

Case Report

The Maraichine Cattle Breed Supports Breeders and Researchers in the Atlantic Coastal Marshlands

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Abstract: The Maraichine breed of cattle originates from the Loire region of France and has been under a conservation programme since 1986. This programme links the conservation of the breed with the conservation of its traditional environment of wet grasslands. In this case report, we describe the different steps of this programme, each of which had its own successes and challenges. We also describe how, throughout this process, researchers have been involved in the generation and dissemination of information covering areas such as stakeholder perspectives, animal performance, and socio-economics. Under the conservation programme, the Maraichine population has expanded in both size and scale. Simultaneously, stakeholder perspectives have also developed, continually shifting the balance between the productivity, conservation, and maintenance of heritage traits. The conservation programme also provided the opportunity to utilise the breed's desirable traits, such as easy calving and disease resistance. Whilst the carcasses are not necessarily as valuable as those of other breeds, farmers have implemented novel economic practices to capitalise on market opportunities. Today, Maraichine cattle and Maraichine breeders offer researchers the opportunity to deepen and enrich our knowledge on sustainable ruminant livestock farming systems.

Keywords: local breeds; beef cattle; rusticity; wetlands; short supply chains; organic farming; ecological value

1. Introduction

Maraichine (MA) cattle are a large breed with several distinguishing physical features (Figures 1 and 2). The standards and characteristics of the breed are described by Berland et al. [1]. Despite their adult size, calves are born small, leading to easy calving. Notably, double-musled traits are not permitted and animals with this trait cannot be selected for breeding. The breed was developed to yield both milk and meat whilst still being suitable for labour. Currently, the breed is under a conservation program and not under any programmes of direct genetic improvement (more details in Section 2.2).

The Atlantic coastal marshlands of France (Figures 3–5) span nearly 260,000 hectares and is home to the Maraichine breed of cattle. This land was reclaimed from the sea during the 17th–18th centuries and shaped by hydraulic engineering and the installation of dense networks of canals, ditches, and sluice gates. The management of water in these networks has made it possible for this land to be utilised for agriculture. Livestock farming on meadows was dominant pre-1960, and then, with the development of drainage techniques

between 1960 and 1990, the mechanised production of cereal crops began. Changes in agricultural policies and pressure from environmentalists prevented further draining and grassland conversion to cropland from the 1990s [2]. Today, the marshlands are a habitat for a diverse array of flora and fauna, recognised and protected by various directives and conservation activities. This biodiversity is dependent on the wetland conditions of the marshes and the grazing practices that maintain grasslands habitats [3,4].

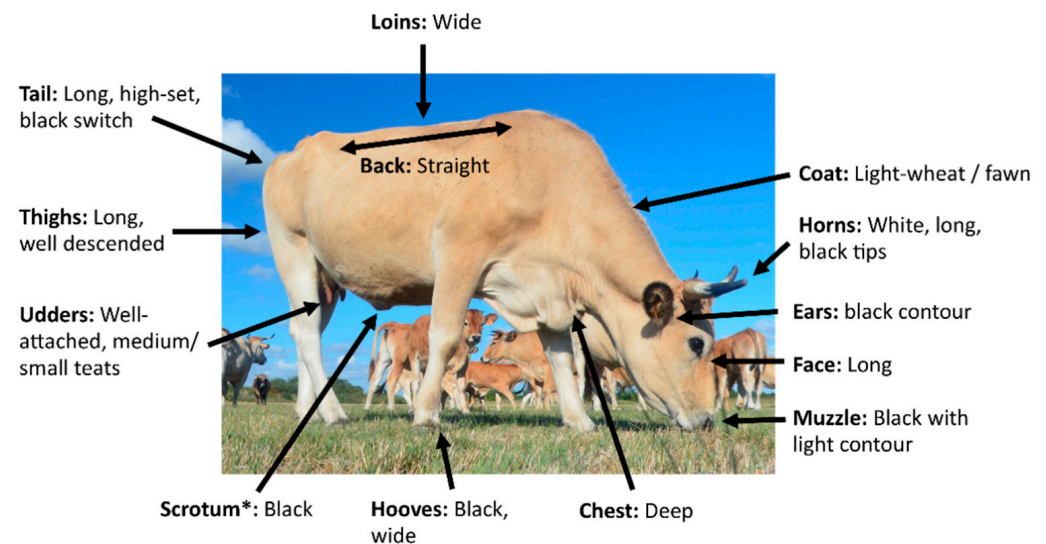


Figure 1. Image of Maraichine cattle with distinguishing physical features identified. * The individual pictured is female and thus has no scrotum. Image adapted from original (photo credit: V. Boutifard, INRAE, 2020).



Figure 2. Maraichine cow and calf (photo credit: V. Boutifard, INRAE, 2020).



Figure 3. Elevation map of France showing the approximate location of the coastal marshlands in which Maraichine cattle are traditionally reared. Image adapted from original (title: GMT_France_20_largest_cities, creator: David Monniaux, source: Wikimedia Commons, license: CC-BY-SA-2.0 (see <https://creativecommons.org/> for license details) accessed on 22 February 2022).



