

Horsepower – Innovation in small-scale agriculture and gardening

Paul Schmit



Abstract

Currently, a transnational LEADER project called “Horsepower - Innovation in small-scale agriculture and gardening” is being planned. The aim of the project, with partners from Luxembourg and Sweden, is to support smallholders and vegetable growers in their technological development and to study their social environment.

According to the current CAP (common agricultural policy) regulations in the two EU-countries involved, the project is to start in 2023 and run until 2025.

With bottom-up participation of farmers and gardeners, new horse-drawn machinery will be co-designed and tested in so-called field laboratories. During the developing process and field testing, advanced computer aided design and electronic test equipment will be used. During the project preparation, a preliminary study on these technologies was successfully carried out, using the example of a horse-drawn mechanical and selective weed cutter for grassland.

For improving the eco-balance and restoring agrarian landscapes, the focus will lie on new tillage technologies for animal traction as well as closed nutrient and energy cycles in low-input and Agroforestry farming systems.

By networking and cross-border cooperation, the information collected will be spread as widely as possible. Therefore, public outreach with field days, online symposiums, public participation in a so-called crowdsourced science and open access publication on an innovation platform in the internet will mark the project.

Kurzfassung

Derzeit ist ein transnationales LEADER-Projekt mit dem Titel “Horsepower - Innovation in small-scale agriculture and gardening” in Planung. Ziel des Projekts mit Partnern aus Luxemburg und Schweden ist es, Kleinbauern und Gemüsebauern in ihrer technologischen Entwicklung zu unterstützen und ihr soziales Umfeld zu untersuchen.

Gemäß den aktuellen GAP-Verordnungen (Gemeinsame Agrarpolitik) in den beiden beteiligten EU-Ländern soll das Projekt im Jahr 2023 beginnen und bis 2025 laufen.

Unter Beteiligung von Landwirten und Gärtnern werden neue pferdegezogene Maschinen mitentwickelt und in sogenannten Feldlabors getestet. Während des Entwicklungsprozesses und der Feldtests werden fortschrittliche computergestützte Design- und elektronische Testgeräte zum Einsatz kommen. Während der Projektvorbereitung wurde eine Vorstudie zu diesen Technologien am Beispiel eines pferdegezogenen mechanischen und selektiven Unkrautschneiders für Grünland erfolgreich durchgeführt.

Zur Verbesserung der Ökobilanz und zur Wiederherstellung von Agrarlandschaften werden neue Bodenbearbeitungstechnologien für die Tieranspannung sowie geschlossene Nährstoff- und Energiekreisläufe in Low-Input- und Agroforstsystemen im Mittelpunkt stehen.

Durch Vernetzung und grenzüberschreitende Zusammenarbeit sollen die gesammelten Informationen so weit wie möglich verbreitet werden. Daher wird das Projekt durch Feldtage, Online-Symposien, öffentliche Beteiligung an einer so genannten Crowdsourced Science und Open-Access-Veröffentlichungen auf einer Innovationsplattform im Internet gekennzeichnet sein.

Résumé

Actuellement, un projet LEADER transnational intitulé „Horsepower - Innovation in small-scale agriculture and gardening“ est en cours de planification. L'objectif du projet, avec des partenaires du Luxembourg et de la Suède, est de soutenir les petits exploitants et les maraîchers dans leur développement technologique et d'étudier leur environnement social.

Conformément aux règlements actuels de la PAC (politique agricole commune) dans les deux pays de l'UE concernés, le projet doit démarrer en 2023 et se poursuivre jusqu'en 2025.

Avec la participation ascendante des agriculteurs et des jardiniers, de nouvelles machines tirées par des chevaux seront conçues et testées dans des laboratoires en champs. Au cours du processus de développement et des essais sur le terrain, des équipements avancés de conception assistée par ordinateur et de test électronique seront utilisés. Au cours de la préparation du projet, une étude préliminaire sur ces technologies a été réalisée avec succès, en utilisant l'exemple d'un désherbeur mécanique et sélectif tiré par des chevaux pour les prairies.

Pour améliorer l'éco-équilibre et restaurer les paysages agricoles, l'accent sera mis sur les nouvelles technologies de travail du sol pour la traction animale ainsi que sur les cycles fermés de nutriments et d'énergie dans les systèmes agricoles à faibles intrants et agroforestiers.

