Important species for conservation and related to water meadows environments:
Fig. 1 - Airone bianco maggiore (Casmerodius albus) - Photo A. Turri
Fig. 2 - Raganella italiana settentrionale (Hyla perrini) - Photo M. Bove
Fig. 3 - Salvastrella maggiore (Sanguisorba officinalis) - Photo Tessaro
Fig. 4 - Licena delle paludi (Lycaena dispar) su Lolium multiflorum - Photo E. Tabacco

Cover: Campari on the Sforzesca water meadows, Vigevano (PV) - Photo G. Molina
Back cover: Campari on the Casterno water meadows, Robecco S.N. (MI) - Photo M. Bove
e Pavoncella during the winter in the waters of the water meadaws - Photo F. Casale
In opening (pag. 1) The water meadows of Bernate and the Ticino from above - Photo M. Tessaro
The silhouettes of the three birds that symbolize the water meadows are by Federico Meroni

Con il contributo di:

SUMMARY

Fig. 5 - The water meadows of the Sfrorzesca hamlet in Vigevano (PV), at the end of the snow - Photo G. Molina

WATER MEADOWS, WHEN HISTORY TEACHES ...

During the winter, thanks to the continuous and precise work of the farmer with his shovel, a thin veil of water flows on the turf of a particular lawn meadow which is prepared and artfully arranged, preventing the formation of frost and allowing the grass to continue to grow and the meadow never stop living.

This is the water meadow!

An ancient multifunctional crop: it produces grass in the cold of winter, welcomes and feeds birds of very rare European species, testifies to an agriculture of our past, fills the aquifers of the subsoil, helps mitigate climate change, and dairy products from cows fed with water meadow grass are healthier.

The farmers of the Ticino Valley tell, by rotating their arms 360 ° towards the corn fields: "... here, once they were all water meadows ..."

Today it is neither possible nor feasible to go back to cultivating meadows in all our countryside, but it is important to know them well because they have enormous potential on many fronts that are complementary with avant-garde grassland forage systems and therefore it is necessary more than ever ... learning from the past to improve the future, and working in the present ...

A German agronomist, traveling to Italy in 1828 to learn about agriculture, was astonished by the production of milk in Lombardy:

"While in the northern part of Europe, we only succeed in our purpose by using roots and stimulating drinks, and all this at great expense, the Lombards get it effortlessly and better than us with their water meadows" (Burger, 1843).

With this publication we want to explain many years of work in the Ticino Park on the conservation and enhancement of the water meadow, we have collected in a single volume its many merits and meanings, making use of the project "Landscapes of water meadows" the "Life of Ticino Biosource" project which represents a European tool for sharing the genius and wisdom of Lombard farmers.

A heartfelt thanks goes to Fabrizio Fracassi, who devoted himself to these issues before us as the Managing Director of Agriculture.

Cristina Chiappa, President of the Ticino Park
Silvia Bernini, , Councilor for Agriculture of the Ticino Park

WATER MEADOWS IN THE "LIFE TICINO BIOSOURCE"

The water meadows are specially flooded fields meadow in winter, where the circulation of water allows forage to grow even in the coldest season, ensuring an otherwise impossible harvest.

For years, many of these agroecosystems were no longer maintained with the methods of winter submersion as this requires additional costly and time consuming maintenance of the ditches and canal networks. However, this technique is proving to be very interesting from a long-term social, economic and environmental sustainability point of view, especially after becoming aware of the limits of industrial agriculture.

The "Life Ticino Biosource" project has recovered 60 ha of water meadows, which are operational during the winter period, and has experiment on 15 ha of meadow irrigation from autumn to spring.

The commitment of the farmers who have joined the LIFE project has therefore combined the agricultural production of fresh forage during the colder season with the creation of an optimal environment for resting and feeding numerous species of birds, in winter and during the migratory pass, and for various species of Lepidoptera that find their ideal habitat in this environment.

The water meadows, in addition to a unique agricultural production, offer food and shelter to species that would otherwise struggle to find food on frozen soils. While in spring and autumn the presence of wetlands exerts a strong attraction for birdlife during the pass. Moreover, these environments must also be considered rich reservoirs of biodiversity due to the presence of amphibians and insects, including numerous species of butterflies.

The monitoring has confirmed that these particular wet meadows favor an increase in biodiversity. In fact, as many as 23 species of birds of community interest have stopped and fed in the marker meadows in the period between January 2017 and August 2019.

The Life Ticino Biosource project further confirmed the role of wetlands in providing significant economic, social and cultural benefits; they help to stabilize climatic conditions and to balance biotic communities.

The methods of "conservative" agriculture, that is, based on the logic of protecting ecosystem balances and therefore protecting biological diversity, are a necessary condition to ensure greater resilience, that is, a greater ability of systems to respond to changes in environmental conditions, today altered especially from anthropogenic activities. With this horizon, the water meadows must be considered, at the same time, both a source of biodiversity and a source of fresh fodder and therefore represent a clear solution to the need for biodiversity conservation and the sustainable use of resources.

Cristina Barbieri, Life Ticino Biosource Project Manager

Fig. 6 - Landscape of water and meadows in the Ticino Valley - Photo M. Tessaro
Fig. 7 - Centocchio of the streams (Stellaria alsine) - Photo M. Tessaro
Fig. 8 - Angular garlic (Allium angulosum) - Photo M. Tessaro
Fig. 9 - Common broom (Lotus uliginosus) - Photo M. Tessaro

AN EMERALD OF BIODIVERSITY

The marcita, custodian of biodiversity in the Po Valley

In the Po Valley, the intensive agriculture of the last 50 years, that of large fields, heavy agricultural vehicles, and the high use of chemicals, has caused the reduction or disappearance of many pre-existing natural habitats.

In the water meadows, which miraculously survived this transformation, plants and animals that were thought to be extinct are still found today: the water meadow can be considered a relic of the plain biodiversity of the past, from which these very rare species can expand and return to colonize the agricultural environments of the plain through the Regional Ecological Network. In recent years, from 2012 to today, the Ticino Park has carried out various surveys on biodiversity in water meadows, particularly on flora, insects, and birds (Bove and Marchesi, 2016)

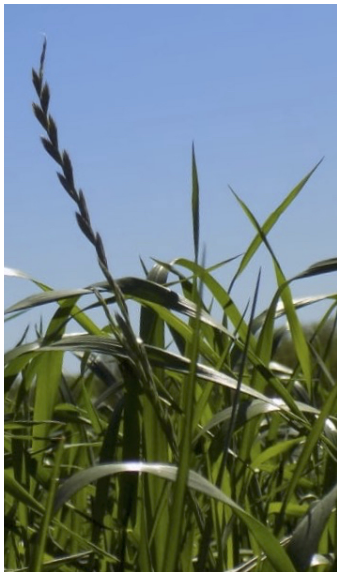


Fig. 10 - Lolium multiflorum in marcita - Photo E. Tabacco

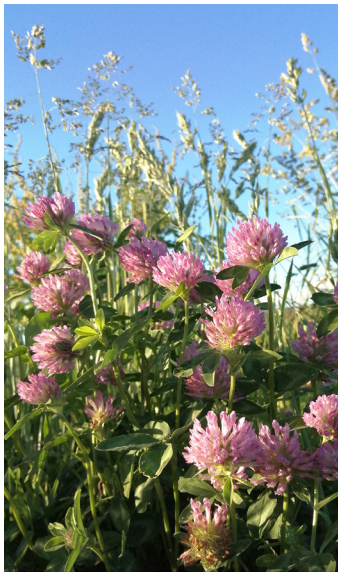


Fig. 11 - Trifolium pratense and Dactylis glomerata - Photo F. Pistoja

A special floristic and forage richness

The water meadow is, first of all, a stable meadow rich in herbs essential for feeding dairy cattle: the mazzolina grass (Dactylis glomerata), the italic ryegrass (Lolium multiflorum Lam.), the clovers (Trifolium spp.), and many other species widely diffused in the meadows, are forage plants of great zootechnical value.

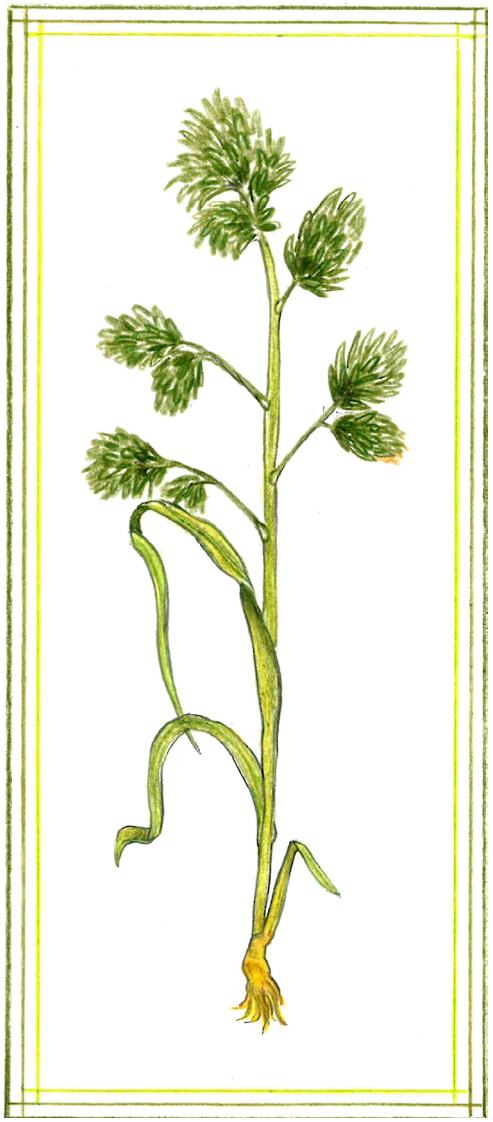
Several rather rare species of hygrophilous plants have also been found in the meadows (species of wetlands such as swamps and peat bogs), considered as authentic relics of the wetlands once present in the Po Valley. The most interesting findings were in marginal areas, such as the banks of drainage or irrigation channels, as well as depressions (even small ones) of the soil surface, which allow these species to take advantage of the water stagnation.

Among the rare species found in the environments of wet meadows and water meadows are mentioned: Allium angulosum, Stellaria alsine, Sanguisorba officinalis, Lotus uliginosus (see pages 2 and 7). Castrovinci (2016)

Fig. 12 - Trifolium repens and Trifolium pratense - Photo E. Tobacco

Fig. 13 - The three most common forage species in meadows - Pastel drawings by Stefania Cattaneo

A - Loglio italico
Lolium multiflorum var. italicum



B - Erba mazzolina
Dactylis glomerata

C - Trifoglio
Trifolium pratense (in alto) e Trifolium repens

A GREEN REFUGE IN THE WHITE WINTER

A green oasis for birds in the cold of winter

The water meadow hosts many species of birds both in summer and in winter: the ornithological censuses carried out in the water meadows from 2012 to 2016 made it possible to detect 88 species throughout the year.

When winter is particularly hostile, temperatures drop below zero and snow covers the whole countryside, animals and especially birds are put to the test because food is scarce, and their bodies need extra energy to resist frost.

In these cases, water meadows, thanks to the flow of water that prevents the land from freezing and melts the snow, offer large quantities of food for the fauna and are a fundamental resource for overcoming the harsh winter.

(Casale 2016).

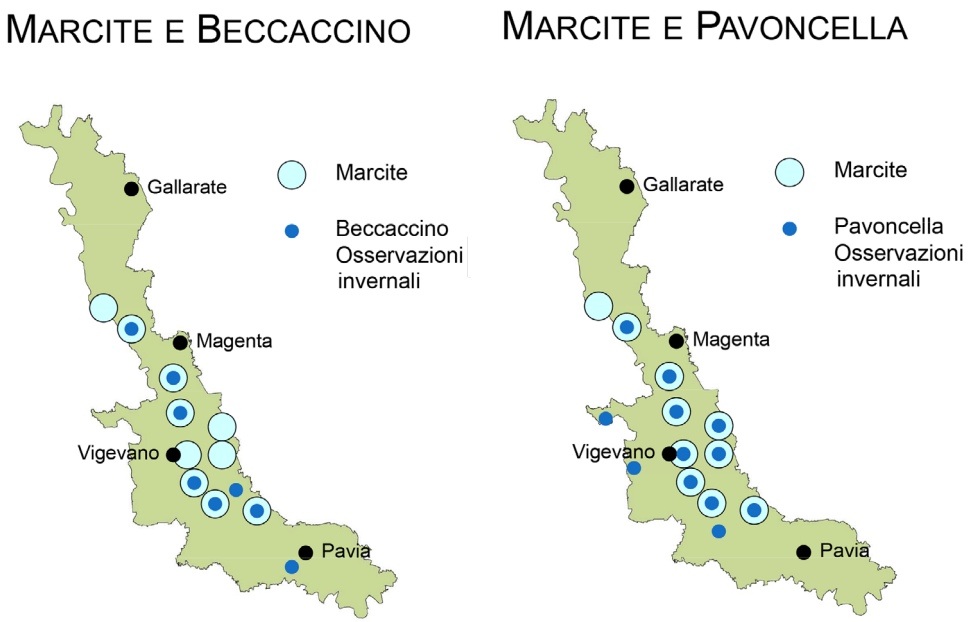


Fig.14 - Osservazioni di specie di Uccelli di interesse europeo e marcite (Casale, 2016)


15


16


17

45 species are identifiable during the snowy and intense cold weeks of winters, among which we can mention, for the remarkable numerical data, Pavoncella (maximum of 422 individuals registered), Snipe (with flocks of 20-30 individuals), Skylark (about 350 individuals), Pispola (over 700 individuals), and for their rarity: Frullino (species in decline in Europe, not commonly a winter visitor in the Po Valley), Tottavilla (species of community interest, in decline in Europe) and Fanello (declining species in Europe, breeding mainly in mountain habitats and wintering in lowland agricultural areas) (Casale 2016).

Casale (2016)

Very rare butterflies and insects in Europe

From the entomological investigations carried out in the Park in recent years, the presence of dozens of species of Coleoptera, Orthoptera, and Lepidoptera insects has emerged. The Lycaena dispar moth, carabid Dolichus halensis, and the Chrysochraon dispar orthoptera are notable among the indicator species of the water meadow environment that are of particular conservation interest.

The first, also called Licena of wetland, is a rare, localized species, an indicator of habitats (Bogliani et al., 2007) and included in annexes II and IV of the Habitat Directive 92/43 / EEC, declining throughout Europe due to the destruction of wet environments .

(Bove and Marchesi, 2016)

Fig. 15 - Lapwing (Vanellus vanellus) - Photo Ticino Park Archive
Fig. 16 - Common snipe (Gallinago gallinago) - Photo A. Turri
Fig. 17 - Skylark (Alauda arvensis) species in decline in Europe, nests in fields cultivated with alfa alfa and winter cereals and regularly attends water meadows in winter - Photo A. Turri
Fig. 18 - Licena of wetland (Licaena dispar) is a diurnal butterfly mainly linked to wet environments such as meadows, water meadows, uncultivated fields, riverbanks, and banks of canals: in the Park, the species has up to three annual generations and nurturing plants of this insect belong to the Rumex genus, such as R. hydrolapathum and R. aquaticus (Pellegrino and Sala, 2016) - Photo Archive Ticino Park
Fig. 19 - Sfrondino (Dolichus halensis) is a carabid described as extinct in the Milanese area, but relatively common on the margins of water meadows and in stable wet meadows (Bogliani et al, 2007) - Photo Archive Ticino Park
Fig. 20 - Chrysochraon dispar is an orthopteran that frequents marshes, swamps, wet meadows, and brackish environments (Nadig, 2016). It is a rare and protected species in France, Germany, Austria, and Switzerland (Detzel, 2016) very likely to be at risk of extinction in Italy (Tami et al., 2005) - Photo Archivio Parco del Ticino

AN AGRONOMIC EXCELLENCE

While in the northern part of Europe, we can only achieve our goal by using roots and stimulating drinks, and all this at great expense, the Lombards get it effortlessly and better than us with their water meadows.

