

Department for Animal Breeding, Nutrition and Laboratory Animal Science
Division Animal Breeding and Genetics
University of Veterinary Medicine

**Endangered Breed Cattle in Brittany France and
Creole Cattle Breed from Mauritius**

By

Jhurry Nazneen Banon

Supervisor:

Dr. Gáspárdy András

Associate professor, Head of department

Budapest, Hungary

2021

Table of Contents

	page
1. List of figures.....	2
2. List of abbreviations	3
3. Introduction and aim.....	4
4. Literature review.....	5
4.1. History of cattle breed.....	5
4.2. The rare breeds in France and Mauritius	6
4.2.1. Armoricaine breed From France	6
4.2.2. Froment du Léon.....	8
4.2.3. Creole Breed from Mauritius	10
4.2.4. Causes for the decrease of the local breeds	13
4.2.5. Why we need to conserve our native cattle breeds?	15
5. Techniques used to repopulate.....	17
6. Food and Agriculture Organisation (FAO).....	20
7. The breeding organizations.....	21
8. Discussion and Conclusion.....	22
9. Summary	24
10. Bibliography	25
11. Annex.....	28
12. Acknowledgements.....	31

1. List of figures.

	page
Figure 1 Armoricaïne cow	7
Figure 2 Brittany butter.....	9
Figure 3 Froment du Léon	9
Figure 4 Creole cow.....	11
Figure 5 Creole cow with some different characteristic but still believed to be pure.....	12
Figure 6: Open nucleus herd breeding scheme-Basis for conserving an indigenous breed and upgrading local population.	19

2. List of abbreviations

AI = Artificial Insemination

EU = European Union

GLAS = Green, Low Carbon, Agri-Environment Scheme

DAD-IS = Domestic Animal Diversity Information System

EFABIS = European Farm Animal Biodiversity Information System

FAnGR = Farm Animal Genetic Resources

M = Male

F = Female

3. Introduction and aim

As the world progresses, there is more and more development in the livestock to have a better production rate. With the involvement of humans, the beneficial characteristics of an animal is kept whereas less helpful characteristics are removed completely across generations. This intervention however has a good and negative sides. While the production of milk increases every day, this doesn't create much variations between generations which make them more prone to disease or decrease their longevity. More cattle breeds are inclined to extinction because of loss of various genetic diversity. Nowadays, thanks to the evolution of technology, we could recognized extinction before the last animal is lost.

During the progression of my thesis, my aims are to review articles papers, books and publication journals on my chosen topic to identify how cattle breeds might be categorized endangered in some EU countries and I would also mention the cattle breed from my country Mauritius named the “ Criollo or Creole” cattle breed which is listed as endangered.

4. Literature review

4.1. History of cattle breed

More than 1000 breeds are listed worldwide with some of them got used to the country's climate while others were introduced by human. Initially cattle have been classified in three different category such as: *Bos taurus taurus*; *Bos taurus indicus* and *Bos taurus primigenius*. Unfortunately today, *Bos taurus primigenius* has been listed extinct since the early 1600s because most of their home was being replaced with farming and being hunted by humans.

Throughout the years, cattle has been of great significance in the farm industry for their productivity and good attitude during handling, from being mounted to producing meat or milk and categorized as "multipurpose" animals. In some countries, they are also considered sacred in religious belief or as an amount of your asset or sacrificed religiously. They have been the most frequent largest species to be domesticated and will not be able to survive in the wild. Nowadays some of the breeds are considered as a companion pet or rescued from the farming industry to be kept until they died of old age.

4.2. The rare breeds in France and Mauritius

4.2.1. Armoricaire breed From France

France is a country found in the western part of Europe. In 2018, France livestock industry has counted approximately more than 19 million bovine population, which is more than what the other European countries have. It is known as one of the top high cattle population. Due to its high cow production, France is able to export cattle mostly to European countries like Italy and Spain for fattening. Brittany is found to engulf the western side of France. In 2018, a number of 777,800 dairy cow, 3,900 veal and 6,600 cattle were counted in Brittany. An amount of 158,000 tons of beef production was recorded the same year and a total of 26% was accounted for the butter production. Brittany occupies 23% of the national organic dairy cattle breeding.

The Armoricaire or Armorican cattle are a French hybrid between the Bretonne Pie Rouge and the English Durham or Shorthorn breed introduced in Brittany in the 19th century. The name Armoricaire was established in 1923 and an official herdbook was set up in 1919. In 1960, along with Meuse-Rhine-Issel and Rotbunt cattle, to design Pie Rouge des Plaines dairy cow so as to have a fresh milk producing breed with better meat yielding traits. In 1982, using the Armoricaire, they tried to introduce the Red Holstein with bigger size and udder type but unfortunately it failed due to the low meat production.

