a specific ecosystem (Hoffman 2014; *Social ecology* 2016).

Studies of natural resource management in preindustrial societies (always interwoven with the management of the commons) have tended to use the 'survival'/'tragedy' dichotomy, generating a stereotyped representation of both

[1] This contribution aims to synthesise two research paths undertaken autonomously but within a shared theoretical framework. It is the outcome of a dialogue between the two authors who exhanged their views on methods, sources and instruments for the purposes of studying sustainability dynamics in the management of natural resources. The first and second sections are the work of Matteo Di Tullio, whereas the third and fourth sections are Claudio Lorenzini's.

the modernisation processes in preindustrial economies (fostered by a sort of social and institutional Darwinism) and the solidarity and reciprocity promoted by *ancien regime* communities. Taking this concept to the extreme, on one hand, this dualism resulted in every type of traditional and collective use of natural resources being considered inefficient and subject to overexploitation (Hardin 1968). On the other hand, emphasis has been placed on the role of institutions – representing collective interests – favouring both persistence and efficiency in resource use (Ostrom 1990; De Moor 2015). However, this approach highlights external elements of change and thus shifts in institutional balance have been interpreted as reactions to prompts rather than internal decisions. Such an approach has also been prompted by a renewed attention to natural disasters, which has led to a broad series of disaster studies. A fundamental contribution in this regard has been the borrowing of the concept of resilience from social sciences, emphasising the social impact of external events and the ability of the various environments to tackle them (*Rural societies* 2013; Curtis 2014; De Keyzer 2016).

From this perspective, natural resource management also risks being interpreted as the constant repetition of fixed and inefficient practices, interrupted by some more or less sudden event determining both its collapse and changes moving in the direction of greater efficiency. On the contrary, we believe that preindustrial societies were more dynamic than is generally believed, in this respect, too. Despite well-established norms and traditions, the need to regulate management practices was an everyday objective. The ability to innovate in the face of external and internal pressures allowed for sustainable employment of (not only environmental) resources and, in the long term, favoured the renewal of the local context (Di Tullio 2014; Di Tullio 2018).

To bypass this dichotomy, we propose here to consider the economic, social and environmental dynamics behind the use of natural resources in preindustrial societies as sustainability practices (Warde 2011; Warde 2019). In our opinion, analysing their management and use, especially in the long term, must necessarily consider each resource in relation to the others. These resources catalyse the rights of individuals and groups who employ them in a functional (we might say 'cooperative') rather than charitable way. Therefore, resources are subject to people's desire to get their hands on them and to any conflicts or changes of context, which also determine the way they are perceived. It is worth pointing out that the term 'conflict' covers (I) all kind of disputes concerning the use of natural resources, arising from various factors (environmental, social, economic or cultural); (II) all disputes implying appealing to formal or informal institutions.

2. Building a database on historical sustainability by means of the study of conflicts

This section presents the initial results of a larger project focusing on long term natural resource management using a holistic approach to observe on this phenomenon by different perspectives. Specifically, what follows is a pilot study focusing on the Lombard plain around Milan and Brescia, which consisted of a systematic reading of the primary sources generated by institutions and larger landowners in the area. Taking into account previous research into various important Milanese 'welfare' institutions[2], for comparative purposes, we produced a new study into Brescia's *Ospedale Maggiore* (the town's main hospital). This case study is particularly well-suited to our aims as a result of an abundance of document series still preserved at the local public archive[3], particularly relating to the institution's financial management and disputes over the use of water. In fact, we believe that the qualification and quantification of disputes, together with other variables, to be the primary way to study natural resource management sustainability dynamics in the preindustrial period[4]. Theoretical and methodological reflection is required to underline this point, before the case studies are analysed.

Current economic theory tends to explain sustainability as strictly correlated with per capita income increases, using the well-known inverted U-shaped curve. Conceived by Simon Kuznets, this curve explains the relationship between economic growth and inequality (Kuznets 1955). Using the same correlation, since the 1990s scholars have argued that economic development initially causes progressive environmental deterioration – because polluting emissions increase for example – yet the environment tends to improve later as the economy achieves higher levels of income and development (measured in terms of GDP per capita). This correlation was first named the 'Environmental Kuznets Curve' (EKC) by Theodore Panayotou (Panayotou 1993; 1997). The latter explicitly noted that early evidence of environmental degradation emerged during the preindustrial period, followed by rapid increases in deterioration during the industrialisation process, and then by a decrease in the extent of degradation in more recent periods. Few studies have taken a longer historical perspective

[2] We are referring to the essays of Barbot 2013 and Di Tullio 2013.

[3] Archivio di Stato di Brescia, *Ospedale Maggiore*, bb. 1148-1177. This project was funded by Bocconi University in Milan's Carlo F. Dondena Centre for the study of social dynamics and public policies. We thank the director (Marco Bonetti) for the precious support he provided and Giulio Ongaro for his thoroughgoing archival research. We also thank Enrico Valseriati for his bibliographical and archival consultancy. For an outline of this institution, see Bonelli 1916, Mariella 1963, *I ricoveri* 2002, Montanari 2014.

[4] On this subject see, for example, *Eaux et conflits* 2012, and the introduction in particular, 7-31. See, also, Mocarelli 2011 and Frioux 2014.

on this issue and these do not consider the pre mid-nineteenth century period[5]. Although the general validity of the EKC is the subject of debate[6], it is useful for this project, in its twofold potential for creating a theoretical framework and considering the possible long-term aspects of this process, in an attempt to explore (rather than outline) the pre-industrial segment of this phenomenon.

Studying the interaction between people and nature and the human impact on the environment goes back a long way, at least to the *Annales* school, passing through the English local history tradition, and, more generally, European and international rural history. It is almost impossible to summarise this vast production. We will simply highlight that it is only in recent times that a renewed attention to environmental issues has led to the development of Environmental History, which has shown a strong international vocation since its conception, and the Global History research approach (Hughes 2006: McNeil 2003)[7]. In the meantime, in other contexts such as in Italy, different historical-environmental approaches have been developed, such as Historical Ecology (*ecologia storica*), which has experimented with a topographical approach, and Eco-history (*eco-storia*), whose studies are based on a critical observation of material sources combined with an interpretation of written documents (Rackham 1980; Moreno 1990; Grove and Rackham 2001). In general, however, historiography has paid greater attention to the contemporary age, too. While medieval studies has maintained a robust and novel interest in these topics, highlighted in recent renewed syntheses (Hoffman 2014; Campbell 2016), early-modern studies has apparently accorded lesser relevance to this objective. There are certainly exceptions to this[8], but most of these studies have concerned northern Europe and adopted a specific approach, in both chronology and object of analysis terms, and focused their attention on individual resources, only rarely considering these within a wider ecosystem and from the perspectives of the various institutional levels involved.

Starting from this long tradition and recent experiments, we hereby propose an analysis of long-term sustainability dynamics focusing on water management in the Milan-Brescia plains. This analysis does not deal with pollution (the 'classic' contemporary society study aim and one which is actually impossible to study and perhaps of limited relevance for pre-industrial societies) but rather the capacity of the institutions and societies observed here to use (or cooperate with) these resources and, generally, to implement durable and sustainable use. For these reasons our focus is on disputes over the use of water, which

[5] See, for example, Lindmark and Acar 2014.
[6] See, for example, the synthesis promoted by Stern 2004.
[7] For Italy, see Armiero and Barca 2004. See, in addition, the volume *Storia economica* 2012.
[8] In particular in the context of dispute related work, see Soens 2012.

characterises the entire period under consideration systematically (although not uniformly). The records produced to resolve controversies over the use (and possession) of natural resources provide us with ample information regarding management practices and trigger questions regarding the reasons behind the emergence of sustainability problems. Taking into account the partial nature of this survey and the 'explorative' character of this research, what follows are draft results and initial speculations stemming from a systematic analysis of archival sources, which therefore require further refinement, elaboration and comparison. We must also bear in mind that this study of the Brescia *Ospedale maggiore* documents constituted an opportunity to test a data collection method, which allowed a format applicable to other institutions and geographical contexts to be defined (Di Tullio and Lorenzini 2018). On the strength of this standard file, we created a database integrating various case studies and the sources employed, with potential for use in studying the sustainability phenomenon on multiple levels, in accordance with diverse methods of investigation and chronological layers. It is possible to switch from long term quantitative dispute reconstruction to specific analysis of a single occurrence or from simply counting the cases related to each resource to integrating them in order to gain an in-depth understanding of their interrelation and interconnection. Moreover, serial analysis of disputes is also useful for the purposes of reconstructing the geography of available resources, mapping institutions and local and territorial jurisdictions, as well as discovering the 'grammar' of conflict and sustainability as it emerges from archival source analysis.

As we have seen, systematic study of conflicts allows, first and foremost, a long-term series of the phenomenon to be retraced, providing an overview of sustainability dynamics which would otherwise be impossible to achieve. Even taking into account possible gaps in the documentation, the limited nature of written documents from more distant times and the partial nature of the case studies analysed, what can be reconstructed through dispute quantification is still extremely interesting and leads on to the formulation of some base speculations, which it might subsequently be possible to verify via analysis focused on the qualitative dimension of the phenomenon or the cross-checking of multiple variables. In what follows we present an initial aggregation of data on disputes involving the Brescia *Ospedale Maggiore* compared with those from the Milan 'welfare' institutions (*Luoghi Pii*) mentioned above (figure 1).

At first glance, it is evident that the risk of distortion in the dynamics determined by the potential loss of the oldest archival sources would seem to be groundless, as the drastic decrease in cases during the eighteenth century shows. In both cases, the dispute trend fluctuated in the fifteenth century, progressively increased in the sixteenth century and peaked in the seventeenth

century. This tendency is reversed from the seventeenth to the eighteenth centuries, when it declines throughout the century, before growing again at the end of the *ancien regime*.

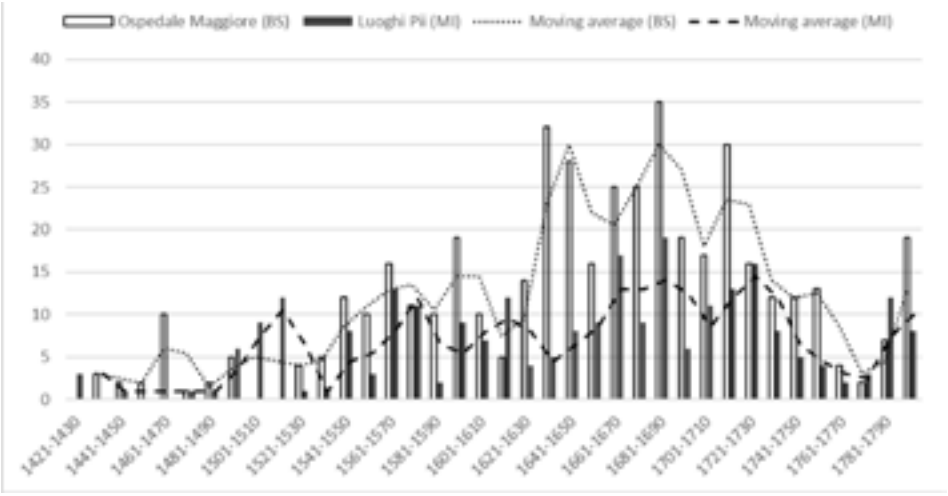

Figure 1. Conflicts for the use of water involving the *Ospedale Maggiore* of Brescia and some 'welfare' institutions of Milan (1421-1800)

However provisionally, the similarities in the two dynamics would seem to confirm the validity of the series outlined thanks to this research methodology. Therefore, certain provisional speculations regarding the dynamics of sustainability and long term natural resource management are legitimate. First and foremost, it is possible to exclude that a one way correlation between economic dynamics and sustainability existed. If an increase in disputes in the second half of the sixteenth century might be justifiable in terms of it having been a period of relative economic growth, in both the State of Milan and the Republic of Venice, it can be noted that the subsequent century's sudden rise occurred during a phase of economic stagnation for most of Italy. Justifying these trends in the light of economic factors, rather than general dynamics, requires considering certain specific issues, i.e. the so-called 'return to the land', a process of growing investment in agricultural estates by wealthy city dwellers (who had accumulated large amounts of capital through trade and manufacturing) and the well-known phenomenon of economic reconversion, characterised by a partial manufacturing transfer from the cities to the countryside (Corritore 1993). These two factors, which intensified during the second half of the sixteenth century, certainly impacted on local resource use and management although the acute related disputes phase ended in the first

decades of the seventeenth century, when a demographic trend inverse also favoured a decrease in tension[9]. We have already shown the phenomenon described above at the micro-level, by examining the land policies of two of the main Milanese welfare institutions included in our analysis, i.e. *Consorzio della Misericordia* and *Schola delle Quattro Marie*. During the early modern period, attempts by these to concentrate property in the more productive lower plains is tangible, according to a pattern which penalised sparse estates as well as those located in the dry plains or hills. Powerful investment, in the form of rent discounts[10], in order to favour the diffusion of the irrigation network and profitable irrigated crops (meadows and rice fields) can also be observed. This emphasises, however, that a discrepancy between the chronology of these investments and the dynamics of the disputes illustrated in figure 1 existed, because constant land concentration in the lower plains (and conversion to irrigated crops) should, at the very least, have determined a continuous dispute dynamic from the sixteenth to eighteenth centuries (Di Tullio and Lorenzini 2018).

A further economic factor to be taken into account concerns the crop changes referred to above. In the seventeenth century, maize farming spread significantly, a notoriously thirsty, water dependent crop, and therefore one likely to lead to an increase in disputes. A link between the increase in disputes, famine and drought (for example in the 1590s and around the mid-seventeenth century; Alfani et al. 2017) is thus clear.

It is, however, clear that simply analysing the economic situation cannot alone explain the complex man-environment interaction phenomenon which catalyses diverse interests and is governed by various institutional levels. It is thus worth trying to take into account some other linked context related factors and it would thus seem useful to briefly consider at least three other elements which may contribute to explaining the phenomenon: political-institutional factors, environmental changes and demographic dynamics. With regard to the latter, the Milan and Brescia trends[11] which certainly contributed to the demographic pressure in the respective provinces can both be easily retraced (figures 2 and 3). In this case too, however, there appears to be no significant correlation between the two variables, because similar trajectories observed for the second half of the sixteenth century diverge almost completely in the

[9] For Lombardy, see De Maddalena 1982 and Sella 1982; for the Republic of Venice, see the classic Beltrami 1961.

[10] This was facilitated by the spread of the so-called *ad meliorandum* lease, which guaranteed a discount on the amount of the lease corresponding to the structural improvements made by tenant in agreement with owners.

[11] The demographic data, kindly provided by Guido Alfani, was taken from the Alfani-Percoco Database used in Alfani and Percoco 2014. For more details see Di Tullio and Lorenzini 2018.

following century. Demographic decreases in the first half of the seventeenth century do not seem to have led to dispute reduction, and in addition to this, sustainability problems paradoxically tended to diminish precisely during the demographic resumption phase, in the late seventeenth and early eighteenth centuries (Alfani 2013; 2016).

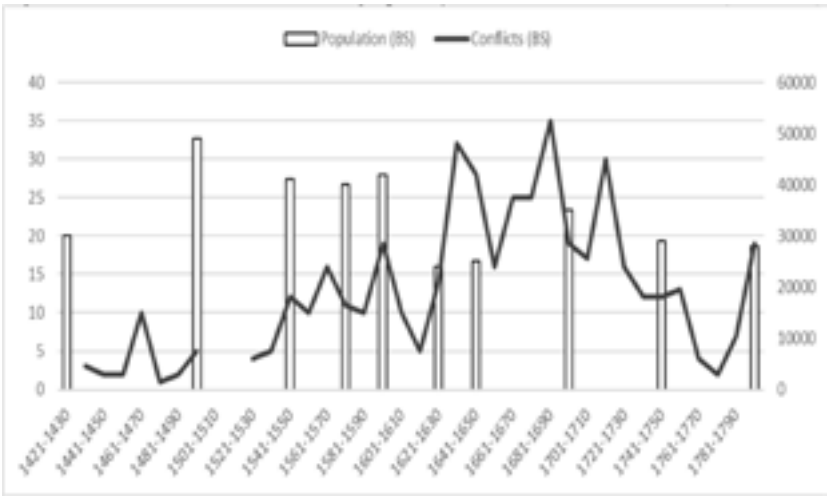

Figure 2. The correlation between demographic dynamics and conflict in Brescia (1421-1800)

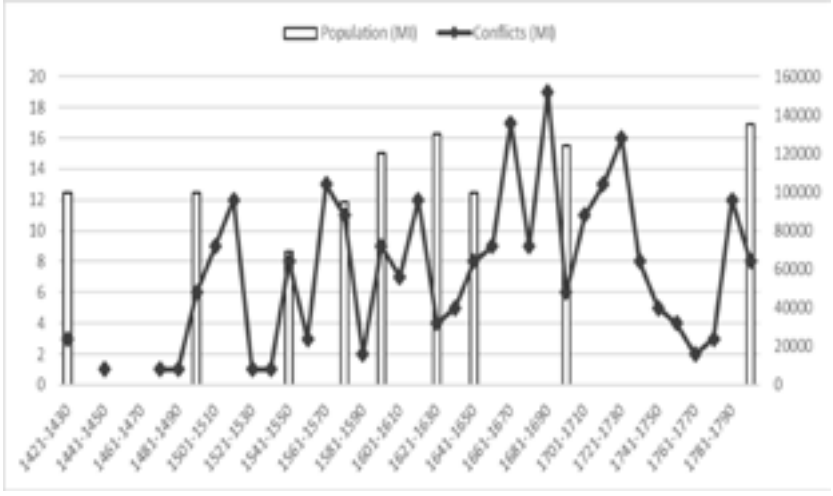

Figure 3. The correlation between demographic dynamics and conflict in Milan (1421-1800)

Certain elements of interaction seem to emerge in both the political-institutional context and as regards environmental issues. However, it should be borne in mind that the former consideration allows for purely speculative conjectures, and the latter leads to interpretations supported by little accurate data with regard to more general dynamics.

For the period considered here, in writing of political-institutional aspects the reference is, in particular, to the well-known state building process and the impact of new bureaucracies on natural resource management norms and practices (Warde 2006a). In other words, the sixteenth and seventeenth centuries' increase in disputes (and the emergence of sustainability problems) might be the flip side of state bureaucracy structuring which started to compete with local institutions for natural resource management. The rise of new state actors would thus have been a destabilizing factor *per se*, as it disrupted century-long management traditions, possibly breathing fresh life into old tensions or acting as a carrier for water resource exploitation intensification. In fact, states might have been interested in exploiting the potential for extraction of the new resources they controlled while managing new interests conveyed by freshly appointed officials and trust members. The acute dispute phase seems to have coincided with the onset of the state building process, while the settling of management practices on new, more or less shared, channels would have favoured a progressive decrease in sustainability problems in the eighteenth century. The resurgence of the phenomenon during the troubled decline of the *ancien regime* also seems to shore up this hypothesis[12].

Moving towards a conclusion regarding the environmental factors, we might also consider certain data emerging from the new database created concerning the Brescia *Ospedale Maggiore*. Archival analysis provides an initial calendar of floods and natural disasters affecting the waterways of the plain around Brescia, although one limited to the seventeenth and the eighteenth centuries (figure 4). Although this data is provisional, it emerges clearly that the intensity of floods coincided with the period of highest dispute.

In summary, it would seem that the greatest sustainability problems derived from environmental changes, especially climate factors, with intensified rainfall making the river and canal streams more unstable. This figure coincides with general climate dynamics studies and, in particular, with the 'mini ice age' phenomenon[13], showing a general drop in temperature and an increase in rainfall from the second half of the sixteenth century to the 1670s, when the

[12] For the evolution of water regulation in Lombardy, see Bigatti 1995; for the Republic of Venice, see Ciriacono 1994.

[13] This was presumably a period of significant climate change with several concequences for the economy, society and culture at a global level. For more details, see Parker 2013 and Blom 2018.

trend reversed[14]. Furthermore, other reconstructions of historic floods in some of northern Italy's rivers are in line with the dynamics observed for Brescia (Alfani 2010: 28, fig. 4).

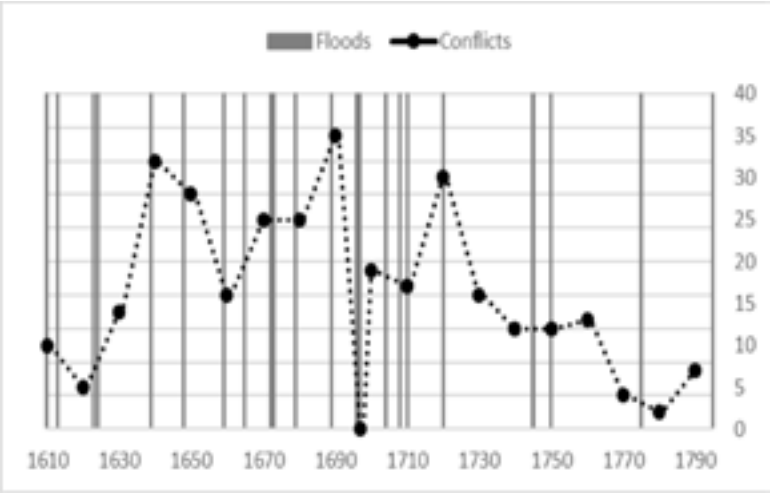

Figure 4. Relationship between floods and conflicts in the plain of Brescia (1610-1795)

All the elements considered suggest that sustainability problems – interpreted through conflict dynamics – have both external (mainly climate, but also demographic dynamics and economic trends) and internal origins (human intervention in water management) (Guidoboni 1998). This dual nature (endogenous and exogenous) seems to be confirmed by qualitative analysis of these conflicts. We cannot list in detail all the different kinds of conflicts included in the database (for which detailed analysis remains largely still to be done) but we will conclude this section by presenting an initial provisional aggregation of disputes involving the Brescia *Ospedale Maggiore* into two macro groups. We have divided up the disputes into 'ordinary and endogenous' and 'extraordinary and exogenous'. The first group includes all disputes involving the members of the consortiums managing the resources primarily or those arising from ordinary management (maintenance, distribution of water, infrastructure cleaning and so on). The second group comprises all disputes relating to unconventional maintenance activities or fostered by factors and actors external to user consortia, such as water theft, abusive excavation of channels, defence of property rights, and so on (figure 5).