(Burger 1843)

The water meadow is capable of producing large quantities of high nutritional quality forage in summer and winter. With the technical means available today, forage can be used green or stored to produce premium milk, thanks to a modern forage system in which technical efficiency, profitability, and attention to the environment cooperate in a virtuous system.

These characteristics have long been known and envied by agronomists across Europe since the 18th century!

Water meadows: a valuable element in a modern forage system

Even in the 1950s, the water meadow was considered one of the cornerstones of the Lombard forage system for feeding dairy cattle. In those years, we began to talk about more intensive forage systems based on the cultivation of corn in single succession, which proved to be unsustainable in the long term. Today the water meadow, like all grassland fodder, can represent a valuable element for a modern forage system, attentive to the typicality of the products and the environmental sustainability of the milk production chain.

Fig. 21

Fig. 22

Fig. 21
Mowing 'today' with mower-conditioner activated by the power take-off - Photo E. Tabacco
Fig. 22
Modern harvesting and silage yard - Photo E. Tabacco

Fig. 23

Fig. 24

Forage of high nutritional quality all year round

The products of these meadows are miraculous. The growth of the vegetation never ceases, except when the atmospheric air is at 6 ° Réaumur below zero (-7.5 ° C), and the lush grass is green in the middle of the waters in the dead of winter.

(Cattaneo 1837)

In the water meadows, there are forage grasses capable of providing food for the cows of the highest quality. In winter and spring, the Italic ryegrass (Lolium multiflorum Lam.) dominates, while in summer, the red and Ladin clovers (Trifolium pratense L. and T. repens L.) prevail. Grass fed to dairy cows provide a balanced feed for energy and protein and can support high milk yields.

Abundant Forage Production

The production of dry matter in a year can reach 150 quintals per hectare (about 30% more than that produced by permanent or alternating meadows in the plains). In a forage system, the productivity of the water meadow makes them competitive with the cultivation of maize, the leading crop of the intensive lowland systems.

The summer forage, as green as it is dry, is almost equal in quality to that of the stable irrigated meadow, and is much higher in quantity. Due to the winter yields, the water meadow produces a surplus that surpasses any other crop.

(Regazzoni, 1844)

Fig. 23
Mowing 'yesterday' with animal tow (Soresi 1914)
Fig. 24
Loading of forage: grass harvesting in the Lombard "water meadows" (illustrator G. Bartoletti, Farmer's Sunday, 1933)

The water meadow's grass used green

The ability of water meadow's fodder to sustain high milk production and to maintain the costs for its production is described skillfully by Domenico Berra in 1811 and taken up with admiration by the German agronomist Giovanni Burger, who traveled to Italy in 1828 to "know of agriculture ".

The grass of the marcite (water meadow) comes from our tenant mainly intended for the nourishment of the cows, which are very greedy for it, despite its wetness; and as soon as they eat it [the grass of the marcite] they begin to produce more copious amounts of milk.

(Berra, 1822)

Even today, the use of green fodder such as water meadow grass allows, in addition to a higher quality, high milk production at competitive costs compared to a conventional system based on the use of silos and concentrates.

Preservation of water meadow fodder

When there is no possibility of directly using green forage in the feeding of dairy cows, it is essential to have a simple and dynamic method of conservation capable of minimizing the loss of quality of the forage.

Fig. 25 - Mowing operations for ensiling or haymaking - Photo E. Tabacco

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Parco Lombardo della Valle del Ticino
e Fondazione Lombardia per l'Ambiente

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Fondazione Lombardia per l'Ambiente e Regione Lombardia, Milano.

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Chrysochraon dispar (Germar, 1835), Chorthippus montanus
(Charpentier, 1825) e Glyptobothrus pullus (Philippi, 830) in Italia
(Orthoptera Acrididae). Atti Acc. Rov. Agiati 255, 8 serie, no. 5, B: 325-342.

Fig. 26 - Conservation in Samarani silos. Information leaflet on fertilization of meadows and pastures. Agricultural office of the Montecatini company, Milan, (1937).

The water meadow is a continuous production forage cultivation; now it happens that the precocity of certain cuts makes it difficult to sharpen them without bad weather spoiling the work. And so, they have very high haymaking costs, they are deterioration of the product and of the turf . [...] In these circumstances, the formation of silos has such a useful character that it should not escape anyone.

(Soresi, 1914)

So wrote Soresi confirming the validity of ensiling as a method of preserving water meadow fodder. Silage is a natural preservation method that is based on the acidification of fodder by lactic bacteria while stored in the complete absence of oxygen, of which Italy has been a master in the world since the eighteenth century. The water meadow grass has been ensiled for over fifty years in the Samarani tower silos, present in all Lombard farms. Even today, the conservation of grass forage has in ensiling the best technique for preserving nutritional quality thanks to the use of simple and flexible methods that allow for the storage of fodder, with a quality similar to green grass. An example of this is the wrapped round bales that have become a characteristic element of our rural landscape over the last twenty years.

Figs. 27 and 28 - Modern conservation technique for ensiling in round bales wrapped with recyclable plastic film - Photo E. Tabacco (left), M. Tessaro (right)

FROM WATER MEADOW A MILK WITH ONE MORE GEAR

Such an abundant, always green and fatty forage provides the cows during the course of winter, from October to April, with a pasture superior to any other in revenue, both for the quantity of milk and the goodness of the butter, as well as for the better cheese quality.

(Cattaneo L. , 1937)

The water meadow is a source of high quality forage able to give dairy products a high nutritional profile, rich and unique sensory bouquet, soft texture and an unmistakable and typical yellow color, an index of the genuineness of the product, respecting the well-being of the cows that feed on its forage.

From the water meadow a healthy and good milk

Historically, it is known that cows feed with fodder from water meadows produce milk with superior properties, and therefore their dairy products are of higher quality.

The distribution of fresh or preserved grass can improve the nutritional, technological and sensory quality of milk (Borreani et al., 2013).

Green grass provides better milk for human nutrition and is capable of giving dairy products unique flavors (Coppa et al., 2015).

The water meadow's grass can vary the composition of the milk fat of the cows. If supplied green, milk with 3% less saturated fat can be obtained.

The Ω-3 fatty acid content of the milk increases by 4 times with the green water meadow grass (by 3 times if stored in wrapped round bales), shifting the Ω-3 / Ω-6 ratio from values close to 1: 5, to values close to 1: 3 and less than 1: 2 respectively with the grass stored in wrapped or fresh round bales (ratio recommended by doctors = 1: 1).

Phases of forage harvesting for green feeding in milk production
Mowers, collector wagon, Italian Red Pied cows at the crib

Fig. 29 - Conditioner mower - Photo E. Tabacco

Fig. 30 - Loading wagon - Photo E. Tabacco

Fig. 31 - Fresh grass is the most appetizing! - Photo E. Tabacco

Fig. 32 - The Friesian, a breed selected for milk production, while feeding on green alfalfa - Photo M. Tessaro

Fig 33 - Indicators of milk quality:
fatty acid content and color of milk derived from conventional feeding systems (silo mais and concentrates)
compared with milk obtained using water meadow, green fodder or stored in wrapped round bales:
the acid content conjugated linoleic (CLA), which has anti-carcinogenic properties, increases with water meadow grass by 25 and 100% respectively if stored or green.
(Borreani and Tabacco, DISAFA, unpublished data).

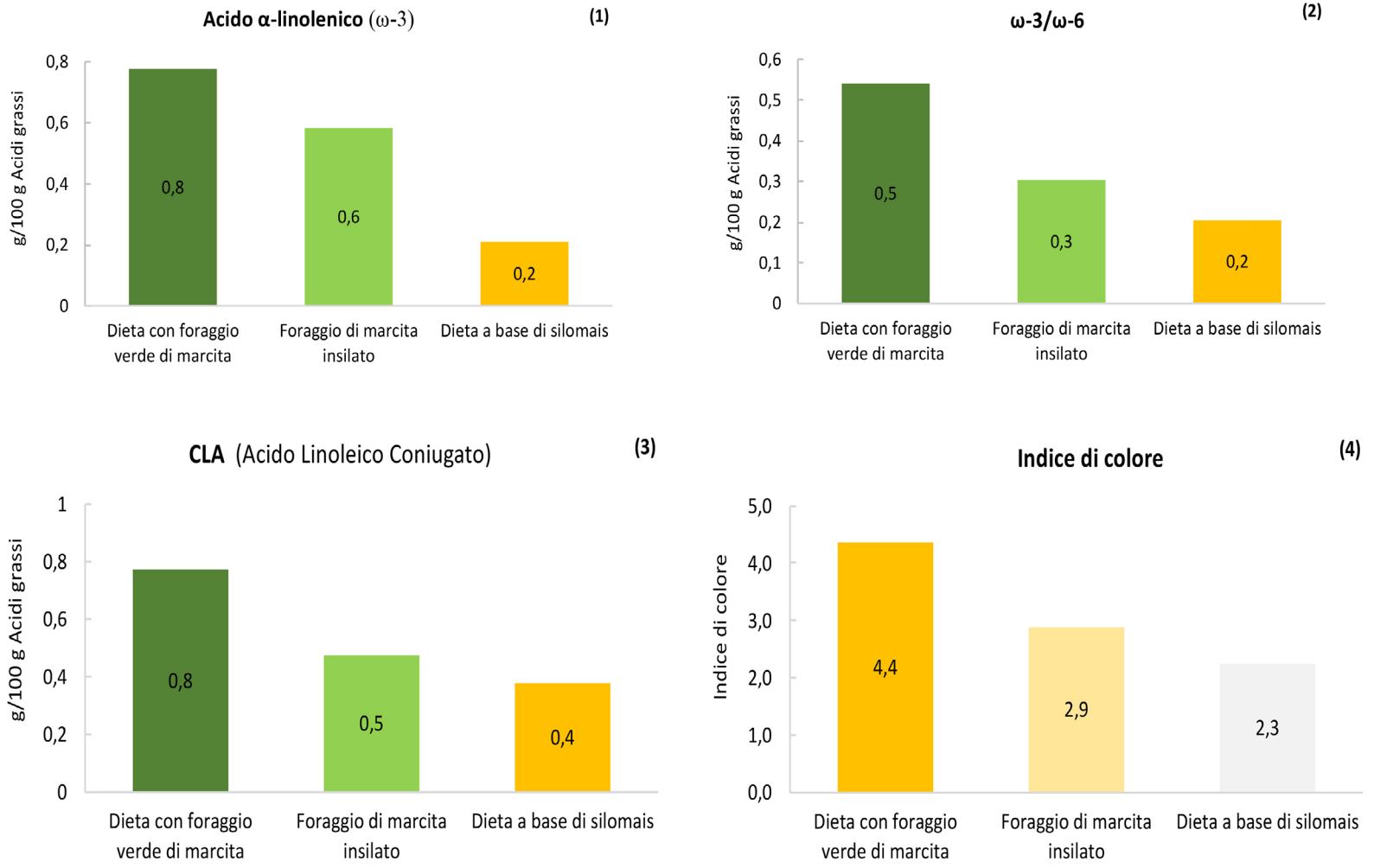

Fig. 34 - The preparation of the curd - Photo M. Tessaro

Fig. 35 - Cheeses before maturing - Photo E. Tabacco

Fig. 36 - Milking parlor, Varzese breed cows - Photo P. Bianchi

The milk, which is obtained from the milking of the cows, which are fed and nourished with the grasses of the meadows, or water meadows of Lower Lombardy, is the sweetest, sweetest, fattest, dense substance that one can desire as food, and it is the one from which the best cream separates and therefore the most excellent butirro.

(Cattaneo A. , 1839)

Water meadow's grass and dairy products

The unique composition of water meadow milk fat also influences its sensory properties. The fat content is about 40% richer in polyunsaturated fatty acids, which gives the dairy products a different consistency: the butter is more spreadable and the cheese softer. Polyunsaturated fatty acids also change the sensory profile, which is richer in aromas, and with more intense and savory notes. (Giaccone et al. 2016)

Water meadow grass and milk color

Water meadow grass also gives milk and dairy products a yellow chromatic note, more intense with fresh grass, thanks to its richness in carotenoids (beta-carotene). In addition to being a distinguishable trait of the wet meadow grass-fed dairy products, therefore a genuine product, carotenoids also have a recognized role in human health as natural antioxidants. (see Graphs of Fig. 33)

Water meadow's grass and animal welfare

Dairy cows are ruminants and need an important component of fiber in their diet, historically supplied through grass fodder. The use of corn, as fodder or feed, has reduced the proportion of fiber in their ration, increasing the onset of ruminal metabolic problems, which can compromise the fertility and longevity of the cows. For this reason, water meadow grass is an optimal forage for their diet and well-being.

Borreani G., et al. (2013) Effect of different feeding strategies in intensive dairy farming systems on milk fatty acid profiles, and implications on feeding costs in Italy. Journal of Dairy Science, 96, 6840-6855.

Coppa M., et al. (2015) Effect of phenological stage and proportion of fresh herbage in cow diets on milk fatty acid composition. Animal Feed Science and Technology, 208, 66-78.

HISTORY OF AN ANCIENT COUNTRY INVENTION

A natural use of abundant water

The genius of the water meadow is in having combined two aspects: on the one hand, the use of warm spring water in winter to water the meadows and prevent freezing, and on the other hand the convergence of different sources of water together, to increase their flow and allow the irrigation of more distant meadows.

This practice was already used by medieval farmers and became a popular technique thanks to the agronomic manuals of the eighteenth and nineteenth centuries, a major period of expansion of the water meadow.

The Cistercian monks: invention or diffusion?

It is commonly believed that the water meadow was "invented" by the Cistercians: in reality, they certainly contributed to its spread, but the practice of running water all year round on the lawn was already used by farmers well before the arrival of the monks in Lombardy from France. *(Comincini 2012).*

In 1789 the Cistercian abbot Angelo Fumagalli pointed out in a publication the expression "water meadow", which he found in some medieval parchments of the Order.