They are usually enrobed with a red colour, a white marking and mucous is light coloured (**Figure 1**). Both the female and male have horns, and they are quite short in dimensions. The bulls can weigh up to 650kg whereas the female weight approximately 650kg so they are medium sized cattle with an average body height close to 138cm for the cow and over for bulls. The robust look of the animal is frequently deceiving since, they are good natured which can survive in cold condition and require very low maintenance. The breed was initially used as meat and milk production but nowadays they are only used for meat. They tend to fatten up very easily, so the heifers are usually monitored before the mating season. The production of milk is usually 4500 L in one lactation of 305 days.

Unfortunately in 2007, FAO of the United Nations registered the Armoricaire breed as “critically endangered”. The population size of the breed has decreased a lot in the previous years, with a total heads of 240 in 2005 and 263 in 2014.



Figure 1 *Armoricaïne cow*

Image sourced: Wikipedia

4.2.2. Froment du Léon

Froment du Léon cow is another French breed indigenous to Brittany. They are described as both “cattle for women” or “castle cattle” because of their good character for being obedient mainly valued during the period where the lords governed from the castles.

Milk production is of very good value, is considered very rich and producing a total of 3500kg during the lactation period of 305 days. It is found that the abundant amount of beta- carotene, vitamin D and omega 3-6-9 in the milk cause the butter (**Figure 2**) to have a characteristic yellow colour. They have a very good fat production, approximately 5.5%. The salted Brittany butter is a well-known local product used in the region traditional gastronomy for its good taste. They are usually enrobed with a lighter or darker wheat colour and maybe marked with spots or patches with their horns pointing upwards (**Figure 3**). They can weight around 500kg for cows while the bulls are heavier around 600-800kg. Their characteristics are as the Armoricaire breed, rustic, well-adjusted to outdoors environment and good natured.

In 1907 a herd book was recorded, the population size went from 25 000 cattle in 1950 to 304 cattle in 2015. Even though the milk is of very good value and rich, especially good for making cheese, the yielding figures are not persuading enough for the agriculture economy. They are mostly considered as dairy cows and would have disappeared after the Second World War. It has been found that the breed was used along with the Alderney breed were used to form Guernsey cattle breed.



Figure 2 *Brittany butter*

Image sourced: uhule.com



Figure 3 *Froment du Léon*

Image sourced: paysan-breton.fr

4.2.3. Creole Breed from Mauritius

Republic of Mauritius is of volcanic origin is an island found in the Indian Ocean approximately 2,000 kilometres away from the south-east seashore of the continent of Africa. The island together with the Reunion and Rodrigues island are identified as the Mascarene islands. The population size sum up to around 35,000 cattle consisting of different breeds but it is mainly the Creole, Friesian, and cross breed Creole- Friesian that are governed the island.

Among them is the Creole breed also recognized as the “Vache Creole” is identified by its off white colour coat, lack of horn, a rounded protuberance on the back with off white hooves and light pink ears(**Figure 4**). Some of the Creole cattle have some slight distinction that are thought to be cross bred but are taken into account as pure (**Figure 5**). The breed is categorized as a dual purpose cattle used for both milk production and the males for beef production. It is assumed that the breed which is unique to the island was introduced from Normandy and Brittany by the French during 1721- 1810 but it is just a theory. In 1966, over 75% of the Creole breed cattle occupied the island but unfortunately it has since been decreased.

M adult weight around 600-700kg while the F weight around 450- 550kg. They have an average lactation period of 255 days with an average lactation production of 2206 litres and their average age at first calving is 964. They are considered robust because they can live on hard conditions and still be able to perform better than the exotic breed. We found average weaning weight of the males at 90 days can be found to be 82.1 while the female ones is around 77.5 which might not be good but on the other hand they can have other undesirable traits that might be good for later. A survey in 2005 was done to identify how many pure bred cattle were on the island, 252 animals from small holdings and 21 from the authority owned farms were considered pure.

Livestock in Mauritius have always been fed with sugar cane, primarily during the sugar cane harvesting season from June to November and also highly fibrous mixture of different fodder available all year round but used when sugar cane tops are not available. Back in the day, farmers tend to use concentrates rarely but nowadays concentrates are commonly used by farmers during late pregnancy or for one or two months following calving. Although, cattle on the government or research farms are always fed with concentrates and supply with minerals.

