Staatliche
Schlösser und Gärten
Hessen

**UNESCO Welterbestätte
Kloster Lorsch**

Draft Cattle: their history, significance and value with a global perspective

Proceedings of the World Draft Cattle Symposium
(March 8–9, 2024)

Laureshamensia

Special Issue 3 | 2026

HESSEN

Propylaeum
FACHINFORMATIONSDIENST
ALTERTUMSWISSENSCHAFTEN

Draft Cattle: their history, significance and value with a global perspective

Proceedings of the World Draft Cattle Symposium (March 8–9, 2024)

Laureshamensia
Special Issue 3 | 2026

Staatliche
Schlösser und Gärten
Hessen

UNESCO Welterbestätte
Kloster Lorsch

Acknowledgments

The publication of this conference proceedings would not have been possible without the active support of many people. Of course, my special thanks goes first and foremost to all the authors for providing their manuscripts. Only by publishing these case studies and specialist articles will it ultimately be possible to strengthen the importance of and work with draft cattle in the way they deserve. The industrial economic system, which is a determining factor in many parts of the world, is increasingly reaching its limits, which is why it is important to take alternatives and traditional cultural practices seriously and bring them into the equation. Working with draft cattle is both, Immaterial Cultural Heritage (ICH) and a modern solution.

I would also like to thank Sven Gareis for his editorial work and Lauren Muney for creating the conference logo. Tatiana Becue, Juan Manuel Carcasona Nevado, Cozette and Robert Griffin-Kremer for their proof-reading of the abstracts. Finally, I would like to express my sincere gratitude to Barbara Corson, Paul Starkey, Cozette Griffin-Kremer, and Rolf Minhorst, who have always motivated me to continue my work on this volume and for the Draft Cattle Center.

Claus Kropp

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 003. DOI: https://doi.org/10.11588/propylaeum.1713.c25077

Welcoming words

As Director of the State Palaces and Gardens of Hesse, it is a great pleasure for me to present this conference proceedings to a wider public and the scientific community. As the first enlisted World Heritage Site in Hesse, the former Lorsch Monastery has been generating a great deal of interest for decades and attracts tens of thousands of visitors every year. For more than ten years, the Lauresham Open-Air Laboratory has uniquely complemented the overall concept of the World Heritage Site and is both a place of education and research. The fact that in March 2024 we were able to welcome more than 126 people from 20 countries to the World Draft Cattle Symposium, underlines the importance that the Open-Air Laboratory has developed in the field of draft cattle. As a direct outcome, the State Palaces and Gardens and Lauresham Open-Air Laboratory established a Center for Draft Cattle Research and Education on site in Lorsch. Just as the Open-Air Laboratory itself, we expect that this conference proceedings will continue to stimulate international efforts and actively contribute to this important field.

Kirsten Worms

Director of the State Palaces and Gardens of Hesse

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 004. DOI: https://doi.org/10.11588/propylaeum.1713.c25079

Patron Statements

The angry farmers protests, which in recent years have spread across many European countries, paint a clear picture: The present agroindustrial modell is experiencing a deep crisis.

The inciting incident for the demonstrations and road blockings in Germany was the governments announcement to refute the tax exemptions for fuel used in the agrarian sector, which most farmers thought was too much. That there was too much pressure put on them with bad prices, bureaucracy and too many obligations. That the government had to be replaced.

But what then? Almost none of the protesting farmers had constructive ideas about how agriculture should proceed throughout the 2020s – in times of climate crisis and the mass extinction of species, with water polluted by fertilizers, microplastics in the soil and multiresistent germs within the intensive meat and dairy industry, which could, in the long term, make antibiotics useless. With an agrarian sector which is dependent on global resource chains like the rest of the economy and vulnerable in times of war, animal epidemics and a completely unpredictable american tariff policy.

In the meantime re-elections have taken place in Germany, and the new government will be led by the conservative CDU/CSU, which already announced to reintroduce the tax exemption for agrarian fuel. As if that would be an answer to the many crises of the agrarian sector.

But the climate- and biodiversity crisis has other demands: Those who work the land know how unpredictable the weather has become nowadays. How important resilience and perserverence now have become, how important experimentation what in the future will still be possible on the field, when tempests as well as droughts increase. When water can no longer be pumped out of the land, but has to be kept there – while at the same time the fields shouldn't be drowned when it rains for months, like in the last autumn and winter.

Under the slogan „regenerative agriculture" many farmers search for a way of farming viable for the future. At the same time many small startups – especially in the vicinity of large cities – begin working their vegetable fields with horses.

Oxen before a plough I have yet only seen in a museum, in the open air museum of Detmold, not far from the village where I grew up. There, ploughing championships are held – staged for museum visitors as a flashback into a preindustrial past. A canvas for nostalgic romanticism in the eyes of many visitors – only farmers might think with horror of the hard labour their ancestors had endured, while they themselves listen to podcasts in air-conditioned drivers cabins and supervize satellite data.

I suspect only a few of them realize that they have also lost something in the process. That many of them are now removed from the earth – their work subject. That they forgot how to read the landscape around them und see themselves as part of nature, integrated into the

Picture: Georg Schweisfurth

all connecting web of life, like taught by Donna Haraway and experienced by many people who have roots in indigenous cultures.

I wish that researching and publicly conveying old agricultural methods would not be smiled upon as a curious hobby, but that we – in the light of the coming challenges – study the agriculture of the past with scientific curiosity.

Tanja Busse

Author, Journalist

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 005-008. DOI: https://doi.org/10.11588/propylaeum.1713.c25081

I'm honoured to have been invited to help introduce this conference. My guess is that a lot of people would think its theme is pretty 'niche' in the modern world, but I believe draft cattle are set to make a resurgence that will be needed to help us tackle many present crises. The issues being discussed at this conference today therefore couldn't be more important.

I don't have personal experience of working with draft cattle – in another life, I hope I will! – but I've long been an advocate of low energy input, renewable, local food systems, and that's where I think draft cattle fit so well.

Modern, industrial agriculture energized by cheap and abundant but polluting and unsustainable fossil fuels has broken up local mixed agroecosystems and pushed farming down monocultural routes where each area produces only the few crops that are most economically advantageous in wider markets. This leads to ecological inefficiencies and social dislocations that we can only paper over for so long through the continued use of cheap energy.

In the longer term, but starting right now, I'm convinced that most places will need to rebuild more robust and resilient, functional, low input and low energy, local agroecosystems. We cannot keep relying on fossil fuel enabled global markets to meet local needs for food and fibre and to protect and maintain local agroecosystems.

These agroecosystems will usually involve mixed husbandry of grassland, cropland and woodland, with domesticated livestock acting as critical intermediaries of nutrient flows and labour, and as critical suppliers for meeting human food and non-food needs. Rather than optimising on one product or input, such agroecosystems involve complex and multifunctional optimisation across the whole ecosystem.

Draft cattle fit beautifully into such systems as low-energy optimisers of traction, transport and other needs. So it's important to retain, build and share knowledge about the necessary skills, technologies and farming methods they involve – which is why I'm delighted that this conference is happening.

One of the problems we face in promoting the resurgence of draft cattle is the image problem of public perceptions that to use draft animals is somehow backward-looking, romantic or nostalgic for past ways of farming. I'm not sure how best to counter this myth, but it seems to me that the more people who are experimenting with draft animals, finding ways to make them work in contemporary agrarian settings, and using the tools of modern ecological and other sciences to show their effectiveness, the more we can build a movement on the ground that will circumvent these objections and carry people with it by demonstrating the practical benefits of draft cattle. So, once again, this is why it's so important to have a conference like this to help build such a movement.

We need to change the narrative about food and farming systems. In the richer countries, and increasingly worldwide, the emphasis has been on removing people from contact with nature, the land and food production

as part of their livelihoods, cutting jobs in the sector and emphasizing high-energy input non-local food systems. I believe that climate change, energy and water scarcities, nature loss and economic/political crisis will dramatically change this in the years to come, whether we like it or not. The more that we can build alternative, job-rich, low-input local models in the meantime, the less traumatic this transition is likely to be. This conference is part of that wider and urgent task.

Chris Smaje

Small-scale farmer, writer, social scientist

For almost five decades now, my organisation 'Local Futures' has been promoting more localised food economies, in reaction to the disastrous effects of a globalised food system, shaped by the need for profits for giant transnational corporations and banks.

We have worked with farmers and farm organisations and with consumer groups around the world to encourage local food movements that help to raise respect for and protect small farmers linked to markets closer to the farm. Structurally, connecting farmers and consumers in this way encourages diversification on the farm, which is absolutely essential in order for the human population to feed itself without destroying ecosystems or destroying their own health. Animals are a central part of healthy, diversified farms, and have been throughout centuries.

In our work, we have seen the multiple benefits that come from draft animals. They have included a beautiful, close relationship between humans and animals. We've seen farmers singing to the bulls that were pulling their plough, asking them: "Please work hard just now for the planting. Then you can go and enjoy delicious grass and flowers in the high pastures".

We've come to consider these intimate relationships between human beings and their working animals essential for humanity, for developing respect for life beyond the human. We cannot and should not seek to develop such relationships with wild animals. But when it comes to meeting our basic needs, this symbiosis is a gift.

These farm animals give birth, they do not, like tractors and other machinery, rust and have to be bought new again and again. Generally, they have been adapted to local ecosystems and they become part of the ongoing cycle of life. And unlike the machinery, which causes pollution, they also provide fertiliser, necessary for healthy soil and sustainable productivity. In this regard, it is vital that we distinguish between smaller-scale, diversified farming and the corporate-led, giant factory farms, which are hideously polluting and destructive.

Raising awareness about draft animals is today particularly needed in the so-called 'less-developed' world, where hundreds of millions of people are being pulled away from the land. Media and advertising romanticize the urban consumer culture, and those who farm, particularly with animals, are made to feel backward and stupid.

I'm extremely pleased to support this symposium, and want to encourage the dissemination of a bigger picture that spells out the need to feed the world through more diversified, localised food economies if there is to be any hope of maintaining biological and cultural diversity.

Helena Norberg-Hodge
Linguist, Author, Filmmaker, Founder of Local Futures

I want to begin with a precaution. The proper use of working animals calls for symphaty, kindness, skill, and talent. That is because we are appealing to the animals´ willingness to help us. This cannot be accomplished by ineptitude and force.

The primary reason to use draft animals – oxen or horses or mules – on the farm or in the woods is economic. Draft animals belong to the land, the land community, and the land economy. This means that they are affordable and they work cheap, unlike the alien machines and chemicals, which belong to industrialism, put the rural economy at the mercy of the urban economy, and are destructive of land and people.

The use of draft animals reduces the scale and speed of work, and it keeps the humans who use them close to the ground. They thus enable the attention and care required by good work.

I once heard an old-timer say of a team of draft horses, “The more you use them the better they work, the better they work the more you use them.” That is true, and it assumes that the teamster has good sense. It does not advise overworking your team.

Wendell Berry

Writer, farmer, environmental activist

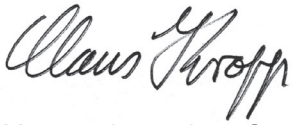
Preface

When I first came into contact with the world of draft cattle over twelve years ago, I would never have believed the importance that this topic would one day have for me. Not only did I gradually become an advocate for the positive impact of draft cattle in agriculture or silviculture, but I also became a draft cattle farmer and trainer myself. It is with great pleasure that I get to teach people about working with draft cattle each year, and I am pleased that the demand for this all-important traditional knowledge continues to grow. Draft cattle can be so much – working companions, community builders, and securers of livelihoods.

Through networking in ALHFAM, AIMA, EXARC, the German and French draft cattle working group, but also through the exchange with colleagues from all over the world, I realized how important it is to bring draft cattle more into the focus of public discussion - not as an echo of the past, but as part of the solution for a better future. The people who still work with draft cattle in so many parts of the world need to be given a loud audible voice of support, there needs to be active advocacy for innovative and animal-friendly harnessing practices, and finally, there needs to be active work on preserving and expanding the traditional knowledge of working with cattle.

Keeping all of this in mind, I would like to state emphatically that the timing for the publication of the proceedings of our World Draft Cattle Symposium of 2024 could not be better. It is the right time because it will help maintain a momentum that can actually bring change. But it is also the right time because in many parts of the world the number of draft cattle is decreasing dramatically, a lot of knowledge is lost every year and therefore there is no time to lose. Let us therefore join forces to face this challenge.

Claus Kropp



Manager Lauresham Open-Air Laboratory
for Experimental Archaeology

Center for Draft Cattle Research and Education

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 009. DOI: https://doi.org/10.11588/propylaeum.1713.c25082

Cattle in Community – a vital part of the past, present and future

Barbara Corson

Abstract

Cattle were the basis of civilization as we know it. Ironically, cattle are now unseen and unknown in the civilizations they initiated and helped to create. In the developed areas of the world, the connection between humans and cattle has been lost, and along with cattle, humans have increasingly lost other connections: with natural processes, with the land, with non-human species, and with other human beings in community.

There is increasing awareness of the problems that loss of connection can cause in economic, sociological and ecological systems, but there is less awareness of the roles that cattle played and still play in agrarian societies past and present. The 10,000 years that humans have been farming with cattle represent a body of knowledge and experience that should guide us into the future. Human communities formed around cattle in the past, and cattle can help us establish connections again.

Résumé

Les bovins ont été à la base de la civilisation telle que nous la connaissons. Ironiquement, ils sont aujourd'hui invisible et inconnu dans les civilisations qu'il a initiées et contribué à créer. Dans les régions développées du monde, le lien entre l'homme et le bovin s'est rompu, et avec le bovin, l'homme a progressivement perdu d'autres liens : avec les processus naturels, avec la terre, avec les espèces non humaines et avec les autres êtres humains de la communauté.

On prend de plus en plus conscience des problèmes que cette perte de lien provoque dans les systèmes économiques, sociologiques et écologiques, mais on est moins conscient du rôle que le bétail a joué et continue à jouer dans les sociétés agraires passées et présentes. Les 10 000 années pendant lesquelles les humains ont pratiqué l'élevage avec le bétail représentent un ensemble de connaissances et d'expériences qui devraient nous guider vers l'avenir. Dans le passé, les communautés humaines se sont formées autour du bétail, et celui-ci peut nous aider à rétablir des liens.

Kurzfassung

Rinder waren die Grundlage der Zivilisation, wie wir sie kennen. Ironischerweise sind Rinder heute in den Zivilisationen, die sie initiiert und mitgeschaffen haben, unsichtbar und unbekannt. In den entwickelten Regionen der Welt ist die Verbindung zwischen Mensch und Rind verloren gegangen, und mit den Rindern haben die Menschen zunehmend auch andere Verbindungen verloren: zu natürlichen Prozessen, zum Land, zu nichtmenschlichen Arten und zu anderen Menschen in der Gemeinschaft.

Das Bewusstsein für die Probleme, die der Verlust dieser Verbindung in wirtschaftlichen, soziologischen und ökologischen Systemen verursachen kann, wächst, aber das Bewusstsein für die Rolle, die Rinder in agrarischen Gesellschaften in Vergangenheit und Gegenwart gespielt haben und immer noch spielen, ist geringer. Die 10.000 Jahre, in denen Menschen mit Rindern Landwirtschaft betrieben haben, stellen einen Wissens- und Erfahrungsschatz dar, der uns in die Zukunft führen sollte. In der Vergangenheit bildeten sich menschliche Gemeinschaften um Rinder herum, und Rinder können uns helfen, wieder Verbindungen herzustellen.

Resumen

El ganado fue la base de la civilización tal y como la conocemos. Irónicamente, hoy en día el ganado es invisible y desconocido en las civilizaciones que él mismo inició y ayudó a crear. En las zonas desarrolladas del mundo, se ha perdido la conexión entre los seres humanos y el ganado, y junto con el ganado, los seres humanos han perdido cada vez más otras conexiones: con los procesos naturales, con la tierra, con las especies no humanas y con otros seres humanos de la comunidad.

Cada vez hay más conciencia de los problemas que la pérdida de conexión puede causar en los sistemas económicos, sociológicos y ecológicos, pero hay menos conciencia del papel que el ganado desempeñó y sigue desempeñando en las sociedades agrarias del pasado y del presente. Los 10.000 años que los seres humanos llevan dedicándose a la ganadería representan un conjunto de conocimientos y experiencias que deberían guiarnos hacia el futuro. En el pasado, las sociedades humanas se formaban en torno al ganado, y el ganado puede ayudarnos a restablecer las conexiones.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 012-017. DOI: https://doi.org/10.11588/propylaeum.1713.c25084

It is a great pleasure for me to participate in a conference dedicated to draft cattle. People who are interested in draft cattle or in any other manifestation of the human-bovine bond are relatively rare today, and getting more rare. This conference is a chance to exchange ideas on how we might be able to reverse that trend, or at least slow it.

We each have our own perspective on why reversing the trend and preserving the role of cattle in community is important, and what steps we could take to accomplish that goal.

Let the exchange of ideas begin! I'll start.

This gathering is important to me because I believe we have serious global problems that we are having trouble solving as a species. And I believe that the reason we can't solve them is: We are out of touch with who we are as human beings, and what our role in the natural world is.

It's like we have amnesia.

A man who wakes up with amnesia doesn't know who he is, or where he is, or who any of the other people in the room with him are. If he sees a fire in one corner of the room, he may *instinctively* react with fear, but instinct will not help him to assess the situation and deal with it effectively. To do that, he needs a working memory of facts like: 'A fire in a fireplace is ok, but fire climbing the curtains is not ok. A person putting logs on a fire in the fireplace is OK, but a person adding gasoline to a fire in the room is not ok'.

You get the idea.

Studying our present world will not help us cure our amnesia, and neither will looking at the past through modern eyes. For the past 75 years or so, industrial technology has allowed us to forget basic realities of the natural world, and it has also increasingly shielded humans from the consequences of that forgetting. In other words, industrialization and technology are both a cause of our current problems, and also the reason that we are unable to solve them. To correct our collective 'amnesia' we need a deeper and more timeless understanding of history and nature, and we need it fast. I believe that the participants in this conference represent an important resource for helping our species attain the deeper understanding that we need.

***Fig. 1** – A relationship with cattle has been part of being human for many thousands of years, as this cave painting from Tassili n'Ajjer in Algeria attests (Wikimedia, Gruban, https://commons.wikimedia.org/wiki/File:Algerien_Desert.jpg, uploaded under CC BY-SA 2.0, https://creativecommons.org/licenses/by-sa/2.0/deed.en).*

In spite of the importance of the cattle-human bond in shaping 'who we are, and how we got here', this bond is something that modern humans seem to be in a hurry to forget. I'm hoping that this gathering will be a step towards reversing that trend.

Like all of you, my ideas about cattle in community have been shaped by the circumstances of my life.

I was born in southeastern Pennsylvania, in the 1950s when tractors had just started to outnumber work horses on US farms. My family did not farm for a living, but it was a rural area and there were lots of small dairy farms where I loved to visit. I wanted to become a veterinarian so that I could help the farmers and their animals, but by the time I graduated from veterinary school in 1989, the area had been 'developed.' The small farms were gone and instead there were houses and highways, gas stations and shopping centers.

The industrialization of agriculture and the loss of small farms and forested areas is not unique to southeastern Pennsylvania, but it had an unique impact on me because I saw it happen and felt the loss personally. Seeing something happen is much different than reading about it. After graduating from vet school, I worked as a large animal veterinarian, but I wasn't helping small farmers; instead, I was part of the industrial agriculture that had replaced them.

To me the downsides of development were obvious and they far outweighed any gains. The people in the new houses, driving on the congested roads didn't understand what had been lost, and they didn't seem especially happy either. I wanted to understand the forces that were driving industrialization, but I didn't know anyone who had answers, or even anyone who was asking the questions. I wanted other people to join me in thinking about why things were changing so fast.

That was why I became a kind of 'volunteer bovine ambassador.'

***Fig. 2** – A live cow can help urban people connect with the more-than-human world (Photo: B. Corson).*

To help make up for the lack of small farms in my life, I had cattle of my own, and I took them to local public events and historic sites, so that people who had never seen or touched a cow could have a chance to do so. And while they were seeing or touching the cow or ox, I tried to engage in conversation to find out what they thought about the questions I had.

Conversation is only possible if you start on 'common ground,' with a subject that is relatable. In my densely populated and urbanized area, people can't really relate a living, breathing cow to anything in their modern life, except beef or milk. But even urban people can relate to modern equivalents of the non-food necessities that cattle provided for humans in the past: materials, power, soil fertility, and community stability. The way I typically tried to engage with people was to remind them of those non-food necessities, by saying something like this:

'Today, we are so dependent on petroleum that we can't imagine how anyone could live without it. But people *did* live without fossil fuels, for hundreds of thousands of years. How did they do it? A big part of the answer to that question is: Cattle. Yes, they used cattle for food, but cattle were even more important for the other things that humans need'.

I don't know if my 'traveling cow show' made a lasting impression on anyone, but the process of trying to think of ways to communicate helped me form and clarify my own thoughts about what humans need to live. What follows is a summary of those thoughts…at least so far! My views are still developing, and I would value feedback from any readers.

What humans need to live: Food

For people in industrialized nations, the list usually starts with 'food,' perhaps because we take air, water, space, and temperature regulation for granted, and like all animals, humans do need food. Specifically, humans are omnivores. The word means 'devours all,' and although that does seem apt in some ways, it's actually not a good description of our nutritional needs. Far from being able to eat everything, omnivores are selective eaters. Omnivores require certain carbohydrates, but we can't digest the most abundant carbohydrate of all: cellulose. We require some nutrients that are naturally present only in animal tissues, and most omnivores (e.g. bears, wolves, pigs) have specialized body parts that enable them to access animal tissues, but humans lack specialized body parts that would enable us to catch and eat most vertebrates, even small ones. Given these facts, you can see that there is something that humans need even more than food, i.e:

Materials and tools

Other animals are born (or hatched) with bodily adaptations and instincts that allow them to obtain food-- and everything else they need to survive in their natural environment. But humans are not born with specialized body parts that allow us to survive in any particular environment. Instead, we make tools that allow us to alter our surroundings, or our interface with our surroundings, to increase the chances that our needs will be met.

For example, we can't swim well enough to catch a fish, but we can make nets and hooks and fishing spears. With our teeth and fingernails alone, we can't dismember even a young rabbit, but we can make a stone knife and use it to skin a bison. We can't eat cassava roots raw, but we can make a fire and cook them. Correct me if I'm wrong, but it seems to me that humans are the only living thing that *needs* tools to survive. Many other animal species use tools on occasion, but tool-making is the human hallmark because our species wouldn't survive without them. Besides using tools to obtain food, humans need to use tools to create protection from the environment in the form of clothing, shoes, and housing. Although many animals make nests or otherwise alter their environment, only humans *need* to make and use tools to do it.

Our use of tools has allowed us to spread to different ecosystems all over the globe. Dependence on tools and technology means that human cultures are inevitably shaped by the materials that are available. The reason cultures on Papua/New Guinea differ from those in Northern Canada is not that different human cultures have different needs, but rather the difference in available materials. Cattle and their relatives the bison and buffalo overlapped developing human cultures in extensive areas of the planet in prehistory, and in those areas, cattle provided unique materials like leather, horn and tallow, as well as food.

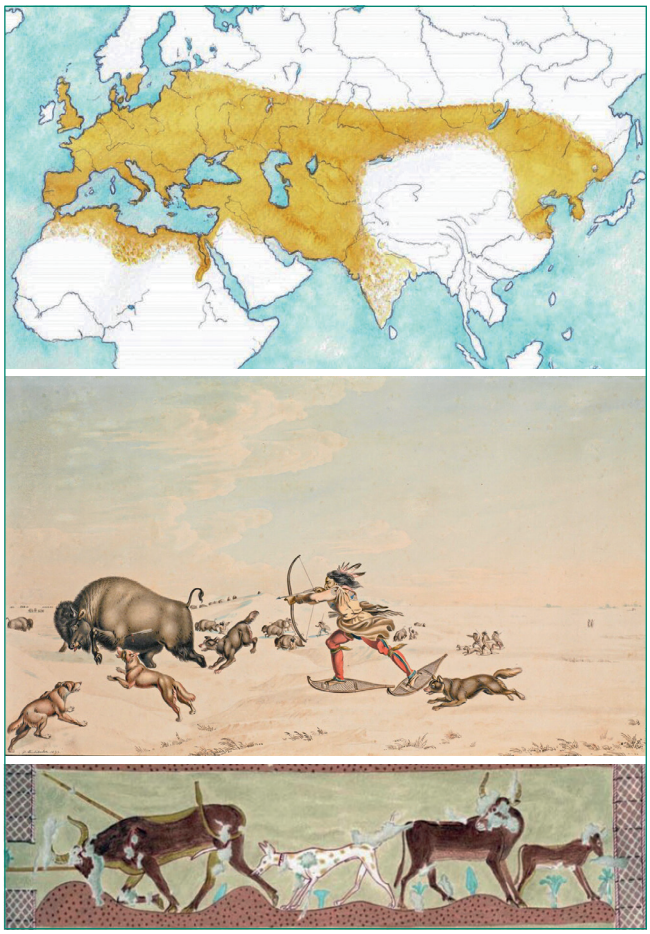


***Fig. 3** – Long before domestication, many human cultures depended on wild bovids such as Aurochs or Bison (3.1 Maximum distribution range of the aurochs, including its subspecies, Picture M. Felius; 3.2 Bison hunting image `Assiniboines hunting on Snow Shoes´, painted by Peter Rindisbacher (1806-1834), public domain; 3.3. Image of a North African aurochs hunt, public domain).*

The relationship between early humans and resources is both practical and numinous. Humans living in contact with nature recognize the importance of resources that sustain human life. Cave art from ancient cultures (see figure 1) is evidence that cattle and other large herbivores were important and even sacred.

Besides our specific dietary needs and our dependence on materials, what else do humans need?

Learning and community

As noted, other animals are born with specialized body parts, and the instincts to use them, but humans are born with very few instincts (e.g. gripping with our opposable thumbs, and suckling). We don't instinctively know how to make and use the tools we need to survive. All the skills a human needs to survive in a given environment have to be learned *by experience*, and since no human would live long enough to learn the necessary skills by their own experience, it is absolutely necessary for humans to live in communities, where experienced individuals can teach skills to the inexperienced and support them while they gain competence.

This helps explain why humans are 'tribal' and the most social of all social animals, and at the same time prone to irrational conflicts with other groups. Clinging to extreme beliefs in spite of contradictory evidence makes no sense until you remember that for humans, being part of a group has been a matter of life and death for thousands and thousands of years. For most of history, being part of a community has been much more important than logic for survival. In other words: 'People don't care how much you know until they know how much you care'.

Energy needs

All living things need energy to do the work of staying alive. Plants can access the energy of the sun and store it, allowing it to be passed to animals as 'food energy'. But the human need for tools means that humans require more energy than other animals. This may seem counter-intuitive: People tend to think that 'tools make human life more efficient'… but it depends on what you mean by 'efficient.'

A mole, for example, uses food energy to move its body and dig underground to obtain more food. A mole's

Fig. 4 *– Humans are not born with instincts and instead need to learn necessary survival skills through mentored experience. These modern children are learning necessary skills through supervised participation (Photos: C. Kropp)*

anatomy and physiology make it very efficient in turning food energy into the work of moving dirt and catching and eating invertebrates. For a human being, it's not a question of *how efficiently* she can dig underground tunnels using her arms and legs, and catch earthworms with her mouth… she simply can't do it. But a human *can* make a shovel or a digging stick. The tool makes digging possible for the woman, but it doesn't make her more efficient than the mole. Because she has to use food energy to find and make the tool, and then move the tool in addition to her own body, she is less efficient, thermodynamically, than the mole is.

It's possible to reduce human energy needs by fine-tuning tool design. As anyone who uses hand tools will know, some shovels or digging sticks or hoes are easier to work with than others. But the work of making and moving the tool is always part of the equation. This is true for all tools and technology, from stone knives to tractors and airplanes.

***Fig. 5** – Tool use enables humans to survive, but tools have energy costs („Woman with a digging stick", von National Museum of Denmark, No known copyright restrictions).*

Something else that adds to human energy needs is the prolonged period of dependency in our offspring compared to other animals. For example: Wolves are social animals, and a baby wolf is dependent on its mother and the pack for a period of weeks to months, but after that it can take care of itself as well as its mother can, and it can also contribute to the pack. Whereas a human infant is unable to do much for itself or for the group for years, because it takes time to develop the strength and skills necessary to use tools. During the period of incompetence, the child is a potential future asset for the group, but a short-term practical liability. In a stone age community, the number of non-productive members (either young or old) is limited either by human choice, or by natural consequences.

Without understanding the unique needs of humans (for materials, omnivore food, energy, and community) it is hard to grasp the significance of draft cattle.

If your source of energy for finding / producing an omnivore diet is limited to humans or other omnivores (e.g. dogs), every worker will also be a consumer and potential competitor, and it will be hard to produce a reliable surplus of food or other necessities.

But if you can incorporate an herbivore into your community, the situation is different. The herbivore can live wherever there are plants producing cellulose, the most abundant organic molecule on Earth. If she is a tame herbivore that you can milk, you have a preservable source of high-quality protein and fat that is sustainable from year to year, as long as the climate supports plant growth.

If an herbivore is used for agricultural power, the resulting crop provides food energy for both herbivores (cellulose) and omnivores (starches, sugars, proteins and fats). Nothing is wasted because after cycling through the herbivore's digestive tract, the plant material returns to the soil in a parallel to natural cycles.

All this is well known to my current audience but for urban people like my neighbors in the United States, it's not known, and it's not enough to just hear the words or read them. The role of cattle in human history is a foreign language to urban people, and it has to be interpreted, which is what I was trying to do with my traveling cow show. It is being done today at outdoor museums and historic farm sites worldwide. An ox pulling a cart gets people's attention and can hopefully get them thinking about the impact of energy sources on human societies.

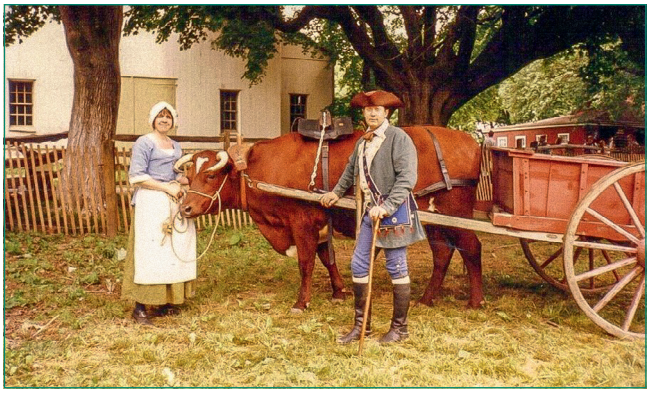


***Fig. 6** – Seeing an ox at a historic site can help urban people think about energy (Photo: B. Corson).*

In industrial societies, people increasingly think physical work is drudgery at best, something to be avoided. So it's common for urban people to express concern about animal cruelty when they see a working animal. Although these concerned people generally mean well, they are often showing their ignorance of what makes for well-being in a social herbivore like an ox or a horse. I think they are also showing some misconceptions about what makes a human happy! Does happiness mean sitting on a couch all day watching TV? To me at least, happiness means learning to make useful and beautiful things, and having the chance to share the creations and experiences with others in the community. Humans naturally want to feel safe, accepted, needed and useful within our communities. That's what human nature has been for thousands of years, but modern life is not answering those needs for many. No wonder so many people in industrial societies are unsatisfied or unhappy.

The fact that so many people have forgotten about the importance of cattle in agrarian cultures in the past and the present may seem like a trivial issue, but it is a sign of a much larger problem, i.e. the growing disconnect between humans and the natural world. As urbanization

and industrialization increase, more and more people are dependent on technology, and unaware of the effects of that technology on the natural ("real") world. Nothing illustrates this loss of contact with reality better than the use of fossil fuel.

At the time of this writing (March 2025) humans on Earth burn 100 million barrels of petroleum[1], 23 million tons of coal[2], and 11 billion cubic meters of natural gas[3] every 24 hours. These are obviously huge numbers, and especially staggering when you realize that the energy in one barrel of petroleum is equivalent to about 24,000 man-hours[4]. In 24,000 hours a human can do a lot of damage but they can also create and build things of lasting value if they choose to do so: planting forests, writing books, teaching children. Living things reverse entropy for a while, but a barrel of petroleum can only burn.

Contrast the idea of burning all that fossil fuel with this diagram which is meant to represent the 'real world', the not man-made world of nature.

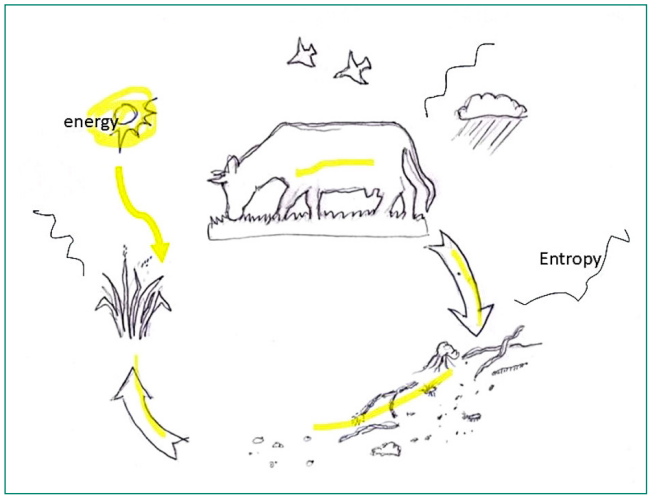


***Fig. 7** – Life on earth depends on the cycle of elements from air, water and soil, through plants, into herbivores and other animals, and back into the air, water and soil (Figure: B. Corson).*

With access to healthy soil, clean water and carbon dioxide, plants are able to capture the sun's energy in carbohydrates and other organic molecules, which in turn provide food energy to herbivores and other animals. All living things produce organic wastes and eventually die, returning the elements to the environment, where they are available to be re-assembled into life again, as long as physical conditions permit.

Each step in the cycle is essential, and so if one step is important, they all are. Humans are used to thinking that life is the important thing, especially human life, but that is a little like thinking the brain is more important than the heart or the skin or the digestive system.

Humans are part of nature because everything we eat, drink or breathe depends on this cycle. But because *we need to use tools to alter nature*, at least a little, in order to survive, we are a little different than other life forms. Humans are so clever bending the limits of nature, that we have forgotten that there *are* limits, and that the limits are what has kept the system going.

We seem perilously close to finding out what happens when you push nature's limits to the tipping point. At this moment in time, we have unparalleled problems… but we also have unparalleled resources. The most important resource of all could be humans themselves. If human activities are causing our problems, the solution would be as 'simple' (and as challenging) as changing human activities. I believe that we could change our behaviours if enough of us wanted to, and I also believe most people would want to change if they understood the situation and saw some alternatives.

This gathering is a step towards developing that understanding and those alternatives, and I am happy to be a part of it.

***Fig. 8** – Imagine if everyone wanted to be part of the solution! (Photo: B. Hiltz, New Ross Freighters, Novia Scotia, Canada).*

1 https://www.statista.com/statistics/271823/global-crude-oil-demand/ (last accessed 21-09-2025).
2 https://www.iea.org/energy-system/fossil-fuels/coal (last accessed 21-09-2025).
3 https://media.market.us/natural-gas-statistics/ (last accessed 21-09-2025).
4 https://www.usni.org/magazines/proceedings/2010/june/our-lethal-dependence-oil#:~:text=In%20the%202006%20documentary%20A,equates%20to%2025%2C000%20man%2Dhours (last accessed 21-09-2025).

Author info
Barbara Corson
Retired Veterinarian, Animal Pathologist
E-Mail: hooftales@msn.com

Appreciating working cattle worldwide, their cultural heritage and future importance

Paul Starkey

Abstract

Over 10,000 years, draft cattle technologies spread worldwide, creating diverse breeds, yokes, implements, carts, machinery, management techniques and cultural associations. People selected draft cattle for characteristics appropriate for agricultural and transport work and other operations. Numerous technologies were developed for harnessing, tillage and transport. These evolved to suit farming systems and socio-economic circumstances, with localised design compromises relating to size, shape, performance and environmental conditions. People developed techniques and rituals relating to working animal age, sex, appearance, team size and operators (generally men). Adapted equipment and techniques became traditional, embellished with folk art designs, colours, accessories and rituals.

The importance of draft cattle in agriculture and transport became embedded in cultural heritages and portrayed in songs, stories, toys, textiles, carvings, ceramics, coins, statues, paintings, books and (in recent years) on bank notes, stamps, photos, films and social media.

The historic importance of draft cattle is widely appreciated, but the 'old-fashioned' perception needs improving. Despite being labour-intensive and slow, draft cattle remain important in many farming systems in Asia, Africa and Latin America and have modern niche roles elsewhere. Where feed is limiting, smallholder farmers may switch to cow traction.

Draft cattle use can continue where there is labour and an enabling environment with support services (needing a critical mass of users). National and local policies, strategies and networks are required to ensure an enabling environment for draft cattle, so they remain an ecologically friendly and sustainable multipurpose power resource suitable for women and men in modern agricultural enterprises worldwide.

Kurzfassung

Über einen Zeitraum von 10.000 Jahren verbreiteten sich Technologien für Zugrinder weltweit und führten zur Entstehung vielfältiger Rassen, Joche, Geräte, Karren, Maschinen, Managementtechniken und kultureller Assoziationen. Die Menschen wählten Zugrinder aufgrund ihrer Eignung für landwirtschaftliche Arbeiten, Transportaufgaben und andere Tätigkeiten aus. Es wurden zahlreiche Technologien für das Anspannen, die Bodenbearbeitung und den Transport entwickelt. Diese entwickelten sich entsprechend den landwirtschaftlichen Systemen und sozioökonomischen Gegebenheiten weiter, wobei lokale Kompromisse hinsichtlich Größe, Form, Leistung und Umweltbedingungen eingegangen wurden. Die Menschen entwickelten Techniken und Rituale in Bezug auf das Alter, das Geschlecht, das Aussehen und die Größe der Arbeitsgruppen der Tiere sowie die Bediener (in der Regel Männer). Angepasste Ausrüstung und Techniken wurden zur Tradition und mit volkstümlichen Kunstmotiven, Farben, Accessoires und Ritualen verziert.

Die Bedeutung von Zugrindern in der Landwirtschaft und im Transportwesen wurde Teil des kulturellen Erbes und in Liedern, Geschichten, Spielzeug, Textilien, Schnitzereien, Keramiken, Münzen, Statuen, Gemälden, Büchern und (in jüngerer Zeit) auf Banknoten, Briefmarken, Fotos, Filmen und in sozialen Medien dargestellt.

Die historische Bedeutung von Zugrindern wird weithin geschätzt, aber die „altmodische" Wahrnehmung muss verbessert werden. Obwohl sie arbeitsintensiv und langsam sind, spielen Zugrinder in vielen landwirtschaftlichen Systemen in Asien, Afrika und Lateinamerika nach wie vor eine wichtige Rolle und haben anderswo moderne Nischenfunktionen. Wo Futter knapp ist, können Kleinbauern auf Kuhzugkraft umsteigen.

Der Einsatz von Zugrindern kann dort fortgesetzt werden, wo Arbeitskräfte und ein förderliches Umfeld mit unterstützenden Dienstleistungen vorhanden sind (wobei eine kritische Masse an Nutzern erforderlich ist). Nationale und lokale Politiken, Strategien und Netzwerke sind erforderlich, um ein förderliches Umfeld für Zugrinder zu gewährleisten, damit sie eine umweltfreundliche und nachhaltige Mehrzweck-Kraftquelle bleiben, die für Frauen und Männer in modernen landwirtschaftlichen Betrieben weltweit geeignet ist.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 018-035. DOI: https://doi.org/10.11588/propylaeum.1713.c25085

Résumé

Au cours des dernières 10.000 années, les techniques d'utilisation des bovins de trait se sont répandues dans le monde entier, donnant naissance à diverses races, jougs, outils, charrettes, machines, techniques de gestion et associations culturelles. Les gens sélectionnaient les bovins de trait en fonction de leurs caractéristiques adaptées aux travaux agricoles et au transport, ainsi qu'à d'autres activités. De nombreuses techniques ont été mises au point pour le harnachement, le labour et le transport. Celles-ci ont évolué pour s'adapter aux systèmes agricoles et aux circonstances socio-économiques, avec des compromis locaux en matière de conception liés à la taille, à la forme, aux performances et aux conditions environnementales. Diverses populations ont développé des techniques et des rituels liés à l'âge, au sexe, à l'apparence, à la taille de l'attelage et aux opérateurs (généralement des hommes) des animaux de trait. Les équipements et les techniques adaptés sont devenus traditionnels, embellis par des motifs, des couleurs, des accessoires et des rituels issus de l'art populaire.

L'importance des bœufs de trait dans l'agriculture et le transport s'est ancrée dans le patrimoine culturel et a été représentée dans des chansons, des contes, des jouets, des textiles, des sculptures, des céramiques, des pièces de monnaie, des statues, des peintures, des livres et (ces dernières années) sur des billets de banque, des timbres, dans des photos, des films et les réseaux sociaux.

L'importance historique des bovins de trait est largement reconnue, mais la perception « démodée » dont ils font l'objet doit être améliorée. Bien qu'ils nécessitent beaucoup de main-d'œuvre et soient lents, les bœufs de trait restent importants dans de nombreux systèmes agricoles en Asie, en Afrique et en Amérique latine, et occupant un créneau particulier ailleurs aujourd'hui. Lorsque les ressources alimentaires pour les animaux sont limitées, les petits exploitants agricoles peuvent se tourner vers l'utilisation des vaches pour le travail.

L'utilisation des bovins de trait peut se poursuivre là où il existe une main-d'œuvre et un environnement favorable avec des services d'appui (nécessitant une masse critique d'utilisateurs). Des politiques, des stratégies et des réseaux nationaux et locaux sont nécessaires pour garantir un environnement favorable aux bovins de trait, afin qu'ils restent une ressource énergétique polyvalente, écologique et durable, adaptée aux femmes et aux hommes dans les entreprises agricoles modernes du monde entier.

Resumen

A lo largo de 10.000 años, las tecnologías relacionadas con el ganado de tiro se extendieron por todo el mundo, dando lugar a diversas razas, yugos, aperos, carros, maquinaria, técnicas de gestión y asociaciones culturales. Las personas seleccionaban sus bueyes y sus vacas de tiro por sus características apropiadas para las labores agrícolas, de transporte y otras actividades. Se desarrollaron numerosas tecnologías para el enganche, el cultivo del terreno y el transporte. Estas evolucionaron para adaptarse a los sistemas agrícolas y a las circunstancias socioeconómicas, con compromisos de diseño localizados en relación con el tamaño, la forma, el rendimiento y las condiciones ambientales. Las personas desarrollaron técnicas y rituales relacionados con la edad, el sexo, la apariencia, el tamaño del grupo de los animales de trabajo y los operadores (generalmente hombres). Los equipos y las técnicas adaptados se convirtieron en tradición y se decoraban con diseños de arte popular, colores, accesorios y rituales.

La importancia de la tracción bovina en la agricultura y el transporte se integró en el patrimonio cultural y se representaba en canciones, cuentos, juguetes, textiles, tallas, cerámicas, monedas, estatuas, pinturas, libros y (en los últimos años) en billetes, sellos, fotografías, películas y redes sociales.

La importancia histórica del uso de bueyes de tiro es ampliamente apreciada, pero es necesario mejorar la percepción «anticuada» que se tiene de él. A pesar de ser laborioso y lento, el ganado de tiro sigue siendo importante en muchos sistemas agrícolas de Asia, África y América Latina, y tiene funciones modernas específicas en otros lugares. Cuando el pienso escasea, los pequeños agricultores pueden recurrir al empleo de vacas para la tracción.

El uso de ganado de tiro puede continuar cuando hay mano de obra y un entorno propicio con servicios de apoyo (que requieren una masa crítica de usuarios). Se necesitan políticas nacionales y locales, estrategias y redes para garantizar un entorno propicio para el ganado de tiro, de modo que siga siendo un recurso energético, ecológico y sostenible con múltiples usos, adecuado para mujeres y hombres en las empresas agrícolas modernas en todo el mundo.

Historical perspective

Cattle were probably domesticated about 10,000 years ago in Mesopotamia and were subsequently used for meat, milk, transport and agriculture. Draft cattle technology gradually spread through the Levant and into South Asia, North and Northeast Africa and Europe[1]. As will be mentioned and illustrated later, the use of yoked draft cattle for ploughing was clearly displayed in ancient Egyptian art, including stone carvings, models, wall art and on papyrus, some dating back over 4000 years[2] (see ***Fig. 1***). By 2000 years ago, draft cattle were widely used in appropriate environments in much of Asia, north and northeast Africa and Europe. Draft cattle technology for agriculture and transport was much later transferred to the Americas (around 500 years ago)[3]. In Sub-Saharan Africa, the use of cattle as riding and pack animals dates back millennia and there was a long history of using cattle for some post-harvest operations in northeast Africa and into the Sahel[4]. The use of draft cattle for cart transport and soil tillage in Sub-Saharan Africa and Madagascar was introduced in colonial times, commencing about 370 years ago in South Africa[5]. In many sub-Saharan African countries, the use of draft cattle only became widespread in the twentieth century, and that is also true for various farming systems in Latin America, South Asia and the Pacific.

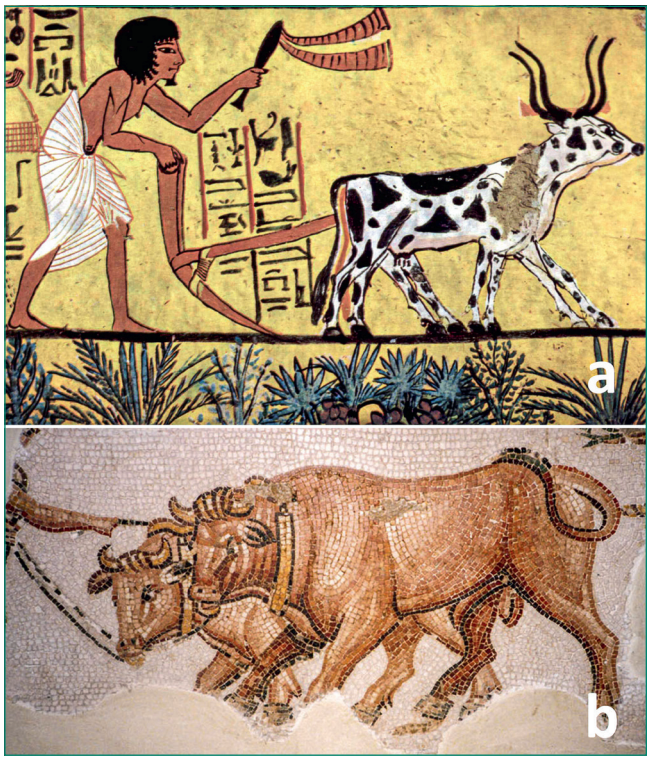


Fig. 1 *Ancient depictions of the use of draft cows and draft bulls. a) Mural of a man ploughing with two cows in the tomb of Sennudem in Egypt, c. 1200 BCE (York Project). b) Pair of draft bulls portrayed in a mosaic in Roman Tunisia, c. 150 CE (P. Starkey).*

1 Pitt et al. 2018.
2 Rossiter 1984.
3 Starkey 2022.
4 Mudamburi/Starkey 2022.
5 Starkey 2000.

Diverse draft animals

While draft cattle are the oldest and most numerous working animals, it is important to note that over time, other species have been found to be better adapted to particular conditions, operations and economic circumstances. After the domestication of horses, their speed made them preferable for many transport operations, including military ones. Donkeys became important for pack transport in mountainous regions and arid climates. For centuries in Europe, oxen were the default animal power source for small-scale farming, but horses became increasingly popular on larger farms in times of peace. In the nineteenth century, as farms and farm equipment increased in size, horses largely replaced oxen on large farms in Northern Europe[6] and North America. Certain other work animal species have filled important niche roles in particular environments, notably camelids (dromedaries in warm deserts, Bactrian camels in cool deserts and llamas in the Andes) and other bovids (water buffaloes in rice-farming systems, yaks around the Himalayas, banteng in Indonesia and goats in many countries). Elephants, reindeer and dogs have also played transport roles in specific situations. Wherever they are used, there are strong cultural associations with all types of working animal, and these are often portrayed and celebrated as cultural heritage. However, for thousands of years, cattle have been the most numerous draft animals, and the most important for smallholder farmers.

Diverse draft cattle: *Bos taurus* and *Bos indicus*

There are two main species of cattle. The first domestication of aurochs probably occurred in West Asia around 10,500 years ago and led to the development of the humpless *Bos taurus* cattle that spread into Europe and North Africa. Some are likely to have migrated with people to West Africa[7], as there are some small breeds of humpless cattle, including the N'Dama, that are resistant to trypanosomiasis (see ***Fig. 14***). Humped cattle or zebus are likely to have evolved from a different strain of aurochs domesticated in the Indus valley around 8,500 years ago[8]. These are thought to have spread with human migrations into much of southern Asia and into northeast Africa, and onto much of sub-Saharan Africa. The zebu cattle are considered better adapted to hot climates, while taurine cattle can cope with cold conditions. Both species have been locally selected for certain characteristics, leading to distinct breeds. Certain breeds, including the Charolais (*Bos taurus*), were selected for their large size and strength for work. Similarly, many Indian breeds of cattle, including the Hallikar and Kangayam (*Bos indicus*) have been selected over the generations for their draft work.

Cattle were introduced into the Americas around 500 years ago, and into Australia and the Pacific about 250 years ago. While many of the initial introductions were with *Bos taurus* animals, there were also introductions of zebus, and much crossbreeding over the years. In general, due to their availability, zebus are the preferred draft cattle in south Asia and most of Africa, while in Europe and North America, taurines remain predominant. In Latin America there is a wide variety of draft cattle, including zebus, taurines and crossbreds.

6 Collins 2010.
7 Pitt et al. 2018.
8 Ibd.

Diverse draft cattle: bulls, oxen and cows

In English (and several other languages) the word 'ox' means a working bovid and/or a castrated male. Historically, most working cattle have been castrated bulls. This has been logical as cows produce a surplus of male animals (only a small number of intact males are needed for breeding) and castration makes bulls more docile. However, intact bulls can be used for work, and this can be seen in several countries including Chad, Nigeria and Honduras. Some portrayals of working cattle in Roman times indicate that intact bulls were used (see ***Fig. 1***) and it has been suggested that the castration of animals was not common in the middle east around that time[9]. It appears clear from murals and papyri that cows were used as draft animals in ancient Egypt (see ***Fig. 1***). Around the world, there are smallholder farmers who use cows for work (see ***Fig. 2***). Provided the work is relatively light and intermittent, draft cows can produce milk and remain fertile[10]. If feed resources are in short supply, it may not be worth maintaining oxen for intermittent work: the feed can go to working cows that can produce calves and milk as well as provide draft power (and meat and manure). Working cows have been important in Europe, North Africa, Indonesia and the altiplano of Bolivia and in particular circumstances in many countries including Cuba and Kenya. In Germany, it was reported that in 1934 there were 2.4 million working cows (about 25% of all dairy cows)[11]. The number of working cows was slightly greater than the number of draft horses and eight times the number of work oxen. An interesting case of an 'exception that proves the rule' could be seen in Portugal towards the end of the twentieth century. Most working cattle in the country at that time were dairy cows, used by smallholder farmers for some tillage and transport work. There were also some teams of draft cattle used to launch fishing boats and pull in fishing nets. These were used twice a day, throughout the year and oxen were the clear choice for this regular, income-generating, heavy work (see ***title Fig.***).

Fig. 2 *Examples of using draft cows. a). Cow traction in Morocco, with yokes fitted with traditional fly-control extensions. b). Cows levelling rice field in Indonesia. c). Cows ploughing in the altiplano of Bolivia. d). Milking a draft cow during a break from field work in the Dominican Republic (all: P. Starkey).*

Diverse harnessing systems

Working cattle have generally been harnessed with wooden yokes. The yokes may be tied to horns (horn/head yokes) or they may rest on the ridge of the back between the shoulder blades known as the withers (withers yokes). With zebu oxen the withers is just in front of the

9 Cabanac/Bonniot-Cabanac 2006.
10 Simalenga/Pearson 2003.
11 Kropp 2024.

Fig. 3 Examples of withers yokes and horn/head yokes for use with one or two animals (P. Starkey).

hump. The term 'neck yoke' has been used in various documents to describe both types of yoke, and also bow yokes[12], and so this terminology is no longer clear and is best avoided. Yokes can be double or single. Pairs of yoked draft cattle can be hitched in teams of four, six, eight or more animals. Teams of animals can be used for heavy ploughing (see *Fig. 7*) and for pulling large loads (see *Fig. 11*).

While head/horn yokes are tied to the animal, withers yokes rest on the withers and are generally loosely secured to the animal with a rope, strap, staves, bow or subframe. The spacing of the animals can be determined by the curved shaping of the yoke or by vertical staves or U-shaped bows. Different yoke sizes are required for various operations, with short yokes being used for ploughing and longer yokes used for transport, ridging and inter-row weeding.

There are advantages and disadvantages of the various types of yoke and frequently there are strongly-held views about the best yokes. The double withers yoke allows animals to move their heads easily and seems more natural. The double head/horn yoke restricts the animals' head movements, which can be an advantage if the animals are not docile. The secure connections to the animals also aid braking, which can be beneficial particularly for transport and logging operations. The bows and staves of withers yokes can allow the animals to push with their shoulders, and this is said to increase their efficiency.