Domenico Berra in his treatise of meadows of the lower Milanese called LA Marcita of 1822 argues that *"among the others who particularly distinguished themselves in promoting irrigation and improving the method were the Monks of Chiaravalle or the Cistercians, and those of Vicoboldone, or the Humiliated, who reduced a great extension of a marshy and uncultivated country into very fertile meadows, which are undoubtedly still the best of our contours". (Berra, 1822)*

Even Giuseppe Soresi a century later, in the manual La Marcita Lombarda of 1914, confirms the role of the Monks, especially the Humiliated, in reclaiming the plain and using it for the water meadow. In fact, already in documents of the early twelfth century, ie prior to the arrival of the Cistercians in the Milanese area (fourth decade of the twelfth century), the expression "prato marcido" appears, while the expression "in marcitis", to indicate a place near Ozzero, it is used in parchments of 1188 and 1189. (Comincini, 2012). *"in marcitis"*, per indicare una località presso Ozzero, viene usata in pergamene del 1188 e 1189. *Comincini (2012).*

Fig. 37 - The "manuals" of Marcita over time

Berra D., (1822)
Dei prati del basso milanese detti a marcita,
Ristampa anastatica
A cura di CM Tartari, 1999
Ed. Il Faggio, Milano

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Sant'Angelo Lodigiano

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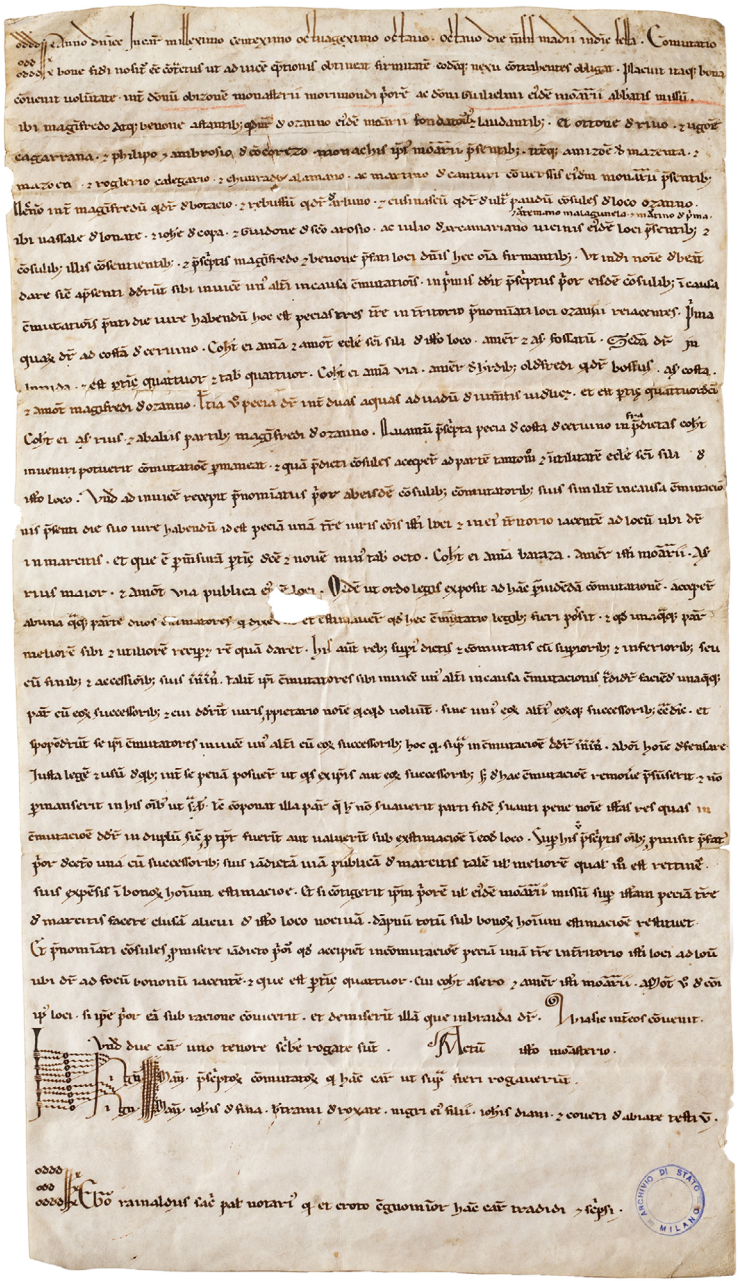
La marcita lombarda,
Ristampa anastatica Società Agraria di Lombardia 2000

Libro de li Prati del Monastero di Chiaravalle (1578)
Ristampa anastatica del Parco Agricolo Sud Milano a cura di Chiappa Mauri L. e Fantoni G., 2001



Id est peciam unam terre iuris communis suprascripti loci et eius territorio iacentem ad locum ubi dicitur in Marcitis et que est per mensuram pertice decem et novem minus tabule octo, coheret ei a mane baraza, a meridie suprascripti monasterii, a sero rius Maior et a monte via publica eiusdem loci.

A plot of land of the Municipality of the aforementioned Ozzero and its territory lying in the locality called at Marcite, of 19 poles minus 8 tables, to which the baraggia borders to the east, to the south the aforementioned monastery, to the west the Rile Maggiore and to the north the public road of the said place.

Super his vero prescriptis omnibus promisit prefatus prior de cetero una cum successoribus suis iamdictam viam publicam de Marcitis talem vel meliorem qualiter modo est rettinere suis expensis in bonorum hominum estimacione; et si contigerit ipsum priorem vel eiusdem monasterii missum super suprascriptam peciam terre de Marcitis facere clusam alicui de suprascripto loco nocivam, dampnum totum sub bonorum hominum estimacione restituet.

In addition to what has been said, the aforementioned prior with his successors also promises, at his expense according to the esteem of upright men, to preserve in the state in which he finds himself, or to improve, the public road called the Marcite; and if it happens that said prior or a person in charge of the monastery, over the said plot of land at the Marcite, makes a dam that would be harmful to someone in the said place, he will have to compensate all the damage estimated by upright men.

Transcriptions and translations by Mario Comincini

Fig. 38 - Parchment of 1188, concerning an exchange of land between the Municipality of Ozzero and the monastery of Morimondo, where the term 'marcita' appears for the first time in the form "in marcitis", indicating a place affected by that agricultural practice. May 8, 1188, Morimondo.
Obizzone de Matreniano, prior of the monastery of Morimondo, receives in exchange from the municipality of Ozzero a plot of land located in the territory of the same Municipality and called alle Marcite, promising to carry out the maintenance of the Via alle Marcite at his own expense and to compensate any damages derived from the lock built on the said plot of land at Marcite.
State Archives of Milan, Religion Fund, Parchments, 1188

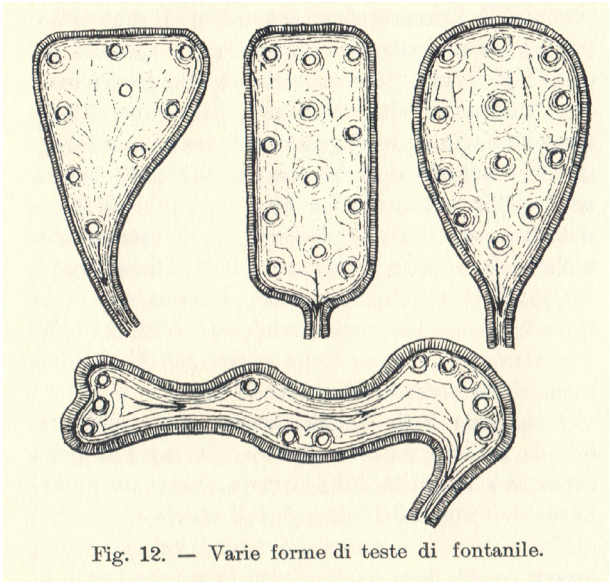
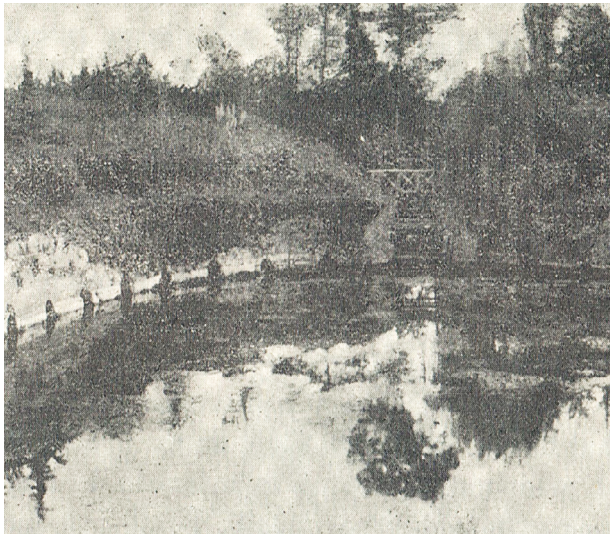


Fig. 39 - Different shapes of the head of a fountain (Soresi, 1914)

Fig. 40 - Head of a masonry fountain (Soresi, 1914)



An ambiguous origin of the name

The meaning of the term "marcite" (derived from 'marcio' which means to rot) seems to derive from the practice of leaving the last cut of grass clippings in the water meadow, or from the marshy appearance that some fields had assumed before being mowed or harvested.

The name of water meadow must have been given in ancient times to such meadows, if I do not think badly, either because in them, from the beginning, the grass grown after the last mowing for fattening was made to decompose, which is practiced from not a few even today; or because the meadows are not yet worked and reduced as they were by those who later succeeded, stagnating the water in them, they will have had to swamp in some part, and consequently their roots will rot.
(Berra, 1822)

A resource for the city

The water meadow produced much more forage than an irrigated meadow and for this reason it was very useful around the cities as it was used to feed the horses, which were very numerous and which required quality nutrition.

The expense of hay "must have been very sensitive to all those who had their farms near the city, where the large quantity of luxury horses, as well as work regarding their feeding, the value of the hay is much higher than that of all those countries where the consumption of this product cannot be so high "

(Berra, 1822).

Even today, it is possible to obtain valuable forage to produce milk and cheese or for feeding horses. In recent studies, previously illustrated, show how "yellow" milk and cheese, obtained from meadow grass and water meadows, possess healthy properties useful for humans.

This agricultural arrangement, from the first wetland reclamation interventions, allowed to convey the spring waters and the "sortume" (outcrop of the aquifer) to dry and cultivate areas that were previously marshy irrigated, and also use the same waters to improve agricultural production and to recover "colo" or waste water that was purified and reused through the filtering action of the soil and the rhizosphere biome, or phyto-purification action.

Fig. 41 - The "pool" of a fountain, or the bubbling of the head of a fountain - Photo Marco Tessaro

THE SIGNS THAT REMAIN IN THE LANDSCAPE

The landscape is a palimpsest of material traces, it is an open book in which we can read the history of the generations that preceded us. Based on market demands, the capacity of the workforce, the availability of economic resources, farmers have transformed the landscape, reclaiming the land, modifying crops, creating new canals, planting new woods.

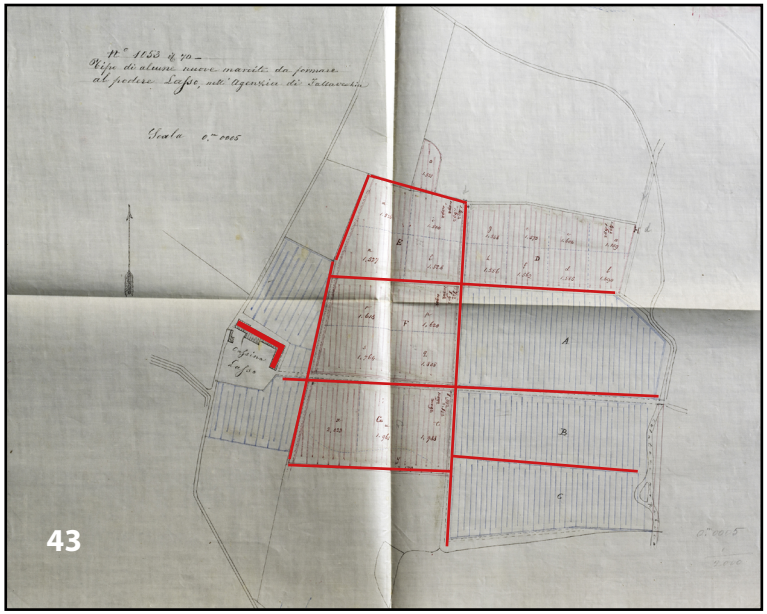
Each transformation has left a mark on the landscape as the result of a huge input of labor: today we can still read its traces, in the limits of the fields, in the streets, in the hydraulic artifacts, to be interpreted with the help of historical documents. An example of this are the transformations that took place in Cascina Lasso, described in the images on the side: rice fields in 1776, then water meadow in 1872, and rice fields again today. Despite the change in culture, the subdivision and dimensions of the "squares" (meadow divisions) impressed by the water meadow in 1872 are still legible today, from aerial photos, while the main water channels with their relative artifacts are still present in reality.

The design of the marcita

The water meadow lawn must not be so flat as to make a pond, nor too inclined so that the water precipitates and flows down too quickly, but that the whole surface is wet in the same way, and the water moves constantly.

(Berra,1822)

To wisely exploit the slopes of the land and allow a continuous flow of surface waters from the canal along with the underground waters of the resurgence (spring water), farmers and agronomists have perfected over time four water meadow systems. It is based on the sequence and connection between the planes of soil (at varied levels), which the water meadow is divided. These articulated and complex drawings of ingenuity are still clearly legible today in some of the water meadows present in the Ticino Park.

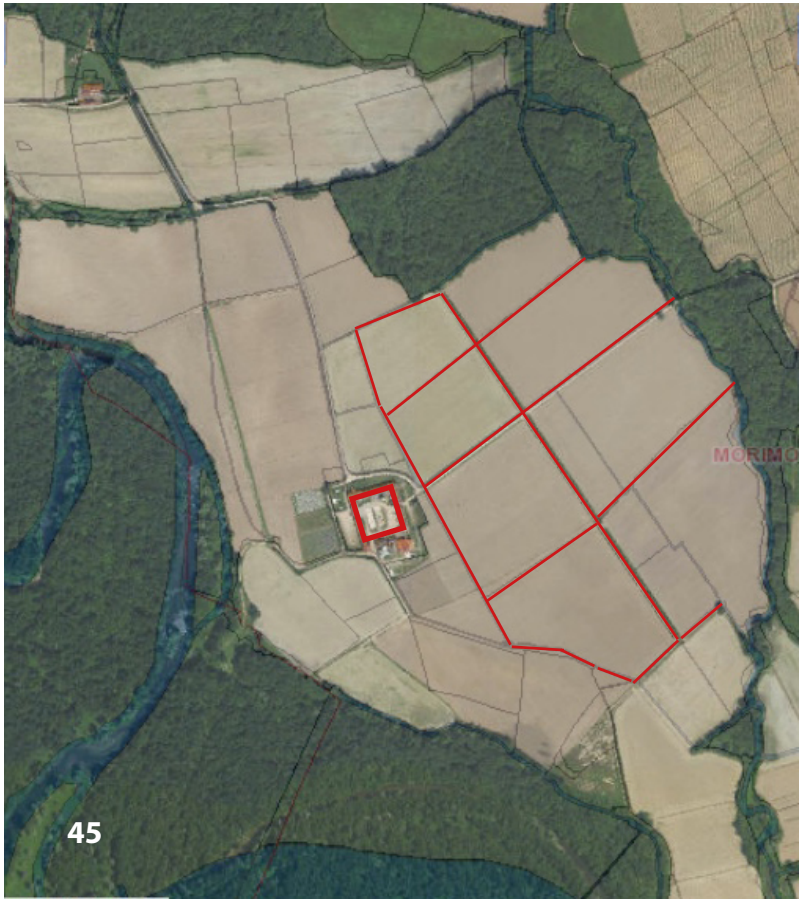


Podere Lasso, province of Fallavecchia (now the municipality of Morimondo), owned by the Ospedale Maggiore of Milan.

Fig. 42 - Map of 1776: the fields east of the farmhouse are filled with rice and woods.
Fig. 43 - Meadows formation project. Executed by Mr. Gaspare Oldrati during the rental period, 1872.
Fig. 44 - Map of 1880: meadows with marcita.
(Maps of the Ospedale Maggiore Archive, Administrative Section, Active Heritage, Houses and Farms, Lasso, Tenants).

Fig. 45 - Image of 2018 (today) rice fields on former meadows. Taken from the Geoportal of the Lombardy Region: orthophoto on a cadastral grid.