A long time ago, Creole cattle were mainly kept in small quantity with approximately 1 to 5 animals in a small animal husbandry as a secondary activity. Originally they were tied in stalls in a shed with a roof made of straw or leaves. With time, the sheds turn into buildings made of bricks or concrete together with iron plates and factors such as flow of air and light dispersion are taken into consideration.

Before natural breeding was used with Creole bulls but in 1960 artificial insemination was introduced. Now, the Creole breed can be cross bred with other breed like the Friesian. The cattle in Mauritius are not influenced with complicated diseases, they are rather subjected to sub- clinical mastitis. A survey in 1974 done by the research unit in Mauritius has shown that 72% of the animals are affected by mastitis in one or more of their mammary gland. We can find also biting flies such as *Stomoxys nigra* and *S. calcitrans* in humid areas, the central part of the island, which affects the cow.



Figure 4 *Creole cow*

Image sourced: Laurent Avon



Light pink ears, muzzle and eyelids, hornless. 100% pure.



Light pink ears, hornless with grey pinkish muzzle. Cross- bred.



Light pink ears and eyelids, with horns. Some grey dots on muzzle. Cross- bred.



Ears and eyelids pink with slight black patch. Black muzzle. No horns. Cross- bred.

Figure 5 *Creole cow with some different characteristic but still believed to be pure.*

Image sourced: Regis Lam Sheung Yuen

4.2.4. Causes for the decrease of the local breeds

The advancement of agriculture together with various innovative machinery were used to raise the production and enhance the efficiency of farming. Rapid growth of the economy causes the farmers to drop the local breed because of their low production and purchase high productive breeds. There was more decrease in local breeds with the introduction of tractors in the 19's because cattle were previously used to cultivate lands or used as a mode of transportation for the crops, therefore a multipurpose cow with a low production. The rise in beef market among consumers meant, using a high performance beef breed.

While machines were created to cultivate land easily, other machines were designed to milk 6 or more cow at a time operated by one person or automated, and aim mainly for Holstein Friesians breed. They are artificially selected to be highly producing cows. In Mauritius, they are currently used to crossbreed with local Creole cattle to introduce new lines. Even though, this helps in creating genetic variety, it contributes in losing the local breed since then there will not be Creole breed which are pure anymore. Also the legalization of importing slaughter animals can discourage the local farmers from investing in the local breed.

Nowadays, farmers are faced up with a lot of obstacles, like climate difference, increased in energy costs, rural decrease and food security. In Mauritius, precisely farmers have a lot of difficulty to find local food such as sugar cane tops or mixed forages due to heavy rains or long droughts or even extended weather. Another factor that has affected the breed in Mauritius is land use for keeping cattle, due to the housing construction and workplaces, farmers cannot expand their farms. Also since Mauritius is a small island, trying to produce food crops to provide both the locals and agro business costs a lot of money which does not favour the agriculture.

Some of the reasons of disappearance of the breeds can be unknown, wars, pests, pandemic diseases and general. Or it can happen that the breed has a changed of name. The rate at which the genetic diversity in cattle is lost is higher than the appearance of the modern new breeds. They can lose their genetic diversity just by crossbreeding with other breeds of the same origin but it hasn't been acknowledged then by the authorities.

The age difference between farmer's generations to hand over the farm and activities has been found to affect the farm industry. More and more inherited young farmers choose to not go into agriculture industry which lead to less farm in the country and eventually no one to relay the local breeds which is the case in Mauritius.

4.2.5. Why we need to conserve our native cattle breeds?

In the development of agriculture, native breeds have only been given a bit of attention. Nowadays with all the changes that's happening in the world, native breeds are being brought back into farming.

Native cattle have always been considered to be more robust than the new breeds. They can survive on scarce food meaning food security is not gonna be a problem. Economically they are less expensive with having less human interventions since they can resist diseases like respiratory infections, parasites and heat. Unfortunately, with the weather changing every day from very hot during summer to very cold during winter, specific cultivation is becoming more difficult and expensive to grow along with keeping modern breeds. So farmers today can be found more prone to reintroduce native breeds in their farms. Even though, the local breed cannot provide the level of high productivity as the exotic breeds, it can overcome all these things. And with the importation of cattle, it can happened that we import the other countries diseases which can be fatal to the local breeds since they might not have immunity against the diseases or diseases that is present but with different bacteria and increase the risk of the local animals.

Unfortunately today, it has been recognised there is a lack of genetic diversity among modern breeds. This is where the native breeds are being taken into consideration. Using native breeds in selection programs can increase the chance of genetic improvement for future generations. It also gives the opportunity to use various types of foods for the breeds and to have a productivity as the exotic one but to be resistant to the local conditions. This allows researchers to find a better understanding of immunity and vulnerability of the breeds providing a better management of the treatments and protocols.