Other, less common harnessing systems include withers yokes made from leather or cloth, forehead yokes and collars. Collars can be 'full', as often used with draft horses, or just three-pads and wooden hames (as shown in *Fig. 14*). An unusual and rare harnessing system is the 'belly' yoke of north Africa designed to allow animals of different species to work together. The 'belly yoke' is based on two single withers yokes each attached to a swingle-tree beneath the walking animals.

Numerous designs of yokes have been developed and become part of the local heritage (see *Fig. 3*). A specially

12 Conroy 2004.

curated exhibition of yokes from around the world was held at the Lauresham Open-Air Laboratory at Lorsch in Germany in 2024, with an attractive and informative catalogue produced to complement it[13]. That exhibition illustrated very many yoke designs, often made with great skill and artistic talent. Many yokes are embellished with carved designs, added not for practical reasons but to celebrate their creativity and cultural heritage[14].

Diverse operations for draft cattle

The earliest uses of draft cattle might have been for simple transport operations (possibly pack transport and dragging loads, perhaps with simple sledges) and for soil tillage with simple wooden implements that evolved into ard ploughs fitted with metal points or shares. Primary tillage and transport have been the main tasks of draft cattle for the past two millennia. Early ploughs were symmetrical ards, with long beams attached to the yoke (see ***Fig. 1*** and ***9***). Many variations of basic long-beamed ard ploughs can be found in use around the world today[15]. They are widely used where cattle are employed for primary tillage in south Asia, north and northeast Africa and in Latin America, where they were introduced by Spanish and Portuguese colonialists (see ***Fig. 2***). The reasons for their long-standing popularity and success include their simplicity for village-level construction and repair, and their ease of transport to the field. Wooden mouldboard ploughs that invert the soil were developed in Europe in the mediaeval period (see ***Fig. 7***)[16]. Following the industrial revolution, factory-made mouldboard ploughs became common in Europe and North America and were introduced into sub-Saharan Africa. Mouldboard ploughs can be used for making ridges and earthing up, but symmetrical ridgers, with two mouldboards, were developed to improve performance.

Wheeled carts became increasingly important for carrying heavy loads. Ox carts were crucial for land transport in the Roman period[17]. Two-wheeled carts were, and remain, the main transport devices pulled by draft cattle, as they are relatively simple to make, use and maintain. Four-wheeled wagons are more expensive and complicated (with steering mechanisms) but they can carry larger and heavier loads, and are suitable for commercial use as well as for caravans, baggage trains and wagon trains. In many countries, resource-poor, smallholder farmers use simple sledges, often made from V-shaped tree-branches that can be dragged by draft cattle. Sledges are very cheap to make, and simple to use, but they scrape on the ground and can cause erosion, causing them to be banned in some countries[18]. Oxen can be ridden and/or used for pack transport (see ***Fig. 4***). While that form of transport is used by pastoralists in Africa and Asia (and also in a few other countries, including the Dominican Republic), this is relatively uncommon as equids are generally better suited for riding and packing.

Secondary tillage using simple harrows has been widespread for millennia, and in their simplest form harrows are simply tree branches that are pulled across land to break up clods and make a seedbed. In the nineteenth century, various designs of steel harrows were developed to replace the traditional wooden frames, and some models included spring tines or discs. Tine weeding with draft cattle appears to have been relatively recent, following the mechanisation of row planting.

In South Asia and East Asia, implements were developed to allow irrigated rice production, with animal-drawn ploughs, harrows and levellers. This technology was spread to appropriate locations worldwide.

An early use of draft cattle was for post-harvest operations, including threshing, by trampling and/or pulling a sledge or a roller. Threshing was illustrated in Ancient Egyptian murals and papyri[19] and mentioned in Semitic religious texts and Greek and Roman writings. Working cattle (and other livestock) were used to turn mills to grind corn and to extract oil. Draft cattle were also used to raise water from wells, by pulling ropes or by turning wheel. The spiral *saqiya* mechanism for raising water seems to have originated about 2300 years ago in the Nile valley and for over two millennia was important for irrigating fields. Such water-raising and post-harvest operations are still undertaken in some countries, although such uses of draft cattle are declining[20].

It is likely that some of the earliest uses of draft cattle were to drag timber, and this has continued in many situations where draft cattle are maintained. There have been some commercial forestry enterprises that have used oxen for logging, including in Chile, Costa Rica, Mexico, India, Myanmar and Malawi[21]. Selective logging with draft animals is seen as a modern solution to forest degradation, and a range of implements have been designed including skids and sulkies[22] (wheeled arches, see ***Fig. 4***). Small-scale logging with draft cattle remains important in some localities, including for smallholder farmers in North America and Europe (including France).

The diversity and range of the types of implements and machines developed for use with draft cattle is huge. However, even more remarkable are the countless variations on each operational theme, developed by local adaptations that became typical of particular localities, and so part of their cultural heritage. Ard ploughs and ox carts, for example, have a few basic principles, but these have allowed so many variations in how they are built, how they perform and what they look like. The boat-shaped ox cart shown in ***Fig. 4*** is only found in one area of Turkey, and other designs of carts have become typical of other areas. All these designs, embellishments and traditional practices add to the worldwide cultural heritage of draft cattle operations.

13 Kropp 2024.
14 Smerdel 2024.
15 Haudricourt/Delamarre 1955.
16 Ibd.
17 Raepsaet 2002.
18 Starkey 2000.
19 Stead 1986.
20 Lowe 1986.
21 Hedman 1991.
22 Cordero 1988.

Fig. 4 Examples the diversity of operations that can be performed by draft cattle. a). Man with two draft cows ploughing in Egypt with a wooden ard. b). Man weeding cotton with oxen using a wide withers yoke in Zimbabwe. c). Men using pack oxen to carry goods to market in Sri Lanka. d). Man loading traditional cart in Turkey. e). Oxen turning a 'trapiche' sugar-cane mill in Honduras. f). Oxen logging with a sulky arch in France (all: P. Starkey).

Women and draft cattle

In much of the world, working with draft cattle has tended to be a job for men. The author estimates he has taken tens of thousands of photos of draft cattle working in over 60 countries worldwide, and he estimates that in over 95% of these photos, men have been in control of the animals and the equipment. Due to his interest in gender issues with draft cattle, the author has been collecting photographed examples of women in control of draft cattle, and these have only occurred on perhaps 100-200 occasions (out of more than ten thousand photo opportunities). On the other hand, there are numerous photos of women assisting with draft cattle operations, for example leading the work animals or planting seeds behind a plough (see ***Fig. 5***). Women are also frequently passengers in ox carts or wagons. In contrast, in the author's photos of donkeys in use for carrying, riding or cultivating, women or children are much more frequently in control, perhaps in as many as half of all photographed occasions in 50 countries. Naturally, those roughly estimated figures are purely indicative, but they do illustrate some differences in the traditional roles of men and women in controlling work animals.

In most countries in the world, traditional roles and ownership relating to cattle have meant that men have generally been responsible for working with draft cattle in both field and transport operations. This generally was the case whether farmers were working with their own animals or paying workers to do the operations. On smallholder operations, where labour is short, men and women may work together with the draft cattle, but it is frequently the men who control the technologies (such as the tillage implements). However, in recent years, women have increasingly been responsible for working with draft cattle, sometimes because men worked away from their farm and were unavailable when the operations were required (see ***Fig. 5***). Historically, this was also the case, notably when men left their farms during times of war. That women can work well with draft cattle is not in any doubt, and the gendered allocation of tasks has been an attribute of societies and cultures, and this may be changing, albeit slowly.

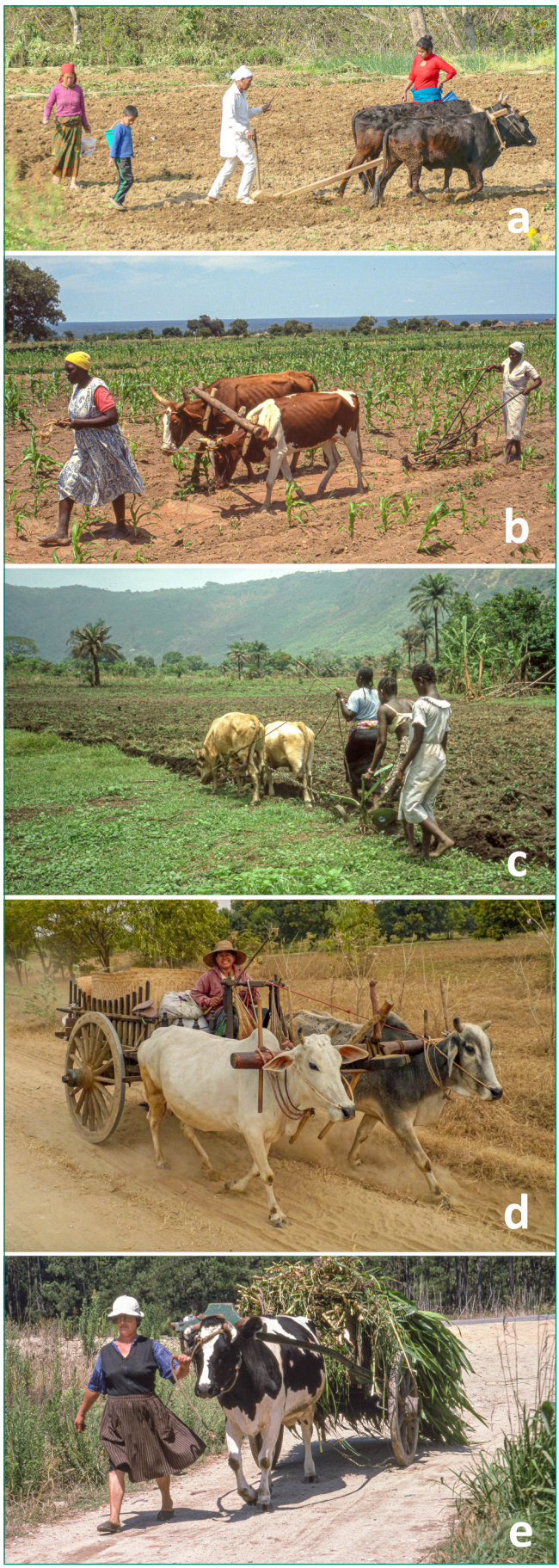


Fig. 5 *Examples of women working with draft cattle. a). Man ploughing with draft cattle in Nepal, as women follow with seeds and fertiliser. b). Women in Zimbabwe weeding with draft cows, as men away in distant jobs. c). Members of a women's association ploughing with N'Dama cattle in Sierra Leone. d). Woman returning from market in an ox cart in Myanmar. e). Woman controlling a cow pulling a cart with forage from a family smallholding in Portugal (all: P. Starkey).*

Adaptation and optimisation

From the moment a draft animal technology is tried in an area (whether by invention or copying from someone else), it is likely to be gradually modified by individual users to better fit their circumstances. This is the beginning of local optimisation. Equipment, techniques and practices gradually change to be appropriate to the local animals and resources. Similarly, the draft cattle are gradually modified, by individual training and by genetic selection and breeding to be appropriate to the work (and other outputs) required of them.

For example, if the initial design of a plough appears heavy, some people may make a lighter plough. If a plough appears liable to break, some people may make stronger ones. Different farmers or blacksmiths may change the angle of attack of the ploughshare, and on a mouldboard plough change the size and curvature of the mouldboard. Yokes may be made lighter or stronger, more or less curved and their length may be varied too.

Some farmers may move from using two animals to using just one, or vice versa. Some may start to train their animals at a young age. Some may sell their working cattle after one or two seasons, while others keep them for many years. Some may use cows for work, while others use bulls or oxen.

Neighbours may copy the more successful of the various management techniques and harnessing and implement options. The result is that the methods and technology gradually evolve in every area, and draft cattle systems diverge.

The result is that within countries, provinces and districts there are unique systems of utilisation associated with particular areas. Whether it be breed of cattle, type and design of yoke or choice and characteristics of implement, there is a great overall diversity, with local areas of relative homogeneity, that people in that area consider to be their normal, traditional practices.

The differences in draft cattle technologies between provinces and regions will be mainly due to the local adaptation and optimisation of utilisations systems appropriate to the local circumstances. However, some differences may also represent technological drift, as imperfect copies gradually lead to changes over time and space. Similar situations occur in biological populations of plants and animals that gradually diverge across their ranges, partly as a result of local adaptation to the environments, and partly due to genetic drift.

Optimisation rather than maximisation

It is important to understand the concept that farmers tend to optimise their draft cattle systems to their local ecosystem(s), available resources and socio-economic circumstances. There have been many researchers who have developed 'better' technologies that maximise certain benefits. For example, ploughs that invert more soil, animals that are larger and stronger or collars that appear to provide a more efficient angle of pull. The researchers have often suggested they have 'perfected' the technologies, only to find that farmers have rejected them. For example,

much time was spent developing and promoting multipurpose wheeled toolcarriers[23], pulled by draft cattle, which were found to be excellent on research stations, but were seldom adopted by smallholder farmers, who preferred a range of lighter and simpler implements (see ***Fig. 6***). While researchers were concentrating on productivity in large fields, the farmers had to consider many more parameters as they generally worked on smaller plots with smaller animals. A large animal may be stronger, but it is also likely to be more costly, require more food and represent a greater financial risk should it die or be stolen. An ox may be stronger, but a cow can give calves and milk besides work. A steel mouldboard plough may be better at soil inversion, but it is heavier to carry to a distant field. A multipurpose implement is a clever concept, but it tends to be heavier and if something fails, all implement options are lost at the same time. A collar-based harnessing system may be efficient, but a wooden yoke may be much cheaper and simpler. Researchers working with farmers to improve their operations need to share the holistic approaches used by farmers and understand that all choices tend to be based on compromises between performance, cost, convenience, risk and other factors.

Fig. 6 *Draft oxen pulling wheeled toolcarriers on research sites. a). Ridging on research station in India (International Crops Research Institute for the Semi-Arid Tropics). b). Testing minimum-tillage planter in Nicaragua c). Earthing up maize in Cuba (both: P. Starkey).*

23 Starkey 1988.

Local traditions and loyalty to these

Whether due to intentional local adaptations or the result of technological drift, the local people that have grown up with a particular technology around them, regard this as traditional and are often very proud of their traditions. They will often praise their own system in comparison with diverging systems in neighbouring areas. A good example relates to yoking systems in France. As noted before, there are two main types of yokes for working cattle. The horn/head yoke fits on the neck just behind the head and is tied to the horns. The withers yoke fits at the other end of the neck, above the withers, close to the shoulders. In much of the world, these two types of yoke seldom overlap, with withers yokes being common in most of Asia and much of Africa, and horn/head yokes being dominant in Latin America and parts of West Africa. In France, there is a chimera of distribution, with many departments having their own traditional yokes that is one of the two types and perhaps very different from those of the neighbouring departments. Despite the close proximity of the two types throughout most of France, neither type has led to the displacement of the other. Both types are strongly defended by their users, as better than those in neighbouring departments. From the technical point of view, this is not surprising, as attempts to show the clear advantages of one type of yoke have seldom achieved a clear overall advantage in terms of training, animal welfare, work efficiency and simplicity in manufacture and use (although most have shown the inefficiencies of poorly fitted yokes)[24]. The lesson from the yoke diversity of France is that farmers appreciate, and are loyal to, their traditional designs, and the potential advantages of the other yokes (claimed by the farmers in their neighbouring departments) have not been sufficient to reject their traditional designs.

Traditional designs and folk art

The boundary between traditional designs and folk art is blurred. If part of a design is attractive but unnecessary, it is clearly art. Yet the traditional, functional designs made by artisans may also be considered as folk art. Many of the technological features of the harnessing systems, implements and carts used by working cattle are clearly part of local folk art and cultural heritage. Extra carving on yokes is very common, as is painting of carts in traditional colours and designs. The coats of the animals may be fashioned creatively, and the tassels of the fly protectors may be intricate and typical of a particular region. In addition, on special days of the year, such as the start of the planting season or the beginning of harvesting, or at the time of religious festivals or important local events, additional drapes, tassels and flags may adorn the working cattle and their implements or carts. Such items are technologically superfluous, but culturally and psychologically important for the farmers and their communities.

In some cases, the benefits of the folk art appear to outweigh the technological efficiency. Examples of this are the wonderfully carved and painted yokes used in parts of Portugal, including by the ox handlers that pull in fishing nets and boats (see ***Fig. 3***).

24 Starkey 1989.

Fig. 7 Illustration of ploughing with a team of four oxen from the mediaeval British Luttrell Psalter, c. 1330 CE (Copyright: British Library Board, Add. 42130, f. 170).

Fig. 8 Painting on a traditional beehive featuring ploughing and harrowing using oxen fitted with collars, Slovenia, 1897 (Slovene Ethnographic Museum).

These yokes are beautiful, with intricate carving and painting of tall panels on top of the yoke beam. They are further adorned by horse-hair plumes. However, the yoke appears to be ergonomically poor, being much heavier than necessary (due to the carved panel) and insufficiently curved to fit the necks of the oxen comfortably. It seems that the importance of the folk art to the people has taken precedence over functional simplicity and the ergonomic comfort of the animals.

Portraying and embedding cultural heritage

Since the domestication of cattle and their employment for work, people have portrayed their uses in many different art forms, including songs and stories, drawings and paintings (using different materials and techniques), stone and wood carvings, metal work, ceramics and other forms of art. Models have been made as ornaments, funerary objects, toys, presents and souvenirs. The roles of working cattle have been described, authorised, proscribed and/or illustrated in manuscripts, laws, texts and books. For example, the biblical book of Deuteronomy dating back to the 7th century BCE, proscribed the muzzling of oxen when they were used for threshing[25]. In Ethiopia, the Orthodox Church prohibits the use of oxen on certain days, and in Nepal, where oxen are widely used, they are not generally worked in the Kathmandu Valley, that is sacred to Lord Shiva.

In general, the portrayal of animal power has been seen as a positive part of the cultural heritage. On Graeco-Roman coins the person working with the animals was often a ruler or other dignitary. This was related to the ceremony marking the foundation of a city, where a dignitary controls a yoked bull and a cow pulling an ard plough to create a furrow marking the initial city boundary[26]. However, the technological accuracy of the designs portrayed can be debateable. On Roman coins the draft animals often appear to be oxen[27]. The writers, artists, sculptors and designers were not necessarily well-informed about (or interested in) specific technical details and so their creations may not correspond exactly to the reality of what they were trying to convey. This creates a dilemma for modern interpretations of historical depictions. Evidence from recent inaccuracies of draft cattle utilisation depicted on bank notes (see ***Fig. 11***) and stamps, suggests that care must be taken when commenting on specific details in historical representations of working cattle. For example, in the mediaeval Luttrell Psalter depiction of four oxen pulling a plough, the horn of one of the rear oxen appears to be on the wrong side of its yoke (***Fig. 7***).

25 Deuteronomy 25:4.

26 Rykwert 1976.

27 Jellonek 2022.

Paintings

For centuries, the importance of working cattle has been portrayed in many types of artwork including drawings, paintings and carvings, and more recently in photographs and films. Some of the oldest and clearest drawings and paintings come from the tombs of ancient Egypt, where they have been painted on walls and included in illustrated papyri, including versions of the Book of the Dead[28]. In such wall paintings and papyri, many dating from around 1000 BCE, the use of cattle is clearly seen for ploughing and threshing and cows are seen providing milk. While the ancient Egyptian artists did not master perspective, they clearly show pairs of animals, yoked and pulling ard ploughs not dissimilar to those seen in modern Egypt (see ***Fig. 4***). Interestingly, many working cattle appear to be cows (with small udders and four teats, see ***Fig. 1***), with masculine anatomy not as clear. This is not surprising, as cows have frequently been used for ploughing in irrigated farming systems, and cows are still used for ploughing in Egypt today (***Fig. 4***).

In mediaeval Europe, the illustrators of manuscripts would sometimes include agricultural scenes. The fourteenth century portrayal of a wooden mouldboard plough pulled by a team of four oxen shown in the Luttrell Psalter has become well known (***Fig. 7***).

In the past millennium, numerous artists have used watercolours or oil-based paints to portray working cattle, with their roles in transport and primary tillage particularly common. In addition to paintings on paper and canvas, working cattle have also been painted on animal skins and wooden panels. In Slovenia, there has been a long tradition of decorating bee-hive panels, and among the many designs, have been working cattle (***Fig. 8***). Some of the paintings of working animals have been more entertaining than accurate.

Stone, ceramics and bronzes

For thousands of years, people have been portraying the importance of working animals through marks and paintings on stone and pottery, the carving of stone and wood, the creation of statues made from bronze and the decoration of tiles and mosaics. The ancient Egyptians carved bas-relief images of working cattle[29]. There are Greek pots with pictures of oxen ploughing[30] and Roman mosaics portraying working cattle, including working bulls (see ***Fig. 1***). More recently, in the early twentieth century, blue ceramic tiles were used in São Bento railway station in Porto to portray some of the history and cultural heritage of Portugal, including depictions of oxen pulling carts. In West Africa, bronze has been used to create three-dimensional art, including the depiction of draft cattle (see ***Fig. 9***).

Models

For millennia, the importance of working animals has been portrayed in models including works of art, technical models, toys and souvenirs. Models of two cattle ploughing have been found in Egyptian tombs dating from about 1850 BCE (***Fig. 9***)[31]. These reinforce in three dimensions the Egyptian paintings of this era, although the sex of the animals is not clear. Models of working cattle, local carts and wagons have been produced for centuries in many countries as toys, souvenirs and works of art. These models acknowledge the cultural heritage of the local designs, which may differ from those of neighbouring areas and countries.

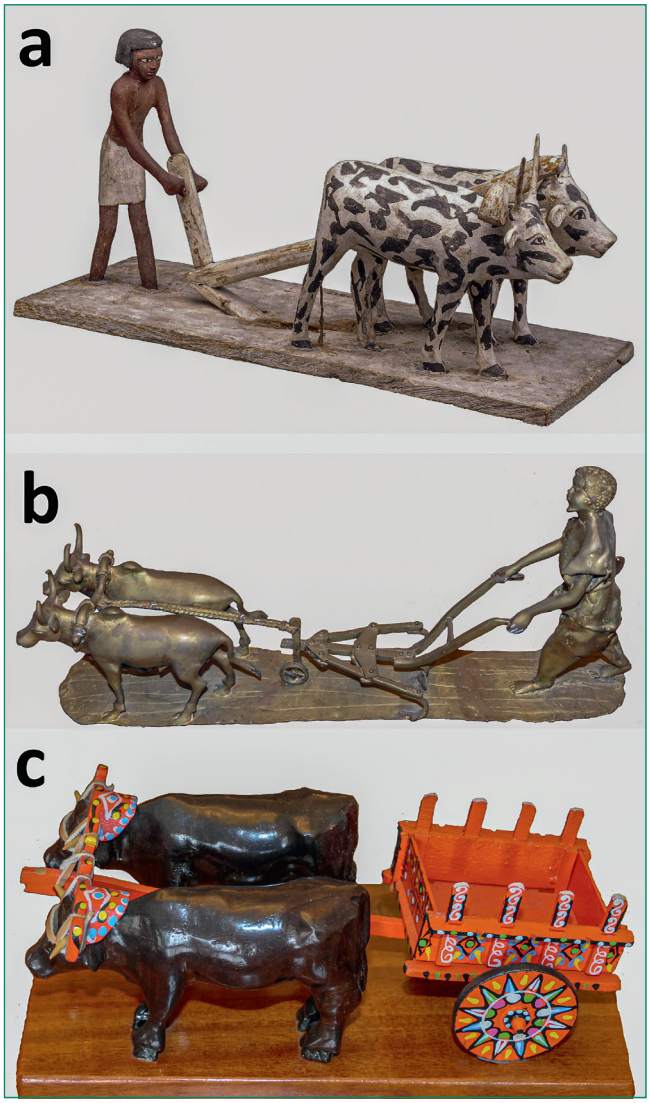


Fig. 9 *Examples of models of draft cattle. a) Ancient Egyptian wooden model of man ploughing with two yoked cattle, c. 1850 BCE (British Museum). b) Recent bronze model of man cultivating with draft oxen in Burkina Faso. c) Recent wooden model of oxen with painted yoke pulling traditionally painted cart in Costa Rica (both: P. Starkey).*

Currencies

As already discussed, working cattle have been portrayed on ancient coins. Examples include a silver Greek coin from Tarsus minted around 425–400 BCE that shows a pair of yoked cattle being worked with an ard plough (***Fig. 10***). As noted above, a 'foundation scene' with yoked pairs of draft cattle pulling ard ploughs was commonly depicted on Roman coins, notably in the period 100 BCE to 100 CE (***Fig. 10***). Oxen have subsequently been portrayed on coins in several countries including the Dominican Republic, Egypt, Ethiopia, Nepal and Vatican City (***Fig. 10***).

28 Rossiter 1984.
29 Haudricourt/Delamarre 1955.
30 Ibd.
31 Andrews 2000.

Fig. 10 Examples of coins featuring draft cattle. a) Silver Greek coin, c. 410 BCE. b) Silver Roman denarius c.27 BCE (both: British Museum). c) Ethiopia one-santim coin, 1977. d) Nepal two-rupee coin, 2006 (both: P. Starkey).

Since the widespread use of bank notes as day-to-day currencies, several countries have portrayed working cattle[32]. Examples include Algeria, Bangladesh, Cambodia, China, Ethiopia, Guinea, Mongolia, Mozambique, Rwanda and South Africa (see ***Fig. 11***). It is interesting to note that 'oxen' is now the name of a cryptocurrency.

As mentioned earlier, artistic representations may not be technically accurate. This appears to be the case in some bank notes, that do not realistically reflect the actual use of working cattle in that country. For example, the 50 Franc note of Guinea Conakry in 1985 shows two large, humped oxen, with a withers yoke pulling a wooden-beamed plough (***Fig. 11***). This image is very different from the work oxen seen in Guinea at this time, as they were dwarf, humpless N'Dama cattle, fitted with head/horn yokes and pulling steel ploughs by chains (similar to ***Fig. 5*** and ***Fig. 14***). It is likely the currency image was inspired by the work oxen and implements used in Cuba (with which Guinea was closely associated at the time). In another example of probable inaccuracy, a 500 taka note issued in 2011 in Bangladesh showed agricultural scenes with four yoked oxen working in a field. The original design may have been based on a photo of two-pairs of animals walking close together while levelling a field (although no implements are shown). In the printed design, the artist has provided a single, four-animal yoke with no staves or ties, which is clearly unusual (***Fig. 11***).

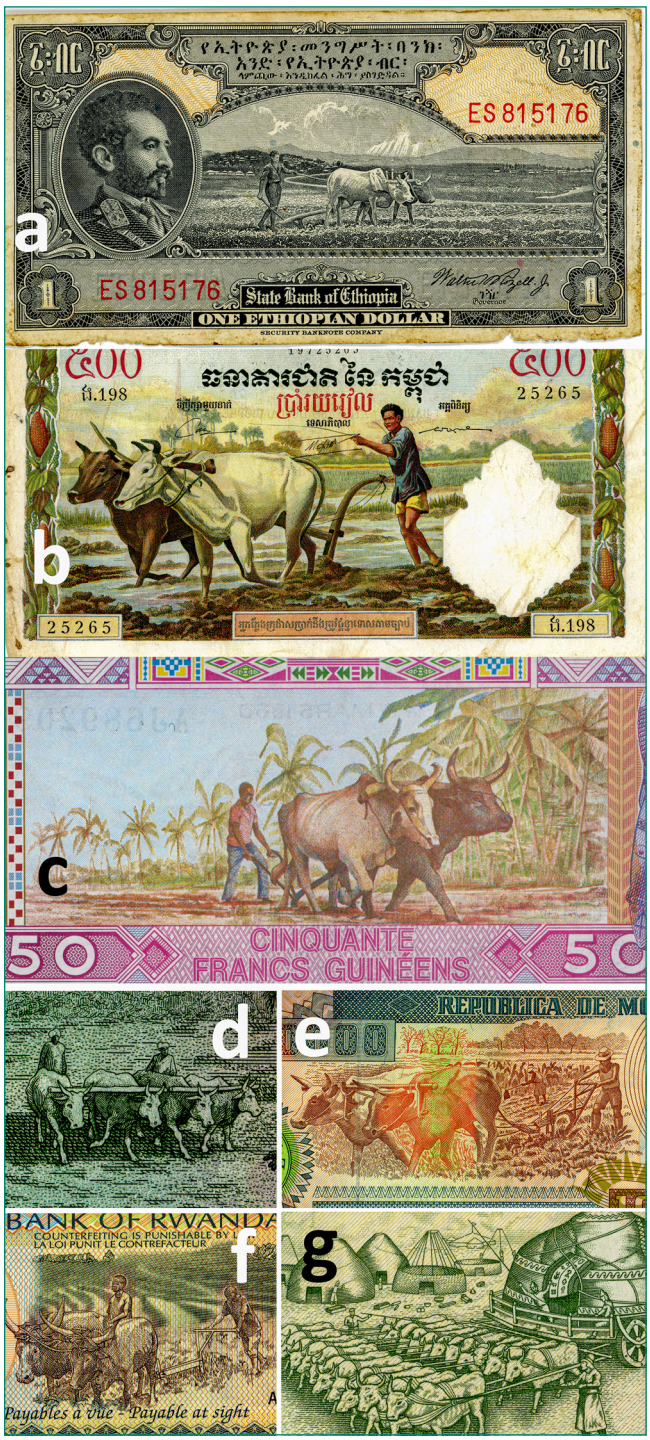


Fig. 11 Examples of bank notes featuring draft cattle. a) Ethiopia, b) Cambodia, c) Guinea (showing Latin American animals and implement), d) Bangladesh (showing unlikely 4-animal yoke), e) Mozambique, f) Rwanda g) Mongolia (all: P. Starkey).

Postage stamps

The first postage stamps were produced in the UK in 1840, and the first designs with animals were produced in Canada in 1851. There was then a proliferation of designs featuring various aspects of the cultural heritage of the issuing countries. In 1899, Cuba created stamps portraying two oxen pulling a wooden-beamed plough. In 1942, Panama issued a stamp showing a pair of oxen fitted with a head/horn yoke pulling a cart loaded with wood. In the 1940s and 1950s, some countries, including the USA and New Zealand, included oxen in the designs of stamps commemorating significant centenaries. By

32 PMG 2021.

the 1960s, many countries produced thematic issues of stamps and some of these included oxen in the context of local agriculture, transport, paintings, traditions and festivals. Some of these are illustrated in ***Fig. 12***.

Fig. 12 *Examples of postage stamps featuring draft cattle (P. Starkey).*

Postcards

Postcards started being used as a rapid means of simple and low-cost communication in the second half of the nineteenth century[33]. In the twentieth century, picture postcards based on photographs become popular, and significant markets developed for tourist postcards designed to be kept as souvenirs and to be sent to friends and relatives. Favourite subjects included beautiful scenes, historic buildings, wildlife and the local cultural heritage. In many countries, working cattle, often pulling traditional carts, were considered part of the local heritage to be highlighted and were included in tourist postcards. Some examples are illustrated in ***Fig. 13***.

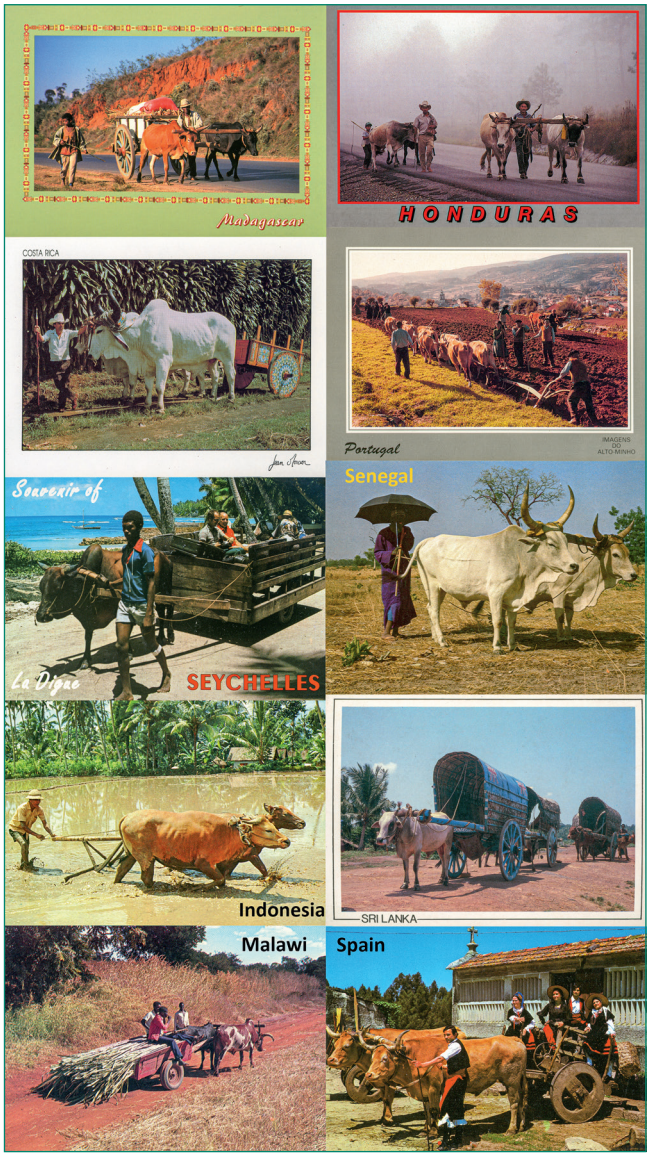


Fig. 13 *Examples of postcards featuring draft cattle (P. Starkey).*

Demonstrating cultural heritage and modern uses

Worldwide, people tend to be proud of their cultural heritage, including the use of draft cattle. Historic uses of draft cattle and associated folk art are generally appreciated and sharing these can be popular, whether in museums, festivals, exhibitions or demonstrations.

The heritage of working cattle is frequently displayed in museums, particularly agricultural and open-air museums. Museum displays may include collections of yokes, tillage implements, carts and wagons. The displays may be accompanied by drawings, paintings or photographs illustrating how the draft cattle were worked, and there may be references to the local cultural heritage of traditions, including carving of yokes and the painting of carts and wagons.

33 Staff 1966.

The Museum of English Rural Life, at the University of Reading, has a large display (and an on-line exhibition) of local designs of carts and wagons from many different counties of England[34]. While work oxen had been the main source of farm power in ancient and mediaeval times, they were gradually replaced by horses, and so the carts and wagons currently displayed would have mainly been pulled by draft horses[35].

With increasing urbanisation, and large populations of people that have limited contacts with, or knowledge of, agriculture, the contents of museums relating to draft cattle may seem to have distant connections to urban people, whether in space or time. The problem of connections is greatest in highly industrialised and mechanised countries and in large cities, anywhere in the world. However, even in countries without massive urbanisation, museums can seem separated from the rural technologies they display. For example, in October 2023, at the Folk Heritage Museum in Kawangjangsa, Bhutan, there was a good collection of traditional equipment used with draft cattle including yokes, ploughs, harrows, muzzles and pack saddles. However, the local museum staff had little knowledge about the uses of these items in its collection, even though similar technology would have been in use in the local rural area.

The words ‘heritage’ and ‘museum’ convey a retrospective approach, which is entirely natural. However, in many countries, draft cattle are part of the present and will be part of the future. Therefore, in addition to celebrating the past, there is a need to publicise the on-going and future value of animal power, through agricultural shows and traditional fairs, exhibitions, demonstrations and networking events. Museums (especially agricultural, rural life, folk and open-air museums) can play an important role in this, provided they are in contact with people and organisations currently engaged in promoting and using animal power.

Two good examples of demonstrating both past and present uses of draft cattle took place in Europe recently. In March 2024, the Lauresham Open Air Laboratory (and now also the Centre for Draft Cattle Research and Education) in Kloster Lorsch, Germany, hosted an international conference on draft cattle. At this event, and also at the subsequent open day for visitors, the displays included demonstrations of mediaeval draft cattle technologies in action, for which the experimental archaeology laboratory is famous[36]. However, they also included practical demonstrations of modern animal power equipment and diverse operations using oxen, including training techniques, logging and the preparation of raised beds (see ***Fig. 14***). The local and international visitors were also able to see a curated exhibition of yokes and related photos showing current draft cattle uses in many parts of the world[37].

In May 2024, the French farmer Philippe Kuhlmann invited farmers and interested persons to a three-day event on his farm, with numerous demonstrations by work oxen and cows (from many different farms) of tillage and logging operations, and the use of different yokes and harnesses. There were exhibitions of past and present yokes and harnesses and various traditional and recently-developed equipment (see ***Fig. 14***). The event culminated in a procession of many different draft cattle through the local town at the time of a traditional fair. This event highlighted the potential and benefits of networks of practitioners and ways in which they can not only share information among themselves, but also involve other interested professionals and the general public.

Fig. 14 *Draft cattle networking events and demonstrations a) Demonstrating N’Dama draft cattle in Guinea, organised by a local network. b). Demonstration of a single ox pulling a modern Kassine disc-ridger at a world draft cattle symposium in Lorsch, Germany. c). Participants preparing draft cattle at a networking event hosted by Philippe Kuhlmann in Châtelus-Malvaleix, France (all: P. Starkey).*

Similar types of demonstration and networking events are also likely to be undertaken at other open-air museums, living history farms and agricultural shows and these can demonstrate and publicise both draft cattle heritage and modern applications. Such links between the past and the present can be important, as the use of draft cattle is increasingly being perceived as a part of history, particularly by young people in urban areas who may not be familiar with current uses. Urban people seldom see draft cattle in use, and the images they do see on social media, television and films and in publications, generally relate to historic situations. Where images of draft cattle are shown in the contemporary world, they may be associated with resource-poor farmers in difficult situations. In these cases, the messages being conveyed are seldom those of positive ‘cultural heritage’ since the

34 MERL 2025.
35 Collins 2010.
36 Kropp 2022.
37 Kropp 2024.

Fig. 15 Examples of artisanal support services needed for draft cattle. a). Demonstration of French yoke making. b). Yoke making in Guinea. c). Cartwheel making in Madagascar. d). Shoeing a draft ox in France (all: P. Starkey).

draft cattle appear to be associated with poverty and lack of modernisation[38]. Indeed, the word 'backward' has been used to describe certain areas in India where the use of draft cattle is common and 'backward' was used to describe areas where oxen were still being used in Britain and France[39]. In the setting of a West African university, a suggestion to promote work oxen was ridiculed by some academic staff as 'a U-turn back to the stone age'. While such words might not be common, young people growing up in urban environments are likely to succumb to the old-fashioned images associated with draft cattle and assume that working cattle are predominantly historical. They need to be informed that using draft cattle can be a sustainable and environment-friendly technology that is still relevant. Working cattle can be 'modern' and highly appropriate for many different farming situations. Therefore, the sharing of draft cattle information in the media, exhibitions and museums should aim to improve societal perceptions to allow the continued use of draft cattle in appropriate ways.

Future of draft cattle: need for support services

Users of draft cattle need certain services to enable them to operate effectively. They need artisans or manufacturers who can supply and repair the technical hardware: yokes and harnesses, carts, wagons and a variety of soil tillage and other implements. They need sources of suitable animals and perhaps assistance with training the animals. The animals may need veterinary and health services, nutritional supplies and possibly farriers familiar with cattle. In some situations, farmers may need specialised financial services, able to provide appropriate credit and perhaps insurance. In rural villages where the use of draft cattle is common, some of these support services are likely to be available from other farmers, and people will be learning from each other, sharing experiences and assisting with equipment adjustments and repairs. The various services needed by draft cattle users depend on there being a 'critical mass' of working animals to justify the provision of the service. This is particularly true of commercial services, whether artisanal or retail, that need regular sources of income to sustain them.

38 Starkey 2011.
39 Liebowitz 1992.

Where draft cattle are being introduced (as is happening in parts of sub-Saharan Africa), it is important that such services are made available from the outset, and a critical mass of users is developed as soon as possible to ensure the essential services are sustainable. This requirement should influence any organisations supporting the introduction of draft cattle technologies. From the point of view of overcoming disadvantage and spreading the benefits widely, it may seem appropriate to introduce small numbers of work animals to disadvantaged people in remote villages. However, to ensure the rapid development of a critical mass of support services, it may be better to initially concentrate on introducing the technology to relatively resource-rich farmers, in good farming land, close to active markets where suppliers and artisans can base their services. Once the local support services have developed within an area, it will be much easier to spread the benefits to the more disadvantaged farmers and the remoter areas. In the author's experience: the idea of testing twenty ox carts in twenty different isolated villages seemed appropriate but actually led to twenty ox carts with unrepaired punctures. When ten ox carts were concentrated in and around one important village, a local artisan started a puncture-repair service.

Where the use of draft cattle is declining, as it is currently in many parts of the world, including much of southern Asia, southern Europe and North Africa, it is important that a critical mass of users is preserved to justify the support services. As the numbers of working animals decline, the artisans responsible for making the carts, carving the yokes and repairing the ploughshares find their traditional work is drying up. They may diversify into other activities or move to an urban setting where work is more abundant. Networks of users may need to be established to keep in touch with the smaller number of people with the knowledge and skills to support draft cattle farmers. Fortunately, the widespread use of mobile phones and social media does facilitate support services meeting farmers' needs in larger catchment areas. However, the cohesion of the systems may be strained, and procedures for passing on skills and services to a new generation of providers may be difficult to achieve.

Need for policies, strategies and networking

Whether the use of draft cattle is increasing, decreasing or stable, there is likely to be a need for national or local policies and strategies to ensure there is an enabling environment for the users of draft cattle and their various support services. Unfortunately, due to the lack of inclusion of animal power issues in modern agricultural, veterinary and forestry degree courses, and in school curricula, few decision makers involved in developing policies and strategies will have great understanding of the issues involved in draft cattle use. This means that in most countries there will be a need for awareness raising to ensure relevant issues are addressed. One of the ways of doing this is through networking.

A network is a group of individuals or organisations who, on a voluntary basis, exchange information and/or undertake joint activities and who organise themselves in such a way that their individual autonomy remains intact[40]. Networking involves making contacts and encouraging reciprocal information exchange and voluntary collaboration. Networks should encourage and facilitate people's participation and actions and link individuals and organisations living or working in different circumstances (or in different 'silos'). Networks can help people and organisations to exchange novel information and experiences and stimulate collaboration and new understanding that may be missing from people's own limited professional vision. Given the general lack of understanding about draft cattle among national decision-makers, national (and international) networks are important for exchanging information relating to draft cattle, publicising issues and promoting strategies[41].

In Europe, there are strong national and international networks linking people concerned with the use of draft horses, notably FECTU (Fédération Européenne du Cheval de Trait pour la promotion de son Utilisation). In France, are many people and organisations involved in networking[42], and there are two networks linking the users of draft cattle: l'Association Attelages Bovins d'Aujourd'hui and l'Association Française des Meneurs de Bovins. Both link current users of draft cattle and support services (including people making yokes) and organise professional meetings and publicity-generating local displays. The Global Draft Cattle Network was recently formed as an outcome of an international symposium on draft cattle held in March 2024 in Lorsch, Germany. Its secretariat is currently based in the Centre for Draft Cattle Research and Education hosted by the Lauresham Open-Air Laboratory, Lorsch, Germany. Two other networks based in the USA, with some interest in draft cattle, are the Draft Animal-Power Network (DAPNet) and the Association for Living History, Farm and Agricultural Museums (ALHFAM). The Netherlands-base EXARC.net, a network concerned with experimental archaeology, is interested in current draft cattle usage as a means to understand historic uses of working cattle.

In the period 1985–2005 there were several animal traction networks in Africa and Latin America that supported research, training and policy development issues relating to draft cattle (and other working animals). Networking was particularly important at that time, as there were small numbers of people in different countries working on draft cattle promotion and technologies. Multidisciplinary networking workshops, visits and publications increased understanding and morale, reduced duplication, provided peer recognition and involved ministries, NGOs and donor representatives, facilitating a critical mass for advocacy and actions. The networking activities were mainly funded by bilateral and international donor organisations and the resulting publications remain available on-line as valuable and highly relevant resources[43]. The formal networking activities generally stopped early in the twenty-first century due lack of donor funding, but some informal networking continues to this day.

One major change in the past twenty years has been the increased understanding of the importance of envi-

40 Starkey 1998.

41 Ibd.

42 Griffin-Kremer 2022.

43 Starkey/Ndiamé 1988; Starkey/Faye 1990; Sylwander/Mpande 1992; Lawrence et al. 1993; Starkey et al. 1994; Starkey/Simalenga 1998; Kaumbutho/Simalenga 1999; Starkey/Kaumbutho 1999; Kaumbutho et al. 2000.

ronmental resilience and sustainability, and the availability of funding for initiatives linked to climate change and low-input, sustainable agriculture. This offers scope for policy and strategy work relating to draft cattle to be approached (and funded) from perspectives of climate-resilience and ecological sustainability. Existing networks promoting such approaches might be a useful entry point for networking activities relating to draft cattle.

With positive, enabling environments draft cattle can remain an ecologically friendly and sustainable multipurpose power resource for suitable modern agricultural enterprises in many countries around the world. Draft cattle can be part of the many solutions required to overcome environmental, climatic and societal issues.

Conclusions

Draft cattle have been important in human civilisations for 10,000 years and remain so today in various regions, environments and socio-economic circumstances. This history has led to a great diversity of working animals, implements, techniques, management systems and related folk art. It represents a wonderful cultural heritage for the world, individual countries and local regions. This has been celebrated in writings, art, sculptures, models, photographs and films, and has also been portrayed on coins, banknotes, postage stamps and other day-to-day items. Past examples of artisanal work and technologies have been exhibited in museums.

Draft cattle are not only historical as they are also used today and will be in the future. It is therefore important to not only preserve the diverse beauty of old technologies, but also to understand the significance of the different designs and variations and the techniques used to employ them. Where possible, this will require discussions with, and deep understanding of, existing and past users to appreciate their points of view and their observations on systems of utilisation. Sharing this knowledge, as well as the technologies, will provide a resource for current and future users of draft cattle and increase public appreciation of the on-going heritage.

With draft cattle use low or declining in many countries there is a need to ensure equipment supplies and support services can remain viable to ensure the continuation of ecologically sustainable draft cattle technologies. Networks and networking events can be important in sharing knowledge and creating a critical mass to influence policies and encourage the inclusion of draft cattle technologies in resilience strategies relating to climate change. This will help ensure the public appreciates the wonderful heritage of draft cattle, as well as enable women and men to adopt, use and further develop the draft cattle technologies and systems that have proven invaluable for so long.

Bibliography

Andrews 2000 C. Andrews, Egyptian Treasures from the British Museum (London 2000).

Cabanac/Bonniot-Cabanac 2006 M. Cabanac/M-C. Bonniot-Cabanac, Religious taboo against eating pork meat. Journal of World Anthropology. Occasional Papers 2 (2006), 17-26.

Collins 2010 E. Collins, The latter-day history of the draught ox in England, 1770–1964. Agricultural History Review 58, 2010, 191–216. URL: www.jstor.org/stable/41330067 [31.05.25].

Conroy 2004 D. Conroy, Ox Yokes. Culture, Comfort and Animal Welfare. TAWS Workshop 2004. URL: www.taws.org/TAWS04-Conroy-040419-A4-all.pdf [31.05.25].

Cordero 1988 W. Cordero, Utilización del sulky en extracción de madera con bueyes (Cartago 1988).

Griffin-Kremer 2022 C. Griffin-Kremer, Eye-to-eye with animal draft in France – a case study in a broader ecosystem. In: C. Kropp/L. Zoll (eds.), Draft Animals in the Past, Present and Future (Heidelberg 2022) 79–86.

Haudricourt/Delamarre 1955 A. Haudricourt/M. Delamarre, L'homme et la charrue à travers le monde. Géographie Humaine 25 (Paris 1955).

Hedman 1991 L. Hedman, The use of draught animals in forestry: a survey of literature (Uppsala 1991).

Jellonek 2022 S. Jellonek, The foundation scene on Roman colonial coins from the Near East in the 3rd century CE. Studies in ancient art and civilization 26, 2022, 163–182.

Kaumbutho et al. 2000 P. Kaumbutho/A. Pearson/T. Simalenga (eds.), Empowering farmers with animal traction (Alice, 2000). URL: www.atnesa.org/empowering1999bookcontents [31.05.25].

Kaumbutho/Simalenga 1999 P. Kaumbutho/T. Simalenga (eds.), Conservation tillage with animal traction. ATNESA 1999. URL: www.atnesa.org/contilworkshopcontents [31.05.25].

Kropp 2024 C. Kropp, The role of draft cattle in (archaeological) open air museums and living history farms – a personal essay. In: C. Kropp/L. Zoll (eds.), Draft Animals in the Past, Present and Future (Heidelberg 2022) 123–128.

Kropp 2024 C. Kropp, Yoke, joug, ayoko. A cultural history of the yoke through the millennia (Bad Homburg 2024).

Liebowitz 1992 J. Liebowitz. The Persistence of Draft Oxen in Western Agriculture. Material History Review 36, 1992, 29–37.

Löwe 1986 P. Löwe, Animal powered systems. An alternative approach to agricultural mechanization (Braunschweig 1986).

Lawrence et al. 1993 P. Lawrence/K. Lawrence/K. Dijkman/P. Starkey (eds.), Research for development of animal traction in West Africa (Addis Ababa 1993). URL: www.animaltraction.net/researchforDevofATinWestAfrica [31.05.25].

MERL 2025 Along the road we go, Museum of English Rural Life (MERL). URL: www.merl.reading.ac.uk/explore/online-exhibitions/farm_wagons/ [31-05-25].

Mudamburi/Starkey 2022 B. Mudamburi/P. Starkey, Draft animals in the world. In: C. Kropp/L. Zoll (eds.), Draft Animals in the Past, Present and Future (Heidelberg 2022) 29–44.

Pitt et al. 2018 D. Pitt/N. Sevane/E. Nicolazzi/D. MacHugh/S. Park/L. Colli/R. Martinez/M. Bruford/P. Orozoco-terWengel, Domestication of cattle. Two or three events? Evolutionary Applications 12, 1, 2018, 123–136.

PMG 2021 Paper Money Guaranty (PMG), Collection inspiration: oxen. URL: www.pmgnotes.com/news/article/8828/collection-inspiration-ox-banknotes/ [31-05-25].

Raepsaet 2002 G. Raepsaet, Attelages et techniques de transport dans le monde gréco-romain (Brussels 2002).

Rossiter 1984 E. Rossiter, The book of the dead. Papyri of Ani, Hunefer, Ahhai (Geneva 1984).

Russell 2012 N. Russell, Social zooarchaeology. Humans and animals in prehistory (Cambridge 2012).

Rykwert 1976 J. Rykwert, Idea of a town. The anthropology of urban form in Rome, Italy, and the Ancient World (Princeton 1976).

Simalenga/Pearson 2003 T. Simalenga/A. Pearson, Using cows for work (Edinburgh 2003).

Smerdel 2024 I. Smerdel, Yokes of the Slovene Ethnographic Museum (Ljubljana 2024).

Staff 1966 F. Staff, The picture postcard and its origins (London 1966).

Starkey 1988 P. Starkey, Perfected yet rejected. Animal-drawn wheeled tool-carriers (Braunschweig 1988).

Starkey 1989 P. Starkey, Harnessing and implements for animal traction (Braunschweig 1989).

Starkey 1998 P. Starkey, Networking for development (London 1998).

Starkey 2000 P. Starkey, The history of working animals in Africa. In: R. Blench/K. MacDonald (eds.), The origins and development of African livestock. Archaeology, genetics, linguistics and ethnography (London, 2000) 478–502.

Starkey 2011 P. Starkey, Livestock for traction and transport world trends, key issues and policy implications. Food and Agriculture Organisation (Rome 2011). URL: 10.13140/RG.2.2.29674.34245 [31.05.25].

Starkey et al 1994 P. Starkey/E. Mwenya/J. Stares (eds.), Improving animal traction technology (Wageningen 1994). URL: www.atnesa.org/improvingbookcontents [31.05.25].

Starkey/Faye 1990 P. Starkey/A. Faye (eds.), Animal traction for agricultural development (Wageningen 1990). URL: www.animaltraction.net/ATagricdevSE88proc [31.05.25].

Starkey/Kaumbutho 1999 P. Starkey/P. Kaumbutho (eds.), Meeting the challenges of animal traction (London 1999). URL: www.atnesa.org/challengesbookcontents [31.05.25].

Starkey/Mudamburi 2022 P. Starkey/B. Mudamburi, Draft animal issues, constraints and opportunities in Africa. In: C. Kropp/L. Zoll (eds.), Draft Animals in the Past, Present and Future (Heidelberg 2022) 9–28.

Starkey/Ndiamé 1988 P. Starkey/F. Ndiamé F (eds.), Animal power in farming systems (Braunschweig 1988). URL www.animaltraction.net/ROATA/WestAfricaNetwork [31.05.25].

Starkey/Simalenga 1998 P. Starkey/T. Simalenga, Animal power for weed control, ATNESA 1998. URL: www.atnesa.org/weedingbookcontents [31.05.25].

Stead 1986 M. Stead, Egyptian life. British Museum (London 1986).

Sylwander/Mpande 1992 L. Sylwander/R. Mpande, Gender issues in animal traction, ATNESA 1992. URL: www.atnesa.org/genderworkshop [31.05.25].