(the permanence of the limits of the fields is highlighted in red)



Note to Figs. 46, 47, 48, 49

Reproductions taken from Soresi's text "La marcita Lombarda" (1914) compared with images taken from above using a drone - Photo M.Tessaro (2018-2019)

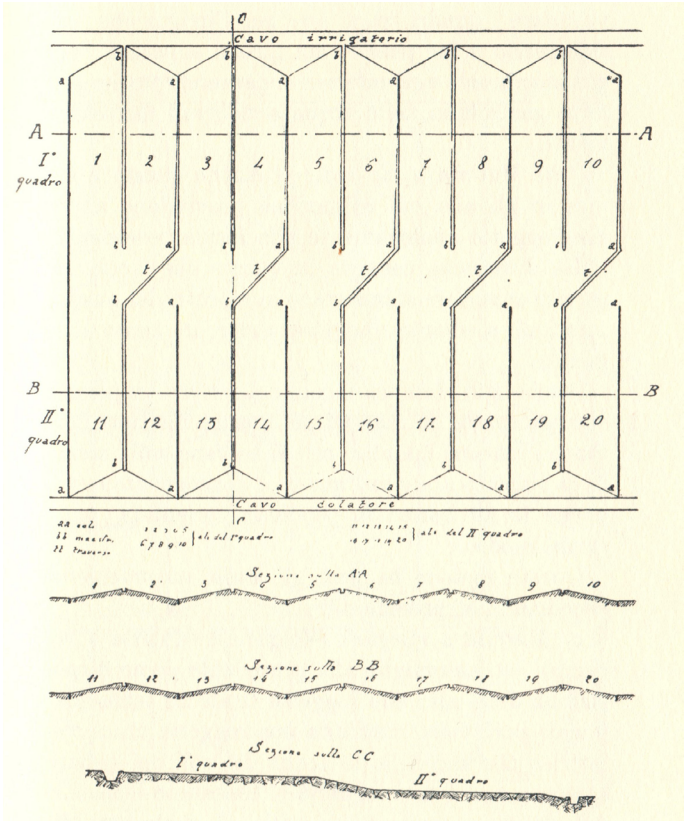


Fig. 46 - Zigzag water meadow

The transition from the upper frame (plane) to the lower one occurs diagonally and the wings maintain the same slope, and so on, the water is guided to descend from one frame (plane) to the other.v

(Marcita of Mulino del Maglio, Ozzero)

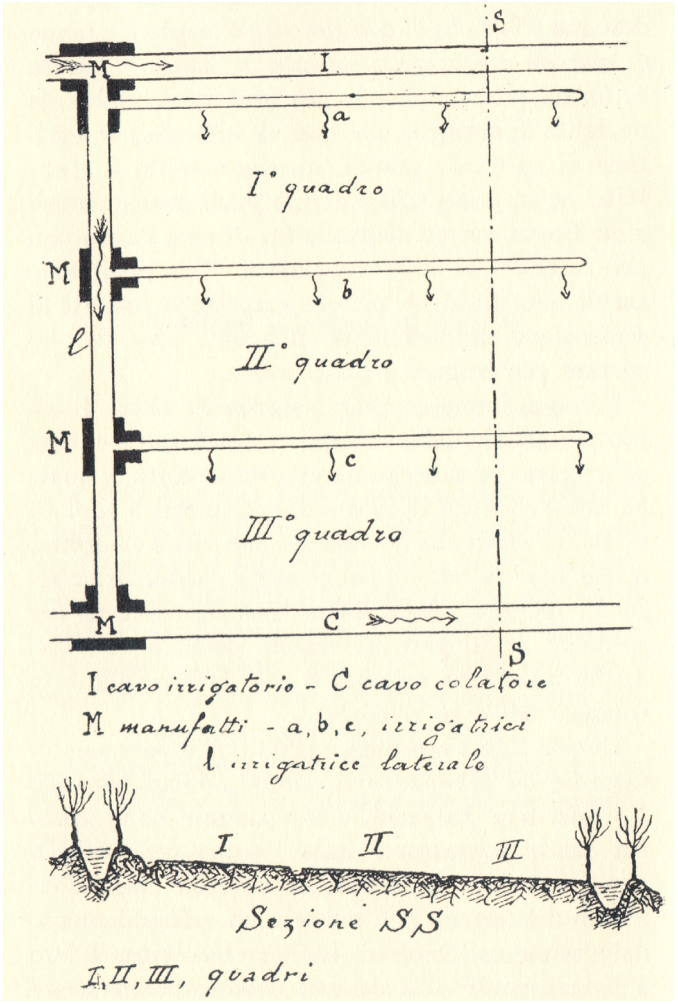


Fig. 47 - Stray water meadow

The water introduced into the head of the canal overflows and irrigates the underlying framework, then collects in the drain that distributes the water into the next square and so on. This has the disadvantage that the paintings are all directly linked and the water cools down a lot in the passage between the paintings. It is used on steep slopes such as river terraces.

(Marcita on pending in the Sforzesca hamlet, Vigevano (PV)

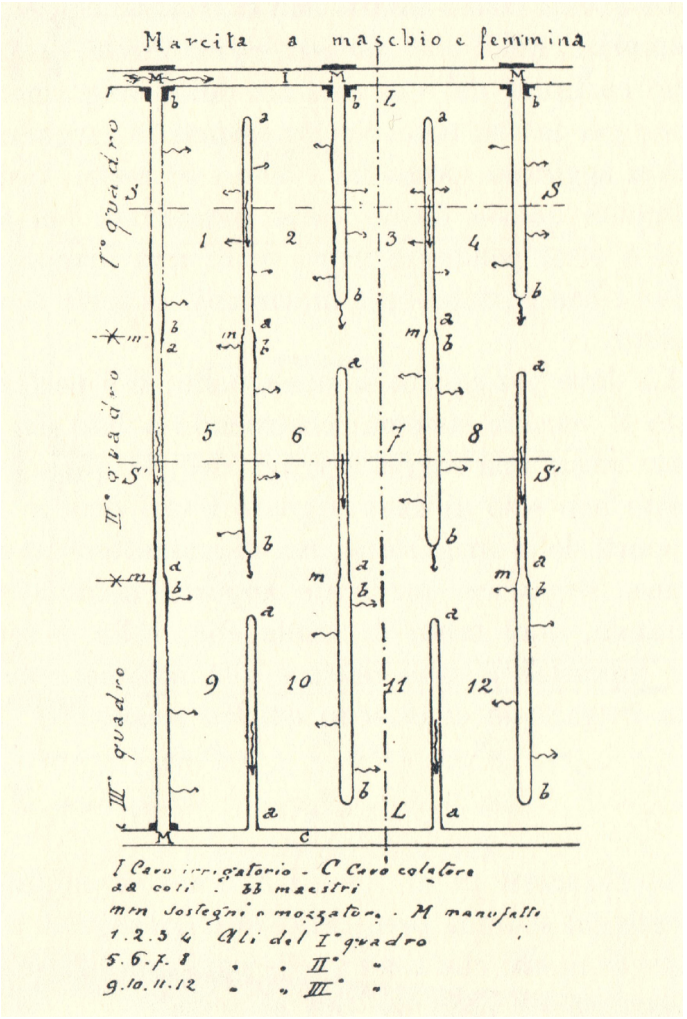


Fig. 48 - Male-female water meadow

The colo channel, at the end of a square (water meadow division), widens and becomes a master in the next square, then it returns to be a colo in the square below; in passing from one square to another, the wings reverse the slope, and so on and on the water is guided to descend from one square to another.

Cascina Gambarina, Abbiategrasso (MI)

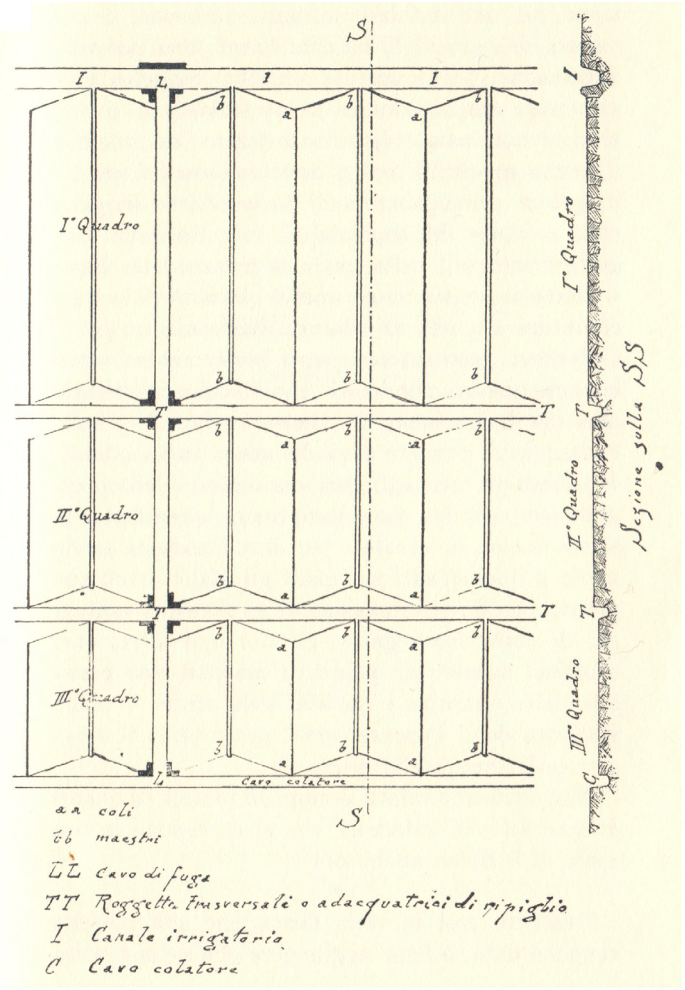


Fig. 49 - Recovery water meadow

The waters of the upper square are collected in a transversal canal, called the escape, which becomes an adacquatore for the next square. The advantage of this solution is that the drain allows you to refill the underlying panels with additional water, and, if necessary, leaves the independent square to be placed in dry conditions for mowing

Marcita dell'Abbondanza - Vigevano, Sforzesca hamlet

A LANDSCAPE HERITAGE

A wealth of artifacts and techniques

The water meadow today retains material and immaterial traces to be read, interpreted and passed on to future generations. It constitutes a material patrimony for the artifacts of which it is constituted and an intangible patrimony of knowledge on the slow and precise management of water, on the maintenance and cleaning techniques of the canals, which have been handed down over time by generations of farmers.

The safeguarding and maintenance of the water meadows in operation are indispensable to guarantee the understanding and readability of the water meadow as a cultural asset by future generations.

For this reason, the landscape of the water meadow has been included in the National Catalog of Historic Rural Landscapes, promoted in 2010 by the MIPAAF (Ministry of Agricultural, Food and Forestry Policies). This catalog constitutes the preliminary census for the establishment of the Register of historical traditional landscapes recognized by the instituting decree of the "National Observatory of Rural Landscape, Agricultural Practices and Traditional Knowledge" by the MIPAAF.

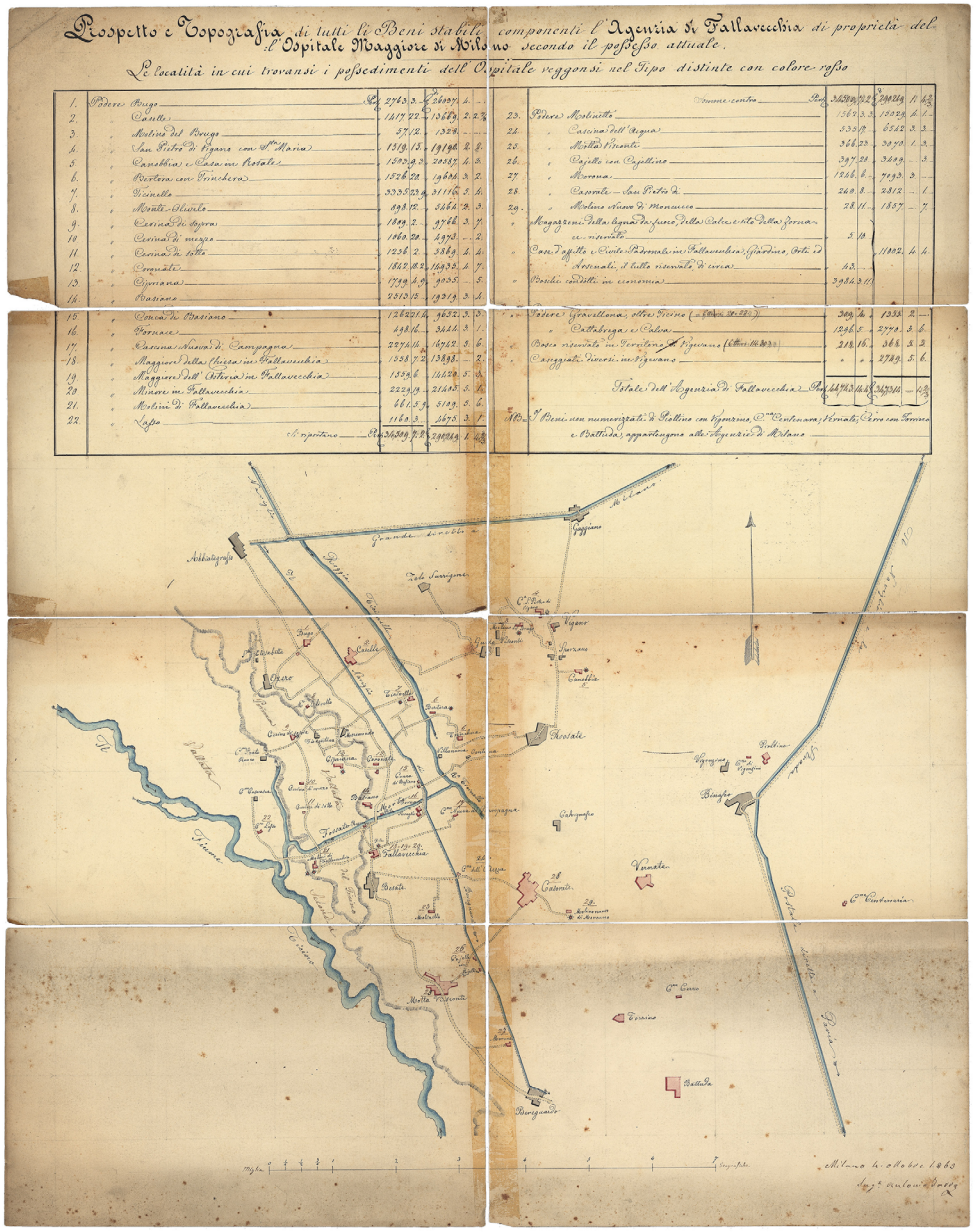


Fig. 50 - Map of the possession of Fallavecchia

Archive of the Maggiore Hospital:
The estates of the Fallavecchia Agency near Morimondo,
in a map dated 1863

A landscape system in motion

The water meadow is part of an articulated and complex system of the agricultural landscape made up of elements and relationships. Agricultural buildings, roads, irrigation canals, rows and hedges, cereal fields and meadows are some of the elements. Working the fields, irrigating, harvesting; living in farmhouses; partying in the yard are some of the relationships that keep the elements of the landscape alive.

A landscape system changes over time and responds to the needs of the society from which it is produced. Every change that occurs in the fields affects the buildings, as these depend inextricably on the production of the fields (Scazzosi and Branduini 2010, 2014). And so, if the meadows increased, the production of forage increased, the livestock increased, and the stables were enlarged. The landscape is a work open to the transformations that man impresses day after day.