They have a special place in the society and culture of the country, so losing them means like losing some part of the cultural heritage. Nowadays, they are also kept as pets or as animals to be presented in local or international societies show so as to determine the best breeds. It is believed that wild environments are considered more important to save than domesticated species. But it really is the domesticated animals that help in the human survival if look after carefully. Today, hornless cattle are preferred over horned one because usually horned ones they tend to get more injured during transportation or slaughterhouse causes losses in finance. Since the Creole breed is hornless, it can be found that farmers are more prone to them.

5. Techniques used to repopulate

Conservation genetics is described as the utilisation of genetic theory and methods to minimize the risk of extinction in endangered species. Conservation genetics also concentrates on the outcome which might have grown from the decrease of formerly big outbreeding populations to a smaller group which decline because of decreased genetic diversity. A lot of small endangered populations have decreased genetic diversity or are closely related within their group. Even though these native breeds remain in rather a small populations, they can be of great importance to farm industry and to value of life. They have particular traits, which have importance in preserving the environment, and characteristics which make them very convenient to less intensive agriculture techniques. Even if in the farm industry some people don't believe that the native breeds are of great importance for today, they might have some good traits that will be valued in the future.

Moreover to having local farms contribution to conservation of native cattle, protecting gene code for the long haul at very cold condition also further add to conserving the variety of cattle breeds in France. Thus, cryoconservation helps in a certain way to preserve endangered breeds in disappearing completely and to keep the national gene code inheritance of native or good animals. Since 1980, cryoconservation meaning *ex situ* is being used for the collection of semen from different farms of native animals. In 1999, the National Cryobank was created to regroup the regional's collections making it easier to share with the other breeders and species and also as a safety net for the future. The National Cryobank is funded by the Ministry of Agriculture and has created new programs for other species where no strategy of this kind has been introduced. Artificial Insemination has been completely introduced in livestock management. These conservation plans are established on the investigation and yearly record of all the livestock together with the farmers forming an inventory which is issued yearly and hand out to all livestock holder. It is essential for breed development and has aid support from the state through the research of the Institut de l'Élevage which manages the herd books of the majority of the breeds, together with many other regional organisations (regional conservation centres, farmer's associations).

In Mauritius, the department of Veterinary Services at the Food and Agricultural Research and Extension Institute ensured the conservation of the Creole cattle breed. One way of the breeding program is the artificial insemination with frozen sperm obtained from productive healthy bulls or with frozen sperm imported from abroad to develop new breeds. Unfortunately, whilst in developed countries the breeding programs are established on the foundation, which permit the utilization of the artificial insemination together with considerable analysis and information recorded and the male significant genetic benefit, here this network doesn't work. With such limitations and assets, Cunningham in 1979 designed an open nucleus- breeding program. Primarily, the better cows are chosen from the small regional farms and government farms and transported to the nucleus herd. Due to the absence of identification of the livestock and their products, along with no administration backing up the tag numbers, it can get quite complicated for authorities to follow up. In 2018, the National Animal Identification System was introduced, which has effectively helps to conduct better the veterinary services and Artificial insemination. This also allows to follow the movement of the animals, the births and deaths and even the diseases or problems encounter. The development of FAnGR has been put in place and is slowly being introduced as a way of collecting and recording data to have a more control on the population of the livestock.

Open Nucleus Breeding Scheme for Conservation and Improvement (involving purebreeding and crossbreeding)

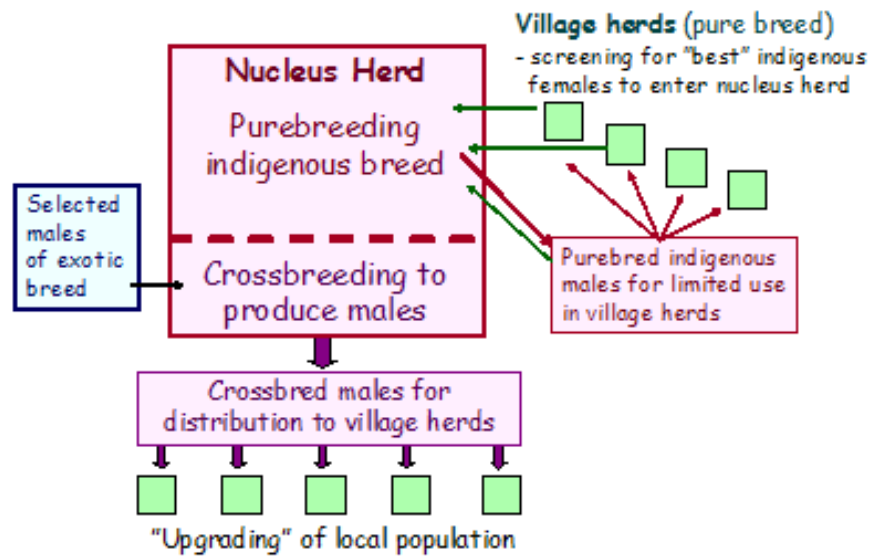


Figure 6: *Open nucleus herd breeding scheme-Basis for conserving an indigenous breed and upgrading local population.*