Author info

Paul Starkey

Museum of English Rural Life (MERL), University of Reading;
Visiting Senior Research Fellow
Oxgate, 64 Northcourt Avenue, Reading RG2 7HQ, UK

E-Mail: p.h.starkey@reading.ac.uk, p.h.starkey@gmail.com

Animal transport in the Balkans, c. 1300 to 1914

William G. Clarence-Smith

Abstract

Terrain, climate, and culture determined the employment of transport animals in the Balkans. Horses dominated pack and riding. Camels, mules, donkeys, and humans also bore loads, and some mules and donkeys were ridden. Humans or mules carried sedan-chairs and litters. Despite the mountainous terrain, wheeled vehicles featured more prominently in the Balkans than in Anatolia. Bovids pulled most vehicles, with buffaloes drawing heavier loads in wagons in the plains. Oxen dominated transport by cart in the hills, and donkeys contributed over short distances. Horses also drew vehicles when speed or prestige were at stake, and briefly powered stage-coaches and urban trams. The Eurasian steppe's grey oxen and small horses were plentiful and cheap, encouraging their widespread use. Mules were surprisingly uncommon, perhaps because of Islamic beliefs and Central Asian customs. Bactrian-dromedary hybrid camels were strong but costly, and associated with Turkish domination, so that few remained after the Ottomans withdrew.

Résumé

Le terrain, le climat et la culture ont déterminé l'utilisation des animaux de transport dans les Balkans. Les chevaux dominaient le transport de marchandises et l'équitation. Les chameaux, les mulets, les ânes et les humains transportaient également des charges, et certains mulets et ânes étaient montés. Les humains ou les mulets transportaient des chaises à porteurs et des litières. Malgré le relief montagneux, les véhicules à roues étaient plus répandus dans les Balkans qu'en Anatolie. Les bovidés tiraient la plupart des véhicules, les buffles tirant les charges les plus lourdes dans des chariots dans les plaines. Les bœufs dominaient le transport par charrette dans les collines, et les ânes y contribuaient sur de courtes distances. Les chevaux tiraient également des véhicules lorsque la vitesse ou le prestige étaient en jeu, et furent brièvement utilisés pour les diligences et les tramways urbains. Les bœufs gris et les petits chevaux de la steppe eurasienne étaient abondants et bon marché, ce qui encourageait leur utilisation généralisée. Les mules étaient étonnamment rares, peut-être en raison des croyances islamiques et des coutumes d'Asie centrale. Les chameaux hybrides bactriens-dromadaires étaient robustes mais coûteux, et associés à la domination turque, de sorte qu'il en restait peu après le retrait des Ottomans.

Kurzfassung

Das Gelände, das Klima und die Kultur bestimmten den Einsatz von Transporttieren auf dem Balkan. Pferde dominierten den Last- und Reittransport. Kamele, Maultiere, Esel und Menschen trugen ebenfalls Lasten, und einige Maultiere und Esel wurden geritten. Sänften und Tragbahnen wurden von Menschen oder Maultieren getragen. Trotz des bergigen Geländes waren Radfahrzeuge auf dem Balkan stärker verbreitet als in Anatolien. Die meisten Fahrzeuge wurden von Boviden gezogen, wobei Büffel in den Ebenen schwerere Lasten in Wagen zogen. In den Hügeln dominierten Ochsen den Transport mit Karren, und Esel leisteten auf kurzen Strecken einen Beitrag. Pferde zogen auch Fahrzeuge, wenn es auf Geschwindigkeit oder Prestige ankam, und wurden kurzzeitig für Postkutschen und städtische Straßenbahnen eingesetzt. Die grauen Ochsen und kleinen Pferde der eurasischen Steppe waren reichlich vorhanden und billig, was ihre weit verbreitete Nutzung förderte. Maultiere waren überraschenderweise selten, vielleicht aufgrund islamischer Überzeugungen und zentralasiatischer Bräuche. Baktrische Dromedare waren stark, aber teuer und wurden mit der türkischen Herrschaft in Verbindung gebracht, sodass nach dem Rückzug der Osmanen nur wenige übrig blieben.

Resumen

El terreno, el clima y la cultura determinaron el empleo de animales de transporte en los Balcanes. Los caballos dominaban el transporte de mercancías y la equitación. Los camellos, las mulas, los burros y los seres humanos también transportaban cargas, y algunas mulas y burros se montaban. Las personas o mulas transportaban las sillas de manos y literas. A pesar del terreno montañoso, los vehículos con ruedas estaban más presente en los Balcanes que en Anatolia. Los bóvidos tiraban de la mayoría de los vehículos, y los búfalos transportaban las cargas más pesadas en carros por las llanuras. Los bueyes dominaban el transporte en carretas por las colinas, y los burros contribuían en distancias cortas. Los caballos también tiraban de vehículos cuando la velocidad o el prestigio estaban en juego, y durante un breve periodo de tiempo impulsaron diligencias y tranvías urbanos. Los bueyes grises y los caballos pequeños de la estepa euroasiática eran abundantes y baratos, lo que fomentó su uso generalizado. Las mulas eran sorprendentemente poco comunes, quizás debido a las creencias islámicas y las costumbres de Asia Central. Los dromedarios bactrianos eran fuertes pero costosos, y se asociaban con la dominación turca, por lo que quedaron pocos después de la retirada de los otomanos.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 036-041. DOI: https://doi.org/10.11588/propylaeum.1713.c25086

Over sixty years ago, Traian Stoianovich famously proposed that some Christian shepherds in the Balkans became muleteers from around 1300, then merchants, and finally bankers from the eighteenth century. However, he used the term 'muleteer' loosely to mean people using any pack animal, in this case mainly horses. Moreover, vehicles featured more prominently in the Balkans than Stoianovich alleged, despite the mountain ranges that stretch from Greece to the Danube and Sava rivers.[1]

Choices of modes of transport related to many factors, such as the relative cost and availability of beasts and vehicles, and the skills of local inhabitants. Terrain and climate suggested which animals and conveyances to deploy, and local cultures had a further influence. In addition, Ottoman policies and capabilities during these centuries deeply affected the building and repairing of roads, and the policing of routes.

Transport resources and infrastructures

In contrast with the Asian part of the Ottoman Empire, where pack camels largely replaced wheeled traffic, vehicles remained numerous in the Balkans, and were accurately depicted in miniatures of the time.[2] Thrace was a major manufacturing centre for four-wheeled wagons, which were smaller and lighter than those made north of the Danube. There were numerous regional types of two-wheeled carts, with solid or spoked wheels.[3]

Estimates of capacity vary widely, but all underline the superiority of draught over pack. A wagon could transport some 800 to 2,400 kilos, depending on the number and strength of animals in a team, whereas a cart drawn by a single ox moved about 500. A camel carried around 250 kilos on its back, compared to about 100 for a horse or mule, and 50 for a donkey.[4]

Different types of thoroughfare suited varying modes of transport. Wagons were largely restricted to main roads in the plains, endowed with causeways, bridges, and ferries. An extra team of animals could overcome steep slopes, but the length of a wagon, combined with the lack of a pivot on its front axle, made it unsuitable for winding and narrow roads. Lighter carts, more manoeuvrable and easier to transport across bodies of water, prevailed on minor roads. As for pack animals, they dominated mountain trails and paths, which were frequently obstructed by rocky ravines and dense forests.[5]

Three great Roman routes fanned out across the Balkans from Istanbul, resembling interwoven braids more than single carriageways.[6] The foremost itinerary was the Orta Kol (central arm), or Via Militaris, which connected with the navigable Danube and Sava rivers at Belgrade.[7] At Niš, a little before Belgrade, a spur led westwards to the Adriatic at Ragusa (Dubrovnik), though it was unsuited to wheeled traffic.[8] Another spur at Niš, accessible to light vehicles, followed the Morava and Vardar valleys south to Salonica (Thessaloniki).[9] Many wagons travelled from Istanbul to Salonica along the eastern section of the Sol Kol (left arm), the old Roman Via Egnatia, and continued thence into northern Greece. However, they could no longer reach the Adriatic on the Via Egnatia, as repairs since Byzantine times had taken the form of shallow stone steps.[10] The Sağ Kol (right arm), or Via Pontica, headed for the Danube Delta, competing with Black Sea shipping, and linking with roads to Inner Asia and Eastern Europe.[11] Other Roman arteries, notably along the Danube, were hardly used any more.

Roman roads had drawbacks, notably heavy and rutted stone paving, insufficient width of minor roads, trajectories straight up and down steep hills, and stretches impassable for vehicles in wet and wintry weather.[12] The Ottomans thus did much to repair, improve, and extend the Roman and Byzantine legacy, though fiscal problems at times reined in their ambitions.[13] Together with railways and steamers, new roads emerged in the nineteenth century, applying novel Western techniques, and raising the number of vehicles.[14]

Caravans most commonly operated in summer, and rarely included more than a hundred animals in times of peace.[15] When security was poor, however, a thousand animals might proceed together under military escort.[16] Caravanserais, whether established by the state or by private initiatives, provided shelter and other services for man and beast.[17]

Draught animals

Bovids drew most goods vehicles. Oxen were slow, but cheap and frugal. Water buffaloes were even slower, and extremely sensitive to heat and cold, but they were exceptionally strong. Buffalo wagons were common in the interconnected plains of Macedonia, Thrace, and eastern Bulgaria, where distances were counted in terms of buffalo wagon performances.[18]

Some laden conveyances were pulled by equids, notably horses harnessed to wagons for reasons of speed or prestige.[19] Contrasting with Roman and Byzantine practice, however, few mules hauled wagons in later centuries.[20] The Aegean islands were unusual in their reliance on mule draught, supplemented by donkeys.[21] Horses and some mules also towed boats on rivers, notably vessels going up the Danube, together with oxen and men.[22]

1 Stoianovich 1960; Stoianovich 1994.
2 Bulliet 1975, 235.
3 Faroqhi 1982; Stoianovich 1994, 72-80; Brown 1687, 48; Clarke 1818, 64; Boué 1840, III, 7.
4 Peysonnel 1787, II, 175; Murphey 1999, 75–77; Haldon 2005, 146f.
5 Boué 1840, III, 45–56; Mehlan 1939; Faroqhi 1982.
6 Boué 1854.
7 Riedler and Stefanov 2021; Zirojević 1987; Jireček 1877.
8 Howell 2017.
9 Hahn 1861.
10 Zachariadou 1996; O'Sullivan 1972.
11 In the absence of a general survey, see Faroqhi 2023; Boscovich 1784.
12 Boué 1840, III, 45–47; Haldon 2006, 139–40.
13 Necipoğlu 2011, 71–74; Atçıl 2015, 276.
14 Gounaris 1993; Boué 1840, III, 48–51; Hahn 1861, 65–6; Mehlan 1939, 287f, 294.
15 Howell 2017, 38; Eliot 1908, 371.
16 Fraser 1906, 220, 279, 284; Gounaris 1993, 25f.
17 Wittman 1803, 83; Gell 1810, xii; Cvijić 1918, 195, 408; Mehlan 1939, 283–286; Heywood 1996.
18 Clarke 1818, 60, 122; Lear 1851, 26; Cvijić 1918, 186; Gounaris 1993, 35; Stoianovich 1994, 72; Bailey 1916, 239; Faroqhi 2023.
19 Stoianovich 1994, 72–74; Faroqhi 1984, 50.
20 O'Sullivan 1972, 32; Stoianovich 1994, 80f.
21 Cvijić 1918, 51, 185f; Anon 1854, 346.
22 Faroqhi 2014, 34; Quin 1836, 101–105; Boué 1840, III, 149-57; Zirojević 1987, 402.

Horses further drew passenger vehicles, notably the carriages of the rich and powerful.[23] In mountainous areas, however, mules might be preferred.[24] Hungarian *kocsi* (coaches) incorporated metal springs for a smoother journey from the fifteenth century, but only spread slowly in the Balkans. As for Western carriages, they did not become common till the late nineteenth century.[25] At the same time, horses powered new stage-coaches, buses, and trams, though steam trains and electric trams fairly quickly replaced them.[26]

Oxen or buffaloes typically pulled *araba*, covered passenger wagons of Turco-Mongol origins, which were constructed with flexible wickerwork to absorb shocks. Segregated groups of better-off women were the main passengers. Before the generalisation of coaches and carriages, elite men employed horse-drawn *araba*, whereas the Inner Asian practice of harnessing Bactrian camels to such vehicles was not adopted.[27]

Riding, litters, and sedan chairs

Social norms glorified horses, and able-bodied elite Muslim men, often together with their retainers, liked to mount fine Arab steeds.[28] Gendarmes, couriers, and pastoralists relied more on local horses.[29] When women rode horses, which they very rarely did, they did so astride in the Inner Asian manner, rather than side-saddle.[30]

Other equids were for other classes. Merchants and clerics bestrode large white riding donkeys in towns, on Middle Eastern lines.[31] Peasants, including a few women, travelled on common donkeys, and sometimes mules, to and from markets and fairs.[32] Some pastoralists watched over flocks and herds on donkeys.[33] Ridden donkeys appeared in caravans to Ragusa, despite difficulties in keeping up with horses and mules.[34] Moreover, leaders of camel caravans famously rode donkeys, to match their camels' slow pace.[35] Neither camels themselves, nor bovids, were ridden.

When not riding, or ensconced in an *araba*, elite women and older or infirm men travelled by litter or sedan chair. Porters commonly carried these conveyances for short trips, notably in towns. A pair of mules, valued for their smooth gait, were preferred for long distances, though horses were substituted where mules were unavailable.[36]

Pack animals

Many historians give the impression that Balkan pack transport relied essentially on small shaggy local horses.[37] These creatures were indeed ubiquitous. Despite their rather uncouth appearance, travellers praised them for their patience, docility, resilience, strength, sturdiness, and courage.[38]

However, mules were active in pack work, especially towards the west and south of the peninsula.[39] Where limestone swallowed up surface water, mules, as well as camels, had an advantage over horses.[40] In the early twentieth century, an Aromanian (Vlach) muleteer in the Pindus Mountains typically worked with a team of four to nine cargo mules, depending on whether he had assistants, and led his team astride a horse.[41]

Richard Bulliet suggests that pack camels were normally limited to supplying military operations in Europe beyond the Thracian Plain.[42] However, Corancez, his source for this, merely notes that camels were especially numerous in Thrace, an observation echoed by many.[43] Camels were certainly common on official or military business, and were mainly owned by the state or by leading Muslim notables.[44] Camels were less dependent on transported forage than equids and carried a heavier load, but they were also considerably more expensive.[45] Many camel drivers were Turkic Muslim Yörük, a service group settled by the Ottomans in the southeastern Balkans.[46]

Pack camels, both official and civilian, ranged well beyond the Thracian Plain, notably to Sarajevo in Bosnia.[47] Some camel caravans went all the way to Vienna and Budapest, though their loads were more often transferred to horses before reaching the Danube-Sava line, as transport riders were wary of the impact on their beasts of humidity, cold, and disease.[48] A decline in pack camels accompanied the gradual Ottoman withdrawal from the Balkans. Camels were exotic beasts, associated with infidel rule, and Balkan Christians thus tended to shun them.[49] Mehlan puts it succinctly, if not entirely accurately: 'the camel came and went with the Turks.'[50]

23 Lear 1851, 41; Abbott 1903, 283f; Fraser 1906, 282.
24 Anon. 1854, 383.
25 Boué 1840, III, 55, 166; Marmont 1839, 8; Engin 2019; Mehlan 1939, 273–275; Stoianovich 1994, 72f.
26 Gounaris 1993; Engin 2019.
27 Davis 1986, 133; Clarke 1818, 198f, 210, 219; Marmont 1839, 8; Davey 1897, II, 292–294, 301f.
28 Bey 1920, 8, 13f, 20, 46, 94, 371; Davey 1897, II, 326, 328.
29 Baldacci 1897, 396, 404; Koh 2022.
30 Clarke 1818, 39f; Boué 1840, III, 55.
31 Tweedie 1894, 31, 159; Cuinet 1890–5, III, 47; Davey 1897, II, 316.
32 Lear 1851, 193f; Jochmus 1854, 71; Abbott 1903, 171, 213; Bailey 1916, 238–241, 258; Cvijić 1918, 179, 442, 448.
33 Quin 1836, 29.
34 Howell 2017, 39.
35 Montagu 1861, I, 310; Boscovich 1784, 12f; Quin 1836, 171; Chervau 1884, 213; Mehlan 1939, 281; Gounaris 1993, 35.
36 Gell 1810, VII; Hahn 1861, 27; Davey 1897, II, 293, 306; Boué 1840, III, 55.
37 Stoianovich 1960, 309; Stoianovich 1994, 74, 260f; Cvijić 1918, 74, 85; Howell 2017, III-IV, 35–39, 84; Heywood 1996, 134–136.
38 Baldacci 1897, 79, 378–380.
39 Gell 1810, VI; Pouqueville 1826-7, II, 342, 390, 577; Leake 1835, I, 284f, 300, 303; Abbott 1903, 78; Eliot 1908, 371; Cvijić 1918, 22, 74, 85, 195–197, 408; Lear 1851; Wace and Thompson 1914, 74.
40 Lear 1851, 237; Fraser 1906, 107; Cvijić 1918, 455; Goodwin 1999, 271; Howell 2017, 38; Boué 1840, III, 53.
41 Wace and Thompson 1914, 12–14, 73–75, Plate II.
42 Bulliet 1975, 235, 316 (n. 49).
43 Corancez 1816, 80f. See also Faroqhi 1982, 532, 535; Brocquière 1807, 251; Burbury 1671, 158; Brown 1687, 38; Boscovich 1784, 11–13; Vandal 1900, 97; Mehlan 1939, 272.
44 Boué 1840, I, 509.
45 Busbecq 1881, I, 218f; Goodwin 1999, 72; Murphey 1996, 172f; Montagu 1861, I, 309f.
46 Faroqhi 1982, 535; Inal 2021, 60.
47 Zirojević 1987, 402; Aleksić 2021, 70; Burbury 1671, 140; Busbecq 1881, I, 97; Jireček 1877, 114f; Vandal 1900, 56; Katić 2021, 91.
48 Busbecq 1881, I, 214, 218, 415; Stoianovich 1994, 74; Mehlan 1939, 280f; Goodwin 1999, 114.
49 Bartosiewicz 2014.
50 Mehlan 1939, 272.

Human beings and donkeys played a major role carrying goods in towns, where narrow and winding streets were often interrupted by steps.[51] Porters, many of them women, also played a role in rural transport, notably in the western mountains.[52] Donkeys carried goods over short distances, typically to and from market in rural zones.[53] In the Pindus Mountains, a small boy led the miller's donkey to collect grain to turn into flour.[54] Bovids were not worked for pack, unlike in parts of the Middle East and North Africa.[55]

The availability and price of animals – breeding and trade

Cattle were raised throughout the Balkans, but the small red and black types were mainly kept for meat, notably in mountainous areas. Medium-sized grey cattle were the usual draught oxen, in demand for agriculture as well as transport, although rarely milked. They mainly came from the north and east, and from the steppe lands beyond. To the west and south, mixed with other breeds, they became too small and weak for draught.[56]

Genetic evidence indicates that large dark 'river' buffaloes, of the Indian type, arrived in the Balkans around the seventh century CE. They did not spread westwards in the Mediterranean beyond Italy.[57] Balkan buffaloes were less common than cattle, and more specialised as draught animals, albeit also valued for their milk. Buffaloes were especially prominent across the central belt of the peninsula, becoming rarer and smaller in Greece.[58]

There was a sharp divergence between supplies of horses of different sizes. Numerous cheap little horses were raised locally, especially to the north and east, and they were supplemented by the vast reserves of the steppe beyond.[59] Imported Arabs were finer, but quite small and delicate. Hardly any large horses were bred across the Ottoman empire, though Hungary and Romania traditionally supplied a few. Western breeds were expensive, and were often poorly adapted to the local climate and diet.[60]

Donkeys and mules were mainly animals of the west and south.[61] That said, northern areas, including Hungary, bred donkeys specifically for sale in the central Balkans.[62] Arumani (Vlach) mountaineers also excelled in raising large jacks to engender good mules.[63] And yet, overall, the Ottoman empire bred so few mules that it had to import some from Iberia for military purposes in the early nineteenth century.[64] Islamic strictures on mule breeding, together with Inner Asian prejudices against these hybrids, may have played a part.[65] It was indicative that a mule fetched a markedly higher price than a pack-horse in the sixteenth-century Balkans, and that this differential persisted over the centuries.[66]

Camels were least integrated into Balkan pastoralism.[67] Mating Bactrians with dromedaries to produce powerful hybrids was a skilled job, performed mainly in western Anatolia.[68] The few official Ottoman Balkan centres for camel breeding were probably limited to state needs.[69] Even Muslim Yörük settlers preferred to raise sheep.[70] There were a few private camel breeders around Salonica in the 1860s, but the quality of their beasts was poor.[71]

Conclusion

The determinants of which transport animals were employed in the Balkans, and how, remain to be fully ascertained. In broad outline, however, the availability of vast numbers of small and cheap horses undermined the position of mules and donkeys, notably in comparison to the western Mediterranean. Similarly, an abundance of grey cattle and water buffaloes reduced the recourse to scarce and expensive large horses. Hybrid camels were strong but exotic, and they failed to become firmly established in the Balkans.

Regional variations complicate this picture, not only influencing the choice of animals, but also whether they were harnessed, yoked, ridden, or laden. Running like a scarlet thread through this story is a contrast between a wetter, flatter, and colder north and east, and a drier, warmer, and more mountainous south and west. In the plains, oxen, buffaloes, and horses could draw wheeled vehicles over considerable distances. In the mountains, pack animals came into their own, largely small local horses, but also mules, donkeys, and camels.

51 Davey 1897, I, 198, and II, 251, 292f, 310f.
52 Boué 1840, III, 170.
53 Faroqhi 2009, XXV; Weigand 1894f, I, 8; Abbot 1903, 232.
54 Wace and Thompson 1914, 76.
55 Planhol 1969.
56 McGowan 1981, 9, 15, 17, 20, 26, 41, 181; Boué 1840, I, 505; Moltke 1854, 34, 59, 231; Chesney 1854, 28, 30; Hahn 1861, 27; Weigand 1894–5, I, 19; Mehlan 1939, 271.
57 Zhang 2020, 179.
58 Boué 1840, I, 505; Wittman 1803, 465; Hahn 1861, 27; Bailey 1916, 239; Cvijić 1918, 186.
59 Marsigli 1732, II, 41–2; Mehlan 1939, 271; Bailey 1916, 239; Wittman 1803, 465; Lear 1851, 400; Goodwin 1999, 109.
60 Clarence-Smith 2014; Yilmaz et al. 2012.
61 Leake 1835, II, 550.
62 Boué 1840, I, 509, and III, 140.
63 Wace and Thompson 1914, 20–1, 31, 84; Pouqeville 1826–7, II, 282–4, 384–5, 390; Leake 1835, IV, 210.
64 Chesney 1854, xxiv, 323.
65 Clarence-Smith 2017.
66 Faroqhi 1984, 49–50; Faroqhi 2010, 300f; Faroqhi 2014, 126.
67 Blunt 1878, I, 215; Stoianovich 1994, 74.
68 Inal 2021, 60–3.
69 Shopov 2019, 171, 173; Jireček 1877, 131; Aleksandar Shopov, email 06. August 2022.
70 Petkova 2019, 29–34; Kotzageorgis 2015, 111–15.
71 Cherveau 1882, 213–14.

Bibliography

Abbott 1903 G. F. Abbott, The tale of a tour in Macedonia (London 1903).

Aleksić 2021 V. Aleksić, Continuity of travel and transport infrastructures from Antiquity to the Middle Ages: the case of Via Militaris in the Morava and Nišava Regions. In: F. Riedler/N. Stefanov (eds.), The Balkan route: historical transformations from Via Militaris to Autoput (Berlin 2021) 54–79.

Anon. 1854 Anon., Handbook for travellers in Greece (London 1854).

Atçıl 2015 Z. Atçıl, State and government in the mid-sixteenth century Ottoman empire: the grand vizierates of Rüstem Pasha, 1544-1561, PhD thesis (University of Chicago 2015).

Bailey 1916 W. F. Bailey, The Slavs of the war zone (London 1916).

Baldacci 1897 A. Baldacci, Itinerari albanesi (Rome 1897).

Bartosiewicz 2014 L. Bartosiewicz, Camels in the front line. Anthropozoologica 49, 2, 2014, 297–302.

Blunt 1878 F. J. Blunt, the people of Turkey: twenty years' residence among Bulgarians, Greeks, Albanians, Turks, and Armenians (London 1878).

Boscovich 1784 R. G. Boscovich, Giornale di un viaggio da Costantinopoli in Polonia dell'abate Ruggiero Guiseppe Boscovich (Bassano 1784).

Boué 1840 A. Boué, La Turquie d'Europe (Paris 1840).

Boué 1854 A. Boué, Recueil d'itinéraires dans la Turquie d'Europe (Vienna 1854).

Brocquière 1807 Bertrandon de la Brocquière, The travels of Bertrandon de la Brocquière to Palestine, and his return from Jerusalem overland to France, during the years 1432 and 1433 (Hafod 1807).

Brown 1687 E. Brown, A brief account of some travels in divers parts of Europe (London 1687).

Bulliet 1975 R. W. Bulliet, The camel and the wheel (Cambridge 1975).

Burbury 1671 J. Burbury, A relation of a journey of the Right Honourable My Lord Henry Howard, from London to Vienna, and thence to Constantinople (London 1671).

Busbecq 1881 O. G. de Busbecq, The life and letters of Ogier Ghiselin de Busbecq, seigneur of Bousbecque, knight, imperial ambassador (London 1881).

Cherveau 1884 M. Cherveau, Une excursion en Macédoine (Dijon 1884).

Chesney 1854 F. R. Chesney, The Russo-Turkish campaigns of 1828 and 1829, with a view to the present state of affairs in the East (London 1854).

Clarence-Smith 2014 W. G. Clarence-Smith, Animal power as a factor in Ottoman military decline, 1683-1918. In: Conference 'War horses of the world', SOAS University of London, 3 May (2014).

Clarence-Smith 2017 W. G. Clarence-Smith, The breeding of mules in Islamic law. Workshop, 'Sharia in motion II', Pembroke College, Cambridge University, 14-16 July (2017).

Clarke 1818 E. D. Clarke, Travels in various countries of Europe, Asia, and Africa, volume the eighth (London 1818).

Corancez 1816 L. A. O. Corancez, Itinéraire d'une partie peu connue de l'Asie Mineure (Paris 1816).

Cuinet 1890-5 V. Cuinet, La Turqie d'Asie: géographie administrative, statistique, descriptive, et raisonnée de chaque province d'Asie-Mineure (Paris 1890–1895).

Cvijić 1918 J. Cvijić, La péninsule balkanique: géographie humaine (Paris 1918).

Davey 1897 R. Davey, The sultan and his subjects (London 1897).

Davis 1986 F. Davis, The Ottoman lady: a social history from 1718 to 1918 (New York 1986).

Eliot 1908 C. Eliot, Turkey in Europe (London 1908).

Engin 2019 V. Engin, Land transportation in Istanbul. History of Istanbul: from Antiquity to the twenty-first century 6, https://istanbultarihi.ist/583-land-transportation-in-istanbul (consulted 08. September 2022).

Faroqhi 1982 S. Faroqhi, Camels, wagons, and the Ottoman state in the sixteenth and seventeenth centuries. International Journal of Middle East Studies 14, 1982, 523–539.

Faroqhi 1984 S. Faroqhi, Towns and townsmen of Ottoman Anatolia: trade, crafts and food production in an urban setting, 1520-1650 (Cambridge 1984).

Faroqhi 2009 S. Faroqhi, Artisans of empire: crafts and craftspeople under the Ottomans (London 2009).

Faroqhi 2010 S. Faroqhi, Horses owned by Ottoman officials and notables: means of transportation, but also sources of pride and joy. In: S. Faroqhi (Ed.), Animals and people in the Ottoman empire (Istanbul 2010) 293–311.

Faroqhi 2014 S. Faroqhi, Travel and artisans in the Ottoman empire: employment and mobility in the early modern era (London 2014).

Faroqhi 2023 S. Faroqhi, Conveying silver coins from Lviv to Istanbul. Martin Gruneweg's description of Armenian merchant caravans. Turcica 54, 2023, 49–76.

Fraser 1906 J. F. Fraser, Pictures from the Balkans (London 1906).

Gell 1810 W. Gell, The itinerary of Greece (London 1810).

Goodwin 1999 J. Goodwin, Lords of the horizons: a history of the Ottoman empire (New York 1999).

Gounaris 1993 B. C. Gounaris, Steam over Macedonia: socio-economic change and the railway factor (Boulder 1993).

Hahn 1861 J. G. von Hahn, Reise von Belgrad nach Salonik (Vienna 1861).

Haldon 2006 J. Haldon, Roads and communications in the Byzantine empire: wagons, horses, and supplies. In: J. H. Pryor (Ed.), Logistics of warfare in the age of the crusades (Aldershot 2006) 131–58.

Heywood 1996 C. Heywood, The Via Egnatia in the Ottoman period: the menzilhanes of the Sol Kol in the late seventeenth to early eighteenth century. In: E. Zachariadou (Ed.), The Via Egnatia under Ottoman rule: 1380-1699 (Rethymno 1996) 129–144.

Howell 2017 J. C. Howell, The Ragusa Road: mobility and encounter in the Ottoman Balkans. 1430-1700, PhD thesis (Harvard University 2017).

Inal O. Inal, One-humped history: the camel as historical actor in the late Ottoman empire. International Journal of Middle East Studies 53, 2021, 57–72.

Bey 1920 I. K. Bey, The memoirs of Ismail Kemal Bey (London 1920).

Jireček 1877 K. J. Jireček, Die Heerstrasse von Belgrad nach Constantinopel und die Balkanpässe: eine historisch-geographische Studie (Prague 1877).

Jochmus 1854 A. Jochmus, Notes on a journey into the Balkan, or Mount Hæmus, in 1847. The Journal of the Royal Geographical Society of London 24, 1854, 36–85.

Katić 2021 T. Katić, Transforming the landscape of the Constantinople Road in the fifteenth and sixteenth centuries: section Niš-Dragoman. In: F. Riedler/N. Stefanov (Eds.), The Balkan route: historical transformations from Via Militaris to Autoput (Berlin 2021) 81–102.

Koh 2022 C. H. Koh, The mystery of the missing horses: how to uncover an Ottoman shadow economy. Comparative Studies in Society and History 64, 3, 2022,[no pages online].

Kotzageorgis 2015 P. P. Kotzageorgis, Nomads (Yürüks) and environment in early modern Halkidiki. Balkan Studies 50, 2015, 95–118.

Leake 1835 W. M. Leake, Travels in northern Greece (London 1835).

Lear 1851 E. Lear, Journals of a landscape painter in Albania, etc. (London 1851).

Marmont 1839 A. F. Marmont, The present state of the Turkish empire (London 1839).

Marsigli 1732 L. F. Marsigli, Stato militare dell'imperio ottomanno: incremento e decremento del medesimo (The Hague 1732).

McGowan 1981 B. McGowan, Economic life in Ottoman Europe: taxation, trade and the struggle for land, 1600-1800 (Cambridge 1981).

Mehlan 1939 A. Mehlan, Die Handelstrassen des Balkans während der Türkenzeit. Südostdeutsche Forschungen 4, 2, 1939, 243–296.

Moltke 1854 H. K. B. Graf von Moltke, The Russians in Bulgaria and Rumelia in 1828 and 1829 (London 1854).

Montagu 1861 M. W. Montagu, The letters and works of Lady Mary Wortley Montagu, edited by her great-grandson, Lord Wharncliffe (London 1861, written 1717).

Murphey 1996 R. Murphey, Patterns of trade along the Via Egnatia in the seventeenth century. In: E. Zachariadou (Ed.), The Via Egnatia under Ottoman rule: 1380-1699 (Rethymno 1996) 171–191.

Murphey 1999 R. Murphey, Ottoman warfare. 1500-1700 (London 1999).

Necipoğlu 2011 G. Necipoğlu, The age of Sinan: architectural culture in the Ottoman empire (London 2011).

O'Sullivan 1972 F. O'Sullivan, The Egnatian Way (Newton Abbot 1972).

Petkova 2019 M. Petkova, The process of sedentarization of semi-nomadic groups of the Yörüks in part of sixteenth-century Ottoman Rumeli: migration control or tax control? Journal of Balkan and Black Sea Studies 2, 3, 2019, 25–43.

Peyssonel 1787 [C. C. de] Peyssonel, Traité sur le commerce de la Mer Noire (Paris 1787).

Planhol 1969 X. de Planhol, Le boeuf porteur dans le Proche-Orient et l'Afrique du Nord. Journal of the Economic and Social History of the Orient 12, 3, 1969, 298–321.

Pouqueville 1826–7 F. C. H. L. Pouqueville, Voyage de la Grèce (Paris 1826–1827).

Quin 1836 M. J. Quin, A steam voyage down the Danube, with sketches of Hungary, Wallachia, Servia, and Turkey, etc. (New York 1836).

Riedler/Stefanov 2021 F. Riedler/N. Stefanov (Eds.), The Balkan route: historical transformations from Via Militaris to Autoput (Berlin 2021).

Shopov 2019 A. Shopov, Cities of rice: risiculture and environmental change in the early modern Ottoman Balkans Levant 51, 2, 2019, 169–183.

Stoianovich 1960 T. Stoianovich, The conquering Balkan Orthodox merchant. Journal of Economic History 20, 2, 1960, 234–313.

Stoianovich 1994 T. Stoianovich, Balkan worlds: the first and the last Europe (Armonk 1994).

Tweedi 1894 W. Tweedie, The Arabian horse: his country and people (Edinburgh 1894).

Vandal 1900 A. Vandal, Les voyages du Marquis de Nointel. 1670-1680 (Paris 1900).

Wace/Thompson 1914 A. J. B. Wace/M. S. Thompson, The nomads of the Balkans: an account of life and customs amongst the Vlachs of northern Pindus (London 1914).

Weigand 1894-5 G. Weigand, Die Aromunen: ethnographisch-philologisch-historische Untersuchungen über das Volk der sogenannten Makedo-Romanen oder Zinzaren (Leipzig 1894–1895).

Wittmann 1803 W. Wittman, Travels in Turkey, Asia-Minor, Syria, and across the desert into Egypt, during the years 1799, 1800, and 1801 (London 1803).

Yilmaz et al. 2012 O. Yilmaz/S. Boztepe/M. Ertugrul/R. T. Wilson, The domestic livestock resources of Turkey: national horse history, breed descriptions and conservation status, 2012, http://www.eaap.org/Previous_Annual_Meetings/2012Bratislava/Papers/Published/13a_Yilmaz.pdf (consulted 14 March 2014).

Zachariadou 1996 E. Zachariadou (Ed.), The Via Egnatia under Ottoman rule, 1380-1699 (Rethymno 1996).

Zhang et al. 2020 Y. Zhang/L. Colli/J. S. F. Barker, Asian water buffalo. Domestication, history, and genetics. Animal Genetics 51, 2020, 177–191.

Zirojević 1987 O. Zirojević, Das türkische Straßennetz (Land und Wasserstraßen) auf dem Gebiet der heutigen Vojvodina und Slawoniens. Acta Historica Academiae Scientiarum Hungaricae 33, 2–4, 1987, 393–403.

Author info

Professor William G. Clarence-Smith

SOAS University of London
2 Kerrison Road, London – UK

E-Mail: wgclarencesmith@yahoo.co.uk

Draft cattle culture in Romania

Ioana Baskerville

Abstract

This study explores the cultural history and economic significance of draft cattle in Romania, focusing on their central role in traditional peasant life from Antiquity until the mid-20th century. Drawing on ethnographic, historical, folkloric, and visual sources, the paper examines how oxen, in particular, were indispensable to Romanian agriculture, providing both labor and symbolic value. The use of cattle for ploughing and transport shaped the organization of rural households, agricultural productivity, and seasonal rituals. Romanian ethnographers emphasized the deep interdependence between animal husbandry and crop production. The ox, revered for its strength, calmness, and obedience, became a mythologized figure in Romanian folklore, customs, and religious beliefs. Rituals marking the agricultural calendar underscore the ox's sacred and practical importance. The decline in draft cattle usage during the 19th and 20th centuries, due to economic changes and mechanization, marked a significant shift in rural livelihoods. Ultimately, this paper demonstrates how draft cattle were not only agricultural assets but also cultural touchstones, embodying the values, resilience, and cosmology of Romanian peasant society.

Résumé

Cette étude explore l'histoire culturelle et l'importance économique des bovins de trait en Roumanie, en mettant l'accent sur leur rôle central dans la vie paysanne traditionnelle depuis l'Antiquité jusqu'au milieu du XXe siècle. S'appuyant sur des sources ethnographiques, historiques, folkloriques et visuelles, cet article examine comment les bœufs, en particulier, étaient indispensables à l'agriculture roumaine, fournissant à la fois une main-d'œuvre et incarnant une valeur symbolique. L'utilisation des bovins pour le labour et le transport a façonné l'organisation des ménages ruraux, la productivité agricole et les rituels saisonniers. Les ethnographes roumains ont souligné la profonde interdépendance entre l'élevage et la production végétale. Le bœuf, vénéré pour sa force, son calme et son obéissance, est devenu une figure mythifiée dans le folklore, les coutumes et les croyances religieuses roumaines. Les rituels marquant le calendrier agricole soulignent l'importance sacrée et pratique du bœuf. Le déclin de l'utilisation des boeufs de trait au cours des XIXe et XXe siècles, dû aux changements économiques et à la mécanisation, a marqué un changement important dans les moyens de subsistance ruraux. En fin de compte, cet article démontre que les boeufs de trait n'étaient pas seulement un atout agricole, mais aussi une référence culturelle, incarnant les valeurs, la résilience et la cosmologie de la société paysanne roumaine.

Kurzfassung

Diese Studie untersucht die Kulturgeschichte und wirtschaftliche Bedeutung von Zugrindern in Rumänien und konzentriert sich dabei auf ihre zentrale Rolle im traditionellen bäuerlichen Leben von der Antike bis zur Mitte des 20. Jahrhunderts. Anhand ethnografischer, historischer, folkloristischer und visueller Quellen untersucht die Arbeit, wie insbesondere Ochsen für die rumänische Landwirtschaft unverzichtbar waren und sowohl Arbeitskraft als auch symbolischen Wert hatten. Der Einsatz von Rindern zum Pflügen und Transport prägte die Organisation der ländlichen Haushalte, die landwirtschaftliche Produktivität und die saisonalen Rituale. Rumänische Ethnografen betonten die tiefe gegenseitige Abhängigkeit zwischen Tierhaltung und Pflanzenproduktion. Der Ochse, der für seine Kraft, Ruhe und Gehorsamkeit verehrt wurde, wurde zu einer mythologisierten Figur in der rumänischen Folklore, den Bräuchen und religiösen Überzeugungen. Rituale, die den landwirtschaftlichen Kalender markieren, unterstreichen die sakrale und praktische Bedeutung des Ochsen. Der Rückgang der Nutzung von Zugtieren im 19. und 20. Jahrhundert aufgrund wirtschaftlicher Veränderungen und der Mechanisierung markierte einen bedeutenden Wandel in der ländlichen Lebensweise. Letztendlich zeigt dieser Artikel, dass Zugtiere nicht nur landwirtschaftliche Vermögenswerte waren, sondern auch kulturelle Bezugspunkte, die die Werte, die Widerstandsfähigkeit und die Kosmologie der rumänischen Bauernschaft verkörperten.

Resumen

Este estudio explora la historia cultural y la importancia económica del ganado de tiro en Rumanía, centrándose en su papel fundamental en la vida campesina tradicional desde la antigüedad hasta mediados del siglo XX. Basándose en fuentes etnográficas, históricas, folclóricas y visuales, el trabajo examina cómo los bueyes, en particular, eran indispensables para la agricultura rumana, ya que proporcionaban tanto mano de obra como valor simbólico. El uso del ganado para arar y transportar determinó la organización de los hogares rurales, la productividad agrícola y los rituales estacionales. Los etnógrafos rumanos destacaron la profunda interdependencia entre la ganadería y la producción agrícola. El buey, venerado por su fuerza, tranquilidad y obediencia, se convirtió en una figura mitificada en el folclore, las costumbres y las creencias religiosas rumanas. Los rituales que marcan el calendario agrícola subrayan la importancia sagrada y práctica del buey. El descenso en el uso del ganado de tiro durante los siglos XIX y XX, debido a los cambios económicos y la mecanización marcó un cambio importante en el estilo de vida rural. En última instancia, este artículo demuestra cómo el ganado de tiro no solo era un activo agrícola, sino también un referente cultural que encarnaba los valores, la resiliencia y la cosmología de la sociedad campesina rumana.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 042-045. DOI: https://doi.org/10.11588/propylaeum.1713.c25087

As in other parts of traditional agrarian Europe, draft cattle played a crucial role in supporting rural livelihoods in Romania. Historical ethnographers have noted that, over the past two centuries, Romanians have raised more large bovines (cows and oxen) than small ruminants (sheep and goats), emphasizing the deep interdependence between crop cultivation and animal husbandry[1]. Draft cattle held a central place in the Romanian traditional economy[2], providing essential resources such as milk, meat, leather, and most importantly, labor. Before the introduction of draft animals, peasants were forced to carry out heavy agricultural tasks manually[3]. Thus, the introduction of cattle significantly reduced the physical burden of farming and became a foundation of peasant subsistence for generations.

Ethnographer Valer Butură identified three distinct phases in the history of animal husbandry in Romania. The first, lasting until 1829, involved the extensive raising of local breeds. The second phase, continuing until the formation of the Romanian nation-state in 1918, focused heavily on draft cattle. The third phase saw attempts to improve local breeds and import new ones[4].

Among various draft animals, the ox became the most favored by Romanian peasants. Castrated bulls, or oxen, were especially suited for arduous tasks like ploughing due to their calm temperament and steady pace. Horses were introduced later but were often viewed by peasants as overly energetic and less obedient. In Romanian agrarian mythology, the ox and horse are frequently cast with contrasting symbolic attributes[5]. Oxen were also recognized for their superior strength; they could pull heavier loads both in fields and on roads. Experts confirmed this popular opinion: "Draft cattle can pull more weight than horses—up to two times their bodyweight for fully trained mature males. Cattle are calmer than horses, but, overall, slower"[6]. Indigenous Romanian cow breeds were also valued for draft use[7].

Poorer households often had to use milking cows for draft work. While dairy breeds are generally less suited for labor due to body structure, mixed-use or meat breeds could be effective. The choice of breed was vital to ensure compatibility with the regional environment and to minimize injury during workload. Proper harnessing and yoking were equally essential to protect the animals[8]. Until the mid-20th century, when collectivization and mechanization took hold under the communist regime, oxen remained integral to Romanian peasant life. Their importance is well-documented through agronomic texts, ethnographic research, folklore, and visual representations.

Romanian agricultural historians have often emphasized the vital role of cattle: "For the peasant household, cattle are as important as land. They are both tools and sources of nourishment and clothing. They provide income directly and indirectly, by enabling the peasant's labor"[9]. Folk literature echoes this sentiment, highlighting how the death or sale of cattle could plunge a family into poverty. Farming tasks were typically organized within families, but if a household had only one draft animal, neighbors would cooperate by pairing their animals[10]. For particularly demanding jobs, multiple pairs of oxen from different households were yoked together. Ethnographers have detailed the variety of tools used with oxen, i.e. ploughs, seeders, harrows, harvesters, and carts[11].

The high value placed on cattle extended into the religious and magical sphere. They were regarded almost as family members, and their loss was both an economic and emotional tragedy. Numerous rituals aimed to safeguard their health and ensure productive farming seasons. Cattle welfare remained a cornerstone of rural subsistence into the 20th century in rural Romania.

In the Romanian lands, the number of draft cattle began to decline in the 19th and 20th century. In his detailed economic analysis of Romanian rural life, P.S. Aurelian noted the drop in oxen populations, especially in the late 1800s, which threatened the subsistence of peasant families[12]. In 1940, agricultural economist Virgil Madgearu observed that one-third of Romanian peasant households did not own an ox, and the majority had only one pair. This shortage contributed significantly to low productivity and poor living conditions[13], as the analyst explained while offering a detailed presentation.

Despite regional differences, Moldavia (Eastern Romania) maintained larger ox populations than Wallachia (Southern Romania) in the 19th century. Plain areas, especially in southern Moldavia and southern Bukovina (Northeastern Romania), had the largest and strongest oxen, attributed to superior pasturelands. Most draft cattle were raised in hills and plains, where cultivated land was more extensive. Sale records often show oxen being sold in pairs, confirming their primary role as draft animals[14]. Buffalo, particularly prevalent in Wallachia, were also used for both draft work and milk production[15].

Due to the scarcity of early written records, Romanian historians and ethnographers have relied on visual sources for documenting early agricultural history[16]. The earliest depiction of oxen pulling a plough in present-day Romania dates from a 2nd-century Roman grave in Constanța County[17], a former Greek colony on the Black Sea. In the Middle Ages, church frescoes often depicted peasants using ox-drawn ploughs[18]. Religious icons of Saint Elijah sometimes show him with a plough pulled by white oxen[19], which is consistent with his folk hagiography and popular believes about his role in protecting agricultural labor.

Given the critical role of oxen in agriculture, a rich ritual system developed around them. April 25th, known as "Marcu boilor" (Saint Mark of the Oxen), was a holiday on

1 Popescu 1986, 175.
2 Vlăduțiu 1973, 20.
3 Ibid., 208.
4 Butură 1978, p. 205.
5 Coman 1996, 30.
6 Rutland 2021, 249.
7 Madgearu 1940, 40.
8 Rutland 2021, 249.
9 Madgearu 1940, 61.
10 Marian 1994, 25.
11 Șerban 1914.
12 Aurelian 1882, 82.
13 Madgearu 1940, 47f.
14 Aurelian 1882, 85.
15 Ibid., 86.
16 Neamțu 1975, 149.
17 Ibid., 149.
18 Edroiu 2017, 148f.
19 Ciubotaru 2017, 120.

which it was forbidden to put oxen to work[20]. Romanian cosmological legends depict the Earth as resting on an ox's horns[21].

Romanian folklore reinforces the sacred status of oxen, a recognition rooted in their vital domestic and economic contributions[22]. Christmas carols praise them as bringers of abundance: “Nothing is better than the good ox/ For he turns the black soil/ And brings white bread”[23]. Such texts affirm the belief that owning oxen ensured agricultural success, wealth, and social standing. The agricultural calendar was punctuated by ceremonies that acknowledged the ox’s role and invoked divine protection for crops and laborers.

Rituals marked the beginning of the ploughing season in early spring. Oxen, ploughs, and ploughmen were blessed with holy water or symbolic protective elements such as basil, garlic, and red ribbons[24]: “The plough and the oxen were sprinkled with holy water so that they would have luck and bring abundant crops”[25]. The ceremonial first furrow was drawn in the ploughman’s yard. A key fertility ritual held during Pentecost in Transylvania, known as “Înstrușarea boului” (The Adorning of the Ox) involved decorating the village’s strongest ox with flowers, bells, and ribbons and parading it through the village[26].

According to Bogdan Neagotă[27], The Adorning of the Ox ritual centers around selecting the most beautiful and robust ox in the village, which is then decorated with flowers, ribbons, bells, green branches, and occasionally traditional textiles. This heavily adorned ox becomes the focal point of a festive procession led by young men dressed in traditional attire, who parade the animal through the village, stopping at each household. At each stop, the ox is greeted with water sprinkling, food offerings, and blessings -- acts believed to bring prosperity and abundant crops to the household in the coming year. Neagotă interprets this ritual action as a rite of passage for youth, especially for adolescent boys transitioning into adulthood, as participation in the ritual was traditionally a marker of social integration and masculine identity. The public performance also reinforced community cohesion and reaffirmed the symbolic link between humans and the natural world. Importantly, this ritual reflects the sacralization of agricultural labor and the ritual elevation of the ox as not just a working animal but as a divine gift and a bearer of fertility, success, and communal well-being. Thus, as described by Neagotă and others, the ritual is more than folklore; it is a layered ceremonial practice where myth, economy, and social structure intersect through the veneration of the ox.

The New Year’s ritual “Pluguşorul” (The Little Plough) symbolically began the ploughing season during the beginning of the agricultural season. Traditionally, decorated oxen and ploughmen visited households, drawing a furrow to bless the land. Some folkloric texts describe a mythical team of six pairs of oxen, highlighting the magical and symbolic weight of the ritual[28]. In the latter half of the 20th century, real oxen were often replaced by symbolic wooden ploughs, with their sounds mimicked by instruments like the “Buhai.”

In Romanian winter carnival traditions, particularly those associated with the New Year, cattle, especially oxen and bulls, feature prominently as ritual masks in masquerade performances. These zoomorphic masks, often elaborately crafted from wood, fabric, and animal hide, symbolize strength, fertility, and the agricultural cycle. The "bull mask", commonly seen in Moldavian and northern Romanian villages, is animated by performers who mimic the animal’s movements and sounds in a theatrical procession accompanied by music, drumming, and rhythmic chanting. This performance, often integrated into broader winter customs like the “Ursul” (Bear Dance) or “Capra” (Goat Dance), enacts themes of death and rebirth, aligning with agrarian hopes for renewal and abundance in the coming year. The inclusion of cattle in these rituals reflects their profound symbolic and economic significance in Romanian rural life, transforming them into sacred figures that bridge the human and natural worlds during the liminal time of the year-end festivities.

Oxen are recurring figures in Romanian folktales, where they are credited with superhuman features like ploughing entire fields overnight or pulling celestial bodies across the sky[29]. Legends tell of God, Adam, or even Jesus as the first ploughman, always accompanied by white oxen[30].

Proverbs and folk poetry reflect the esteem in which oxen were held: “The ox is so good and kind/ When a lad yokes him/ He ploughs all day and night/ Without asking food or water”[31]. Proverbs emphasize respect and gratitude: “Don’t burden the ox—it’s not a mule,” “Don’t upset the ox—it’s God’s creature,” “A man without oxen is like a slave with bound hands”[32].

The central role of draft cattle, especially oxen, in Romanian traditional life reveals a deep, multifaceted interdependence between agricultural labor, economic subsistence, social organization, and ritual practice. From practical tools of cultivation to sacred beings enshrined in folklore, proverbs, and ceremonial rites, oxen have been both literal and symbolic pillars of rural existence. Their strength and reliability ensured not only the viability of peasant farming but also served as markers of status, sources of communal identity, and subjects of veneration. Despite their decline with the advent of modernization and mechanization, the enduring presence of oxen in myth, ritual, and memory highlights their lasting cultural and historical significance. Romanian ethnographic and folkloric traditions preserve this legacy, attesting to how vital animal-human relationships shaped the rhythms, values, and cosmologies of agrarian life for centuries.

20 Popescu 1986, 188.
21 Brill 1981, 226.
22 Coman 1996, 29.
23 Maria 1898, 19.
24 Ghinoiu 2001, Oltenia, 2001, 273.
25 Ghinoiu 2009, Dobrogea, Muntenia, 2009, 316.
26 Mușlea 1972, 157.
27 Neagotă 2009.
28 Ciubotaru 2017, 119; Stahl 1965, 156.
29 Niculiță-Voronca 1903, 9, 197–198.
30 Pop 1998, 83.
31 Herseni 1997, 583
32 Cuceu 2006, 67–68.

Fig. 1 New Year Plough (Ruginoasa – Iași County, Romania, © Folklore Archive of Moldavia and Bucovina, 1978).

Fig. 2 Carrying the dead on a sled, during summer (Șipote – Iași County, Romania © Folklore Archive of Moldavia and Bucovina, 1975).

Bibliography

Aurelian 1882 P. S. Aurelian, Sketches on the Economic State of Romania in the 18th Century (Bucharest 1882).

Brill 1981 T. Brill, Romanian Folk Legends (Bucharest 1981).

Butură 1978 V. Butură, Ethnography of the Romanian People: Material Culture (Cluj-Napoca 1978).

Ciubotaru 2017 S. Ciubotaru, Agrarian Customs in Moldova and Their National Context (Iași 2017).

Coman 1996 M. Coman, The Romanian Mythological Bestiary (Bucharest 1996).

Cuceu 2006 I. Cuceu, Dictionary of Romanian Proverbs (Bucharest/ Chișinău 2006).

Cuceu/Cuceu 1988 I. Cuceu/ M. Cuceu, Ancient Romanian Agrarian Customs: Typology and Text Corpus 1 (Bucharest 1988).

Edroiu 2017 N. Edroiu, The Plough in the Romanian Lands (until the 18th Century) (Cluj-Napoca 2017).

Ghinoiu 2001 I. Ghinoiu (Ed.), Sărbători și obiceiuri, Responses to the "Romanian Ethnographic Atlas" Vol. I – Oltenia (Bucharest 2001).

Ghinoiu 2009 I. Ghinoiu (Ed.), Sărbători și obiceiuri, Responses to the "Romanian Ethnographic Atlas", vol. V – Dobrogea, Muntenia (Bucharest 2009).

Herseni 1997 T. Herseni, Christmas Carols and Customs (Bucharest 1997).

Niculiță-Voronca 1903 E. Niculiță-Voronca, Romanian Folk Beliefs and Customs (Cernăuți 1903).

Mușlea 1972 I. Mușlea, Ethnographic and Folkloric Research 2 (Bucharest 1972).