If you keep the visual and functional link between fields and buildings alive, you can understand this complex landscape system.

Scazzosi L., Branduini P., (2010)
Historic Rural Landscapes, for a national catalog. MIPAAF, Laterza

Scazzosi L., Branduini P. (2014)
Landscape and rural buildings. Tips for landscape design and evaluation.
MIBACT, Maggioli ed. Sant'Arcangelo di Romagna

Fig. 51 - Map of the Ticinello possession

Archive of the Ospedale Maggiore: Functioning heritage of houses and farms Fallavecchia, "Map of the old census, 1775 - 1776".

Relations of use between buildings and cultivated fields

Two landscape systems are reconstructed below in order to illustrate the historical evolution of the relationship between fields and farm buildings, or the "field-farmhouse" relationship. The documentary sources for the reconstruction are the Teresiano (1722) and Lombardo-Veneto (1866) land registers.

The relationship between fields and buildings in 1722

The cereals, harvested, collected and dried on the farmyard, were stored in the granaries. The grinding took place in the mill and the husking in the rice pile. Fresh grass from the meadows or dried and stored in barns fed the dairy cows in the stable. The timber was used for the maintenance of the buildings of the farmhouse and the Maggiore Hospital.

The food products from the farms were transported along the Naviglio di Bereguardo, the Naviglio Grande and then the inner circle of canals to reach the Cà Granda and fed the hospital canteen.

The relationship between fields and buildings in 1866

Marker meadows are introduced, production of holes for dairy and working cattle increases.

The stables are enlarged. The products continue to be used on the farm and then transported to the Maggiore Hospital.

The relationship between fields and buildings today

Cascina Ticinello (Fig. 53)

The rice is processed and stored on the farm and then sold to industrial rice mills. The corn is fermented and stored in horizontal silos. The grass is stored dry in wrapped bales or packed fresh in plastic bales. The milk is transported daily to the Latte Milano dairy.

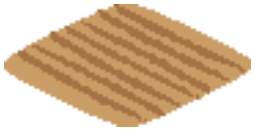
The relationship of use between the fields and the buildings remains: the buildings are almost totally used, the fields are cultivated with different crops in rotation, biodiversity is partly preserved.

Cascina Nuova di Campagna (Fig. 54)

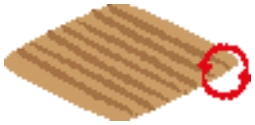
Single-succession rice and soy (cultivated in implementation of the Community Agricultural Policy as a "greening" crop) are transported to Cascina Bugo, where they are processed, stored, then sold to industrial rice mills and partly directly to the public. The relationship of use between the fields and the farmhouse is lost: the buildings are unused, the fields are cultivated with few single-succession crops, biodiversity is low.

Fig. 52 - the landscape of the meadows overlooking Monte Rosa in the Ticino Valley - Photo E. Tabacco

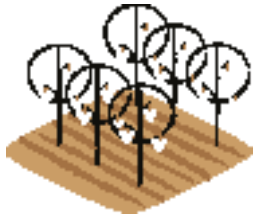
Legend Figs. 53 - 54



Aratorio asciutto: arable land to produce cereals, not irrigated

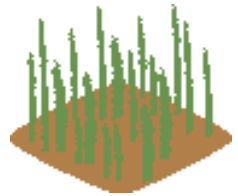


Aratorio adacquatorio a vicenda: rotation irrigated land to produce cereals, irrigated with canal water or spring for surface flowing in spring and summer.

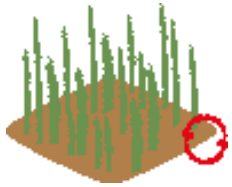


Aratorio adacquatorio avitato: irrigated land with vineyard to produce cereals and table wine, irrigated with canal water or spring for spring-summer surface flow.

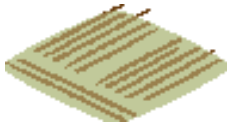
Rotation paddy, cultivated in annual rotation with other cereals



Not irrigated meadow



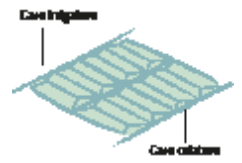
Prato adacquatorio a vicenda: rotation irrigated meadow to produce fodder alternating with cereals, irrigated with canal water or spring for surface flow in spring and summer.



Non-irrigated garden to produce vegetables for family consumption.

Dry grown rice, alternating with submersion.

Corn, lawn and alfa alfa for bovine feed.



Cable drip Lawn marking. Adacquatore, colatore, water meadow

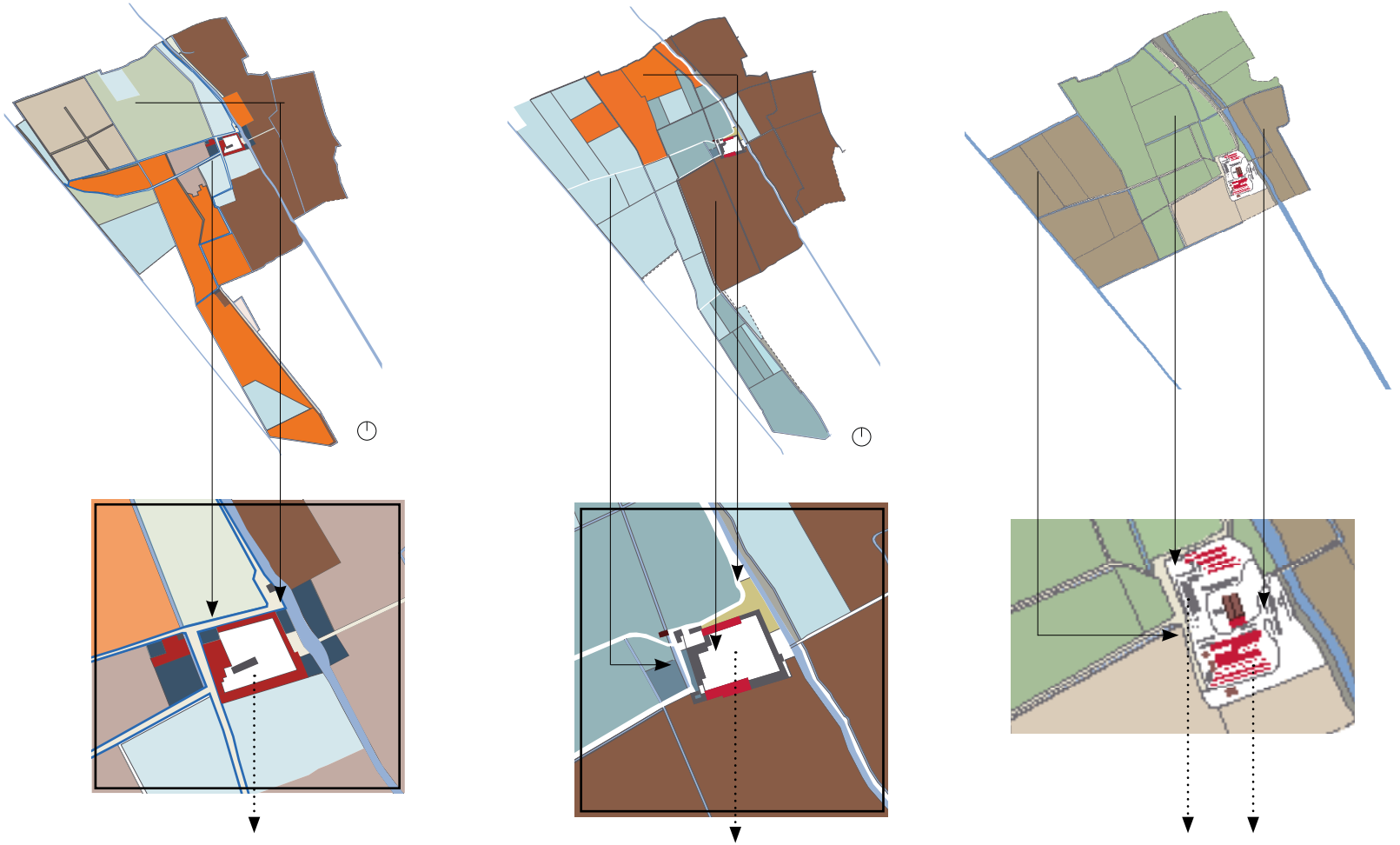
Fig. 53 - Cascina Ticinello *(Municipality of Morimondo)*

Graphic elaborations by Federico Meroni

A - Redesign and interpretation on the basis of Teresian land registry, 1722

B - Redesign and interpretation on the basis of Lombardy-Veneto land registry, 1866

C - CURRENT SITUATION (2017)



Transport of products to Cascina Fornace and / or to Fallavecchia, then to the Maggiore Hospital

Transport of products to Cascina Fornace and / or to Fallavecchia, then to the Maggiore Hospital

Sale of rice in industrial rice mills

Sale of milk to latte Milano

House with mill and rice pile

"Case da massaro" with stables

Stack

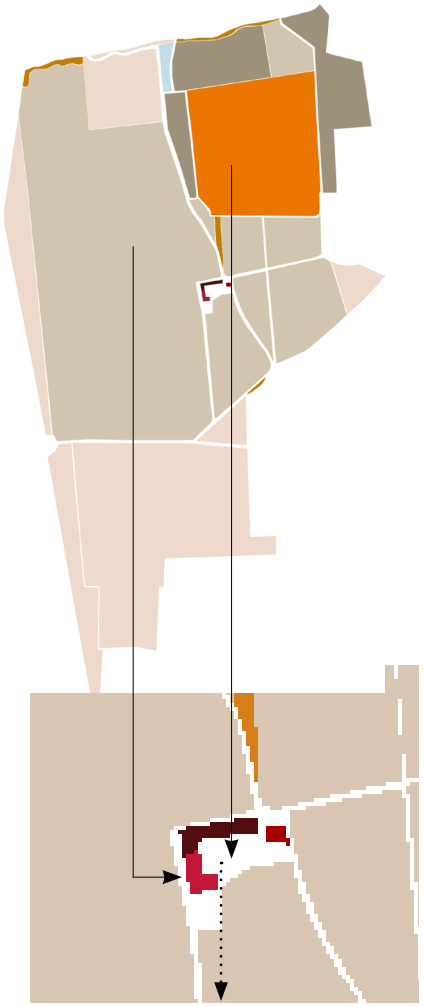
Stable

Silos for fodder

Stables

Fig. 54 - Cascina Nuova di Campagna *(Municipality of Morimondo)*

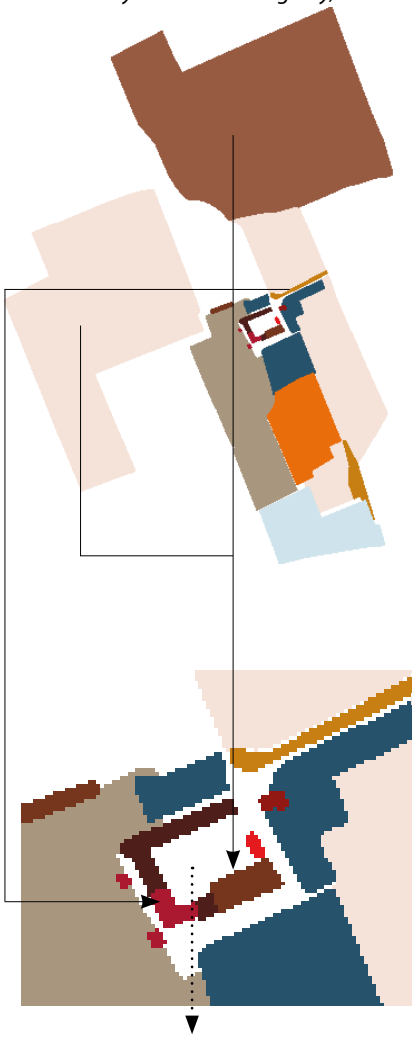
A - Redesign and interpretation on the basis of Teresian cadastre, 1722



Transport of products to Cascina Fornace and / or in Fallavecchia, then at the Maggiore Hospital

- *Owner's house*
- *Oratory of S. Anna*
- *Stables*

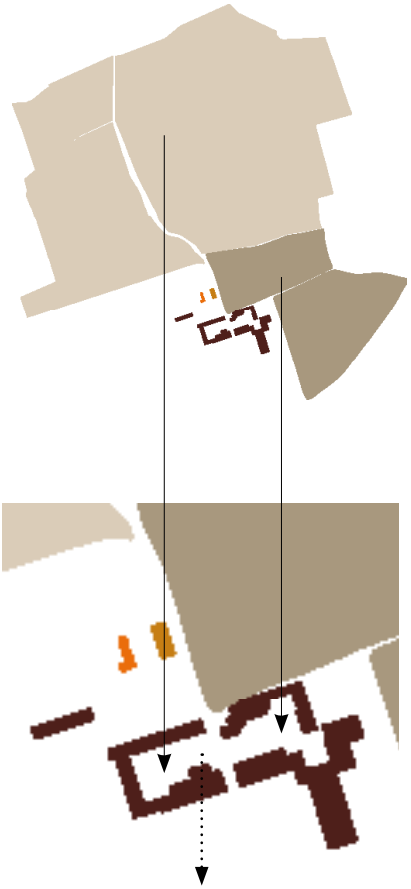
B - Redesign and interpretation on the basis of Lombardy-Veneto land registry, 1866



Transport of products to Cascina Fornace and / or in Fallavecchia, then at the Maggiore Hospital

- *Stables*
- *Crop storage buildings*

C - CURRENT SITUATION (2017)



The rice is transported to Cascina Bugo and subsequently sold to the public and industrial rice mills

- *Original core of the farmhouse where the owner lived (now disused)*
- *Buildings for agricultural purposes, not pertaining to the tenant of the farmhouse*
- *Residential building in use*

THE SHOVEL MANUAL SKILL

The drowner, manager of a hydraulic work of art

The operations carried out by the drowner comply with precise rules, as valid in the past as in today. The manual care to be devoted to the maintenance of the ditches is the same as in the past.

In cleaning ditches, do not dig too deeply into the earth because it causes [...] unnecessary loss of a quantity of water in summer irrigation [...] and [...] loss of the bottom soil itself [...]
introduce water into the main carrier so that the banks of the ditches can be easily leveled so that the water overflows equally in all its parts, a job that we call stemming [...]
with trampling lowers all those small heights made by moles or from the wheels of the wagons, and with the shovel trod in the lawn in the manner of a spade they give leverage to the bark, matching all those cavities made by the treads of the animals, and trying to reduce the whole face of the lawn again equal [...]
diligently plugging all the little holes made by the passage of mice is an essential thing to practice [...]
give the lawn enough water to flow continuously throughout the winter [...]
ensure from time to time that the embankment of the main ditches is always the same height [...]
remove from the ditches all the leaves, shoots and all those materials transported by the water that you will find gathered and still at the mouth of the ditches or near the outlets [...]

G. Soresi, The Lombard water meadow (1914)

The same operations were "brought to light, shown and explained" by the Drowners masters to the Drowners students during the Drowners Course carried out during the Life Ticino Biosource project (Action E2.5). The cover photos of this publication are dedicated to them.

Fig. 55 - Lowering of water meadow from sediments (Soresi, 1914)

Fig. 56 - Refurbishment before winter submersion (Soresi, 1914)

Fig. 57 - Cleaning the water ditches (Soresi, 1914)

Fig. 58 - Drainage of the ditches before the winter submersion - Photo M. Tessaro (2016)

Fig. 59 - Remaking of the wings (Soresi, 1914)

Fig. 60 - Arrangement of the "edges of the ditches" for irrigation - Photo G. Molina (2020)

A MODEL RECOVERY

The restoration of a water meadow

The Ticino Park has been dealing with the protection of existing meadows for thirty years through a Maintenance Regulation. In collaboration with farms, it takes care of its optimal management and encourages its increase through examples of recovery.