[14] A recent synthesis on the topic was proposed by Alfani 2010, especially 24-29.

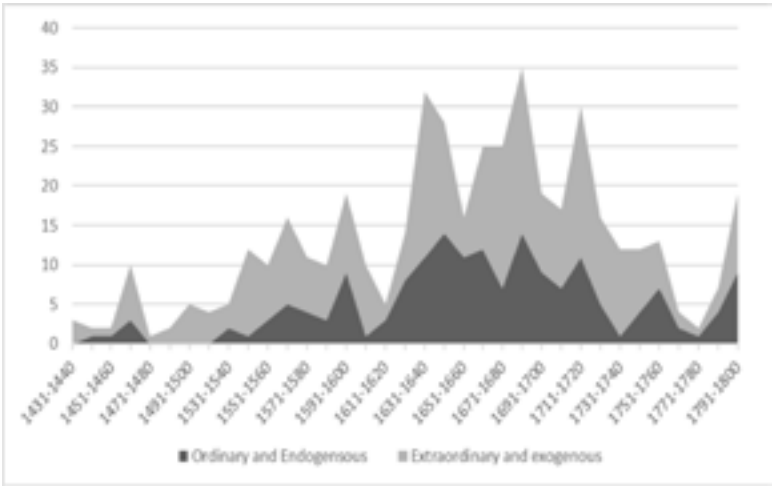

Figure 5. Qualification of the conflicts that occurred in the plain of Brescia (1431-1800)

What emerges is extremely interesting. In the first reduced dispute phase, conflicts were almost completely 'exogenous' in nature. This trend remained unchanged in the sixteenth century, with a partial exception in the last decade. This tendency was broken in the seventeenth century when 'endogenous and ordinary' disputes became more significant, in a context of increasing litigation. The growing importance of 'ordinary' disputes correlates with the noted economic and demographic stagnation, resulting in a presumed abandonment of waterworks or less careful maintenance. Nevertheless, this is also the period in which flooding increased significantly. This could be considered both cause and consequence of 'ordinary and endogenous' disputes, but, above all, it undoubtedly confirmed that the emergence of sustainability problems had contemporary endogenous and exogenous origins.

Finally, on the strength of dispute qualification, our interpretation of the second half of the seventeenth century's decreased litigation phase might be made more complex. As previously argued, we consider the eighteenth century fall in disputes to have been indicative of the new role played by the state, which led to a new period of general agreement after a settlement phase. However, during that time 'extraordinary and exogenous' conflicts decreased significantly while litigation of an endogenous nature was quite frequent (even in absolute terms) and this probably means that internal stability was very far from having been achieved.

3. Water and forests: a Carnia case-study

In the geographical-historical treatise *Amphitheater of Europe* (*Anfiteatro di Europa*) written by Venetian scholar Giovanni Nicolò Doglioni and published in 1623, the Tagliamento River was illustrated as follows: «this is the main» river in Friuli, «it stems from Mount Mauro, and its flow has the virtue of receiving wood and anything else falling within it» (Doglioni MDCXXIII, 942). This was a necessity, rather than a virtue. In order to increase the value of one of the largest wooded areas in the Republic of Venice (Carnia), water was essential to the transport of this fundamental resource. The relationship between water and forests is a symbiotic one: without water, forests would have remained merely a potential resource, throughout the entire modern age and right up to recent times.

Understanding how this relationship developed requires explaining certain aspects of the history of the forest economy in the Venetian area in the modern age. We will use examples concerning Carnia (figure 6), the largest Patria del Friuli Alpine region during the Early Modern period.

Figure 6. Marco Sebastiano Giampiccoli, *La Provincia della Cargna*, post 1780; particular of the Lumiei and Tagliamento valleys

As regards the origin of the forest sustainability issue, its starting point coincided with and resulted from fear of timber scarcity. Over time, a constantly growing population put such pressure on forests that it could potentially compromise their survival. This conclusion is valid from the sixteenth century onwards, and became unanimous in European societies around the mid-

eighteenth century (Ward 2011, 159-163; Radkau 2012, 92-134). However, the common need to exploit this resource – «Everything in the European scene points to it» is the well-known formula created by Fernand Braudel (Braudel 1981, 362) – led to an awareness of the need to preserve these assets for generations to come, an awareness which might be summed up in the presumption of a link between timber and food supply. Depriving communities of this resource meant the ability to feed the population was undermined.

A tangible example of the validity of this assumption is the community pleas (*suppliche*) presented when the state applied restrictive measures to these resources. The case of the Republic of Venice is well known in this regard, with its precociously protectionist legislation which required depriving village communities of specific sectors. Bans (*bandi*) – at first on some specific materials such as oak, then on entire forest sectors – first issued in 1479 had twofold goals, one overt and another resulting from the need to guarantee timber supply to the Arsenal and regulate water inflow from the upper Adriatic to safeguard the lagoon (Vergani 2006; Appuhn 2000; Appuhn 2009; Lazzarini 2014-2019). These were 'Venice-centric' measures which had little to do with the quest for sustainable resource use.

Both at the end of the fifteenth century and during attempted public forest reforms at the end of the eighteenth century (Lazzarini 1998; Bianco and Lazzarini 2003), communities succeeded in voicing their complaints to the state which they saw as guilty of betraying a pact. In the light of their specific legal status as collective resources – as were most forests in the territory of the Republic of Venice – property was the state's, which granted use to communities (Barbacetto 2008): this measure was adopted with a view to guaranteeing citizens' very survival. If this pact was compromised, complaints about the possible consequences were inevitable. By way of example: on 1st April 1609, following a declaration by the collective goods superintendent (*provveditore ai beni comunali*) prohibiting the lease of the goods themselves, the Carnia communities resorted to Venice to challenge this measure. The soil's barrenness «all wild terrain, and inaccessible rocky mountain» («tutto fra alpestri, et inaccessibili monti»), could guarantee sustenance for no longer than three months per year. With no other sources of income, the population was destined for extinction. Moreover

> in 1580 distinguished Mr. Pietro Zane, forest superintendent, deprived citizens of the use of 47 woods, reserved for the Arsenal, which were vital to their subsistence, with the obligation to preserve them. This involved great and incredible damage. However, this being in favour of the state, they obeyed cheerfully as if they were ready to shed their blood as their ancestors had at every public request (Barbacetto 2000, 94-95).

Two and a half centuries later, Dr. Giovanni Battista Lupieri, a shrewd observer of Carnia's economy, reiterated the same concepts:

> forests were rightfully considered to be the most natural resource, the safest, the most productive, more profitable than any other in this country. It seemed that Providence tried to compensate for the uncertain and miserable harvest of agricultural products with the profits deriving from woods, which were consequently considered the region's main source of wealth (Lupieri 1852, 3-4).

In the same way that uncultivated land is barren, forests which were not cut down, or whose distance made them inaccessible, constituted an unproductive sector or failed resource. It is nevertheless indisputable that for a growing population, and thus consumers, even the most inaccessible and previously uneconomical resources become useful means with which to satisfy collective needs. Witold Kula in *The Problems and Methods of Economic History* has argued as follows in this regard:

> In the evolution of productive forces, the tendency to exploit scarcer natural resources appears evident: coal, as a source of energy, is less abundant than timber or waterfalls; naphta is scarcer than coal; fissile materials are scarcer than naphta. Man tries to address this increasing shortage of resources in two ways: 1) developing communication media; 2) looking for alternatives. […]
>
> Man's dependence on nature is a constant, inevitable phenomenon, because man needs a continuous exchange of material with nature for the sake of his own existence. The more man learns to exploit nature's hidden potential, the more he ends up depending on it, although dominating it. This apparently paradoxical conclusion derives from the nature of socially indispensable needs (Kula 1972, 553-554).

Comment on the current affairs of the day aside – when these words were published (1963) the oil crisis was imminent, although observed from the particular standpoint of communist Poland – underlining the dependence of man on resources constituted an attempt to understand the strategies adopted in order to minimise this dependence. The use of water for yarding and timber transport is one such strategy.

In terms of 'remedies' to be adopted in timber supply, it is worth highlighting that the search for substitutes, such as peat (*torba*) is contemporary to the debate surrounding the (alleged) shortage of timber, during the second half of the eighteenth century (Vecchio 1974, 47-49). Above all, it must be remembered that until cableways and railways were introduced, the preferred timber transport method was water, from yarding to landing it in the plains or in harbours. Integration between these two resources – water and woods – was perfect until at least the end of the nineteenth century, and it continued in some timber supply chain phases, at least until the progressive mechanisation of the productive process which took place in around the mid-1960s.

It is clear that integrated use of water and timber is essential to increasing the value of both resources, especially the latter, as without water a forest is as

precious as it is unproductive. A long historiographical tradition has viewed the Venetian policy on water (mainly) and forests favourably. From this perspective – part of the 'myth' of Venetian good governance – the role of the state in safeguarding these resources has been strongly emphasised, whereas the role of local communities in resource use has been neglected. This different perspective (state *versus* community) has been interpreted by contemporaries, in the light of unsustainability as a farsighted state intervening to protect resources otherwise destined to disappear, showing something resembling environmental sensitivity (Zannini 2012).

The historiographical effects of this interpretation have led to a gap. It has been observed that «with regard to local customs, which still constituted a strong opposition to Venetian policy on forests, there appears to be a disproportion in the studies so far carried out. A widespread attention devoted to analysing the precocious Venetian legislative experience has not been matched by an equally widespread historiographical reflection on the meaning of local customs and on their opposition to those hoped for by Venice» (Sansa 2012, 262)[15]. The following is an attempt to fill this gap using cases and examples of disputes which bring across the complexity of daily life.

Perfect forests-water integration had a flip side[16]. Both communities and the state were well aware of the close connection between logging and water flow regulation (and therefore, water flow in rivers). It was only in the eighteenth century, though, that this link was critically observed, basically with regard to communities. If the latter were granted use rights, including to lease resources to traders for sale, and if, at the same time, the needs of a growing local population increased, then regular water outflow would also be undermined by indiscriminate logging.

Interestin the relationship between deforestation and water control – and not only during the eighteenth century – is typically a plains issue, and the Venetian case is probably one of Northern Italy's most prominent. However, responsibility for not compromising water flow was mainly shared by communities and especially timber traders, interested in ensuring smooth transport. There was significant shared investment in the construction of water barriers (so called *roste*) near rivers to protect villages (Lorenzini 2006).

In February 1768 the small village of Preone on the right bank of the Tagliamento, not far from the confluence of the Lumiei creek, presented a petition to the Senate for permission to build a parish church. At that time villagers had to go to Socchieve, on the left bank of the river, to attend church, with the constant risks that this passage entailed. These risks exacerbated over time:

[15] From this perspective (compared on the Alpine area), see Dodgshon 2009.
[16] I am referring to the title of one of the few essays on these aspects: Hollister-Short 1994.

«Since lately the banks of the Tagliamento and Lumiei rivers have considerably expanded due to 'wild' deforestation, and the mountains are becoming smaller, being deprived of the woods, even light rain generates streams everywhere which converge into the Tagliamento, making it impossible to pass for some weeks»[17].

The debate which emerged in the eighteenth century on this issue within the rural academies was often biased, mainly regarding anti-community prejudice aimed at limiting the rights exercised by villages over forests. In any event, as the excerpt quoted above shows, this link was also a familiar one in village squares and homes. The official debate neglected one fact in particular: using water for transport was not recent but rather a centuries' long fact of life. It had always been a sustainable form of management, as it had been guaranteeing logging transport since at least the beginning of the thirteenth century.

What had changed was perceptions of the relationship between people and resources, including forest resources, with the emergence of fears of timber scarcity (Warde 2006b). The solutions adopted by states, at the time of the Restoration, reinforced control over forests, to the extent of the founding of specialised military formations[18].

The distribution of timber traffic routes towards the Veneto plains and Venice closely follows the main rivers: the Adige, Brenta, Piave and Tagliamento. However, the different morphological conformations of the mountains and the characteristics of the rivers made flow uneven. The stream-like nature of the Tagliamento for most of its course, for example, caused difficulties for raftsmen which were unknown to their counterparts operating on the nearby Piave or Brenta rivers. Moreover, there was a precise raft port geography, where loads of timber were prepared. Previously, timber was transported to sawmills over land, or by exploiting river flow itself (floating loose trunks). The synthesis elaborated by Antonio Lazzarini in 2007[19] well describes how the distance between the source of these streams and the first harbours was changing, to the point that specific forest sectors were definitely more desirable than others in accordance with the potential they offered for smooth timber transport. Limitations on raft navigation thus became a key element in the potential for increasing forest value.

Moreover, whilst raft navigation could take place almost year round, the floating of loose trunks had to wait for periods in which water's carrying capacity was highest, i.e. when the snow melted or in late fall, when rainfall

[17] Archivio di Stato di Udine, *Archivio notarile antico*, b. 2019, Romano Antonio Sovrano di Enemonzo, f. 5, 20 February 1768.
[18] For the French case, see Whited 2000.
[19] Lazzarini 2007; for a detailed reconstruction of the fluvial axis Cismon-Brenta, see Occhi 2006. For the Piave river, see Vendramini, 2009, 125-146.

is usually more abundant. This applies even more to deforestation and the complex and varied systems devised to reduce the costs and effort involved in timber transport towards the main rivers. The wide array of solutions adopted (in consideration of land morphology but also due to the different cutting and working practices) was a primary land based activity, with animals dragging trunks or tracks being created along which trunks could be slid, but it was to an even greater extent a water based activity involving the creation of artificial dams (*argini*, *invasi*) and sluice gates being built across small rivers (*stue*, *stuetti*) obliging work to follow stream carrying capacity closely.

On 11th September 1673 the communities of Mediis and Priuso, at the confluence of the Lumiei and Tagliamento Rivers, reported the heirs of Nicolò Nigris, a rich trader from Ampezzo, to the judges in Tolmezzo. They demanded that two experts be appointed to assess the damage caused by the Nigris family to the villages by a water barrier built near a sawmill which guaranteed a regular water inflow thus allowing timber to reach its destination directly, without it needing to be «dragged by oxen». This diversion of the course of the streams caused an atypical inflow to the village's barriers, damaging them[20]. Timber reaching the sawmill by floating down river was clearly either not a usual practice or a recent innovation as forest transport into using cattle and horses had already been taking place for some time and this continued until recent times.

The association between indiscriminate deforestation and lack of water control, with ensuing environmental disaster, was tragically demonstrated in the night between fourteenth and fifteenth August 1692. A dreadful flood caused by continuous and intense rain, which had disastrous repercussions across Carnia, struck the Tagliamento valley and especially the little village of Buarta. The mountain over the village collapsed onto it, destroying it and killing its 60 inhabitants. The landslide caused a blockage in the Tagliamento River, creating a lake which lasted for several years before river flow was restored. The damage to the Carnia area as a whole was so severe that the Dominante exempted the region from taxation on flour (*macina*) for ten years (Spinotti 1740, 83-85; Sclippa 2005)[21].

Many considered the destruction caused by water as a consequence of forest «extermination» (Bianco 2001, 79), arguing that deforestation was too intense and the local population's impact on resources too heavy: the situation required regulation. The response of the state was to prohibit the leasing of forests to traders for twenty years and this was implemented by the timber and forests

[20] Archivio di Stato di Udine, *Archivio Perusini*, b. 237, *Gastaldia di Tolmezzo: atti giudiziari XVII sec.*, reg. *Libro secondo dell'anno 1673*, c. 43r.
[21] On these aspects, overall, see Pfister 2009.

superintendents on 25th February 1698. The assumption was clear: the main effect of the «extermination of the woods» was in the towns, where «cutting in a careless and indiscriminate manner by means of the lease to particular traders» (Spinotti 1740, 236-238) contributed to disaster.

The document depicts an all too common scenario linking communities and traders, bound together by greed and not at all interested in safeguarding resources. The situation was thus deemed unsustainable. The measure brought about at least one result. The chronology of leases stipulated by two of the most important local trading families, the Lenna family from Socchieve and the Nigris family from Ampezzo, show a gap immediately before and after 1698. The Lennas were granted a lease on the sector above Mt. Grasia, not far from Buarta, in 1669 and then reappear as leaseholders only in 1709, when they were granted a lease on Rio Negro, Naiarda and Naiarduzza forests for 29 years by the parish of Socchieve. For the Nigris family the gap lasted until 1718, when Sauris granted it the Osanghen forest lease for 10 years[22].

These communities probably found themselves in the difficult situation of having to comply with the limitations imposed by the Republic and forego the proceeds deriving from forest leases in order to restore environmental order, which seemed to have been compromised by excessive exploitation. Thus over time the constant material exchange between man and nature (to quote Witold Kula) implies limitations which need to be acknowledged for resource use to be sustainable once again.

4. Concluding remarks

This *excursus* through diverse places and periods involved comparing partially different research methodologies with the aim of retracing the sustainability practices promoted by preindustrial societies regarding the use of natural resources. As is frequently the case, the variety of approaches generated a complex analysis while maintaining a certain homogeneity in results. What emerges quite clearly from our studies is that sustainability practices were once an everyday life issue, rather than a necessary and quasi prescribed response to a shock, which had little to do with local dialectics.

Reconstructing this complicated network of relationships and sustainability practices required adopting a research approach which analysed the phenomenon from various perspectives. In other words, defining reasons, methods, needs, will, successes and failures in the management of natural resources (water, in particular), required attempting an analysis of the various

[22] I am referring to Lorenzini 2004-2005, 142. See also Occhi 2015.

dimensions underlying the phenomenon, interweaving the economic and social dynamics, the environmental picture and the demographic process and so on. In this context, conducting a comparison between studying water management in the long term, starting from a systematic reading of archival sources, and a more limited case study analysed in the light of a broader territorial and chronological context emerged as useful.

Moreover, whilst the focus here was water, it is evident in all the case studies analysed that understanding a specific resource's management practice requires considering the multitude of actors involved and the relationship between the different resources. In particular, what we observed regarding the relationship between water and forests in Carnia prompted the following argument: it is only by taking into account the complex natural resource system at a local scale of analysis that we can truly understand the complexity of managing these, highlighting the various methods employed and the differing reasons behind them that motivated and formed the basis for everyday sustainable practices.

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The Tiber river and hydraulic risk: models of interpretation in history

Paolo Buonora

1. Introduction

In accordance with an old dichotomy, humanism and science balance their interpretations of natural disasters somewhere between determinism and anthropocentrism with varying points of view and approaches to the relevance of human action *versus* the role of natural factors, generating very different natural event interpretation models.

In the 19th century, positivistic approaches seemed to promise a future in which anything was possible for humankind, and the collapse of this illusion generated what we now call environmental awareness. Traditional Italian agricultural systems (*mezzadria* or *metayage*) accorded a significant role to common sustainable resources like woods, marshes and marginal lands (Sergio Anselmi).

Much of the relevant action of the modern era was conceived from a sustainable perspective: the management of the Venetian lagoon, the plan to transform marshes by means of 'colmate' integrated drainage/irrigation/hydraulic energy systems (Lucio Gambi).

It is interesting to take a small step backward in the past to examine the theological approach to explaining natural disasters. Hypothetical direct action by God in the natural context, perhaps via intermediate Anima mundi, earthquakes, volcanic eruptions and floods, were seen as the effects of divine punishment. The Jesuits' Aristotelian reinterpretation (Athanasius Kircher) saw natural disasters as having natural causes. In both approaches, discovering the order and harmony of the natural laws through mathematics (the "language of God" in Galileo) was a watershed in planning to manage the natural world and its waters and prevent floods. From Machiavelli to Galileo the violent force

of water was the battlefield on which the new scientific theories and ruler ambitions were put to the test (Urban VIII Barberini).

Tiber river flood prevention is related both to the ability to predict extraordinary events and to a combination of manmade and climatic factors which changed dramatically over time. This paper will outline the absence of an appropriate scientific view in the 17th-18th centuries on the part of the "Pope's architects" and the combined effect of deforestation and climate change in causing historic floods.

Hydraulic science now warns that dramatic events may occur over a very long time frame, i.e. 2-4 centuries. This gives a new perspective to contemporary Tiber flood problems: Tiber flood risk management must therefore focus on both the contemporary hydrogeological context and the climate changes that can potentially produce extraordinary events in the very long run.