Pop 1998 D. Pop (Ed.), Romanian Folklore from Crișana and Banat from the Early 20th Century (Baia Mare 1998).

Madgearu 1940 V. N. Madgearu, The Evolution of the Romanian Economy after the World War (Bucharest 1940).

Marian 1994 S. F. Marian, Romanian Holidays 1, Caro Gobl (Ed.), Re-edited by Iordan Datcu (Bucharest 1898/1994).

Neagotă 2009 B. Neagotă, Ceremonialul 'Boului împănat' în Transilvania. O abordare istorico-etnologică / The Feast of the Ceremonial Ox in Transylvania. A Historical-Ethnological Approach. In: A. Cristea, J. Nicolae (ed.), Mosteniri culturale. Cultural Heritages (Alba Iulia 2009) 192–218.

Neamțu 1975 V. Neamțu, Cereal Production Technology in Wallachia and Moldavia until the 18th Century (Bucharest 1975).

Popescu 1986 A. Popescu, Romanian Work Traditions in Customs, Folklore, and Folk Art (Bucharest 1986).

Rutland 2021 C. Rutland, The Cow: A Natural and Cultural History (Princeton/Oxford 2021).

Stahl 1965 H. H. Stahl, Ethnographic Comments on the "Little Plough". Ethnography and Folklore Journal 10, 2 (1965).

Șerban 1914 M. Șerban, Our Social-Agrarian Issues (Bucharest 1914).

Vlăduțiu 1973 I. Vlăduțiu, Romanian Ethnography (Bucharest 1973).

Vuia 1975 R. Vuia, Studies in Ethnography and Folklore (Bucharest 1975).

Author info

Ioana Baskerville

Romanian Academy – Iași Branch, 2 Codrescu Street, 700482, Iași, Romania

E-Mail: Ioana.baskerville@acadiasi.ro

Draft Cattle Use in the regions of Brașov, Buzău and the Apuseni Mountains, Romania

Claus Kropp and Vlad Dumitrescu

Abstract

Romania is one of the few countries in Europe that still has a vibrant culture of draft animals, and draft horses continue to play an enormous role in agriculture in remote low mountain regions. Nevertheless, the use of draft cattle is under enormous pressure, and there has been a dramatic decline in the number of teams in use. A survey project conducted in three regions takes a look at the complex reasons for this development and at the same time highlights individual aspects that are still characteristic for the use of draft cattle in Romania today.

Résumé

La Roumanie est l'un des rares pays d'Europe où la culture des animaux de trait est encore très vivante, et les chevaux de trait continuent à jouer un rôle considérable dans l'agriculture des régions montagneuses reculées. Néanmoins, l'utilisation des bovins de trait est soumise à une pression énorme, et le nombre d'attelages utilisés a considérablement diminué. Une enquête menée dans trois régions examine les raisons complexes de cette évolution et met en évidence certains aspects qui caractérisent encore aujourd'hui l'utilisation des bovins de trait en Roumanie..

Kurzfassung

Als eines der wenigen Länder in Europa hat Rumänien noch eine lebendige Zugtierkultur und die Rolle von Zugrindern für die Landwirtschaft in abgelegenen Mittelgebirgsregionen ist weiter enorm. Nichtsdesto trotz steht die Nutzung von Zugrindern unter enormem Druck und es ist ein dramatischer Rückgang eingesetzter Gespanne zu verzeichnen. Ein in drei Regionen durchgeführtes Surveyvorhaben wirft ein Blick in die vielschichtigen Gründe für diese Entwicklung und beleuchtet zugleich Einzelaspekte, die für die Nutzung von Zugrindern in Rumänien bis heute charakteristisch sind.

Resumen

Rumanía es uno de los pocos países de Europa que aún conserva una cultura ganadera muy viva y el papel del ganado vacuno en la agricultura de las remotas regiones montañosas sigue siendo enorme. Sin embargo, el uso del ganado de tiro está sometido a una enorme presión y se ha registrado un drástico descenso en el número de yuntas en uso. Un proyecto de encuesta realizado en tres regiones analiza las complejas razones de esta evolución y, al mismo tiempo examina cada uno de los aspectos que siguen siendo característicos del uso del ganado de tiro en la Rumanía actual.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 046-051. DOI: https://doi.org/10.11588/propylaeum.1713.c25088


1. Baltata romaneasca


2. Plavani


3. Porumbi


4. Romanian Brown


5. Suisse


6. Simmental

Tab. 1 *Illustrated table showing the various regional cattle varieties in the study area.*

Introduction

Romania is one of the few countries in Europe that still has a very lively draft cattle culture[1]. Nevertheless, there are no concrete surveys on the current status of draft cattle farming. As a result, it is difficult to assess the actual situation beyond generally emerging trends towards decline. In 2021, in cooperation with the Romanian photographer Vlad Dumitrescu, there was an opportunity to take a closer look at three selected regions during field trips. These were Brașov County (central Romania), Buzău County (south-eastern Romania) and the Apuseni Mountains (western Romania). The aim of the visits was to identify as many draft cattle farmers as possible in these regions and to interview them using a standardized form[2].

The following key points were to be recorded:

- Occupation, age
- Number of draft cattle in use (incl. sex)
- Breed[3]
- Areas of use
- Type of harnessing

In addition, subjective assessments of the respondents should be recorded for the following questions:

- Reasons for working with draft cattle
- Current problems and challenges in relation to the use of draft cattle

The results of the surveys will be presented in more detail below and finally contextualized.

1 See Baskerville, in this volume.

2 The form was developed by the author and used in the same way for other surveys (e.g. for Northern Uganda and Namibia). See Kropp/Simataa and Kropp/Okumu in this volume.

3 Here, regionally predominant names were documented; it was not always possible to assign them precisely to a breed; there also appear to be regional varieties.

Brașov County (Central Romania)

As part of the preparations for the survey, extensive research was initially carried out in the county to find out where there was evidence that draft cattle were no longer being used. It became clear that in addition to Brașov city there were no draft cattle to be expected especially in the northern part of the district, so that the survey should mainly focus on the low mountain ranges in the east and west. It was also decided to include communities in the border regions of neighbouring districts as well. Finally, the following localities were visited in the period from June 4 to June 22, 2021: Vulcănița, Şinca Veche, Şinca Nouă, Lunca Câlnicului, Holbav (Braşov county); Mărcuş, Dobârlău, Bicfalău, Chichiş (Covasna county); Dragoslavele (Argeş county).

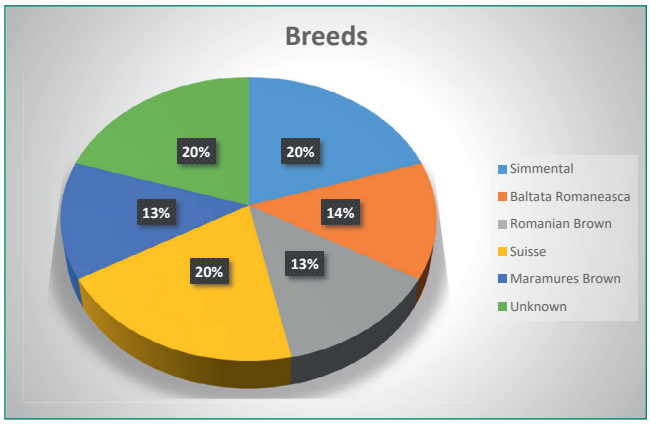


Fig. 1 Distribution of cattle breeds for the Brașov study area.

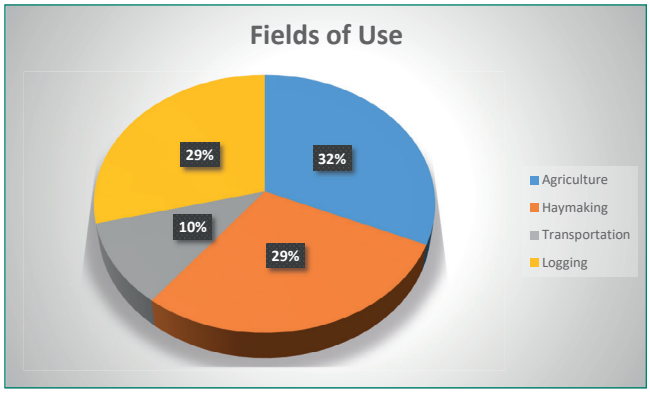


Fig. 2 Fields of use of draft cattle for the Brașov study area.

A total of 13 questionnaires were successfully completed and evaluated (see Fig. 1 and 2). A total of 26 draft cattle were identified in the region, all of which were ox teams that were also worked exclusively with the double withers yoke. The average age of the draft cattle farmers was 64.5 years, and all but one of the interviewees described themselves as farmers. All respondents were also male.

Fig. 3 A team of oxen in Brazov County during the survey tour 2021 (Picture: Vlad Dumitrescu).

Buzău County (South-eastern Romania)

The survey took place between July 9 and 11, 2021 and proved to be more difficult than in the first study area due to the poor condition of the roads and paths and the rough terrain. It sometimes took several hours of walking to reach the individual draft cattle farmers. For these reasons, it was not possible to exhaustively record all active owners of this region during the survey period. Nevertheless, a representative cross-section was achieved.

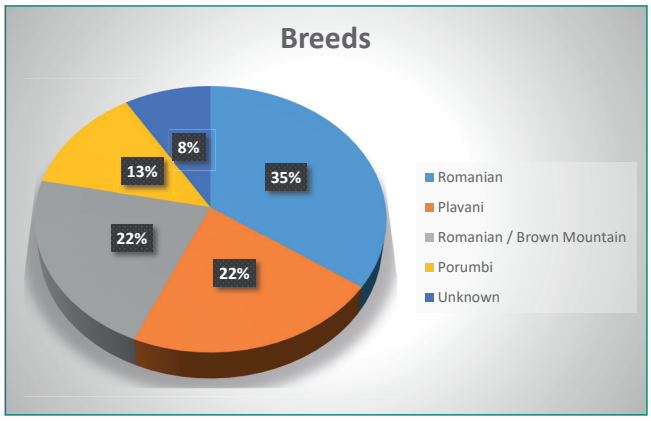


Fig. 4 Distrubution of cattle breeds for the Buzău study area.

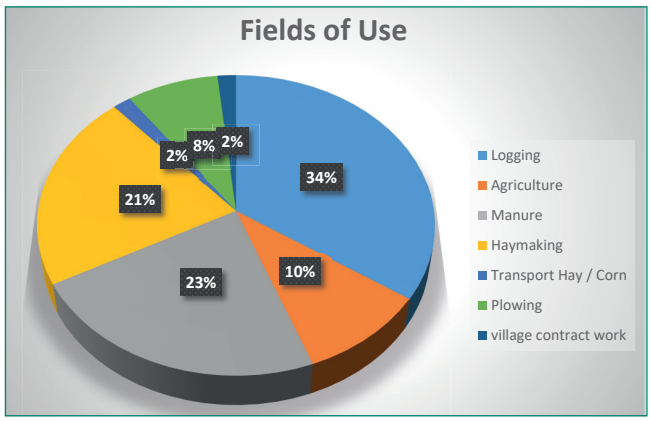


Fig. 5 Fields of use of draft cattle for the Buzău study area.

Fig. 6 Hay transport in the Buzau region during the survey tours in July 2021 (Picture: Vlad Dumitrescu).

A total of 23 questionnaires were completed and evaluated for the district (see Fig. 4 and 5). 58 draft cattle were documented, with a total of 54 oxen and four cows. Unlike in Brașov, there were also several owners with more than a single team. All animals were worked in the double withers yoke. The average age of the draft cattle farmers was 57.3 years. The vast majority of respondents described themselves as farmers; in two cases, the profession of forester was also mentioned. The draft cattle farmers identified in the study area were all male.

Apuseni Mountains (Western Romania)

The last of the three study areas was visited in September 2021. As in Buzău, road conditions were sometimes poor and it was very difficult to reach the draft cattle farmers. For this reason, it was not possible to conduct a complete survey here either, only a representative cross-section. A total of 28 questionnaires were completed. The average age of the draft cattle farmers in this case was 54.42 years. Apart from one fireman and one shepherd, all other respondents described themselves as farmers. As in study area one, only oxen were kept in the Apuseni Mountains. It is interesting to note that a total of 24% of respondents owned four draft oxen - a significantly higher percentage than for the other regions.

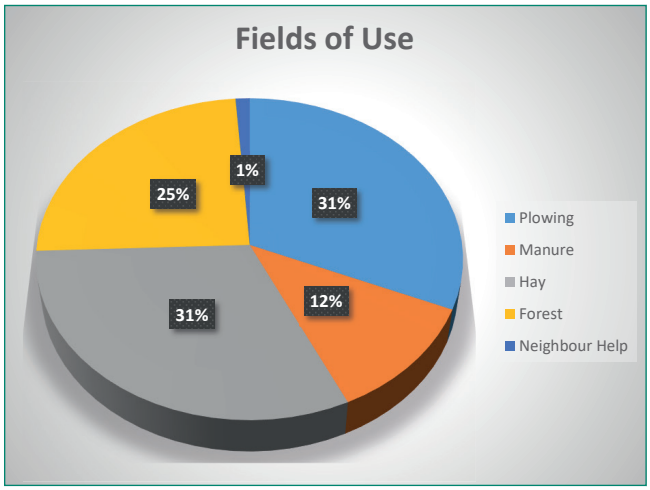


Fig. 7 Fields of use of draft cattle for the Apuseni Mountain study area.

It is also worth mentioning that greater conformity was observed among the cattle breeds; 90% of the cattle were identified as belonging to the Baltata Romaneasca breed. The remaining ten percent were described by the respondents as crossbreeds. As in the other study areas, all cattle in the Apunesi Mountains were harnessed exclusively with the withers yoke.

Fig. 8 Young draft cattle farmer in the Apusesi survey region in 2021 (Picture: Vlad Dumitrescu).

Overarching problems for draft cattle farmers

Regardless of the individual study areas, the questionnaires also identified a number of overarching problems for draft cattle farmers in Romania. For example, a central problem for many of the respondents is that, unlike in the past, draft cattle can no longer be used profitably. Especially the use in the area of neighbourly help, in the context of contract work (transport and plowing services), has decreased enormously and many of the cattle were accordingly described as “underutilized”. This impression was confirmed during several interviews conducted by the authors with former draft cattle farmers in the Brașov study area in April 2023. Many of them ultimately stopped keeping cattle precisely because of this underutilization. The second frequently cited problem of feeding costs for draft cattle should also be seen in close connection with this. It is therefore not (or no longer) possible to adequately finance the winter feeding costs.

When asked why, despite the problems mentioned, the respondents still decided to keep draft cattle, the answers were always the same across the three study areas: On the one hand, the animals were used because the inaccessibility of the study areas (e.g. road conditions, extremely steep terrain) meant that modern machinery could only be used to a limited extent or not at all. On the other hand, many interviewees mentioned the great importance of draft cattle for Romania's cultural heritage; more than one interviewee gave quotes such as “a life without draft cattle is unimaginable for me”.

Fig. 9 In rare cases (here in the Apunesi region), women can be seen working with draft cattle as well (Picture: Vlad Dumitrescu).

A danger to the preservation of the draft animal culture that should not be underestimated is certainly to be found in the fact that many skills are being lost with the death of the older generation of ox drivers. Even if young people want to start working with draft animals again, there is a lack of people who can teach them these skills. That is why it is so important to preserve the existing culture—as an investment in the future.

Summary

The study has shown that the draft cattle culture in Romania is under enormous pressure and that more and more important parameters such as infrastructure and utilization spectra are failing. Although it can be recognized that – the more remote the region – working with draft cattle remains important and that even younger people continue to practice this culture, a dramatic collapse can nonetheless be observed overall. According to an oral statement by one of the draft cattle farmer interviewed in Holbav (Brașov district), 100 teams were still being used there in the early 2000s – currently (as of 2025) there are only two left.

The extent to which this trend can be reversed remains questionable. It is possible that the circular economy practised by small farmers in the low mountain regions could receive more support from the national government. High-value nature farming, which involves the use of draft cattle and horses, is a key factor in the preservation of the outstanding biodiversity in these regions. If the management of steep slopes with the help of draft animals is discontinued, all that remains is succession and reforestation – with all the associated consequences.

Fig. 10 *The mosaic like cultural landscape in the low mointain ranges is a key factor for high biodiversity and is often only possible to maintain with the help of draft animals (Picture: Vlad Dumitrescu).*

Author info
Claus Kropp

Manager Lauresham Laboratory of Experimental Archaeology
Center for Draft Cattle Research and Education
UNESCO World Heritage Site Lorsch Abbey
Nibelungenstr. 32 – 64653 Lorsch – Germany

E-Mail: c.kropp@kloster-lorsch.de

Author info
Vlad Dumitrescu

Photographer

www.vladdumitrescu.ro

Working cattle in France: jumping the hurdles of invisibility

Cozette Griffin-Kremer

Abstract

Working with cattle in real life in France and Europe may look quite visible to the Lorsch colloquium attendees, but there are hurdles to making it visible to other actors. We can contribute to improving this situation by highlighting the recent historical context of cattle draft, present-day experts, the active networking to promote working with cattle and one of its major initiators. Finally, we can examine the issue of invisibility and the communication gap between oxdrivers, researchers and decision-makers.

Résumé

Le travail avec les bovins dans la vie réelle quotidienne en France et en Europe peut sembler tout à fait visible pour les participants au colloque de Lorsch, mais il existe des obstacles qui les rendent invisibles pour d'autres acteurs. Nous pouvons contribuer à améliorer cette situation en mettant en avant le contexte historique récent du travail avec les bovins, les experts actuels, le travail de réseau actif pour promouvoir l'attelage bovin et l'un de ses principaux initiateurs. Enfin, nous pouvons examiner la question de l'invisibilité et du fossé communicationnel entre les meneurs de bœufs, les chercheurs et les décideurs.

Kurzfassung

Die Arbeit mit Rindern im Alltag in Frankreich und Europa mag für die Teilnehmer des Lorsch-Kolloquiums gut sichtbar sein, doch gibt es Hindernisse, die sie für andere Akteure unsichtbar machen. Wir können zur Verbesserung dieser Situation beitragen, indem wir den jüngsten historischen Kontext der Rinderzucht, heutige Experten, die aktive Vernetzung zur Förderung der Arbeit mit Rindern und einen ihrer wichtigsten Initiatoren hervorheben. Schließlich können wir uns mit dem Problem der Unsichtbarkeit und der Kommunikationslücke zwischen Ochsenführern, Forschern und Entscheidungsträgern befassen.

Resumen

El trabajo con ganado en la vida diaria en Francia y Europa puede ser claramente visible para los participantes del coloquio de Lorsch, pero existen obstáculos que lo hacen invisible para otros actores. Podemos contribuir a mejorar esta situación destacando el contexto histórico reciente del tiro de ganado, los expertos actuales, la red activa para promover el trabajo con ganado y uno de sus principales impulsores. Por último, podemos examinar la cuestión de la invisibilidad y la falta de comunicación entre los conductores de ganado, los investigadores y los decisores.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 052-059. DOI: https://doi.org/10.11588/propylaeum.1713.c25089

Introduction

The title here is meant to be provocative. The question is: "invisible to whom"? People who are active in some historical or agriculture-related museums and sites, in regional or national parks, in go-slow tourism and festival events, are often well aware of working animals, perhaps specifically of working cattle, and may call on them as part of their professional or hobby activities. Some small farmers or market gardeners in France certainly use cattle as co-workers, at times well-coordinated with mechanized, or even motorized, equipment.

Yet, this source of energy too often remains invisible to many people logically concerned with alternate energy resources: citizens in search of information, planning officials at every level, and researchers who wish to inform them. With agriculture and stockbreeding often depicted as major and negative players in the climate crisis, there is no lack of public interest in innovative potentials for food production utilizing animals in circular economies.

Documenting present-day skills and a historical trade

A two-pronged documentation project to make skills and history visible through film, photographs and interviews was carried out in 2011 in collaboration with a working mule-trainer, oxdriver and author, Olivier Courthiade, in the Ariège region in southwestern France[1]. In a first session in April, he brought together elder experts and their friends to talk about the horse- and cattle-dealing trade and training of cattle over an 'Oldtimers Dinner' in his home and took them to visit his own collection of yokes and harness in the eco-museum located in the nearby village of Alzen[2].

Fig. 1 *Elders in the courtyard of Méras farm (Photo C. Griffin-Kremer).*

Fig. 2 *Part of the Courthiade yoke collection at the Alzen Ecomuseum (Photo C. Griffin-Kremer).*

The Ariège project involved filming and photographing Olivier's regular work, first in April and then in August, 2011, on his own farm and upland pastures: handling stud duties for horses, logging in the upland section of the farm with his mules, field-manuring with one experienced ox team, breaking in young oxen, and relating domestic tasks such as the regular upkeep of harness. He also hosted an adult education group that provided the opportunity for in-depth analysis of the challenges to his brand of small-farming in very hilly country and complemented this with extensive comments on historical illustrations of ox teams, on his own collection of documents and models, and on his equipment. This collaboration resulted in 28 DVDs of an average 40 minutes each (over 18 hours total) plus accompanying photographs.

Fig. 3 *Olivier logging with his mules in their Landais yoke (Photo C. Griffin-Kremer).*

To take just one example of challenges to hill farming with animal draft, it suffices to watch Olivier logging with his mules in a Landais yoke in the upland section of the farm. This quickly revealed the literal obstacles to continuing the practice. The mechanical tree-felling was done in 'modern' style, assuming the subsequent hauling would be done by machine, so that the felled trees were left helter-skelter, not at all easy for the mules to reach, and considerably increasing the amount of work required. This highlights the reality that animal draft is nestled in broader comprehensive processes, in which each step

1 Under the auspices of, at that time, the CNRS CEPAM, Sophia Antipolis at the University of Antibes; cameraperson Carolina Carpinschi, inquiry Cozette Griffin-Kremer, host Olivier Courthiade, see references in Thanks below.

2 Ecomusée d'Alzen, Vidallac, 09240 Alzen, presently closed (10/02/2025).

needs to be thought through in advance to make the whole run smoothly. A correlate to this 'unsmoothness' is that it affects the safety factor considerably, even more because working alone is already borderline.

Work like this in a real-life situation makes it difficult to coordinate with the photographer and, when time is so short, impossible to break down the processes into easily handled units. This is precisely what can be done in the more protected atmosphere of open-air museums or historical sites and part of their usual educational duties. In contrast, working alone on a tight schedule, often overloaded, and without the matrix of a multi-generational household can also mean working on the edge of financial precarity. Fortunately, the safety issue was at times mitigated by help from experienced friends or trainees.

The August session was dedicated to extending the April Oldtimers' Dinner by visiting five households to interview people who once worked as *maquignons* (livestock dealers) and their wives[3]. *Nota bene*, cattle and horse dealers could be highly regarded for their reputation of reliability, but also admired for their wiles. Generally, stockbreeders and farmers knew who was who. Olivier prepared a standard protocol for the interviews, all while leaving the room for a quite natural conversation (that is, a semi-directed inquiry enabling subsequent comparison). All of these households had their own collections of yokes, harness and other accessories such as bells or yoke spires (*suberjougs* or *béjouets*), as well as photograph albums to comment on.

Fig. 4 *André Sidoin Pauly, Carolina Carpinschi, Olivier Courthiade (Photo C. Griffin-Kremer).*

Needless to say, there was much laughter, often over close calls or something unpleasant – one of the questions in Olivier's protocol was: 'what was the worst thing that ever happened?'. In the close-call category, a cart ended up directly over the lady, oxen and all, and her husband just barely managed to pull her out, safe and sound. In all of these sessions, there was only one note of tragedy. The *maquignon* trade involved carrying astounding amounts of cash, so… there was also one tale of unpunished murder. This contrasted to lively sessions with much mirth, the invigorating glow of nostalgia and some impressive dusting-off of splendid yokes with their lines totally intact. There was much conversation around these long lines (called *juilles*) that were cut from one animal hide in a continuous spiral and sewn with cat gut. No one can make these lines today, although it is not hard to recover ox cues at antique sales and, luckily, there are still farriers who can shoe oxen as well as people making yokes and cow collars of various complexity.

Fig. 5 *Olivier harnessing a team, note the juilles used to secure the yokes (Photo C. Griffin-Kremer).*

Fig. 6 *Olivier explaining harness and accessories (Photo C. Griffin-Kremer).*

What clearly emerges from the videos of Olivier at work and the in-depth interviews with the *maquignons* and their families is what is missing today: The ecosystem they were once embedded in no longer exists with its recognition of their prestige know-how, the multi-generational helping hands, a plethora of trades supplying equipment, and the societal attitudes that could make small-farming like Olivier's viable. All the *maquignons* likewise agreed that there is no longer the pool of triple-purpose animals, with suitable morphology and character, for trainers like him to pick and choose from to create a true fit among handlers, animals, their equipment, the terrain and the tasks to be done.

3 See full list of interviewees at end of article.

This highly colourful past of the *maquignons*, with their tales of remarkable expertise and intimate knowledge of horses and especially cattle, is in fact a welcome complement to the thriving scene – if at an expectedly small scale – of using working cattle in France today. Although the major print gateway to oxdriving (and other animal draft), *Sabots* magazine, is no longer in existence, communication has been taken up by the blog site *Attelages bovins d'aujourd'hui* (Working Cattle Teams Today)[4], piloted by Michel Nioulou, now seconded by Léonnie Biteau in the younger generation of cattle draft enthusiasts. Michel continued pioneer Laurent Avon's census: presently some 130 people or groups with working oxen (121 pairs and 60 solo animals, with a dozen projects in development)[5].

Some oxdrivers like Laurent Martin are moving from sharing experiences to professionalizing training in regular sessions. His project includes working with handicapped people of all ages, a delicate as well as promising aspect of human/cattle contact[6]. In addition, transmission of ecosystem skills is fairly well assured, as indicated by the yoke-makers like Michel Nioulou, Gilles Pequignot and Lionel Rouanet, among others, while Véronique Nioulou has revived the art of making traditional fly masks to protect cattle at work and saddlers like Jean-Claude Mann in Alsace, among others, can provide cow collars. On a broader front, work has progressed on setting up two groups: a "Fédération National des Animaux de Travail" (a National Working Animal Federation) and an "Association française des meneurs de bovins" (French Association of Cattle Handlers)[7].

The tradition of oxdrivers' meetings was effectively upheld with two meetings in 2024, although no longer centralized as in the past at the Alsace Ecomuseum[8]. Two 2025 meetings are already scheduled, one in May and a second in November. If there is for the moment no educational institution providing training in this kind of animal-handling, that is no longer seen as an insurmountable issue, and every oxdrivers' meeting has proven that all kinds of technical innovations are under way. There is also a consensus on the role of positive image-building necessary for cattle draft to be seen as a technology for the future.

Fig. 7 *Lionel Rouanet's miniature yoke with juilles and goad, made for Olivier Courthiade (Photo C. Griffin-Kremer).*

Fig. 8 *Joël Blanc with red and black Vosges breed at the Ecomusée d'Alsace Alsace (Photo C. Griffin-Kremer).*

In the *maquignons'* reminiscences about their work, they emphasized the nigh inexhaustible availability of various breeds of cattle suitable for work, their "fit" with local geography, farming and harness. Most oxdrivers in France are familiar with the Vosges cattle breeder, Philippe Kuhlmann, who still aims at triple use – meat, milk and draft power – and is among the rare cattlemen left who do so[9]. However, there are some other breeders who are on the watch for animals with the right "profile" for work. As a heartening example from across the Rhine, we saw in the March 2024 Lorsch meeting that the Rhaetian Grey Cattle (*Rätisches Grauvieh*) are being actively promoted for their aptitude as draft animals and the 'Use' (*Nutzung*) section of the breed's Swiss website actually mentions *six* fields of activity[10].

During the 2022 oxdrivers' meeting at Philippe Kuhlmann's farm, all the attendees stopped for a moment of silent homage to the passing of a man who was a vital link to present interest in working cattle, as well as a

4 Blog site Attelages bovins d'aujourd'hui http://attelagesbovinsdaujourdhui.unblog.fr/ [10-02-2025].

5 L. Biteau, pers. comm. [12-04-2025].

6 L. Martin, 2 Mains 4 Cornes https://2mains4cornes.fr/ [12-04-2025].

7 Fédération National des Animaux de Travail https://www.reseaufaireacheval.fr/actualites/creation-dune-federation-nationale-federation-nationale-des-animaux-de-travail and Association française des meneurs de bovins https://www.helloasso.com/associations/association-francaise-des-meneurs-de-bovin [04-05-2025].

8 Oxdrivers' meeting at Gentioux-Pigerolles in May 2024: http://attelagesbovinsdaujourdhui.unblog.fr/2023/05/15/premier-rassemblement-autour-de-la-traction-bovine-du-22-au-24-septembre-2023-gentioux-pigerolles-23/ ; Courgenard meeting in September 2024: http://attelagesbovinsdaujourdhui.unblog.fr/2024/10/07/rassemblement-autour-de-lattelage-bovin-organise-par-lassociation-francaise-des-meneurs-de-bovins-afmb-20-21-22-septembre-2024-courgenard-72/ ; 2019 meeting at Ecomusee d'Alsace: http://attelagesbovinsdaujourdhui.unblog.fr/2019/06/30/quatorzieme-rencontre-de-bouviers-en-alsace-ungersheim-68/ [10-02-2025].

9 P. Kuhlmann, Ferme le Mail, 23270 Châtelus-Malvaleix.

10 Rhaetian Grey Cattle https://www.raetischesgrauvieh.ch/rassenportrait/nutzung [10-02-2025].

scientist specialized in cattle breeding, Laurent Avon[11]. Laurent was the "inventor" of census-taking of working ox teams in France, a pioneering challenge, which he did alongside his assignments to assess cattle herds for the Institut de l'Elevage (Stockbreeding Institute, presently called the IDELE)[12].

Fig. 9 *(left to right) Nicole Bochet (†2024), Véronique and Michel Nioulou, Joël Blanc, Laurent Avon (†2022) at the Fête de la Vache Nantaise 2018 (Photo C. Griffin-Kremer).*

One easy way to present the stakes involved in Laurent's dedication to safeguarding and promoting local breeds is to look at the Wikipedia site (in French and English) for just one of the breeds he was concerned with, the Villard-de-Lans[13]. It has the usual detailed section on morphology, but also an especially well-developed passage on "triple aptitude", breeding for meat-milk-work, and emphasizes that local practice was to sell males to the plains areas and use cows exclusively for ploughing and logging. The females were prepared for this diversity of work early and used carefully, so that their milking and reproductive qualities were not negatively affected. The article also mentions details that show the pride in deep commitment to the special "fit" of local breeds to local conditions, and the Villard has been hailed in postage stamps and through the erection of a commemorative statue[14].

On to invisibility and the communication gap

Among his many professional affiliations and commitments, Laurent Avon was an active member of a learned society, the Société d'Ethnozootechnie or SEZ which brings out the semi-annual journal *Ethnozootechnie*. Over the years of its publication, the journal has brought out four issues dedicated to cattle, one of them even entitled 'Les boeufs au travail' (Working Cattle)[15]. Laurent's 2009 census of working cattle showed 170 ox teams in France plus one in Belgium and laid the foundation for the present-day oxdrivers' network. As testimony to his many contributions to working cattle, he was a guest of honour at the 2018 edition of the Fête de la Vache Nantaise in Le Dresny, of which he was also an ardent promoter[16]. Laurent's work has been continued by Michel Nioulou's own inquiry to extend the list of contacts that today makes up the information hub for oxdrivers' meetings and other activities. Yet in the *Ethnozootechnie* journal's 15-page homage to Laurent[17], there is *not one word* on the census of ox teams that was among his proudest achievements and well known to so many breeders, as well as to all the French people attending the Draft Cattle meeting in Lauresham. As a note on the many threads that converge over time in today's network, Laurent was also among the attendees of the 2004 Rencontre d'Alzen organized by Olivier Courthiade and the author, which included both French and international guests, such as the German Working Group's Rolf Minhorst, Jörg Bremond and Gerd Linden, Belgian Nathalie Bozet, as well as the English transport specialist Paul Starkey and museum director Richard Harris from the Weald & Downland Open-Air Museum[18].

The second example attesting to some unexpected invisibility is an article published in the *Journal of Rural Studies* in September 2023 by French academics which links working animals and an agro-ecological transition under way in the present[19]. The article itself is quite positive about the renewal of connections between small farming and the potential use of working animals. However, the search for direct information from reports on actual users of working animals seems to have produced only one, quite old result[20], because the authors were hunting either in academic journals or in what they termed the "grey literature" of the popular press, and not actively seeking out people. The people, many of whom were attending the Draft Cattle Colloquium, are nonetheless very easy to find: They pop up in any online machine search in bundles on the first page, as does the oxdrivers' online blog, *Attelages bovins d'aujourd'hui*.

Fortunately, in the meantime, the lead author has located the French network, is delighted to be connected and is refining his perspectives on working animals, including cattle. Needless to say, the article serves as eloquent testimony to a communication gap. At the time of writing the article, the *Rural Studies* authors were unaware that there were two successful magazines, *Sabots* (Hooves) and *Attelages* (Teams), both dedicated to working horses, cattle, mules, donkeys, even an occasional goat. *Sabots* regularly featured an 'Oxdrivers' Corner' section that included articles on and by experts in France such as Olivier Courthiade, Philippe Kuhlmann and others, as well as reports on every one of the yearly Alsace Ecomuseum oxdrivers' meetings since 2005 and on the annual meetings of the German Cattle Harnessing Working Group (Arbeitsgruppe Rinderanspannung), until 2022 when *Sabots* and *Attelages* "retired" with their editor, François Durand.

11 Homages to L. Avon https://association-ferme.org/2023/06/hommage-laurent-avon.html or https://www.associationlaferrandaise.com/actualites/hommage-a-laurent-avon/ or https://association-ferme.org/2023/06/hommage-laurent-avon.html [10-02-2025].

12 IDELE https://idele.fr/detail-article/races-francaises-a-faibles-effectifs-24-fiches-races-statistiques-2009 [10-02-2025].

13 Cattle breed Villard-de-Lans https://fr.wikipedia.org/wiki/Villard-de-Lans_(race_bovine)#cite_ref-EdLAvon_13-0 and English https://en.wikipedia.org/wiki/Villard-de-Lans_(cattle_breed) [10-02-2025].

14 See Footnote 10.

15 See Ethnozootechnie articles on cattle in Bibliography.

16 Fête de la Vache Nantaise https://www.ouest-france.fr/pays-de-la-loire/nantes-44000/a-plesse-la-fete-de-la-vache-nantaise-portee-a-lecran-d6b6dcdc-f8d4-11ee-8656-3015bc260248 [10-02-2025].

17 Gastinel et al 2022.

18 Griffin-Kremer 2004.

19 Miara et al 2023.

20 Griffin-Kremer 2009.

Fig. 10 *Michel Schwartzentruber and André Kammerer at the Ecomusée d'Alsace (Photo Jean-Léo Dugast).*

Evidently, *Sabots* and *Attelages* hovered in the "grey literature" that is not adequately flagged up by the researchers' tools to access the popular press. Even a more learned publication such as *Ethnozootechnie* is not easily brought up online through a simple search of, say, "traction bovine en France", although it is accessible through the French National Library at GALLICA and has internal indexing, for example under 'bovin' 'boeuf' or 'traction bovine'. This forms a total contrast with the blog *Attelages bovins d'aujourd'hui*, which is now gatewayed by active participation on Facebook[21] and Instagram[22], bridging the gap between oxdrivers and the people trying to find them. Perhaps among the most pertinent questions for future development is whether or not visibility via social media will be massive but atomized, attracting people only when there are events and not sustaining an effective action community.

What conclusion might we draw from the two examples of a communication gap between the Ethnozootechnics Society, the French academics' article and the lively world of the oxdrivers? Perhaps there are more questions than answers. In spite of effective networking among cattle draft users, do working animals receive recognition as a potential factor in future transitions in agriculture? There are so many examples of proposals for the transformative potentials of various agricultures – sustainable, agro-ecological, regenerative, and so on – but working animals seem rarely to figure among the perspectives discussed[23].

Does this disconnect between innovation perspectives and on-the-ground practice occur because people who write do not harness horses or yoke oxen? A good many people who write *and* yoke attended the Draft Cattle Colloquium. Will the two colloquia in Lorsch help raise awareness and invigorate scientific research to, literally, cast its net wider, connect with cattle breeders and oxdrivers? The German G.E.H. (Society for the Conservation of Old and Endangered Livestock Breeds)[24] has regularly arranged presentations of working cattle breeds in the yearly Berlin "Green Week". If the annual French SIA (International Agricultural Fair) in Paris certainly shows off horses working in sports like coach-driving and draft contests, it has also featured both horses and cattle working in farming in past years. Is the problem a glass ceiling, some sort of cultural bias, that prevents the oxdrivers from reaching researchers and decision-makers?

We might recall that the 1997 congress and *Ethnozootechnie* issue dedicated to working cattle received so many proposals to present papers that a follow-up meeting of the same title, 'Les boeufs au travail', was held at the Bergerie Nationale (National Breeding Research Station) in 1998[25]. At that time, Gérard Larcher[26], a leading French parliamentarian and presently President of the French Senate, deeply concerned then as now with agriculture and especially stockbreeding, made bold proposals to the oxdrivers on new paths. He first suggested they organize representation of themselves and the stakes in-

21 Facebook https://www.facebook.com/AttelagesBovins/ [12-04-2025]
22 Instagram https://www.instagram.com/attelagesbovinsdaujourdhui/ [12-04-2025]
23 Smaje 2020, Dufumier/Le Naire 2019, L'Atelier Paysan 2021.
24 G.E.H. Gesellschaft zur Erhaltung alter und gefährdeter Haustierrassen e.V. https://www.g-e-h.de/ [10-02-2025].
25 FAIR 1999.
26 G. Larcher https://www.senat.fr/senateur/larcher_gerard86034e.html [12-04-2025].

volved in their work in the promotion and safeguard of local breeds and, second, that they undertake to set up a convention with the French State. He likewise made the sort of ground-breaking proposal we see in discussions of regenerative or alternative agriculture and agroecology, noting that France could get along quite well for large-scale food production with *only* the North, the Brie and the Beauce regions! In that case, the rest of the country's land could be a platform of invention to provide an entirely different relationship with local animal breeds, most specifically referring to cattle and other working animals[27].

Colloquia and now a new Center for Cattle Draft Research and Education in Lorsch should help propel visibility of the potentials of working cattle to the public and serve as a resource for future small farming, but then, what is the next step or steps? Might it be possible to envision and implement a deeper, more radical reorganization of some aspects of agricultural production? In that case, is only a diffuse, informal trickle-up effect plausible, without support from local or regional governments? Is it possible to flag up the ensemble of barriers to upscaling that include a lack of visibility as well as many other factors such as legal issues of inheritance, land-use classifications and authorizations, and small-investment financing[28]. Perhaps using draft animals, including working cattle, leads us to more fundamental questions about the nature of land itself, of how we perceive and regulate it.

Thanks to

Olivier Courthiade (organizer-host) La Ferme de Méras, Nescus, 09240 La Bastide de Sérou

Carolina Carpinschi (camerawoman), First Prize for a Thesis in Science and Technology, France https://sfhst.hypotheses.org/prix-de-these-de-la-sfhst/archives [10-02-2025]; at that time (2011-12) attached to CDHTE/CNAM Axes Techniques et Vie Quotidienne, Paris

The Interviewees (in order of appearance)

Aimé and Denise MASSAT, Sabarat (09253)

André Sidoin and Jeannine PAULY, Laveret, Lézat sur Lèze (09167)

André and Madame ESTAQUE, Montesquieu Avantès (09200)

Roger and Madame BONZOM, Campagne-sur-Arize (09075)

Joseph CASTET, La Carille, Soueich (31550)

Gérard and Maïté RESPAUD and their family, Le Gay near Le Mas d'Azil (09290)

Further Research

The original *maquignons* DVDs have been deposited at the Archives Départementales de l'Ariège (Contact: archives@ariege.fr)

27 FAIR 1999, 10-12.

28 FEVE (Fermes En ViE) https://www.feve.co/installation/ressources-installation/autorisation-exploiter-agriculture ; Perino 2016 https://www.film-documentaire.fr/4DACTION/w_liste_generique/C_36765_F [10-02-2025] ; Vanuxem 2022.

Bibliography

Dufumier/Le Naire 2019 M. Dufumier/O. Le Naire, L'agroécologie peut nous sauver. Domaine du Possible/Actes Sud (Paris 2019).

Ethnozootechnie Journal of the Société d'Ethnozootechnie in French, accessible online at GALLICA. https://gallica.bnf.fr/ark:/12148/cb343806311/date.

Ethnozootechnie 1995 Journal of the Société d'Ethnozootechnie in French 55,1995, on cattle transhumance.

Ethnozootechnie 1997 Les boeufs au travail (Working Cattle). Journal of the Société d'Ethnozootechnie in French 60, 1997.

Ethnozootechnie 2002 Journal of the Société d'Ethnozootechnie in French, Special issue (Varia) 3, 2002, on the history of cattle and sheep breeds.

Ethnozootechnie 2006 Les bovins. De la domestication à l'élevage (Cattle: from domestication to stockbreeding). Journal of the Société d'Ethnozootechnie in French 79, 2006.

Ethnozootechnie 2006 La transhumance bovine dans le Massif Vosgien et l'Arc Alpin. Approche ethno-écologique (Cattle transhumance in the Vosges Mountains and the Alpine Arc: ethno-ecological approach). Journal of the Société d'Ethnozootechnie in French, Special issue (Varia) 7, 2006.

FAIR 1999 Les boeufs au travail (Working Cattle), published by the FAIR (Festival Animalier International de Rambouillet) (1999).

Gastinel et al 2022 P-L Gastinel/C. Danchin-Burge/B. Denis/E. Verrier. L'oeuvre et l'héritage de Laurent Avon (The work and legacy of Laurent Avon). Ethnozootechnie 111, 2022, 87–101.

Griffin-Kremer 2004 C. Griffin-Kremer, Rencontre internationale Les Boeufs au Travail. 22-24 octobre 2004, Écomusée d'Alzen. Ethnozootechnie 75, 2004, 152–153.

Griffin-Kremer 2009 C. Griffin-Kremer, Dynamics of informal networking. Two studies of cattle draft in the perspective of deeper time. Int. J. Herit. Stud. 15, 2–3, 2009, 192–208 (https://doi. org/10.1080/13527250902890712).

L'Atelier Paysan 2021 Reprendre la terre aux machines, Manifeste pour une autonomie paysanne et alimentaire, Anthropocène Seuil (2021).

Miara et al 2023 M. Miara/P. Boudes/T. Rabier/M. Gafsi, Animal traction in developed countries. The reappropriation of a past practice through agroecological transition. Journal of Rural Studies, online 15 September 2023, 103–124 (https://doi.org/10.1016/j.jrurstud.2023.103124) (NB not free access).

Perino 2016 H. Perino, documentary film Les Agronautes, 2016.

Smaje 2020 Ch. Smaje, A Small Farm Future (Vermont/London 2020).

Vanuxem 2022 S. Vanuxem, La Propriété de la Terre (Marseille 2022).

Author info
Cozette Griffin-Kremer
Associate Researcher (AR) CRBC (Centre de recherche celtique et bretonne)
https://nouveau.univ-brest.fr/crbc/fr/membre/cozette-griffin-kremer
FR-29200 Brest and during the Ariège inquiry (2011-12), AR at the CDHTE/CNAM Axes Techniques et Vie Quotidienne, Paris
E-Mail: griffin.kremer@wanadoo.fr

Draft cattle utilization in Germany – Perspectives, Potential and Limits

Claus Kropp

Abstract

After an almost complete hiatus in draft cattle farming in Germany between 1950 and the early 2000s, working with draft cattle has regained importance over the last twenty years. Old triple-purpose breeds (milk, meat, and labor) play a special role in this, as do various initiatives (including the Center for Draft Cattle Research and Education). Ultimately, however, long-term re-establishment depends on whether the public understands draft cattle farming as something separate from any nostalgia and beyond mere hobbyism.

Résumé

Après une interruption quasi totale de l'agriculture à traction bovine en Allemagne entre 1950 et le début des années 2000, le travail avec ces animaux a regagné en importance au cours des vingt dernières années. Les anciennes races à triple usage (lait, viande et travail) jouent un rôle particulier à cet égard, tout comme diverses initiatives (notamment le Centre de recherche et d'éducation sur les bovins de trait). En fin de compte, cependant, le rétablissement à long terme dépendra de la capacité du public à comprendre que l'agriculture à traction bovine de trait est une activité distincte de la nostalgie et qui va au-delà du simple hobby.

Kurzfassung

Nach einem fast vollständigen Hiatus in der Zugrinderhaltung in Deutschland zwischen 1950 und den frühen 200er Jahren, gewinnt die Arbeit mit Zugrindern in den letzten zwanzig Jahren wieder verstärkt an Bedeutung. Alte Dreinutzungsrassen (Milch-Fleisch-Arbeit) spielen dabei eine besondere Rolle, genauso wie verschiedene Initiativen (u.a. Zentrum für Zugrinderforschung und Ausbildung). Eine langfristige Re-Etablierung hängt zuletzt aber davon ab, ob die Haltung von Zugrindern von der Öffentlichkeit auch losgelöst etwaiger Nostalgiebemühungen verstanden wird und jenseits reiner Liebhaberei.

Resumen

Tras una pausa casi total en la cría de ganado de tiro en Alemania entre 1950 y principios de la década de 2000, el trabajo con ganado de tiro ha recuperado importancia en los últimos veinte años. Las antiguas razas de triple uso (leche, carne y trabajo) desempeñan un papel especial en este sentido, así como diversas iniciativas (entre otras, el Centro de Investigación y Educación sobre Ganado de Tiro). Sin embargo, en última instancia, su restablecimiento a largo plazo depende de que el público entienda la ganadería de tiro como algo ajeno a la nostalgia y más allá del mero hobby.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 060-065. DOI: https://doi.org/10.11588/propylaeum.1713.c25090

Introduction

Germany is one of the countries in Central Europe that had a very lively draft cattle culture up until the 1950s[1]. However, due to the industrialization of agriculture, the decline in the number of small and micro farms, and a series of land consolidations, this practice almost completely died out and much traditional knowledge was lost. Over the last twenty years, however, a new dynamic has emerged, leading to a revival and restructuring. To discuss this development will be the focus of the following paper.

Fig. 1 Draft Cattle at work on a field in the 1930s in Germany. The oxen are harnessed with a forehead yoke (Picture: Sammlung Hesse).

Establishing a Status Quo

At the annual meeting of the Draft Cattle working group of Germany on March 18th 2022, the results of a draft cattle survey conducted by the author in 2021 was presented. This was the first time since 2011[2] that up-to-date data on the status of draft cattle in Germany had been systematically collected.

Looking first at the absolute figures, it is striking that the number of draft cattle kept in Germany has almost doubled compared to 2011. While only 23 draft cattle owners could be identified in 2011, the number had already risen to 41 in the survey year. The number of draft cattle kept has developed similarly. While there was a total of 51 draft cattle (26 cows, 24 oxen, and 1 bull) in 2011, a total of 91 were counted in 2021 (49 cows, 35 oxen, 2 heifers, and 5 bulls). In any case, it is clear that the centuries-old tradition of using draft cows in particular for the classic three-purpose-use (meat, milk, labor) is still practiced in Germany in the 21st century.

Looking at the distribution of draft cattle owners across the individual federal states, Rhineland-Palatinate (9), Hesse (7), and Bavaria (7) stand out in particular. In total, draft cattle farms were registered in ten of the 16 federal states; only for Saarland, Bremen, Saxony, Saxony-Anhalt, Mecklenburg-Western Pomerania, and Thuringia did the survey yield no results.

The survey also looked more closely at the distribution of cattle breeds, revealing that several breeds listed in the Red List of Endangered Livestock are among the top five. According to the survey, the breeds used for draft purposes in Germany are primarily Red Highland Cattle/Rotes Höhenvieh (20), Rhaetian Grey Cattle/Rätisches Grauvieh (20), Fleckvieh (13), Black Pied Lowland Cattle/Schwarzbuntes Niederungsrind (7), and Hinterwälder (5). It can therefore be concluded that the use of these breeds as draft animals can also be important for their preservation. It is often the still widespread selection based on character that makes these breeds so essential for draft animal work.

Fig. 2 A team of Raetian Grey cattle oxen plowing a field in 2023 (Picture: Gerhard Döring).

Although it should be noted at this point that most draft cattle farms in Germany (30) were classified as private by the respondents, it can be observed that an increasing number of animals are also being used in part-time and full-time agricultural and forestry activities. This makes it all the more important for developers and manufacturers to focus their attention on machines and equipment designed specifically for draft cattle in the future.

Fig. 3 Cultivating with a cow of the Red Highland Cattle (Rotes Höhenvieh) breed in Brandenburg (Picture A. Masson).

Finally, the survey also asked about the type of harness used. It is striking that the overwhelming majority in Germany use a three-pad-collar harness (35), with only very few using other types of harness such as a forehead yoke (2), bow yoke (2) or head yoke (1). The withers yoke,

1 Steinmetz 1935.
2 Neumann 2011.

Fig. 4 Participants of the World Draft Cattle Symposium during a pre-conference tour in March 2024 (Picture: Lauren Muney).

which is widely used in other countries, was not registered at all. When asked about the reasons for this clear preference for the collar, this may be an expression of regional traditions in addition to the equally widespread use of single harnesses. In addition, the adjustable three-pad collar is still widely considered one of the most effective and animal-friendly forms of harness. However, it is also clear that, depending on the area of work and terrain, the yoke harness can offer clear advantages.

(Inter)national Center for Draft Cattle Research and Education

From March 8th to 10th 2024, more than 125 cattle experts, farmers, scientists, historians, archaeologists, museum specialists, and engineers from 21 countries gathered in Lorsch, southern Hesse, for the first World Draft Cattle Symposium. The symposium was initiated by the Lauresham Open-Air Laboratory, a museum institution that has been intensively engaged with the topic of draft cattle for over ten years, both historically and practically, as well as in a modern context, through various third-party funded projects. In 2021, the institution had already hosted a world congress called "Draft Animals in the Past, Present and Future[3]" which was held digitally due to the pandemic and attended by over 500 people. During the comparative examination of various draft animals that took place at that time, it became very clear that – even though the importance of draft cattle is still very high in a global context – they receive little attention in public discussion compared to other draft animals. Like no other draft animal, it is understood by political decision-makers, agricultural lobbies, and even many laypeople as part of a narrative of a primitive past that needs to be overcome with "more modern" working methods. Accordingly, cattle drivers in many countries face the problem of being publicly denounced as backward—even though there are so many positive examples, including from the so-called Western world, where draft cattle can be used as part of ecological operations in agriculture, viticulture, and even forestry[4]. Addressing this problem and bringing together different stakeholders and disciplines for the first time was the main intention of the symposium from the outset. It was recognized that each country has its own specific problems and challenges to overcome and that the discussion about the importance of draft cattle in the 21st century can only be advanced if as much knowledge as possible is accumulated and contextualized. One of the key outcomes of the event was therefore the establishment of an International Center for Draft Cattle Research and Education[5], which aims to bring together joint efforts and create an international platform for professional exchange. At the same time, the center provides important research impetus to help strengthen the potential role of draft cattle in discussions about sustainability and innovative, resource-saving working methods. It is important to break new ground and provide political decision-makers with comprehensive, factual, and expert information about the potential and limitations of draft cattle.

The founding of the Draft Cattle Center ultimately also boosted the positive dynamic for draft cattle use in Germany. As it provides access to various teaching and experimental fields, meadows, a forest for training purposes, as well as to agricultural and forestry machinery and a large collection of farming implements, it serves as a hub function on a national level. Due to fellowships from craft cattle experts from Scotland, USA or Lithuania, several workshops were organized in 2025 for members of the ox-drivers community and therefore additional skill-training opportunities created.

3 See Kropp / Zoll 2022.

4 See Kropp in this volume.

5 See https://kloster-lorsch.de/en/freilichtlabor-lauresham-laboratory-for-experimental-archaeology/center-for-draft-cattle-research-and-education/ (last accessed 12-09-2025).

Fig. 5 *Health Check and body-weight estimation prior to the start of the draft cattle performance tests (Picture: Ina Pöhlmann).*

Reintroducing Draft Performance tests for cattle

As one of the first big initiatives of the Draft Cattle Center on a national level, a group consisting of cattle experts and specialists took over the development of a new edition of so called draft cattle performance tests. Draft performance tests for working cattle originally had a long tradition in Germany. Similar to the performance tests for horses that are still carried out today, the relevant testing system experienced a particular boom between 1918 and 1939. In his dissertation published in 1933, Heinrich Bohley describes the intention of the performance tests for cattle at the time very clearly: *"The evaluation of this performance concept boils down to determining the respective performance of the farm animal in question through precisely planned tests in order to primarily utilize the animals with above-average dispositions as far as possible in terms of breeding and to obtain descendants with better dispositions in terms of performance from them"6*. After the end of the Second World War and in the course of the motorization and industrialization of agriculture, the importance of draft cattle as beforementioned and thus also the will to systematically test their working performance rapidly declined and the testing system in Germany died out completely. The three-purpose use (milk, meat, work), which is so central to draft cows, also became less and less important in the breeding system and, in this context, the selection of individual breeds according to character and suitability.