This is the case of the restoration of a water meadow after decades of neglect, at the Mulino del Maglio in the municipality of Ozzero, started thanks to the project "Landscapes of water" co-financed by the Lombardy Region. The techniques of restoration of the artifacts and recovery of hydraulic paths were shown to encourage farmers to put a historic agricultural system back into operation, with high production potential and an increase in biodiversity.

At the end of the first phase of restoration, the refinement of the recovery and the functional reactivation of the water meadow was guaranteed by the Life Ticino Biosource project with the arrangement of ditches and grassy structures, three years of winter submersion, various interventions of the drowners, and days in the field of professional training of new drowners (Action E2.5).

Interdisciplinary work and careful observation

The phases of knowledge and intervention were based on a highly interdisciplinary work, continuous exchange of knowledge, and mutual respect face of a restoration intervention: the scientific preparation of agronomists and architects was also combined with the practical experience of management by the farmers and construction of new masons' artifacts by masonry.

In fact, we have operated in compliance with the historical material and the form in order to restore functionality to the artifact, following the traces of the existing water channels, cleaning the artifacts from vegetation, and consolidating them where necessary, removing only the parts that were no longer cohesive, a "cuci-scuci" intervention.

For the completion of some artifacts, of which few traces remained, we proceeded with a careful observation of the proportions, the arrangement of the existing bricks and stones (shoulders and bottom) and with the use of materials found on site following cleaning, or from neighboring farms.

Fig. 60 - The abandoned water meadow - Photo P. Branduini (2016)

Fig. 61 - Reshaping operations of the ditches - Photo P. Carnaghi

Fig. 62 - Recovery of hydraulic structures - Photo M. Stabilini

Fig. 63 - Overseeding of grassy mixture - Photo M. Bove

Fig. 64 - Regrowth of the turf - Photo M. Bove

Fig. 65 - Watering tests - Photo M. Bove

A site of not accidental antiquity

As discovered (see page, 21), the first known document bearing the expression "in marcitis" (1188) concerns precisely the territory of Ozzero, more precisely, a place where the mill called "del Maglio" would have been built on the river Rile because, in fact, it operated a hammer for metalworking. In 1391 "keys and levers" used in the construction of the Milan Cathedral were forged here.

From the fifteenth century there has been a dual use: in 1581 there were two wheels for bellows and a hammer for working iron, tin and copper; three millstones, two for mixing (millet and rye) and one for wheat and three for rice. (Comincini, Magnani, 2007). With the eighteenth century, the forging activity ended and the Teresian cadastre (1722) only indicates the presence of a "house, 4-wheel mill with pile and olive press" owned by Mr. Rezzonico; in the nineteenth century it became the property of the Casa Pia dei Sordomuti Poveri di Campagna of the Milan Province.

Over the course of the century, as agriculture improved, the pasture was structured with numerous channels and transformed into a naturally irrigated meadow, with a specialized part as a water meadow. During the twentieth century, both meadows of the Maglio land were governed by water meadows: in the west meadows, today the traces of a combination of a "sculling or flat meadows" with a "zig-zag" wing can be read, according to Soresi's definitions (Soresi; 1914 - see pages 26 and 27); while the east water meadow is a simple sculling water meadow which on the west side is divided by a drain that feeds the painting below.

Phases of the recovery of the Maglio's water meadow, Property Pio Istituto dei Sordi, Milan, Municipality of Ozzero

The tangible and intangible permanence in the landscape - Mulino del Maglio in Ozzero

The presence of a mill is documented since 1391 (M. Comincini - A- Magnani, Ozzero. Two millennia of history, Rho 2007) first as a "mallet" for the supply of construction keys for the Milan Cathedral, then as a grain mill

The so-called "road of the water meadows" is mentioned in the parchment of 1188, from the Abbey of Morimondo (see page 21)

The zig-zag design of the marcita, as reported in the Soresi manual, 1914 (see page 26) is documented here since 1854 (Lombardy Veneto land registry)

The use of water meadows has been documented since 1854 (Lombard-Venetian Land Registry)

The "River Rile" is mentioned in the 1188 parchment of the Abbey of Morimondo; the design of its course and the related artifacts are documented in the 1832 drawing kept in the archives of the Ospedale Maggiore (see page 47 - Fig. 81)

The existence of the forest is documented since 1854 (Lombard-Venetian Land Registry)

Fig. 66- Drone footage of the Mulino del Maglio Photo M. Tessaro (2019)

The winter submersion paradigm of the water meadow

There is no water meadow without winter submersion, understood as the continuous flow of living water. If there is no winter use of water, it can be defined as a permanent meadow that receives water in the summer, in a discontinuous manner, to make the grass grow and when winter arrives, the summer irrigation ends, it turns yellow and "rests". If, on the other hand, when temperatures drop, water is continuously introduced onto the meadow, the grass starts to grow again and the water meadow is "alive".

The water meadow, unlike the irrigated meadow, however, requires an accurate hydraulic arrangement that allows the continuity of the water flow and therefore the growth of regular and uniform grass. The presence of irregularities in the slopes of the water meadow prevents the regular distribution of water: where the altitude is too high the water does not reach and the grass does not grow and freezes, where the altitude is too low the water stagnates and the grass decays. The presence of a dense, complex and ancient irrigation network is the other fundamental requirement of a "historical" water meadow but if it is not combined with an accurate hydraulic arrangement and continuous submersion, it cannot be said that the water meadow " lives".

These are the criteria that have guided the model recovery of the functionality of the water meadow of the Mulino del Maglio di Ozzero (MI) and of all the other recoveries implemented with the Life Ticino Biosource project, grouped into 2 main types described in the following paragraph. As well illustrated in the photos on this page concerning the Maglio water meadow, the recovery of the LIFE water meadows, the grassland surfaces, the structures, the slopes and the regularity of the water flow are always slow and progressive and, like all interventions which imply the vitality of biological cycles and hydraulic regulation, require refinement interventions also in the following years.

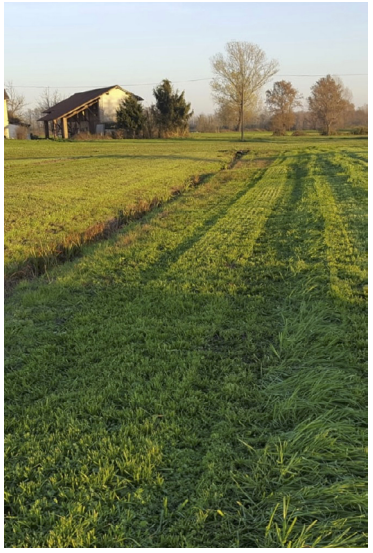


Fig. 67 - The Maglio's abandoned water meadow - Photo M. Bove
Fig. 68 - The arrangement of the threads of the ditches is fundamental for a good distribution of water - Photo E. Tabacco (2017)
Fig. 69 - Result obtained after processing and re-sow with an appropriate floristic mixture - Photo E. Tabacco (2019)

Fig. 70 - Detail of the regrowth after re-seeding Photo E. Tabacco (2018)

THE RECOVERY INTERVENTIONS OF THE LIFE PROJECT

The prerequisite of the water meadow is water: for availability and distribution.

As we have seen, a water meadow is distinguished from an irrigated meadow if it still has a hydraulic structure that allows winter submersion of a uniform and constant veil of water.

What characterizes it is therefore a "structural factor", linked to the presence of physical elements (water carriers and drains, regulation artifacts, slopes of the land, quality of the turf) and a management one: linked to the presence of expert labor (the camparo) that is able to properly regulate the flow of water in summer and especially in winter.

The water meadows recovery interventions in the Life Ticino Bio-source project (Action C4) involved the surface conformation of the plots, the irrigation network, the slopes of the meadow wings, the forage quality of the turf and the availability of irrigation water.

All these interventions, even in their different specificities, always have two common objectives: to obtain maximum uniformity and regularity in the winter circulation of water (as the camparo says "... in water meadow 1 cm sheet of water must flow , to be continuously adjusted ... ") and the best growth and development of the italic ryegrass *(Lolium multiflorum var. italicum)*, the product of the water meadow.

The opportunity offered by the Life Ticino Biosource project was to start the recovery of abandoned meadows, a qualitative leap compared to the thirty-year management of meadows in the Ticino Park based on maintaining the existing one.

Experience has made it possible to restore about 60 ha of meadows to their full functionality, therefore circulating water throughout the winter. Some useful indications have been drawn from it to define the Guidelines for the recovery of abandoned meadows, grouped into two types.

Fig. 71 - Marcite di Bereguardo: winter watering - Photo G. Molina (2018)

Fig. 72 - Marcita di Fallavecchia (MI): end of the recovery and spring production intervention in grass silo - Photo M. Bove (2019)

Type 1. WATER MEADOW WITH SUMMER MANAGEMENT

It represents the simplest case: the water meadow is in good or fair storage conditions. It has a good structure and, even if the winter submersion is not practiced, it is operated according to the good summer agronomic practices (care of the surface morphology and slopes, regular summer mowing, good cleaning and maintenance of irrigation networks and hydraulic artifacts). The canals are clearly evident and their slightly buried base, the regulation artifacts are clean and fairly functional; the slope of the land is appropriate except in some places and allows a fairly even flow of water.
In cases such as these, recovery consists in resuming the autumn works to prepare the irrigation network and in intervening locally with the correction of slopes and altitudes where the circulation of water shows small irregularities in the grassland; it is therefore a question of eliminating the causes that locally prevent the full uniformity of flow and resuming the winter submersion abandoned for some time. Manual labor is also required.

LIFE recoveries carried out:
Cascina Boscreva, Robecco S. Naviglio (MI); Cascina Moriano, Bereguardo (PV); District Fallavecchia, Morimondo (MI); Cascina Nuova, Vigevano (PV); Cascina Selva, Ozzero (MI); Cascina Criminale, Gambolò (PV); Cascina Madonnina, Terdoppio Valley in Gambolò (PV).

Fig. 73 - Robecco SN (MI) - Cascina Boscreva water meadow, grass growth in winter frost - Photo M. Bove (2019)

Fig. 74 - Cascina Criminale's water meadow, winter irrigation - Photo G. Molina (2018)

Type 2. WATER MEADOW WITHOUT SUMMER MANAGEMENT

It represents the most complex case: the water meadow has poor to very poor conservation conditions.
It has a compromised morphological structure, it is not carried out according to good summer agronomic practice (insufficient or absent mowing, rare or no summer irrigation), wet submersion is not practiced in winter. The channels are not very evident, buried or blocked by sediment that limits or interrupts the flow of water; the regulation artifacts have deteriorated, are covered with vegetation and malfunctioning; the slope of the land is irregular and does not allow a uniform flow of water.
After an initial general cleaning operation by mowing / shredding the spontaneous vegetation, which also favors the identification of existing structural elements in the water meadow and its general conditions, recovery can take two directions:
2.1 - Recovery in respect of material permanence
2.2 - Removal of material permanence and reconstruction of the drawing.

(See next page)

Fig. 75 - Marcita delle Fasanette after recovery - Photo M. Bove (2019)

Fig. 76 - Water meadow of Roverina after resowing of the wings - Photo M. Bove (2019)

2.1 - Recovery in compliance with material permanence.

Maintenance of the existing irrigation network without changes or displacements of ditches, except for their reshaping (enlargement or reduction of the section) to favor the flow of water; cleaning and consolidating existing artifacts, mechanical intervention on the grassy wings by plowing and / or surface processing (milling, harrowing, rolling) with possible slight movements of earth inside the wings aimed at re-establishing the correct slopes and eliminating surface irregularities; final overseed with 40 kg / ha of 97.5% Loglio italico (L. multiflorum, ssp Italicum) and 2.5% Ladin clover (Trifolium repens).

It is a very respectful restoration intervention of the existing structure, with a more decisive action to restore the correct slopes that cannot be read due to prolonged abandonment: it is a delicate conservative restoration - almost of rural archeology - which also requires manual work.

LIFE recoveries carried out:
Mulino del Maglio di Ozzero (MI), (Figure 73 on the previous page)
Cascina Roverina di Vigevano (PV), Marcita delle Fasanette di Gambolò (PV)

2.2 - Removal of material permanence and reconstruction of the drawing.

Partial or total elimination of artifacts; plowing of all the water meadow including the internal irrigation network and general leveling of the plot; re-tracing of the irrigation network with repositioning and / or new construction of the artifacts; reconstruction of the slopes of the meadow wings; final overseed.

This type of intervention, even more decisive and intense, is apparently simpler and faster, but in reality it is very difficult and risky: in fact, although it is plowed over the entire surface, the water meadow retains the signs and characteristics that the soil has acquired over time. Furthermore, even a change in the positions of the artifacts or a small displacement of the sediment of the irrigation network can affect the functionality of the water meadow during the submersion.

LIFE recoveries made:
C.na Pietrasanta di Abbiategrasso

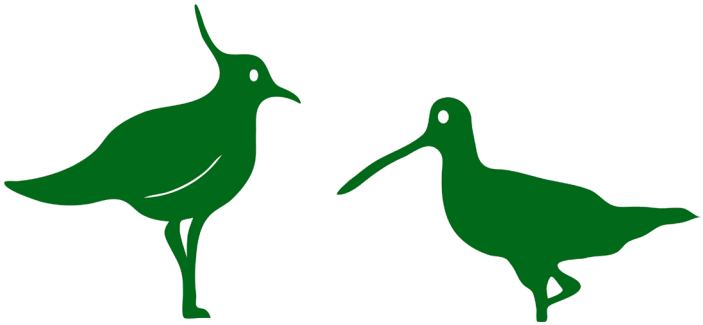
As regards Type 2, the experience of the Life Ticino Biosource Project leads us to conclude that the best results for recovery of a water meadow without summer management are obtained with method 2.1, that is, respecting the permanence of materials. Method 2.2 is strongly discouraged, that is the removal of permanencies with reconstruction: in fact the furrows of a water meadow modeled by decades or centuries of management, the minimal slopes, the signs on the ground and the traces of irrigation artifacts, although apparently not following prolonged abandonment, they can never be completely eliminated. The ditches and ancient traces, even after plowing, return to mark the field and therefore do not guarantee the correct and uniform submersion of the soil.

Fig. 77 - Cascina Pietrasanta: recovery of irrigation networks (M. Bove, 2018)

Fig. 78 - Cascina Pietrasanta: total plowing with restoration of wings and ditches (M. Bove)

Fig. 79
The results of the Life Biosource project (Action C4): recovered meadows, submerged wet meadows, main faunal observations.

AZIONE (prog. LIFE)	SUP. (Ha)	numero aziende agricole	SPECIE DI IMPORTANZA EUROPEA		
			UCCELLI	ANFIBI	FARFALLE
C 4.2 Recupero Marcite	**62**	**11**	Pavoncella *(Vanellus vanellus L.)* Beccaccino *(Gallinago gallinago L.)* Falco di palude *(Circus aeruginosus L.)* Cicogna bianca *(Ciconia ciconia L.)* *Airone bianco maggiore (Casmerodius albus)"*	Rana di Lataste *(Rana latastei B.)* Raganella italiana settentrionale *(Hyla perrini)*	Licena delle paludi *(Lycaena dispar H.)*
C 4.3 Sommersione Prati Umidi	**20**	**9**	Tottavilla *(Lullula arborea L.)* Saltimpalo *(Saxicola torquatus L.)* Fanello *(Linaria cannabina L.)* Pispola *(Anthus pratensis L.)*	Raganella italiana settentrionale *(Hyla perrini)*	Licena delle paludi *(Lycaena dispar H.)*



"THE PREREQUISITE OF WATER MEADOW IS WATER"

We told how the water meadow contains more thoughts, more different meanings, and more reflections.