2. Text

In the history of philosophy, humanism and science have acted as two poles in a crucial contradiction: an oxymoron, so to speak. If God placed man at the centre of the world, in his own image, what limits can science impose on human action and will? If everything is determined by the laws of physics and chemistry, man is no more than a ball thrown around by external factors and free will as the basis of anthropocentrism disappears. Conversely, if these laws can be ignored by God, generating floods and earthquakes at will to punish human sins, science's value in controlling natural phenomena is limited.

The importance of this issue increased as modern science and technology moved forward to traditional human activities in agriculture, industry, and engineering: in the 19th century, everything seemed finally to be potentially encompassed by human ambition. Crossing continents and mountains via canals, and then railways, became a reality.

Jules Verne is the literary expression of this positivistic approach, to cite just one well-known writer, but he was not alone. When plans to link up the Po plains to the sea and the port of Genoa were discussed at the beginning of the 20th century, Italian Emilio Salgari wrote an "instant" book, a work of fiction. In his *Naviganti della Meloria* he imagined that a secret, subterranean canal, made in the Middle Ages by the Republic of Genoa to attack its rival Venice had been discovered (Salgari 1902.). Or, to give a non-literary example, after the foundation of the new Italian kingdom, general Giuseppe Garibaldi, now a member of parliament, promoted a project by engineer Filopanti in 1875 designed to create a totally new riverbed for the Tiber river, several miles out of

Rome where the river had caused many catastrophic floods.[1]

As we know, this positivistic approach had its day, and our current perspective is very different. Science and technology proved capable of generating two catastrophic world wars in the 20th century, and took it to the brink of atomic apocalypse (where it still is), not to mention the natural environmental disasters caused by modern industry. In other words, the collapse of the positivistic illusion generated what we now call environmental awareness. This has had a remarkable impact on historical disciplines. In Italy great historian Alberto Caracciolo proposed giving "a historical perspective to this consciousness", enquiring into the extent and type of forecasting applied by traditional agricultural systems such as sharecropping (metayage), and past management of common sustainable resources. From his experience as an economic historian, he knew that people had not always been as careless and imprudent as they were in the 20th century (Caracciolo 1988; Caracciolo and Bonacchi 1990).

Several key cases concerning Italy in modern times are relevant here. One is the management of the Venetian lagoon: for centuries, the tenuous balance between sea and river action in the lagoon was key to the political interests of the Venetian government and their hydraulic technicians. Conserving the lagoon was a matter of life and death for Venice and the city did not hesitate to deviate major rivers to prevent the lagoon filling up with mud: being able to forecast meant action, and sometimes very expensive action.[2]

A different example is the positive use of solid transport in the management of marshes, as planned and practiced at the border between the Grand Duchy of Tuscany and the Papal States, in Val di Chiana[3]. After many centuries of futile efforts to prevent floods, in the 19th century engineer Fossombroni (Fossombroni 1835) started deliberately to extend mud waters during heavy rains in the low plains, to raise the level over time, until they were high enough for normal drainage.

A third example is the integrated drainage/irrigation/hydraulic energy systems to be found in almost every central Italian town (*Proposte e ricerche* 17/1994). The basic elements for supplying water and energy (Buonora 1994) for these growing urban systems were:

1. an artificial canal from the main river with a riverbed safely outside the city walls and only controlled canal flow inside the town centre;

[1] Available at: http://www.archiviocapitolinorisorsedigitali.it/piante/376.htm .

[2] See the complete map series in the State Archive in Venice, available at: http://www.archiviodistatovenezia.it/web/index.php?id=63

[3] See the State Archive in Rome's cartography collection, available at http://www.cflr.beniculturali.it/Cartografica/cartografica.html, Collezione I, map 17/173: large map of the agreement between the Papal States and Tuscany, also signed by Carlo Maderno.

2. this canal supplied energy to a series of mills, each at a different level from the others, feeding a small lake to enhance water pressure and involving limits on the number of mills;
3. alternate use of water at all times – when it was not moving waterwheels, water was employed to irrigate large vegetable gardens inside the city walls, a basic resource for the urban population. Traditionally this took place on Sundays, but more frequent use was often needed in summer.

This model of water use is a long-lasting and traditionally Mediterranean one: it can be found, with some small differences, from Morocco's Atlas mountains to Greece and Andalusia in Spain.

Now, if city and country people were able to forecast nature's behaviour and create complex and stable settlement systems in medieval and Early Modern times, how can natural disasters be explained? What theological approach can manage non-regular natural behaviour? Existing approaches were essentially twofold, both at the origins of modern science, both assuming that physical matter could not move by itself.

The first was the Neoplatonist *Anima Mundi* explanation[4]. God has an intermediary in the natural world, the true soul of all existing things, who acts on physical matter in accordance with God's laws and this World Soul "qual grand'animale, in tutte le parti da se stesso si muove" (Bonini 1663, 35) (like a great animal, it moves all its parts by itself). Nevertheless, God could play His role both within (*ad intra*) natural laws through his intermediary, and outside them (*ad ultra*), in an extra-ordinary way.

The Jesuit Aristotelian interpretation – i.e. Athanasius Kircher's – was different: natural disasters had a natural cause and our task was to identify these. To explain earthquake and floods simultaneously, Kircher made an amazing model of the earth's structure in which an eternal fire at the centre boiled enormous lakes deep under the surface. Usually water arrived at springs fresh and regularly, but sometimes greater heat produced an extraordinary flood, or even a volcanic eruption of planet earth's inner fire.

The basic belief in natural harmony and mathematics' key role in understanding natural laws (Galileo's "language of God") was crucial to the birth of modern sciences. Galileo's disciple Benedetto Castelli, the father of hydraulics, wrote the first treatise *Della misura dell'acque correnti* in 1628: measuring water flow made it possible to determine flood danger and these could be prevented by regulating riverbed and bridges cross sections with mathematical exactitude.

[4] See Chigi Pope Alexander VII's allegory, in the engraving from a Pietro da Cortona drawing made for a doctoral thesis at the ancient Sapienza University in Rome, London, British Museum, available at: http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=714806&partId=1&searchText=spierre%2C+francois&page=1

The most relevant Italian case is probably the Po basin between Bologna and Ferrara. In 1152 the river Po generated a major flood in Ficarolo, near Ferrara, whose causes were both natural and manmade, shifting the riverbed leftwards. As a result of this, the river Reno, coming from the Apennine mountains near Bologna, could no longer find an easy path to the ancient Po di Primaro, and increasingly flooded the plain between the two towns.

The resulting legal dispute lasted for at least two centuries with Cardinal Corsini tasking Benedetto Castelli to survey the situation in 1625. This latter believed that the key to solving the problem lay in Galileo's law of falling bodies, and tried to demonstrate that water architects (what we call engineers today) had to link up the various Apennine rivers: the speed of river flow would prevail over the water level and maintain the riverbed by carving it out naturally and preventing floods (Castelli 1660, 152-184).

Another good example of this incessant struggle against the natural force of the waters is the long story of the building and maintenance of Ponte Felice (Felice Pieretti was Pope Sixtus V), north of Rome. This bridge was made to replace an ancient Roman bridge over the Tiber near Magliano which collapsed in the 16th century. As at that time the engineering know how involved in building bridges over wide, fast-flowing rivers did not exist, the bridge was made beside it. However, when attempts were made to force the river inside a new bed the result was one of architecture's greatest failures, and for years a great deal of money was required to keep the river in the right direction and bed. Nearby a stone monument to Barberini Pope Urban VIII, who forced the river under the bridge "*sotto il quale non voleva passare*" (where it did not wanted to pass) is still standing.[5]

In actual fact, it was several centuries before Castelli's mathematical accuracy goal was achieved and all the components of water flow could be set down in a formula, the early 19th century (Prony, Venturoli, Eytelwein). Until then people had frequently to struggle against unpredictable events like floods. A useful overview of people's relationship with nature in Early Modern times is Machiavelli, who compared floods to political uncertainties:

> Et assomiglio quella [la Fortuna] a uno di questi fiumi rovinosi, che, quando s'adirano, allagano e' piani, ruinano li arberi e li edifizii, lievono da questa parte terreno, pongono da quell'altra: ciascuno fugge loro dinanzi, ognuno cede allo impeto loro, sanza potervi in alcuna parte obstare. E, benché sieno cosí fatti, non resta però che li uomini, quando sono tempi quieti, non vi potessino fare provvedimenti, e con ripari et argini, in modo che, crescendo poi, o andrebbono per uno canale, o l'impeto loro non sarebbe né si licenzioso né si dannoso (*Il Principe*, cap. XXV).

[5] Many Ponte Felice maps are available online in the Rome State Archive's cartography section, mentioned above.

Journalist and writer Adriano Sofri (Sofri 2013) has written interestingly about Machiavelli's vision of fate (Fortuna). His view is that if men do not make mistakes, if they do not fail and fight bravely, they have an around 50% of chance of winning out against the force of nature: no more, but also no less, a fair competition.

On the subject of the contemporary climate change challenges we face, it is clear that the forecasting ability we need goes far beyond the traditional "human memory" that was the basis for farming know-how and even the memories of historically long lasting institutions. We need data from both historic archives and scientific disciplines, as events may occur over a very long time frame, i.e. 2-4 centuries: this is the time frame for Tiber flood risk management, if we take potential climate changes into account.

We are not dealing here with more major climate changes like those of the Holocene era which began 10,000 years ago but with historical phenomena like the Little Ice Age, lasting from the end of 16th to the 19th century. Wallace Broeker has argued that a limited increase in temperatures in the northern hemisphere may melt the polar ice in water, making it less salty and heavy and preventing it from sinking in the depths of the north sector of the Atlantic Ocean. This dynamic is capable of stopping the great ocean conveyor in a very short time: just 20 years, according to Broeker's forecast. The consequences of this for Europe may be significant, as oceanic circulation would no longer carry warm water and humid air from the Caribbean seas along European coasts, making for colder winters, hotter summers and a drier climate throughout the year. But this would take a long time – as was the case for the Little Ice Age and perhaps before – see the Sea People invasion in Egypt in the late Bronze Age.

Putting all the possible data together (ancient literary and archival sources and more recent measurement data), hydraulic engineers today can outline a series of exceptional Tiber floods in Rome from 1180 up to 1870. Nevertheless, D. Camuffo and S. Enzi argue that:

> "The really exceptional phenomena, such as great winters, can occur at any time, even in periods when atmospheric healing reaches the highest levels. This means that society continues to be unprepared for natural events, when it only bases its choices on the most recent climatic trends. The current period is a particularly fortunate one, which cannot, however, last much longer.
>
> The anthropogenic effects on the territory could have an enormous weight, both for good and evil" (Camuffo and Enzi 1995, 123).

We have an excellent example of a negative climate and anthropogenic effect combination on a river with has happened at the mouth of the river Tiber over several centuries. Geological surveys outline a very clear scenario: regular

deposits of mud and solid transport increased dramatically in the 16th century. In my opinion, this dangerous combination is a product of:

1. an increase in river basin population, prompting the cutting down of woods not only in the traditional regulated way in the mountains and hills, but also beside the riverbed, weakening river banks and vegetal soil protection;
2. Little Ice Age, i.e. more heavy rains at lower altitudes.

As the chronicles make clear, the 1598 flood in Rome (more than 1500 deaths) and the other floods that followed were mud floods, whose effects on the town resembled that of a bomb. We can indeed measure the essence of the phenomenon on river mouth deposits in the huge increase in these in those years.

Get prepared, argue the experts. They are right, as the long Tiber riverbed is today a sequence of artificial sectors, with hydroelectric power plants and dykes all the way along. It is very hard to retrace the original course of a river that was exploited to take olive oil, wine, and wood from the surrounding regions to Rome for centuries. What might happen if climate change breaks down this tenuous contemporary balance between nature and technology? (Bencivenga and Bersani 2001a, 2001b)

Rome is not completely safe, after the building of the big riverbanks after the 1870 flood: there were other big floods in 1915 and 1937 in the Ponte Milvio area. Although this may have been a consequence of the non-completion of the original project, hydraulic experts have been able to draw up a map of potential flood areas in Rome every 200 years covering a large part of the city centre, and the entire Prati district (Calenda 2014).

Since a 1998 seminar (Buonora 2001), the State Archive of Rome supplied historic maps to the Roma La Sapienza and Roma Tre universities' research teams with which to measure the original riverbed and apply stochastic models to these historical scenarios. We can thus say that this work has a true basis with which to see both what happened in the past and what could happen in the near future, as almost 200 years have passed since 1870. I must admit that my intellectual satisfaction for the positive results of this work notwithstanding, all satisfaction vanishes when I pass the marble inscription marking the 1870 flood water level, in the courtyard of my State Archive in Rome everyday: it is shoulder height.

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Military-engineered floods as defense from the enemy: a brief review, and case study from WWI in Northern Italy

Silvia E. Piovan and Michael E. Hodgson

1. Water against the enemy

The use and the manipulation of the environment in war time is ancient (see Tucker & Russell, 2004 for an interesting review) and was mostly directed against food and water supplies. For example, in the U.S.A. history, well known are the campaigns of Sherman in burning in Georgia and the Carolinas (Barrett 1996; Brady 2005; Piovan et al., in press), of Sheridan in the Shenandoah Valley (Gallagher 2006; Stackpole 1992) during the Civil War, and the near extinction of bison during the Plains Indian Wars (Isenberg 2000). In war times water can be more critical than food (Dutch 2009). An example comes from the territorial conflicts between Padua and Vicenza cities (northeast of Italy) during the Middle Ages (14th century). In order to deprive Padua's inhabitants from water, the city of Vicenza diverted the waters from the Bacchiglione River (passing by Vicenza first and then through Padova) to the Bisatto canal (Genio Civile 1879; Vallardi 1886-1899). The main concept behind these examples is the deprivation of one or more fundamental ecosystem service to the enemy such as drinkable water, food, energy from waters (mills), and materials for clothes (cotton, leather, etc.).

On the other hand, water, in particular, has been used since the ancient time to provide an important ecosystem service in war times – a defensive weapon against the enemy through human-induced floods. Many cases can be cited. For example, in 1584 and 1586, large inundations were caused in the Zeeland Flanders by the Dutch rebels against the Spanish dominance, breaking both seawalls and dikes (de Kraker 2015). In pre-unification time, Italians induced a large flood in the Piedmont region during the Independence War (1859-1860) to keep Austrians far from Torino (Porro 1898; Boggio 1860). In the 20th centuries, the Allies breached dikes in the Netherlands during the Second World War, causing relatively small scale inundations for tactical purposes against the Nazi (de Kraker 2015).

The main purpose of this contribution was to provide a short review on the use of artificial floods during war time for offensive or defensive purposes by means of four case studies from Germany, China, Pacific Ocean and Italy. In particular, the last case study will be discussed in greater detail to introduce a topic not yet treated by the scientific literature – the huge engineered flood planned (but never implemented) in the northeast of Italy during the First World War by the Italian army in order to prevent the possible deep advance of the Austro-Hungarians after the Caporetto Italian defeat.

1.1. The Dambusters

During the Second World War many military-engineering floods were performed in different countries and in different ways. Well known artificial floods created by the bombing of dams are those performed by the Allies on the Möhne and Eder River in North Rhine-Westphalia (central western Germany) during the "Operation Chastise". The Möhne River is a tributary of the Rhine River and the Eder River joining the Fulda River (Weser river catchment). At wartime, both rivers served a large industrial area through two large hydroelectric power plants. The attack on the two dams was carried out on 16-17 May 1943 by the Royal Air Force (RAF) 617 Squadron, using a particular kind of bomb called a "bouncing bomb". Both dams were breached, causing catastrophic flooding on the Ruhr and in the Eder valley. About 1,600 civilians (both German and Soviet forced laborers) perished. Although Germans rapidly repaired the dams, the production was compromised until September (Cooper 2013).

Figure 1. Breached Möhne Dam on the Möhne River, taken by Flying Officer Jerry Fray of No. 542 Squadron from his Spitfire PR IX. From Staerck (ed.) (1998).

1.2. China's Sorrow

Perhaps the most known catastrophic human-induced flood in the pre-WWII time was the flood from the Yellow River (China) in 1938 by the Chinese Nationalist Government during the early stage of the Second Sino-Japanese War. The flood was an attempt to stop the advance of the Japanese army who, already occupying the northern China, were rapidly advancing to the western and southern part of the country. The Yellow River is the second longest river in Asia and the sixth largest in the world. The river changed its path many times during history, especially due to the continuous aggradation of the river bed (Yu 2002). The management of the Yellow River's waters was one of the most important duties of China's traditional central government. The major task in the control of the river was to build and maintain the massive levees which contained the waters in the middle and lower part of its course. A failure of the levees with a subsequent flood was considered a failure of the government and a sign the current dynasty should not rule (Lary 2001; Todd 1949).

The flood, defined as "largest act of environmental warfare in history" (Dutch 2009), was the result of a breach performed at the beginning of June 1938 by excavation (no explosions were used) in the southern dyke of the river at Huayuankou in Henan, about 50 kilometers to the west of the Japanese vanguard. Before the breach at Huayuankou, two attempts of destroying the dykes with explosives at Zhongmou and Zhaokou failed. The work of a huge number of Chinese soldiers with simple tools as spades, picks and hammers produced a relatively small leak of water. The river started to gush in its season of full waters (Lary 2001) to create a massive flood. The flood extended for 45,000 km^2 in a southeast direction, drowning 890,000 inhabitants. The deliberate flood affected an estimated 12.5 million people and had dramatic consequences on the agriculture since it occurred at the eve of the summer harvest (Muscolino 2015, p. 61). Unfortunately, the flood did not prevent the Japanese advance to their objective, the city of Wuhan, since they simply followed another route around the flood. Finally, the strategic decision to break the dyke of the China's Sorrow bounced back to the Chinese government and is remembered as "a political mistake of enormous proportions" (Lary 2001). As Muscolino (2015 p. 66) noted, the damages of the flood were magnified by other breaches in the dikes in 1939. What was an epic tragedy for humans, livestock animals and settlements turned into a opportunity for wildlife (e.g. egrets, geese and rabbits and, more) for a new wilderness.

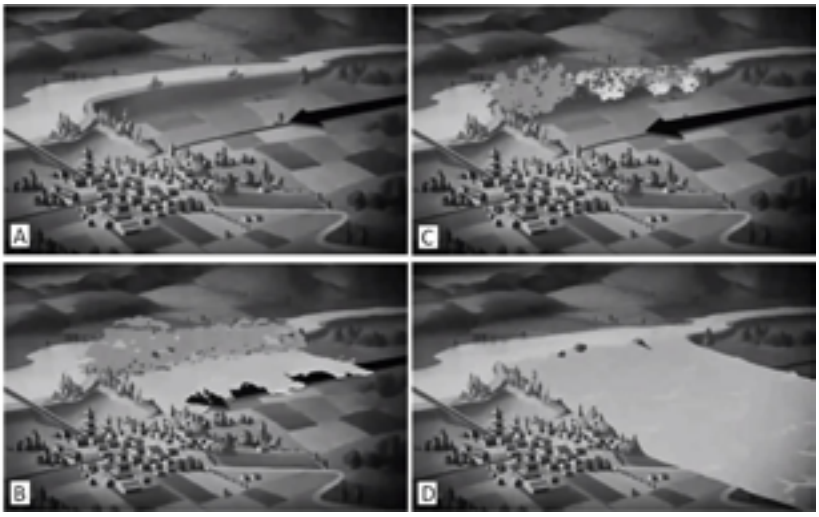

Figure 2. Sequence of images from the You Tube video: https://www.youtube.com/watch?v=yO-o_2XoI0KM (05 May, 2018), explaining what the government envisioned: A) after the arrival of the Japanese Army, B) destruction of the southern dike of the Yellow River just downstream of Huayuankou, C) halt the enemy with D) minor damages for the Chinese settlement. Evidently the video does not show a realistic spread of the water but instead a "straight path" as to avoid the complete destruction of the town.

1.3 A "Water Backup" for the Nuclear Bomb

During the final stages of the WWII, the United States considered using the ocean itself as a weapon for generating a tsunami, in its war against Japan. This operation, still not well known and almost unknown in the academic literature, was named "Project SEAL". It has its origin in April 1944 from a request of the Commander South Pacific Area (COMSOPAC) to the New Zealand Government to conduct an investigation of the "potentialities of offensive inundation by waves generated by means of explosives" (Leech 1950). The tests were carried out by the 24th Army Troops Company, New Zealand Engineers, the US navy and the Royal New Zealand Navy between June 1944 and August 1945 in waters around New Caledonia and Auckland. About 3,700 bombs (mostly TNT) were exploded during the tests, showing that the location of the charge and the use of multiple charges were key to obtaining the tsunami desired. Those experiments demonstrated the weapon was feasible and, under favorable conditions, capable to generate a tsunami wave to inundate a small city along the shore. The project, lead by Prof. Leech (Auckland University College) was closed in January 1945 mostly because both the pessimistic opinion of the United Kingdom authorities and the outcomes of the Allies in the Pacific theatre of the war. After the end

of the war, Leech was called to follow the second nuclear bomb experiment in Bikini (August, 1946) for analyzing the subsequent sea waves. In his report (Leech 1950) he writes "the use of atomic bombs as multiple charges may be (more) practicable". The experiments of "Project Seal", originally intended for the creation of a tsunami big enough to inundate the coast of Japan and as "a backup" to the use of the atomic bomb, were never exercised in a war.