Figure 4. Land of INRAE experimental research farm of Saint-Laurent-de-la-Prée in Charentais marshlands. Description of the image: territory crisscrossed by canals and ditches; in the background on the right, sales crops; in the background on the left the River Charente; in the foreground natural meadows; through the meadows a reed bed (photo credit: F. Vincent and V. Boutifard, INRAE, 2020).

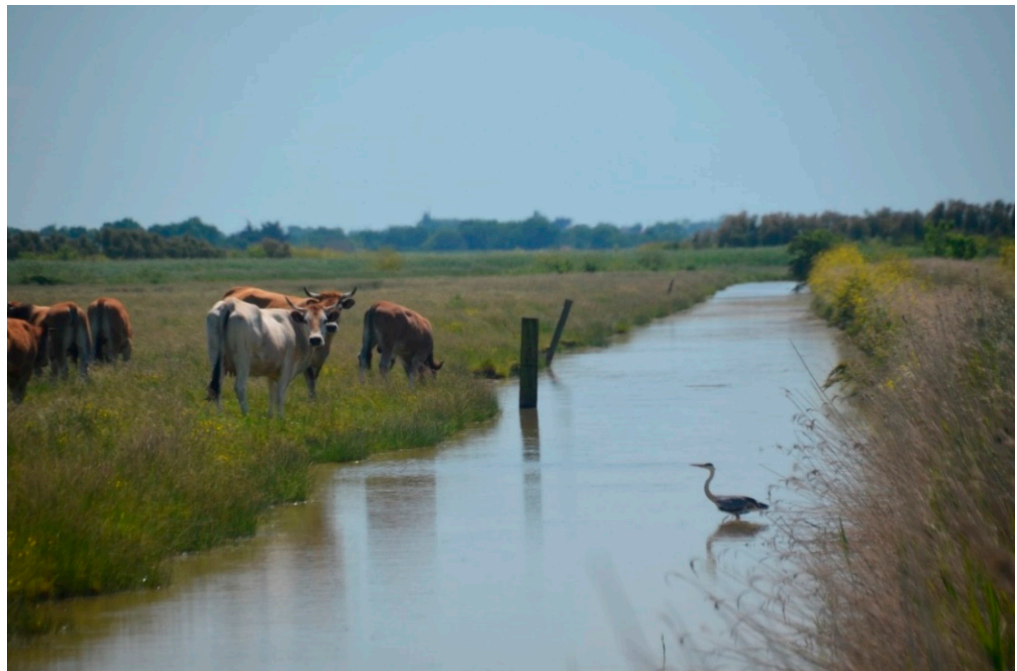


Figure 5. Maraichine cows in the Charentais marshlands (photo credit: V. Boutifard, INRAE, 2020).

Farmers are not the only stakeholders within this area. Steyaert et al. [2] distinguished three categories of human-centred perceptions, revealing the different values and perspectives people have towards this area: (1) those who perceive the marshes as a constraint to human development that has to be reduced—water managers, farmers, landowners, and municipal mayors comprise most of this group; (2) those who recognize that the marshlands offer specific features favouring some human activities over others—extensive livestock farmers, shellfish farmers, fishermen, and some hunters share this point of view; and finally (3) nature conservationists who consider the marshes as a “sanctuary” for nature and who want to control, reduce, or exclude human activities that affect the natural function of these areas.

In the 1980s, within this area, the MA breed (Figure 4) began a revival and in 1988 the “Association for the Valorisation of the Maraichine Breed and Wet Grasslands” (Maraichine Association) was founded. MA cattle originated from the “Poitou” region of France but almost disappeared in the mid-20th century. Today, the MA breed comprises of approximately 1600 mature females (>2 years old) from 125 breeders [5].

This paper reports how researchers and breeders collaborated in the revival of the breed. We present (1) the main steps of the development of MA rearing, (2) the evolution of MA livestock farming systems and breeders’ representations concerning the breed and its environment, and (3) the performance of MA cattle animals assessed on an experimental farm [6,7]. Throughout, we will describe research contributions relating to those activities.

2. Dynamic of Maraichine Cattle Rearing: Between Conservation and Valorisation

Several publications detail the dynamic of MA rearing until the end of the 2000s [1,2,8,9]. For more recent periods, descriptions come from the observations of the authors and their experiences working with the MA Association. We relate this dynamic, based on the work of Audiot [10], to other local breeds. The five main stages are:

1. Decline of MA population (1960–1980);
2. Reconstruction and preservation (1986–1990);
3. Conservation (1991–1995);
4. Conservation and valorisation (1996–2007) (we define valorisation as the appreciation of the value of the breed, the promotion of this value, and possibly the creation of an economic value);

- Valorisation and conservation: diversification (2008–present) (during this stage valorisation is a more important stake).

For each step, we describe the issues concerning the MA breed, its environment, farming systems and breeding practices, the sale of its products, and the group of breeders and their collective project. Figure 6 represents this dynamic, showing only three dimensions: the breed conservation, the products marketed by the breeders, and the associated marketing methods. As these dimensions evolve continuously and contiguously, the five steps are not shown in Figure 6. Table 1 gives information about the evolution of population size. Details are given in each step description [5].