Image sourced: G. Saraye RS/SRS 2014

6. Food and Agriculture Organisation (FAO)

The Food and Agriculture Organisation of the United Nations ensure the preservation of plant and animal genetic potential. In 1983, a committee on genetic potential was created for Food and Agriculture issuing an international assembly that particularly focuses on the genetic diversity for food and agriculture. They have located the threatened species around the world and has implemented schemes to conserve these crucial assets. FAO has a department that is committed to the animal genetic potentials.

The farm animal genetic resources successful management as per the FAO involves a full understanding of breeds traits, together with the population density and grouping, how they are geographically located, and inbred and outbred genetic variety. The combination of these unusual kinds of information generate the best full description imaginable of genetic diversity in and between breeds, and hence enabling a successful organization of FAnGR. These goals are tackled by one of the four Strategic Priority Areas of the Global Plan of Action for Animal Genetic Resources taken on by 109 countries at the first international Technical Conference on Animal Genetic Resources, conducted in Interlaken, Switzerland in 2007, and validated by FAO Conference (FAO 2007).

The DAD-IS has been created by FAO to allow considerable available online information, instruments, instructions, recommendations, page links and people's contacts to help the organization of farm animal genetic resources. EFABIS has been created from this network.

Many corporations support collaborate with the FAO on different preservation schemes such as Rare Breed International (RBI), European federation of Animal Science (EAAP), United Nations Environment Programme (UNEP), and World Wildlife Fund for Nature (WWF) and the World Conservation Network (WCN).

7. The breeding organizations

France Génétique Elevage, conservation programs were created in 1970 together with the financial help from the Ministry of Agriculture. The programs began in 1976 for the Bretonne Pie-Noire and the Flemish breeds to finally focus on 15 more niche breeds which were primarily started by the Institut de l'Élevage. The base of the programs are to distinguish, know the whereabouts and traits of the today's breeds, groups and animals. It includes constant refreshing of national record (animals and farm), to which each M and F are valued for the upcoming future. The breed worthiness and the value of each animal is evaluated in respect to the conservation aims. The top heifers are located and work with them to produce new genes of bulls, so the collected semen from them can be cryopreserved in artificial insemination centres but they have to have a mutual correspondent to have a normal breeding of the groups for the future. Livestock breeders are allowed to have access to the collected semen from bulls chosen on historic types. Data of individual breeder and practical details are monitored and recorded. The Armoricaine breed which was once closed to extinction, has been able to reach 301 cows on 81 farms with the help of the organisation today. While the Froment du Léon breed reached 344 cows on 98 farms. There is another organisation that helps breeders to achieve the conservation of the breeds is named the "Races De Bretagne".

In Mauritius being an island, most of the livestock are monitored by the local Curepipe Livestock Research Station. It manages planned investigation in the farm and poultry section and adjusts related information and systems to the local weather. The department has closed connection with the researchers, smallholders and the rest of the staffs to make sure that the projects are arranged accordingly. It is more specifically the Animal Production Division, one of the subdivision that focuses on the preservation of livestock genetic resources. Their goals is to also increase the efficiency of the farm animals along with maintaining the biodiversity of the animals or using the locally accessible food supply. There is also the Livestock Extension Division to support the partners in the livestock part and supply aids all around the island. Their main goal is to supply assisting helps and guidance to the agriculture community for sustainability of the animals' efficiency, ameliorate living conditions of farmers and to reinforce food security.

8. Discussion and Conclusion

I have evaluate data on these breeds. I have viewed the techniques of conservations. The total count of these native breeds has been continuously increasing. This is positive reports of these breeds that were near to be vanished from the earth. The genetic characteristics of these breeds which could be beneficial in the near future have been conserved. The lack of horns of the Creole cow breed is a great advantage for owners. Farmers are realising the advantages and are especially trading the Armorican meat since the fattening process is quicker. Froment du Léon has a milk rich in fat which gives it an advantage for butter- making and makes the region popular for this. These breeds have all got used to the respective country climates and are robust ones that give birth to better calves. Through attempt and acknowledgement of the devotee breeders and the organisations, these breeds are having a comeback. Froment du Léon has been exhibited at the international agriculture show, Ceva Santé Animale and the Foundation du Patrimoine, and was among the winners for genetic biodiversity in 2018.