2. The 1918 Italian army secret plan to manage water gates

2.1. Introduction

During WWI in the Southern Venetian Plain (SVP), some dramatic secret plans involving artificial floods by rivers were designed by the Italian Army in order to stop the advance of the Austro-Hungarian enemy. After the breakthrough of the front in Caporetto by the joint action of Austrian and German troops, the Italian army stood on the line of the Piave River (Figure 3). The choice to move the front back to the Piave River allowed the Italian army to halt the advance of the Austro-Hungarian army, but initially created fear. Nothing in fact could completely prevent the enemy from penetrating deeper into the Venetian plain and to the center of Italy. Thus, the Commando Supremo (Main Command) of the army considered the possibility of new rearward fronts (Selmin and Piovan 2014). A first defensive line south of the Piave ran between Bassano del Grappa, Asolo and Treviso; a second one joined Vicenza, Fontaniva, Cittadella, Castelfranco and again Treviso. Another line was planned along the Bacchiglione River. The last front was the Mincio-Po line, involving the secret plans for a massive flood.

Figure 3. Map showing the setting of the front lines during the last phases of the WWI in the northeast of Italy. The arrow shows the direction of the advance of Austro-Hungarians after the defeat of the Italian Army at Caporetto (noted with a star). The planned flood is shown by the blue polygon. Modified from United States Military Academy at West Point Department of History Archive https://www.usma.edu/history/SiteAssets/SitePages/World War I/WWOne15.gif (05 May, 2018)

2.2. Geographical Setting

The SVP is located in the northeast of Italy, in the southern part of the Veneto Region and is characterized by a very low-gradient (<1% slope) and a dense network of rivers and canals. This area has a long and uninterrupted history of interrelationships between natural fluvial processes, such as floods and avulsions and human activity, since at least the late Middle Ages. In those times, land reclamation of large wetland areas began, and rivers were put under control through the construction of high artificial embankments (Bondesan 1989). The major rivers of the SVP are the Po and the Adige, the first and the second Italian rivers by length, respectively. Minor rivers are the Fratta, partially canalized in the Gorzone canal in its final tract in the second half of the 16th century (Pasetti 1865), the Brenta and the Bacchiglione Rivers, both artificially deviated by their original courses and rectified during the Modern age, and the Tartaro-Canalbianco system, deeply modify in the mid-20th century (Miliani

1939). As very high aggradation of sediments occur in the river beds, rivers in the SVP are supraelevated, higher than the surrounding floodplain (Piovan et al. 2012). The secondary hydrography consists of a high dense network of canals (both incised and supraelevated), artificially created to drain the lands and irrigate the agricultural fields. The hydrography and geomorphology of this area would be key points for the project and the outcome of the engineering flood planned in 1918.

2.3. The Secret Plans

As with the front line on the Piave River, the Mincio-Po one was based on the strategic role of the rivers. The Mincio-Po, in particular, could provide a series of artificial floods to inundate vast areas in the Grandi Valli Veronesi and between the Adige and the Fratta-Gorzone Rivers in the so called Bassa padovana, both parts of the SVP, to stop the possible advance of the enemy.

On November 12th, General Armando Diaz issued general directives for a possible withdrawal to the Mincio-Po line. In the secret document "Direttive particolari per la 2a e 3a fase del ripiegamento dal Piave al Mincio-Po (19 November 1917), signed by the General Lieutenant of the Army E.F of Savoy, there are particular instructions such as in this translated point of the text:

> (point 12): «The inundation on the left side of Adige are shown by the attached sketch [map in Figure 4]. They are prepared by the general command of the *genio*[1] (…) and will be done when the order is given (…)»

The document, stored at the Museo della Terza Armata (Museum of the Third Army) in Padova included a map, based on the Istituto Geografico Militare (IGM) topographic maps, illustrating the expected inundated areas colored in blue and the subdivision of the SVP under each Italian army. A second map (with similar contents) is stored at the Museum of the Third Army. This second map shows also the location of the hydraulic structures that could serve to manage the flood from rivers. The structures included spillways (both active and historical), water gates and pumping stations. With an analysis of the maps it is possible to give a general description of the planned flood that never occurred.

2.4 The Inundation that Never Occurred

The plans for the inundation were based on eight openings of the levees in

[1] The *genio* was one of the specialties of the army, whose task is the ordinary and extraordinary maintenance of infrastructures and works (in this case, the operations for the flood) to support the combat activity.

from existing hydraulic structures (Figure 5 and Figure 6). The area to be flooded was divided into seven zones, each zone generated by one opening on the levee, except zone 4, that was served by two structures. The openings were planned mainly on the Adige River but also on the Tartaro-Canalbiaco system (zone 1, the furthest to the west), on the Gorzone canal (zone 6) and on the Bacchiglione River (zone 7, the easternmost one). Zone 3 was the smallest inundation area (about 11 km^2) while zone 7 was the largest (about 210 km^2). In total, the flooded area would cover about 600 km^2. Since the Italian Army held the front along the Piave River (which is now referred to as "the Sacred River" for Italians), the planned flood in the SVP was never initiated.

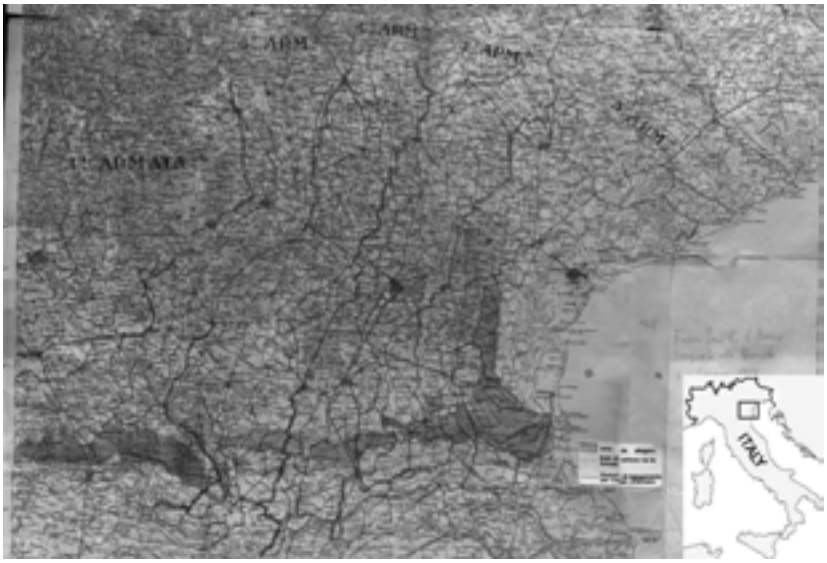

Figure 4. Subset of the map of the planned flood in the Southern Venetian Plain (1918) and, in the inset, the area covered by the map in the northeast of Italy. By courtesy of the Museo della Terza Armata, Padova.

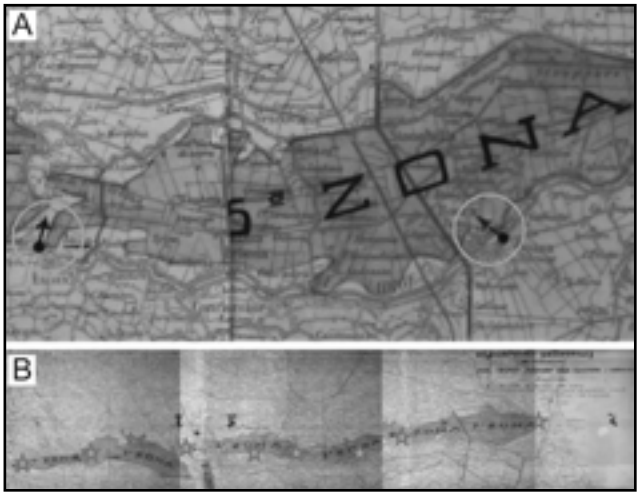

Figure 5. A) Details of a second version of the map of the planned flood in the Southern Venetian Plain (1918) showing, with the black arrows, the points from where the waters could be managed by mean of water gates on rivers and canals; B) all of the levee openings. By courtesy of the Museo della Terza Armata, Padova.

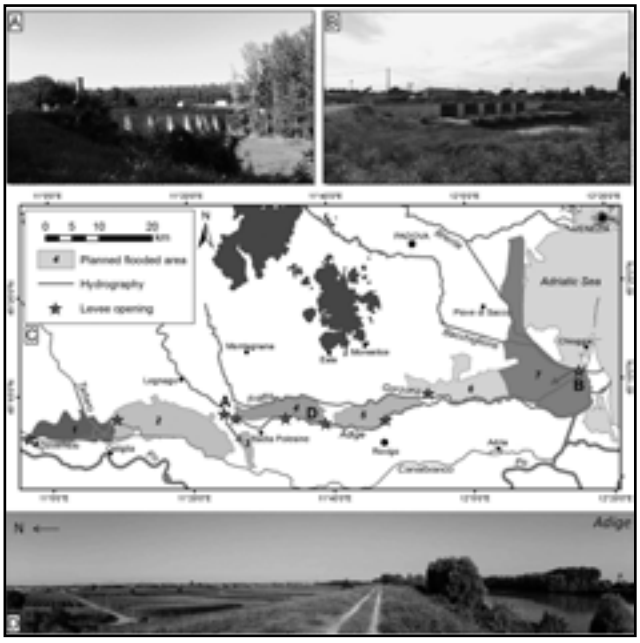

Figure 6. Examples of hydraulic structures that would be used to manage the 1918 planned flood in the Southern Venetian Plain A) Rosta Castagnaro spillway; B) Bacchiglione water gate near Chioggia; C) map showing the planned flooded areas and the levee openings along rivers and canals. The two arrows show the direction of the waters from the two water gates in A) and B); D) landscape view of the fields north of the Adige River (on the right): note the supraelevated river "over" the lands.

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Land reclamation and credit in Italy from Unification to the Fascist age

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1. Introduction

A great deal of historical-geographical and historical-town planning research has reconstructed man's environmental intervention, the evolution of settlement conditions and the development of productive forces in Italy. Historiography has shown renewed interest in issues such as river and stream regulation, colonisation and land estate transformation, the elimination of malaria and everything encompassed by the wider conception of land reclamation. However, an overview study concentrating on the relationship between management of the environment and the availability of economic resources and the more strictly financial issue, access to credit difficulties and the short and long term commitment of the state and the private sector to bringing work to fruition is still absent.

An analysis of the legal framework reveals the determinant impact of the Padua-Veneto reclamation tradition which developed during the Serenissima period on the legislative choices taken from Italian Unification until the late 19th century. Faced with the complex problem of draining its marsh lands, the Italian state borrowed the consortium formula on the basis of the example of practicality and efficiency it had provided in the past. Undoubtedly, the association model was the most affordable for the new kingdom in financial terms and the most coherent with its liberal principles. For some time there was no attempt to take full stock of the fact that the fortunes of the northern reclamation bodies were bound up with specific economic, social and environmental factors and vain attempts were made to export elsewhere a specific *modus operandi* which had developed over the long term.

It was only towards the end of the 19th century that a marked change of direction took place, a shift away from a model whose indiscriminate adoption

had blocked the implementation of policies attentive to diverse regional conditions and distribution of capital.

The need to follow up hydraulic drainage with work designed to make the reclaimed land cultivable in the most profitable way and for farms to be built was thus understood in this period. The principle of supplementary work was immediately implemented, however. In reclamation history, theory and practice took different trajectories because the implementation of the innovative ideas taken on board in legislative terms was affected by many factors, first and foremost of which was financial.

2. From Unity to the end of the 19th century

After Unification and until the end of the 19th century it was believed to be appropriate to apply standardised laws across the country. However, whilst in Northern Italy the reclamation issue related to extended areas whose improvement was in the interests of the people living in multiple towns, in the South and the two larger islands reclamation work was fractured and sometimes affected very small areas. This does not mean that draining marshlands in these areas was more straightforward: southern reclamation work did not require the building of a dense network of drainage canals and installing large water pumps but was subject to the functioning and reorganisation of a great many water catchment areas which none of the individual owners had a say over.

When his 1878 law was on the point of being presented to the Chamber, Alfredo Baccarini did not conceal the deleterious state of the country's economy nor the obstacles standing in the way of attempts to invest public financial resources in reclamation work.

In 1882, with the first thoroughgoing law on reclamation by Alfredo Baccarini, Minister for Public Works, the state began to take a direct interest in reclaiming uncultivated land. Baccarini understood that many marshy, malaria infested areas would remain so, especially in certain areas of the country, unless the state undertook to intervene directly and offer significant financial contributions to landowners. He had also realised that achieving certain economic objectives was dependent on policies designed to make significant progress in the public hygiene and sanitation field. 'First category' reclamation work – directly implemented by the state which shouldered 50% of the financial expense – encompassed work primarily motivated by health concerns and those in which significant health benefits combined with tangible farming improvements. It was an important step towards overcoming the idea that consortia were the only possible solution to the issue of reclaimed marshlands:

the state admitted the inevitability of its own action not only financially but also in organisational managerial and executive terms.

In the 1860s and 70s it was difficult for those tasked with reclamation to supply credit institutions with the guarantees required to gain loans, because the granting of loans was blocked by the fact that land estates were already in considerable debt (Serpieri 1957, 86). And the Baccarini law did not lead to the desired advancement of work. Implementation soon ground to a halt in the face of the significant cost involved in agricultural transformation and the reluctance of credit institutions as regarded work whose time frame could not be accurately forecast (Mozzi 1924, 11).

When the Genala law of 1886 obliged the consortia to demonstrate, at the project presentation phase, that they possessed the financial means required to complete the reclamation work, an extremely singular situation emerged. Capital could be collected solely via loans but the credit institutions authorised to grant these were unwilling to grand funding unless consortia had already obtained permission for work. In order to bring this impasse to an end, a new law introduced in 1893 saw Genala specifying that consortia had only to present a financial plan in order to obtain permits and simply state how they intended to procure the capital needed for the work.

As we will see, the thorny issue of funding protracted for the whole Giolitti period, without ever being satisfactorily resolved.

3. From the first Consolidated Act to 'integral' reclamation

Giuseppe Pavoncelli, Minister for Public Works in the new Di Rudiní government, presented a new law proposal to the Chamber on 2nd February 1898 (Disegno Pavoncelli 1898). Pavoncelli was aware of the constraints on permits and the need for a law which took greater account of the country's varied hydrogeological situation. In the face of the difficulties encountered by consortia in the southern regions, implementation of 'first category' work as it had been established by Baccarini 20 years earlier was once again a state prerogative with provision for exceptions to this involving conceding it to communes, provinces and consortia. Furthermore, whilst Baccarini limited himself to requiring the building of roads between the reclaimed land and neighbouring towns to supplement 1st category work, the 1898 law proposal foresaw the inclusion in 1st category projects of *reforestation and land stabilisation work in mountain and dune areas*, co-ordinated with reclamation work, and *water channelling in the plains and stream regulation* in the event that fixed and long lasting reclamation work should be required in marsh lands. Such work was required above all in the central-southern regions.

It was a step forward in the evolution of the reclamation concept, but the time was not yet ripe to place hydraulic drainage in its narrowest sense in the dock on the basis of a belief in its inadequacy for the purposes of correcting the hydrogeological instability of many areas of the country.

It was now evident to legislators that the work required to restore the water balance in southern Italy and the islands differed notably from that required in the Po plains and was more complex and costly. This was taken into account in the new law proposal which recognised that in some marshy areas, above all in the south, it would be impossible to obtain reclamation without removing the causes of the damage deriving from the state of the mountain basins and the disordered state of many water courses. With the funds set aside by the law it should thus have been possible to do reforestation, consolidation and clearing work on mountain streams and plains rivers where these were directly connected to hydraulic draining work. For Pavoncelli, with sums easily affordable from state coffers it should have been possible to reclaim a third of Italian plains providing 1,270,000 hectares of new terrain for agriculture (Disegno Pavoncelli, 1898, 7).

Despite the many innovations ushered in, the Pavoncelli project was criticised by those who believed it necessary to embrace a wider concept of reclamation work at this point. The contribution in the Chamber by malaria expert Angelo Celli highlighted the law's fundamental defect in once again proposing a uniform legal framework for the whole country which made it impossible to solve the health issue (Atti Parlamentari, Camera dei Deputati, leg. XX, first session, Debates, 6 July 1898, 6521.).

In these years attention to the living standards of the peasantry was growing and studies into malaria aetiology were beginning to bear fruit. Celli noted that malaria was causing two million hectares of land to remain unfarmed. 63 of the kingdom's 69 provinces and 2823 town councils were registering cases of marsh malaria. 11 million people were being exposed to the disease and two million contracted it every year with 15,000 dying. Although it was not then known that the infection was transmitted by the anopheles mosquito, scientists had identified plasmodium in human blood, thus refuting the disease's miasma origin and downgrading theories by which clearing land was simply a matter of hydraulic drainage. Celli did not simply underline the need for more effective action but also asked that norms indispensable to safeguarding the health of workers on such projects from the risk of contracting the disease be integrated into the law (Atti Parlamentari, Camera dei Deputati, leg. XX, first session, Debates, 6 July 1898, 6522.-6523).

Whilst in the north of Italy, with its permanent rivers, the issue of health safeguards could be distinguished from hydraulic use, the same could not be

said of regions in which drought contributed to constraining the introduction of intensive farming (Omodeo 1922, 63-67). The problems of the south were thus not simply a matter of the presence of the large estates. Many small and medium sized landowners were not sufficiently encouraged to undertake land drainage work: there were no guarantees for them that the expense involved in reclaiming land which was, in any case, in summer, transformed into sufficiently profitable pasture land, would be offset by higher land value. However, if, together with land drainage, the law foresaw other work designed, for example, to ensure irrigation of the land or electricity production, the attitude of the small and medium landowners would have changed at least in part, and the establishment of consortia might have had been more successful (Barone 1986, 11).

The Pavoncelli proposal was approved by the Chamber in July 1898 but it was 18th November before the new minister, Pietro Lacava, presented it to the Senate. After a brief discussion the original project was made law (236) on 18th June 1899 with minor amendments. The law underlined the need to reorganise current provisions including those of past governments. To this end a commission was appointed whose work terminated with the promulgation of a Consolidated Law approved by royal decree on 22nd March 1900.

The Consolidated Law set out that the reclamation work to which the new provisions applied should be made up of drainage and filling in work, both natural and artificial, of lakes and ponds, marshes and swamp land, with the government entrusted with overall jurisdiction and work inspection. Work other than drainage could be included in projects solely to the extent that it was necessary for hydraulic reclamation. The new law set aside 250 million lire for 1st category work and promised to fund others in the near future.

Believing it had spent as much as it could, the government expected co-operation from the private sector. In particular, it hoped that the latter would show a willingness to implement farming reclamation in the shortest term possible, at its own expense.

In those years northern landowners were interested primarily in completing hydraulic drainage which, in some cases, was sufficient to ensure farming or at least to make investment in subsequent land improvement profitable. Moreover, a pressing need to restore social order in the countryside prompted a desire to start work awaiting implementation as soon as possible and drainage work implied lower technical implementation issues than more complex work. Farming reclamation, which was already the subject of legal provision although solely for a specific area of the country (Law no. 4642 of 11th December 1878 on the Roman countryside and subsequent Law no. 1489 of 8th July 1883 which provided for the expropriation of land held by owners who failed to carry out their reclamation obligations), was made obligatory everywhere with the

Bertolini law of 1911 following on from a diverse economic juncture and the development of a new power balance between the state and landowners.

The dynamics between the political forces and the economic interests, the need to respond to social tensions, and limited awareness of the malaria issue help us to understand why there was no significant shift away from traditional approaches despite all the theoretical pre-requisites existing for an innovative law.

The early 1900s were, in any case, especially important years in the evolution of the reclamation concept. At the outset of the new century, the attention of lawmakers to the country's southern areas and their hydrogeological state grew. Governments understood the importance of provisions designed to create favourable conditions in these regions for private investment both in agriculture and industry (Castronovo 1995, 166) and, from 1904 onwards, parliament enacted a series of 'special laws' for Campania, Calabria, Sardinia and Puglia to supplement that already approved for Sicily (Acquarone 1981, 368-377; Melis 1996, 241).

The limitations of the 1900 Consolidated Law began to show, however, and this was especially the case in the context of the serious floods of 1905 and 1907, which required the adoption of exceptional measures. Many highly important hydrogeological provisions – first of all that relating to mountain basins and the management of the great rivers which were key to the success of reclamation work – had effectively not been taken into account and owners' difficulties finding capital for this had led to stagnation.

4. Lending for reclamation

Giolitti's economic policy aimed at restoring the health of the banking system and state finances. Agricultural loans were primarily granted by the savings banks. In the south Banco di Napoli and Banco di Sicilia and in the centre Monte dei Paschi di Siena were active in this sector. There were also the agricultural Casse Rurali, first set up in 1883 in the Padua province by Leone Wollemborg, and the Casse Rurali Cattoliche proliferated around these (Marconato 1984). The development of the Banche Popolari, bound up with the name Luigi Luzzatti, were also notable. However, these banks focused primarily on business loans, neglecting land improvement loans (Bandini 1963, 84-85).

If on one hand greater public funds enabled the government to undertake a wide reaching programme of public works, the country was still lacking a lending system capable of and willing to undertake funding work involving the mobilisation of huge sums of capital for long periods of time. As they had to advance the sums payable by the state and local government, the consortia

found it impossible to start work even when permits had been granted or, even worse, to continue work which had already begun.

On the strength of their long traditions, the Padua consortia offered good guarantees to lending institutions. However, above all in the Veneto and Emilia regions, demands for capital were markedly higher than those in other parts of the country and went beyond the capacities of local funding institutions. It was thus precisely the northern owners who exerted powerful pressure on the state for greater contributions and concessions.