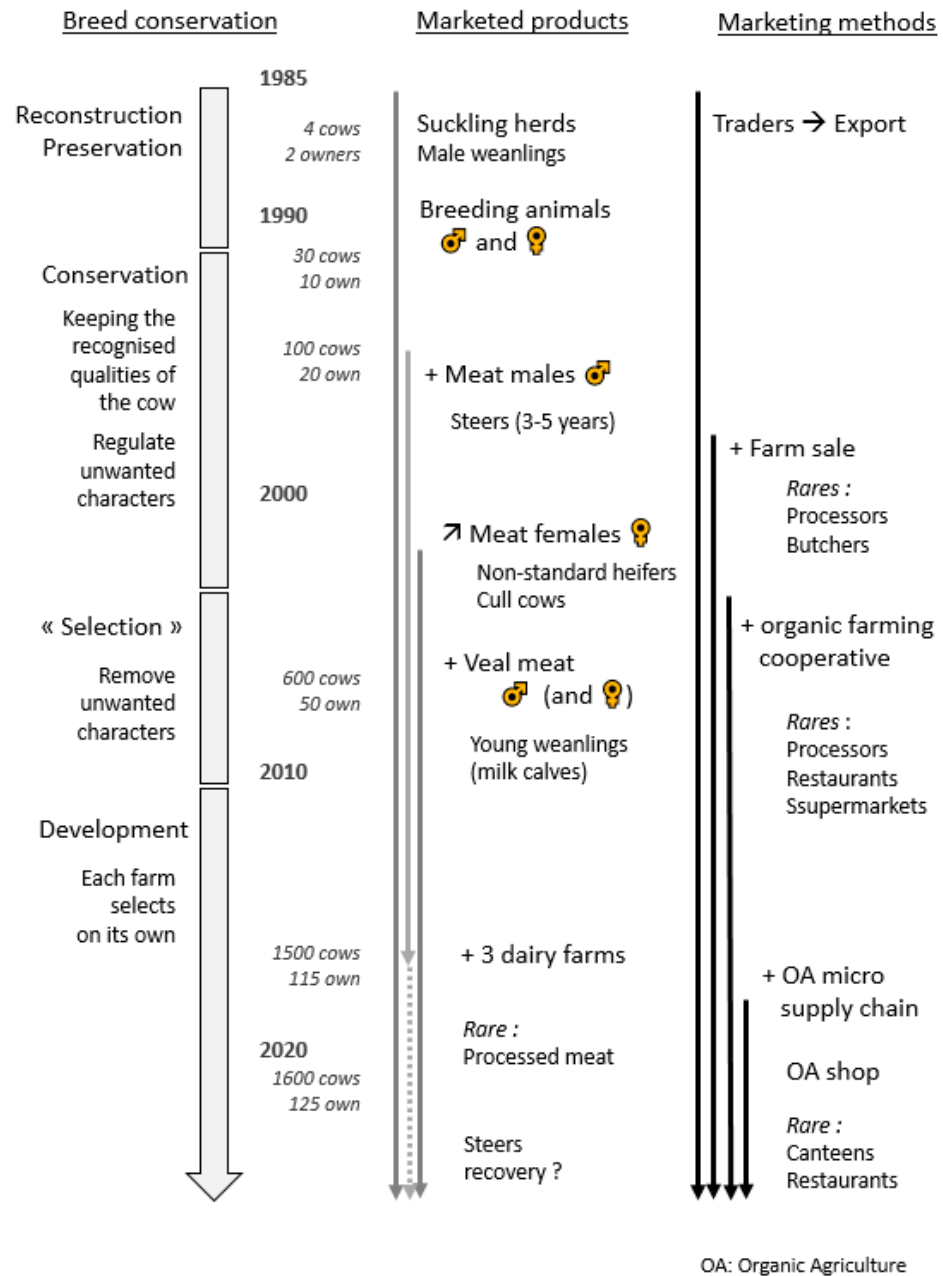


Figure 6. Dynamic of Maraichine cattle breeding. Schematic representation (OA: organic agriculture).

Table 1. Evolution of population size of the Maraichine breed and average inbreeding rate [5].

Year	1986	1990	1995	2000	2005	2010	2015	2020
Number of breeders	3	8	19	28	45	62	105	127
Number of cows (older than 2 years)	4	28	98	241	456	796	1304	1666
Number of natural breeding bulls	0	6	12	23	44	55	71	80
Number of artificial inseminations	-	44	17	21	26	27	96	54
Average inbreeding rate (%)	-	-	0.8	1.1	2.4	3.4	3.9	-

2.1. Decline, 1960–1980

In the pre-war period, the MA breed, like all the others, was reared on subsistence farms; it provided a small amount of milk and sometimes meat for the family. It was mainly valued for its traction force, particularly in the heavy clay soil of the marshes. The MA population declined between the 1960s and 1980s in favour of mechanisation and more specialised breeds. Many dairy herds opted for the Normande breed. Meanwhile, the Parthenaise breed, developed from the original MA breed, was selected for meat production by gradually developing the animals' conformation (i.e., an animal with a "good" beef conformation has significant back muscle development, corresponding to the so-called "noble" cuts of meat).