Ranging from harmony with nature to new visions of sustainable, circular and ecological agriculture, from the story of the historical events of our territory to the reading of landscape systems: the water meadow always has something new to tell us ... an entire story to tell us about.

Mario Comincini, as a profound historian, reminds us that "the prerequisite of water meadow is water" and this assumption still teaches us something about how to enhance and protect it today, when water saving has become a categorical imperative of our era.

In the meadows, the water finds a path, renews itself and purifies itself, along with the grass that is the foundation of a precious and circular supply chain that has contributed to the richness of the Milanese area throughout history.

Today, in the Po Valley Plain, we risk the loss of our water to the Adriatic Sea if we don't use water for agriculture in the most appropriate and intelligent ways.

The water meadow teaches us to use water in winter, to recharge the aquifer, to fill the fertile sponge of the agricultural soil that is ready in spring when water is needed for sowing. The soil is thus protected from intense and sudden rains and can resist the erosion of the earth and fertility, an increasingly rare and delicate quality of the soils.

The map on the next page depicts the work of collecting and managing spring water, which was conveyed into "rivers" (today often referred to as "canals") and slowed down by water jumps, bringing "blue gold" to the fields and numerous mills.

Fig. 80 - Water jump to the Sforzesca water meadows - Photo G. Molina

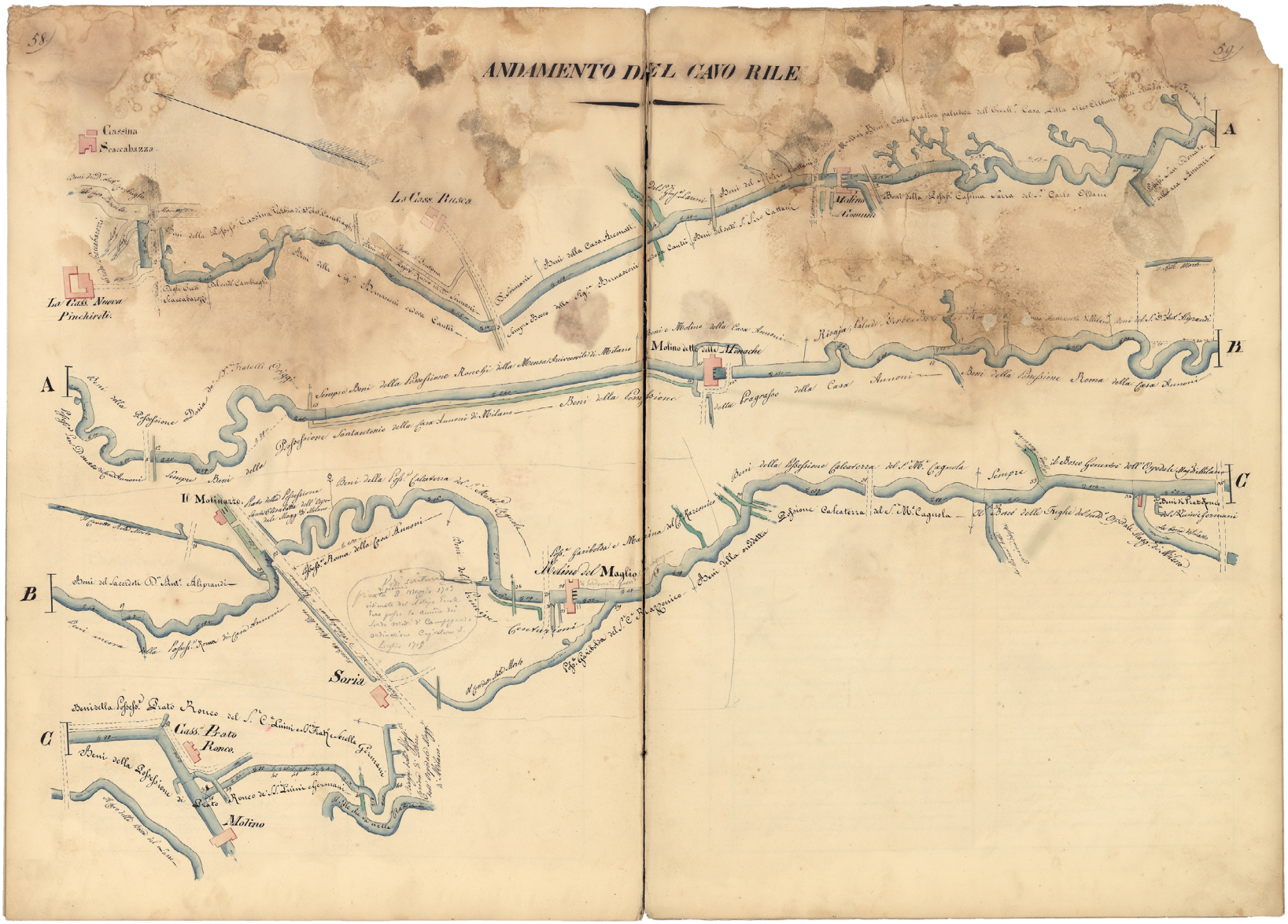
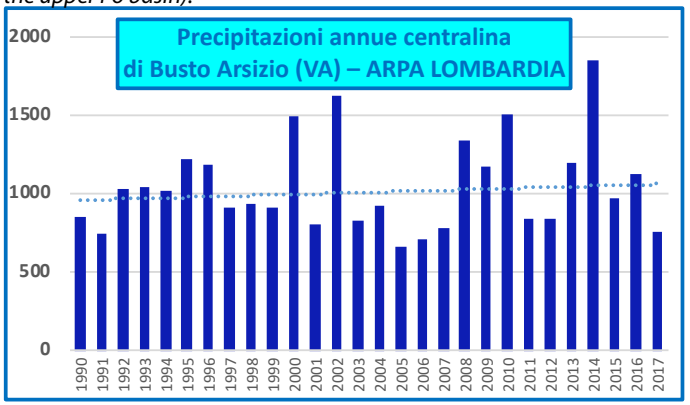


Fig. 81 - The course of the Roggia Rile: the source, the tributaries, the hydraulic artifacts (Archive of the Ospedale Maggiore, Maps, Censo Nuovo N. 151, Ing. Paolo Bianchi, 1832)

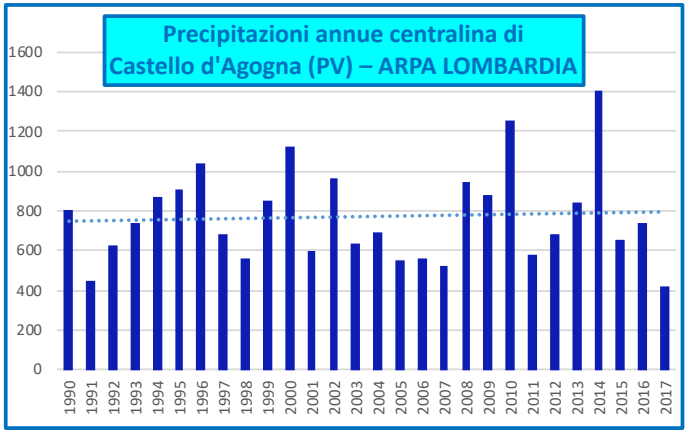
Figure 82 - Annual rainfall in two Lombardy weather stations (Ticino Park elaborations on Arpa Lombardia data)

Precipitation recorded by ARPA LOMBARDIA weather stations from 1990 to 2017 in Busto Arsizio (VA) and Castello d'Agogna (PV): in 30 years the total amount of water has not changed, so the potentially storable water is always the same (Fig. 83, A and B: the flow of water in the upper Po basin).



A - Busto Arsizio (VA)
1990-1999 = 987 mm/year
2000-2009 = 1034 mm/year
2010 – 2017 = 1136 mm/year

B- Castello d'Agogna (PV)
1990-1999 = 752 mm/year
2000-2009 = 748 mm/year
2010-2017 = 823 mm/year



THE RACE TOWARDS THE SEA

Climate change in the water cycle

A study carried out by the Ticino Park and the East-Sesia Irrigation Association leads us to reflect on the changes in the dynamics of the water cycle in the Po water basin, in particular in the irrigated rice-growing plain located north west of the basin.

The reading of the amount of annual rainfall over the last thirty years carried out on two meteorological stations (Fig. 82 A and B: ARPA data of weather stations Busto Arsizio (MI) and Castello d'Agogna (PV), 1990-2017) it shows us that climate change has not decreased the amount of water falling from the sky. This means that the water that falls from the sky is always the same or even more.

Climate change also clearly affects another sector of the water cycle: the accumulation in the caps of glaciers, in particular those in the Alps, which are constantly reducing.

So why is our perception of a lack of water? Why are we so well aware and sensitive to the need for "water saving"?

It is quite evident how the temporal and distributive dynamics of the rain phenomenon have changed: it rains more intensely and for shorter times, the water flows faster on the surface without penetrating the water table and long dry periods are increasingly frequent.

Summer 2019 was a lesson: the irrigation distribution network was at its best and even beyond the optimal reservoir regime, yet many farmers were unable to wet the fields (data processed by Est Sesia on the lower Lomellina). Thus, as in the last ten summers, in the month of June, the drought alarm was raised. In fact, many farmers, especially rice growers who in recent years have switched from sowing in water to dry, were unable to water their fields.

What happened?

(Fig. 83, A and B: the flow of water in the upper basin of the Po).

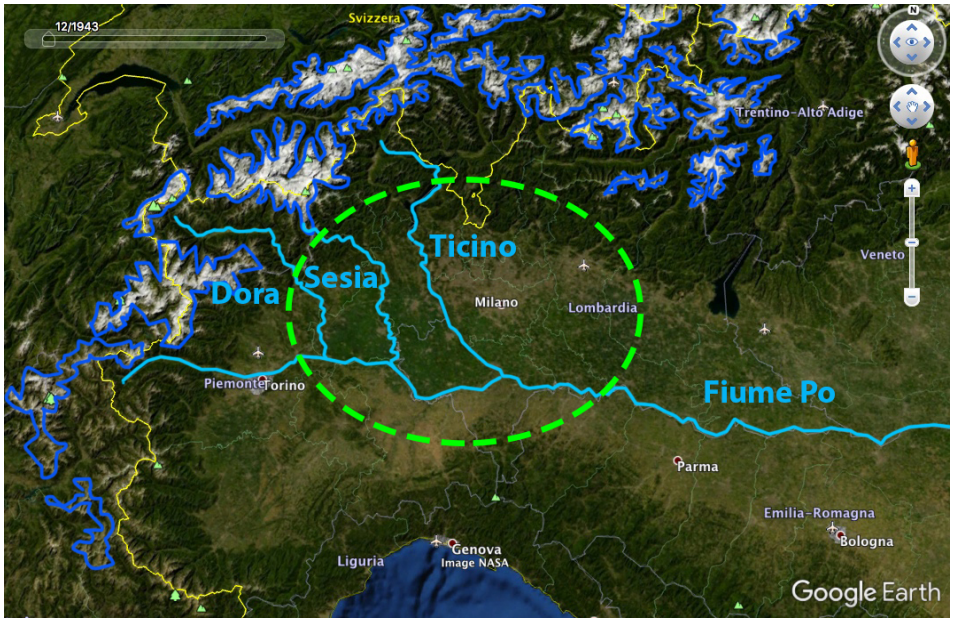


FIG. 83
A TICINO BASIN IN CONDITIONS OF BALANCE (1943)

The Ticino basin is in equilibrium: the ice reserve is constant, heavy snowfalls, regular rains ... consequently the reservoirs of the alpine lakes have rare fluctuations and the aquifers are full and act as a water reserve.
The whole system plays a role of "thermal and hydraulic flywheel" and therefore compensates for extreme phenomena of drought and high rainfall.

SOURCE:
Ticino Park elaboration on NASA image
(the oval dashed in green symbolizes the accumulation in the groundwater)

FIG. 83
PO BASIN IN DIS-BALANCE CONDITIONS (2016)

The Ticino basin has moved away from the condition of equilibrium: the high temperatures are reducing the precious water reserve of the glaciers, the snowfall is scarce which, instead of consolidating, melts quickly, the rains are not regular and therefore increase the runoff and the speed of surface waters, causing dangerous fluctuations in the reservoir levels of the lakes and difficulties in recharging the aquifers.
The calming contribution of the entire system is lacking: glaciers, lakes and strata are unable to stop the water flowing on the surface and play the role of reserve, water shortages are increasingly frequent and evident.

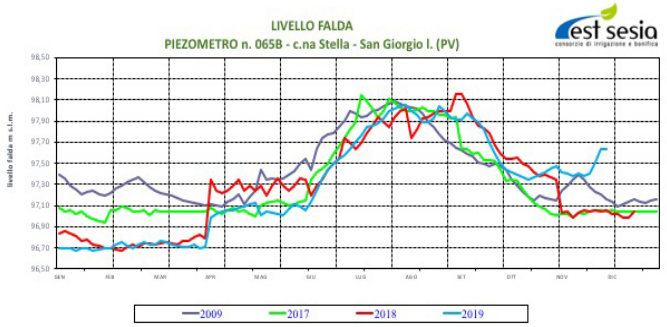
The collective impression is that "there is no water".

SOURCE:
Ticino Park elaboration on LANDSAT image
(the oval dashed in green symbolizes the accumulation in the reduced groundwater)

Fig. 84 - Subsidence of the water table in a mainly rice-growing area

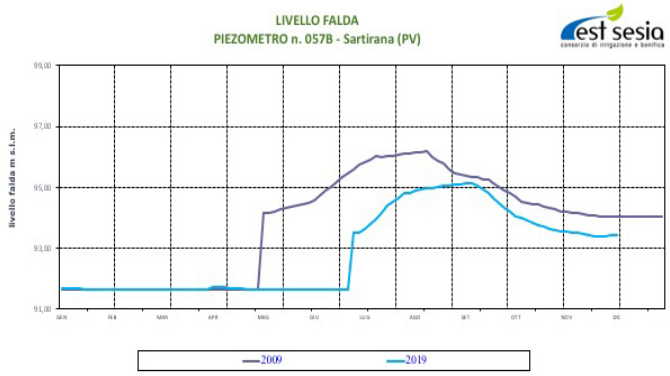
A- Annual trend: comparison of the years 2009, 2017, 2018 and 2019

In S. Giorgio di Lomellina, where from 2009 to 2019 the area cultivated with the practice of traditional rice paddy or submerged sowing has always predominated, the groundwater level has very similar trends in the 4 years considered, demonstrating that it is precisely the rice field cultivation practice that influences the groundwater level.



B - Annual trend: comparison of the years 2009-2019

In Sartirana di Lomellina (PV), in 2009 with high diffusion of the traditional paddy field or submerged sowing, the recharge of the aquifer occurs 2 months earlier than in 2019 when the practice of dry paddy or sowing in alternate rows is now much more widespread .