Ten years on from the Consolidated Law it was clear that the sums set aside by the law were not sufficient for all category 1 work. As, for the law, reclamation's purposes were lofty social ones, the consortia demanded that the state find the means to complete what it had begun. Law 702 of 20th June 1912 provided that the state was to contribute to paying off loans taken out for the implementation of work, thus diluting the financial commitment over time and enabling its contributions to be partially dependent on future checks. The consortia remained responsible for anticipating sums required for the implementation of the work, however.

In a conference held in Padua in May 1913 the statute of the new Federazione dei Consorzi di Scolo e Bonifica delle Provincie venete e di Mantova was approved and an item tasked the Commissione esecutiva provvisoria della Federazione to suggest ways to source the funds required for the work to be implemented.

During the Convegno dei bonificatori, held again in Padua in September 1913 with the participation of the government, senators, members of parliament, local and provincial government representatives and those interested in economic issues and reclamation (Leone Romanin-Jacur, Giulio Alessio and Luigi Fano), Luzzatti affirmed that it was time to stop supporting manufacturing industry and that national savings should focus on the land, on "creating and strengthening small land ownership" and the "draining of marsh and swamp land". He underlined that reclamation could not begin without guarantees around the availability of the funds required to complete it (Luzzatti 1933, 124-140).

In the face of the inability of Cassa Depositi e Prestiti to respond to reclamation demands, the Consorzio di Credito per le Opere Pubbliche was set up in 1919 and permitted to issue bonds. However, it soon became clear that this was not the right approach either and that what reclamation work primarily needed was capital at modest interest rates.

5. Public and private financial commitment on the eve of war

In the 1860 to 1900 period the sum spent by the state in reclamation work was around 169 million lire. For the period of time from 1900 and the eve of

World War One the state contributed to the tune of around 205 million lire to marshland reclamation work. From Unification to 1900 the state's average annual spending on reclamation was around 4,300,000 lire whilst 14,600,000 lire was spent in each of the 14 subsequent years. Thus three times as much was being spent in the 20th century than in the forty years leading up to the turn of the century.

Regions receiving the most state contributions were, in order, Campania (124 million), Tuscany (82 million) Emilia Romagna (51 million), followed by Puglia (29 million) and Veneto (20 million). The scale of the investment would thus appear to be modest in relation to the volume of marsh land. In some cases the state acted to reclaim extended areas in which work of considerable complexity was required. In Central Italy the most significant work related to the reclamation of the Roman countryside, the Tuscan Maremma, Lake Bientina in the provinces of Pisa, Lucca and Florence, Val di Chiana and certain huge scale work in the lower Volturno basin. In the south the main work took place in Campania in the provinces of Caserta and Naples, with the filling in of Lake Salpi in Puglia, and the Cervaro and Candelaro valleys in the Foggia province. On the islands the only region benefitting from state action between 1870 and 1900 was Sicily, with the first work taking place in Sardinia in 1901-18. In Northern Italy significant capital was employed in the Burana reclamation, in work on the lower Ravenna plains and the Mantua-Reggio countryside. Significant funding was also granted to the area between the Adige and Po Rivers in the Rovigo province where there was a serious water drainage problem. Work on the Padano-Polesano canal completed in 1900 had been shown to be insufficient and, from 1903 to 1912, this had to be supplemented with new water pumps and secondary work leading to excellent agricultural and health benefits (Rossini and Vanzetti 1987, 601-603).

The complex issue of the reclamation work continued to be approached without suitable funding, however. Work was diluted across too large a number of businesses, compromising the efficiency of the work done, nurturing disputes between those tasked with the work and landowners and leading to increased costs and protracted work time frames.

The state had available to it fairly reliable elements for financial assessments of reclamation work under way or planned, drawn from work already tendered or approved by recent regulatory plans. A comparison of the Italian state's spending from Unification to the issuing of the Consolidated Law with those from 1900 to the eve of World War One and those still to be invested makes clear that from the early 20th century onwards the state's commitment to reclaiming marsh lands and hydrogeologically unstable areas increased significantly. A great deal remained to be done, however, precisely on Italy joining the war.

6. From reconstruction to the advent of Fascism

Interruptions to work due to difficulties in accessing credit led to fears of serious economic losses even before the country joined the war. In the years prior to the war, reclamation costs had been kept to affordable levels and with it the interest required on capital. During the war the situation changed radically, however.

Minister of Public Works Ivanoe Bonomi expressed a belief that consortia co-operation with the state had to be guaranteed as the task of implementing work for a total of over 120 million lire was theirs, and that an active public work policy was the best response to likely postwar unemployment (Archivio Centrale dello Stato Presidenza del Consiglio dei Ministri, 1917, bundle 6/1, letter dated 22 May 1917).

The specific situation in the Italian territories which had suffered war damage prompted landowners to make insistent demands for a lending institution capable of fostering economic recovery in these areas. Thus, in the spring of 1919 (legislative decree No 497 of 24 March 1919) the Istituto Federale di Credito per il Risorgimento delle Venezie was set up and entrusted with the task of anticipating compensation for war damage payable by the state. The institute was granted funds of more than two and half billion lire (*L'Istituto Federale di credito per il Risorgimento delle Venezie* 1927, 5).

Right from its first year the new body took on the task of guaranteeing provisional funding for work which had already been approved by the authorities, in agreement with the Federazione dei Consorzi di bonifica. The institute then contributed to resolving the nagging problem of agricultural credit on which restarting productive work in the areas most damaged by the war depended.

In May 1921 the act founding the Sezione di Credito Agrario dell'Istituto Federale di Credito was signed. The task of the section was to supply farmers, bodies and agricultural associations with business loans in addition to those granted for land estate and improvement work. In 1921 the work of the Istituto Federale di Credito enabled new reclamation work to begin on over 160,000 hectares of land divided up between 20 consortia and employing a considerable workforce: a daily average of 5138 workers, 4700 labourers and 438 specialist technicians. The following year the average rose to 6500 workers per day, without counting the large number of specialised workers who built the water pump, heating and electrical machinery required by the work in other parts of Italy. By the end of April 1922 the institute had granted funding worth around 96 million lire for reclamation (Ermacora 1922, 14).

In addition to governmental support land reclamation in Northern Italy could count on the work of Federazione dei Consorzi Veneto-Mantovani, which sought out the capital required to implement new projects even before the plants damaged during wartime had been fully restored to working order.

After the armistice thought was given not only to the works destroyed during the war but also to setting in motion work which had been on hold for some time and to launching farming reclamation. Such an ambitious plan required huge capital as a result of a significant increase in workforce and building material costs (Ermacora and Rodinò 1924, 29). While prior to 1915 projects for work granted or in progress cost under 150 million. This sum tripled immediately after the war (Ravà 1922, 136).

After the Sacchi Law was passed in 1912 the state had sought to facilitate consortia access to credit. However, the availability of funds affected the development of local lending activities. Once again, therefore, an imbalance was created which favoured Northern Italy, where such institutions were relatively numerous, well-organised and willing to commit capital to work whose nature they had learnt to understand and whose success they could now foresee. But even in the north it was not always easy to source capital for long term work.

In March 1918 (legislative decree 361 of 21 March 1918) a parliamentary commission had been set up whose task it was to study provisions required to mitigate the consequences of the shift from a wartime to a peacetime economy and find a solution to the unemployment problem (Commissione per il Dopoguerra 1919). It had become indispensable to set up a body able to lend money for socially useful work done by semi-public and private bodies because the Cassa Depositi e Prestiti could, by law, only fund initiatives by public bodies and, in any case, had insufficient funds (De Rosa 1979, 14).

In May 1919 Ivanoe Bonomi underlined that he was unable to provide funding for reclamation work as a result of growing difficulties on the part of town councils and provinces in making a contribution in the light of marked increases in labour costs. The post-war economic crisis struck the industrial sector increasingly hard and for the lion's share of demobilised soldiers agricultural work seemed to be the only opportunity. Opera Nazionale Combattenti, set up in late 1917, also seemed to push in this direction. In this context reclamation work seemed to offer a significant contribution to solving the employment problem.

To facilitate sourcing cash by concession holders as far as possible, the state thus moved to make easier the creation of new lending institutions specialising in funding public work. Consorzio di Credito per le Opere Pubbliche was set up in September 1919 with headquarters in Rome (with royal decree 1627 of 2 September 1919, converted into law no. 488 on 14 April 1921). Cassa Depositi e

Prestiti was part of the Consorzio, of which it was one of the main components, as were Istituto Nazionale delle Assicurazioni and Cassa Nazionale delle Assicurazioni Sociali, and Casse di Risparmio had also applied for membership. The purpose of the new body was to give loans for public works (De Rosa 1979, 11; Mozzi 1925, 43-49).

But whilst the international economy was expanding powerfully, in Italy the situation was increasingly critical. In March 1920 grouth in raw material prices caused by scarcity blocked all productive efforts: iron, concrete and bricks were prohibitively expensive to the extent that work to reduce the unemployment rate was limited to strengthening embankments, building roads and reclamation not involving massive use of these materials. In these conditions, bringing an adequate programme of public works to fruition was an uphill task. The reclamation sector, in any case, had the greatest development potential. Given the great difficulties encountered by attempts to divide up and transform the large land holdings, the state tried to make new farmable areas available to the peasantry. With royal decree law 1465 of 8th October 1920 the idea of "temporarily occupying" lands whose owners had been declared not to have fulfilled their reclamation duties was mooted. This decree prompted many owners to carry out improvement and reclamation work and many disease ridden areas were reclaimed. ONC was also conceded the opportunity to buy up marsh lands to transform and distribute to former servicemen.

The work to be done by the consortia belonging to the Federazione Nazionale delle Bonifiche required around 800 million in capital. The request which the President of the Federazione felt realistically able to put forward to the Consorzio di Credito per le Opere Pubbliche was 400 million, distributed over ten years (De Rosa 1979, 45-46). In the face of this demand and pressure from various sides to find a solution to the many hydrogeological instability problems, the Consorzio di Credito per le Opere Pubbliche granted loans worth more than 200 million for the funding of reclamation work and irrigation over the next two years. The Consorzio also made available a further 500 million for new loans, 200 of which funded hydroelectric plants in the south and 230 northern reclamation (*Atti del Congresso Regionale Veneto delle Bonifiche* 1922, 83).

In the years which followed (1923-1924) the Consorzio di Credito per le Opere Pubbliche granted significant further funds for reclamation. The regions receiving the most funding were the Veneto (70 million) and Emilia Romagna (50 million) regions. Though not to the same extent, large scale work was also funded in Lombardy and Lazio (De Rosa 1979, 124-135).

7. Funding on the basis of the New Consolidated Law

While the Northern Italian regions were concentrating mainly on funding agricultural transformation, in Central-Southern Italy the reclamation issue was more complex, and the need for capital seemed disproportionate to local savings resources.

The New Consolidated Act approved on 31st December 1923 recognised the differences between northern and southern reclamation work and thus the need to bring state contributions into line with specific local needs. In Southern Italy and Sicily 70% of expenses fell on the state, 10% on the province and 20% on owners. Funding for the clearing of water courses linked to reclamation work was shared out between the state (5/6ths) and the provinces (1/6th) while mountain basin reclamation work was entirely paid for by the state (Article 155). In Sardinia 75% of the cost of reclamation work was paid for by the state with 12.5% respectively payable by the provinces and the owners (Article 160). In the other regions 5/10ths of the expenses for 1st category work were paid for by the state with 1/10th respectively by the provinces and communes and 3/10ths from owners. These percentages relate to cases of direct work by the state who anticipated funds and then claimed back the sums due from other contributors later. When reclamation work was tendered out, the law provided for larger public contributions.

Much thoroughgoing drainage work was put on a par with hydraulic work and thus subject to the same legal regulatory framework as the latter, with the same contribution mechanism applying. This involved road building work required to link up the reclaimed area with neighbouring towns and the work needed to use reclamation canals for internal irrigation purposes where the economic benefits were clear. Reforestation work and the consolidation of mountain basins and dunes was also covered where it was co-ordinated with reclamation work, as was clearing and reinforcing river and stream beds and embankments in the plains to the extent that it was strictly necessary to health and hygiene in the lands reclaimed and work serving to guarantee irrigation.

The law also did not neglect a further prerequisite for all land transformation, the availability of drinkable water. The state obliged the councils to provide reclaimed land with drinking water and this enabled them to contract loans with the Cassa Depositi e Prestiti and instituitions authorised to grand agricultural credit in general.

The very same day on which the 1923 Consolidated Law came into force, a new agricultural credit provision was issued, law 3139 of 30th December 1923 designed to assist those reclaiming land in agricultural land improvement work. This provision enabled the Department for the Economy to contribute

to the payment of interest on mortgages granted for 'improvements, namely plantations (olive groves, vineyards, orchards), crop transformations and limited reorganisation of lands and farm buildings. The contribution of the Department for the Economy also covered credit operations designed to build farm roads, lodgings for farm workers or animal sheds, wells and drinking troughs, mountain clearance and reforestation fence off land, extend the use of electrical energy, build irrigation structures (Ministero dei Lavori Pubblici 1926, 28-30).

The years which passed between the approval of the 1923 Consolidated Law and the Mussolini Law of 1928 were characterised by debate on reclamation work. In this phase a great deal of work was done and work continued in vast areas of Italy, in some regions more than others. Reclamation expenses grew as compared to the four year period from 1919 to 1922, moving from 78 million per year to 98 million (in 1938 currency values) (Stampacchia 2000, 68).

A favourable situation in the primary sector, in the presence of high prices and an inflationary context which facilitated the purchase of land by many peasants, ended in 1927 when a pronounced currency hike led to a fall in agricultural prices with consequences in the countryside (Staderini 1982, 17).

In this period there were a great many calls for public funds to be granted to reclamation work. The state was able to respond only intermittently to these. Whilst, towards the end of 1928, the agricultural crisis seemed to be over from a production level perspective, private investment continued to struggle. The state thus decided to launch a funding plan whose purpose was to reclaim large swathes of land and flood the domestic agricultural market prompting a rise in consumption. One of the main purposes of the 24th December 1928 Legge sulla bonifica integrale no. 3134, referred to as the Mussolini Law, was to incentivise investment. A policy focusing on the implementation of public works, and reclamation in particular, also seemed an effective way of reducing unemployment problems.

The law set aside sums worth 7 billion lire over a 14 year period for land transformations, thus boosting reclamation work significantly. Most of the law's provisions remained on paper, however. In fact, after 1928 a very large number of landowner consortia working on reclamation were created, but only very few of the projects begun had the potential to be completed.

With the Mussolini Law of 1928 Fascism made the wholesale reclamation concept its own. Once it had grasped the demagogic potential of this theme, the regime's main concern was to demonstrate that its own notion of reclamation "was entirely different from that which had thus far been attempted in Italy and that its programme would consequently reconsider the issue of the reclamation of Italian land afresh, moving entirely away from attempts made previously to

resolve the issue, attempts which for the simple fact that the issue had not ceased to be topical, were unfortunately to be considered failures" (Trentin 1938-9, 15).

The Mussolini Law did not achieve its aims for various reasons: the advent of the international economic crisis, which obliged the government to downscale its spending in this sector every year; resistance from certain landowners to wholesale reclamation work; an indiscriminate proliferation of funding applications, many of which related to work of secondary importance or limited scale which made it necessary to perform a selection process (Stampacchia 2000, 172-173).

Until 1934 consortia proliferated but these failed precisely where they were most crucial, namely in ensuring that private sector work followed on from public work. From 1935 to 1938 state investment in reclamation dropped from around 461 to 143 million lire. Subsequently, progressively growing military commitments in African and Spanish wars led to an almost complete paralysis in land reclamation work (Novello 2003).

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L'Approche par les Services Ecosystémiques (ASE) comme contribution à la gestion du lac Tchad

Armel Sambo

1. Introduction

La dégradation de l'environnement observée dans le Sahel en général influence progressivement l'évolution des ressources en eau du lac Tchad. D'environ 24 000 km^2 dans les années 1960, le lac Tchad oscille depuis les années 1980 entre 14800 km^2 et 1700 km^2 (Lemoalle et Magrin 2014, 23-24). Cette variabilité des eaux du lac Tchad illustre les effets des changements climatiques. Situé donc dans une zone sahélienne, le lac Tchad a toujours produit des opportunités aux populations de part les Services Ecosystémiques (SE) qu'il offre. Le débat depuis quelques années autour de son évolution hydrologique met ainsi en exergue l'efficacité de la politique de gestion des ressources en eau développée par les Etats et les usagers. Malgré la mise en œuvre de la GIRE (Gestion Intégrée des Ressources en Eau), des difficultés pour une gestion durable des ressources naturelles persistent. Il reste à savoir si une meilleure reconnaissance des SE rendus par le lac Tchad pourrait contribuer à résoudre ce problème de gouvernance et favoriser ainsi une gestion durable et équitable de ses ressources.

Depuis deux décennies, la notion de SE occupe une place croissante en gestion de l'environnement. L'idée de services rendus, par les milieux naturels aux sociétés humaines est certes ancienne. Toutefois, la notion actuelle de SE s'est surtout développée dans les années 1970 à 1990. Puis, entre 1990 et 2005, la notion de SE a trouvé sa place dans les champs scientifique et institutionnel, notamment à l'international. Ce processus d'institutionnalisation de la notion aboutit en 2005 à la publication du *Millennium ecosystem assessment* (MEA). La définition communément admise de SE ou écologiques est ainsi celle du MEA: «bénéfices que les êtres humains retirent des écosystèmes sans avoir à agir pour

les obtenir»[1]. De plus en plus, des politiques environnementales font référence à la nécessité d'adopter une approche par les Services Écosystémiques (ASE) pour évaluer les meilleures stratégies de gestion et les choix d'aménagement. L'ASE à pour «objectif d'élargir son usage et de souligner, à différentes échelles territoriales, l'importance de la protection des écosystèmes et de la biodiversité pour le maintien de l'activité économique et du bien-être» (Wallis et al. 2011, 21). Ainsi, il est utile d'évaluer les SE qu'offre le lac Tchad dans cet espace semi-aride. Comment l'ASE permet-elle une meilleure gestion des ressources du lac Tchad? Cet article viseà présenter les SE rendus par le lac Tchad et à savoir si une meilleure reconnaissance des ces derniers pourrait contribuer à favoriser une gestion durable et équitable des ressources en eau.

La méthodologie adoptée pour conduire cette étude a consisté d'abord à la collecte des informations (entretiens, observations des activités économiques, lecture des ouvrages, articles scientifiques, archives, etc.), ensuite à leur traitement et enfin, à l'analyse. Plusieurs approches (synchronique, systémique, etc.) ont été choisies dans le cadre de l'analyse, de l'interprétation des données et du recoupement des informations recueillies. Ces approches ont nécessité une lecture pluridisciplinaire des situations, mobilisant des éléments de géographie politique, d'écologie, d'hydrologie, etc. L'article est organisé en trois parties. D'abord, l'analyse porte sur la variabilité du lac Tchad et ses différents SE; ensuite, l'article présente la pression exercée sur certains services comme source de tensions et des conflits par les usagers du lac Tchad; enfin, il analyse les stratégies endogènes résultant de la gestion des ressources et l'importance de l'évaluation des SE comme outil de gestion rationnelle et durable des ressources en eau dans la région du lac Tchad.

2. Variabilité du lac Tchad et ses différentes offres écosystémiques

Le lac Tchad est caractérisé par une variabilité de sa superficie en eau libre. Il est depuis quelques années au niveau du «petit lac». Malgré son état, il offre aux populations plusieurs services écosystémiques malgré son état.

2.1. Un lac situé au cœur du Sahel et reconnue par son caractère variable

Le lac Tchad, principal point d'eau douce au cœur du continent africain est partagé par quatre pays riverains à savoir le Cameroun, le Nigéria, le Tchad et le

[1] Il faut reconnaitre que le concept de « services écosystémiques » fait actuellement débat parmi les scientifiques. Ainsi, il existe plusieurs courants de pensée sur les définitions et même sur la classification des services écosystémiques.

Niger (confère carte ci- dessous). C'est le plus grand point d'eau du bassin tchadien. C'est un lac endoréique. Il est situé dans une zone semi- aride. Il joue un rôle prépondérant dans l'organisation de la vie économique, sociale et culturelle des populations du bassin. Il offre de ce fait des atouts importants pour l'agriculture, la pêche et de l'élevage – autant d'atouts pour une région à l'économie essentiellement rurale. Cependant, le lac est en voie de disparition.

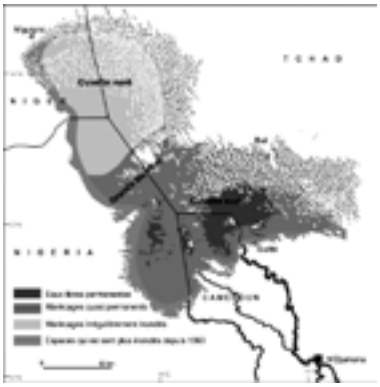
Au cours des derniers siècles, on a constaté une variation de sa superficie en eau libre. Depuis le XIX^{e} et le XX^{e} siècle, le bassin du lac Tchad a connu plusieurs épisodes de sécheresse. Les variations de la pluviométrie se sont répercutées sur les écoulements des fleuves contributeurs (Logone, Chari) et donc sur le volume en eau du lac.