Molecular studies in 2013, on the Creole cattle breed has shown that there is a restricted amount of pure breed that is left on the island. According to the report of 2005 (Regis Lan Sheung Yuen), the average lactation length (days) was found to be 255 ± 62 (average \pm SE) while the peak production was found prior to 30 days. Thus, the conservation programs help in keeping the breed alive.

The most successful technique of preservation is the involvement to fully use the breed. It requires precise and cautious judgement of the breeds in their local environment in contrast with the imported breeds and theirs crossed breeds in the exact viable circumstances. Breeds that show good ability should be put into assessment and development programs either in research station or outside in the field conditions.

Breeds are considered part of the conservation that each help separately to the biodiversity of the cattle. Successful genetic management is attained by keeping records for example in herd books, about the breed and its traits and genes, which helps maintain the inbreeding and monitor the important features. This helps in a way to identify native pure breeds that require protection and also find particular new genes that can be added to the genetic pool. Herd books recording helps in a way the system to maintain purebred native but inbreeding can cause a lot of problems like higher rates in genetic disease or low fertility or less resistance to diseases. Crossbreeding has been maintained and controlled for decades now and is not always unpleasant. In field, it has never decrease the part of the breed in the local history and its position in the cultural heritage.

9. Summary

The purpose of my thesis was to research about the Armoricaine and Froment du Léon cattle which are rare native breeds to France and the Creole cattle indigenous to Mauritius. I wanted to see if the conservation techniques of these breeds are effective in stopping them from being extinct. The shocking decline in 2001, of the Creole breed was from 32, 332 to 273 shows more than 90% loss of the breeds over the whole island. As of then, the Livestock Research Development has since open a conservation program to evaluate the breed and maintain the population. While the Froment du Léon was listed as “endangered-maintained” in 2007, by 2014 a total heads of 314 was counted. The Armoricaine breed is still listed as “critically-endangered” but the population is gradually increasing, a number of heads of 263 has been counted in 2014.

I looked at the properties of these breeds and some of the reasons for their drop. I evaluated the conservation techniques that are recently being put in place. I found that through devotee breeders and restricted accessibility of semen through artificial insemination that these breeds are still making a recovery. The Cryobank is of great help in preventing the loss of the breed in case of a calamity of disease outbreak. The organisations and the FAO are registering information on the populations of these breeds and will put in motion a plan if the conservation techniques start to fail.

In France, through the GLAS scheme the department of agriculture put in motion encouragements for farmers to keep these rare native breeds. Conservation of these native breeds define as its genetic features being conserved. Although, these features are not in favour now, they may be useful in the near future.

10. Bibliography

2018. *Agricultural production - livestock and meat*. [https://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_livestock_and_meat#:~:text=Livestock%20population,-Majority%20of%20livestock&text=The%20majority%20of%20livestock%20are,and%20Poland%20\(7.1%20%25\)](https://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_livestock_and_meat#:~:text=Livestock%20population,-Majority%20of%20livestock&text=The%20majority%20of%20livestock%20are,and%20Poland%20(7.1%20%25).).
2019. *agriculture and agrifood industry in brittany: clear and comprehensive*.
[http://www.synagri.com/ca1/PJ.nsf/b1bff1bdc37df748c125791a0043db4a/c9d2368e7c2d20d4c12584700027407e/\\$FILE/ABC-Agrifood-industry-in-Brittany-Clear-Comprehensive-figures2019.pdf](http://www.synagri.com/ca1/PJ.nsf/b1bff1bdc37df748c125791a0043db4a/c9d2368e7c2d20d4c12584700027407e/$FILE/ABC-Agrifood-industry-in-Brittany-Clear-Comprehensive-figures2019.pdf).
- Agriculture.govmu.org*.
<https://agriculture.govmu.org/Documents/Animal%20Production%20Division/National%20Animal%20Identification%20System.pdf>.
- Bett et al. 2013. *Cattle Breeds: Extinction or Quasi- Extant*.
- Boettcher, Paul. 2010. *Why should we conserve Animal Genetic Resources*. Rome.
- Boodoo, AA. 1989. "Milk production from tropical fodder and sugar cane residues- Case study: On farm research in Mauritius."
- Cryobanque Nationale*.
http://www.cryobanque.org/index.php?option=com_content&task=view&id=21&Itemid=6&lang=en.
- Danielle et al. 2016. *The Christian Science Monitor*.
<https://www.csmonitor.com/Business/The-Bite/2016/0908/Why-we-should-protect-disappearing-livestock-breeds#:~:text=Not%20only%20do%20%E2%80%9Clocal%20breeds,less%20cost%20D-intensive%20to%20raise>.
- Dominique et al. 2018. "Animal Genetic Resources."
https://www.animalgeneticresources.net/wp-content/uploads/2018/06/Bled_France_NatRepText.pdf.
- Evolution*. <https://www.evolution-xy.fr/en/cattle/genetic-selection>.
- Farei.mu*. <https://farei.mu/farei/departments/>.
- Felius et al. 2014. "On the History of Cattle Genetic Resources."