2.2. Reconstruction/Preservation, 1986–1990: An Aesthetic Heritage Approach

In 1986, a farmer identified the four last specimens of MA cattle. In 1988, he founded "The Association for the Valorisation of the Maraichine Breed and Wet Meadows" (the "MA Association" from this point onwards) with two other individuals, one from the French Livestock Institute (Idele), and the other a naturalist. From the beginning, the conservation objectives of the MA Association concerned both the breed and also the wet grasslands. Gradually, they re-established the population. To manage the risk of inbreeding, they sought other cows showing physiological correspondence to past descriptions and recollections of the breed. They took the parentage into account empirically by querying owners about their cows. They inseminated these cows with the semen of old Parthenais bulls designated as "old type", which were no longer used by Parthenais breeders. The aim was to find tall cows with a wheat colour, black mucous membranes, and long horns with black tips (often lyre-shaped). Once found, the cows were entrusted to the "owners", who had a few meadows, mostly in marshlands, and a stable or a shed. These "conservation farms" took care of the animals and the MA Association organised reproduction. At this time, almost all of the animals born were maintained as replacements. During this period, the MA population increased from four mature females from two breeders in 1987 to 30 females from 10 breeders in 1990 [5].

2.3. Conservation, 1991–1995: Control of the Animal Population by the MA Association

During the conservation period, the number of MA cows, bulls, and owners increased. The new farmers were also located in the marshlands, in the same area (called Marais Poitevin) where the founders sought cows and breeders to join the conservation programme. Idele was in charge of the animal inventory (as for other local breeds). These inventories were a tool to manage animal mating and cow movements between farms. Still today, the conservation strategy is not formally defined and functions through the use of inventories and farm visits. The MA Association is, above all, a farmers' association. The MA Association set up a novel system to stimulate and control population growth. It owned all of the MA bulls for natural mating and made them available to the farmers free of charge. The MA Association also owned 10% of each female, thus providing them with some control over sales. Pure-bred breeding was imposed by the convention for the conservation of the breed, which each breeder had agreed to. At this time, some farmers

started to rear MA cattle. They were breeders and/or cereal farmers who maintained, with a few MA animals, wet meadows that were not suitable for cultivation. These cows were desirable for their autonomy in these environments, their resistance to diseases, and also for their maternal ability. Natural mating was the favoured practice (Table 1 shows that the artificial inseminations decreased from 44 in 1991 to 17 in 1995). The calves that were not retained as replacements were sold for export (as weanlings). However, they often had a “poor” conformation and were not well-valued in the market. Therefore, phenotypic conformation became a criterion for selecting animals; the MA Association decided that males with muscular hypertrophy (double-muscled) would not be retained as bulls. The conservation purpose was to maintain the ease of calving and the hardiness of the animals, which was deemed necessary for the utilisation of the wet grasslands (western marsh grasslands have a short grass season and hot summers). Excluding the double-muscle gene was also a way of distinguishing MA from the Parthenaise, while the MA animals still carried the Parthenais breed code (for administrative purposes). Due to a good maternal ability, the females were predominantly sold for rearing, driving an increase in herd sizes. This conservation project was accompanied for a long time by geneticists from Idele who analysed the prevalence of the double-muscle gene in the MA population.

In 1995, in the Charente marshes, INRAE-SLP purchased four MA cows [1]. Researchers aimed to study a sustainable rearing approach based on the use of natural marshland meadows and the development of a local breed. The MA cattle were compared to Charolais (CH) cattle, which had already been studied on an experimental farm. At the same time, an agricultural secondary school also bought five MA cows, a notable shift from their pre-existing intensive cropping and dairy farming system. The use of the breed in both research and teaching environments was a sign of strong support for the MA Association and its conservation programme. This enhanced the reputation of the breed in the eyes of funding communities and the national breed organization in France. During that time, the MA population increased from 30 females from 10 breeders in 1995 to 100 females from 20 breeders in 1995 [5]. In these three periods, the breeders were all in the marshlands, but between the second and the third periods, farms dispersed further north and south.

2.4. Conservation/Valorisation, 1996–2007: Can the MA Cattle Be Preserved Be Valued?

In 1999, the MA breed was granted official recognition by the French authorities as a “very small breed” (less than 1000 individuals) with its own code (i.e., breed number 58). The number of animals increased again, from 100 females from 20 breeders in 1996 to 600 females from 50 breeders in 2007 [5]. The co-ownership of females was abandoned but farmers remained attached to the heritage value of the breed. A “bull farm” was set up within the farm of one MA breeder. The bull farm brought together bulls from one farm to another. It allowed farmers to observe and compare bulls: size, hooves and foundation, conformation, and coat aesthetics. Herd inventories were also used to compare lineage.

During this time, the primary research focuses were the performance of the MA herd, the farming system, and meat quality. The MA Association and researchers worked collaboratively on these issues. Mating plans were developed and “intervention research” was conducted with the input of sociologists [4]. The breed gradually gained the support of two regional conservation organisations created to promote the local breeds of two regions, i.e., the “Conservatoire des ressources génétiques du Centre Ouest Atlantique” (CREGENE) [11] and “Conservatoire des races animales en Pays de Loire” (CRAPAL) [12]. From this period onwards, the farms were spread out over two administrative regions along a 200 km coastal stretch.