Les dernières périodes de sécheresses (1905/1908, 1912/1914, 1940/1944, 1972/1984) ont été très sévères et longues. La décrue de 1905, qui a été importante, a conduit le lac Tchad à se scinder en deux parties séparées par l'exondation de la Grande Barrière (Beauvilain 1989, t. 1, 96). Cette séparation a donné naissance à un lac Nord et à un lac Sud. Au début de 1908, on a assisté à un assèchement de la partie Nord du lac au niveau du parallèle de Bosso (Saibou Issa 2001, t. 1, 50). En 1914, le lac s'est coupé en deux cuvettes. Ces phénomènes se sont reproduits partiellement en 1916. Après une période de stabilité relative, l'on a observé un relèvement du niveau d'eau dans les années 1950-1960. Pendant, les décennies 1970 et 1980 furent catastrophiques. Le lac sud, actuel lac, continue de se rétrécir et la surface des deltas est en augmentation.

Le lac Tchad avait en 1963 une superficie d'environ 25 000 km^2. Suite à la sécheresse de 1973, sa superficie en juillet n'était que de 9000 km^2 et le volume de ses eaux d'environ 30 milliards de m^3. Cette baisse du niveau d'eau a abouti en novembre 1975 et 1976 à l'assèchement de la cuvette nord (Beauvilain 1989, 2). Depuis lors, cette cuvette n'est alimentée que de façon épisodique et le lac se retrouve réduit à la seule partie Sud. Le constat qui se dégage est que, d'environ 24 000 km^2 dans les années 1960, le lac Tchad oscille de nos jours entre 2000 et 1700 km^2. Il est peu profond (1,5 mètre en moyenne) avec un volume d'eau variant entre 30 milliards et 20 milliards de mètres cubes (Sambo 2010, 37).

Depuis 2014, l'on observe une augmentation légère de sa superficie en eau libre. Il varie entre 2000 km^2 et 2500 Km^2. Des chercheurs à l'instar de Magrin et Lemoalle pensent que c'est la variabilité bien connue de la superficie en eau du lac qui crée ces modifications, sans que l'on puisse invoquer avec certitude un effet du changement climatique (Magrin et al. 2015).

Carte: Localisation et évolution du lac Tchad



Source: Magrin et al. 2015, *Atlas du Lac Tchad*, 24

Dans tous les cas, au moment où le besoin en eau se fait sentir, l'on note plutôt sa diminution. Toutefois, sa présence a permis le développement de plusieurs activités à savoir l'agriculture, la pêche et l'élevage (Sambo 2011a, 117-120). L'eau en se retirant laisse derrière elle des terres exondées, très fertiles et riches en pâturages. Ces espaces, une fois libérés, sont immédiatement occupés par les populations. Plus de 80% des riverains du lac Tchad reconnaissent son importance et confirment une tendance générale à la baisse des opportunités qu'il leur offre. Aucune étude systématique et quantitative permettant de confirmer ou de préciser ces avis et perceptions n'est disponible à ce jour.

La disparition éventuelle du lac constitue donc, pour la région, un risque majeur aux manifestations plurielles. Si l'on y ajoute la quantité d'eau retenue par les ouvrages de captage sur les affluents du lac Tchad et celle qui s'évapore, on peut s'interroger sur son avenir. L'on constate que sa disparition progressive ne fait pas que des malheureux: dans la cuvette nord, par exemple, la productivité en poissons est forte grâce à la présence des mares d'eau. Ainsi, le recul d'eau du lac Tchad présente un écosystème qui offre des services aux populations.

2.2. Un lac offrant des services écosystémiques multiples, mais en baisse

La présence du lac à permis le développement de plusieurs activités à savoir l'agriculture, la pêche et l'élevage (Sambo 2011a, 117-120). C'est pourquoi, le principal avantage d'un «Petit Tchad» par rapport au Moyen Tchad selon l'expertise collégiale de la CBLT (Commission du Bassin du Lac Tchad), «est la plus grande amplitude de la décrue annuelle (le marnage dans chacune des cuvettes) qui fournit des plus grandes surfaces particulièrement fertiles, accessibles pour

la culture et l'élevage principalement dans la cuvette sud» (Lemoalle et Magrin 2014, 16). Du coup, l'on est tenté de penser que le recul des eaux du lac rendrait le plus de services aux populations dépendant directement de ses ressources.

Ainsi, c'est sur la base des enquêtes de terrain menées dans les localités de Darak et de Kofia, des entretiens avec les experts, et des études effectuées de façon parcellaire, que se dégagent les éléments qui suivent. Ceux-ci contribuent à caractériser l'évolution des ressources aux abords du lac Tchad, qui donnent à voir une baisse drastique de certaines offres écosystémiques. L'on peut sans être exhaustif établir la liste des SE du lac Tchad en identifiant quatre services-clés reconnus dans les travaux sur les SE: les services d'approvisionnement, les services de régulation, les services culturels et enfin les services d'assistance comme le démontre le tableau suivant.

Il importe de préciser que ce tableau est le résultat des enquêtes de terrain et de la littérature qui existe sur l'évaluation des opportunités qu'offre le lac Tchad. La valeur «*utile*» de ces services peut être évaluée localement. Ici on s'est appuyé par type d'écosystèmes, de milieux ou d'infrastructures écologiques (exemple: services rendus par l'eau, la terre[2], les zones humides, les haies, etc. Bien plus sur la base de l'évaluation des écosystèmes pour le millénaire (Millennium Ecosystems Assessment), les indicateurs suivant ont été retenu (variation du nombre d'espèces, diversité spécifique), variation d'abondance d'espèces particulières (emblématiques, cynégétiques, endémiques, entités vivantes sacrées, etc.), variation de l''abondance relative des espèces utilisées par l'homme, variation de l'indice de niveau trophique moyen des espèces prélevées, etc). Les catégories des offres écosystémiques identifiés ici s'appuient sur le rapport du MEA. Ce sont des services qu'on peut qualifier de classique car ils sont reconnus par plusieurs autres rapports. Sur cette base donc, et à la lecture des certains travaux, nous avons mis en perspective la baisse des SE (donc, la «quantité» disponible) avec la hausse des besoins (= usage anthropique de ces SE). Ici, les perceptions que les populations ont de l'évolution des SE ont été prises en compte. Il s'agit ici d'une baisse en valeur absolue car les ressources sont disponibles mais désormais il y a une pression sur celles-ci. La période concernée va des années 1970 à 2000. Elle prend en compte ici les périodes des grandes sécheresses et aussi de forte croissance dans le bassin du lac Tchad. Il est vrai que les crises écologiques ont fortement influencé les SE mais depuis une décennie l'une des causes majeures des conflits est la contribution de la forte croissance démographique observée dans cette région.

[2] Voir à propos: http://fr.wikipedia.org/wiki/Service_%C3%A9cosyst%C3%A9mique.

Tableau 1: Liste des SE associés au retrait des eaux du lac Tchad, et tendance en 2012

Services écosystémiques	**Description**	**Tendance**
Approvisionnement	Disponibilité constante en ressources en eau de surface, (alimentation des eaux souterraines, écoulement régulier des eaux)	En baisse
	Disponibilité en vivres et en nourriture (productions agricoles, poissons, cheptel, etc.	En hausse
	L'utilisation progressive des eaux pour l'irrigation (pour les cultures maraichères) et les arbres fruitiers (manguiers, goyaviers, etc)	En hausse
	Disponibilité en bois pour l'énergie	En baisse
	Disponibilité en natron	En hausse
	Disponibilité d'une zone d'abri, de nourrissage et de reproduction des poissons	En baisse
Régulation	Inondation des plaines (fertilisations des sols)	En baisse
	Régulation de la température et du climat résultat de la présence du lac	En baisse
	Frein à l'avancée du désert	En baisse
	Elimination des polluants	En baisse
Culturels	Activités touristiques (zone de distraction)	En baisse
		Non exploitée
	Activités cultuelles et sociales (rites de pêche ; festivals liés à l'eau etc.)	En hausse
Assistance	Maintien de la biodiversité	En baisse
	Attrait des animaux sauvages	En hausse
	Offre en habitats en milieux humides	En baisse
	Formation et rétention des sols et des humus propice pour l'agriculture	En baisse

Source: Enquête de terrain, juillet 2012

Le constat qui se dégage de ce tableau est que l'essentiel des offres écosystémiques est en baisse. En même temps, les besoins en SE s'accroît, ce d'autant plus que la population ne cessent aussi d'augmenter. A l'inverse, certains services ne sont pas suffisamment exploités. Il s'agit par exemple de la valorisation touristique du lac Tchad comme zone de distraction. Pendant longtemps, aucun pays riverain n'a pu mettre en place une politique touristique qui prend en compte les potentialités du lac. Et aujourd'hui la situation vient

de s'empirer avec les attaques des insurgés de Boko Haram. Depuis 2002, face à la montée des nouvelles menaces sécuritaires liées à l'expansion du terrorisme fondamentaliste de Boko Haram depuis le Nord Est du Nigéria, les îles du lac Tchad se présentent comme une base arrière aux membres de cette secte. Et depuis sa radicalisation en 2009, la secte multiplie des attaques sur les rives du lac Tchad au point de contrôler certaines activités commerciales. Ceci peut aussi s'expliquer bien avant les attaques de Boko Haram par l'absence de la culture touristique mais aussi par un manque de volonté politique des Etats riverains de développer le tourisme. Pourtant, c'est une possibilité dans un contexte de baisse de productivité de multiplier les revenus des agriculteurs, des pêcheurs et des éleveurs. Il s'agit par exemple de les former dans le cadre de la transition des SE, à la «polyactivité» (exemple: cultures + tourisme «écologique») etc.

Le constat qui se dégage est que les services d'approvisionnement, de régulation et d'assistance sont en constante diminution. Cette diminution est le résultat d'une forte pression sur les ressources car face à l'expansion démographique, les besoins se font de plus en plus sentir. Ainsi, en 1974, la superficie du lac en eau était estimée à 25 000 km^2 et son bassin conventionnel comptait 5 millions d'habitants. En 2000, la superficie en eau libre est passé à 2000 km^2 tandis que la population a pratiquement doublé et est passée à environ 11 millions d'individus. Plus de deux millions de personnes y vivent en 2013 avec une forte concentration des populations sur les rives Nord (cuvette nord et archipel), qui offrent encore des potentiels fonciers importants» (Lemoalle et Magrin 2014, 20-21). A l'horizon 2020, la population dépendant du lac et de ses ressources connexes est estimée à 35 millions (Sambo 2010, 58). Même les berges du lac autrefois désertes voient selon Magrin (Magrin 2007, 21) leurs densités démographiques augmenter pour atteindre 60 habitants au km^2. L'assèchement progressif des cours d'eau et la diminution de l'étendue du lac Tchad au fil de temps ont favorisé la raréfaction de l'eau dans la région. Certaines rivières et mares d'eau se sont totalement asséchées, d'autres par contre ne disposent d'eau qu'en saison de pluies.

Dans tous les cas, la raréfaction de l'eau s'accompagne aussi de l'amenuisement des ressources halieutiques. Ces variations du niveau de l'eau entraînent des modifications de la faune. Déjà, dans les années 1980, on comptait environ 200000 pêcheurs produisant 100000 tonnes de poisson par an (Mangaral 1980, 36). La quantité de poissons pêchés dans le bassin du lac Tchad varie aussi en fonction des conditions climatiques de la région. La baisse du niveau d'eau du lac et la régression de ses affluents résultant de la persistance de la sécheresse ont eu des impacts sur le stock de poissons. Par exemple, de 140 000 tonnes en 1966 la production piscicole a baissé jusqu'à 70000 tonnes en 1983. Les *Alceste baremore*, espèces prisées sont devenues rares selon les pécheurs.

Cette faune ichtyologique présente un potentiel de production halieutique théorique estimé à 150 000 tonnes. La production de poisson a été, en 2002, de 93000 tonnes. Aujourd'hui, le lac Tchad est complètement appauvri de ses ressources en poissons alors même que les besoins ont augmenté. Ses affluents connaissent une situation analogue. Ceci est la conséquence logique d'une gestion calamiteuse, cruelle de ces ressources par les pêcheurs de la région. On utilise toutes sortes d'outil pour capturer, même les fretins. On assiste même à la disparition de certaines espèces prisées et certaines zones d'alevinage et de pêche se sont asséchées. Egalement, les espèces lacustres telles que les *Hydrocunus*, les *labeos* et *distichodus* n'ont pas survécu aux dures conditions climatiques (CBLT 1998, 20). L'évolution hydrologique du lac a réduit la diversité du peuplement de poissons dans son ensemble. A cela il faut ajouter la pollution (biologique, chimique etc.) qui contribue à la dégradation des environnements générant les SE. Une étude effectuée sur le fleuve Logone démontre clairement que le lac Tchad sert d'exutoire des tous les rejets des eaux usées des villes dans la vallée du Logone (Sambo 2014b, 74). Aussi, la majorité de la population de ces centres urbains déverse-t-elle ces eaux usées provenant des usages domestiques dans les rues. L'insuffisance, voire l'absence des caniveaux d'évacuation des eaux usées et de pluie facilitent la toxicité des eaux lorsqu'elles sont déversées dans le fleuve. Bien que le secteur minier soit très peu développé dans le bassin, sinon quasi inexistant mise à part l'exploitation récente du pétrole à Komé (Doba) et l'extraction de l'or au Tchad qui se fait de façon artisanale, la plupart des usines du secteur industriel de cette région sont localisées aux bords des cours d'eau (Chari et Logone)[3]. Elles rejettent leurs déchets dans ces fleuves souvent sans traitement préalable, menaçant de ce fait la qualité des réserves d'eau du bassin. Une étude (CIMA/ SOGEC) effectuée au Tchad en 2002 indiquait déjà la caractérisation des rejets industriels dans le Logone (Sambo 2010, 246). Ainsi, face donc à la baisse des ressources naturelles, l'on va observer une course vers certaines ressources engendrant du coup des tensions et des conflits d'usage.

3. De la pression d'accès aux ressources aux conflits autour de la baisse des certains services écosystémiques

La baisse des certaines ressources (eau, poissons, terres fertiles, etc.) et services écosystémiques, associée à l'explosion démographique, est une source de compétition entre usages et entre usagers. La cohabitation est difficile, entre

[3] Plusieurs usines du secteur industriel sont présentes au Tchad et dans la partie camerounaise du Logone. Il s'agit entre autres des Brasseries du Logone, la Manufacture des Cigarettes Tchadiennes (MCT), les usines du Coton Tchad, les Abattoirs Frigorifiques de Farcha, etc. (Tchad) et au Cameroun la Société de Développement de Coton, les tanneries, etc.

les différentes communautés vivant aux abords et sur les îles du lac Tchad surtout dans un contexte où l'on observe une pression sur les ressources.

3.1. Une pression de plus en plus accrue sur les ressources du lac Tchad

Au fur et à mesure que les ressources s'amenuisent, les relations entre les différentes communautés se compliquent. La complication provient du fait que l'on enregistre désormais une pression sur les ressources. La croissance de la population dans le bassin du lac Tchad est un élément déterminant: en 2000, plus de 30 millions des personnes dépendent directement des ressources du lac Tchad alors que, dans le même temps, il régresse. Il constitue aujourd'hui un pôle de concentration humaine important au sein du Sahel central. Il fait partie des espaces ruraux qui ont connu une forte croissance démographique au cours des dernières décennies (Lemoalle et Magrin, 2015, 42). Les populations s'y installent, motivées par le potentiel piscicole, agricole et pastoral, auquel contribue en partie le retrait des eaux, générateur de surface utile supplémentaire (Sambo 2011a, 117).

Les grandes sécheresses des années 1973-1974 et 1984-1985 ont contraint les populations à migrer. C'est pendant cette période que l'on a observé la plupart des migrations de masse dans la région du lac Tchad (Sambo 2010, 185). Désormais dans ce contexte, les populations suivent donc l'eau, les poissons et les terres fertiles. Ce comportement est leur réponse à la sécheresse: l'installation s'opère là où les ressources naturelles sont disponibles (Saibou Issa 2001, 71). De ce fait, on constate une forte concentration des populations autour du lac. Les eaux du lac sont exploitées comme des eaux internationales (Saibou Issa 2001, 83). La présence des ressources ne se soumet pas aux frontières tracées par l'homme. Au contraire, les minerais, les fleuves, la faune souvent se trouvent de part et d'autre des frontières et engendrent des conséquences aux droits des propriétés, créent des externalités et empêchent l'utilisation unilatérale de ces ressources. Le statut transfrontalier de ces écosystèmes aquatiques et les ressources qu'on en tire ne peuvent être que source de confusion, dans la mesure où la délimitation est imprécise. Dans un contexte de rareté de ressources, de plus en plus, l'idée de frontière qui était illusoire dans la mentalité surgit, ce qui rend complexe le déroulement de la pêche et de l'élevage.

Ainsi, la baisse de certaines ressources (eau, poissons, terres fertiles, etc.) et services écosystémiques est une source de compétition entre les différents usagers, ceci dans un contexte où l'on observe une forte concentration des populations autour de ce lac. La cohabitation est difficile, entre les différentes communautés vivant aux abords et sur les îles du lac Tchad. Tensions et conflits sont la traduction directe de ces pressions croissantes sur les ressources. La

pression humaine croissante sur les ressources «est jusqu'ici régulée par des systèmes coutumiers qui permettent d'éviter des conflits graves» (Lemoalle et al, 2014, 24). L'action collective, la répartition des responsabilités et le partage des bénéfices pourtant une tradition dans cette localité deviennent de plus en plus bouleversée.

4. Des conflits liés à l'accès aux ressources en eau

L'existence de conflits dans un espace tel que le lac Tchad, en SE, mais à l'environnement en évolution permanente est une réalité. La baisse des certaines ressources (eau, poissons, terres fertiles), associée à l'explosion démographique, est une source de compétition entre usages et entre usagers. La cohabitation est difficile, entre les différentes communautés vivant aux abords et sur les îles du lac Tchad. Tensions et conflits sont la traduction directe de ces pressions croissantes sur les ressources. Cette géopolitique met en présence différentes communautés locales, des migrants issus de différents Etats proches, ainsi que différents types d'usagers à l'intérieur d'un même secteur d'activité ainsi qu'entre secteurs (agriculture, élevage, pêche).

Il importe de préciser que les conflits les plus récurrents sur le lac Tchad opposent les pêcheurs de différentes communautés. Cela relève non seulement du caractère instable des pêcheurs suite à la variabilité du lac mais aussi c'est le secteur d'activité qui a connu le nombre les plus élevés des migrants étrangers (Maliens, Sénégalais, Béninois, etc.) du fait de l'attractivité du lac. En 2008 à Darak par exemple, l'on estime la communauté malienne à plus de 600 personnes (Sambo 2010, 187). La cohabitation suite à la raréfaction des ressources halieutiques entre les pêcheurs locaux et les pêcheurs débouche généralement des conflits.

Les migrants étrangers sont pour la plus part accusés d'utiliser pour la pêche du matériel prohibé comme le filet à petites mailles. Les pêcheurs tchadiens par exemple accusent les pêcheurs des autres pays d'utiliser des techniques de pêche peu respectueuses. C'est ainsi que les autorités tchadiennes saisissent et détruisent les filets à maille des Camerounais et Nigérians (Sambo 2010, 187). En 1983, le souci de contrôler certaines îles poissonneuses du lac débouche sur un affrontement qui oppose pêcheurs nigérians et tchadiens sur le lac Tchad. Cette dispute à la différence des autres voit l'intervention militaire, d'où l'affrontement des troupes des deux pays (Saibou Issa 2002, 72).

Au Nord du lac Tchad, Les conflits réguliers ont été également observé entre février et avril 2012 et ont surtout opposé les pêcheurs locaux et étrangers migrants à cause de l'utilisation des motopompes devenu de plus en plus une

forme de pratique de pêche permettant l'exploitation des portions du lac afin de capturer des grosses quantités de poisson par jour. Dans la cuvette sud du lac Tchad, les conflits les plus réguliers opposent généralement les pêcheurs tchadiens et nigérians.

Par ailleurs les conflits d'usage opposent sur le lac Tchad les éleveurs et les pêcheurs sur les rives. De tels conflits opposent aussi lesdits éleveurs aux pêcheurs sur certaines îles. En saison sèche, le bétail en quête de point d'eau pour s'abreuver envahit, très souvent, les zones riches en poissons. Ce faisant, ils chassent les poissons entrainant ainsi la colère des pêcheurs. Pour résoudre ces conflits, les autorités des villages tels que Bagaram, Torroya et Bol ont demandé aux pêcheurs d'éviter de fixer les filets dans les zones où les éleveurs viennent abreuver leurs troupeaux. Dans d'autres villages, on leur demande de pêcher dans la nuit, car à cette heure les animaux se sont déjà retirés.