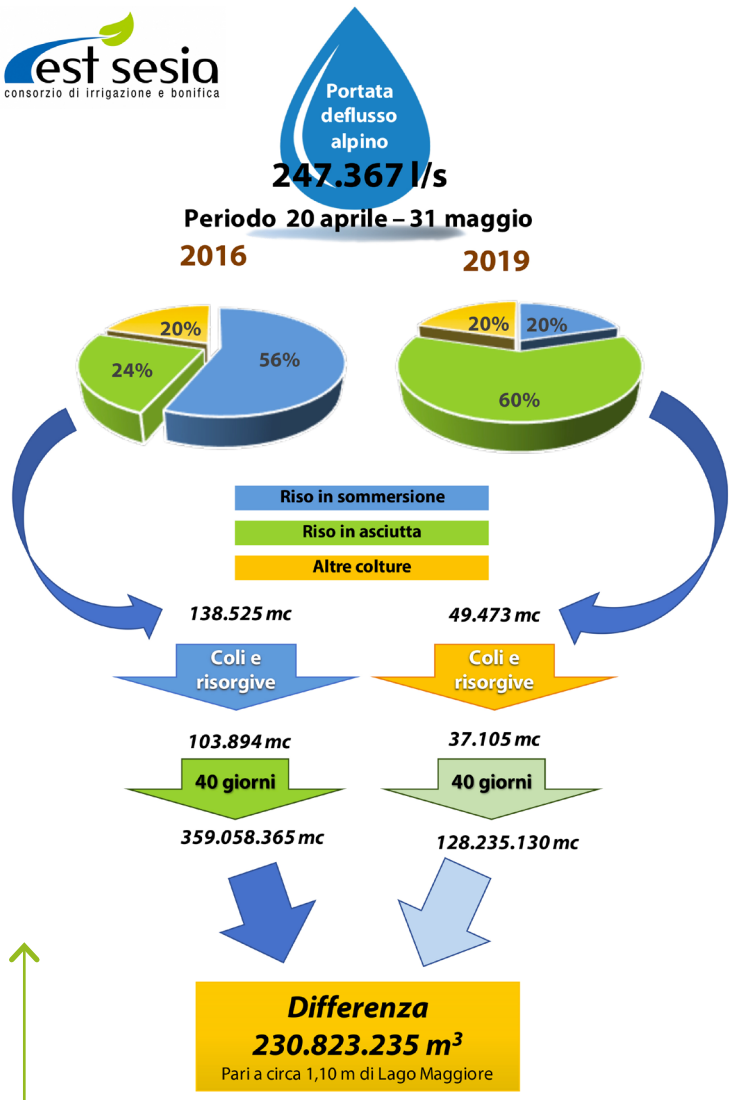
Thanks to its dense network of piezometers, the Associazione Irrigua Est Sesia has analyzed the dynamics of the groundwater, identifying how the variation of the "groundwater subsidence" (the depth at which the aquifer is located in order to allow capillary ascent into the ground and the consequent lower use of irrigated resources on the surface) can be explained by the change in rice cultivation practices from traditional continuous submersion to dry and therefore depends on the moment in which continuous submersion is started (Fig. 84 A and B).

Basically, the climatic dynamics coupled by the cultivation of dry rice paddies and the reduction of grasslands in the plain, a conspicuous loss of aquifer recharge resulted in an increase in subsidence, i.e. displacement of the stratum to greater depths which make it less available for the fertile layer.

As often in ecological imbalances, the phenomenon has triggered a vicious cycle in which technical innovation acted as an accelerator, unknowingly increasing the damage.

The dry rice cultivated area in the East Sesia area increased from 25% of the total rice cultivation area in 2016 to 60% in 2019 (fig. 85), with peaks in certain areas of 80-90%. Apparently an advantage as authoritative sources indicate that the consumption of irrigation water per hectare is reduced from about 14,000 cubic meters / year for a submerged paddy field, to "only" 10,000 cubic meters / year for a dry paddy (Ente Nazionale Risi in https: / / www.risoitalia- no.eu/submersion-and-asciutta-a-confronto/). In reality, in terms of the system this is not a real water saving, in fact, the submerged paddy field guarantees greater recharge of the aquifer as it is continuously flooded starting from the beginning of April, while in the dry paddy this happens only 2 months later (about mid-June) because before it is flooded it is only irrigated every 10-15 days.

Furthermore, the recharging of the aquifer in spring is also more efficient as it occurs in situations of less evapotranspiration due to still low temperatures and in the presence of soils that are still moist due to spring precipitation.



The phenomenon became most evident when the dry surfaces exceeded those in submersion: from mid-June onwards, in fact, there is a concentration of the demand for irrigation water because of the high demand of dry rice fields (which begin continuous submersion in the summer heat, dusty soils and groundwater without recharging) the irrigation requests of many other crops must also be added, first of all corn and meadows, with the consequence that irrigation water is not enough for everyone (as happened in 2019 when, despite an excellent spring flood in the irrigation network, the southernmost farms remained dry - source Est Sesia, February 2020).

With traditional continuous submersion sowing, the demand for irrigation water is instead more distributed because, thanks to the full recharge of the aquifer in spring, the paddy reaches a water balance with the underground aquifer that requires only "one drop of water" to maintain submersion, freeing up precious irrigation volumes for other summer crops.

In short, in the name of an apparent water saving of the dry paddy in spring, a lot of water was "lost": it is estimated that more than 230 million cubic meters of water are lost every year in 40 days - fig 85. All this water, which did not enter the spring circulation of the aquifer system and agricultural land, was left to flow unused in the main irrigation network towards the sea instead of "lingering" in the immense aquifer, a "reserve sponge" from which to draw. This "sponge" supports both the agricultural cycle of thousands of companies and the green network of hedges, rows, grassy embankments and wetlands delocalized in the plain, with all their heritage of biodiversity and environmental resilience that from this water " slow "benefits.

Unfortunately, we are not exaggerating in affirming that, in recent years, we have increasingly observed "landscapes of dust" in a plain known throughout Europe for its "water landscapes" ... and the cause is not water shortages!

Fig. 85 - The decrease in the area cultivated with rice with the traditional submersion technique from 2016 to 2019 (portion in blue in the two pie charts), replaced by the rice field with dry sowing (portion in green in the two pie charts), it determined in 40 days the reduction to almost 30% of the irrigation water used and the flow of fountains and drains; this means that more than 230 million cubic meters of water, equal to 1.10 m, have been left in the main canals, unused and given to the Po and the Adriatic Sea (because in spring there is no demand for water from other crops) of greater height than the entire surface of Lake Maggiore.
Graphic elaboration Ticino Park on East Sesia data (2020)

“USING WATER TO SAVE IT”: agricultural practices for the Lombard-Piedmontese Po Valley

The Community Agricultural Policy and the Rural Development Plan set objectives on the theme of water for the fight against climate change which, in general terms, are more than acceptable: “... guarantee the sustainable management of natural resources and action for the climate ... “(EU Reg. 1305/2013 - art. 4, b),” ... make the use of water in agriculture more efficient ... “(EU Reg. 1305/2013 - focus area 5a), “... increase the efficiency of the Lombard irrigation system ...” (PSR Lombardia 2014-2020). However, it is also necessary to always ensure that the application of EU measures is consistent with the “suitability of the various agricultural territories” and its agri-environmental characteristics.

In the case of the Po Valley, reducing the volumes of water used actually means causing a shortage of irrigation for agricultural crops linked together and wasting an immense amount of water that still flows in the main channels, unused, up to the Po river and the Adriatic Sea. Furthermore, the non-use of irrigation water with the sliding system eliminates the vital benefit provided to territorial agroecosystems, causing a very serious loss of biodiversity and the spread of the most resistant invasive plant and animal species.

In fact, the use of water with the sliding method represents a positive external impact of agricultural activity on agroecosystems, which can be defined today as “positive externality”, that is a clear example of an ecosystem service offered by agriculture to the biodiversity of rural territories.

Fig. 86 - Autumnal flooding of meadows for the pass fauna - Photo M. Bove (2018)

Fig. 87 - Winter care of water distribution - Photo M. Bove (2015)

In the Lombard-Piedmontese plain, where the practice of run-off irrigation has been widespread for centuries, water saving is achieved, paradoxically, by distributing the water on the fields, both with agricultural practices that require water (continuous submersion paddy or traditional), and with the activation of its circulation in seasonal periods where it is not normally used (water meadows and flooded meadows): the proposal can be translated with the slogan "use water to save it".

In these specific areas, traditionally rich in irrigation water not extracted from the subsoil, the fundamental EU objective of water saving is not achieved by replacing the irrigation method by flow with other irrigation methods with low water consumption, such as rain systems. or drop. In fact, if these drip or rain systems were used extensively, it would lead to the "emptying" of the groundwater and a water shortage in the soils which, in addition to reducing agricultural production capacity, would put a strain on the entire agro-ecosystem causing serious alterations , such as the progressive replacement of native species with invasive and more resistant ones and a serious impoverishment of plant and animal biodiversity.

Having therefore acknowledged that in the Po Valley the irrigation methods with low water consumption, such as rain or drip systems, are not suitable for widespread crops such as rice, corn, soybeans, other cereals and meadows, from the work and analysis carried out by Parco Ticino and five proposals are born from Est Sesia, immediately applicable through agricultural policies.

Fig. 88 - Maintaining winter irrigation - Photo E.Tabacco (2016)

Fig. 89 - Typical wooden lock, Marcita di Bernate - Photo M. Tessaro

1. return to the "traditional paddy field", abandoning the "dry paddy field": it allows to improve the balance between surface water and groundwater, especially in spring, when the demand for irrigation water for other crops is less and evapotranspiration much lower . Achieving this balance reduces summer water demand for rice and leaves valuable volumes of irrigation water for grassland systems and summer cereals.
2. return to circulate irrigation water even in winter, through: submerging winter rice fields, flooded meadows, meadows, water circulation in the company network. This favors the winter balance between surface water and groundwater, bringing the cultivated countryside in spring to a situation of soil moisture such as to be able to start the seeds in better conditions and with less water waste.
3. make alternative crop choices to maize, a crop that requires a lot of water, for example by modifying the livestock feeding system with the introduction of grassland crops such as lawns and weeds or forage that require less water in summer, such as alfalfa (especially where the irrigation water must be raised or pumped with energy consumption). These choices help to replace part of the corn grown for silage, also increasing the vegetational coverage of the soil all year round and the water retention capacity given by the greater quantity of organic substance present in the grassland systems, as well as allowing the production of a large part of the farm. protein quota for the zootechnical ration, so as to reduce the dependence on feed and soy (production certainly more "dewatering": see Bove et al. 2017 in the bibliography on page 14)
4. enhance practices for the increase of organic matter in soils: cultivation with minimal processing techniques, organic fertilization (with company reuse from relying on litter), permanence of winter cover crops, reintroduction of green manure crops ... or innovative techniques of ecological agriculture.
5. increase the variety of the rural landscape with measures to protect the farm score and the fine water network, flanked by incentives for vegetation elements and biodiversity, such as hedges, wetlands, grassland buffer strips.

Fig. 90 - Jump of the ditch: ancient technique used by campari to pass beyond the irrigation ditches that distribute the winter water
Photo M. Bove (2020)

Figure 91 - Life Ticino Biosource Project
(Action E.2.5 - Course for campari, organized by the Ticino Park)
Young people and farmers talk about the intangible heritage of knowledge and talk about the best use of water
Photo M. Bove (2018)

Fig. 92 - Paddy field in submersion prepared for sowing in water, at the end of March - Photo M. Tessaro

Fig. 93 - Paddy field in dry working phase, pre-sowing, in mid-May - Photo M. Bove

THE PARTICIPATED WATER MEADOWS

The Community of the "snow miracle"

The well-being of the local community is strictly dependent on the improvement of ecosystems and cultural diversity (UN Conference on Sustainable development RIO + 20, 2012): they can strengthen the resilience and capacity of a community to cope with climate change and natural disasters.

A group of people who attach a specific value to cultural heritage to the point of supporting it and passing it on to future generations is a "Community of heritage" (Council of Europe, Faro Convention on the value of cultural heritage, 2005).

It shares responsibility for cultural heritage through public participation and encourages everyone, especially the young and the disadvantaged, to participate in the process of identifying, studying, interpreting, protecting, conserving and enhancing cultural heritage.

This publication is the result of the activity carried out for years to transmit the value of the culture of the water meadow and create a community of heritage around it. We have worked with many collaborators, constantly discussing the scientific and symbolic meaning of the water meadow and, above all, what it can represent for an agriculture that knows how to talk about the future.

The path that accompanied these pages was full of encounters, exhibitions, conferences, lectures, experiences in the field, but, above all, of sharing between past and future, young and old, peasant world and academia, manual skill and intellectual humility.

Fig. 94 and 95. Ozzero (MI), Mulino Maglio. Above: lesson in the field, Prof. Borreani (KINGDOM, Disafa). Modern bale ensiling techniques are being tested in the field to preserve water meadow fodder - Photo M. Bove (2018)

Fig. 96 - Ozzero (MI), Mulino Maglio - Visit to the marcita organized by Legambiente - Photo M. Bove (January 2019)

Fig. 97 - Robecco Sul Naviglio (MI), Cascina Grande - Visit to the meadows organized by Progetto Aretè - Photo M. Bove (February 2020)

Fig. 98 - Vigevano (PV), Frazione Sforzesca - Campari Action E2.5 course of the Life Ticino Biosource project: course to present the water meadow and the work of the camparo "master of the shovel", with classroom and field lessons. 40 people took part, including farmers and agronomists. - Photo G. Molina (2018)
A video of the course was made: "The manual skill of the shovel":
https://ticinobiosource.it/corso-sulle-marcite/

Fig. 99 - Ozzero (MI), Mulino Maglio - "team building" day in the marcita. (January 2019) The water mead has been the site of visits and days of work with farmers, environmental associations, university courses, companies, schools, families and therapeutic communities - Photo M. Bove (October 2018)

These photos and this publication are auspicious for the consolidation of the Community which unites everyone in the common goal of strengthening the relationship between man and nature and innovating agriculture by learning from the experience of the past.

Fig. 100 - Exhibition "Landscapes of Marcita from land to milk"
https://ente.parcoticino.it/paesaggi-marcita-video-mostra

Made with a project co-financed by Parco Ticino and the Lombardy Region.
It tells the multiple meanings of the water meadow: historical, landscape, environmental, productive. The exhibition (consisting of panels, films and photographs) is itinerant and has been exhibited dozens of times in Milan, in various municipalities of the Park and other municipalities of Lombardy and Piedmont, combined with presentation conferences with speakers, Park officials, university teachers , farmers and agronomists.

Sforzesco Castle in Abbiategrasso (MI) - Photo G. Molina (2017)

Fig. 101 - Pavoncelle at the edge of the meadows - Photo E. Tobacco

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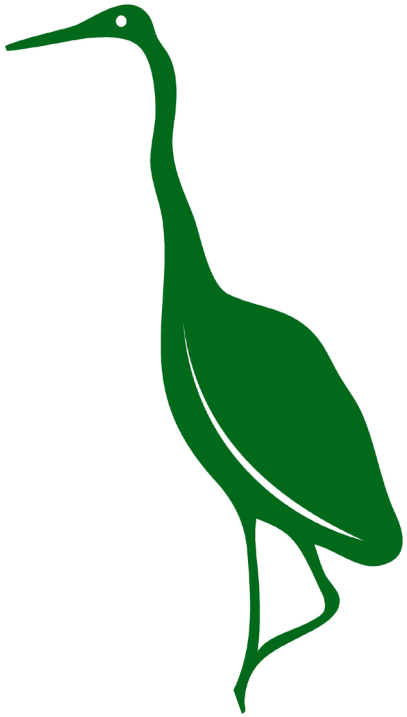

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