Many farmers wished to improve the economic value of their products. The conformation of the female cattle was still sub-optimal for the mainstream meat market. Crossbreeding with more productive breeds (with “better conformation and faster growing” breeds from the region (Parthenaise, Blonde d’Aquitaine) or others (Charolaise or Limousine)) could have increased the value of weanlings, but this was still prohibited by the MA Association and its breeders, as the priorities continued to be the conservation and

development of the heritage breed. Farmers castrated and fattened males to reduce the need to sell females. At the same time, researchers began to study steer performance. This intensified the debate between breeders and raised several questions: should animals be selected for conformation and market value? Should double-muscle genetics be excluded from the population? The MA Association began genotypic analysis on potential breeding males. Even today, males with homozygosity of the cular gene are not selected [13]. These tensions between conservation and valorisation (between local and hardy animals on the one hand and marketable animals on the other hand) are also problematic for other heritage breeds [14].

Between 2000 and 2009, a small group of farmers and INRAE-SLP trialled direct-to-consumer sales of meat. This made it possible for breeders to judge the animals based on criteria other than conformation (e.g., hardiness, behaviour, and aesthetics) and by “ecological” practices [8]. This was also a period in which some farmers attempted to sell “pink meat” (veal) (from suckling calves reared until 6 to 8 months, whose meat is pink, neither white nor red due to their feeding—grazing or hay in addition to milk) [15]. One of the objectives was to reduce the export of weanlings to Mediterranean countries due to the low profitability and animal welfare impacts of doing so.

During this period, new farmers arrived and established herds, implementing novel breeding practices and focussing on grassland management. They typically produced animals using organic agriculture (OA) practices. Production was orientated towards the conservation of wildlife and biodiversity in marshlands and local meat sales were favoured [16]. Many of these new farmers established themselves in the northern area of the marshlands (Marais Breton) because of encouragement and support from local farmer associations. The number and diversity of farmers wishing to improve the economic value of their meat was increasing, creating a debate around the basic principles and practices. These principles had to be shared by all the MA breeders and by the main buyers (traditional butchers and direct-sale buyers at that time). From 2001 onwards, breeders tried to collectively draw up specifications for the production of beef, following the model of official quality labels. A regional quality institute helped the MA Association but the process was aborted in 2007 due to difficulties in facilitating cooperation between breeders. This was primarily due to differences in opinion, particularly with regard to elements of sustainability, such as biodiversity and the use of cereal feeds for fattening. The geographical distribution of breeders also proved to be a logistical challenge.

2.5. Valorisation/Conservation, 2008–Today: Diversifying Products and Buyers of MA Meat

In this period, the MA population increased from 600 females from 50 breeders in 2008 to 1600 females from 127 breeders in 2020 [5].

2.5.1. More Products and More Diversity to Sell

At the end of the 2000s, a group of organic breeders re-launched an attempt at defining common breeding practices with a new set of objectives and principles. At this time, many new breeders established their farms, choosing the MA cattle. Consequently, the demand for female cattle increased and many pre-existing farms sold their female stock to new breeders. The little-known “pink meat” was mainly marketed by those practising OA and most frequently sold by direct sale. At the same time, steer production was decreasing while the sale of female carcasses was slightly increasing. Breeders found it too constraining to rear steers for 3 to 4 years, in terms of space and fattening requirements. A few farmers milked MA cows and processed their milk. On its farm, INRAE-SLP showed that selling a calf as veal meat generated a 45% higher margin (marginal benefit, i.e., income for sale minus cost for cutting and transporting carcasses) than selling weanlings (averages from 2009 to 2020) [17]. However, some farmers considered direct sales to be time-consuming and outside of their skills and interests [9,18].

2.5.2. A New Collective Organisation through a Micro Supply Chain

In the mid-2010s, OA was becoming increasingly common, with many conventional farms converting to OA and new OA farms being established. The INRAE-SLP converted to OA in 2017. In 2018, they organised a “collaborative research” project on MA rearing. In addition to updating knowledge on livestock and meat, a large-scale program was conducted. This involved leading and participating in an innovative collective design process [19,20], which focused on systems for enhancing the valuation of the MA cattle and wet meadows. The collective design method used is called KCP (knowledge, concept, and proposals) [21,22]. They organised several workshops where they managed to bring together a diverse group of stakeholders (i.e., farmers, local institutions, supply chain operators, consumers, environmental associations, researchers, and farm advisors). The participants identified knowledge gaps, acquired new knowledge, and then reflected on desirable solutions to common problems. At the end, projects were defined concerning the organisation and governance of a local supply chain and the organisation of the local promotion of MA meat [19,20]. The implementation of these projects began in 2022.