The main purpose for the group of experts in relaunching a systematic draft performance test therefore was to provide a further structural framework for the growing draft cattle culture and, above all, to establish common quality standards. It was important to both the test committee and the active members of the draft cattle community in Germany that the trials should not be a competition, but rather a joint review of best-practices. It should also explicitly not be about demanding maximum performance from the animals (in terms of maximum pulling power), but rather the average pulling power that the animals should be able to deliver over a period of several hours. Finally, it was also clear that these regulations could only pose as the first step on a long road towards returning to well established testing systems.

On November 16, 2024, after more than 75 years, the time had finally come. A total of 15 working cattle plus teamsters from four federal states were participating in the premiere of the new draft cattle trials[7]. They were carried out on the grounds of Center for Draft Cattle Research and Education. About 200 spectators came to witness this extraordinary opportunity to see some of the best trained working cattle in Germany. It is also important to note that from the 15 participating draft cattle, 6 breeds from the national list of endangered livestock were represented. This continues the development that was already immanent through the survey results from 2011 and 2021: old heritage breeds are a key aspect for the whole question of revitalizing draft cattle use in Germany. Another noteworthy circumstance was the fact that not only oxen but also several cows took part in the trials.

6 Bohley 1932, 17.

7 For a full report on the Trials see Kropp 2025.

Fig. 6 *Draft Performance Trial (35% of body-weight pull) with an ox of the Raetian Grey Breed (Picture: Ina Pöhlmann).*

Fig. 7 *Draft Suitability Trial (Obedience, Human-Animal relationship) with a heifer of the Hinterwälder breed (Picture: Ina Pöhlmann).*

Eventually, all of the six animals participating in the draft suitability test as well as the nine animals participating in the draft performance test successfully passed the different elements of the trials.

Summary

There is no doubt that working with draft cattle seems to be gaining ground again in Germany. At the same time, the establishment of new organizational and structural elements such as the Draft Cattle Center and draft performance tests also indicates a trend toward professionalization. These are certainly important steps toward a new draft cattle culture at a national level, which is necessary for the long-term re-establishment of draft cattle in agriculture, forestry, and transport, as well as for therapeutic purposes. Only if we are successful in seperating the work with draft cattle from the widespread image of "being a thing of the past", real change can be achieved.

Bibliography

Bohley 1932 H. Bohley, Die Arbeitsleistung des Bayreuther Scheckviehs (Untersuchungen in 5 bäuerlichen Betrieben des Bezirkes Kulmbach – Oberfranken), vorgelegt an der TU Münschen 1932.

Kropp 2025 C. Kropp, Auf dem Weg zu alter Stärke. Zugeignungs- und Zugleistungsprüfung für Rinder in Lorsch, Starke Pferde. Internationales Magazin zur Förderung der Arbeit mit Pferden und anderen Zugtieren (29), Nr. 113 (2025), 90-92.

Kropp / Zoll 2022 C. Kropp, L. Zoll (Eds), Draft Animals in the Past, Present and Future (Bad Homburg v.d.Höhe 2022), online available at: https://doi.org/10.11588/propylaeum.1120 (last accessed 11-09-2025).

Neumann 2011 J. Neumann, Bewertung der aktuellen Zugrindernutzung in Deutschland. Bachelorarbeit Humboldt Universität Berlin (2011), online available at: https:://www.zugrinder.de/de/literatur (last accessed 11-09-2025).

Steinmetz 1935 H. Steinmetz, Kuhanspannung in Deutschland (Berlin 1935).

Author info
Claus Kropp

Manager Lauresham Laboratory of Experimental Archaeology
Center for Draft Cattle Research and Education
UNESCO World Heritage Site Lorsch Abbey
Nibelungenstr. 32 – 64653 Lorsch – Germany

E-Mail: c.kropp@kloster-lorsch.de

The use of animal traction in Pinar del Río Province, Cuba

Raymundo Vento Tielves

Abstract

In Pinar del Río, Cuba's westernmost province, the use of draft cattle dates back to the beginning of Spanish colonization. In this region, animal traction remains a vital option for agricultural production and transportation, and is widely used by farmers and in everyday life, both rural and urban. A diagnostic assessment was conducted to understand the current use of animal traction in Pinar del Río. The study covered the entire province. Information was obtained through surveys, and small farmers were contacted. Using participatory methods, a diagnostic survey was conducted in Pinar del Río province. The survey was designed to determine the level of animal traction use. The study showed that animal traction constitutes an important and widely used source of energy. In Pinar del Río province, animal traction has been of great importance throughout history, especially in the agricultural sector and particularly among tobacco producers. Oxen are the most commonly used draft animals in rural areas for agricultural mechanization and transportation. Draft cattle, a source of power, have consolidated traditions in Pinar del Río and are part of the region's history. Draft cattle will forever be an indelible part of Pinar del Río's rural culture.

Résumé

À Pinar del Río, province dans l'ouestde Cuba, l'utilisation de la traction bovine remonte au début de la colonisation espagnole. Dans cette région, la traction animale demeure une option essentielle pour la production agricole et le transport, et est largement utilisée par les agriculteurs et dans la vie quotidienne, tant en milieu rural qu'urbain. Une évaluation diagnostique a été menée afin de comprendre l'utilisation actuelle de la traction animale à Pinar del Río. L'étude a porté sur l'ensemble de la province. Les informations ont été obtenues par le biais d'enquêtes et les petits agriculteurs ont été contactés. À l'aide de méthodes participatives, une enquête diagnostique a été menée à bien dans la province de Pinar del Río. L'enquête visait à déterminer le niveau d'utilisation de la traction animale. L'étude a montré que la traction animale constitue une source d'énergie importante et largement utilisée. Dans la province de Pinar del Río, la traction animale a joué un rôle crucial tout au long de l'histoire, notamment dans le secteur agricole et surtout chez les producteurs de tabac. Les bœufs sont les animaux de trait les plus couramment utilisés en zone rurale pour la mécanisation agricole et le transport. Le bétail de trait, source d'énergie, ont consolidé les traditions à Pinar del Río et font partie intégrante de l'histoire de la région. L'attelage bovin restera à jamais une partie indélébile de la culture rurale de Pinar del Río.

Kurzfassung

In Pinar del Río, der westlichsten Provinz Kubas, reicht der Einsatz von Zugvieh bis in die Anfänge der spanischen Kolonialisierung zurück. In dieser Region ist die Zugkraft von Tieren nach wie vor eine wichtige Option für die landwirtschaftliche Produktion und den Transport und wird von Landwirten und im Alltag sowohl auf dem Land als auch in der Stadt häufig genutzt. Um die aktuelle Nutzung der Zugkraft von Tieren in Pinar del Río zu verstehen, wurde eine diagnostische Bewertung durchgeführt. Die Studie deckte die gesamte Provinz ab. Informationen wurden durch Umfragen gewonnen und Kleinbauern kontaktiert. Mittels partizipativer Methoden wurde in der Provinz Pinar del Río eine diagnostische Umfrage durchgeführt. Ziel der Umfrage war es, den Umfang der Nutzung tierischer Zugkraft zu ermitteln. Die Studie zeigte, dass die Zugkraft von Tieren eine wichtige und weit verbreitete Energiequelle darstellt. In der Provinz Pinar del Río hatte die Zugkraft von Tieren im Laufe der Geschichte eine große Bedeutung, vor allem im Agrarsektor und insbesondere bei Tabakproduzenten. Ochsen sind die am häufigsten eingesetzten Zugtiere in ländlichen Gebieten für die landwirtschaftliche Mechanisierung und den Transport. Zugvieh als Kraftgeber hat in Pinar del Río Traditionen gefestigt und ist Teil der Geschichte der Region. Zugvieh wird für immer ein unauslöschlicher Teil der ländlichen Kultur von Pinar del Río sein.

Resumen

En Pinar del Río, la provincia más occidental de Cuba, el uso del ganado de tiro se remonta a los inicios de la colonización española. En esta región, la tracción animal sigue siendo una opción importante para la producción agrícola y el transporte, y es ampliamente utilizada tanto por agricultores, así como en la vida cotidiana, tanto rural como urbana. Se realizó una diagnóstico para comprender el uso actual de la tracción animal en Pinar del Río. El estudio abarcó toda la provincia. La información se obtuvo mediante encuestas y contactando a pequeños agricultores. Se realizó una encuesta en la provincia de Pinar del Río utilizando métodos participativos. El objetivo era determinar el nivel de uso de tracción animal. El estudio demostró que la tracción animal constituye una importante fuente de energía ampliamente utilizada. En la provincia de Pinar del Río, la tracción animal ha tenido gran importancia a lo largo de la historia, especialmente en el sector agrícola y particularmente entre los productores de tabaco. Los bueyes es el ganado de tiro más utilizados en las zonas rurales para la mecanización agrícola y el transporte. El ganado de tiro, como fuente de energía, ha consolidado tradiciones en Pinar del Río y forma parte de la historia regional. El ganado de tiro será siempre una parte indeleble de la cultura campesina pinareña.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 066-073. DOI: https://doi.org/10.11588/propylaeum.1713.c25091

Introduction

The use of work animals in Pinar del Río Province (as in all Cuban regions) dates from the early European colonisation of the island. Animal power in this most westerly region of the country remains a vital option for agricultural production and transport, and is widely used by both large-scale and small-scale farmers, and in the daily round of rural and urban life. The renewable bio-energy source provided by work animals is very important for mechanized cropping in the agricultural production systems of Pinar del Río Province. Animal traction plays a vital role in the production of tobacco, which is grown by individuals and cooperatives and is the most important crop of the Province.

Agricultural production in its evolution towards more commercial models develops production systems that are characterized by monoculture, overexploitation of natural resources and dependence on export markets. In this model of agro-industrial agriculture, based on the concept of the Green Revolution, there is evidence of an increase in the dependence on external inputs, thereby causing negative impacts on soils, biodiversity and forests, with high rates of soil erosion, deforestation, environmental pollution, coupled with high energy consumption and an increasing increase in production costs, among other undesirable effects[1].

Since its inception, agriculture has been an activity requiring considerable energy consumption. From ploughing the land to harvesting and food processing, each stage of the agricultural cycle requires a significant energy input. In the modern era, with the mechanization and industrialization of the agricultural sector, energy consumption has increased even further, posing significant challenges and opportunities for the sustainability and efficiency of the global food system[2].

The development of agriculture in Cuba was characterized by a broad boom in mechanization that benefited all agricultural crops and livestock. More than a thousand combines were introduced into rice cultivation, which mechanized its harvest to 100 percent, and sowing with seeding machines and aircraft was introduced. Irrigated areas increased significantly from 160,000 to 580,000 hectares, and water reservoir capacity increased more than 100-fold. In sugarcane cultivation, in the 1970s, collators were introduced that carried 98% of the manually cut cane, and more than a thousand combines cut 25% of the canes[3].

At the height of agro-industrial development in Cuba during the 1970s and 1980s, Cuban agriculture was characterized by the massive introduction of tractors, harvesters, large-scale irrigation systems, hybrid seeds and an emphasis on production of monoculture in large areas. In addition, 48% of chemical fertilizers and 82% of pesticides were imported[4].

One of the main aspects to consider when it comes to energy consumption in agriculture is the use of agricultural machinery and equipment. From tractors and combine harvesters to irrigation and storage systems, agricultural machinery relies heavily on fossil fuels to operate. This energy consumption not only entails significant economic costs for farmers but also contributes to greenhouse gas emissions and climate change[5].

According to Ríos, 2017, in 1989 an acute economic crisis began in Cuba with the collapse of the European socialist block and the disappearance of the Soviet Union. At that time, 85% of Cuban trade was with socialist countries and only about 10% with capitalist countries. This caused purchasing power to be reduced to 40% and fuel imports to fall to a third.

During the 1990s, Cuba needed to make urgent transformations in its agricultural production model, based on an almost total reconversion of its agro-industrial production model, transforming it into a subsistence agriculture model, due to the sudden collapse caused by the lack of inputs, caused by the disintegration of the socialist camp in Eastern Europe and the USSR[6].

A series of important challenges are looming in Cuba's agricultural sector, which must be addressed with appropriate techniques and technologies. Climate change has been occurring in Cuba for several years, reflecting global phenomena and the particularities of Cuba's geography. These changes have had repercussions on the production of some agricultural crops. For these reasons, it is very important to implement strategies and develop tools that facilitate the adaptation of agriculture to the changes the climate is experiencing and will continue to experience in the future[7].

In many cases, tractors are used to perform certain tasks where animal traction may be more economical or convenient. Despite the great advances in motorized power in agriculture, draft animals will continue to be the primary source of power on farms in many regions where the use of tractors and tractor-drawn machinery is not profitable. It should not be forgotten that the use of machinery can only be achieved where agricultural systems generate sufficient income to cover the costs of acquiring, operating, maintaining, repairing, and depreciating said machinery[8].

Animal-drawn mechanization has currently been revitalized in the country. This technology preserves soils and reduces air pollution. The use of this energy source will always be relevant in a group of tasks where its efficiency has been demonstrated in areas that are difficult to mechanize due to slopes, stony terrain, and obstacles; in small garden plots, for personal consumption[9].

According to Suárez-León and Ríos-Hernández, 2019, 25% of the energy capacity of Cuban agriculture corresponds to oxen, which contributes to fuel savings. This behaviour allows promoting and encouraging the use of animal traction in all those tasks where it is convenient from a technical and economic point of view in the agricultural sector.

The objective of this work is:

Show evidence and experiences of the use of draft cattle in Pinar del Río province of Cuba

1 Funes 2017; FAO 2019.
2 Gutiérrez Soto y López Sandin 2024.
3 Ríos 2017.
4 Machín et al. 2010.
5 Gutiérrez Soto y López Sandin 2024.
6 Díaz y Vento 2015.
7 García 2020.
8 Olivet Rodríguez et al. 2020.
9 Olivet et al. 2018.

Fig. 1 Province of Pinar del Río (TUBS, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Pinar_del_Rio_in_Cuba.svg).

Fig. 2 Topography of Pinar del Río (Google Earth (Data SIO, NOAA, U.S. Navy, NGA, GEBCO, https://shorturl.at/HqMYT).

Development

Brief description of the province of Pinar del Río.

The Republic of Cuba consists of an archipelago with an area of 110 860 km^2 and a population of 11 million. The relief is generally flat, with 77% of the country less than 100 metres above sea level. Twenty-two percent of the country is in the range 100 m to 200 m and only 1.3% is over 500 m. Cuba has a tropical climate with average temperatures around 25-26°C. Annual rainfall varies between 1200 and 1500 mm. The tropical climate influences many aspects of animal power, including animal breed and disposition, management systems, working hours, feed quality and quantity and farm production systems. Pinar del Río Province is located in the west of the island of Cuba. Figure 1 shows an image of the province of Pinar del Río.

The province of Pinar del Río can be divided into two broad agro-ecological zones, a mountain area named Guaniguanico mountain range, with altitudes ranging from 100 to 800 metres, dominates the northern zone. The southern zone is characterized by flat plains, with slopes of 0 to 15%. In both zones, the topography of areas under agricultural crops is relatively flat or gently rolling, although farmers in the mountainous regions may work on slopes of between 12 and 30%.

The region studied presents a marked diversity of soils, with generally light, sandy soils predominating. They are soils at high risk of erosion due to their physical characteristics and low organic matter content. Soil erosion is significant in the region, and it is estimated that approximately 75% of agricultural soils show significant levels of erosion.

Pinar del Río Province is largely agricultural and most of its gross domestic product derives from agriculture and forestry. The principal crops grown are tobacco, coffee, rice and other crops. Forestry is also important, as is pastureland. Tobacco, forestry, coffee and rice have the greatest economic importance in the Province. Generally, in the southern zone there are abundant irrigation systems, and practically all producers have access to water. In the mountain zone, the broken terrain and the limited access to suitable water supplies limit irrigation systems.

Methodology used in the development of this work

Using participatory methods, a diagnostic survey was undertaken in Pinar del Río Province. The survey was designed to ascertain the level of use of animal power. The participatory methodology involved visits within the study areas, surveys of farmers, meetings with farmers and agriculturalists and workshops.

Farming systems in Pinar del Río

According to Díaz and Vento, 2015, to understand the emergence and development of Urban Agriculture in Cuba, it is useful to understand the process of evolution of agriculture on the island. There have been four significant periods, differentiated as follows:

First: Up to 1959 agricultural production was characterised by sugar grown practically as a monoculture, with some important commercial production of tobacco. There was limited development of technology, and it is reported that the sector only had 9,000 low-powered tractors.

Second: After the Cuban Revolution in 1959, there was an urgent need to increase agricultural production to better feed the country's population. The country decided on the path of industrialized agriculture. So, with the help of other socialist countries, and inspired by the success of the Green Revolution, the number of tractors was increased significantly, reaching figures of over 90,000 (with a range of power) by the decade of the 1980s. With the associated agricultural implements and combine harvesters, crops were completely mechanised and reached levels of sophistication on a par with those in first world countries. It also allowed expansion of the cultivated area, an increase in the diversity of crops produced, widespread use of fertilisers and irrigation, genetic improvement of crops and animals, and an intensive use of agrochemicals. All this was, of course, energy intensive and required the use of huge volumes of fuel.

Third: In the 1990s, with the collapse of the USSR and the socialist bloc in Europe and the disappearance of the Council for Mutual Economic Assistance (CAME or COMECON), Cuba was suddenly left without access to the inputs necessary to sustain the high technological level of its agro-industrial agricultural model. At the same time, of course, the sector lost the negative impacts of the system, including the economic, energy related, environmental, social and cultural impacts faced by intensive agricultural systems throughout the world. Cuba was faced with the choice of transforming its agricultural production model or perish.

Fourth: From the end of the 1990s to the first decades of the 21st century was a period of transition for Cuban agriculture. The trend was now toward more sustainable models of agroecological production and the development of the programmes of urban and peri-urban agriculture. Family farming was invigorated and production was more environmentally friendly. This is not to say that high technology production options were not pursued in specific sectors, if that was deemed appropriate.

The organisation of agricultural production is characterized by a combination of private and state farms:

- Credit and Services Cooperatives (CCS)
- Agricultural Production Cooperatives (CPA)
- Basic Units of Cooperative Production (UBPC)
- Un-associated private farmers
- State enterprises

The size of the farms varies according to the principal crop, the condition of the land and particular characteristics of the region. A tobacco farmer may commonly have 5 ha to 67 ha and there are cases of farmers with more than 130 ha. Amongst farmers of horticultural and vegetable crops, the property sizes range from 5 ha to 67 ha. In the mountain areas, the size of famer holdings is subject to greater limitations and varies between 2.5 ha and 20 ha.

Use of animal traction in Cuba.

The famer commonly employs work animals for ploughploughing, ridging, weeding and transport, as do the larger farms in the region. The most frequently used animals in Pinar del Río are bovines (oxen and bulls and some cows). Oxen are mainly used for field work and transport (sledges and carts).

The farmer commonly employs work animals for ploughplouging, ridging, weeding and transport, as do

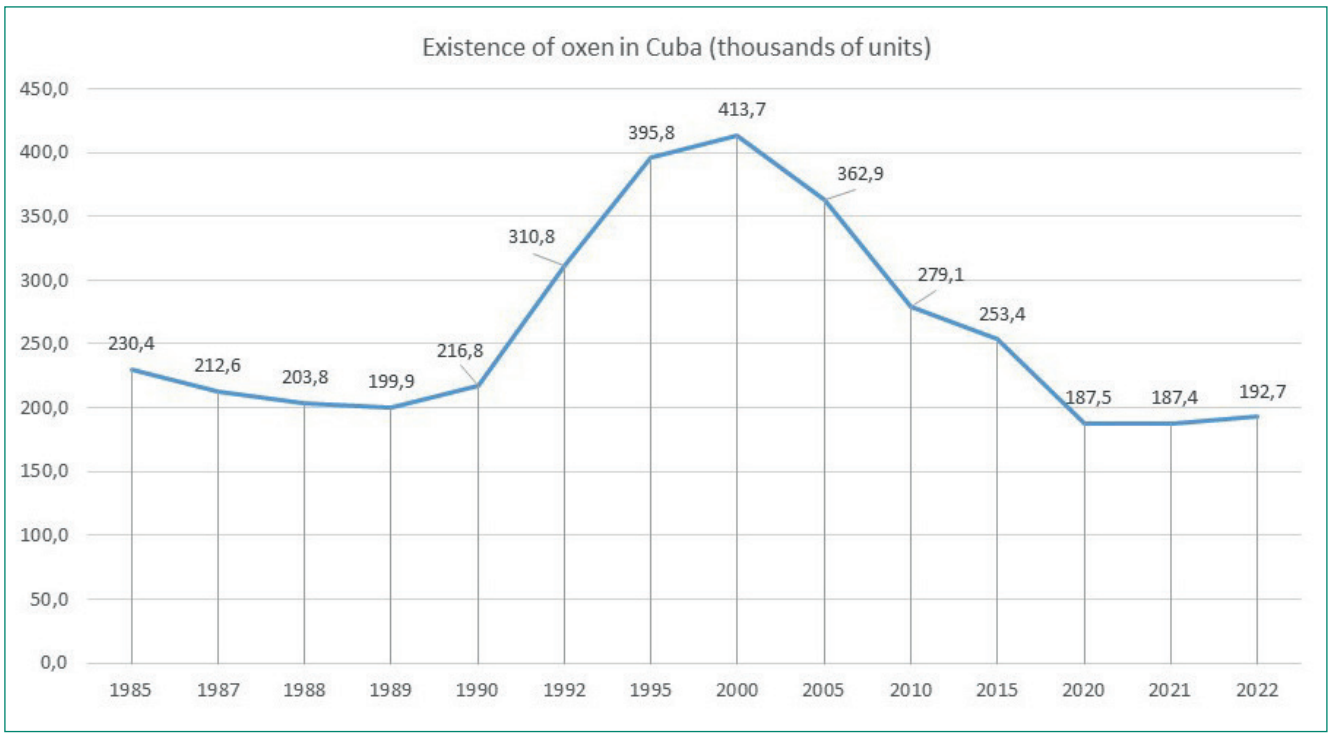


Fig. 3 Total number of draft oxen in Cuba from 1985-2022 (Graph R. Tielves).

the larger farms in the region. With the introduction of large numbers of tractors into Cuban agriculture in the 1960s and following years, the number of draft animals employed in agricultural work decreased. At the beginning of the 1990s, Cuba experienced and economic crisis that was exacerbated by changes in the world order, especially the disappearance of the socialist block in Europe. The shortage of petroleum products was a catalyst for an increase in the use of draft animals by many types of cooperative and large-scale production units, as economic possibilities declined for using tractors in mechanized agriculture. Figure 2 shows the changes in the work oxen population in Cuba.

Use of draft cattle in Pinar del Río

In the province of Pinar del Río, animal traction has been of great importance throughout history, especially in the agricultural sector and particularly among tobacco producers. This has allowed farmers to develop methods of training and using animal power in their agricultural and transportation work for years, making it a traditional legacy.

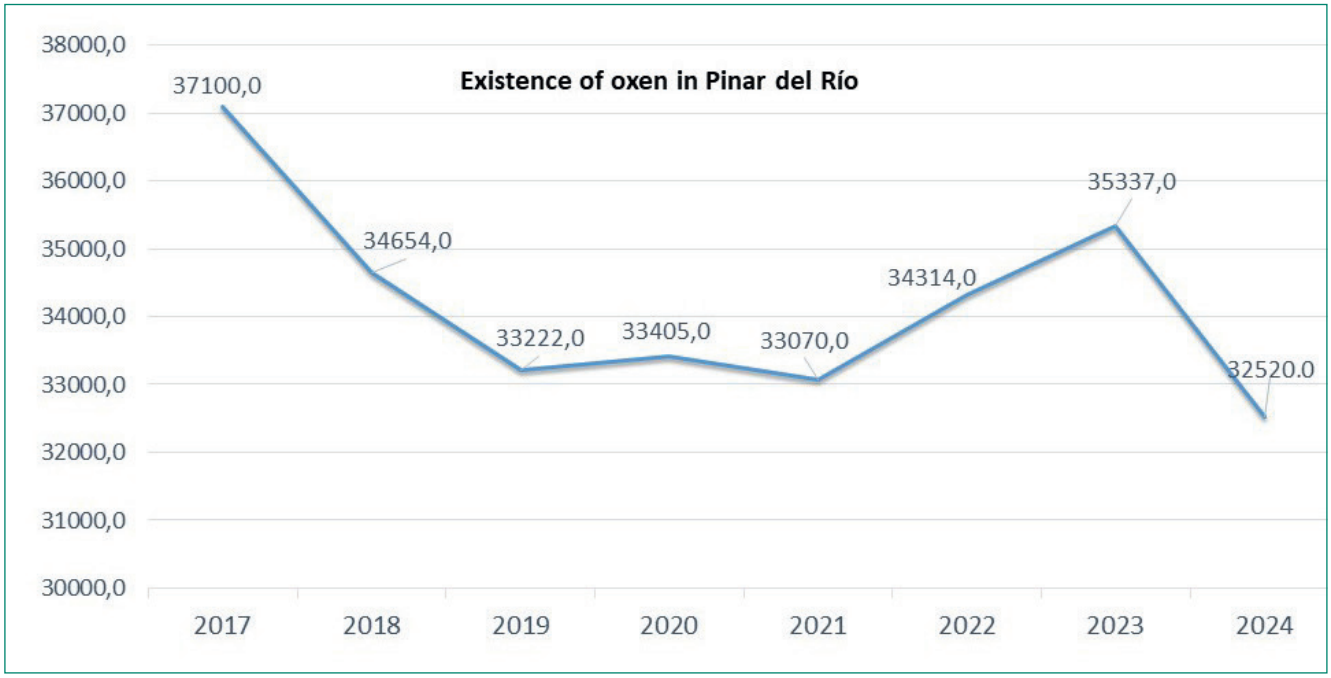


Fig. 4 Total number of oxen in the provinve Pinar del Rio from 2017-2024 (Graph R. Tielves).

The most common and widespread draft animal in the agricultural sector in Pinar del Río is the Bovine, especially the ox. It is used to make multiple contributions to agricultural production, performing different tasks on crops and in transportation activities inside and outside the farms. In short, it is designated that the integral use of animals in tasks such as ploughploughing, furrowing, sowing, fertilizing, weeding and transportation, among other tasks, makes it an important source of energy on agricultural production farms.

In the province of Pinar del Río, the use of animal traction makes it a bastion of the use of this source of energy in Cuba. For years, tobacco producers have left an important legacy of tradition in the use of draft cattle, a result that has influenced the existence of draft cattle in the province. Figure 3 shows the existence of draft cattle in the province of Pinar del Río.

According to the Evaluation Report for the First Semester 2024, from the Department of Agricultural Engineering, of the Provincial Delegation of the Ministry of Agriculture in Pinar del Río, it is recognized that despite the existing limitations, outstanding results are achieved in the use of animal traction, which made it possible to face the limitations of diesel fuel and implements for tractors, by having 16,255 yokes of oxen on the producers' properties, with an average of five implements per yoke available for agricultural work.

Breeds of draft cattle used in the province of Pinar del Rio

The types of draft cattle used by farmers in Pinar del Río are *Bos taurus* ('European') and *Bos indicus* ('Asian' or zebu) breeds. All people surveyed and interviewed confirmed that they prefer oxen for field operations. Figure 4 shows examples of these breeds used by farmers.

The farmers said their liking for oxen is due to the following characteristics:

- Oxen are tame and hard working.
- Oxen present little danger to their drivers.
- Oxen are willing to work hard for long periods.

The most frequently used draft cattle in Pinar del Río:

- oxen,
- bulls and
- some cows

The implements for the Draft cattle

For a long time, the most commonly used animal-drawn implements in Cuba have been metal mouldboard ploughploughs and traditional wooden ploughploughs, very similar to others widely used in different regions of the world. Harrows, cultivators, wooden rakes, and two-wheeled carts are the basic models.

It is common on farms to have the following module of implements for animal traction:

- Mouldboard ploughplough
- Traditional stick ploughugh
- Spiked tooth harrow
- Disc harrow
- Furrower
- Cultivator
- Transport sled
- Bogie

Depending on their production systems, state farms, production cooperatives (CPAs), and basic cooperative units (UBPCs) may have all these implements, or may have smaller packages. Essentially all have at least one mouldboard plough, wood plough, cultivator and spike-tooth harrow.

The mouldboard ploughs are commonly used for primary tillage, with subsequent passes by spike-tooth harrows or disk harrows. The implements most used for secondary tillage and weed control activities are cultivators.

It is common for some farmers to carry out the initial preparation of the soil with a tractor-mounted plough and disc harrow, and to carry out subsequent tillage operations with animal traction. However, most farmers say that they prefer to do everything with animal traction.

Fig. 5 *Different breeds of cattle in Use in Pinar del Rio (Picture: R. Tielves).*

Which are the biggest limitations and potentials in the use of draft cattle?

According to surveys carried out among farmers, the main limitations to the development of animal traction include the following elements:

- Limited sources of feed and animal care
- Lack of supplies for harnesses, collars, saddles canvasses and ropes
- Risk of theft of the animals
- Increasing cost of animal care and protection

The main potentials for the development of animal traction in Pinar del Río are expressed in:

- The use of animal traction in Pinar del Río agriculture increases every day as an energy possibility in the face of fuel shortages
- Environmental perspective for the revitalization of conservation criteria in soil management
- Strengthening concepts that involve the rational use of animal traction

Fig. 6 *Farmer and his ox-drawn mouldboard plough in Pinar del Rio province (Picture: R. Tielves).*

Conclusions

The results of this work allow us to define the following conclusions:

- The employment of animal traction is very important in Pinar del Río Province.
- Oxen are the draft animals most used in rural areas in agricultural mechanization and transportation.
- The energy source of Draft Cattle has established traditions in Pinar del Río, and it forms part of the regional history.
- Draft cattle will forever be part of the culture of the farmers in Pinar del Río.

Bibliography

Departamento de Ingeniería Agropecuaria 2024 Departamento de Ingeniería Agropecuaria, Ministerio de la Agricultura en Pinar del Río. Informe valorativo del Primer Semestre 2024.

Díaz/Vento 2015 L. Díaz/R. Vento, La experiencia del programa de Agricultura Urbana en la ciudad de Pinar del Río, Cuba. Revista Agriculture for Development 25, 2015.

FAO 2019 FAO, Cambio climático y seguridad alimentaria y nutricional en América Latina y el Caribe, 2019. URL: http://www.fao.org/3/ca2902es/CA2902ES.pdf. [Date of website access e. g. 02-05-25].

Funes-Monzote 2017 F. Funes-Monzote,Integración agroecológica y soberanía energética. Agroecología 12, 1, 2017,57–66. URL: https://revistas.um.es/agroecologia/article/view/330351/229311. [Date of website access e. g. 02-05-25].

García 2020 A. García, El sector agropecuario y el desarrollo económico. El caso cubano. Econ. y Desarrollo 164 2, 2020. URL: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0252-85842020000200005. [Date of website access e. g. 13-05-25].

Gutiérrez-Sotol 2024 G. Gutiérrez-Sotol. López-Sandin, El Consumo Energético en la Agricultura. Desafíos y Oportunidades. Revista De Ciencias Agroalimentarias Y Biotecnología 1, 1, 2024, 14–19. URL: https://doi.org/10.29105/rcab1.1-5. [Date of website access e. g. 12-05-25].

Machín et al. 2010 B. Machín/A.D. Roque/D.R. Ávila/P.M. Rosset,Revolución agroecológica.El Movimiento de Campesino a Campesino de la ANAP en Cuba. Cuando el campesino ve, hace fe (La Habana 2010).

Rodríguez et al. 2020 Y.E. Olivet Rodríguez/D. Cobas Hernández/E.F. Olivet Acosta, Aprovechamiento de la tracción animal en el cultivo del fríjol (Phaseolus vulgaris L). REDEL. Revista Granmense De Desarrollo Local 4, 2020, 346–356. URL: https://revistas.udg.co.cu/index.php/redel/article/view/1504. [Date of website access e. g. 13-05-25].

ONEI 2023 ONEI: Anuario Estadístico de Cuba, Serie Sector Agropecuario, Inst. Oficina Nacional de Estadísticas e Información (ONEI) (La Habana 2023). URL: https://www.onei.gob.cu/. [Date of website access e. g. 13-05-25].

Ríos-Hernández 2017 A. Ríos-Hernández, La agricultura en Cuba. Apuntes históricos. Ingeniería Agrícola 5, 3, 2017, 63–64. URL: https://revistas.unah.edu.cu/index.php/IAgric/article/view/707. [Date of website access e. g. 12-05-25].

Suárez-León/Ríos-Hernández 2019 J. Suárez-León/A. Ríos-Hernández, A diagnosis on existence and use of agricultural machinery in Cuba. Revista Ingeniería Agrícola 9, 4, 2019, 69–77. URL: https://revistas.unah.edu.cu/index.php/IAgric/article/view/1175/1932. [Date of website access e. g. 12-05-25].

Author info

Raymundo Vento Tielves. PhD

Center for the Study of Environment and Natural Resources.
University of Pinar del Río

E-Mail: tielve@upr.edu.cu

Draft Cattle Use in Northern Uganda

Claus Kropp, Boniface Okumu

Abstract

Following the end in 2006 of the 20-year civil war, northern Uganda once again has a large number of draft cattle in use. However, a survey covering 13 districts in 2023 also revealed a number of problems, including issues with harness systems, the health of draft animals, and ways in which suggestions for improvement, such as improved yoke designs, animal training techniques, can be implemented in the long term.

Résumé

Après la fin de la guerre civile qui a duré 20 ans jusqu'en 2006, le nord de l'Ouganda utilise à nouveau un grand nombre de bovins de trait. Cependant, une enquête menée dans 13 districts en 2023 a également révélé un certain nombre de problèmes, notamment des questions liées aux systèmes de harnais, à la santé des animaux de trait et aux moyens de mettre en œuvre à long terme des suggestions d'amélioration, telles que la conception de jougs améliorés et les techniques de dressage des animaux.

Kurzfassung

Nord Uganda verfügt nach dem Ende des zwanzig Jahre andauernden Bürgerkriegs 2006 wieder über eine hohe Anzahl an im Einsatz befindlichen Zugtieren. Im Zuge eines 13 Distrikte einschließenden Surveys aus dem Jahr 2023 wurden allerdings auch eine Vielzahl an Problemen deutlich, darunter im Bereich der Anspannungssysteme, in Bezug auf den Gesundheitszustand der Zugrinder aber auch in der Art und Weise wie verbesserte Jochformen überhaupt langfristig implementiert werden können

Resumen

Tras el fin de la guerra civil que duró 20 años en 2006, el norte de Uganda vuelve a contar con un gran número de ganado de tiro en uso. Sin embargo, una encuesta realizada en 13 distritos en 2023 también reveló una serie de problemas, entre ellos cuestiones relacionadas con los sistemas de arneses, la salud del ganado de tiro y las formas en que se pueden aplicar a largo plazo las sugerencias de mejora, como el diseño de yugos mejorados y las técnicas de adiestramiento de animales.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 074-077. DOI: https://doi.org/10.11588/propylaeum.1713.c25092

Fig. 1 Woman plowing with a team of bulls in Oyam district (Picture Boniface Okumu).

Introduction

Between March 30th and May 25th 2023, a total of 133 farmers from 13 districts in north and north central Uganda participated in a survey[1] on the use of draft cattle. The interviews were done by community-based trainers of the Oxen Clinic Uganda which randomly selected the farmers in the respective districts[2]. There were some challenges that were encountered that need mentioning at this point:

a. Rainfall irregularities: the districts of Lamwo, Pader, Gulu and Omoro received rain later than usual which led to delay of the activities in those areas subsequently making the survey taking longer than planned.

b. Local leaders' interference: for unknown reasons, some local leaders were discouraging some farmers from participating in the survey. The districts of Kole, Kiryandongo and Gulu were the most affected by this and as a result the majority of the farmers refused to take pictures.

c. Accessibility: in some districts, the road infrastructure was very poor and therefore getting to the farmers was oftentimes a challenge for the community-based trainers.

d. Natural death: the death of a prominent community leader affected the activity in Omoro district because farmers released cattle from work (to let them roam free again) earlier than usual and subsequently before any photos could be taken.

The authors had several reasons for conducting the survey in this particular region. On the one hand, northern Uganda has a very fertile soil and over 80% of the population rely on agriculture for livelihood. It had a long-standing tradition of draft animal use, which was almost completely destroyed by the civil war from 1987 until 2006. Much traditional knowledge was lost across the region, and in many respects, it was necessary to start almost from scratch when it came to working with draft animals. Government of Uganda in collaboration with the different development partners such as Catholic Relief Services (CRS), Gulu Archdiocese, Peace Harvest, US organization Tillers International and many others, work was finally undertaken to re-establish working practices and, at the same time, improve the methods of harnessing draft cattle (e.g., yokes). The Oxen Clinic Uganda Company Limited, which was established as a result of this project, continues this work to this day, and the survey project thus made it possible to evaluate the success of the measures taken over the past decades.

Survey Results

First, it should be noted that the combined results from all 13 districts are evaluated and analyzed here. It can be seen that the average farm size was between 2.5 and 5 hectares of cultivated land[3]. A team of animals is generally used for this purpose – in most cases oxen and bulls, and less frequently cows. In only a few cases four or more animals were hitched together. Traditional withers yokes were the main harnessing system, but in about ten percent of cases an improved bow yoke was also utilized (see ***Fig. 2***).

The breeds used were equally divided between Zebu and Watussi Ankole. The average age of the working an-

1 For the general structure of the survey sheets please see Kropp / Dumitrescu in this volume.

2 The breakdown were as follows: Gulu district 10 farmers, Kole district 10, Omoro district 10, Oyam district 10, Nwoya district 10, Masindi district 10, Dokolo district 11, Kiryandongo district 10, Lira district 10, Alebtong district 10, Lamwo district 10, Pader district 11 and Amuru district 11 farmers. Kole district initially was not among the districts but due to the cattle rustling taking place in Agago district by the karamojong worriors, the survey could not be carried out there due to security reasons and subsequently Kole district replaced it.

3 There is a possibility that some farmers did not give the correct size of their land and the number of draft cattle for fear of taxation from the Government, fear that they may not be given free things by development partners. This is a common occurrence basing on previous experiences.

imals was determined to be five years, and the weekly work intensity is three to five hours.

95.5% of the farmers surveyed were male, and the main field of work for cattle was stated to be mainly field work, although it should be emphasized that this primarily refers to plowing. Planting and weeding, on the other hand, were only very rarely mentioned. Other, much less common uses for cattle were transportation and logging.

Challenges

If attempted to rank the main problems mentioned by respondents, the following picture emerges:

1. Animal diseases and parasites
2. Spare parts procurement
3. Injuries caused by harnessing
4. Availability of drinking water for cattle
5. Poor veterinary care
6. Poor road conditions

Fig. 2 *Traditional Ugandan Withers yoke (on the top) in comparison to an improved bow yoke (at the bottom), both Nwoya district (Picture Boniface Okumu).*

At this point, it is necessary to take a closer look at the second and third points mentioned above. As already mentioned in the introduction, the work of Tillers International and the Oxen Clinic Uganda has provided local farmers in northern Uganda with support in the use of soil cultivation equipment and the development of more effective yokes. In many cases, for example, a new yoke was developed for one of the teams in the community and then made available to them. During the surveys, it was found that although these yokes and the plows were gratefully accepted and used, the farmer returned to the traditional method of harnessing once repairs became necessary. The main reasons cited for this were a lack of financial resources.

Fig. 3 *Pressure points on the hump of an ox (on the left) during plowing in Lamwo district (Picture: Boniface Okumu).*

The above observation has a direct impact on the third-ranked issue, namely injuries to animals caused by the yoke. Since many of the traditional withers yokes are not optimally adapted to the animals and the yoke pins can also cause sensitive pressure points in the neck area of zebu cattle (see ***fig. 3***), the improved yoke system offers a solution here. This is all the more important given that the animals are also more productive when harnessed in an improved manner.

Reasons for draft cattle use

The main reason given for using draft cattle was the time saved, especially when compared to using hand tools alone. In addition, many of the respondents also emphasized the simplicity of handling the cattle and noted that their use led to an improvement in soil fertility (without going into further detail why, however). Another particularly important reason cited was that draft oxen also contribute to generating new financial resources (especially through increased yields and an expansion of the area that can be cultivated and also providing tillage services to neighbouring farmers at fee), which in turn provides new opportunities for education, especially for children.

Fig 4 Farmer Richard Onek with his kids in Pader district (Picture: Boniface Okumu).

Summary

The current situation regarding draft cattle use in northern Uganda is extremely complex, and both conducting the survey as well as its results reflect the unstable political situation and the ongoing socio-cultural trauma suffered by society particularly in Acholi sub region due to the long civil war. In many ways, this is slowing down positive developments, and according to the surveys, decades of support and provision for the population by public authorities have meant that many farmers now lack the self-help potential that is once again required.

Nevertheless, working with draft animals in northern Uganda is of enormous importance for securing people's livelihoods and, as mentioned above, indirectly enables a higher level of education for the population.

Author info

Claus Kropp

Manager Lauresham Laboratory of Experimental Archaeology
Center for Draft Cattle Research and Education
UNESCO World Heritage Site Lorsch Abbey
Nibelungenstr. 32 – 64653 Lorsch – Germany

E-Mail: c.kropp@kloster-lorsch.de

Author info

Boniface Okumu

Managing Director Oxen Clinic Uganda
Gulu Uganda

E-Mail: oxenclinicug@gmail.com

Draft Cattle Use in the Zambezi Region, Namibia

Claus Kropp, Joseph Simataa

Abstract

The Zambezi region in northeastern Namibia still has a functional and prosperous draft animal culture. Challenges can be identified in the increasingly difficult external conditions, which are exacerbated in particular by man-made climate change. Bush fires, epidemics, and droughts place enormous strain on draft cattle farmers. Intensive training of cattle is often not feasible. The same applies to the use of more animal-friendly and effective harnessing methods.

Résumé

La région du Zambèze, au nord-est de la Namibie, possède encore une culture d'animaux de trait qui fonctionne et est prospère. Les défis à relever sont liés à des conditions extérieures de plus en plus difficiles, exacerbées en particulier par le changement climatique anthropogène. Les feux de brousse, les épidémies et les sécheresses ont un impact énorme sur les éleveurs de bovins de trait. Un entraînement intensif des bovins n'est souvent pas possible. Il en va de même pour l'utilisation de méthodes d'attelage plus respectueuses des animaux et plus efficaces.

Kurzfassung

In der Sambesi-Region im Nordosten Namibias gibt es noch immer eine funktionierende und prosperierende Zugtierkultur. Herausforderungen ergeben sich aus den zunehmend schwierigen äußeren Bedingungen, die insbesondere durch den vom Menschen verursachten Klimawandel verschärft werden. Buschbrände, Epidemien und Dürren stellen eine enorme Belastung für die Zugrinderfarmer dar. Eine intensive Ausbildung der Rinder ist oft nicht möglich. Gleiches gilt für den Einsatz tierfreundlicherer und effektiverer Anbaumethoden.

Resumen

La región del Zambeze, en el noreste de Namibia, sigue teniendo una cultura ganadera funcional y próspera. Los retos surgen de las condiciones externas cada vez más difíciles, que se ven agravadas en particular por el cambio climático provocado por el hombre. Los incendios forestales, las epidemias y las sequías suponen una enorme presión para los ganaderos. A menudo no es posible adiestrar intensivamente al ganado. Lo mismo ocurre con el uso de métodos de arnés más eficaces y respetuosos con los animales.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 078-081. DOI: https://doi.org/10.11588/propylaeum.1713.c25093

Fig. 1 A team of four oxen wearing a traditional withers yoke (Photo: Joseph Simataa).

Introduction

The Zambezi region in the far northeast of Namibia is a narrow strip of land between Botswana, Zambia, and Angola. In the tropical climate that prevails there, the use of draft animals for agriculture and transport is still widespread. A survey[1] conducted by the authors in October 2023 was intended to provide more detailed insights into the exact situation on the ground and, above all, to identify the greatest challenges and regional characteristics.

1 For a detailed insight in the general survey structure used, please see Kropp / Dumitrescu in this volume.

Fig. 2 One of the most important uses for draft cattle in the Zambesi region is agriculture (Photo: Joseph Simataa).

Survey Results

A total of 23 individual survey questionnaires were collected for the region. Care was taken to ensure that the sample was as representative as possible, but the data base remains small at present.

Looking first at the size of the farms surveyed, these ranged between 3 and 4 hectares, with 72% of respondents using two pairs of oxen to cultivate their fields. Without exception, the animals belonged to the Sanga cattle group, a mostly zebu-type cattle breed that is commonly used in Namibia and other regions of Africa. The use of a simple withers yoke without specific adaptation to the individual animals was also a clear result of the survey. With an average usage time of four hours, all oxen without exception were used for agricultural work, and 63% were also utilized for transport tasks. The average age of the draft oxen was determined to be seven years.

Challenges

Respondents cited a variety of different challenges in connection with the keeping and use of draft animals. The most frequently cited problem was the persistent drought in the survey area, which often makes it impossible to feed the animals adequately and get them through the winter. This is also linked to the animals' suboptimal physical condition, which limits their resilience, especially when performing heavy work such as plowing. This situation is also exacerbated by the fact that the rain season in this region of Namibia is becoming shorter and shorter. Whereas conditions used to be favorable from November to February, this period has now been reduced to January and February only. This means that working cattle have significantly less time to recover physically after the dry season.

Another problem mentioned was the high incidence of various animal diseases, coupled with the fact that veterinary care is not always adequate or available at all. This also leads to increased mortality among draft cattle.

Finally, the devastating effects of fires were cited as a major challenge. These often lead to the destruction of grazing land for the animals and thus to a mutual reinforcement of the other problems already mentioned.

Reasons for draft cattle use

Essentially, four main reasons can be cited that were repeatedly mentioned by the respondents:

Firstly, it was repeatedly emphasized that working with draft cattle is a comparatively inexpensive method of working compared to other options (e.g. combustion engines). Furthermore, the simplicity of harnessing and working with cattle was also emphasized in this context—animals are often yoked with experienced oxen and put to work without a long training period.

Another main reason is seen in the multifunctionality of draft cattle. Cattle are extremely versatile, especially in transportation, and are sometimes even used to transport small boats over land to the nearest body of water. Multifunctionality in this context also means the value of the products of the animal, both the primary (meat, skin) and well as secondary (milk) ones.

Finally, the fourth main reason given for the use of draft cattle was their sociocultural significance. Many of the respondents identified working with oxen as an integral part of their culture.

Summary

It is striking that the Zambezi region can still be said to have a functional and prosperous draft animal culture. The challenges lie less in the loss of people who want to continue working with draft cattle and more in the increasingly difficult external conditions, which are exacerbated in particular by man-made climate change. Bush fires, epidemics, and droughts place enormous strain on draft cattle farmers. Intensive training of cattle, which can otherwise be advantageous in terms of precise work in the field, is often not realistically feasible. The same applies to the use of more animal-friendly and effective harnessing methods.

Author info
Claus Kropp

Manager Lauresham Laboratory of Experimental Archaeology
Center for Draft Cattle Research and Education
UNESCO World Heritage Site Lorsch Abbey
Nibelungenstr. 32 – 64653 Lorsch – Germany

E-Mail: c.kropp@kloster-lorsch.de

Author info
Joseph Simataa

Subsistence Farmer
Ministry of Environment, Forestry and Tourism – P.o box 1981, Katima Mulilo

E-Mail: simataa11joseph@yahoo.com

Challenges in reinvigorating draft animal power in India and some opportunities

D. K. Sadana, M. Din, S. Das, M. Shrivastava, T. Motilal

Abstract

Bullocks provide farmers with an efficient, cost-effective, and sustainable means of performing various agricultural tasks. In many rural areas, draft animal power continues to be relevant and plays a vital role in supporting agricultural activities, particularly for small-scale farmers. Fragmentation of land over generations is a continuing process and it does not spur the use of tractors or minor machines, or even tillers. Hence, draft animal power will continue to be relevant in the existing situation of small land holdings. Their strength, adaptability, and cultural importance make them valuable assets in many farming systems in the country. Specialized attention including legislation for welfare of draft animals and systematic animal breeding programs exclusively for draft purpose will further help promote draft animal power. The benefits they bring to sustainability by saving on fossil fuel use, and promoting biodiversity can make them valuable assets in agricultural systems of any country.

Résumé

Les bœufs fournissent aux agriculteurs un moyen efficace, rentable et durable d'effectuer diverses tâches agricoles. Dans de nombreuses zones rurales, la traction animale reste pertinente et joue un rôle essentiel dans le soutien des activités agricoles, en particulier pour les petits exploitants. La fragmentation des terres au fil des générations est un processus continu qui n'encourage pas l'utilisation de tracteurs, de petites machines ou même de motoculteurs. Par conséquent, la traction animale restera pertinente dans le contexte actuel des petites exploitations agricoles. Leur force, leur adaptabilité et leur importance culturelle en font des atouts précieux dans de nombreux systèmes agricoles du pays. Une attention particulière, notamment une législation sur le bien-être des animaux de trait et des programmes systématiques d'élevage exclusivement destinés à la traction animale, contribuera à promouvoir davantage la traction animale. Les avantages qu'ils apportent en matière de durabilité, en permettant d'économiser les combustibles fossiles et de promouvoir la biodiversité, peuvent en faire des atouts précieux dans les systèmes agricoles de tous les pays.

Kurzfassung

Zugrinder bieten Landwirten eine effiziente, kostengünstige und nachhaltige Möglichkeit, verschiedene landwirtschaftliche Aufgaben zu erledigen. In vielen ländlichen Gebieten ist die Zugkraft von Tieren nach wie vor Bedeutung und spielt eine wichtige Rolle bei der Unterstützung landwirtschaftlicher Aktivitäten, insbesondere für Kleinbauern. Die Fragmentierung von Land über Generationen hinweg ist ein fortlaufender Prozess und fördert nicht den Einsatz von Traktoren oder kleineren Maschinen oder sogar Bodenfräsen. Daher wird die Zugkraft von Tieren in der bestehenden Situation kleiner Landbesitze weiterhin relevant sein. Ihre Stärke, Anpassungsfähigkeit und kulturelle Bedeutung machen sie zu wertvollen Ressourcen in vielen landwirtschaftlichen Systemen des Landes. Besondere Aufmerksamkeit, einschließlich Gesetzen zum Wohlergehen von Zugtieren und systematischen Tierzuchtprogrammen ausschließlich für Zugzwecke, wird dazu beitragen, die Zugkraft von Tieren weiter zu fördern. Die Vorteile, die sie für die Nachhaltigkeit durch die Einsparung fossiler Brennstoffe und die Förderung der biologischen Vielfalt mit sich bringen, können sie zu wertvollen Ressourcen in den landwirtschaftlichen Systemen jedes Landes machen.

Resumen

El ganado de tiro ofrece a los agricultores una posibilidad eficaz, económica y sostenible de realizar diversas tareas agrícolas. En muchas zonas rurales, la tracción animal sigue siendo relevante y desempeña un papel fundamental en el apoyo a las actividades agrícolas, especialmente para los pequeños agricultores. La fragmentación de la tierra a lo largo de generaciones es un proceso continuo y no fomenta el uso de tractores o máquinas pequeñas, ni siquiera de escarificadores giratorios. Por lo tanto, la fuerza de tracción animal seguirá siendo relevante en la situación actual de pequeñas propiedades agrícolas. Su fuerza, adaptabilidad e importancia cultural los convierten en recursos valiosos en muchos sistemas agrícolas del país. Una atención especial, incluyendo leyes sobre el bienestar del ganado de tiro y programas sistemáticos de cría de animales exclusivamente para fines de tiro, contribuirá a promover aún más la fuerza de tracción animal. Las ventajas que aportan a la sostenibilidad al ahorrar combustibles fósiles y al fomento de la biodiversidad pueden convertirlos en recursos valiosos en los sistemas agrícolas de cualquier país.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 082-087. DOI: https://doi.org/10.11588/propylaeum.1713.c25094

Fig. 1 *Bullocks in Telangana state (Picture: D. K. Sadana).*

Introduction

Since ages, bullocks have been an integral part of Indian agriculture. Even though there has been a huge reduction in the number of draft animals in the country, yet hilly and tribal areas, small and marginal farmers, and fragmented fields continue to benefit from and hence support the survival and continuity of bullocks. Larger attention to mechanized farming (in view of the need for voluminous food) and a general neglect of bullock system even in the areas where these seemed competitive has led to drastic reduction in their numbers. A spurt in attention to natural and ecological farming in recent years, has augured renewed efforts to revisiting the bullock based systems. Some efforts made in this regard have highlighted the challenges confronted in search for avenues to promote their use. This article is an attempt to revisit the challenges faced and, in the process, possibly find a path or 'a road ahead'. This has an assured global relevance in view of the imminent climate change.

Draft Animal Power (DAP) in India

At the turn of the century – just a quarter century ago – Draft Animals were the main source of power for agricultural activities in more than half of India's farm land. DAP has remained the source of energy for ploughing and other agricultural operations as well as for haulage. Draft animals covered 60 percent of total cultivable area (around one hundred million hectares) for agricultural operations and also saved around 6 million ton of diesel by the transportation of 25,000 million ton Km of freight per year[1]. Rising human population in the recent decades and the concomitant steady increase in cropped area also increased the demand for farm-power. It has been noted that during the Eighties and Nineties there was around 21% increase in gross cropped area in the country[2]. Around the same time tractors and other forms of mechanical power started becoming available to meet the gap (of required farm power) and also to provide speed to operations like tillage and irrigation. Mechanical systems (mainly tractors) made inroads especially in the vast expanses of plain regions like Punjab, Haryana and Uttar Pradesh.