L'occupation progressive des abords immédiats des berges du Lac Tchad par les éleveurs et les agriculteurs entraîne aussi souvent des oppositions entre ces groupes. Ces conflits naissent du fait que les éleveurs utilisent l'eau pour l'agriculture et la végétation environnante comme pâture. En saison sèche à Darak par exemple, l'exondation du lac libère des espaces qui sont rapidement occupés par les agriculteurs. Les pâturages du coup se réduisent et au même moment les voies de transhumance se raréfient. Les plantations sont tellement serrées que les pistes de transhumance forment un labyrinthe (Sambo 2011a, 118). Les éleveurs accusent les agriculteurs de les empêcher de circuler librement dans cette région. Et de l'autre côté, en réaction les paysans se plaignent que les éleveurs détruisent leurs plantations. C'est ainsi que l'on assiste régulièrement à des disputes et à des bagarres entre les deux groupes. Selon le responsable de l'élevage de la CBLT, la zone de Darak demeure dans le bassin l'un des plus grands espaces de transhumance. Les animaux viennent de partout: Cameroun, Niger, Nigeria, Tchad, et aucun système de gestion et de contrôle de ces mouvements n'est coordonné. L'on ne peut dans ce cas qu'aboutir à des malentendus et à des rixes entre éleveurs et agriculteurs.

5. L'évaluation des services écosystémiques comme outil de gestion rationnelle et durable des eaux

Il importe de préciser qu'à partir de ces SE ont résulté un certain nombre de stratégies d'adaptation aux changements climatiques. Il est intéressant maintenant d'évaluer les SE afin d'améliorer la gestion des ressources en eau. Une analyse théorique permet de le considérer à priori comme un outil de gestion rationnelle et durable des eaux.

5.1. Les stratégies de gestion des ressources résultant des services écosystémiques

Les populations ne sont pas restées inertes face à la baisse des ressources naturelles. Elles ont, de manière spontanée développée des stratégies d'adaptation pour mieux gérer les ressources disponibles. L'adaptation aux changements climatiques s'inscrit donc naturellement dans un cadre de développement puisque tous les pays s'efforcent d'une manière ou d'une autre à gérer les mêmes systèmes sociaux, écologiques et économiques en vue d'instaurer un développement durable[4]. Ainsi, pour s'adapter à la baisse de certains services, les populations spontanément ont développé des pratiques pouvant être qualifiées de résilience. Ces pratiques, parfois méconnues, souvent peu formalisées et encore moins transmises hors des communautés d'origine, gagnent ou gagneraient à être intégrées dans les stratégies de développement durable. Il est donc intéressant d'impliquer plus fortement ces connaissances et pratiques dans les projets de développement communautaire (Sambo 2014, 173). Ces pratiques sont détaillées dans le tableau ci-dessous.

Tableau 2: Les stratégies d'adaptation de gestion rationnelle des ressources naturelles du lac Tchad

Systèmes	**Impact du Changement Climatique**	**Pratiques endogènes d'adaptation au CC**	**Les cadres stratégiques dans lesquels intégrer ces savoirs**
Agriculture	Variabilité pluviométrique	Réaménagement des calendriers agricoles	Mise en place des ressources/ informations nécessaire aux paysans permettant la maitrise des données sur la pluviométrie - Sensibilisation sur l'évolution des calendriers de la pluviométrie
	Diminution des ressources en eau	Irrigation pour la culture	Gestion rationnelle des mares d'eau, aménagements des ouvrages hydro-agricoles, etc.
		Recharge artificielle des nappes souterraines	Développement des infrastructures de rétention d'eau pour la recharge des eaux souterraines

[4] Ceci concerne particulièrement les Etats les plus vulnérables aux effets des changements climatiques (les pays les moins avancés et en voie de développement).

Élevage	Raréfaction de l'eau pour le bétail	Transhumance	Organiser la transhumance
		Préservation des mares d'eau	Construction des mares d'eau artificielles (rétention des eaux de pluie) Renforcement des capacités (sur une gestion durable et concertée) des structures de gestion des mares
		Gestion des mares d'eau naturelles	Aménagement durable des mares d'eau
Pêche	Baisse du stock de poissons	Gestion communautaire des pêcheries,	Appui financier des populations à travers des associations Renforcer les capacités des communautés
		la préservation des mares d'eau sacrée	Revaloriser de cette tradition

Source: Sambo 2018, 11- 25.

Ce tableau montre que dans une perspective de développement, la prise en compte de ces pratiques endogènes est un point essentiel. Précisément: cette intégration contribue à l'amélioration de la capacité de résilience des populations du bassin du lac Tchad, aux impacts du changement climatique. En d'autres termes: la connaissance des pratiques locales, leur formalisation et diffusion, constituent une ressource technique et organisationnelle pour les Etats riverains. Ces savoirs faire ont donc toute leur place, sinon tout leur rôle, dans les projets de développement. A titre d'exemple, on indique quelques techniques en matière de gestion de l'eau, issues du *savoir faire* traditionnel et *local*: techniques d'irrigation et de pompage d'eau, existence des mares d'eau sacrées, aménagement des mares d'eau, etc. (Sambo 2018, 11).

Sur le terrain, on constate la diffusion large de ces pratiques, souvent facilement adoptées par les populations. Cette dynamique d'appropriation gagnerait donc à être valorisée. Egalement, l'existence de ces pratiques locales permet de relativiser certains discours trop exclusivement alarmistes en ce qui concerne la gestion du lac Tchad. Cet état des pratiques témoigne du fait qu'il existe, dans une certaine mesure, une appropriation par les paysans des problèmes environnementaux par les populations de la région.

La baisse en valeur relative des ressources pousse désormais les populations à une course effrénée pour l'accès aux ressources naturelles. On se retrouve

dans une situation où les hommes sont constamment à la recherche de l'eau et des poissons, sans tenir compte des délimitations frontalières, ce qui engendre régulièrement des conflits d'usage intercommunautaires et interétatiques.

6. Contribution de l'évaluation des services écosystémiques à la gestion du lac Tchad

L'ASE n'a pas été véritablement appliquée dans la gestion du lac Tchad. Il s'est agi ici de voir la pertinence de cette approche comme outil de gestion de ce milieu naturel après avoir évalué les différents services écosystémiques. Elle a été appliquée en France avec plus ou moins de succès (Lespez et al. 2016, 1). Cette notion est souvent présentée comme une piste majeure d'amélioration des pratiques de gestion des milieux naturels, en développant la conscience des décideurs politiques, des acteurs économiques et des citoyens, en freinant la consommation des ressources naturelles, en finançant les actions de préservation de l'environnement, etc.

L'ASE est donc présentée comme une piste majeure d'amélioration des pratiques de gestion des milieux naturels. L'évaluation des SE est nécessaire afin de fournir par exemple des outils de planification plus performants. Il est intéressant de savoir déterminer à travers cette approche les ressources disponibles, de planifier les activités d'accès et de contrôle des celles si notamment à travers les stations des pompages d'eau d'irrigation, la pêche, les pâturages, etc. Lorsqu'on connaît la quantité d'une ressource, l'on peut donc aisément prévoir et organiser sa gestion dans l'espace et dans le temps. Ainsi, l'ASE est d'un apport important dans la planification de l'exploitation des ressources (eau, poissons, pâturages, etc.) du lac Tchad compte tenu des différentes tendances présenté ci-haut. Dans un environnement marqué par la raréfaction des certaines ressources, il faut pouvoir prendre de meilleures décisions concernant l'utilisation et la gestion durable des SE des zones humides en estimant leur importance pour la société. Du moment par exemple où est initié un projet de transfert d'eau du bassin du Congo vers le lac Tchad, il serait utile de voir entre le moyen lac et le petit lac actuel, quelle la situation hydrologique qui rendrait le plus de services aux populations dépendant directement de ses ressource (Lemoalle et Magrin 2014, 16).

Il a été aussi prouvé que lorsqu'on maîtrise les ressources disponibles, l'on peut mieux les gérer. Les décisions en matière de gestion et de développement pèchent généralement par manque d'information (et contribuent à l'érosion, à la transformation et à la dégradation rapides et continues des zones humides) comme les plaines inondables du bassin du lac Tchad. L'ASE peut amener les décideurs à limiter la consommation de certaines ressources naturelles. L'on

peut prendre ainsi les cas des ressources exploitées abusivement comme l'eau, les espèces de poissons en voie de disparition, etc. C'est une contribution à la conservation de la biodiversité. La meilleure participation des populations à la prise des décisions est ainsi souhaitée car c'est un gage de prise de conscience de danger qui menace leur environnement. C'est dans ce sens que l'ASE se présente comme un cadre d'évaluation favorisant le décloisonnement et des méthodes opérationnelles, qui permettent de créer les conditions propices à une sensibilisation du public.

Toutes fois, l'ASE présente des limites dans la gestion du lac Tchad: Par ailleurs, les procédures économiques de comptabilité et de prise de décision présentent de nombreuses faiblesses structurelles. Il est très rare que les décisions tiennent compte de la valeur économique totale et des avantages des services commerciaux et non commerciaux procurés par les zones humides. Des systèmes complexes imprévisibles, des connaissances lacunaires sur le lac malgré les travaux existants constituent des entraves à l'évaluation. C'est ainsi que pour Barnaud (Barnaud et al. 2011, 9): «Ces services sont liés au fonctionnement de systèmes socio-écologiques complexes au sujet desquels les scientifiques sont rarement en mesure d'énoncer avec certitude des relations de cause à effet, soit parce que ces systèmes sont par nature imprédictibles, soit par que leurs connaissances sur ces systèmes sont incomplètes».Au-delà des incertitudes méthodologiques (prise en compte des aménités environnementales, monétarisation, etc.) et des difficultés techniques (question d'échelle par exemple), cette stratégie confirme l'émergence d'un nouveau paradigme de gestion des ressources naturelles (Lespez et Barraud 2016, 1).

7. Conclusion

La dégradation de l'environnement durant les XIX^{e} et XX^{e} siècles a transformé la physionomie du bassin du lac Tchad, mais aussi celle des sociétés qui l'entourent, et plus particulièrement des relations entre certaines des catégories d'acteurs qui composent ces sociétés. Cette transformation a conduit progressivement à la régression des cours d'eau et à la baisse des SE du lac Tchad. En même temps, la population n'a fait que croître. Cette double contrainte environnementale et de pression anthropique a conduit à de fréquents mouvements migratoires dans la région. Les populations se déplacent constamment à la recherche des terres fertiles, des réserves d'eau riches en poissons et des mares d'eau pour abreuver le bétail.

Les éléments présentés ci-dessus sont nouveaux pour la zone d'étude concernée. En effet, à cette échelle d'analyse et relativement à ces SE, la

littérature disponible est à ce jour peu développée. Ainsi, au-delà de ces éléments qualitatifs et issus d'observations de terrain, on constate l'utilité d'installer une capacité pérenne d'observation des SE dans la zone entourant le lac Tchad. Cette capacité de veille et d'analyse, nécessairement pluridisciplinaire, pourra notamment fournir aux Etats membres de la CBLT des données utiles à la décision sur les problématiques environnementales. Désormais, les SE sont sortis du cadre scientifique pour devenir un instrument de décision politique. Enfin, cet outil d'accompagnement aux politiques publiques pourra servir de cadre pour la collecte de données et l'animation de concertations contribuant, aux différentes échelles de territoire, à la prévention des conflits entre usages et usagers des SE du Lac Tchad et de ses affluents.

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Services écosystémiques et tourisme en moyenne montagne à l'âge contemporain: les cas du mont Abetone et du mont du Cerreto

Elisa Tizzoni

1. Introduction

Dans la plupart des territoires de moyenne montagne, la recherche de nouveaux volets économiques, souvent associée à la diversification de l'offre touristique, a stimulé la réflexion autour des ressources et des services accordés (actuellement ou potentiellement) par cet environnement (Perrin-Malterre 2015).

Pour autant, à partir des années quatre-vingt-dix, l'image stéréotypée de la montagne européenne s'imposant sur la scène publique et dans les travaux de recherche, marquée par l'isolation et le sous-développement[1], a été dépassée par une nouvelle approche (Dallari et Gaddoni 1996; Scaramellini 73-89; Cervaso 2005, 345-374), étant donné que

> la relation entretenue en Europe avec les espaces de moyenne montagne a changé : de «territoires du vide», ils sont souvent devenus dans les esprits de véritables réserves de nature, d'espace et de ressources, relativement proches des centres urbains, donc accessibles ; ils ont par là même suscités de nouveaux comportements et de nouvelles convoitises, et sont perçus comme le théâtre d'un renouveau (Bettinger et Ormaux, 2011).

Ainsi, des travaux s'appuyant sur des cas d'étude ont remis en question la supposée faiblesse de la moyenne montagne, qui est de plus en plus appréciée par les touristes, à la recherche d'une destination où faire de la randonnée ou pratiquer des sports d'hiver, d'un patrimoine naturel intact et d'une atmosphère paysanne traditionnelle (Gumuchian 1984; Rieutort 1997).

De leur côté, les historiens peuvent contribuer de façon significative au débat concernant l'avenir de la moyenne montagne européenne; le renouvellement de

[1] La moyenne montagne européenne était définie un « espace malade » par Mignon 1999, 7-30.

l'enquête historienne promu par l'approche environnementale, en particulier, nous permet de repenser à nouveau frais l'histoire de ces territoires.

D'ailleurs, pendant les dernières années l'histoire environnementale, initialement confinée dans des limites géographiques et conceptuelles assez étroites, a étendu de façon considérable l'éventail de sujets abordés et les outils méthodologiques employés par les chercheurs, à tel point que cela représente aujourd'hui l'une des démarches les plus prometteuses au sein de l'historiographie contemporaine (Crosby 1995; Ingold 2011; Grove 2001; Ford 2007). Après avoir dépassé le double «monopole» imposé par l'approche critique, sous l'angle méthodologique, et par l'attention presque exclusive à l'Amérique du Nord, où se concentraient la plupart des premiers centres de recherche, aujourd'hui l'histoire environnementale est développée dans plusieurs pays et aborde une grande variété de sujets et approches (Winiwarter 2004; Locher et Quenet 2009; Frioux et Lemire 2012). Parmi les concepts utilisés par les spécialistes des enjeux écologiques, la notion de service écosystémique, qui «bien que non stabilisé et encore sujet à controverses, […] exprime les multiples avantages que les sociétés humaines, pour leur bien-être, retirent de tout écosystème» (Serpantié et al. 2012) offre de riches perspectives de recherche aux historiens environnementaux.

La notion de service écosystémique, en particulier, favorise le dialogue entre l'histoire environnementale, les autres courants historiographiques et les autres disciplines qui font de l'environnement leur objet d'étude, d'autant que l'étude des avantages apportés par les éléments naturels entraîne une réflexion générale sur la société, l'économie, la culture propres à une civilisation.

L'application du concept de service écosystémique s'avère donc très efficace pour mieux comprendre l'évolution du rapport entre les communautés humaines et l'environnement, ce dernier étant considéré comme objet historique.

Compte tenu de ces remarques, cette contribution va aborder les transformations environnementales dans la moyenne montagne par rapport aux services écosystémiques fournis par ce milieu, en se penchant sur les effets éclatants de l'épanouissement du tourisme à l'âge contemporain.

L'ambition de cette recherche est donc celle d'évaluer les caractères et la transformation des services écosystémiques apportés par les montagnes européennes «mineures», en nous penchant sur les services culturels fournis par le tourisme, qui a été conçu par les acteurs locaux comme l'un des volets économiques principaux pour la moyenne montagne à l'âge contemporain.

La recherche qui fait l'objet de cette contribution s'appuie sur deux cas d'étude situés dans les Apennins tosco-émiliens, lla station touristique Cerreto Laghi, près du col du Cerreto, dans la région italienne de l'Emilia-Romagna, et celle du mont Abetone, en Toscane.

Il faut préciser que l'historiographie traditionnelle (Barberis 1992; Vitte 1992; Bernardi 2000; Gemmiti 2000) a longtemps insisté sur la marginalité et le sous-développement des Apennins, en termes démographiques (diminution et vieillissement de la population), économiques (pénurie des revenus, crise de l'agriculture et d'autres secteurs) et enfin sociaux (chômage, bas taux d'instruction etc.), imposés par leur isolement tant physique (infrastructures et réseau routier limités) que socioculturel (intégration incomplète du style de vie traditionnel dans les rythmes et les modèles de la modernité).

L'historiographie courante, toutefois, a développé une réflexion sur la longue durée à l'égard des transformations qui ont affecté l'environnement des Apennins italiens (Albera et Corti 2000), et qui a mis en lumière son dynamisme,par rapport à la naissance de la proto-industrie ou à la spécialisation des métiers, entre autres (Armiero 2002).

Dès lors, les territoires objet de l'enquête offrent beaucoup de pistes de réflexion grâce à leur situation et aux caractères originaux de leur développement touristique, à partir de l'épanouissement du tourisme de masse jusqu'à l'essor des nouveaux modèles de développement, basés sur la conservation et la mise en valeur du patrimoine naturel.

2. Les milieux du mont Abetone et du col du Cerreto: présentation

La zone touristique d'Abetone s'étale sur la haute «Valle della Lima», comprise entre l'Alpe delle Tre Potenze (1940 m.) et Punta Monticelli (Lenzi 1969, 6); du point de vue administratif, les municipalités intéressées sont celles de Abetone, Cutigliano, Piteglio et San Marcello Pistoiese (Lenzi 1969, 6).

Bien que ce milieu soit habité depuis l'époque préhistorique, nous allons nous pencher sur les transformations les plus importantes par rapport au développement touristique, qui remontent à l'âge connu comme «l'età leopoldina» (Petracchi 2000; Cassi 1988, 45).

Sous le royaume du Grand-Duc de Toscane Pietro Leopoldo (1765-1790), l'économie locale reposait sur les activités agro-sylvo-pastorales, qui comprenaient la culture des céréales «anciennes» (comme l'épeautre) et du fourrage, le commerce du bois et de ses fruits (châtaignes, baies, champignons), l'élevage et sur les services aux voyageurs (relais de poste, auberges etc.).

En raison de l'importance stratégique acquise par ces lieux, situés à la frontière avec le Grand-duché de Modena, le réseau routier fut étendu et amélioré, avec l'inauguration de la «Strada Leopoldina (ou Regia)», reliant les versants montagnards de Modena et Pistoia (1781).

Sous l'impulsion des initiatives promues par le Grand-Duc, les anciennes habitations temporaires liées aux rythmes saisonniers de l'élevage et de la

sylviculture furent remplacées par des établissements permanents, situés le long des principaux parcours routiers.

À cette époque la vigilance sur l'utilisation du patrimoine forestier, placé sous le contrôle direct du Grand-Duc (Magona Granducale), puis sous celui du Demanio Forestale, contribua de façon considérable au maintien des services écosystémiques de régulation apportés par le milieu montagnard (Romby 1988).

Dans la première moitié du 19e siècle, les premières manufactures industrielles dans les secteurs de la métallurgie et de la transformation du bois, favorisées par la disponibilité d'eau et de matières premières, fixèrent leur siège dans le milieu montagnard près du mont Abetone, freinant ainsi considérablement le dépeuplement.

En outre, le massif montagneux qui comprend les monts Abetone, Cimone et des autres cimes entre Pistoia et Modena étaient fréquenté par des spécialistes scientifiques et naturalistes, qui construisirent un observatoire géographique et d'autres structures, utilisées plus tard par les premiers alpinistes (Manicardi 2017; Bortolotti 1963, 237).

De plus, la présence d'un vaste patrimoine naturel sauvegardé attirait les familles les plus connues de la Toscane, qui choisissaient l'Abetone pour leur retraite estivale et construisaient des somptueuses maisons estivales (Villa Mantegazza, Villa Gardini etc.; Andreini Galli 1989).

Quelques décennies plus tard, vers la moitié du 19e siècle, la «conquête» des Apennins par le chemin de fer (l'inauguration de la «Ferrovia Porrettana» entre Bologna et Pistoia remonte au 1864; Marchi 2003) favorisa davantage l'essor économique de la zone et augmenta son attrait chez les voyageurs[2].

Grace aux facteurs locaux mentionnés et sous l'influence des tendances générales du tourisme, l'essor du tourisme dans la haute Valle de la Lima, en particulier, remonte à une époque relativement lointaine par rapport aux autres territoires des Apennins et son développement a été également rapide dans le cas du séjour estival comme hivernal(Cassi 1988, 81).

Les guides touristiques répandus à cette époque et les articles publiés dans la *Gazzetta d'Italia* et le *Touriste* vers le milieu des années soixante-dix du 19e siècle signalent la présence de nombreux voyageurs attirés par le patrimoine naturel de la montagne autour de Pistoia (Tigri 1878).

À partir des premières années du 20e siècle, grâce aux investissements des entrepreneurs locaux et non, on assiste à la diffusion des sports d'hiver dans les Apennins et à l'essor de la station touristique d'Abetone, qui bénéficia plus tard du soutien au tourisme blanc par le régime fasciste (De Rossi 2017).

[2] À la fin du 18e siècle «même si en Italie le kilométrage des lignes touristiques de montagne ou de moyenne montagne ne pouvait pas être comparé à celui de la Suisse, il n'était pas négligeable», Maggi 2002, 371.

Cependant, en 1937 selon la *Guida pratica ai luoghi di soggiorno e di cura d'Italia* éditée par le Touring club d'Italie, l'une des publications les plus diffusées parmi les touristes à cette époque, le patrimoine forestier, le paysage et le climat restaient les attraits les plus importants de la station touristique de l'Abetone, s'identifiant ainsi avec :

> La grandiosa foresta demaniale dell'Abetone, che ha una superficie di 3.700 ettari, ed è costituita di abeti, larici, pini silvestri, faggi, castagni, aceri e betulle [...] rappresenta la maggiore attrattiva . [...] A questa ricchezza e varietà di spettacoli naturali e ai grandiosi scenari alpestri, che si godono dal passo e dai dintorni, va aggiunta la bontà e la salubrità del clima, l'aria imbalsamata e fresca che visi respira (*Guida pratica* 1937, 253).