At the same time, a group of OA farmers sought to expand their consumer base by raising awareness of what they saw as the environmental value of the MA breed and marshland environment. They developed management practices orientated towards the conservation of domestic wildlife and biodiversity (Signoret, op. cit.; “nature farmers” network Dulac and Signoret [23,24]). Their approach incorporated their rearing strategy with social networks and economic opportunities. They established a micro supply chain called “Biodiversity Maraichine” [25], associating naturalists of a national nature protection association [26], the MA Association, and two organic cooperative shops. A set of specifications for practices was drawn up. It considered breeding practices, the quality of the animals, meat sold, and the ecological value. Through that, naturalists, consumers, and breeders discussed sustainability and progress. For the year 2021, this micro supply chain marketed a total of 16 cows and 22 calves, which came from 19 OA farms (at this point the MA Association comprised of 127 farms, 30 of which were OA). More recently, they have begun to sell veal to school canteens and restaurants. This diversification requires managing the “material balance” of animal carcasses, i.e., organising and prioritising the supply of different pieces of meat to different buyers. Achieving this requires knowledge of the composition of carcasses, which is an ongoing objective of a regional research programme.

As the population and the number of breeders increased, the collective management of conservation also changed. Currently, the MA Association no longer buys all of the bulls and some MA breeders manage the selection by themselves (female replacements and also sometimes bulls). For these selection processes, CREGENE has reported that the criterion of muscular hypertrophy is less discussed between farmers. A consensus seems to be emerging amongst farmers about accepting a great diversity of cattle phenotypes within MA populations, whether “aesthetic” or functional (robustness, productive aptitudes).

3. MA Breeders’ Farming Systems and Representations

Three surveys were conducted with MA farmers: in 2004 [27], 2018 [28,29], and 2019 [30]. The 2004 survey focussed on farming systems and accounted for 84% of the 45 MA breeders. The 2018 survey also studied farming systems but went further to also investigate the social representations of breeders. The 24 farmers surveyed (21% of the 115 breeders) were chosen to represent a diversity of situations. In 2019, a qualitative survey focussed on 11 breeders’ representations of biodiversity.

Table 1 summarises the information collected concerning farming systems in 2004 and 2018. In 2004, 42% of MA breeders were pluriactive workers (e.g., with a complementary non-agricultural activity). In 2018, the rate of pluriactivity had reduced to only 25% of farmers surveyed, suggesting a “professionalisation” of MA rearing. In 2004, as in 2018, most farms had multiple agricultural ventures. Half of them produced cash crops, whereas, for two-thirds of the farmers, marshland meadows represented 100% of their grasslands. Over this period (2004–2018) herd sizes gradually increased from an average of 10 head

to 30 head, though there was a large range in herd sizes (Tables 1 and 2 and Figure 6). The majority of farmers had other livestock, such as suckling cattle of other breeds, dairy cattle, goats, or poultry (66% in 2004 and 75% in 2018). Those who had another suckling breed represented 47% in 2004 compared to only 25% in 2018, which possibly illustrates a preference for the MA breed. In 2004, as in 2018, reproduction was mainly by natural mating with bulls (owned by the MA Association). In 2004, spring calving represented 92% of farms, consistent with the use of meadows and natural mating in pastures. In 2018, exclusive spring calving only accounted for 38% of farms, whereas 42% of farmers spread calving across the year. The direct sale of meat explains the need to spread out calving to meet year-long market demand. In 2004, only 58% of farmers sold animals for slaughter (42% sold finished animals or weanlings) compared to 92% in 2018. The direct sale of meat has developed substantially: in 2004, 45% of farmers were selling directly on-farm, compared to 75% in 2018. Direct sales to catering (e.g., restaurants) continued, but represents a very small portion of sales (<1%). In 2018, eight farmers sold more than 80% of their animals in short supply chains (SSC), ten farmers between 40–60%, and five farmers less than 20%, while only one farmer did not sell any animals in SSC.

Table 2. Results of the two surveys with Maraichine farmers (2004 [27] and 2018 [29]).

Variable	Survey 2004	Survey 2018
Number of Maraichine cows in the population	450	1500
Number of Maraichine bulls	44	84
Total number of livestock farmers	45	115
Number of surveys (% of total number)	38 (84%)	24 (21%)
Surveys results:		
Number of farms located in marshland	26%	92%
Elements of activity and production		
Pluriactivity: does the farmer have another, non-farming activity?	42%	25%
Does she/he produce crops for sale?	55%	54%
Does she/he have another livestock?	66%	75%
Does she/he rear another cattle breed?	47%	25%
Average number of cows in the herd (min–max)	10 (2–36)	30 (2–80)
Distribution of calving		
Spring calving	92%	38%
Autumn calving	0%	21%
Calving spread over the year	8%	42%
Marketing		
Does she/he sell meat animals? (not only weanlings)	58%	92%
Does she/he practice direct sales?	45%	75%

Figure 7 shows that MA cows are reared on farms that are broadly diverse, either in terms of agricultural area, the number of cows per farm, or farming systems (survey 2018). Maraichine cows are reared in grassland-based systems (11 farms of the 24 studied: 46%) and in mixed crop–livestock farming systems. Farms with cash crops represented more than 25% of used agricultural area, also accounting for 46% of the farms. Two farms grew some cash crops (<20% of UAA) and had a grassland-based system.

Farmers' perceptions of wildlife and biodiversity varied greatly [28]. Some farmers placed an inherent value in it or viewed it as a source of personal enjoyment. Many farmers considered custodianship of it as a source of accomplishment and pride, using it in communication and marketing to their customers. Others saw utility in it, valuing the economic benefits that can arise through sound ecological management ("in dry periods, we are happy to have this type of meadow"). Meanwhile, some regarded it as of little concern or responsibility to them ("I am not a nature reserve, my job is to produce"). In reality, any individual farmer harbours a blend of these attitudes, in varying degrees.