As a consequence, bullocks started reducing in numbers. Reduction was, however, slow in the regions like hilly, rainfed and non-irrigated areas that, to a good extent, continued the use of bulls and bullocks. One important reason why the bullocks find a continuity is: large number of relatively small size of land holdings by individual families. As also confirmed recently, small and marginal holdings (below two hectares) constituted 86% of the total land holdings covering half the total cultivable land in the country[3]. Earlier, Phaniraja and Panchasara had reported that more than 55% of the total cultivated area in the country was still managed by using draft animals as against about 20% by tractors[4].

1 Phaniraja/ Panchasara 2009.
2 Anon 1993.
3 Anon 2019.
4 Phaniraja / Panchasara 2009.

This trend has marginally changed in the recent years. Despite the advent of mechanization, however, DAP is relevant even today at least in half of the country. Bullocks, in small or large numbers, are available and continue to serve in all the different states. Also, the other working livestock (buffalo, camel, equine, mule, donkey, yak and mithun) are each regionally important based on the local ecosystem and make valuable contributions to agriculture and transportation.

In hilly and drier regions, tractors and tillers are uneconomic; being expensive for small farmers. In a study on economic utilization of tractor per annum, it was shown that the break-even point for owning a tractor is more than 400 hours[5]. Only the large farmers can manage this much usage in a year. Small/medium farmers, if they do not own at least one bullock, find it more convenient to hire a tractor on hourly basis.

Bullock-driven Agriculture

Farmers harness strength of bullocks to carry out labour-intensive work without relying solely on human effort. Bullocks are highly adaptable and can work in muddy, marshy or uneven fields, steep slopes, small terraced farms, and narrow pathways where machinery may have difficulty operating. Their maintenance costs are lower than that of modern machinery, making them a practical choice for resource-limited agricultural communities. As the bullocks are highly adaptable, there are situations where small farmers were able to undertake timely operations in the face of climatic uncertainties like drought or excessive rainfall. Hence, the bullock owners, to a good extent, were able to manage labour for farm operations.

Fig. 2 *Bullocks used for cultivation in the state of Maharashtra (Picture: D. K. Sadana).*

Fig. 3 *Bullock use for taking out oil from coconut or from nuts in Andhra Pradesh (Picture: D. K. Sadana).*

Bullocks are often more affordable as compared to machinery and can be purchased or bred on the farm. Additionally, bullocks can graze on common pastures and consume agricultural byproducts available at relatively lower cost or produced at the farm itself. Even when the bullocks are working in the fields, they help improve soil by softly breaking up compacted soil and raising aeration for better root-penetration. They also incorporate organic matter into the soil improving its fertility and structure. Unlike the tractors, they minimize soil compaction and promote better crop yields. Especially useful in drier regions - the lesser soil manipulation by the use of bullocks significantly saves soil moisture.

Bullocks are an integral part of natural and ecological farming. Use of bullocks eases transition to biodiverse multi-crop mixed natural farming systems. Farm activities like land preparation and weeding are more effectively achieved by using bullocks than by using machinery. Thereby, the use of bullocks makes farming practices more environment-friendly. Bullocks offer renewable energy and a sustainable alternative to heavy machinery, significantly reducing the carbon footprint of agriculture. Moreover, unlike the fossil-fuel consuming tractors and machinery, bullocks do not emit harmful greenhouse gases and do not contribute to environmental pollution. The reduced reliance on fossil fuels aligns with eco-friendly practices. Bullock-driven farming also contributes to the preservation of diverse ecosystems. Akila and Chander (2009) opined that draft bullocks are better than tractors for small and marginal farmers when the farmers can meet out the feed cost by their own sources or grazing in common lands and the number of work days are improved[6].

At many places across the country, bullocks are an integral part of the local systems, holding cultural significance in many societies, representing agricultural heritage and local traditions. Their use in farming practices helps preserve local customs, socialising and maintaining the traditional knowledge associated with agriculture. Their presence preserves cultural identity and fosters a sense of community pride. At the same time, the minimized use of machinery helps protect wildlife habitats, ensuring a balanced coexistence between agriculture and nature.

5 Shambhu / Chaudhary 2012.

6 Akila / Chander 2009.

A. Draft Cattle Breeds (major state where present)

01. **Amritmahal (Karnataka)**
02. Bachaur (Bihar)
03. Bargur (Tamil Nadu)
04. Dagri (Gujarat)
05. Hallikar (Karnataka)
06. Himachali Pahari (Himachal Pradesh)
07. **Kangayam (Tamil Nadu)**
08. Kenkatha (Uttar Pradesh)
09. Khariar (Odisha)
10. Kherigarh (Uttar Pradesh)
11. **Khillar (Maharashtra)**
12. Konkan Kapila (Goa and Maharashtra)
13. Kosali (Chhattisgarh)
14. Ladakhi (Ladakh)
15. Motu (Odisha)
16. **Nagori (Rajasthan)**
17. **Nimari (Madhya Pradesh)**
18. Poda Thurpu (Telangana)
19. Ponwar (Uttar Pradesh)
20. Pulikulam (Tamil Nadu)
21. Siri (Sikkim and West Bengal)
22. **Umblachery (Tamil Nadu)**

B. Dual-purpose Cattle Breeds (Draft as well as Milk)

23. Badri (Uttrakhand)
24. Belahi (Haryana)
25. Binjharpuri (Odisha)
26. Dangi (Gujarat)
27. Deoni (Maharashtra)
28. Gangatiri (Uttar Pradesh)
29. Gaolao (Maharashtra)
30. Ghumusari (Odisha)
31. **Hariana (Haryana)**
32. **Kankrej (Gujarat)**
33. Kathani (Maharashtra)
34. Krishna Valley (Karnatak)
35. Ladakhi (Ladakh)
36. Lakhimi (Assam)
37. Malnad Gidda (Karnataka)
38. Malvi (Madhya Pradesh)
39. Masilum (Meghalaya)
40. Mewati (Uttar Pradesh and Rajasthan)
41. Nari (Rajasthan)
42. Ongole (Andhra Pradesh)
43. Punganur (Andhra Pradesh)
44. Purnea (Bihar)
45. Red Kandhari (Maharashtra)
46. Sanchori (Rajasthan)
47. Shwet Kapila (Goa)
48. Tharparkar (Rajasthan)
49. Thutho (Nagaland)
50. Vechur (Kerala)

Tab. 1 *Draft cattle breeds, and breeds maintained for dual purpose.*

Livestock providing DAP

Amongst all the livestock species, bullocks are the major contributor to Draft Animal Power. Thus far there are 53 registered cattle breeds in the country. Of these 22 breeds are considered as 'Draft type' (See Tab 1: *Draft cattle breeds, and breeds maintained for dual purpose*). The draft breeds are well spread out in different parts of the country and continue to provide farm-power effectively in their respective regions. In the year 2010, research organizations in India (notably the ICAR-NBAGR, National Bureau of Animal Genetic Resources located at Karnal-132001) had undertaken to locate, identify and document new livestock breeds for registration in the national gazetteer. Interestingly, the recently identified breeds of cattle (numbering 23) are all of draft type. Milk breeds were documented long ago, but draftability as a capacity (or as a trait in selection programs) has not been given due consideration. At least half of the 22 draft breeds in the country are highly reputed for their draftability. The list starts with *Nagori* breed of Rajasthan valued for its strength and endurance in the arid and semi-arid landscape and often marked as the best draft breed in the country. Some more breeds in elite draftability list are: *Amritmahal*, *Kangayam*, *Khillar*, *Nimari* and *Umblachery*. Moreover, *Hariana* and *Kankrej* – both dual-purpose (draft and milk) breeds - have excellent draft qualities. All the draft breeds are well adapted to their respective regions and positively contribute to field operations/transportation.

Farm Implements using DAP

The traditional implements are based on long experience and these have broadly served the purpose of the farmers. Carts, in general, are of traditional type with a large wooden wheel fitted with an iron rim. Axle and bearings are loose, as a result of which energy is wasted and efficiency is low. Efforts have been made in designing new implements based on animal-machine-environment interaction and showing higher efficiency in farm conditions. Only a few of these new implements have been accepted under the field conditions. Slow penetration of the newly developed implements together with the easy availability of the non-DAP mechanized systems has led to closure of such research projects.

Meeting inadequacies in DAP

In respect of welfare of DAP animals, there are situations where the draft animals face insensitive treatment like 'no rest during long hours of work', 'spikes' that cause pain, nose ropes, injury on the body part that is constantly hitting the yoke etc. During their working life the animals are subject to such inadequacies which could be prevented by humane care and adopting simple measures. Basic provisions need be provided - like appropriate well-fitting equipment for lower fatigue and preventing injury while working, prevention of overstraining, appropriate and sufficient feed to ensure health and energy for work, general and ethnoveterinary health care, allowing working ani-

mals to rest from work at regular intervals and allowing them the freedom to satisfy their natural instincts. Special attention must be given in case of injuries and sickness or forcing the animals to work in adverse ambient conditions. In general, adoption of painless methods for nose-roping, shoeing, branding, dehorning etc. are expected and need to be promoted. There are state laws to prevent any misuse and abuse of draft animals. Trainings and awareness can help observance of the laws. Some organizations like Animal Welfare of India and '*Animal Rahat*' highlight and attend to such issues[7].

Challenges in promoting DAP

While the benefits of bullock-driven agriculture are undeniable, there are challenges that come with maintaining this practice in the modern world. Widespread use of the bullocks might struggle to meet the demands of large-scale commercial agriculture due to their slower pace and limited capacity compared to modern machinery. At the field level, the other important challenge is: to be able to utilize the bullocks for a longer duration than just 2-3 months in a year. It is a common observation that the cropping season in India usually lasts for only around 60-70 days in a year – around 30 days in winter cropping (*Rabi* season) and bit longer during summer cropping (*Kharif*). Even though bullocks perform varied tasks and several field operations (viz. tillage, seedbed preparation, harrowing, ploughing, sowing, weeding, harvesting, threshing, winnowing, post-harvest operations as well as occasional but wider use in transportation, lifting of water, collection of oil from seeds etc.), keeping them idle for three fourth of a year doesn't make economic sense.

Working with bullocks demands a certain level of expertise and training. It is a challenge to keep the DAP system alive and relevant for the farmers who are also the keepers of traditional knowledge. Farmers/users must possess a deep understanding of animal behaviour and handling techniques. The traditional system of this knowledge passing from generation to generation is now weakening.

Furthermore, the newly developed implements in the organizational setup face the challenge of their acceptance at the farmer's level. How to further improve the DAP implements and involve media in raising awareness on imminent climatic problems are the other issues.

Opportunities for promoting DAP

Experiments have shown that selection of improved implements coupled with efficient harnessing systems is most likely to enhance the power output. The use of an improved yoke has made it possible to achieve 16–30% increase in draught capacity under sustained loading and 20–30% increase in field capacity of implements, resulting in an increase in command area of draught animals, compared to traditional yokes[8].

In view of the low annual utilization of the bullocks for farming, alternate use can be enhanced e.g. agro-processing (and allied tasks) during idle periods by using rotary mode operations. This would require more efficient rotary gear systems for operating the DAP machines. Bullocks have been demonstrated to run on treadmill-like machines and generate electricity[9]. Based on the pattern of hiring a tractor on hourly payment basis for field operations, WASSAN (an NGO cited above) has established resource centers for bullock-driven implements in some villages in Andhra Pradesh. Farmers in the villages and around can enquire and hire implements for use. With general availability of mobiles in the villages now (using the well-established digitization in the country) this concept (being termed as 'uberization') can be promoted into mobile based application for wider use of DAP implements from resource centers at present and possibly for the use of bullocks in future.

Hitherto, the state level subsidies for purchase of tractors, and the excessive promotion of 'tractors for farming' has generally disregarded 'bullocks for farming'. Wherever feasible and more efficient, utilization of bullocks must receive acceptance and also support in media which has ignored the environmental benefits of using bullocks and the pollution caused by tractors consuming fossil fuels. Some breed societies and self-help-groups are promoting bullock driven farming and instituted one state-level award (in 2021) for keepers of indigenous breeds of cattle and bullocks in Himachal Pradesh. Further support to this approach is expected to yield better results. Some efforts in developing new and innovative equipment for DAP have been initiated by civil society organisations like WASSAN[10] and Manav Vikas Sansthan[11].

The integration of bullocks into modern farming practices showcases the harmony between tradition and innovation. Slowly, farmers are combining the strength and precision of bullocks with advanced technologies. This fusion marries the wisdom of generations with the possibilities of the future, creating a dynamic sustainable farming landscape.

Conclusions

Overall, bullocks provide farmers with efficient, cost-effective, and sustainable means of performing various agricultural tasks. In many rural areas, DAP continues to be relevant and plays a vital role in supporting agricultural activities, particularly for small-scale farmers. Fragmentation of land over generations is a continuing process and it does not spur the use of tractors or minor machines, or even tillers. Hence, DAP will continue to be relevant in the existing situation of small land holdings. Their strength, adaptability, and cultural importance make them valuable assets in many farming systems in the country. Specialized attention including legislation for welfare of draft animals and systematic animal breeding programmes exclusively for draft purpose will further help promote DAP. The benefits they bring to sustainability by saving the fossil fuels, and promoting biodiversity can make them valuable assets in agricultural systems of any country.

7 Animal Rahat 2023.
8 Netam/Jaiswal 2018.
9 The Indian Express 2022.
10 https://wassan.org (last accessed 06-10-25).
11 https://www.rainfedindia.org (last accessed 06-10-25).

Bibliography

Akila/Chander 2009 N. Akila/M. Chander, Tractors Vs Bullocks. *Livestock International* 2, 2009, 21–22.

Animal Rahat 2023 Animal Rahat. URL: https://www.animalrahat.com/the-animals-we-help/bullocks/ [Date of website access, 18.09.2025).

Anon 1993 Anonymous, Report of the Technical Committee of Direction for Improvement of Animal Husbandry and Dairying Statistics. Department of Animal Husbandry & Dairying, Ministry of Agriculture, Government of India (1993).

Anon 2019 Anonymous, All India Report on Number and Area of Operational Holdings. Agriculture Census Division Department of Agriculture, Co-operation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India (2019).

Netam/Jaiswal 2018 A. Netam/P. Jaiswal, Role of animal power in the field of agriculture. Int. J. of Avian and Wildlife Biology 3, 1, 2018, 62–63.

Phaniraja/Panchasara 2009 K. L. Phaniraja/H. H. Panchasara, Indian Draft Animals Power. A Review. Veterinary World 2, 10, 2009, 404–407.

Schambhu/Chaudhary 2012 V. B. Shambhu/S. K. Chaudhary, Utilization Pattern of Tractors in Nalanda District of Bihar. A Case Study. Agricultural Mechanization in Asia, Africa & Latin America 43, 1, 2012, 9–13.

The Indian Express 2022 The Indian Express. URL: https://indianexpress.com/article/trending/trending-in-india/bullocks-run-on-treadmill-like-machines-and-generate-energy-8170393/ [18.09.2025].

Author info
D. K. Sadana
Indigenous Livestock Society-India & Former Principal Scientist
ICAR-NBAGR, Karnal
E-Mail: sadana.dk@gmail.com

Author info
Maharani Din
Former Project Coordinator (UAE) ICAR-CIAE, Bhopal & Member WGoL (RRA Network)
E-Mail: mdinicar@gmail.com

Author info
Sabyasachi Das
National Coordinator, RRA_N & Director WASSAN, Hyderabad
E-Mail: sabyasachidasindia@gmail.com

Author info
Malyaj Shrivastava / Tatsama Motilal
Revitalizing Rainfed Agriculture Network, Hyderabad
E-Mail: malyaj@wassan.org ; tatsama.m27@gmail.com

Animal traction in an agroecological approach to the mechanisation of smallholder farming systems

Tim Harrigan

Abstract

Agroecology highlights biodiversity and mimicking natural processes to build resilient agricultural systems. Mechanisation can enhance biodiversity and lessen environmental impact when aligned with agroecological principles. In the context of draft animal power, the preference is for small-scale, low-impact machinery that supports regenerative practices. Draft animals offer a cost-effective, environmentally friendly alternative to mechanised power units for small-scale farmers, enhancing soil health through nutrient cycling of organic inputs. Advocacy and education are vital to fostering a positive perception of working animals and the benefits of draft animal use. Livestock creates a closed-loop system, where manure and compost enrich the soil, feed the plants, and support soil biota. Natural systems favour biological diversity. Incorporating draft animals into farming systems combines traditional knowledge with scientific and modern practices, contributing to sustainable and resilient agriculture. Modern draft power should utilise its mechanical advantage to generate a biological advantage for the crop. New machinery will manage the complexity and diversity of planting and harvesting multiple crops within the same space. With these capabilities, agricultural machinery aligns with agroecological principles, supporting polycropping systems while enhancing soil health.

Kurzfassung

Die Agrarökologie legt den Schwerpunkt auf Biodiversität und die Nachahmung natürlicher Prozesse, um widerstandsfähige Agrarsysteme aufzubauen. Mechanisierung kann die Biodiversität fördern und die Umweltbelastung verringern, wenn sie mit agrarökologischen Prinzipien in Einklang gebracht wird. Im Zusammenhang mit Zugtieren werden kleine, umweltschonende Maschinen bevorzugt, die regenerative Praktiken unterstützen. Zugtiere bieten Kleinbauern eine kostengünstige und umweltfreundliche Alternative zu mechanisierten Antrieben und verbessern die Bodengesundheit durch den Nährstoffkreislauf organischer Stoffe. Aufklärung und Bildung sind entscheidend, um eine positive Wahrnehmung von Arbeitstieren und den Vorteilen des Einsatzes von Zugtieren zu fördern. Vieh schafft ein geschlossenes System, in dem Gülle und Kompost den Boden anreichern, die Pflanzen ernähren und die Bodenbiota unterstützen. Natürliche Systeme begünstigen die biologische Vielfalt. Die Einbindung von Zugtieren in landwirtschaftliche Systeme verbindet traditionelles Wissen mit wissenschaftlichen und modernen Praktiken und trägt so zu einer nachhaltigen und widerstandsfähigen Landwirtschaft bei. Moderne Zugkraft sollte ihren mechanischen Vorteil nutzen, um einen biologischen Vorteil für die Pflanzen zu erzielen. Neue Maschinen werden die Komplexität und Vielfalt des Anbaus und der Ernte mehrerer Kulturen auf derselben Fläche bewältigen. Mit diesen Fähigkeiten stehen landwirtschaftliche Maschinen im Einklang mit agroökologischen Prinzipien, unterstützen Mischkultursysteme und verbessern gleichzeitig die Bodengesundheit.

Résumé

L'agroécologie met l'accent sur la biodiversité et l'imitation des processus naturels afin de mettre en place des systèmes agricoles résilients. La mécanisation peut améliorer la biodiversité et réduire l'impact environnemental lorsqu'elle est alignée sur les principes agroécologiques. Dans le contexte de la traction animale, la préférence va aux machines à petite échelle et à faible impact qui favorisent les pratiques régénératrices. Les animaux de trait offrent une alternative rentable et respectueuse de l'environnement aux unités motrices mécanisées pour les petits agriculteurs, améliorant la santé des sols grâce au cycle nutritif des matières organiques. La sensibilisation et l'éducation sont essentielles pour favoriser une perception positive des animaux de trait et des avantages de leur utilisation. Le bétail crée un système en boucle fermée, dans lequel le fumier et le compost enrichissent le sol, nourrissent les plantes et favorisent les biotes du sol. Les systèmes naturels favorisent la diversité biologique. L'intégration des animaux de trait dans les systèmes agricoles combine les connaissances traditionnelles avec les pratiques scientifiques modernes, contribuant ainsi à une agriculture durable et résiliente. La traction moderne devrait utiliser son avantage mécanique pour générer un avantage biologique pour les cultures. De nouvelles machines permettront de gérer la complexité et la diversité de la plantation et de la récolte de plusieurs cultures dans un même espace. Grâce à ces capacités, les machines agricoles s'alignent sur les principes agroécologiques, soutenant les systèmes de polyculture tout en améliorant la santé des sols.

Resumen

La agroecología se centra en la biodiversidad y en imitar los procesos naturales para crear sistemas agrícolas resilientes. La mecanización puede mejorar la biodiversidad y reducir la contaminación del medio ambiente cuando se ajusta a los principios agroecológicos. En el contexto de la tracción animal, se prefiere la maquinaria a pequeña escala y inofensiva para el medio ambiente que favorece las prácticas regenerativas. El ganado de tiro ofrece una alternativa rentable y respetuosa con el medio ambiente a las unidades de tracción mecanizadas para los pequeños agricultores, ya que mejoran la salud del terreno mediante el ciclo de nutrientes de los insumos orgánicos. La promoción y la educación son fundamentales para fomentar una percepción positiva del ganado de tiro y los beneficios de su uso. El ganado crea un sistema de ciclo cerrado, en el que el estiércol y el compost enriquecen el terreno, alimentan las plantas y favorecen la biota del terreno. Los sistemas naturales favorecen la diversidad biológica. La incorporación del ganado de tiro en los sistemas agrícolas combina los conocimientos tradicionales con las prácticas científicas y modernas, contribuyendo así a una agricultura sostenible y resiliente. La tracción moderna debería aprovechar su ventaja mecánica para obtener una ventaja biológica para las plantas. La nueva maquinaria superará la complejidad y la diversidad del cultivo y la cosecha de múltiples cultivos en la misma superficie. Con estas capacidades, la maquinaria agrícola se alinea con los principios agroecológicos, apoyando los sistemas de policultivo y al mismo tiempo mejorando la salud del terreno.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 088-095. DOI: https://doi.org/10.11588/propylaeum.1713.c25095

Agroecological approach to mechanisation and the role of draft animals in farming systems

Agroecology emphasises biodiversity and mimicking natural processes to develop resilient agricultural systems. Agroecological approaches are viewed as production systems rather than merely technologies. Diverse ecosystems are more resilient to environmental changes, improving agriculture's ability to adapt to climate change and other challenges. Mimicking natural processes and promoting biodiversity helps these systems respond to disturbances and naturally control pests. Refer to Wenzel et al. and HLPE for an extensive review of agroecological practices for sustainable agriculture, such as crop rotations, intercropping, relay cropping, and tillage management[1].

An editorial published in Nature[2] cites the international research consortium Ceres2030[3], reporting that out of approximately 570 million farms worldwide, more than 475 million are smaller than two hectares. Animal power is a crucial component of many small farms. In an agroecological approach, animal power is evaluated within social, cultural, and economic contexts. Modern draft animal power considers environmental and ecological factors, combining local knowledge with science and modern practices, and fostering resilient and sustainable farming systems. In practice, draft animal power often complements traditional knowledge and practices. Preserving and applying this knowledge can enhance ecological benefits. Crop yields in response to inorganic and commercial fertilisers are diminishing, and research has shown substantial yield benefits when combining inorganic fertilisers with organic nutrient sources. Livestock creates a closed-loop system where manure and compost enrich the soil, feed the plants, and support soil biota. Their manure is a natural fertiliser and source of organic matter, cycling crop nutrients, building soil health, and reducing reliance on commercial fertilisers.

Healthy, productive soil forms the basis of a successful farming system. The moderate hoof action of livestock can stimulate plant growth by gently stressing the plants, prompting them to regenerate and grow more vigorously, which results in increased root biomass. As animals move across a field, they deposit manure rich in organic matter and nutrients while trampling grass, leaves, and other plant materials. Animal hoof action helps build up soil organic matter through processes like incorporating plant material, compost, and manure, which stimulates soil biology, improves soil aeration, promotes root growth, enhances soil aggregation, creates microhabitats for microorganisms, and encourages a diverse plant community. However, excessive and prolonged hoof traffic can compact the soil and harm its physical properties.

Draft animals can be a cost-effective alternative to wheeled vehicles for small-scale farmers[4]. Several features of agricultural machinery are custom-built for draft animals, ensuring that the equipment is efficient, safe, and suitable for use with horses, oxen, donkeys, or mules. These features balance the animals' capabilities and welfare with the efficiency and functionality required by those operating them. The hitching system, including yokes, collars, and harnesses, is designed to be comfortable and safe, distribute the load evenly, absorb shocks, and minimise the risk of injury or discomfort.

Over-cultivation and over-grazing degrade soils. Restoring and enhancing soil fertility is a concern widely shared by smallholder farmers. Crop yield responses to inorganic and commercial fertilisers are diminishing, and research has demonstrated substantial yield benefits when combining inorganic fertilisers with organic nutrient sources such as manure and compost. Mixed crop and livestock systems support soil health and build biological soil fertility. Integrating crop and livestock systems offers an opportunity to improve soil health and promote sustainable intensification. Livestock-based cropping systems enhance soil fertility and crop yield by cycling nutrients from manure, compost, and cover crops.

Our approach is agroecological - a production system, not a simple tillage or planting technology. Machines are part of a broader system where ecological and social benefits are valued and sought after. Designing agricultural machines to promote polycropping and soil health involves creating equipment capable of managing the complexity and diversity of planting, crop care, and harvesting multiple crops in the same area. Machines should be compatible with low-disturbance tillage and crop residue cover and operate in fields with cover crops, including planting main crops without completely removing the cover crops. With these capabilities, agricultural machinery aligns with agroecological principles.

Soils and cropping system mechanisation

Mechanisation can reduce the workload of conducting farming operations profitably on small farms. Soils influence the design of appropriate-scale mechanisation and cropping system management. Understanding and managing soils is crucial for selecting suitable crops and maintaining soil quality and health.

Fundamentals of soils

You will often hear some key terms describing soils. *Soil quality* refers to the ability of the soil to carry out ecological functions and provide ecosystem services that benefit humans by providing clean air and water and sustaining soil resources. Soil quality parameters such as water infiltration rate and aggregate stability are measurable and quantifiable. Cropping and management practices can enhance or diminish soil properties such as aggregate stability, water infiltration rate, nutrient cycling, and the diversity of soil organisms.

Soil health differs from soil quality. It concerns how soil functions within an ecosystem and is difficult to measure with a single parameter. Soil health indicates biological integrity, a balance among soil organisms, resilience to recover from environmental stress, and the capacity to provide ecosystem services such as protecting water quality, maintaining soil biological fertility, nutrient cycling, soil formation, and supporting biodiversity.

1 Wenzel et al. 2014; HLPE 2019.
2 To end hunger 2020.
3 Laborde et al. 2020.
4 Harrigan 2022.

Fig. 1. *Livestock cycle crop nutrients, and the moderate hoof action of livestock can stimulate plant growth, resulting in greater root biomass (Picture: T. Harrigan).*

Soil texture refers to the relative proportions of sand, silt, and clay. It influences the choice of tillage and cropping systems. Clay soils should not be worked when wet, but they resist wind erosion. Sandy soils are prone to blowing and benefit from cover crops and conservation practices to prevent wind erosion. Some crops adapt to slow drainage and poor aeration, while others need loose, friable soils and irrigation for good yields. Coarse-textured soils have low moisture-holding capacity, and drought often limits production more than on finer-textured soils, but they are easier to work with.

A *soil aggregate* is a mass of fine soil particles glued together by clay, organic matter, and microbial and root exudates. Soil aggregation is a sign of soil quality and soil health. Naturally occurring aggregates are called peds. Soil aggregation enhances permeability and encourages root growth, soil aeration, and water infiltration. Soil aggregates resist wind and water erosion. Excessive tillage and traffic break down the aggregate structure and reduce the soil's ability to recover from external stressors such as tillage and vehicle traffic.

Soil organic matter serves as an indicator of soil quality and is a vital component of soil health. Organic matter consists of material from plants and animals that forms humus, a dark-coloured and decay-resistant residue resulting from organic matter decomposition. Soil organic matter and humus are essential for forming and stabilising soil aggregates, providing a significant source of plant nutrients, and supporting soil biological activity. They also play a crucial role in water retention, drought resistance, and soil resilience.

Annual additions of organic material are essential to increase or sustain soil organic matter in most managed cropping systems. New organic materials support soil microbes and release crop nutrients. Green manures, cover crops, livestock manure, and compost are organic inputs that can replace crop residues and soil organic matter lost to the cropping system. Plants grow easily in moist soils, and because soil aeration is poor in wet areas, decomposition is slow, leading to greater organic matter accumulation than in dry soils.

Fig. 2 *The in-line strip tiller loosened and firmed the soil in a narrow planting zone, retaining protective crop residues between the rows (Picture: Maria Jones).*

Frequently tilled, well-aerated upland soils often have conditions favourable to excessive microbial activity and organic matter oxidation (loss). Increasing or maintaining natural organic matter levels under conventional management of such soils is challenging. Crop residues act as mulch and help build soil organic matter by keeping the soil cool and moist. Mulches like straw add organic matter, suppress weeds, moderate soil temperature, reduce evaporation, retain soil moisture, and decrease soil erosion from overland flow. While crop residue may be harvested for feed, animal bedding, fuel, or burned to simplify certain cropping practices, the overall result is the loss of soil organic matter.

Continuous row cropping and moldboard plough-based tillage systems generally lead to the most significant decline in soil organic matter. Small grains are less harmful. Well-managed pasture or hay crops can increase organic matter levels. No-till and low-disturbance tillage are less disruptive than the moldboard plough and disk harrow. Strip tillage confines soil disturbance to narrow bands for seedbeds and retains protective crop residue between rows. Crop residues create a mulch or protective soil cover. The residue shields the soil from raindrop impact, slows water movement to enhance infiltration, and conserves moisture for crops by reducing surface evaporation.

Evolution of tillage implements.

Tillage involves working the soil to improve growing conditions. It can help incorporate soil amendments like lime and fertiliser, manage crop residues, relieve compaction, improve water infiltration, prepare a seedbed, and control weeds. In the U.S., early farmers mainly used hand tools. Even today, many smallholder farmers in sub-Saharan Africa prepare the soil with hand tools and hope to access draft animals for field work and transport. Globally, draft animals remain essential in reducing the labour of field work and increasing the productivity of small-scale farmers.

Many growers notice that crop yields often improve after tillage, which helps loosen the soil. Conventional (intensive) tillage practices leave less than 15% of the soil surface covered with protective crop residue after planting the next crop. The mouldboard plough is one of the most aggressive and intensive tillage implements. Some growers perform 'skim' ploughing at a depth of five to eight centimetres to minimise the negative impacts of deeper soil disturbance. Moldboard ploughing is decreasing on most US farms unless specific soil conditions favour it, although it remains widely used on small farms worldwide. Conservation tillage refers to cropping systems that retain more than 30% of surface residue cover after planting. Examples include no-tillage, mulch-tillage, and strip-tillage. Current cropping systems have evolved to focus more on soil biological health. In the U.S., the Natural Resource Conservation Service (NRCS) uses the Soil Tillage Intensity Rating (STIR factor) to classify the intensity of soil disturbance after tillage. The STIR factor considers the type of tillage tool, depth, speed, and the percentage of surface area disturbed.

Fig. 3 *Mono-cropping evolved to make planting, weeding, and harvest mechanisation more efficient. Modern machines will be compatible with poly-cropping systems such as inter- and relay-cropping (Picture: T. Harrigan).*

From a management perspective, the main goals of soil conservation include creating conditions for rapid water infiltration, reducing the volume and speed of water runoff and overland flow to decrease sediment transport, and covering the soil with protective crop residues or vegetative cover to keep it stable. Conservation tillage aligns better with agroecological objectives than intensive tillage with the mouldboard plough. The 'clean', residue-free tillage based on the mouldboard plough and disc harrow was the primary cause of wind and water erosion that devastated the American prairies in the 1930s and continues globally. Inversion tillage removes the protective vegetative barrier, destabilising the soil surface. Topsoil is the most productive and biologically active layer, containing most organic matter and vital plant nutrients. Exposed soil is vulnerable to topsoil loss. When soil erosion happens, particles can carry away nutrients, sediment, and other pollutants that contaminate lakes and streams and harm soil health.

Intensive tillage loosens and warms the soil, buries crop residues, and injects excess oxygen, accelerating the oxidation and loss of humus. Close contact between crop residues, soil microorganisms, moisture, and oxygen promotes rapid decay that quickly consumes new organic material. Conservation tillage, especially no-till, concentrates organic matter in the top few centimetres of the soil. This improves moisture infiltration, reduces crusting and erosion, and makes nutrients available where roots are most abundant. Purposeful, sustainable systems such as organic and biodynamic farming focus on extensive livestock management, crop rotations, and biological nitrogen fixation to build organic matter and improve soil health[5]. Sustainable cropping practices minimise soil disturbance, maintain a protective vegetative or residue cover on the soil surface, and add organic inputs from manure, compost, and cover crops.

Mechanisation can enhance or detract from an agroecological approach, depending on how it is implemented and managed. Incorporating ecological principles into machinery design and management aligns mechanisation with agroecological objectives. Mechanisation should support regenerative practices; small-scale, low-impact equipment is often most suitable. Well-designed machines minimise their environmental footprint by reducing soil disturbance, promoting biodiversity, and mitigating negative impacts. Collaborating with draft animal practitioners can inspire innovation in machinery design and ensure the machines align with agroecological principles.

Fig. 4 *Strip-till planting zones minimise soil disturbance and are compatible with agroecological principles (Picture: T. Harrigan).*

Mono-cropping evolved to make planting, weeding, and harvesting more efficient. Mechanisation often conflicts with poly-cropping systems, such as inter- and relay-cropping, which recognise the inherently biological nature of agriculture. There is a need to develop machines capable of managing the complexity and diversity of planting and harvesting multiple crops in the same area. Additionally, there is a need for machinery that is appropriately sized and suited for work in fields with cover crops, including the ability to plant main crops without completely uprooting the cover crops. With these capabilities, agricultural machinery aligns with agroecological principles, supporting polycropping systems while enhancing soil health.

5 Stockdale/Cookson 2003.

Mechanisation technologies

The agroecological approach we adopted in West Africa enhanced sustainability and addressed environmental, financial, social, and cultural dimensions. This method can be applied to any region using animal traction. Animal-powered, appropriate-scale mechanisation was crucial in increasing agricultural productivity, boosting farm and household incomes, and reducing the physical labour demanded of women and children. The process involved linking science and engineering with local social and cultural knowledge.

The functional component of draft animal power is the tool or implement. Tools and implements are mechanical systems. There is a need to utilise the mechanical advantage of machines to promote soil health and create a biological benefit for the crop. An agroecological approach values low-disturbance tillage, protective crop residue, organic inputs, biological diversity, and active root systems. Introducing new machines often leads to redesigning the farming system, requiring changes in subsequent operations, such as using the sweep cultivator for full-width weed control and soil loosening instead of a mouldboard plough. The timing of field operations may also need to change. For instance, earlier weed control and timing the first field operations to synchronise with rain events when the soil is soft and friable whereas the traditional practice was to schedule hand-weeding at 21-day intervals. Our work achieved the best results with the animal-drawn sweep weeder aligned with the biological intervals of weed emergence and growth. Numerous ripple effects occur when initiating changes in cropping and farming systems, necessitating adaptations, which are often required during the redesign process.

Cropping system: in-line ripper, low-disturbance planter, sweep cultivator.

In sub-Saharan Africa, the soils are highly weathered and have low natural fertility. Small-scale farming and low farm incomes predominate. The moldboard plough is the primary tillage tool. We adopted a pragmatic approach to improve the lives of poor, smallholder farmers. Animal traction suits local conditions well. Our innovations, such as affordable planters and strip-tillage rippers, have increased crop yields and saved time, especially for women. This approach aligns with the local physical, social, and economic realities, prioritises affordability, builds local capacity for machine innovation, manufacturing, and repair, and empowers farmers with adaptable options within their means.

Our main aim was to decrease intensive tillage and start restoring soil health and natural soil productivity. We combined local knowledge and experience with equipment design to support integrated practices, such as low-disturbance tillage with in-line rippers for strip tillage, shallow sweep tillage for seedbed preparation, and weed control. We redesigned planters for low-disturbance tillage and residue management. We trained local artisans to build and repair machines, source materials locally, craft specialised seed plates, and design furrow openers and closers for low-disturbance strip tillage. This approach benefits smallholder farmers by conserving soil moisture, reducing tillage intensity, saving time and labour, and maintaining crop residue cover on the soil surface.

Fig. 5 *Local artisans built a furrow opener for residue-clearing and consistent seed depth, and furrow closers and press wheels adapted for low-disturbance, soil-stabilising in-line strip tillage (Picture: T. Harrigan).*

Working with local farmers, we redesigned the local farming system by introducing an innovative in-line ripper for strip tillage to replace the moldboard plough. A key improvement was a rolling basket behind the ripping shank to break up soil clods and level the seedbed within the narrow, tilled zone. The ripper tills a narrow band of soil about 20 cm wide and 15 cm deep, retaining protective crop residues between the rows and capturing water as the rainy season begins. In fields with minimal weed pressure, this innovation reduced cost compared to a moldboard plough by replacing the solid steel main beam with an open web truss design fabricated from locally available materials.

The draft, or pulling force required of the draft animals, decreased by half compared to a plough, from an average of 93 kilograms-force (kgf) to 43 kgf for the in-line ripper. The 54% reduction in draft is significant because most draft animals lose body condition during the dry season and are in poor working condition at the start of the tillage and planting season. With the in-line ripper, they can cover the same ground with less effort, or more ground with the same effort, enabling faster planting and weed control. The animal's physical condition and productivity improve as the rainy season brings abundant forage. The cost of the in-line ripper in 2020 was FCFA 25,000 (38€).

Low-disturbance, minimum tillage planter

Our work introduced innovations, including a planter, which significantly improved seed placement, reduced bird predation, and increased crop yield by 50-150% compared to hand planting. Recognising deficiencies in earlier planter designs, including a French-derived planter from Mali and models commonly used in Brazil, we developed a new planter suitable for the region. The planters imported from Mali were costly, intended for intensively tilled seedbeds, and poorly suited for fields with soil clods and crop residues.

Fig. 6 *Compared to hand-planting, the seeds were placed at a uniform depth and consistent spacing; seeds germinated faster and emerged uniformly (Picture: T. Harrigan).*

We trained local artisans to build a planter featuring a low-cost seed-plate drive mechanism, a furrow opener for residue-clearing and maintaining consistent seed depth, along with furrow closers and press wheels adapted for low-disturbance, soil-stabilising in-line strip tillage. An innovative furrow opener ensured precise seed placement. Small concave disc furrow closers replaced high crown sweeps, aiding crop residue flow. Among the redesigned components was a narrower press wheel optimised for the narrow tillage zone created by the in-line subsoiler.

The planter innovations greatly enhanced maize planting efficiency. The planter's mechanical advantage improved the maize crop's biological efficiency. Compared to hand planting, seeds were uniformly placed at the same depth and spacing; germination was quicker, and emergence was more uniform. Side-by-side grain yield comparisons in farmers' fields showed a significant yield benefit from machine planting over hand planting, ranging from 50% to 150%. Much of this increase was due to less seed loss to birds. Birds can easily find and steal seeds planted by hand, but cannot easily locate seeds planted by machine. The average draft of the planter was 20 kgf, which is manageable for even a single donkey, the draft animal most preferred by women farmers[6].

Mechanical weed control

Effective weed management is essential for profitable crop yields. Weeds compete with crops for water, sunlight, and nutrients, harbour pests, and can be toxic to livestock. Controlling them is burdensome for smallholder farmers as it requires considerable labour and resources. Early-season weed control is crucial; small, young weeds are easier to uproot before establishing extensive root systems.

Fig. 7 *Low-crown, low-pitch cultivator sweeps under-cut weeds and loosens the soil, reducing cultivator draft and improving weed control (Picture: T. Harrigan).*

In Africa, weed control choices depended on weed pressure, often requiring multiple cultivations. Traditionally, farmers used locally built five-shank cultivators, relying on deep and aggressive soil disturbance to uproot and bury weeds. However, this design had three significant problems: 1) clogging with crop residue, 2) high draft (pulling force), and 3) inadequate weed control due to insufficient root cutting. Our lead farmer removed two of the five shanks to address these challenges and used only three to improve crop residue flow and prevent plugging. However, the draft remained high, similar to the moldboard plough, and weed control was poor.

We addressed the challenges of high draft and poor weed control by designing a locally made, low-crown, low-pitch sweep cultivator that effectively undercuts weeds while preserving protective crop residues on the soil surface. These low-pitch sweeps covered most of the interrow area at a shallow depth of about five centimetres. They improved weed control and enhanced the cultivator's stability and ease of use for farmers. They increased the productivity and effective width of root cutting by 20%, lowering the cultivator's draft by 22%, from 93 kgf to 73 kgf, compared to the three-shank cultivator.

Fig. 8 *When soil conditions are suitable, the sweep cultivator can replace the moldboard plough, saving time and labour, and retain crop residues on the soil surface (Picture: T. Harrigan).*

6 Pousga et al. 2025; Scheidweiler 2022.

The sweep weeder alone proved effective for shallow weed control, residue retention, and creating a suitable planting bed in moist and friable soils after early-season rains. This method eliminated the need for the mouldboard plough and minimised soil disruption, reducing both time and labour to just a third of traditional ploughing. Sweep tillage aligns with our agroecological approach by maintaining low-disturbance tillage and crop residue to restore soil quality and health. These broad, flat sweeps operate at a shallow depth of 5 cm, undercutting weeds and slicing through roots just below the soil surface while causing minimal disturbance to the soil structure. Shallow sweep tillage conserves protective crop residues, decreases tillage intensity, retains soil moisture, and enhances soil health. It will be crucial for smallholder farmers to transition from the mouldboard plough and adopt an agroecological approach to improve soil health, natural soil fertility, and crop yields.

Precision mechanical weed control

Innovations in weed control technology, such as developing low-crown and low-pitch sweeps, have further optimised weed control and seedbed preparation. These updated designs enable full-row width root cutting at a shallow depth, effectively undercutting weeds while causing less soil disturbance than traditional high-crown sweeps. For seedbed preparation, sweeps create an even, friable surface by removing weeds and breaking up soil clods without inverting the soil. By retaining valuable moisture and organic matter in the topsoil layers, sweeps prepare a seedbed conducive to seed germination and root growth, aligning well with agroecological objectives.

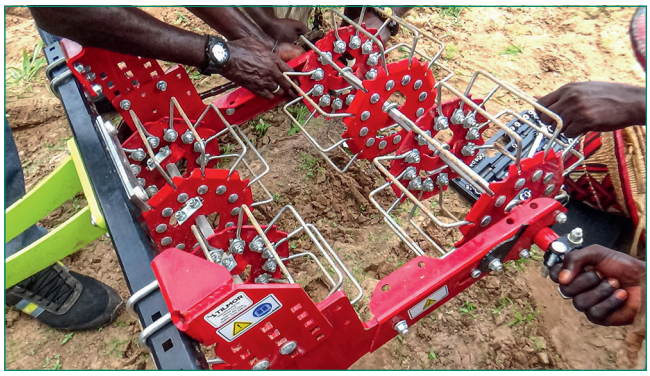


Fig. 9 *Modern weeding tools can be adapted for animal traction. This basket weeder, coupled with a finger weeder and spyders, works well within and between the rows (Picture: T. Harrigan).*

Well-designed weeding tools are essential, each suited for different crop growth and weed development stages. Modern weeding tools like flex-tine and basket weeders are effective during early weed stages, functioning best on loose soil and dry conditions. Spyders work well between and close to the row for burying small weeds within the row. Finger weeders are useful for larger, well-rooted crops, targeting plants between and within the row without harming the crop. These modern weed removal tools require precision and control to avoid damaging the growing crop. These implements can be adapted for animal draft, highlighting modern animal traction's relevance.

Integrating diverse weed management strategies, timely interventions, and innovative tools can boost weed control, increase crop yields, and lessen farmers' workloads. Precision mechanical weed control promotes sustainable agriculture by reducing chemical inputs, effectively managing weeds, and lowering tillage intensity. This approach combines new tools with a comprehensive understanding of the soil-crop-weed ecosystem. It embodies an environmentally conscious and ecologically friendly approach.

Improving the perception of draft animals

The public perception of draft animal use is an important topic worth discussing. Draft animals are often seen as outdated or inefficient in areas with access to modern machinery. However, well-trained animals can demonstrate the precision required for modern farming practices. Advocacy and education will be essential to foster a positive perception of working animals and the benefits of draft animals. Employing draft animals helps preserve traditional skills, such as horse or oxen training, harness and yoke making, and farming techniques. Working with draft animals can improve soil health, and engaging with them provides hands-on learning opportunities, especially for younger generations, to understand agriculture, history, and animal care.

Fig. 10 *Demonstrations of ploughing, planting, and harvesting can present a modern vision of draft animals, showcasing their efficiency, precision, and practicality, and their role in sustainable agriculture and soil health (Picture: T. Harrigan).*

There is an increasing recognition of the disconnect between humans and the natural environment. Hands-on experiences reconnecting people with nature are in high demand and highly valued. Working with draft animals offers a direct link to nature and the land. Engaging with draft animals provides a holistic learning experience, emphasising emotional intelligence and practical skills.

Refocusing public perception of working with draft animals to value their positive benefits will require education and awareness, while emphasising their practical, environmental, and cultural advantages. Demonstrations of ploughing, planting, and harvesting with draft animals can showcase their efficiency, precision, and practicality, highlighting their role in sustainable farming and promoting soil health, which will resonate with environmentally conscious audiences.

Conclusions

Agroecology emphasises biodiversity and mimicking natural processes to develop resilient agricultural systems. Mono-cropping evolved to make planting, weeding, and harvesting more efficient. Mechanisation often conflicts with poly-cropping systems, such as inter- and relay-cropping, which acknowledge the inherently biological nature of agriculture. Tillage and planting methods have evolved from intensive soil disturbance with no protective surface crop residue to conservation tillage and residue management, to a focus on soil biological health with minimal soil disturbance, extended rotations with living cover crops and active root systems, plant and soil biodiversity, and natural soil fertility. Designing agricultural machinery to support polycropping and soil health involves creating equipment capable of managing the complexity and diversity of planting, crop care, and harvesting multiple crops in the same area. Machinery should be compatible with low-disturbance tillage and crop residue cover and operate in fields with cover crops, including planting main crops without entirely removing the cover crops. Draft animals provide a cost-effective, environmentally friendly alternative to mechanised power units for small-scale farmers, promoting soil health through nutrient cycling of organic inputs. Working with draft animals can enhance soil health, and engaging with them offers practical learning opportunities—especially for younger generations—to gain knowledge about agriculture, history, and animal care.

Acknowledgements: I warmly thank Robert Burdick and colleagues at Tillers International for their collaboration in developing appropriate-scale mechanisation in Burkina Faso, Uganda, and Senegal. Their knowledge, skills, and abilities are remarkable. Additionally, I wish to recognise Grammarly's assistance in reviewing and refining this article's grammar, word usage, and clarity.

Bibliography

Harrigan 2022 T. M. Harrigan, Refining Animal Traction. Linking Physical and Social Processes. In: Staatliche Schlösser und Gärten Hessen (ed.), Draft Animals in the Past, Present, and Future (Lorsch 2022) 197–210.

HLPE 2019 HLPE, Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (Rome 2019).

Laborde et. al. 2020 D. Laborde/J. Porciello/C. Smaller, Ceres2030. Sustainable Solutions to End Hunger (2020).

Nelson 2020 R. Nelson, Viewpoint: International agriculture's needed shift from energy intensification to agroecological intensification. Food Policy 91, issue (C), 2020.

NRCS 2019 NRCS, Reduced tillage to increase soil health and soil organic matter content. Conservation Enhancement Activity E345D. USDA-NRCS (2019).

Pousga et al. 2025 S. Pousga/S., V. Millogo/M. Kere/M. Jones/C. Bihoun/I. Traore/A. Barro/T. Harrigan/G. A. Ouedraogo, Use of ASMC seeder prototype by women. Assessing the use of donkey (Equus asinus) as animal power source in agricultural mechanisation in Hauts-Bassins region of Burkina Faso. International Journal of Environment, Agriculture and Biotechnology 10, 1, 2025, doi:10.22161/ijeab.101.17.

Scheidweiler 2022 M. Scheidweiler, The introduction of draft donkey in Burkina Faso, West Africa. In: Staatliche Schlösser und Gärten Hessen (ed.), Draft Animals in the Past, Present, and Future (Lorsch 2022) 87–94.

Stockdale/Cookson 2003 E.A. Stockdale/W.R. Cookson, Sustainable farming systems and their impact on soil biological fertility-Some case studies. Chapter 11. In: L.K: Abbott/D.V. Murpy (eds.), Soil biological fertility. A key to sustainable land use in agriculture (Dordrecht 2003).

To end hunger 2020 To end hunger, science must change its focus. Nature 586, 15 October 2020, 336.

Wenzel et al. 2014 Wenzel/M. Casagrande/F. Celette/J.F. Vian/A. Ferrer/J. Peigne, Agroecological practices for sustainable agriculture. A review. Agron. Sustain. Dev. 34, 2014, 1–20. https://doi.org/10.1007/s13593-013-0180-7.

Author info

Tim Harrigan, Ph.D.

Emeritus Professor, Michigan State University
4716 Dietz Rd., Williamston, MI. 48895 U.S.A.

E-Mail: harriga1@msu.edu

Draft animal power: a proper way to lift water in remote villages

Antonio Perrone

Abstract

A prototype has demonstrated that a medium sized draft animal is capable of lifting at least 2500 liters of water per hour up to a six-meter distribution tower. In these situations - frequent in a great number of areas – animal-driven pumps and grain mills are significantly cheaper than pumps and mills powered by fuel engines, and - in certain frequent conditions – also cheaper than photovoltaic devices. This study delves into the case of a farmer, who already uses draft animal power for 120 days a year for transport and land cultivation. This utilization time can be considered the most frequent case in remote villages of areas where the rural economy prevails. The study examines the case in which the farmer has decided to increase his revenues by renting the services of his animals for water-lifting and grain milling. This can be done on the days of the year in which his animals are not engaged in land cultivation and transport. A further result highlighted by the analysis is that if all the work performed today worldwide by animal traction were supplied by fuel engines, the parts of fossil CO2 emitted into the atmosphere - by any kind of engines and for any kind of transport and duties – would increase by roughly 0,5% 0.5%. The energy supplied today by working animals is 1.4% of all the renewable energies produced in the world.

Résumé

Un prototype a démontré qu'un animal de trait de taille moyenne est capable de lever au moins 2 500 litres d'eau par heure jusqu'à une tour de distribution de six mètres. Dans ces situations, fréquentes dans un grand nombre de régions, les pompes et les moulins à grains actionnés par des animaux sont nettement moins coûteux que les pompes et les moulins alimentés par des moteurs à combustible et, dans certaines conditions fréquentes, également moins coûteux que les installations photovoltaïques. Cette étude a examiné en détail le cas d'un agriculteur qui utilise déjà la force animale pendant 120 jours par an pour le transport et la culture des terres. Cette durée d'utilisation peut être considérée comme le cas le plus fréquent dans les villages isolés des régions où l'économie rurale est prédominante. L'étude a examiné le cas où l'agriculteur a décidé d'augmenter ses revenus en louant les services de ses animaux pour le pompage de l'eau et la mouture du grain. Cela peut se produire les jours de l'année où ses animaux ne sont pas utilisés pour le labour et le transport. L'analyse a également révélé que si tout le travail actuellement effectué dans le monde par la traction animale était assuré par des moteurs à combustion, les émissions de CO2 fossile dans l'atmosphère (provenant de tous types de moteurs et pour tous types de transports et de tâches) augmenteraient d'environ 0,5 %. L'énergie fournie aujourd'hui par les animaux de trait représente 1,4 % de toutes les énergies renouvelables produites dans le monde.

Kurzfassung

Ein Prototyp hat gezeigt, dass ein mittelgroßes Zugtier in der Lage ist, mindestens 2500 Liter Wasser pro Stunde auf einen sechs Meter hohen Verteilungsturm zu heben. In solchen Situationen – die in vielen Gebieten häufig vorkommen – sind tierbetriebene Pumpen und Getreidemühlen deutlich kostengünstiger als Pumpen und Mühlen mit Verbrennungsmotor und unter bestimmten häufigen Bedingungen auch kostengünstiger als Photovoltaikanlagen. Diese Studie hat den Fall eines Landwirts untersucht, der bereits 120 Tage im Jahr Zugtiere für Transport und Bodenbearbeitung einsetzt. Diese Nutzungsdauer kann als der häufigste Fall in abgelegenen Dörfern in Gebieten angesehen werden, in denen die ländliche Wirtschaft vorherrscht. Die Studie hat den Fall untersucht, in dem der Landwirt beschlossen hat, seine Einnahmen zu steigern, indem er die Dienste seiner Tiere für das Heben von Wasser und das Mahlen von Getreide vermietet. Dies kann an den Tagen des Jahres geschehen, an denen seine Tiere nicht mit der Bodenbearbeitung und dem Transport beschäftigt sind. Ein weiteres Ergebnis der Analyse ist, dass, wenn alle Arbeiten, die heute weltweit mit Tierkraft durchgeführt werden, durch Verbrennungsmotoren ersetzt würden, der Anteil der fossilen CO2-Emissionen in die Atmosphäre – durch alle Arten von Motoren und für alle Arten von Transporten und Aufgaben – um etwa 0,5 % steigen würde. Die heute von Arbeitstieren gelieferte Energie macht 1,4 % aller weltweit erzeugten erneuerbaren Energien aus.