L'épanouissement du tourisme près du col du Cerreto, une des stations du ski les plus connues des Apennins près de Reggio Emilia, présente à la fois des similitudes et des différences avec le site de l'Abetone.

Dès l'antiquité et jusqu'à l'époque moderne, le commerce et les services aux voyageurs représentaient les activités économiques les plus importantes auprès du col du Cerreto, traversé par une ancienne route reliant la ville de Reggio Emilia, en Emilia-Romagna, et celle d'Aulla, en Toscane, à travers les Apennins (aujourd'hui route nationale 63).

Ce territoire se trouve au carrefour entre la plaine du Po, la Ligurie et la Toscane, la montagne fournissait alors surtout des services écosystémiques d'approvisionnement (bois et fruits, eau, fourrage) et de régulation (présence d'un climat mitigé en été), tandis que la présence de nombreux sanctuaires et monastères paysages offrait ce que l'on appelle des services écosystémiques culturels (Formentini 1937).

La centralité de ce territoire augmenta vers la fin du 18e siècle, lorsque la nouvelle route construite sur initiative du Duc de Modena et Reggio Emilia et passant par le col du Cerreto remplaça un axe routier plus ancien, situé près du col du Cerreto, qui transitait par le col de l'Ospedalaccio» (Salvo et Canossini 2003, 327)[3].

Depuis l'époque napoléonienne, toutefois, la route passant par le col de la Cisa fut choisie comme axe routier principal reliant la plaine du Po et la côte méditerranéenne, ce qui aboutit à la marginalisation du col du Cerreto par rapport aux flux de marchandises et de voyageurs (Caroli 1998)[4].

Par conséquent, les habitants firent face au chômage et à la crise socio-économique de deux façons: une partie d'entre eux se déplacèrent en plaine ou dans la ville collinaire de Castelnovo ne' Monti, qui offraient des services de

[3] Le col de «l'Ospedalaccio», qui prend son nom d'un ancien hôpital très important au moyen âge, fut abandonné à la suite de problèmes hydrogéologiques.

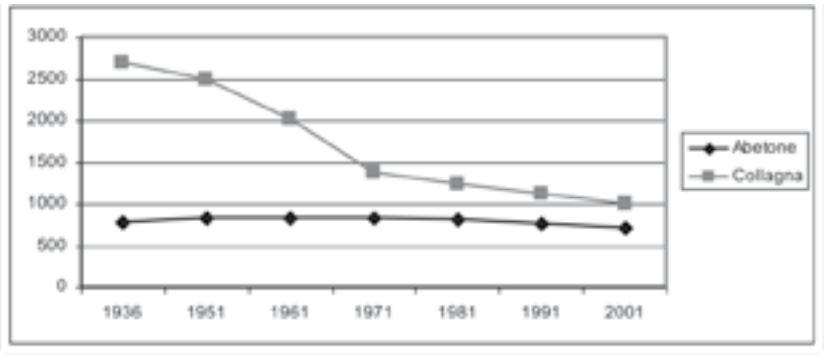
[4] Le chemin de fer et plus tard l'autoroute furent construits le long du tracé de la route Cisa.

typologie urbaine (hôpital, écoles etc.) à la recherche d'un nouvel emploi ; une autre partie tenta de convertir les habitations traditionnelles et implanter de nouvelles activités pour pratiquer le tourisme d'hiver (*Ri-conoscere* 2008; Zobbi 2005).

À partir de la moitié du 19e siècle, d'ailleurs, en faisant connaître ces endroits à un large public par moyen des revues publiées par le Touring club italien et d'autres associations sportives, les premiers randonneurs et alpinistes «découvrirent» les bois et les petits lacs éparpillés près du col du Cerreto.[5].

Dans les années Trente un nombre croissant de travailleurs des villes voisines (La Spezia et Reggio Emilia, surtout) se rendit près du col et des petits lac du Cerreto pour des randonnées et des vacances, par le biais de l'OND (Opera nazionale dopolavoro) et d'autres initiatives du régime fasciste en faveur du tourisme populaire (Tizzoni 2011).

L'évolution démographique des municipalités de Collagna et Abetone



Données Istat – Institut statistique Italien.

Initialement un camping destiné aux militaires en service à l'Arsenal maritime de La Spezia fut implanté près du col du Cerreto, du côté de la province d'Apuania (l'actuelle Province de Massa Carrara), alors qu'à la fin de la décennie un Comité soutenu par les Ept de La Spezia et de Reggio Emilia et par le Cai promut la construction d'un hôtel tout près, dans une zone se trouvant dans la municipalité de Collagna, en province de Reggio Emilia. Le rapport présenté par le Comité, qui requit des contributions publiques, nous informe du fait que le col du Cerreto à cette époque été très fréquenté par les randonneurs et les sportifs provenant des villes proches, attirés par les pistes de ski mais aussi par le paysage, la vue suggestive et le climat favorable tant en hiver que pendant la saison estivale. Selon les auteurs du rapport, le manque d'hébergements

[5] Parmi les nombreux exemples, voir *Bollettino* 1881, XV, XLV-XLVIII.

posait des contraintes au développement du tourisme, qui satisfaisait aussi un besoin social, puisque les travailleurs et les jeunes auraient pu bénéficier de l'environnement salubre du milieu[6].

3. Les acteurs locaux face à la crise du tourisme de masse

Vers la moitié des années soixante-dix, l'apparition des premiers symptômes de crise du tourisme de masse à fort impact environnemental imposait de repenser la mise en tourisme des Apennins et d'engager les acteurs locaux dans une réflexion autour du futur de ce milieu.

Les effets négatifs de la soi-disant modernisation et du tourisme de masse, (parmi lesquels la spéculation immobilière et la perte de l'identité traditionnelle), d'une part, et le procès d'intégration européenne, d'autre part, posaient des défis supplémentaires au milieu montagnard (Broggio 1992).

Dans le cas de la montagne autour de Pistoia, entre la fin de la deuxième guerre mondiale et la fin des années soixante, le dépeuplement et la transformation du cadre socio-économique local entraînèrent des modifications importantes des services écosystémiques apportés par l'environnement montagnard.

Du point de vue démographique, on a assisté à l'exode d'une partie significative de la population, déplacée vers le fond de vallée ou vers les villes en plaine (Lenzi 1996, 18), et au vieillissement de la population, en corrélation avec la diminution du taux d'activité (42, 08% en 1931, 36,12% en 1967), malgré l'augmentation du nombre de commerces et services aux touristes, comme coiffeurs, cordonniers etc. (Lenzi 1996, 19).

Le secteur primaire, y compris l'exploitation forestière, perdit son importance dans l'économie locale, de plus en plus tertiarisée et basée sur le tourisme, tandis qu'une partie des «casali» (fermes traditionnelles) étaient converties en hébergements touristiques (Lenzi 1996, 18-21).

En fait, dans le deuxième après guerre la station d'Abetone fut investie par l'essor du tourisme hivernal de masse et bénéficia de la présence de champions de ski locaux ensuite devenus célèbres au niveau international, Zeno Colò et Celina Seghi (Sbetti 2017).

Hébergements hôteliers dans la municipalité d'Abetone

1955		**1961**		**1967**		**1969**	
hôtels	lits	hôtels	lits	hôtels	lits	hôtels	lits
19	656	23	846	23	942	29	1087
10	272	12	333	17	452	20	489

Lenzi, *La recente evoluzione*, cit., p. 25.

[6] *Relazione del Comitato promotore per la erezione di un albergo alpino al passo del Cerreto* 1938.

Fréquentation touristique dans la municipalité d'Abetone

Hébergements hôteliers						
	italiens		étrangers		total	
	arrivées	nuitées	arrivées	nuitées	Arrivées	nuitées
1963	9457	46415	514	1746	9971	48161
1964	10853	48276	385	1333	11238	49609
1965	10733	47435	346	1041	11079	48476
1966	10678	47194	306	720	10984	47914
1967	11584	55218	322	830	11906	56048
1968	10862	50047	368	1366	11230	51413
Hébergements non hôteliers						
	italiens		étrangers		total	
	arrivées	nuitées	arrivées	nuitées	arrivées	nuitées
1963	1289	13231			1289	13231
1964	496	11274			496	11274
1965	488	11045			488	11045
1966	482	10827			482	10827
1967	677	19063			677	19063
1968	1065	20874			1065	20874

Lenzi, *La recente evoluzione*, cit., p. 26-27.

Giovanni Bortolotti, dans un guide de 1963 adressé aux randonneurs et aux alpinistes, soulignait que cette portion des Apennins présentait des connotations touristiques particulières:

> la catena appenninica, nel tratto di crinale considerato, si presta infatti ad essere esaminata globalmente perché costituisce, con le dorsali che da essa si staccano e con le valli che esse determinano, non solo un gruppo oro-idrografico nettamente distinto, ma altresì un complesso turistico ed alpinistico ben definito ed omogeneo, ottimamente servito per ciò che concerne viabilità, ferrovie, auto-servizi, impianti meccanici di risalita per sciatori ecc.[7].

Cependant, selon l'auteur cité, durant les années soixante la montagne près de Pistoia, abandonnée par les habitants à la recherche de meilleures conditions de vie, risquait de devenir «selvatica e inaccessibile»[8].

[7] «La chaîne des Apennins, dans la crête considérée, se prête à être examinée globalement car elle constitue, avec les dorsales qui se détachent et les vallées qu'elle forme, non seulement un groupe oro-hydrographique bien distingué, mais aussi un complexe touristique et d'alpinisme bien défini et homogène, très bien doté de routes, lignes ferroviaires, remontées mécaniques etc». (Bortolotti 1963, 21 [traduction des éditeurs]).

[8] «sauvage et inaccessible», Bortolotti 1963, 8-9[traduction des éditeurs].

Selon l'auteur cité, donc, il faudrait envisager des nouvelles formes de tourisme basées sur la mise en valeur du patrimoine naturel, dans le but de concilier exploitation économique et conservation de l'environnement:

> Se vi è una salvezza per i montanari, essa riposa unicamente nella valorizzazione di ciò che la città non potrà mai togliere loro: lo sfruttamento dei salti d'acqua, il miglioramento delle culture forestali specializzate e soprattutto la valorizzazione turistica ed alberghiera delle bellezze naturali. […]. Solo quando i montanari avranno cessato di considerare i boschi che costituiscono il completamento indispensabile e la difesa della montagna, come cataste di legna da ardere o da cuocere ed i germogli delle nuove piante della foresta come pingui pascoli per le proprie pecore; solo allora il problema della valorizzazione della montagna sarà correttamente impostato […]. Occorre creare, insomma, una coscienza montanara tra gli abitanti dei nostri Appennini, come già esiste sulle Alpi, e solo così si potrà salvare la montagna dalla inesorabile progressiva rovina[9].

Pendant la même période l'affirmation du tourisme dans le milieu du Cerreto, qui devait d'ailleurs combler son retard par rapport aux stations de ski des Apennins mieux connues, progressait à un rythme plus lent que dans le site d'Abetone, les entrepreneurs extérieurs jouant un rôle clé par rapport à la réalisation et l'aménagement des structures et des services aux touristes.

Vers la fin des années cinquante – début années soixante, donc, après une première phase de négociation avec des entrepreneurs de la ville voisine de Parma, la société de Reggio Emilia SVAR (*Società per la valorizzazione dell'appennino reggiano*) obtenait l'autorisation de construire une station touristique d'hiver et des remontes mécaniques près du col du Cerreto (*I problemi turistici* 1956; *Il turismo nella montagna reggiana* 1968; *Dati e notizie* 1969).

De leur côté, pendant la même période les élus de la Province de Reggio Emilia s'interrogeaient sur le futur du tourisme, pendant que les préoccupations écologiques commençaient à mobiliser une partie considérable de l'opinion publique mondiale et les premiers mouvements environnementaux mettaient en question le tourismede masse dans le but de sauvegarder le patrimoine naturel, menacé par l'urbanisation contemporaine.

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[9] «Les seuls moyens de survie pour les montagnards sont représentés par la valorisation de ce que la ville ne pourra jamais leurs enlever: l'exploitation des cascades, l'amélioration des cultures forestières spécialisées et surtout la valorisation touristique et hôtelière des beautés naturelles. […] Seulement quand les montagnards cesseront de considérer les bois qui constituent l'achèvement indispensable et la défense de la montagne, comme des amas de bois de chauffage ou de cuisson et les pousses des nouvelles plantes de la forêt comme gras pâturages pour leurs brebis; alors seulement la question de la valorisation de la montagne sera correctement formulée. […] Il faut créer une conscience montagnarde chez les habitants de nos Appennini, tel que cela existe déjà dans les Alpes, ce n'est qu'ainsi qu'on pourra sauver la montagne de l'inexorable, progressive ruine» Bortolotti 1963, 69-70 [traduction des éditeurs].

Dans le but de saisir les problèmes principaux qui affectaient le milieu montagnard et planifier des solutions, en 1975 l'Administration Provinciale de Reggio Emilia rédigea une proposition d'intervention globale relative au tourisme montagnard, en se penchant particulièrement sur le site du Cerreto.

Selon l'étude citée, à cette époque l'essor du tourisme et, par conséquent, la modernisation de la montagne autour de Reggio Emilia étaient encore faibles et incomplèts, en premier lieu car la taxe de dépeuplement se maintenait haute dans le cas des villages ruraux et dans les stations touristiques (*Zone bianche* 1975).

D'autre part, la présence de plusieurs foyers d'habitation éparpillés autour des villages principaux posaient des difficultés par rapport aux transports et à l'aménagement des services publics, compte tenu du fait que les centres urbains les plus proches étaient situés à plus de 45 km (*Zone bianche* 1975).

Dans ce document, de nombreuses mesures étaient envisagées, parmi lesquelles : la création d'un Parc Naturel, la conservation du milieu rural finalisée à sauvegarder les équilibres hydrogéologiques du terrain et promouvoir l'agriculture et la sylviculture traditionnelles, en accord avec la IV^e^ directive C.E.E; «un moderno e razionale sviluppo che non ripeta gli errori compromettenti del passato»[10].

Dans ce cadre, les bois étaient reconnus parmi les attractions touristiques principales, sans sous-estimer leur rôle pour la sauvegarde de l'environnement : «questo patrimonio può costituire, se opportunamente salvaguardato e potenziato, un vero e proprio sistema di protezione ecologica e di difesa e tutela dei beni naturali e delle risorse finite»[11].

Exploitations commerciales

	hôtels	**restaurants**	**cafés**	**magasins alimentaires**	**magasins non alimentaires**
1960	3	3	4	1	1
1980	9	10	12	6	4
2000	9	11	17	7	6

Giuseppe Delfini, *Cerreto dei contrari*, «Tuttomontagna», june 2000, <http://www.tuttomontagna.it/> (10 février 2018).

D'ailleurs, le tourisme était censé être «una delle componenti del processo di equilibrio che si vuole instaurare nelle comunità montane reggiane, componente

[10] «un développement [du tourisme]moderne et rationnelqui ne répète pas les erreurs compromettantes du passé» (*Zone bianche* 1975, 3) [traduction des éditeurs].

[11] «ce patrimoine, si convenablement sauvegardé et développé, peut constituer un véritable système de protection écologique et de défense des richesses naturelles et des ressources limitées», (*Zone bianche* 1975, 2) [traduction des éditeurs].

legata strettamente alle altre più sopra descritte quindi non esclusiva»[12].

Ces considérations dérivent en partie de la confiance absolue dans le tourisme comme facteur de progrès :

> Siamo senz'altro d'accordo con chi ritiene di non poter risolvere i problemi della montagna puntando quasi esclusivamente sull'incremento del turismo. Le aree più fortemente incentivate nella regione sotto questo aspetto non denunciano infatti, almeno alla lettura dei dati statistici, risultati di sviluppo diversi dalle aree contermini[13].

Le tourisme, donc, n'était pas le remède infaillible à la marginalisation, mais la mise en valeur des attraits locaux pouvait stimuler le tissu socio-économique local et promouvoir une nouvelle forme de modernisation, plus attentive aux enjeux environnementaux.

Donc dans le cas de la station touristique de l'Abetone comme dans celle du Cerreto, le conflit auparavant envisagé entre les anciens services écosystémiques (d'approvisionnement et de régulation) et les "nouveaux" services culturels apportés par le tourisme, était finalement surmonté par une conception éco-compatible du tourisme, qui engageait les acteurs locaux dans un projet de développement commun.

4. Conclusions

Si l'on considère que l'étude de l'environnement en tant qu'acteur historique est justement l'objet de l'approche environnementale, la mise en tourisme des Apennins et des autres territoires de moyenne montagne ne pourrait pas être comprise entièrement sans prendre en compte les services écosystémiques fournis par le milieu montagnard et son évolution au cours du 20e siècle.

Comme nous l'avons souligné, le tourisme représenta le moteur du changement pour les localités d'Abetone et du Cerreto, en imposant de profondes modifications pour l'environnement pour la société.

Ces deux cas d'étude s'éclairent l'un l'autre, d'autant plus que les différents parcours de développement du tourisme promus par les collectivités territoriales et les acteurs externes (ces derniers plus significatifs dans le cas du Cerreto) ont de nombreuses similitudes.

Tout d'abord, les caractères environnementaux d'origine des territoires faisant l'objet d'enquête (le paysage, le climat etc.) ont constitué l'attrait principal dans la

[12] «l'un des composants du processus d'équilibre que l'on veut instaurer dans les communautés montagnardes en Province de Reggio Emilia», (*Zone bianche* 1975) [traduction des éditeurs].

[13] «Nous sommes sans doute d'accord avec ceux qui pensent que les problèmes de la montagne ne peuvent pas être résolus au moyen de la croissance du tourisme. Les zones de la région les plus stimulées sous cet aspect, en effet, ne le montrer pas, du moins à la lecture des statistiques et desdifférents résultats des zones limitrophes» (*Zone bianche* 1975, 2) [traduction des éditeurs].

phase aurorale du tourisme, à tel point que l'on constate une sorte d'identification des services écosystémiques culturels avec ceux d'approvisionnement et de régulation pourvus par la montagne.

Toutefois, suite à l'essor du tourisme de masse, l'assimilation entre le développement touristique et la modernisation s'accompagne de la sous-évaluation des services écosystémiques traditionnels fournis par la montagne, jugés comme étant l'expression de la faiblesse du tissu économique local.

Dans ce cadre, l'urbanisation stimulée par le tourisme dota le milieu des Apennins de structures et de services typiquement urbains, l'objectif affiché (mais pas toujours réalisé) étant de mettre un frein au dépeuplement montagnard.

À partir des années soixante-dix, par contre, les élus et les observateurs locaux, sous l'influence de l'environnementalisme qui allait se diffuser dans l'opinion publique à cette époque, manifestèrent l'exigence d'une offre touristique plus durable, conçue comme outil pour la préservation et la valorisation du patrimoine naturel et pas seulement comme volet économique.

Par-delà les spécificités des milieux objet de cette recherche, l'étude de cas permet d'enrichir la notion de service écosystémique avec de nouvelles articulations, par rapport à l'interaction entre différentes catégories.

En effet, des tendances générales (notamment les changements intervenus dans le comportement des touristes, la diffusion d'une conscience écologique sensible aux défis environnementaux, l'adoption de modèles de gestion du pouvoir public plus participatifs et attentifs aux besoins du territoire etc.) ont stimulé l'intégration entre les services d'approvisionnement, de régulation et culturels par le biais du tourisme.

On observe que les dernières formes de tourisme faisant appel au concept de durabilité et d'éco-compatibilité se distinguent par la mise en valeur du patrimoine naturel et identitaire local, et par le lien entre préservation des équilibres environnementaux et compétitivité sur les marchés touristiques.

Ainsi, la reconversion de l'offre touristique des aires qui est le sujet de la recherche qui tend à l'écologie, qui faisait ses premiers pas à la fin de la période prise en compte dans cette contribution, aboutità la participation de la station de l'Abetone au projet de développement du tourisme soutenable et compétitif NECSTour[14] et à l'inclusion du milieu du Cerreto dans le Parc national de l'Apennin tosco-émilien.[15]

Finalement, le tourisme dans ces milieux a été réorienté vers des objectifs de développement durable, qui, s'ils restent loin d'être atteints, représentent

[14] Créé en 2009, le réseau NECSTouR vise à promouvoir le tourisme durable et la compétitivité des régions adhérentes par le biais des "observatoires de destination", l'échange de best practices et l'adoption de standard de gestion écologiques.

[15] Le Parc national des Apennins tosco-émiliens, institué en 2001, s'étend sur environ 22.000 hectares de la Toscane à l'Émilie-Romagne.

aujourd'hui le cadre idéal et programmatique pour la conservation des services écosystémiques fournis par la moyenne montagne.

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Ecosystem Services in Floodplains

edited by
Dario Canzian and Elisabetta Novello

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This volume is a collection of essays by European environmental scholars on the ecosystem services theme. The Millennium Ecosystem Assessment (MEA), carried out between 2001 and 2005 at the behest of the United Nations General Assembly, was designed to assess the consequences of the changes which have taken place in the environment on human wellbeing as well as to improve conservation and the sustainable use of ecosystems, by identifying the contributions these made to economic and social progress over the course of the centuries.
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ISBN 978-88-6938-183-6
9 788869 381836
€ 16,00