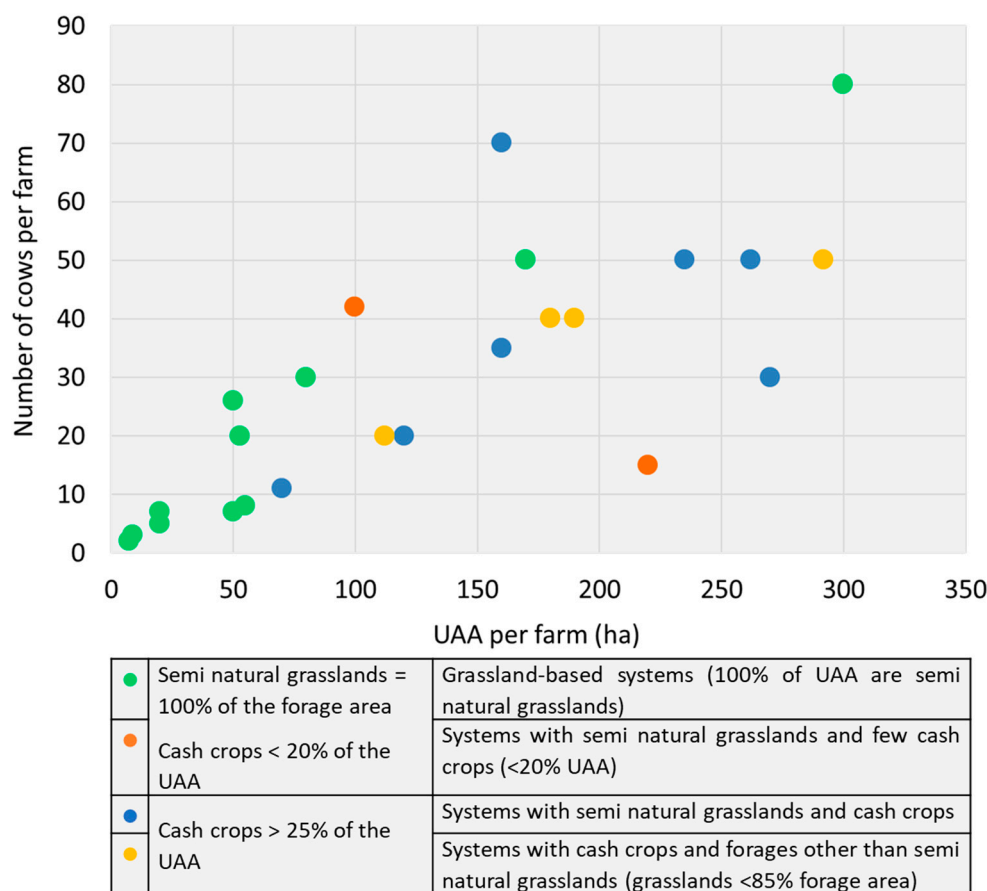


Figure 7. Types of farms defined by their main production (% cash crops) and forage system (% grasslands in forage area). They are positioned on a graph crossing used agricultural area (UAA) and number of Maraichine cows [29].

The 2018 survey highlighted the diversity of 24 farmers’ perceptions around the MA breed [31]. All farmers perceived the breed as being rustic, easy to breed (especially due to its unassisted calving), and having good disease resistance, good milk yields, and a high maternal ability. However, perceptions were contrasting when it came to ecological management, cattle nutrition, and marketing. Whilst many farmers recognised the specificity of the breed for the management of the marshland environment, others believed that any breed of cattle would have sufficed. With regards to nutrition, many appreciated the breed’s capacity to utilise rough wetland grasses with low nutritive value and low levels of intervention for fattening. Contrastingly, other farmers opt for a more conventional productivity-based approach, utilising fodder crops or concentrates [29].

4. Performance of the MA Cattle

This section summarises the experimental work researchers conducted to assess the animal performance and traits of the MA cattle. These results were obtained from four data sets described in the Supplementary Material (S1).

Some of the rusticity traits mentioned by the breeders are well demonstrated by scientific long-term data. Roche et al. [32] confirmed the “ease of calving” of the MA breed. From 2000 to 2005, more than 97% of the MA cows calved without incidents, whether they wintered in a stall or were free range. Conversely, in the same herd, Charolais (CH) cows were helped in 6 to 46% of calvings, depending on the year. Data collected on MA cows exclusively from 2010 to 2020 showed the same trend with 99% of births requiring no calving assistance (652 calves in total). The low birth weight of the MA calves compared with CH calves may partly explain these results (mean and standard deviation (SD)): 38.0 kg