Resumen

Un prototipo ha demostrado que un ganado de tiro de tamaño mediano es capaz de elevar al menos 2500 litros de agua por hora hasta una torre de distribución de seis metros. En estas situaciones, frecuentes en un gran número de zonas, las bombas y molinos de grano accionados por animales son significativamente más baratos que las bombas y molinos accionados por motores de combustible y, en determinadas condiciones frecuentes, también más baratos que las plantas fotovoltaicas. Este estudio ha examinado el caso de un agricultor que ya utiliza la fuerza del ganado de tiro durante 120 días al año para el transporte y el cultivo del terreno. Este duración de la utilización puede considerarse el caso más frecuente en las aldeas remotas de las zonas donde predomina la economía rural. El estudio ha examinado el caso en el que el agricultor ha decidido aumentar sus ingresos alquilando los servicios de sus animales para sacar agua y moler el grano.Esto puede ocurrir en los días del año en los que sus animales no se dedican al cultivo del terreno y al transporte. Otro resultado del análisis es que, si todo el trabajo que hoy en día se realiza en todo el mundo con tracción animal se realizara con motores de combustible, las emisiones de CO2 fósil a la atmósfera —por cualquier tipo de motor y para cualquier tipo de transporte y tarea— aumentarían aproximadamente un 0,5 %. La energía que hoy en día proporcionan los animales de trabajo representa un 1,4 % de todas las energías renovables producidas en el mundo.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 096-101. DOI: https://doi.org/10.11588/propylaeum.1713.c25096

Introduction

The annual report of the FAO on the state of agriculture SOFA 2022, on page 45, among others says: "For the majority of African small-scale producers, the transition to animal draft power would mean a real progress […] In many cases, advanced manual tools and animal traction are probably the best options for increasing power supply […]."[1]

The interest in the use of draft animal power for the generation of electricity is demonstrated by numerous studies, some of which were performed by public scientific institutions in India, and also by dozens of patents issued in several countries. Several videos are also available on the web[2].

Another study on this matter has been performed in Italy and the main results have been shown, among others, by Perrone, Nasab and La Scala in 2023[3].

The status of the art

With an innovative design, a tested prototype in Italy has solved the main problem of the animal driven electric generators: the high torque of the first shaft of the round multiplier.

The torque is proportional to the resistance to the shaft and inversely proportional to the speed of the shaft. In the systems, as those available on youtube – in which the generator has been put vertically in the center of the round path walked by the animal – the speed is half round per minute so the torque is very high. In the design of the system the circular path, where the animal walks, has considered the first sprocket of the rounds multiplier. Then it has been built a vertical wheel of two meters of diameter as the second sprocket of the rounds multiplier. So the speed of the shaft of the large wheel is higher and then the torque is lower and the system is easy manageable.

This solution has reduced the torque of the slow shaft of the system by several times and has demonstrated how this primary source of energy can be applied safely, affordably and reliably for the production of an electric current. A video of the test is available on the web[4].

In summary, a pump has been powered by an electric generator, which is moved by a rounds multiplier, which in turn is driven by a draft animal walking in circles.

Method

The study here described – devoted to those remote villages where the rural economy is prevailing – has investigated the case of a farmer who already uses the draft animal power for transports and land cultivation 120 days a year. This timespan of work per year can be considered the most frequent case in remote rural villages.

The study has examined the case in which the farmer has decided to increase his revenue, renting the services of its animals for water lifting and grain milling, during the days in which his animals are not engaged in the land cultivation and in transport.

The foundational data has been that of rural villages where the salary of a farmer is approximately 67,93 US$[5], the cost of fuel is approximately 1,43 US$[6], draft animal power is still in use and the demand for energy is less than 1 kW.

The continuous working power of a man does not exceed 100 W, while the drafting power of a medium sized working animal could be considered, as hereafter specified, to be around 400 to 800 W. It can be concluded that animal drafting power can increase the productivity of the farmer by at least three or five times.

The abovementioned data utilized in this study is shown in ***Table 1***.

It is important to remember that the numbers of animals referred to represent all the animals present in the mentioned countries, but only a part of them is engaged in rural works.

In the same way it shall be remembered that the mentioned countries have been chosen as examples but many other countries and rural areas respond to similar parameters.

The cost of the kWh

Several sources of energy are in use in those remote villages not connected to the electrical grid. These are photovoltaic, wind power, biogas, fuel engines and manual labor.

These sources have been discussed in Perrone, Nasab and La Scala[7] in respect of their efficiency, which will serve as a framework for this analysis: An average output of less than 1 kW. In that study the net present value of different investments in these energy sources was

TABLE 1

	SALARY	FUEL	ASSES	BUFFALOES	CATTLES	HORSES
BANGLADESH	$ 59,76	$ 1,13	=	725.000	23.935.000	=
MADAGASCAR	$ 73,90	$ 1,31	157	=	10.322.680	496
BURUNDI	$ 105,00	$ 1,56	=	=	1.077.539	=
SIERRA LEONE	$ 63,00	$ 1,52	=	=	700.000	438.219
MALAWI	$ 38,00	$ 1,60	5.613	=	3.848.948	87
AVERAGE	$ 67,93	$ 1,43				

1 FAO 2022.
2 Jakhar et. al 2018; Chandrakar et al. 2013; Swain et al. 2015; Perrone 2020.
3 Perrone 2020; Perrone et al. 2023.
4 http://www.wedap.eu/ (last accessed 06-10-25).
5 www.Salaryexplorer.com (last accessed 06-10-25).
6 www.Globalpetrolprices.com (last accessed 06-10-25).
7 Perrone et al. 2023.

TABLE 2			
AVERAGE SALARY	$ 67,93	$ 67,93	$ 67,93
ANNUAL SALARY	$ 815,18	$ 815,18	$ 815,18
COST OF FEED OF 2 ANIMALS (estimed)	$ 163,04	$ 163,04	$ 163,04
YEARLY COST OF THE TEAM	$ 978,22	$ 978,22	$ 978,22
DAYS IN TRANSPORTS AND SOIL CULTIVATION	120	120	120
DAYS IN WATER LIFTING AND GRAIN MILLING	120	180	180
% PERCENTAGE ATTRIBUTABLE TO THE WATER LIFTING ETC.	50	60	30
COSTS ATTRIBUTABLE TO THE WATER LIFTING ETC.	$ 489,11	$ 586,93	$ 293,47
YEARLY COST OF THE EQUIPMENT DEPRECIATED IN 10 YEAR	$ 40,00	$ 40,00	$ 40,00
YEARLY COST TEAM AND EQUIPMENT ON ELECTRICAL TASKS	$ 529,11	$ 626,93	$ 333,47
HOURS PER DAY	6	6	6
kW OUTPUT	0,60	0,60	0,60
kWh OUTPUT: DAYS PER HOURS PER kW	432	648	648
cost per kWh	$ 1,22	$ 0,97	$ 0,51

calculated. Here instead the focus lies on the costs of energy if it is produced in the villages themselves.

The present study is focused on the comparison between the efficiency of fuel engines, draft animal power and photovoltaic as a primary energy source for those remote villages not connected to the electrical grid.

The cost of the kWh produced through draft animal power

Table 2 shows the analysis of the cost of a kWh generated by draft animal power.

The costs of salaries and of fuel are deduced from the sites referred to above. The cost of feed and veterinarians for the two animals has been considered as 1/10 of a person salary multiplied by 2.

For the first column it is assumed that a farmer uses a pair of animals for transport and land cultivation for 120 days a year, and rents out their services for the same amount of time.

For the second column it is assumed that the farmer rents out his two draft animals for 180 days, aside from his own transports and land cultivation.

The third column represents the same situation of the second column. But in this case the farmer considers that 70% of his costs have been compensated by transports and soil cultivation. So only 30% of the yearly cost are attributed to water lifting and grain milling.

As far as the cost of the equipment is concerned, it shall be referred that in the aforementioned Perrone, Nasab and La Scala the cost of the equipment has been calculated to around 1.000,00 US$ with retail parts purchased in Italy, with sprockets made of steel and worked on a lathe. For this study it is assumed that similar sprockets made with pressed metal sheet will be easy to find on the market. While calculating the cost of mechanics in certain markets, let's remember that through e-commerce web sites it is quite easy to find motorcycles which cost significantly less than 800,00 US$. So the proposed yearly cost of the equipment (400 US$ for the equipment depreciated over fifteen years) here assumed seems to be reasonable.

All the costs have been calculated for an equipment driven by two middle sized working animals so the output of 600 W can be considered quite reasonable[8].

Dividing the yearly cost of the system for the kWh output offers the following results - shown in Table 2: 1,22, 0,97 and 0,51 US$ per kWh with an average cost of 0,90 US$.

The cost of the kWh produced with fuel engines

The cost of the kWh produced with fuel engines has been calculated analysing the technical sheets of equipment easily available on the market and with an output of around 1 kW.

In this table the depreciation cost of the engine and the manual labour cost haven't been added. So the real cost should be considered greater than that shown in ***table 3***.

8 Goe/McDowell 1980.

TABLE 3				
MODEL	HONDA EU 10i	PRAMAC Pmi 1000	EINHELL TC-PG 10/E5	EINHELL TC-IG 1100
POWER kW	1,0	1,0	0,68	1,0
OPERATION POWER kW	0,9	0,425	0,45	0,7
TANK LITERS OIL	0,25			
TANK LITERS GASOLINE	2,1			
TANKS LITERS TOTAL	2,35	2,1	4	6,5
AUTONOMY HOURS	3,3	3,2	6,6	5,4
POWER OUTPUT WITHIN THE AUTONOMY kWh	2,97	1,36	2,99	3,60
FUEL CONSUMPTION PER HOUR	0,71	0,66	0,61	1,20
FUEL CONSUMPTION PER Kwh	0,79	1,54	1,34	1,81
COST OF FUEL PER LITER	$ 1,43	$ 1,43	$ 1,43	$ 1,43
COST OF FUEL PER kWh	$ 1,13	$ 2,20	$ 1,91	$ 2,57
AVERAGE COST OF kWh				**$ 1,95**

TABLE 4		
OUTPUT FROM A 2 ANIMALS DRIVEN ELECTRIC GENERATOR		
Watts of power from a 2 animals driven generator	W	600
Operation hours per day	h	6
Wh/d output from the animal driven electric generator	Wh/d	3.600
DIMENSIONING OF A PHOTOVOLTAIC PLANT WITH THE SAME CAPACITIES		
Terms of comparison from the animal driven daily output	Wh/d	3.600
Sun irradiation as for well insolated areas		4
Basic Wp required (Wh per day/ sun irradiation)	Wp	900
Oversizing for no peak sun hours, Figure 12 of WB mentioned document		1,8
Oversized plant, as per Figure 12 of WB mentioned document	Wp	1.620
For 2 days storage, see paragraph 5.3.of WB mentioned document	d	2
Wp	Wp	3.240
Overall efficiency of the plant, see paragraph 5.1 of WB said document		0,774
Wp to have the same pumping services of an animal driven pump	Wp	4.186

Modules costs for Wp (ex-factory- China)		$ 0,20
Increase of cost from the factory to the assembler in the village		1,5
Cost of Wp delivered in the village		$ 0,30
number of Wp required		4.186
Ex works photovoltaic modules cost		$ 1.255,81
Masonry for the fundations		$ 200,00
Frame and fences		$ 400,00
Construction, assembly, installation and testing		$ 400,00
Cables and fittings		$ 100,00
Electrical components		$ 250,00
Gran Total		$ 2.605,81
YEARLY RATE FOR 15 YEARS DEPRECIATION RATE		$ 212,53
MAINTENANCE AND INSURANCES		$ 200,00
YEARLY COST		**$ 412,53**

The data presented in ***Table 3*** for tank capacity, autonomy and power output, have been deducted from technical sheet shown by the manufacturer on their websites.

The power output along the hours of autonomy has been obtained multiplying the operation power in W per the said hours.

The fuel consumption per hour has been obtained dividing the capacity of the tank by the hours of autonomy of the engine.

The fuel consumption per kWh has been determined dividing the fuel consumption per hour by the operation output.

The cost of fuel per kWh has been determined by multiplying the fuel consumption per kWh by the average cost of fuel as per ***Table 1***.

As a result the average cost of the kWh in the mentioned rural area, produced with a small fuel engine, has an average cost of 1,95 $.

Let's remember that the costs of the equipment, the cost of transport of the fuel to the village and that of the manual labour for refuelling and maintenance haven't been considered. So the cost of the fuel engines should be considered somewhat higher.

The cost of the kWh produced with a photovoltaic plant

The cost of a kWh produced by a photovoltaic plant in a village with an output comparable with that of draft animals, has been calculated using, as well as possible, the methodology shown in the World Bank document *Solar Pumping: The Basics*.

Figures and paragraphs mentioned in ***Table 4*** refer to that document[9].

In ***Table 4*** the referred "Oversizing for no peak sun hours" refers to the fact that a pumping station will receive sufficient power only in the very sunny hours of the day: At sunrise and sunset the power won't be sufficient to drive the pumps or other equipment. Similarly, a high increase is needed for a "two day storage", necessary for continuous power availability in case of cloudy days. The "Overall efficiency" factor has been taken from the aforementioned World Bank document and refers, among others, to manufacturing tolerance, temperature, controls, cables and their connections.

In the analysis of costs none of the classical components, such as the inverter, have been inserted, so the real cost of a plant is greater than which is deduced here.

After determining the purchase cost, the yearly depreciation rate has been calculated following the method presented by the Depreciation Calculator site and ammortamento.com[10].

The result of these calculations shows that the purchase costs of the photovoltaic plant are around 2.605,00 US$ and the yearly costs around 412,00 US$.

These costs are greater than those in the third column of ***Table 3*** referred to the annual cost of the draft animal power while the animals were engaged in water pumping and milling, i.e. 333,47 US$.

9 World Bank 2018.

10 Depreciation Calculator; www.ammortamento.com (last accessed 06-10-25).

Some consideration on the method

For the selection of a source of energy to implement, technical literature suggests, as is commonly known, the so called 'LCOE' method i.e. the Levelized Cost of Energy[11]. The procedure here utilized is a simplified method because the starting data was simpler than those of big investments in the energy field.

The technological assessment

The technological assessment of draft animal power for water lifting and grain milling has been discussed in the afore mentioned Perrone, Nasab and La Scala Paper[12].

The use of draft animal power as referred to in said paper has shown the following strengths and weaknesses.

Due to the difficulty to always impose the same gait onto the draft animal, it is difficult to always achieve the same voltage, which makes it difficult to use draft animal power for lighting and for battery charging.

The DC pumps and the DC motors have demonstrated their capacity, within a certain range, to be driven with any voltage and any amperage so the irregular gait of the animals doesn't present a limit in their utilization for electricity production.

The test described in "http://www.wedap.eu/fl/videofl.html" has demonstrated that a medium sized working animal is capable of lifting at least 2500 liters of water to a height of 6m per hour.

The test has been certified by an independent engineer and, from the animal welfare point of view, by an independent veterinarian, "http://www.wedap.eu/fl/or/ingsardellarep.pdf" and "http://www.wedap.eu/fl/or/allavoro.pdf".

It is important to remember that the electric motors here discussed can be utilized not only for pumping and milling but also for powering other rural equipment such as threshers, winnowers, milking machines, fruit sorters and squeezers. This equipment, now moved by farmers by cranks and pedals, are easily available via e-commerce on the web. The substitution of their cranks and pedals with sprockets and a belt thus would be very easy.

The potential of the system

The potential of the system is enormous. The prudential estimated number of working animals in the world is, today, around 200,000,000.

If all the work performed today worldwide by animal traction would be taken over by fuel engines, the parts of fossil CO2 emitted into the atmosphere - by any kind of engines and for any kind of transports and duties – would increase by roughly 0,5%. The energy supplied today by working animals makes up 1.4% of all the renewable energy produced in the world[13].

The recognized international standards for animal welfare recognize that the here described kind of job is not stressful for the animals. Therefore there is no contraindication to using animals for this type of work.

11 www.Nrel.gov (last accessed 06-10-25).

12 Perrone et.al. 2023.

13 Perrone 2020.

Conclusion

Draft animal power is the cheapest primary source of energy in those remote villages where the rural economy is prevailing, where the demand for energy is less than 1 kW and where working animals are still in use.

This is true in those large areas where the average monthly salary of farmers is approximately 67,93 US$ and where the cost of fuel is approximately 1,43 US$ per liter.

This source of energy can power, among others, pumps, mills, threshers, winnowers, milking machines, fruit sorters and squeezers.

A comparison with different sources of energy has given the following results:

Wind energy and photovoltaic plants are not transportable and in some cases more expensive than draft animal power.

The average cost of draft animal power, as a primary source of energy, has been calculated to approximately 0,90 US$ per kWh with a minimum percentage of the said money spent outside the village. In some cases this cost can drop down to 0.51 US$ per kWh.

The use of fuel engines as a source of energy was labeled with an average cost of approximately 1,95 US$, all of which spent outside the village.

For an analogous amount of energy the yearly cost as well as that of the kilowatt, of a photovoltaic plant seems to be in certain cases greater than that of a draft animal power generator i.e. 412,53 versus 333,47 US$.

A photovoltaic plant isn't capable of supplying similar services as draft animal power because it is non transportable and incapable to always supply energy when required, but only in sunny hours. All the money for its utilization would also be spent outside the villages. The purchase cost of one photovoltaic plant is approximately five times greater than that of a draft animal power generator.

SOFA 2022, the annual report of the FAO on the state of agriculture states: "In many cases, advanced manual tools and animal traction are probably the best options for increasing power supply."

Today there are at least 200.000.000 working animal, distributed throughout millions of villages in the world.

While the average, continuous power output of a human exceeds not more than 100 W, that of a draft animal can reach between 700 or 800 W, which means the use of draft animals can increase the productivity of farmers – in the aforementioned tasks - by several times.

This increase of productivity is incomparable in case of water pumping. Let's imagine the case of a farmer who has to lift several liters of water from a well and then has to carry this water to his home with buckets and bins.

Instead the draft animal powered electric pump can lift a lot of water to a distribution tower and then the pipes can distribute this water to hundreds of taps in hundreds of households.

Bibliography

Chandrakar et al. 2013 S. K. Chandrakar/D. L. Soni/D. K. Yadav/L. K. Sahu, Experimental study on animal powered mechanical device for home lighting system. International Journal of Environmental Engineering and Management 4, 2013, 471–482.

Depreciation Calculator Depreciation Calculator at calculator.net, URL: https://www.calculator.net/depreciation-calculator.html [Date of Website access: March 2024].

FAO 2022 FAO, The State of Food and Agriculture 2022. Leveraging automation in agriculture for transforming agrifood systems (Rome 2022). URL: https://doi.org/10.4060/cb9479en [Date of Website access: March 2023].

Goe/McDowell 1980 M.R. Goe/R.E. McDowell, Animal traction Guidelines for Utilization, Department of Animal Science, Cornell University (ed.) (Ithaca/New York 1980).

Jakhar et al. 2018 O. Jakhar/R. R. Choudhary/M. Budaniya/A. Kumar, Experimental study of camel powered electricity generation unit. In: AIP Conference Proceedings 1953, 1 (2018), Online Edition. URL: https://doi.org/10.1063/1.5033175 [Date of Website access: March 2024).

Perrone 2020 A. Perrone, Sustainable energies for remote villages. A new target for the corporate social responsibility. In: 2020 AEIT International Annual Conference (AEIT). IEEE (2020) 1–6.

Perrone et al. 2023 A. Perrone/Nasab/M. La Scala, Draft Animal Power Versus Photovoltaic. A Benchmark. Presentation at 2023 AEIT International Annual Conference in Rome.

Swain et al. 2015 S. Swain/A. Dash/A. Mohapatra/D. Behera/B. Behera et al., Utilization of animal energy for postharvest operations in rotary mode, Journal Crop and Weed 11, 1, 2015, 75–79.

World Bank 2018 World Bank, Solar Pumping. The Basics (World Bank, Washington, DC, 2018).

Author info
Antonio Perrone
WEDAP, Grottaglie I
E-Mail: aperrone@wedap.eu

Towards a culture of training and curating skills. The Role of Living History Farms

Peter Watson

Abstract

The history and development of Howell Living History Farm in Mercer County, New Jersey (USA) illustrates how important it is to preserve and value the methods, practices, processes, and craftsmanship that have been accumulated over decades in places like this to ensure their future.

Résumé

L'histoire de la création et du développement de la Howell Living History Farm dans le comté de Mercer, dans le New Jersey (États-Unis), montre à quel point il est important de préserver et de valoriser pour l'avenir les méthodes, les pratiques, les processus, mais aussi les compétences artisanales qui ont été accumulés au fil des décennies dans des lieux comme celui-ci.

Kurzfassung

Anhand der Entstehungsgeschichte und Entwicklung von Howell Living History Farm in Mercer County, New Jersey (USA) wird verdeutlicht, wie wichtig es ist, Methoden, Praktiken, Prozesse aber auch handwerkliche Fähigkeiten, die an Orten wie diesen über Jahrzehnte angehäuft worden sind, auch für die Zukunft erhalten und in Wert gesetzt werden müssen.

Resumen

La historia y el desarrollo de Howell Living History Farm, en el condado de Mercer, Nueva Jersey (EE. UU.), aclara la importancia de preservar y valorar para el futuro los métodos, las prácticas, los procesos y también las habilidades artesanales que se han acumulado a lo largo de décadas en lugares como este.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 102-107. DOI: https://doi.org/10.11588/propylaeum.1713.c25097

Fig. 1 *Howell Living History Farm Assistant Director Kevin Watson using Belgian work horses Bill & Jessie and a Syracuse 401walking plow to give a young visitor a chance to experience farming (Photo: Peter Watson).*

For those who use living history to preserve the work, play, stories, traditions, and lifeways of times past, the ability to transfer knowledge and skills from one generation of practicioners to another is of critical importance.

How can we ensure that the living, intangible cultural heritage held in our hands is as safely and comprehensively kept as the material culture that supports and reflects it? Can the historical skills of a farmer, miller, butcher or tailor be collected, registered, curated and preserved like the tools and equipment they use?

The questions are familiar to many in this room – those who work in the fields of living history, experimental archaeology, performing arts and cultural preservation. But the answers remain works in progress as the related challenges emerge.

According to UNESCO, the world's chief historian of heritage that communities recognize as critical to their identity and continuity, “intangible cultural heritage must be relevant to its community, continuously recreated and transmitted from one generation to another." Safeguarding it requires a constant transfer of the knowledge, skills and meaning at its core – something that all good ox drovers, horse teamsters and practitioners of trades, traditions and good businesses know from experience. Replacements are the lifeblood of the future.

I began to understand it personally when, as a mid-1970s Peace Corps volunteer in a West African project to increase protein levels in human diets through improved bovine production, my job was to show farmers how they could use their beef and dairy cattle for tillage and transport operations most often done by hand.

Fig. 2 *Peace Corps Volunteer Joe Howell with Bariba farmers in northern Benin, West Africa, 1975 (Photo: Joseph Howell).*

The job included making sure that the work I was doing continued. Both then and now, a big part of the job of every Peace Corps volunteer is to work with local teachers, trainers and in my case, extension agents to develop transition and transfer systems that ensure continuity. Volunteers have two years to do that, and I proved to be not very good at it. It took me nearly three and a half, ... but in all truth, that was because I was learning so much from the farmers I worked with, and about a culture that held so many fascinating, invaluable lessons for me, that I found it hard, and at times even counterproductive, to speed my plow, or the oxen who pulled it.

When I left, I worked in international agriculture for ten years before a friend and former Peace Corps volunteer Dick Rosenburg – a Michigan dairy farmer and the

Fig. 3 Tillers International founder Richard Rosenburg with Lauren Muney of the Association for Living History, Farm & Agricultural Museums (ALHFAM) during the 2023 Haying Field Day of the Midwest Ox Drovers Association (MODA) (Photo: Pete Watson).

founder of Tillers Research International – encouraged me to visit living history farms like Old Sturbridge Village in Massachusetts, Ross Farm in Nova Scotia, and Iowa Living History Farms in Des Moines, Iowa... to look at yoke designs and fabrication methods that might be of value in a project I was then doing for the US Agency for International Development. He also recommended a visit to the Smithsonian Institution in Washington DC, for a look at their yoke collection. If he had known about the Slovenia Ethnographic Museum and the collection of yokes curated by our good colleague Barbara Sosic, he would have certainly sent me there as well.

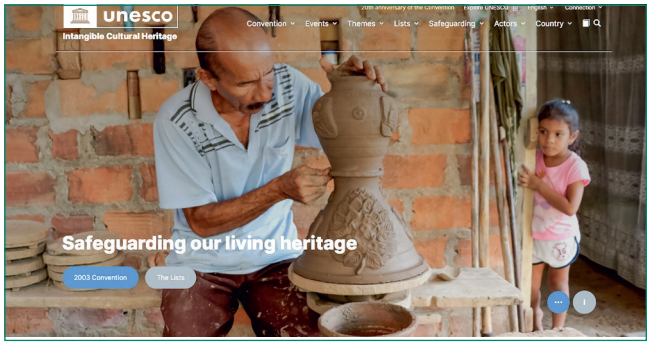


Fig. 4 UNESCO Intangible Cultural Heritage webpage, section "Livelihoods" (Source: https://ich.unesco.org/en/home).

Those visits to Living History Farms and Agricultural Museums led to me to an overwhelming question: Were the collections that I saw – and that there were likely hundreds more of worldwide – ever used to inform the project designs, adaptive research, and field work that I was part of? Were the centuries-old woodworking traditions of Benin, where I was a Peace Corps volunteer, considered when UNFAO-Project PNUD carved out the gameplan for the animal traction project I was part of? Are those woodworking traditions on the UNESCO World Heritage List of Intangible Culture right now?

To explore that question from the ground up, and thanks to the intuition and advice of the illustrator of a technical manual I was working on, I accepted a temporary position at a new, county-owned living history farm in Titusville, New Jersey, USA. Here, there was someone who had grown up on and worked an all horse powered farm until 1952, and who was ready to put one back together. Halsey Genung, 4th generation NJ farmer, helped me, illustrator Mary Kennington (eventually Watson) and two Rutgers University agriculture students open Howell Living History Farm to the public in 1984. As its donor Inez Howell wished, the farm's purpose was to be a park and cultural facility where "the way of living in its early days could not only be seen but actually tried by the public, especially children: milking a cow, gathering eggs in a homemade basket, helping to shear sheep, carding wool, spinning and weaving...".

Fig. 5 *Each year, 65,000 visitors explore the history and heritage of Howell Farm, a 130-acre farmstead restored to reflect the agriculture and lifestyle of a typical New Jersey (USA) farm of the years 1890-1910 (Photo: Peter Watson).*

In her letter dated March 10, 1974, she wrote: "Could volunteers build the way they built in the early days with similar tools? And let the public watch and lend a hand? Older people could teach the young how to sew a fine seam, or find hickory nuts to crack with a stone on the hearth, or find wild herbs for curing the miseries, [...] or just go off fishing with a hickory stick pole."

She ended the letter with an intriguing, compelling and future-determining question: "Now what else can you think of?"

The 'what else' was not for everyone. In the 42 years I've been there, two million people have watched and lent a hand. A third of them are school children who learned about ice harvesting, maple sugaring, sheep shearing, and what it takes to grow crops and raise animals. Only a fraction, but an all important one, participated in the farm's internships in sustainable agriculture. They were from all over the world, and came to study yokes, harnesses, farming and gardening tools, and much more... for farms they were building, or working or dreaming of. They were seen by two million people who had opportunities to hear their stories, help them grow and harvest crops using methods from the past, and see the importance of those methods today.

Hi everyone at the farm,
I wish to let you know that am still strong with the memories and experience at the farm while I was an intern during the year 2001 with Rob as my instructor. I am doing well on my farm with skills acquired from the Howell Farm. May God bless you always for the good work (you do). I normally follow you through the farm web, thanks to your web experts. Kindly, my warm regards to all stakeholders of the farm.

(Edward Chicati)

His story is just one of many: inspiring, compelling, and telling of what the past can bring to the future, if we're good enough historians to make it a possibility. I often think about the Ecuadorian farmer who spent a summer with us, learning how to make yokes and bows, to break and train oxen, and to use sickle bar mowers. He and his family sold organic milk to the Hilton Hotel in the capital city of Quitto, and they wanted to increase production and sales. The constraint to expansion was forage production. Their farm was in the hills above the city, and was too steep for tractors. His grandfather remembered that oxen were once used there, but his grandsons couldn't find anyone in the community who remember how. The knowledge of ox use had been lost in less than a single lifetime.

The story begs the question. How can we learn, preserve and share what Halsey Genung and countless others taught and stand to teach us? How can methods, practices, processes and systems painstakingly learned through the mediums we work in – whether living history, experimental archaeology, indoor or outdoor museums, or in the hills outside Quito, Ecuador –be here tomorrow?

Halsey died just a year ago and I wrote:

If you knew Halsey, you know he didn't think there was anything extraordinary about the contributions he made to Howell Farm. His job was to farm the place with horses, and he did it because he loved it, and because he knew how.

He had grown up helping his father do what he called teaming -- using horses to do everything from plowing people's gardens, to delivering sand and coal to greenhouses, to making and selling hay from their own fields. They used teams to help with farming and logging operations in the Great Swamp, where according to Halsey they could have made a living pulling trucks out of places where the trucks had no business going. In New Providence where they had their farm, they plowed sidewalks with a V-plow made with hardware forged by Halsey's uncle, a blacksmith and farrier whose shop is still there...ironically, now as a nail salon. They had a delivery route that required leaving home at 2 a.m. to buy vegetables at a market 12 miles away, returning before dawn to do chores before starting the route. Halsey remembered how proud he was the day his father handed him the lines before dozing off on the way through the hills. He drove through the darkness not knowing that he wasn't really driving at all, but getting a lesson from a very good pair of horses.

His grandfather had teamed as well, and was one of several farmers hired to dig the basement of the neighboring town's YMCA, where he used a plow and a slip scoop to remove the layers of soil where the foundations would go. Halsey brought the scoop to Howell Farm once, after a hurricane left flood debris in the lane. He pulled it with Blaze & Frank -- the team he depended on for anything, and everything, for nearly 20 years.

He wouldn't say much when I'd tell him how instrumental he was in helping the farm survive the process of becoming a public park, or building its future as a place where people could find what the donor, Inez Howell, hoped they would. I'm pretty sure he believed, as she did, that in the history we preserve there are ways of working, and living, that can make a better world.

Fig. 6 *Kenyan farmer and agricultural extension agent, Edward Chicati, with Howell Farm oxen Bud & Jake during the Farm's "Internship in Sustainable Agriculture" (Photo: Pete Watson).*

Fig. 7 *Halsey Genung using a 3-section harrow with Blaze, Pearl and Jake (Photo: Pete Watson).*

Howell Farm couldn't -- and wouldn't -- be a good place to find them, had it not been for Halsey. He was born a hundred years too late according to his mother -- something he liked to talk and laugh about, when there was time for such things. Like when we're waiting to water hot horses, or making the long drive home from a supply trip to Lancaster or a farm with a horse we might buy. Few 'historic farmers' get to do what we had a chance to do: learn firsthand what must often be gleaned from the pages of history books, or collections of photographs, or trial and error, or from how-to videos that live in the clouds.

About a year ago, an ALHFAM colleague asked me if Howell Farm would host the 2024 ALHFAM Conference. We had done it before, and knew how it would impact the daily farming, maintenance, program, research, and office operations that must happen if peas are to be planted tomorrow. We agreed to because we know that what we have so painstakingly learned over the past 40 years can be lost in a single missed, mistaken, or misinformed passing of the lines, in the failure of a succession plan, or in the realities born of the hands of time.

Our call for proposals is a call for help from people in the fields that nourish us all: agriculture, art, archaeology, education, research, engineering, curatorial science, history and history applied.

Curating Living History: Preserving Skills and Intangible Culture is the theme we'll explore during a two-part conference that will use hands-on training workshops as the inspiration for keynotes, papers and roundtable discussions that engage all participants in the work of strengthening the standards, best practices and professional skills needed to preserve living history's invaluable intangible culture.

Whether you are a curator, interpreter, museum director, or practitioner of a skill presented at a historic site, your contribution is essential to the goal of the conference, which is to share tools, methods, ideas and experiences that can strengthen the preservation of intangible culture. We hope you will consider joining us.

ADDENDUM

The conference was attended by more than 200 ALHFAM members and guests who participated in a program that included 63 live, hands-on workshops and 22 live and virtual classroom sessions and keynotes. The Conference Proceedings will be published in the fall of 2025 and will include links to videos and oral histories associated with the program.

ALHFAM's searchable archive of its Proceedings and other publications, the ALHFAM Skill & Knowledgebase (ASK), contains more than 4,000 records and will soon give users new and better access to digital information generated at conferences, regional workshops and training programs, and at member sites and partnering history organizations.

Author info
Peter Watson

Director Howell Living History Farm
Mercer County Park Commission (NJ)

E-Mail: pwatson@howellfarm.org

Histories written in (cattle) bone – an archaeozoological and osteological perspective

Barbara Corson, Matilda Holmes

Abstract

Cattle are not designed for carrying loads or pulling weights. Their wild ancestor, the aurochs (*Bos primigenius*) evolved to be excellent at grazing and browsing in herds, but since their interactions with humans some 10.000 years ago, domestic cattle (*Bos taurus and Bos indicus*) have been exploited, in life, for milk and power. This paper investigates the effects of one aspect of domestication on the skeleton of cattle – that of draught work. We combine approaches, using observations taken from modern animals through the lens of veterinary science, and paleopathologies recorded on archaeological material. The stories presented show how loading can affect the skeleton of draught animals, problems in diagnosis in the living, and problems in determining a cause in the dead. In either case, it is shown that when cattle are used for draught work it affects their skeleton, sometimes with extreme consequences.

Résumé

Les bovins ne sont pas faits pour porter des charges ou tirer des poids. Leur ancêtre sauvage, l'aurochs (*Bos primigenius*), a évolué pour être efficace dans le pâturage et le broutage en troupeaux, mais depuis leur interaction avec les humains il y a environ 10 000 ans, les bovins domestiques (*Bos taurus* et *Bos indicus*) ont été exploités, de leur vivant, pour leur lait et leur force. Cet article examine les effets d'un aspect de la domestication sur le squelette des bovins : le travail de traction. Nous combinons plusieurs approches, en utilisant des observations faites sur des animaux modernes à travers le prisme de la science vétérinaire et des paléopathologies enregistrées sur du matériel archéologique. Les résultats présentés montrent comment l'effort de traction peut affecter le squelette des animaux de trait, les problèmes de diagnostic chez les animaux vivants et les problèmes de détermination de la cause chez les animaux morts. Dans les deux cas, il est démontré que lorsque les bovins sont utilisés pour le travail de traction, cela affecte leur squelette, parfois avec des conséquences extrêmes.

Kurzfassung

Rinder sind nicht dafür geschaffen, Lasten zu tragen oder Gewichte zu ziehen. Ihre wilden Vorfahren, die Auerochsen (*Bos primigenius*), entwickelten sich zu hervorragenden Weidetieren, die in Herden grasten und Blätter fraßen. Seit ihrer Begegnung mit dem Menschen vor etwa 10.000 Jahren werden domestizierte Rinder (*Bos taurus* und *Bos indicus*) jedoch zu Lebzeiten für die Milchproduktion und als Zugtiere genutzt. Dieser Artikel untersucht die Auswirkungen eines Aspekts der Domestizierung auf das Skelett von Rindern – nämlich die Zugarbeit. Wir kombinieren verschiedene Ansätze und stützen uns dabei auf Beobachtungen moderner Tiere aus veterinärmedizinischer Sicht sowie auf paläopathologische Befunde aus archäologischen Fundstücken. Die vorgestellten Fälle zeigen, wie sich Belastungen auf das Skelett von Zugtieren auswirken können, welche Probleme bei der Diagnose bei lebenden Tieren auftreten und welche Schwierigkeiten es gibt, die Ursache bei toten Tieren zu bestimmen. In beiden Fällen zeigt sich, dass sich der Einsatz von Rindern als Zugtiere auf ihr Skelett auswirkt, manchmal mit extremen Folgen.

Resumen

El ganado vacuno no está diseñado para transportar cargas ni tirar de pesos. Sus ancestros salvajes, los uros (Bos primigenius), se convirtieron en excelentes animales de pastoreo que pastaban en manadas y se alimentaban de hojas. Pero desde su encuentro con el hombre hace unos 10 000 años, el ganado doméstico (Bos taurus y Bos indicus) se ha utilizado durante su vida para la producción de leche y como animal de tiro. Este artículo investiga los efectos de un aspecto de la domesticación en el esqueleto del ganado: el trabajo de tiro. Combinamos diferentes enfoques, utilizando observaciones tomadas de animales modernos a través de la lente de la ciencia veterinaria y paleopatologías registradas en material arqueológico. Los casos presentados muestran cómo la carga puede afectar al esqueleto del ganado de tiro, qué problemas surgen al diagnosticar a animales vivos y los problemas para determinar la causa en animales muertos. En ambos casos se demuestra que cuando el ganado se utiliza para el trabajo de tiro, esto afecta a su esqueleto, a veces con consecuencias extremas.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 108-115. DOI: https://doi.org/10.11588/propylaeum.1713.c25098

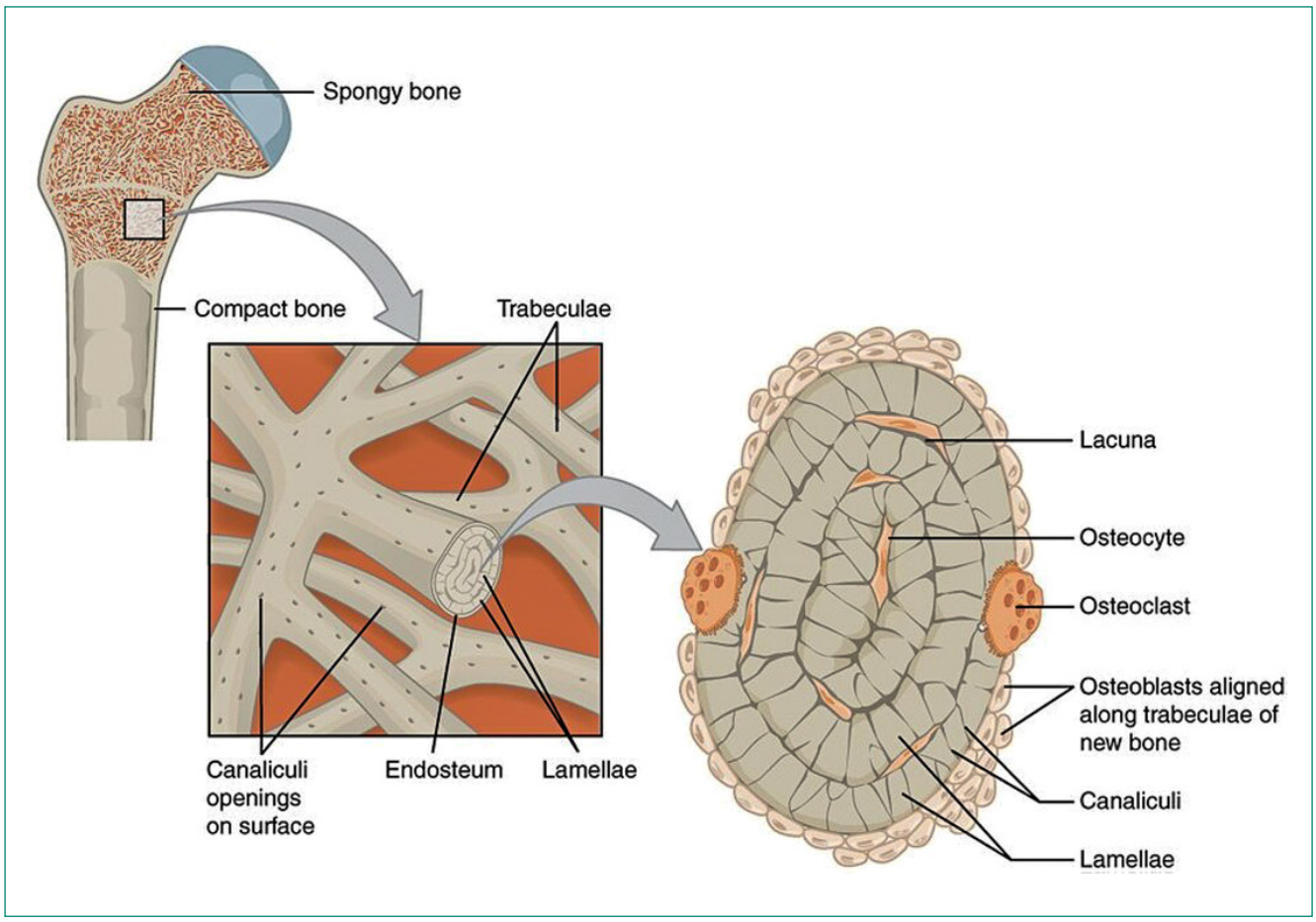


Fig 1 *Schematic illustration of bone structure (Graph: OpenStax College - Anatomy & Physiology, Connexions; Web site. http://cnx.org/content/col11496/1.6/, Jun 19, 2013., CC BY 3.0, taken from https://commons.wikimedia.org/w/index.php?curid=30131413).*

Introduction[1]

Bone is important in vertebrate animals for support and movement, and for controlling the balance of minerals like calcium and phosphorous, which are essential for metabolic functions. Bones also serve as a site where blood cells are produced, so although it can appear that bones are static and unchanging, in the living animal they are in a constant state of change.

How bones do all these things is complex, but there is a simple way of starting to explain it: "form is function." In the physical world, the shape of something determines what it can do, and vice versa. For example: a ball can roll because it is round, and conversely, round objects roll, but cuboid objects do not. The shape of a bone depends on—and determines-- it's function in the body.

Understanding bones starts with learning how they are shaped on the macroscopic level (with the naked eye), and continues with understanding the microscopic level and molecular level. At the microscopic level, all animal tissues are made up of two components:

- cells that are characteristic of the tissue
- the "stuff-between-the-cells", generically called the interstitium or the matrix.

To visualize the three-dimensional microscopic structure of bone, it may help to think of a loaf of raisin bread. The raisins in the bread are analogous to cells, and the bread or dough is equivalent to the matrix.

But a loaf of bread is *not* a good analogy for how bone tissues works, or functions. In living bone tissue, there is constant interaction between the cells and the matrix, so a better analogy for bone function is a bee hive that is being built and maintained by the bees that are living there. Like a hive of bees, the living cells constantly monitor each other, the environment, as well as the structures they are building.

All tissues have cells and interstitium, but the unique hallmark of bone tissue is the fact that the interstitium or matrix is mineralized and made rigid by precipitates of calcium and phosphorous. The mineral precipitate is what makes bones hard and stiff, so that they can function for support. Long bones like those in the legs act like levers to allow animals to move. As mentioned, the mineral deposits also act as a storage depot for calcium, phosphorus and other minerals that are essential for metabolism in vertebrate animals.

For the paleozoologist, the mineralization is important for another reason: it is why bones don't decay. Even after an animal has been dead for years, you can often see evidence of (at least some of) the things that were going on while it was still alive. It's a little like looking at the ruins of Pompei.

But the mineralization also means that it's harder to look at bone under the microscope. To look at the kidney or liver under the microscope, you cut very thin slices, but bone is difficult to cut because it shatters. On the other

1 This and the following chapter (A story told by a bone) are based on a written transcript presented by co-author Barbara Corson during the World Draft Cattle Symposium in 2024.

hand, you can use x-rays to study bone because of the mineral, but the lack of mineral means that soft tissues don't show up on radiographs.

Bone structure and function is complex and a involves a lot of biochemistry, but it's still possible to make a few useful generalizations[2]:

1. Like any living tissue, bone needs oxygen and energy to keep working. These necessities are carried in the blood, and bones have lots of blood vessels. Anything that affects the blood supply to a particular area will affect the bone quickly, for example a blood clot that plugs a blood vessel, or a fracture of the bone that tears the vessels apart.
2. Because they function as levers, being stressed (subjected to forces) is part of daily life for the long bones of animals (like those in the legs and feet). Bone tissue that is subjected to forces tries to get stronger by making more bone and repairing damage. Bone tissue that isn't stressed tries to save resources by removing bone from areas where it isn't needed. The process of adding bone where it's needed, and removing it where it's not is called "remodeling".
3. In an immature (growing) animal, bones lengthen is specific areas called growth plates. In these areas, cartilage tissue is produced which is gradually mineralized and turned into bone. Growth plates are visible with the naked eye as well as microscopically, which allows rough age determination.
4. Like other tissues, bone can be injured in various ways, including infection, physical trauma, neoplasia (tumors), nutritional imbalances and degenerative conditions. Practitioners of modern western medicine diagnose diseases by trying to determine which of these processes are or were involved.
5. Any living tissue, (including bone) responds to injury by becoming inflamed. Inflammation is a complex subject, but its signs can be summed up in four words: redness, heat, swelling, pain. Inflammation is the first step in tissue healing, but if it gets out of balance or goes on too long, it can become a problem in its own right.

Using these general rules, you can often piece together a kind of picture of what was going on in the animal's body when it was alive by looking at its bones with your naked eyes and/ or using x-ray or microscopic technology if that's available to you.

This can be both fun and useful, but disease processes are complex, it's a mistake to be too sure that you can know everything about an animal from its tissues alone. Sometimes the bones match the rest of the story:

A 10-year-old ox showed signs of severe arthritis, including lameness and swollen stifle joints when he was alive. After death, his bones definitely confirmed the clinical impression. The rough irregular surfaces of the affected femur (thigh bone) show how bone responds to long term inflammation, compared to the smooth surfaces of the normal femur.

But the bones can also tell stories that you didn't expect. For example, I performed a post-mortem on a normal-looking thoroughbred broodmare that had died suddenly. I diagnosed intestinal Salmonellosis as the cause of death. There was no history of muscle or skeletal problems, and since I wanted a set of horse bones for teaching purposes, I collected hers and cleaned them, assuming that they would be normal. But to my surprise, she had deformed lumbar vertebrae consistent with a diagnosis of spina bifida occulta. If I had been presented with only that vertebra, it would have been logical to conclude that the mare had suffered from neurologic issues during her life, but she apparently did not, at least none that anyone noticed. One of the pathologist's mottoes is: *Mortui vivos docent* (the dead teach the living). But they don't teach us everything we want to know! Sometimes they leave us with even more questions.

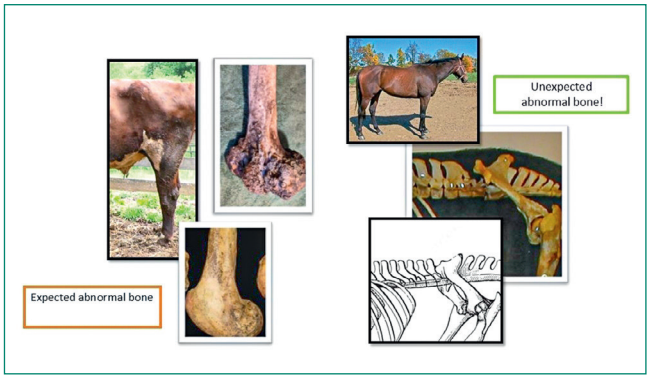


Fig. 2 *Bones provide information. Sometimes the information confirms the expected diagnosis, and sometimes the information is a surprise! (Photos and Drawing: B. Corson)*

A story told by a bone

A year or two ago, I was honored to participate in the examination of a particular bovine bone from an archeologic site in Mannheim (Vogelstang "Hinter der Nachtweide"), Germany[3].

It was the lower leg bone of an adult bovine, what we would call the "shinbone" in English. The shinbones are actually analogous to the long bones of the human hand and foot, which generates some confusion: should they be called 'leg bones' or 'foot bones'? A good way to avoid the issue is to call them 'metapodials' which roughly translated means 'after the foot' in Latin. Normal metapodials are smooth, dense, and symmetrical.

Fig. 3 *Normal metatarsal bone from adult cattle (Photo: M. Holmes).*

2 For general info, also see: https://ohiostate.pressbooks.pub/vethisto/chapter/5-bone-microanatomy/ (last accessed June 27th 2025).

3 The osteological material was kindly provided by the State Office for Cultural Heritage Management Baden-Wuerttemberg. For context of the excavation see Damminger / Gross 2009.

Compared to the normal bone, the Mannheim bone is rough and porous along the mid-shaft. The roughening does not, however extend to the joint surfaces. The bone is also deformed/ bent along its long axis. There is a clearly defined hole visible in one view of the bone.

Fig. 4 *Photographs of the Mannheim metatarsal; plantar view (**top**), lateral view (**bottom**) (Photo: C. Kropp).*

There are a number of disease processes that could cause a bone to be deformed and disorganized, including

- a nutritional disease like rickets
- a neoplastic disease (a bone tumor)
- a bacterial infection of the bone with subsequent inflammation resulting in fracture;
- an open fracture with a resulting infection and inflammation, prolonging healing

To decide which of these processes was involved, it would help to see inside the bone macroscopically and microscopically, but cutting slices of this artifact is not really an option. Instead the bone was radiographed. To evaluate pathology, the lesions have to be compared to normal. Figure five illustrates how normal bones appear on x-ray, using a human foot. Humans have five metapodial bones in each limb; the second metatarsal is indicated. Notice that the outline of the bones is smooth and discrete and there is a well-defined hollow space in the middle: the marrow cavity.

Fig. 5 *X-ray image of a human foot (Source: https://commons.wikimedia.org/wiki/Category:X-rays_of_normal_feet_by_dorsoplantar_projection#/media/File:Fu%C3%9F_re_r%C3%B6ntgen.png).*

Compare the normal radiographs with these of the Mannheim bone: you can see that the internal structure of the matrix is disorganized and 'chaotic', instead of being uniform in density. You can see the hole in one of the views; unlike the rest of the tissue, the margins of the hole are dense and clear-cut.

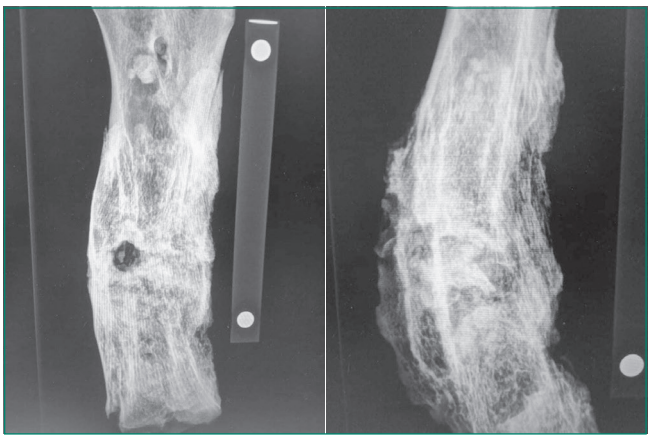


Fig. 6 *Radiographic details of the Mannheim metatarsal (Source: C. Kropp).*

Adding the radiographic information to the macroscopic examination gives us enough information to rule out two of the possible diagnoses listed above; i.e., neoplasia and rickets show different internal patterns of bony remodeling than those seen here, and neither of

those diseases is common in adult cattle. It's logical to conclude that the changes were most likely caused by a combination of bacterial infection and traumatic injury (fracture), but can we determine which problem happened first? Was there an infection that caused inflammation, weakening the bone and resulting in a pathologic fracture? Or was there an open fracture in which bone fragments pierced the skin, exposing them to contamination and allowing an infection to take hold?

There are various clues that can help us decide which is most likely. Fractures heal by creating new bone, which takes time. Radiographs (x-rays) therefore can give you an idea of how old the fracture is. Figure seven shows a recently broken human collar bone. The ends of the broken bones are clear cut, with no bony tissue connecting them at all, because there hasn't been time for the bone tissue to respond to the injury

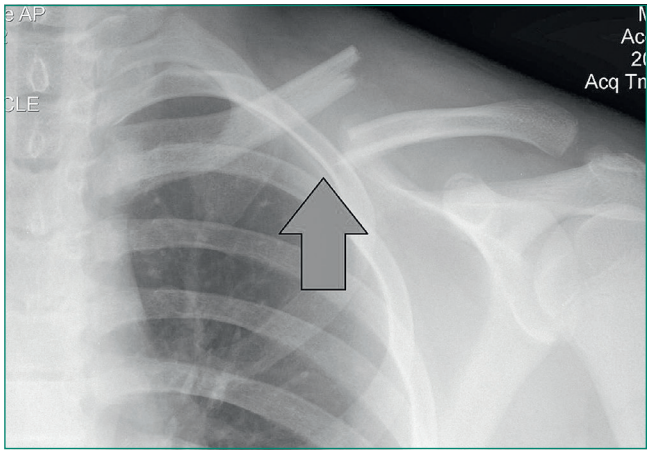


Fig. 7 *Acute clavicle fracture (Source: Majorkev at English Wikipedia, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=59569959).*

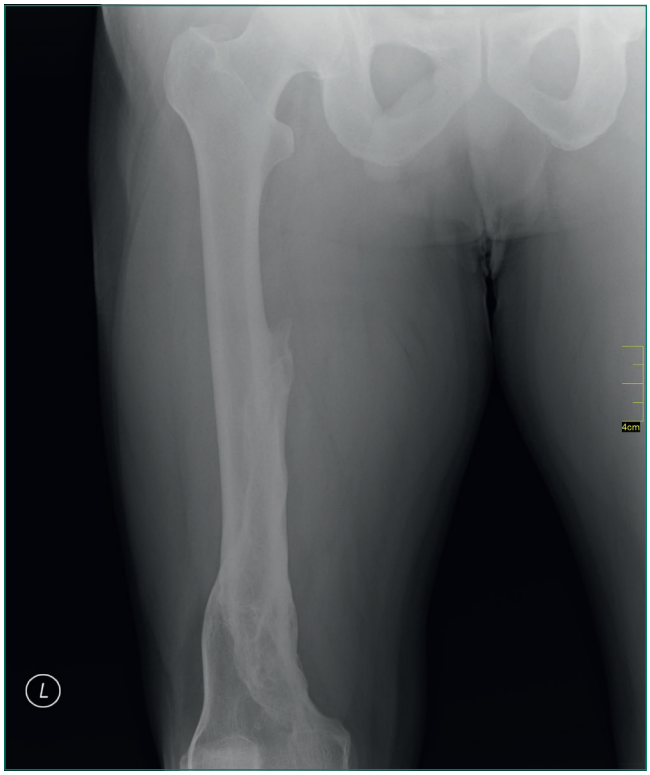


Fig. 8 *Healing spiral fracture of the femur (Source: https://commons.wikimedia.org/wiki/File:Medical_X-Ray_imaging_DPV03_nevit.jpg).*

Figure eight shows a healing fracture of the human thigh bone. There are no sharp edges; everything is "fuzzy" because of the mineralizing matrix that is being laid down to re-create the original shape of the bone.