Fentress Swanson, Abbie. 2015.

<https://www.npr.org/sections/thesalt/2015/08/03/429024245/wanted-more-bulls-with-no-horns?t=1604256208975>.

France Génétique Elevage. <http://en.france-genetique-elevage.org/>.

Froment du Léon Cattle. <https://www.fondazioneSlowFood.com/en/ark-of-taste-slow-food/froment-du-leon-cattle/>.

Hiemstra et al. 2010. "Local cattle breeds in Europe."

Himme, Ben. n.d. <https://www.pathwayz.org/Tree/Plain/SELECTIVE+BREEDING>.

<https://www.ceva.com/en/News-Media/Press-releases/Froment-du-Leon-cattle-Bordelaise-cattle-and-the-Pyrenean-donkey-were-the-big-winners-at-the-French-National-Prize-for-Animal-Agrobiodiversity-Awards-2018>. <https://www.ceva.com/en/News-Media/Press-releases/Froment-du-Leon-cattle-Bordelaise-cattle-and-the-Pyrenean-donkey-were-the-big-winners-at-the-French-National-Prize-for-Animal-Agrobiodiversity-Awards-2018>.

Huffman, Brent. n.d. *Britannica*. <https://www.britannica.com/animal/cow>.

List of cattle breeds. https://en.wikipedia.org/wiki/List_of_cattle_breeds.

McMahon, Shauna. 2016. "Native Irish cattle breeds and their fight against extinction."

Office, Central Statistical. 1991 and 2000. "Digests of Agricultural Statistics."

O'Hagan, Maureen. 2019. <https://undark.org/2019/06/19/cows-holstein-diversity/>.

Pizzi et al. 2013. "Conservation of endangered animals: From biotechnologies to digital preservation."

2020. *Roy's farm*. <https://www.roysfarm.com/armoricain-cattle/>.

SGP. <https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=26711>.

Sheung Yuen, Regis Lam. 2005. "Characterisation of the Creole cattle in Mauritius."

Slow Food Foundation for Biodiversity. <https://www.fondazioneSlowFood.com/en/ark-of-taste-slow-food/creole-cow/>.

Sponenberg, Phillip. 2020. "Conserving the Genetic Diversity of Domesticated Livestock."

<https://www.ulule.com/lebeurre-couleurfroment/#about-owner>.

<https://en.wikipedia.org/wiki/Cattle>.

<https://en.wikipedia.org/wiki/Armorica>.

<https://en.wikipedia.org/wiki/Mauritius>.

Wikipedia. https://en.wikipedia.org/wiki/Froment_du_L%C3%A9on.

Wikipedia.

https://en.wikipedia.org/wiki/Conservation_genetics#:~:text=Conservation%20genetics%20is%20an%20interdisciplinary,conservation%20and%20restoration%20of%20biodiversity.

11. Annex

Table 1 *Distribution of adult Creole and all breeds across the island (2001)*

District	Number of M Creole breeds		Number of F Creole breeds		Total number of heads Creole breeds	
		All		All		All
Port Louis	Nil	31	Nil	136	Nil	167
Pamplemousses	1	61	40	443	41	504
Riviere du Rempart	6	196	51	489	57	685
Flacq	1	112	29	808	30	920
Moka	1	35	58	469	59	504
Plaines Wilhems	3	25	47	137	50	162
Grand Port	2	52	23	206	25	258
Savanne	Nil	22	7	209	7	231
Black River	Nil	63	4	287	4	350
Overall	14	597	259	3184	273	3781

Table 2: *Share of sectors within the Agricultural Production*

Sector	Share of sectors in agriculture (%)	
	Year	
	1990	1999
Sugar cane, tea & tobacco	72	54
Government services	2	2
Livestock & poultry	8	13
Fishing	4	4
Foodcrops & others	14	27