(SD = 6.2; $n = 27$) vs. 48.2 (SD = 5.5; $n = 38$), respectively. MA calf weight was confirmed with long term data: 38 kg (SD = 3.4) on 431 calves from 2010 to 2016. Regarding other reproductive metrics, MA cows are not outstanding. They have a significantly lower calving rate compared with CH cows (94.4 vs. 98.2, respectively) explained by the failure to get pregnant and embryo mortality events. However, significantly lower calf mortality (5.0 vs. 11.1%) leads to a similar weaning rate (number of weaned calves/number of cows put to bull) between the two breeds [32]. These MA calving rates were lower during the period 2009–2019 and were higher in spring than in autumn calving (94 vs. 88%, respectively) with once again very low calf mortality rates (7 and 5%), which leads to acceptable weaning rates (89 vs. 85%). This decreased reproductive performance in autumn is once more explained by failure to get pregnant and embryo mortality events. In terms of milk production, MA multiparous cows produce on average 8.0 kg/day (SD = 1.71) over 25 weeks post-calving, which makes it a breed comparable to the Salers breed, which is considered as a good milking suckler cow [33].

During this same experiment, autumn calf growth rates were 945 g/d (SD = 262) from birth to six months, without any supplementation except hay ad libitum during housing. Furthermore, Nozières et al. [34] showed that there was not a significant difference in growth rates between CH and MA male spring calves from birth to weaning (1000 g per day), supporting the good maternal ability of MA cows. Nozières et al. [34] reported that CH steers performed equally well, or better than MA steers under marshlands conditions. The authors suggest that the level of performance of these CH steers could be explained by an adaptation of the herd reared and selected in this environment for 25 years. A dataset provided by Hocquette et al. [35] on carcass characteristics confirmed the lower carcass value attributed to the MA animals according to meat sector criteria. Most of the INRAE-SLP MA steers ($n = 74$) are classified R+ (22% of the animals), R= (43%), and R− (15%) according EUROP classification, similar to Salers steers (R=: 74% and R−: 24%; $n = 72$), while CH steers are classified U (41%, $n = 535$) and R+ (45%), and Limousine in U (17%, $n = 59$) and R+ (83%). Lastly, measurements on the muscle characteristics and meat quality showed that it was difficult to assertively characterise MA meat due to a high variability of the results between animals, whereas CH steers were associated with a higher percentage of fat and a lower tenderness [35].

Finally, regarding animal health care, long term data on veterinary expenses attest to its good disease resistance: only EUR 17.60 per livestock unit per year (SD = 11.50) from 2009 to 2020, of which 49% corresponded to treatments to control gastrointestinal nematodes, which are very common infections in wet grasslands.

5. Discussion and Conclusions

This case report of a heritage breed and its rearing for 30 years is also the chronicle of a heritage cattle breed and the research it has generated. The MA Association succeeded in restoring the MA population from 8 to 1666 in 30 years and in getting 127 breeders to join the conservation programme. They developed original tools, such as the co-ownership of females, the ownership of bulls, and a bull farm. Their effectiveness at the beginning of the programme was underlined by the low inbreeding rate of the population (3.9% in 2015). The multiplication of breeders led the MA Association to reflect on the valorisation stakes. Currently, the micro supply chain “Biodiversity Maraichine” gathers diverse stakeholders to improve economic value for organic farms, to foster wildlife in marshlands, and to increase the awareness of consumers concerning these factors. This report highlights a programme that has a far broader value for breeders than an economic, animal performance, or even breed conservation objective. It illustrates the steps of this programme and underlines the solutions they designed and also the social difficulties encountered; dealing with differences of representations is an issue for a collective organisation.

This case study can act as a source of insight and a framework for the revival or development of other ruminant breeds, providing information, ideas, and lessons. The animal ownership model, micro supply chain, and diverse collaborations are examples of

novel approaches that could potentially be adopted/adapted for other ruminant species. Such approaches attracted funding, new farmers, and raised the value and status of the MA breed. Meanwhile, challenges such as difficulties in establishing meat quality protocols highlight potential barriers to be considered.

Research surrounding the MA breed and MA Association covered a variety of disciplines. Farming-systems science showed the socio-economic and technical diversity of farms. Social sciences showed differences between actors' representations, showing that diversity was a tool to facilitate dialogue. Animal sciences analysed animal performance, helping breeders to better know their animals. The researchers' positions vis-à-vis the breeders have also varied, depending on the person and the period and especially the question at stake. Sometimes the researchers' objective is to generate knowledge and disseminate that to the breeders (e.g., milk production assessment). They often co-construct the questions and the research protocols they implemented (e.g., meat quality analysis). In some cases, the researchers participate in the MA Association strategy for the conservation and valorisation of the cattle. They thus get involved in this action, as a facilitator but also as an actor (a breeder concerning the experimental farm).

Research is ongoing and continually developing. Social science researchers studied social representations and, now, with ecological and technical sciences, they study collective organisations to sell MA products in short supply chains and also to manage wild biodiversity at farm and territory scales. On the experimental farm, animal science research is addressing new questions to test cattle rusticity (i.e., welfare during hot summers, watering quality in marshes) and concerning meat production (i.e., assessment of calves' morphologies, analysis of carcasses composition, and on-grass fattening and its role on meat quality).

Lastly, this case study provides an example of how a small number of driven and innovative farmers can work cooperatively to develop and establish something far greater than their own farm.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/ruminants2020011/s1>, Four data sets used to analyse MA animal performances [36].

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