As we saw (***Figure 6***) in the Mannheim metapodial, there is a lot of unorganized bone that connects the two pieces of misaligned bone. This is evidence that the fracture is not recent. Based on the amount of mineralization present, the bone must have been trying to heal for months. But the lack of organization is evidence that inflammation was preventing the bone from completely remodeling the original structure (You could say it's analagous to people in a termite-infested house trying to make repairs without being able to get rid of the termites first!)

Taken together the observations support the conclusion that the bony injury (fracture) was the initial problem, and that inflammation from wound infection was secondary and ongoing.

And what about the discrete hole? Is that part of the disease process? Or could it be evidence of some kind of puncture, possibly an attempted treatment of the animal, or a post-mortem artifact (something that happened after death) ? The most likely scenario is that the hole formed as part of the disease process, as a sequestrum.

Fig 9 *Sequestrum in a child's thighbone (Source: https://commons.wikimedia.org/wiki/File:Bony_sequestrum_in_a_child_femur.jpg).*

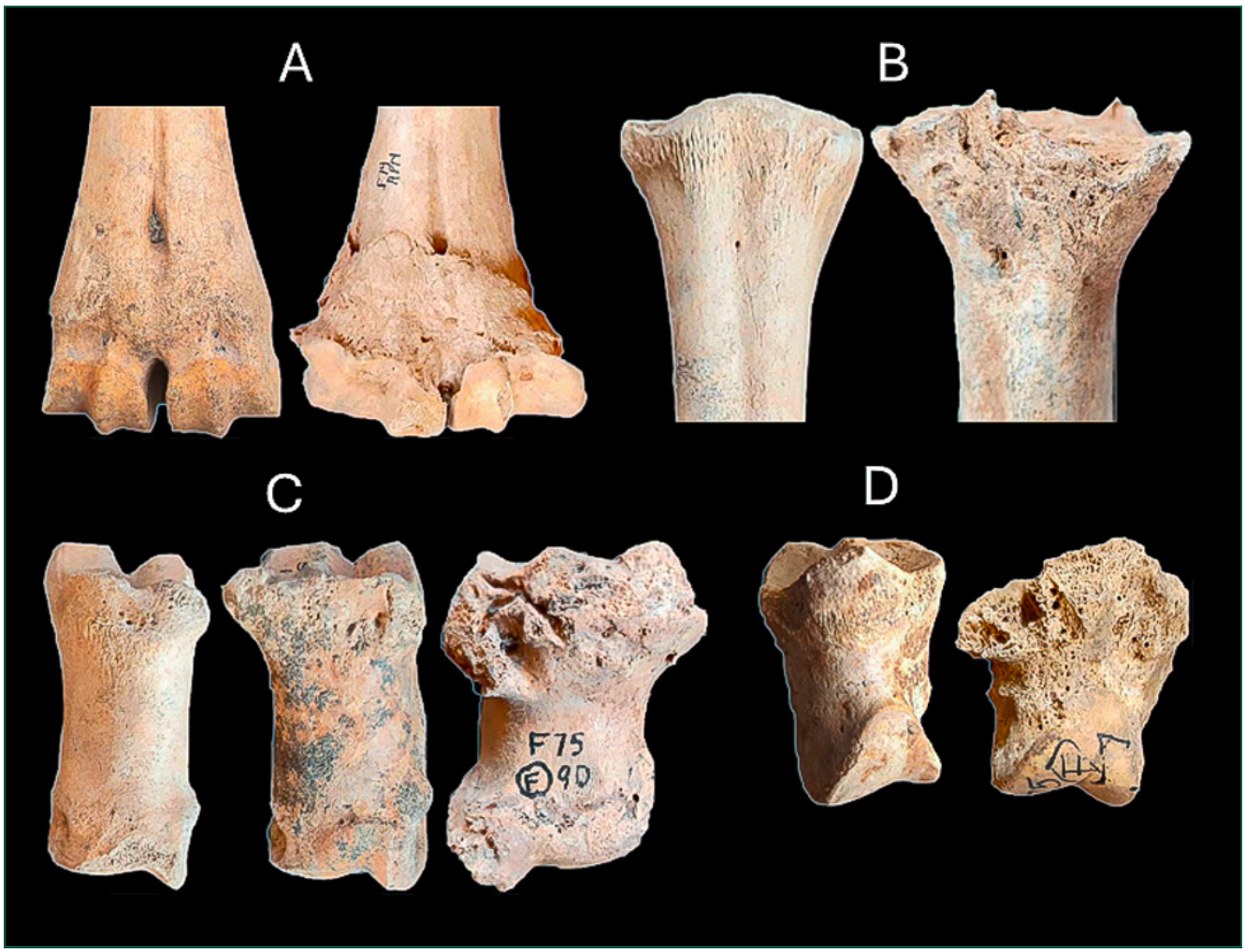


Fig. 10 Examples of deformations affecting cattle lower leg bones. Unaffected, healthy bones are pictured on the left. A: distal metapodial; B: proximal metapodial; C: first phalanx; D: second phalanx (Image: M Holmes).

If a piece of bone loses its blood supply (because of either a fracture or a blood clot), that portion of bone will die, and the surrounding tissues try to clean up the debris. The dead fragment is called a sequestrum. If it's small enough, clean- up can be completed inside (like a small home repair where you can burn the debris in your fireplace) and there is no external evidence. If the sequestrum is larger, the clean-up process can only proceed through an opening in the surface, called a draining tract or fistula. The fistula is something that the bone tissue builds deliberately, like a chute to funnel debris outside and it is typically lined with dense bone to help channel all the debris to the outside. The lining of the fistula shows up on x-ray as a cuff of radiodense material.

Findings from a pathological examination are formulated as a "pathological anatomic diagnosis", which includes:

- The process causing the disease (e.g., inflammation),
- The time-frame (how long the process has been going on),
- An assessment of distribution (one spot in the body, vs many spots in the body) and
- The severity of the process (i.e., how much did it affect the animal's function).

Even if you can see all the animal's tissues and know the animal's history, it can be hard to get consensus among pathologists regarding diagnoses, leading to the joke that 'if you ask five different pathologists, you will get 6 different opinions'. In spite of the general truth in that little joke, all five of the US veterinary pathologists who considered this bone agreed that the most likely sequence of events in this case was:

An open fracture with contamination of the wound, followed by prolonged inflammation (months to years in duration!) and the development of a fistula. During this time the animal would have been three-legged lame, making it likely that humans were caring for it during its disability.

Zooarchaeology

Zooarchaeology has been a distinct sub-discipline of archaeology since the 1960s and from the beginning bones exhibiting pathologies (changes caused by disease) and sub-pathologies (deformations that may not be related to disease) have been recorded and their origin a matter of speculation. One of the areas of palaeopathology (the study of bone disease in ancient specimens) that has created a large body of work concerns the use of animals for draught work. Archaeologically it is important to be able to understand developments in animal power, having inferences for domestication, agriculture, economy and human-animal relationships.

As described above, bone has a very structured response to trauma, resulting in loss or addition, depending on the nature and location of that trauma. Groundbreaking research using the lower limbs of cattle with known life histories found a correlation between these changes and cattle used for draught work[4]. Archaeological examples of the types of changes to the bones of cattle lower legs and feet are provided in Figure 10, which illustrates how severe these effects can be. Subsequent studies have built on this work making it more applicable to archaeological material, taking into account the effect of sex, age and weight[5]. Some deformations are more common in older animals, related to diseases such as osteoarthritis, while larger, heavier, male cattle are also more likely to be affected by these pathological changes. Conversely, younger animals are less likely to exhibit deformations that may take months or years to develop.

The results of research into draught related skeletal changes are useful for answering specific questions, but if considered on a broader scale it raises several observations that should be taken into account by those working with draught animals and zooarchaeological material alike:

- Younger animals rarely exhibit bone deformations linked to draught work. It is notable that none of the studies recorded draught animals less than six years of age.
- Older and larger animals are more likely to develop bone changes linked to draught work.
- Animals with moderate to heavy workloads will potentially exhibit pathological or sub-pathological changes to a greater extent than those with light workloads even if the latter work for several years.
- Animals with heavy workloads used for one season are less likely to exhibit pathological or sub-pathological changes.
- It is hard to tell how severely an animal has been affected by bone changes, but the potential for deformations to limit joint flexibility and cause pain has implications for the welfare of draught animals.

In summary, we have well-established methods for recording changes to cattle bones that can result from draught work. We can compare the severity and take age and size into consideration but cannot say with any certainty how that animal may have been affected, or how much work the animal was asked to do, the nature of that work, or how long the animal was working for. Similarly, animals that were worked when young, with minimal workloads or over a short period of time will be invisible in the archaeological record.

Bibliography

Bartosiewicz et al. 1997 L. Bartosiewicz, W. Van Neer and A. Lentacker, Draught Cattle: Their Osteological Identification and History. Musee Royal de L'Afrique Centrale Belgique, Annales Sciences Zoologiques 281 (Tervuren 1997).

Carlson Dietmeier 2018 J. K. Carlson Dietmeier, The oxen of Oxon Hill Manor: pathological analyses and cattle husbandry in eighteenth-century Maryland. International Journal of Osteoarchaeology 28(4) (2018), 419-427.

Damminger / Gross 2009 F. Damminger, U. Gross, Zur Ausgrabung und Erforschung einer Wüstung in Mannheim-Vogelstang. Ein Beitrag zur früh- bis hochmittelalterlichen Siedlungsgeschichte am unteren Neckar, in: J. Biel (Ed.), Landesarchäologie. Festschrift für Dieter Planck zum 65. Geburtstag (Stuttgart 2009), 557-584.

Holmes et al. 2021 M. Holmes, R. Thomas, H. Hamerow, Identifying draught cattle in the past: lessons from large-scale analysis of archaeological datasets. International Journal of Paleopathology 33 (2021), 258-269.

Thomas et al. 2021 R. Thomas, L. Bellis, R. Gordon, M. Holmes, N. Johannsen, M. Mahoney, D. Smith, Refining the methods for identifying draught cattle in the archaeological record: lessons from the semi-feral herd at Chillingham Park. International Journal of Paleopathology 33 (2021), 84-93.

4 Bartosiewicz et al. 1997.

5 Carlson Dietmeier 2018; Holmes et al. 2021; Thomas et al. 2021.

Author info
Barbara Corson
Retired Veterinarian, Animal Pathologist
E-Mail: hooftales@msn.com

Author info
Matilda Holmes
Consultant Zooarchaeologist
E-Mail: mattibee.holmes@gmail.com

Interpreting Palaeopathology: biographies of two draught oxen

Matilda Holmes, Barbara Corson, Claus Kropp

Abstract

The use of animal power in early cultures revolutionised agriculture and the relationships people had with animals. Attempts to identify draught animals in the archaeological record are one of the most common areas of investigation in zooarchaeological studies relating to pathological or sub-pathological deformations to bones. While such changes do affect the bones of draught animals, there are many other potential causative factors, rendering interpretation ambiguous. A recent opportunity to record the skeletons of two draught oxen with known life histories has provided new data that can be compared with archaeological material. This paper describes the skeletal modifications observed using widely accepted methods and compares findings with the biography of the animals. The results show relationships between the type of harness, persistent use of the animal on one side of a team and scale of pathological changes throughout the skeleton. Findings have the potential to refine how we identify and interpret draught animals in the archaeological record as well as informing aspects of welfare today.

Résumé

L'utilisation de la force animale dans les cultures anciennes a révolutionné l'agriculture et les relations entre les hommes et les animaux. Par la suite, les tentatives d'identification des animaux de trait dans les trouvailles archéologiques constituent l'un des domaines d'étude les plus courants dans les recherches zooarchéologiques portant sur les déformations osseuses. Si les changements pathologiques affectent effectivement les os des animaux de trait, il existe de nombreux autres facteurs potentiels, ce qui rend l'interprétation ambiguë. Une récente opportunité d'examiner les squelettes de deux bœufs de trait a fourni de nouvelles données qui peuvent être comparées avec le matériel archéologique. Cet article décrit les modifications squelettiques observées à l'aide de méthodes largement acceptées et compare les résultats avec la biographie connue des animaux. Les résultats montrent des relations entre le type de harnais, l'utilisation persistante de l'animal d'un seul côté de l'attelage et l'ampleur des changements pathologiques dans l'ensemble du squelette. Ce projet pourrait permettre d'affiner la manière dont nous identifions et interprétons les animaux de trait dans les trouvailles archéologiques, tout en fournissant des informations sur certains aspects du bien-être animal aujourd'hui.

Kurzfassung

Der Einsatz von tierischer Zugkraft in frühen Kulturen revolutionierte die Landwirtschaft und die Beziehungen der Menschen zu Tieren. In der Folge ist die Identifizierung von Zugtieren in archäologischen Funden einer der häufigsten Untersuchungsbereiche in der Zooarchäologie, die sich mit Knochenverformungen befasst. Zwar beeinflussen pathologische Veränderungen die Knochen von Zugtieren, doch gibt es viele andere mögliche Ursachen, was die Interpretation erschwert. Eine kürzlich erfolgte Untersuchung der Skelette zweier Zugochsen lieferte neue Daten, die mit archäologischem Material verglichen werden können. Dieser Artikel beschreibt die anhand allgemein anerkannter Methoden beobachteten Skelettveränderungen und vergleicht die Ergebnisse mit der bekannten Biografie der Tiere. Die Ergebnisse zeigen Zusammenhänge zwischen der Art des Geschirrs, der dauerhaften Nutzung des Tieres auf einer Seite des Gespanns und dem Ausmaß der pathologischen Veränderungen im gesamten Skelett. Das Projekt hat das Potenzial, die Identifizierung und Interpretation von Zugtieren in archäologischen Funden zu verfeinern und gleichzeitig Aufschluss über Aspekte des heutigen Tierschutzes zu geben.

Resumen

El uso de la fuerza de tracción animal en las primeras culturas revolucionó la agricultura y las relaciones entre el hombre y los animales. En consecuencia, la identificación de ganado de tiro en hallazgos arqueológicos es uno de los campos de investigación más comunes en la zooarqueología, que se ocupa de las deformaciones óseas. Aunque los cambios patológicos afectan a los huesos del ganado de tiro, existen muchas otras causas posibles, lo que dificulta la interpretación. Un estudio reciente de los esqueletos de dos bueyes de tiro ha proporcionado nuevos datos que pueden compararse con el material arqueológico. Este artículo describe los cambios esqueléticos observados mediante métodos generalmente aceptados y compara los resultados con la biografía conocida de los animales. Los resultados muestran la relación entre el tipo de arnés, el uso prolongado del animal en un lado del tiro y la dimensión de los cambios patológicos en todo el esqueleto. El proyecto tiene el potencial de perfeccionar la identificación e interpretación del ganado de tiro en los hallazgos arqueológicos, al mismo tiempo, proporcionar información sobre aspectos relacionados con el bienestar animal en la actualidad.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 116-123. DOI: https://doi.org/10.11588/propylaeum.1713.c25099

Methods

The skeletal remains of two draught oxen were examined macroscopically and recorded in detail with the aim of providing data to investigate the extent to which the working lives of the two oxen are reflected in skeletal changes, and to test commonly used zooarchaeological methods to analyse size, age and sex of cattle in the archaeological record. Recording focused on pathological and sub-pathological observations and measurements of the long bones and skull. In addition, basic data such as anatomy, side, tooth wear, fusion of the epiphyses and butchery were recorded. All elements were photographed and weighed. Data are available at https://doi.org/10.6084/m9.figshare.30665003.

Recording pathological and sub-pathological changes

Traditional zooarchaeological methods employed to investigate the use of cattle for draught work has focused on the autopodia (metapodials and phalanges) and horns[1]. Bartosiewicz et al. provided methods to record changes affecting the autopodia by ascribing a score to the severity of changes on a scale of 1 (none) to 4 (severe). These scores can be converted into a *pathological index* to summarise the extent of the changes in an animal or population of animals within the archaeological record. Subsequent research has been carried out to refine these methods, taking into account the effect of fragmentation, body weight/ size and age on the pathological and sub-pathological changes observed. The resulting *modified pathological index* (mPI) devised by Holmes et al. was used to record deformations of the autopodia of the two cattle[2].

Deformations of other elements (skull, vertebrae, long bones and pelves) do not currently have a recognised recording protocol, but basic pathological indices were assigned to them to make the extent of changes comparable to those for autopodia. This presents a new method that is open to refinement. For definitions of terminology see *Histories written in (cattle) bone – an archaeozoological and osteological perspective* (this volume).

Crania: symmetry of the skull was investigated by taking measurements along the midline above the os nasale along the entire os frontale up to the frontal eminence to determine any axial deviations.

Vertebrae: a scale of severity was devised to record pathological and sub-pathological changes. The following deformations were recorded and are illustrated in ***Figure 1***: Pitting (scale of 0-3), grooving (scale of 0-2), enthesophytes (scale of 0-3), osteophytes (scale of 0-2) and eburnation (presence of absence) on the cranial and caudal articular surfaces; osteophytes and enthesophytes of the lateral processes; asymmetry (presence or absence) of the dorsal and ventral processes; enthesophytes affecting the dorsal process; and articular contour change. In all cases 0 represents no change, and the higher numerical value represents most severe change.

Long bones and pelves: The presence or absence of enthesophytes, osteophytes, eburnation, grooving and pitting was recorded for the proximal and distal articulations and shafts as well as any asymmetry, fused elements or other lesions.

Values were ascribed to the deformations of the vertebrae and long bones to allow them to be easily compared with the autopodia:

Pathological value = score/ total possible score*

*the total possible score includes only observable zones, for example, where metatarsals have fused tarsals at the proximal articulation the score did not include pitting, eburnation or grooving as it was impossible to record these changes.

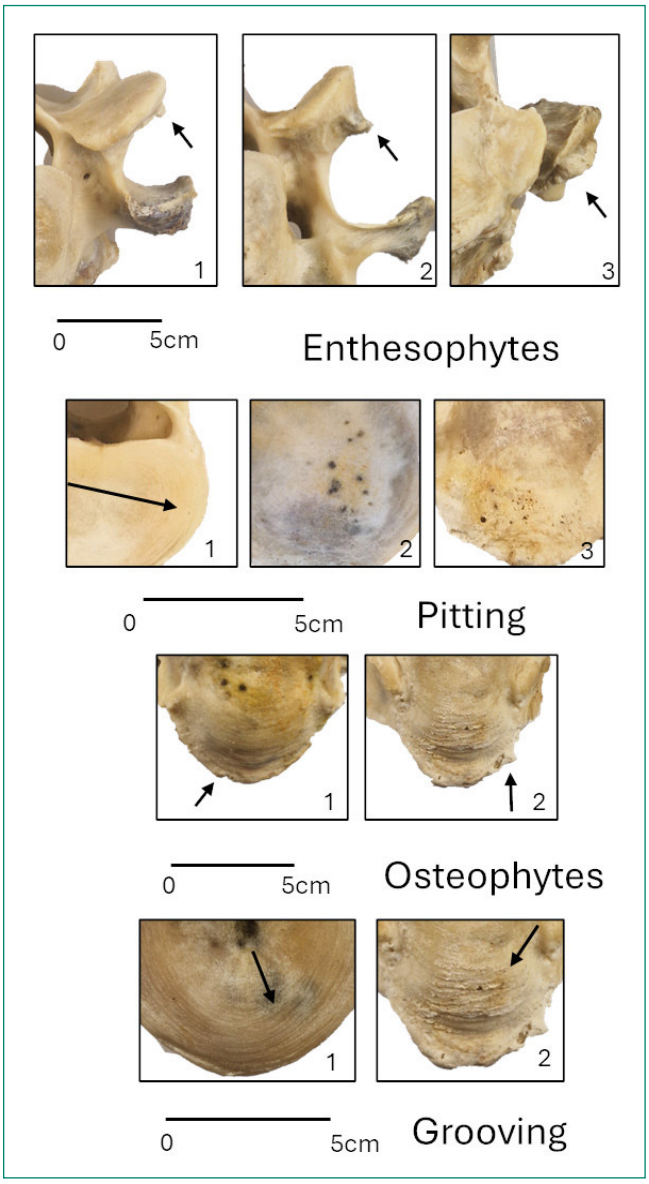


Fig. 1 *Scale of deformations recorded for vertebrae.*

Measurements

Long bone measurements were recorded following von den Driesch[3]. Sex was investigated using pelvis morphology[4] and metacarpal measurements[5]. Heights were calculated using greatest length measurements of the long bones[6].

1 Holmes et al. 2021, Thomas et al. 2021, Bartosiewicz et al. 1997, Onar and Kahvecioğlu 2015.
2 Holmes et al. 2021.
3 Von den Driesch 1976.
4 Greenfield 2006.
5 Davis et al. 2012.
6 Matolcsi 1970.

Biographies

Mani (***Figures 2 and 3***)

Mani was a draft ox of the Vosges breed, just under eleven years old at the time of slaughter, with a withers height of 145 cm and a live weight of 780 kg. He started work at two and was castrated at the age of three. On the farm in the French Vosges mountains, Mani was harnessed in a double head yoke as a team of two, mostly on the right side. The ox's workload was considerable: mainly used for logging, transporting hay and manure and haymaking, in particular turning and raking hay. During the summer there were peaks of up to 5 hours of work per day, 5 days a week. The nature of the landscape meant that Mani worked primarily on slopes, some very steep. During the growing season, the ox was usually kept outside, while in winter he was housed in a stone barn with a hard floor. Until the time of slaughter, he was still regularly used for work.

Fig. 2 *Mani logging in the Vosges mountains with his owner Philippe Kuhlmann and wearing a double head yoke (Photo: M. Nioulou).*

Fig. 3 *Mani (on the left) during a heavy pull in a double head yoke. Visible is the asymmetrical tension in the neck area due to different head positioning of the two animals (Photo: M. Nioulou).*

Videos of Mani moving at work and being led in hand were examined by B. Corson. There was no obvious lameness in any single limb, though several indications of altered musculoskeletal and/ or neurological dysfunction were observed:

- Asymmetrical oscillations of the body when walking, with the body curving more strongly to the right than the left;
- Asymmetrically shortened stride length in the hind limbs (failure to “track up”), the right subjectively more severe than the left;
- Occasional slight circumduction of the right hind limb;
- Inconsistent toe dragging in both hind limbs;
- Asymmetry of the pelvic landmarks, with the right ilium and ischium subjectively lower than the right;
- Occasional abrupt tail swishing, consistent with discomfort, pain or irritation.

Darius (***Figures 4 and 5***)

Darius was a draft ox of the Rhaetian Grey breed, slightly over twelve years old at the time of slaughter, with a wither height of 138 cm and a live weight of 700 kg. He started work at two and was castrated at the age of two and a half years. Darius was usually harnessed in a three-pad collar and used in a team and for individual tasks. His workload was not particularly hard in his early years; it was only from the age of six onwards that he was used for more demanding agricultural work such as ploughing. During particularly intensive work phases, Darius was used up to four times a week for 1-3 hours per day, almost exclusively on flat terrain. The ox was kept outdoors all year round, but had a straw-strewn shelter available during the winter months.

For the six months prior to slaughter, Darius was no longer used for heavy work, as he had developed signs of pain in the shoulder area while pulling heavy loads.

Fig. 4 *Draft ox Darius in 2017 during an agricultural field day harnessed with a three-pad collar (Photo: M. Funke).*

Fig. 5 *Darius during heavy plowing as a single in a three-pad collar (Photo: A. Keil).*

Results – Mani

Age, sex, height

The mandibular wear stage was calculated at J, consistent with an animal between 8 and 16 years of age. Although all long bones were fused, the second cervical to tenth thoracic vertebrae had incomplete fusion of the anterior and ventral physes (***Figure 6***). The pelvis was morphologically consistent with a male, and the metacarpal measurements plotted with males[7].

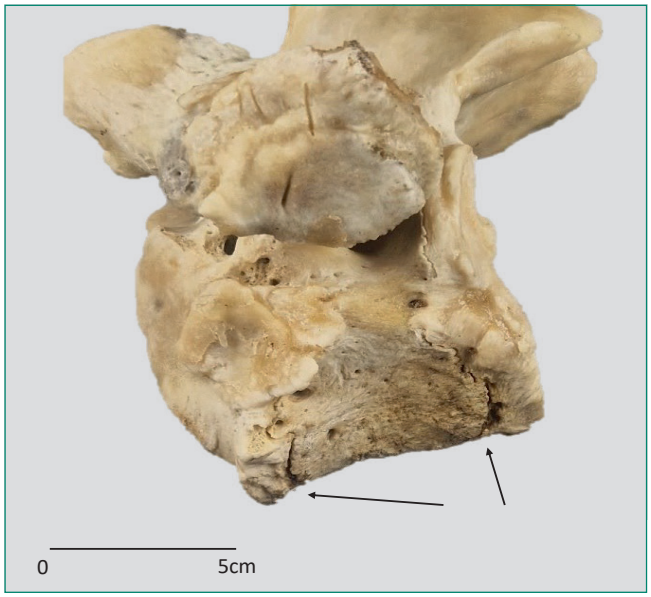


Fig. 6 *Fusion line of physis on a thoracic vertebra.*

Depending on the long bone used to calculate them, heights ranged from 153cm to 175cm (mean= 164cm; median= 161cm), and all measurements from the left side were slightly lower than the right side (***Table 1*** *in Suppl. Data Rep.*). A paired sample T-test was used to compare the lengths of the major long bones from both sides, which produced a significant difference (t= -3.97, p= 0.01), with those on the left (mean= 38.5; SD= 10.8) being shorter than those on the right (mean= 38.7; SD= 10.7).

Axial skeleton

Skull – axial asymmetry was observed visually and confirmed by the metrical data: the frontal bone above the orbita was deformed a maximum of 12mm towards the left (***Figure 7***). There was bilateral malocclusion of the second premolars and first molars of the maxillae and mandibles.

Fig. 7 *The skull of Mani illustrating the asymmetry in the longitudinal plane.*

Vertebrae - considerable deformations affected all, but particularly the second cervical to the seventh thoracic vertebra (***Figures 8*** and ***9***). All ribs exhibited eburnation and articular contour change.

Pelvis– the pelvis was fused at the pubic symphysis and as well as exhibiting prolific enthesophytes and osteophytes, the acetabular rim had slight articular contour change and eburnation.

Upper limb bones

Enthesophytes were present and common on all upper limb bones, to the point that recording each individually was hindered by the time available. Instead, each bone was photographed to illustrate the nature of the enthesophytes (available in the supplementary data). ***Table 2*** (in Suppl. Data Rep.) and ***Figures 8*** and ***9*** summarise the pathological changes affecting the major limb bones.

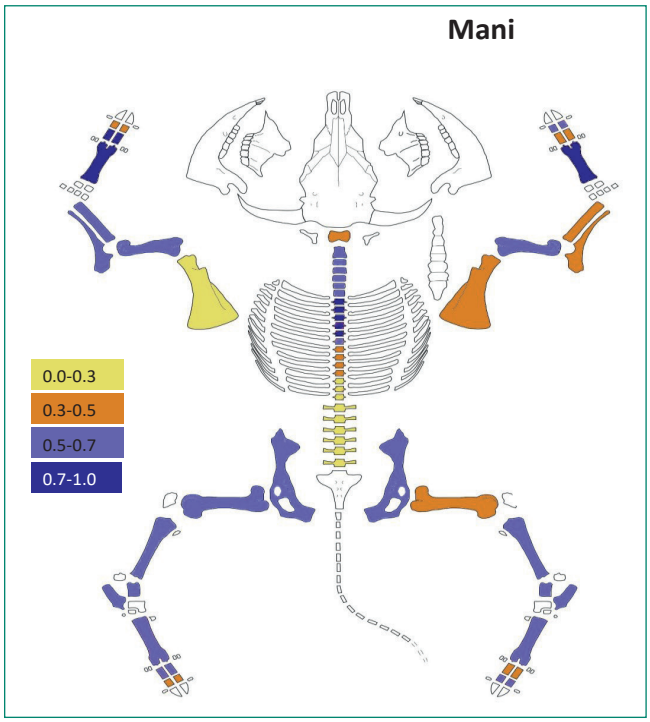


Fig. 8 *Relative severity of deformations affecting the skeleton of Mani.*

Scores ranged from 0.20 (right scapula) to 0.63 (tibiae) and were generally similar for the left and right sides, except for the right radius and ulna and right femur, which were less affected than those of the left. Of note were the scapulae, both of which had relatively low scores when compared to other elements; fusion of the left os malleolare to the left distal tibia; and both astragali that had considerable deformations due to the broadening of the distal end (***Figure 10***). Carpals were also commonly affected; and the left radial and lunate were fused together.

Autopodia

The autopodia pathology scores are slightly greater for the foreleg (anterior), ranging from 0.45 to 0.88, than the hindleg (posterior), ranging from 0.38 to 0.64. This is to be expected as the forelimbs carry most weight in cattle and so are affected by pathological and sub-pathological changes more than those of the hindlimbs[8].

7 Davis et al. 2012.

8 Bartosiewicz et al. 1997, Holmes et al. 2021, Thomas et al. 2021.

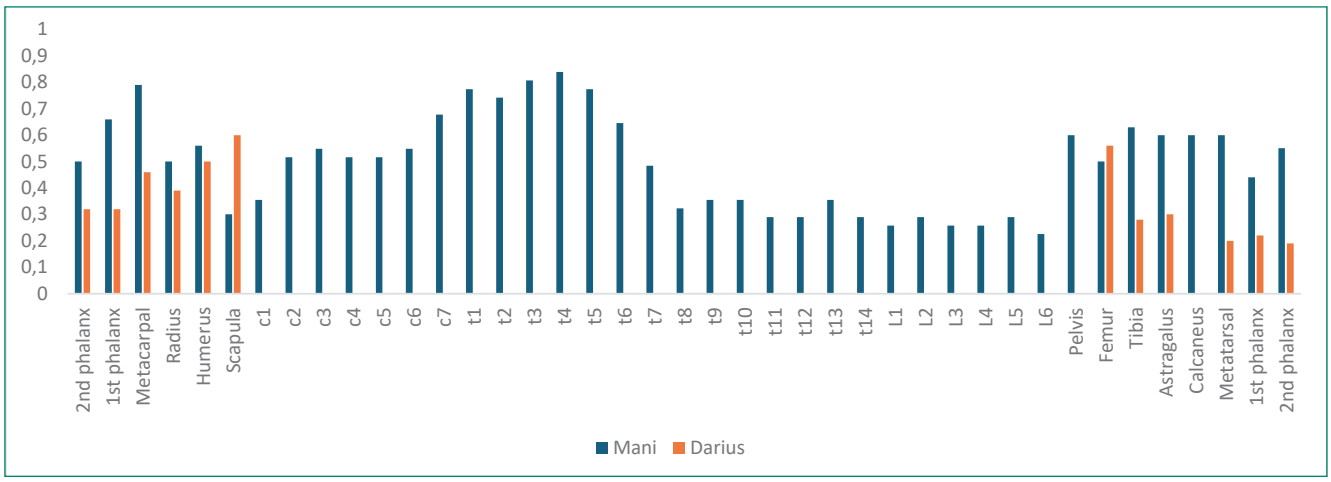


Fig. 9 Relative severity of deformations affecting the major limb bones, combined scores

All pairs of sesamoids were fused together, except for one pair from the right foreleg. All had articular contour change and one of those from the left hind limb had grooving.

There was no significant difference between the left and right scores of the upper limb bones or autopodia when tested with a paired T-test.

Results – Darius

Age, sex, height

As with Mani, the mandibular wear stage indicates that Darius was between 8 and 16 years of age. All long bones were fused. Although the pelvis was not present, the metacarpal measurements were consistent with a male. The mandible exhibited bilateral malocclusion of the lower second premolar.

Fig. 10 Illustration of deformation affecting the right astragalus of Mani, observed as broadening of the distal trochlea.

Heights varied from 147cm to 162cm (mean= 154cm; median= 154cm) (***Table 1*** in Suppl. Data Rep.) and there was no statistical difference between the left and right sides when compared with a paired T-test (t= 1.62, p= 0.16).

Axial skeleton

The skull, vertebrae and pelves were not available.

Upper limbs

Scores ranged from 0.0 (right astragalus and both calcanea) to 0.7 (left femur) (***Table 2*** in Suppl. Data Rep., ***Figures 9*** and ***11***), with both scapulae also scoring high (0.6). Although there was no significant difference between the pathological scores of the left or right sides, the right humerus and astragalus and left femur were more affected than their associated element.

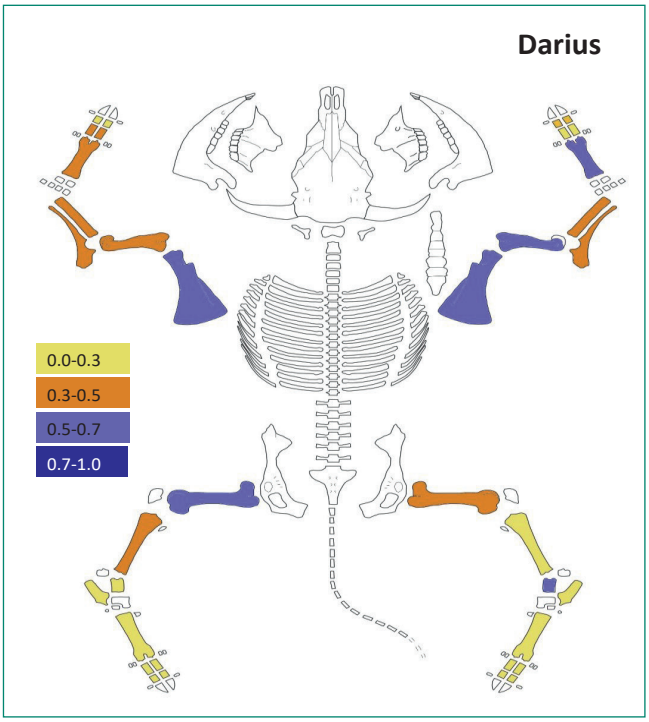


Fig. 11 Relative severity of deformations affecting the skeleton of Darius.

Autopodia

Pathological indices for the autopodia ranged from 0.25 to 0.50 for the forelegs and 0.14 to 0.25 for the hindlegs (***Table 2*** in Suppl. Data Rep., ***Figures 9*** and ***11***).

There was no significant difference between the left and right scores of the upper limb bones or autopodia when tested with a paired T-test.

Discussion

Skeletal analysis of the two draught cattle allowed the testing of commonly used zooarchaeological sexing and ageing methods, which provided consistent data reflecting the known life histories of the two oxen. However, the heights calculated from the lengths of bones using widely accepted indices were greater than the live values for both animals, the means varying by c.19cm for Mani and c.16cm for Darius. The range of heights calculated using different bones also varied considerably: a discrepancy of nearly 20cm for Mani and 15cm for Darius. Taken together, this suggests that the use of absolute heights with archaeological data should be treated with caution.

The incomplete fusion of Mani's cervical and thoracic vertebrae was unexpected. These bones are expected to close in the fifth year[9], although a study of 112 modern bulls of 6 breeds, ranging from 1 to over 15 years found that in 5-year-old bulls at least half the vertebral epiphyses were fused, while only 10% of the thoracic vertebrae remained open at 6-years of age[10]. It may therefore be expected, under normal circumstances and taking into account delayed fusion caused by castration, that fusion would be complete in an animal as old as Mani. Given that Mani began work at 2 years, before the cervical and thoracic vertebra had completely fused, it is possible that the subsequent strain from his workload prevented them from doing so.

Overall, the combined, comparable, limb and autopodia scores for Mani (mean= 0.54, SD=0.16) were significantly greater (t= 4.2, p= <.005) than Darius (mean= 0.33, SD= 0.19). Although they used an unmodified pathological index, the autopodia pathological index values for working oxen (between 0.17 and 0.40) recorded by Bartosiewicz[11] were comparable to those of Darius (0.28) both being considerably lower than the scores for Mani (0.59).

This implies that Mani was severely affected by his working life to a greater extent than Darius. While it is possible that Mani could have had a systemic pre-disposition to bone deformations, the combination of enthesophytes recorded on all long bones indicating strain placed on the soft tissues and differences between the severity of pathological indices between the left and right sides (radius/ ulna and femur), indicates that the cause was more likely to be external. Furthermore, these findings are consistent with the observable asymmetry in Mani's gait described above.

One likely factor causing such a difference in the pathological scores of the two oxen is the different workloads they were subjected to. For example, where Mani had to work up to 5 hours, walking over 20 km a day during the hay season, Darius would have worked for only a few hours maximum. The landscape would also have had an effect as Mani worked on steep hillsides, while Darius only ever had to work on flat land.

As well as having distinct workloads, the two oxen were harnessed differently, and it is likely that some of the pathological and sub-pathological changes reflect this. The double head yoke (used by Mani), especially when employed on steep terrain, has specific characteristics:

- Individual animals do not pull in a straight line, but tend to push either toward the centre of the yoke (where the chain is attached) or outward. This leads to asymmetrical strain on the head, front limbs and spine.
- Since the yoke is attached behind the horns in the neck area (with the pull being taken up by the forehead plate), use on steep terrain or with animals of different sizes also leads to increased, sometimes asymmetrical tension and pressure points from the yoke bow in the animals' neck area.
- With a head harness, the pulling force is taken from the forehead area and, accordingly, changes in the pulling angle are compensated for by a change in head posture. This, in turn, has an impact on the skull and spine.

All three of these aspects of the double head yoke may explain the high pathological scores of Mani's second cervical to seventh thoracic vertebrae, and the asymmetrical morphology of those vertebrae and the skull itself. The position of Mani on the right side of the pair is also consistent with the shorter limb bones, greater deformation scores and pathological scores of some left elements that combine to suggest he placed more weight on the inside during his working life.

The skull is complex in its development, functions and adult morphology. It is difficult to measure with consistency, but Mani's skull was markedly asymmetrical. The causality of asymmetry can be difficult to assess, as it could potentially be affected by adaptive and functional vs mal-adaptive/ pathological factors[12]. However, it remains possible that it was caused or exacerbated by his pushing into the left side of the head yoke.

The use of an adjustable three-pad collar, such as that used by Darius, also has specific effects on the animal:

- 90% of the pull is taken up by the shoulders and only 10% by the neck.
- If the collar padding is misaligned due to a pull angle that is too flat or too steep, there can be uneven strain on the shoulder joint. Unlike the head yoke, animals cannot correct the pull angle themselves.

Although no vertebrae were available for Darius, his scapulae and right humerus had high scores, the former were affected to a greater extent than those recorded for Mani (***Table 2*** in Suppl. Data Rep.). It is highly likely that this reflects the use of the three-pad collar, which would have transferred the load into Darius shoulders. There is no one-sided tension produced by a three-pad collar and this can be observed in the similar bone measurements and pathology scores from left and right sides.

Conclusion

Bone disorders are multifactorial and complex, so caution must be taken when drawing conclusions relating to the

9 Silver 1969.

10 Thomson 1969.

11 Bartosiewicz et al. 1997. Table 18

12 For example, Ono et al 2023 and Frost 2003.

cause and effect of pathological and sub-pathological changes in isolation. However, this study has served to illustrate that inferences can be made, even if tentatively, when such deformations are integrated with known life histories. Further work needs to be carried out on similar animals to place the results of this investigation in context, but as a preliminary study it has provided a base line data set for future studies that might incorporate upper limb bones and the axial skeleton.

From an animal health perspective, additional methods for investigating changes in the skull and other skeletal tissues could include serum chemistry and hormone levels in the living animal and histology, radiology, or mineral analysis in postmortem samples. Many studies have examined the effect of occupations on the human skeleton[13] and animals[14] but studies of the effects of work on draught cattle tissues are less common. This study has shown how severe such changes can be, and this and future investigations will be crucial to inform better health and welfare in working animals. The combination of a greater workload, harness and extreme terrain have affected the skeleton of Mani to a much greater degree than Darius, and factors such as these should be taken into account when working with animals and some allowance given to duration and nature of the work and harnessing choices if possible. The importance of using a well-matched pair of cattle in a head yoke has been reinforced by the asymmetry affecting Mani. The pressure of the three-pad harness is also not without adverse effects, possibly causing lameness observable as deformations to the shoulders (scapulae and right humerus) in Darius.

In zooarchaeology, consideration of the skeletal changes to draught cattle have focused largely on the autopodia and, less commonly, the horns, skull and pelvis. This study has shown that the upper limbs and vertebrae can be affected as much as the lower limbs and that there is potential for detailed biographies to be attempted from complete skeletons in the archaeological record, illustrating the potential for different harnessing methods to affect the skeleton, in particular the axial skeleton, scapulae and femora. This method is in its infancy, and is not without challenge, but it is hoped that it will provide a stepping stone for more detailed consideration of the pathological and sub-pathological deformations affecting the whole body of working animals.

Note: From experience, M Holmes notes that the pathological and sub-pathological changes recorded on Mani's bones are greater than any she has observed on cattle in the archaeological record. This suggests he was potentially subjected to more intense work, over a longer period than many of those draught animals in our past. Comparisons are easier to make with horse remains, which commonly exhibit enthesophytes, exostoses, articular contour change and osteophytes similar to those recorded on Mani. However, Mani represents one animal, who may have been susceptible to bone deformations and further work needs to be carried out on other working animals with known biographies.

13 For example Barbe and Popoff 2020, Gemne and Saraste 1987, Alves-Cardoso and Assis 2021.

14 For example Salmi et al. 2020, Broster et al. 2009, Diedrich 2017.

Bibliography

Alves-Cardoso / Assis 2021 F. Alves-Cardoso, S. Assis, Exploring "wear and tear" of joints and "muscle function" assumptions in skeletons with known occupation at death. *American Journal of Physical Anthropology,* 175(3) (2021), 689-700.

Bartosiewicz et al. 1997 L. Bartosiewicz, W. Van Neer and A. Lentacker, Draught Cattle: Their Osteological Identification and History. Musee Royal de L'Afrique Centrale Belgique, Annales Sciences Zoologiques 281 (Tervuren 1997).

Barbe / Popoff 2020 M.F. Barbe, S.N. Popoff, Occupational activities: factors that tip the balance from bone accrual to bone loss. Exercise and sport sciences reviews, 48(2) (2020), 59-66.

Broster et al. 2009 C. Broster, C. Burn, A. Barr, H. Whay, "The range and prevalence of pathological abnormalities associated with lameness in working horses from developing countries." Equine Veterinary Journal, 41(5) (2009), 474-481.

Davis et al. 2012 S.J. Davis, E.M. Svensson, U. Albarella, C. Detry, A. Gotherstrom, A.E. Pires, C. Ginja, Molecular and osteometric sexing of cattle metacarpals: a case study from 15th century AD Beja, Portugal, Journal of Archaeological Science 39 (2012), 1445-1454.

Diedrich 2017 C. Diedrich, Pathologic historic mining horses from central Europe. Journal of Pathology and Disease Biology, 1 (2017), 8-33.

Frost 2003 H.M. Frost, Bone's mechanostat: A 2003 update. The Anatomical Record, Part A 275A (2003), 1081-1101.

Gemne / Saraste 1987 G. Gemne, H. Saraste, Bone and joint pathology in workers using hand-held vibrating tools. Scandinavian Journal of Work, Environment and Health, 13 (1987), 290-300.

Greenfield 2006 H. Greenfield, Sexing fragmentary ungulate acetabulae. In: D. Ruscillo (ed.), Recent Advances in Ageing and Sexing Animal Bones. Oxbow (Oxford 2006). 68-86.

Holmes et al. 2021 M. Holmes, R. Thomas, H. Hamerow, Identifying draught cattle in the past: lessons from large-scale analysis of archaeological datasets. International Journal of Paleopathology 33 (2021), 258-269.

Matolcsi 1970 J. Matolcsi, J., Historische Erforschung der Körpergrösse des Rindes auf Grund von ungarischem Knochenmaterial. Zeitschrift für Tierzüchtung und Züchtungbiologie, 87(2) (1970), 89-137.

Onar / Kahvecioğlu 2015 V. Onar, K.O. Kahvecioğlu, Osteological evidences of Byzantine draught cattle from Theodosius Harbour at Yenikapi, Istanbul. Mediterranean Archaeology and Archaeometry, 15(2) (2015), 71-80.

Ono et al. 2023 S. Ono, C. Tachiki, T. Morikawa, Y. Aihara, S. Matsunaga, K. Sugahara, A. Watanabe, T. Kawamata, Y. Nishii, Morphological Evaluation of Cranium Facial Asymmetry in Class III Malocclusion Patients. Applied Sciences, 13(11) (2023), 6533-6545.

Salmi et al. 2020 A-K. Salmi, S. Niinimäki, T. Pudas, Identification of working reindeer using palaeopathology and entheseal changes. International Journal of Paleopathology, 30 (2020), 57-67.

Silver 1969 I.A. Silver, The ageing of domestic animals, in: D.R. Brothwell, E.S. Higgs (Eds.), Science and Archaeology, Thames and Hudson (London 1969), 283-302.

Thomas et al. 2021 R. Thomas, L. Bellis, R. Gordon, M. Holmes, N. Johannsen, M. Mahoney, D. Smith, Refining the methods for identifying draught cattle in the archaeological record: lessons from the semi-feral herd at Chillingham Park. International Journal of Paleopathology 33 (2021), 84-93.

Thomson 1969 R.G. Thomson, Vertebral body osteophytes in bulls. Pathologia Veterinaria, 6(1) (1969), 1-71.

von den Driesch 1976 A. von den Driesch, A Guide to the Measurement of Animal Bones from Archaeological Sites, Harvard University Press (Cambridge, Massachusettes 1976).

Author info
Matilda Holmes
Consultant Zooarchaeologist
E-Mail: mattibee.holmes@gmail.com

Author info
Barbara Corson
Retired Veterinarian, Animal Pathologist
E-Mail: hooftales@msn.com

Author info
Claus Kropp
Manager Lauresham Laboratory of Experimental Archaeology
Center for Draft Cattle Research and Education
UNESCO World Heritage Site Lorsch Abbey
Nibelungenstr. 32 – 64653 Lorsch – Germany
E-Mail: c.kropp@kloster-lorsch.de

Concluding Remarks

Rob Collins

For much of the past 20 years, I have been a volunteer, then an instructor, and finally a board member for Tillers International. In the instructor role, I teach students, historians, homesteaders, international guests, and hobbyists the craft of working oxen. I also teach classes in woodworking and traditional crafts. In most woodworking and oxen classes, I begin with the same joke: most traditional skills can be done six ways. Two of those six ways are arguably the "best" way – although experts may disagree as to which is truly the best. Another two of the six will work under less-than-ideal conditions. The final two ways are likely to injure or kill you. The essential task in teaching traditional skills, then, is to move toward the best practices, understand the times when compromise is necessary, and to gently abandon those things which can, and should, be replaced.

These proceedings contain a wide-ranging look at the state of draft cattle around the world in 2024. Some of it is clearly the 'state of the art:' those practices which have worked for millennia and – although they may differ across cultures – represent effective and efficient practices. Examples here would be the German three-pad collar and the American-style bow yoke. In the summer of 2025, I spent a week at Lauresham with Claus Kropp and now he is employing a Tillers' bow yoke for some tasks, while I am home in the United States prototyping three-pad collars for possible work in the developing world.

Some practices documented within these proceedings fall into a middle group: places and situations where draft cattle are being used, but not necessarily maximized, due to various cultural or economic factors. Where draft cattle and oxen are used only for primary tillage, for example, we can envision opportunities for expanded use in weed control, power generation, transport, or road building. Where farmers revert to less-than-ideal equipment because of economic barriers, we can imagine possibilities rather than obstacles.

Also reported in these proceedings – notably in Barbara Corson's and Matilda Holmes's work on skeletal pathologies – are practices to include in that third category mentioned earlier: those lessons that act as cautionary tales and those practices to be avoided whenever possible. For draft cattle to remain viable, we need to work to replace injurious hitching and harnessing methods from the past with low-stress training and ergonomic equipment.

So now what? Seeing these proceedings as a snapshot of best practices, opportunities, and existing challenges in 2024, the danger is that we also see them as just part of the lexicon of oxen and draft cattle literature, a document to go on a shelf for reference sometime, someday.

But 'someday' has arrived. These proceedings are a call to action, or rather, several calls to action. A single path won't ensure the viability of oxen and draft cattle going forward, just as no single event or action tipped the scales away from their widespread usage. As members of the draft cattle community, none of us can complete this work alone; together, sharing the load, we can preserve the knowledge and skills of working cattle -this intangible culture- provided that we commit to gathering and sharing it faster than it is being lost.

No matter the connection to the draft community, we have a role to play. Historians: collecting examples of oxen culture from around the globe may be more important now than ever. Open air museums have become the first, and often only, place where the public sees oxen working. As that touchstone, we need to advocate for more usage of draft cattle in institutional settings. Scientists and researchers: objectively testing yokes, harnesses, equipment, and methods in both the laboratory and the field lends a seriousness to draft cattle. Teachers and leaders: intentionally building networks for sharing knowledge, techniques, and objectives will facilitate better adoption of draft cattle as a workable solution to future agricultural problems. Writers and thought leaders: changing the narrative about working cattle as a realistic option will shift political will to incentivize their use. And finally, practitioners and farmers: employing draft cattle while adapting and reinventing their use will show the world in clear terms that the past and future are as one and that humans remain 'cattle people.'

Clearly, these roles need to interconnect. For too long, a hindrance to oxen and draft cattle culture was its fragmented nature. Best practices lived in isolation. Deeply held traditions resisted change either by distance or intent. Innovation and exchange seemed threatening. With these proceedings, however, that work – and the support of our fellow travelers – seems a bit more certain.

Published in: Staatliche Schlösser und Gärten Hessen, Claus Kropp (Eds.), Draft Cattle: their history, value and significance with a global perspective (Heidelberg, Propylaeum 2026), 124-125. DOI: https://doi.org/10.11588/propylaeum.1713.c25100

Fig. 1 *Annual meeting of the Midwestern Ox Drovers Association (USA) at Tillers International in 2022 (Picture: MODA).*

Author info
Rob Collins

Social Studies / English Teacher
Board Chair at Tillers International
Sherwood, MI (USA)

E-Mail: rcollins@cpschools.org

Imprint

Draft Cattle: their history, significance and value with a global context

Proceedings of the World Draft Cattle Symposium (March 8–9, 2024)

Laureshamensia

Forschungsberichte des Freilichtlabors Lauresham

Special Issue 3 | 2026

Online-Issue / Print on Demand

Bad Homburg v.d. Höhe 2026

Published by Claus Kropp in association with the State Palaces and Gardens of Hesse

Responsible for the press: Kirsten Worms
State Palaces and Gardens of Hesse,
Schloss, 61348 Bad Homburg v. d. Höhe

Tel. 0 61 72 / 92 62 – 0
Fax 0 61 72 / 92 62 – 190

info@schloesser.hessen.de
www.schloesser-hessen.de

Editor
Claus Kropp M.A.

Layout Design
Michael C. Thumm

Cover:
Draft Oxen use in Holbav, Romania.
Picture: Vlad Dumitrescu.

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at https://dnb.dnb.de.

Propylaeum
FACHINFORMATIONSDIENST ALTERTUMSWISSENSCHAFTEN

The electronic open access version of this work is permanently available at https://www.propylaeum.de
urn: urn:nbn:de:bsz:16-propylaeum-ebook-1713
doi: https://doi.org/10.11588/propylaeum.1713

Published by
Heidelberg University / Heidelberg University Library, 2026
Propylaeum – Specialized Information Service Ancient Studies
Grabengasse 1, 69117 Heidelberg, Germany
https://www.uni-heidelberg.de/en/imprint
e-mail: ub@ub.uni-heidelberg.de

ISBN 978-3-96929-489-5 (Softcover)
ISBN 978-3-96929-488-8 (PDF)

unesco

Kloster Lorsch
und Altenmünster
Welterbe seit 1991

UNESCO WELTERBE
KLOSTER LORSCH

In 2024, more than 126 scientists, museum professionals as well as draft cattle practitioners gathered at the UNESCO World Heritage Site Lorsch Abbey for the first World Draft Cattle Symposium. This proceedings provides a comprehensive overview of the conference results and gives a deep insight into the history, significance and value of draft cattle with a global perspective.