Table 2: *Breeds and production systems by species in Mauritius.*

Species	Breeds	Systems
Cattle	Creole	Backyard
	Friesian	Backyard, intensive
	Mixed Zebu breeds	Intensive systems for fattening
Goats	Local	Backyard
	Boer	Commercial Intensive systems
Pigs	Large White	Backyard & commercial intensive systems
	Landrace	Backyard & commercial intensive systems
Commercial Chicken	Local chicken	Backyard range system
	Commercial Hybrids	Predominantly intensive system.
Deer	Rusa spp	Extensive/range and intensive/feedlots systems

Table 2 *Distribution of French cattle breed around France and their current population size.*

Breed	Total number of Heads In France	Global Status of population
Abondance	150,000	Not Listed
Aubrac	140,000	Not at risk
Aure et Saint- Girons	320	Endangered- maintained
Bazadaise	3,400	Not at risk
Béarnaise	324	Critical- maintained
Betizu	<150	Critical
Bleue du Nord	1,490	Endangered- maintained
Blonde d'Aquitaine	560, 000	Not at risk
Bretonne Pie Noir	15,000	Not Listed
Charolais	4.22 million	Not at risk
Ferrandaise	1,939	Endangered- maintained
Limousin	2.69 million	Not at risk
Lourdaise	268	Critical- maintained
Maine-Anjou	40,000	No concern
Mirandaise	616	Endangered-maintained
Normande	~2.1 million	Not at risk
Parthenaise	43,187	Not at risk
Pie Rouge des Plaines	263	Not Listed
Salers	300,000	Not listed

12. Acknowledgements

I would like to thank my supervisor Professor Gáspárdy András for giving me the opportunity and guidance in this thesis work. I would also like to thank my family home and around the world and my best friend Nuzhah for their advices and enormous supports.

HuVetA

ELECTRONIC LICENSE AGREEMENT AND COPYRIGHT DECLARATION*

Name: Jhurry Nazneen Banon.....

Contact information (e-mail): JyZeen@gmail.com.....

Title of document (to be uploaded):.....

.....

.....

Publication data of document:.....

Number of files submitted:

By accepting the present agreement the author or copyright owner grants non-exclusive license to HuVetA over the above mentioned document (including its abstract) to be converted to copy protected PDF format without changing its content, in order to archive, reproduce, and make accessible under the conditions specified below.

The author agrees that HuVetA may store more than one copy (accessible only to HuVetA administrators) of the licensed document exclusively for purposes of secure storage and backup, if necessary.

You state that the submission is your original work, and that you have the right to grant the rights contained in this license. You also state that your submission does not, to the best of your knowledge, infringe upon anyone's copyright. If the document has parts which you are not the copyright owner of, you have to indicate that you have obtained unrestricted permission from the copyright owner to grant the rights required by this Agreement, and that any such third-party owned material is clearly identified and acknowledged within the text of the licensed document.

The copyright owner defines the scope of access to the document stored in HuVetA as follows
(mark the appropriate box with an X):

I grant unlimited online access,

I grant access only through the intranet (IP range) of the University of Veterinary Medicine,

I grant access only on one dedicated computer at the Ferenc Hutýra Library,

I grant unlimited online access only to the bibliographic data and abstract of the document.

Please, define the **in-house accessibility of the document** by marking the below box with an **X**:

I grant in-house access (namely, reading the hard copy version of the document) at the Library.

If the preparation of the document to be uploaded was supported or sponsored by a firm or an organization, you also declare that you are entitled to sign the present Agreement concerning the document.

The operators of HuVetA do not assume any legal liability or responsibility towards the author/copyright holder/organizations in case somebody uses the material legally uploaded to HuVetA in a way that is unlawful.

Date: Budapest,daymonth.....year

Author/copyright owner

signature

HuVetA Magyar Állatorvos-tudományi Archívum – Hungarian Veterinary Archive is an online veterinary repository operated by the Ferenc Hutýra Library, Archives and Museum. It is an electronic knowledge base which aims to collect, organize, store documents regarding Hungarian veterinary science and history, and make them searchable and accessible in line with current legal requirements and regulations.

HuVetA relies on the latest technology in order to provide easy searchability (by search engines, as well) and access to the full text document, whenever possible.

Based on the above, HuVetA aims to:

- increase awareness of Hungarian veterinary science not only in Hungary, but also internationally;
- increase citation numbers of publications authored by Hungarian veterinarians, thus improve the impact factor of Hungarian veterinary journals;
- present the knowledge base of the University of Veterinary Medicine Budapest and its partners in a focussed way in order to improve the prestige of the Hungarian veterinary profession, and the competitiveness of the organizations in question;
- facilitate professional relations and collaboration;
- support open access.