Grâce à la mise en réseau et à la coopération transfrontalière, les informations recueillies seront diffusées aussi largement que possible. Par conséquent, le projet sera marqué par une sensibilisation du public avec des journées pratiques, des symposiums en ligne, la participation du public à une science dite „crowdsourcée“ et une publication en libre accès sur une plateforme d'innovation sur Internet.

Resumen

Actualmente, se está planificando un proyecto transnacional, con socios de Luxemburgo y Suecia, denominado “Horsepower – Innovation in small-scale agriculture and gardening”. El objetivo del proyecto conocido como LEADER es apoyar a los pequeños agricultores y hortelanos en su desarrollo tecnológico y estudiar su entorno social.

De acuerdo con la actual normativa de la PAC (Política Agrícola Común) en los dos países de la UE implicados, el proyecto se iniciará en 2023 y se prolongará hasta 2025.

Con la participación ascendente de los agricultores y hortelanos, se diseñará una nueva maquinaria de tracción animal probándola más tarde en los llamados laboratorios de campo. Durante el proceso de desarrollo y las pruebas sobre el terreno se utilizarán equipos avanzados de diseño asistido por ordenador y de pruebas electrónicas. Durante la preparación del proyecto, fue preciso un estudio preliminar sobre estas tecnologías, utilizando el ejemplo de una desbrozadora mecánica y selectiva para praderas tirada por caballos.

Para mejorar el equilibrio ecológico y restaurar los paisajes agrarios, la atención se centrará en las nuevas tecnologías de labranza para la tracción animal, así como en los ciclos cerrados de nutrientes y energía en los sistemas de cultivo de bajos insumos y agroforestales.

Mediante la creación de redes y la cooperación transfronteriza, la información recogida se difundirá lo más ampliamente posible. Por lo tanto, la difusión pública con días de campo, simposios en línea, la participación pública en la llamada ciencia crowdsourced y la publicación de acceso abierto en una plataforma de innovación en Internet marcarán el proyecto.



Locally led rural development in Europe

In December 2020, the LEADER Local Action Group LËTZEBUERG WEST, regrouping seven municipalities and eighteen associations from Western Luxembourg as well as Luxembourg’s Chamber of Agriculture, and the LEADER LAG PH, regrouping the communities of Perstorp and Hässleholm in Sweden’s southernmost province Skåne, agreed to carry out together an EU-funded trans-national LEADER project called “Horsepower - Innovation in small-scale agriculture and gardening”.

The project aims to support European smallholders and market gardeners in their efforts to maintain sustainable food production and to study the social impact and technological feasibility of modern horse-powered agriculture.

The project initiator is the European network SCHAFF MAT PÄERD (SmP), an NGO based in Tuntange/Luxembourg, which supports the use of draught horses in modern-day small-scale farming. The main partner of the project is HÄLDE HÄSTKRAFT, a full-time horse entrepreneur company from Vittsjö in Sweden. Synergies have been established with the Department of Earth Sciences - Natural Resources and Sustainable Development of UPPSALA UNIVERSITY in Sweden¹ (Figure 1).

The LEADER program has been implemented in the European Union since 1991 by around 2800 LAG’s covering 61 % of the rural population in the EU bringing to-

gether public, private, and civil-society stakeholders in a particular area for locally led development. LEADER stands for the French acronym “Liaison Entre Actions de Développement de l’Economie Rurale” meaning “Links between actions for the development of the rural economy”².

LEADER projects are carried out under the national and regional Rural Development Programmes (RPDs) of each EU Member State and are co-financed by the European Agricultural Fund for Rural Development (EAFRD). Fundamental to the LEADER method is that there are residents and operators in an area that drive and influence the development. Characteristics for the LEADER method are:

- Bottom-up perspective
- Local knowledge
- Cooperation
- Tripartite partnership
- Innovation
- Locally made decisions²

After a project preparation phase from 2021 to 2022 for building up the international network, visiting and analyzing the individual regions, as well as drawing up an action plan, the project is planned to start in 2023 with the implementation of the reformed Common Agricultural Policy in all EU countries.

For the project that follows, the main objectives are developing, manufacturing, and field-testing state-of-the-

1 Junge 2021.

2 LEADER/CLLD 2018.

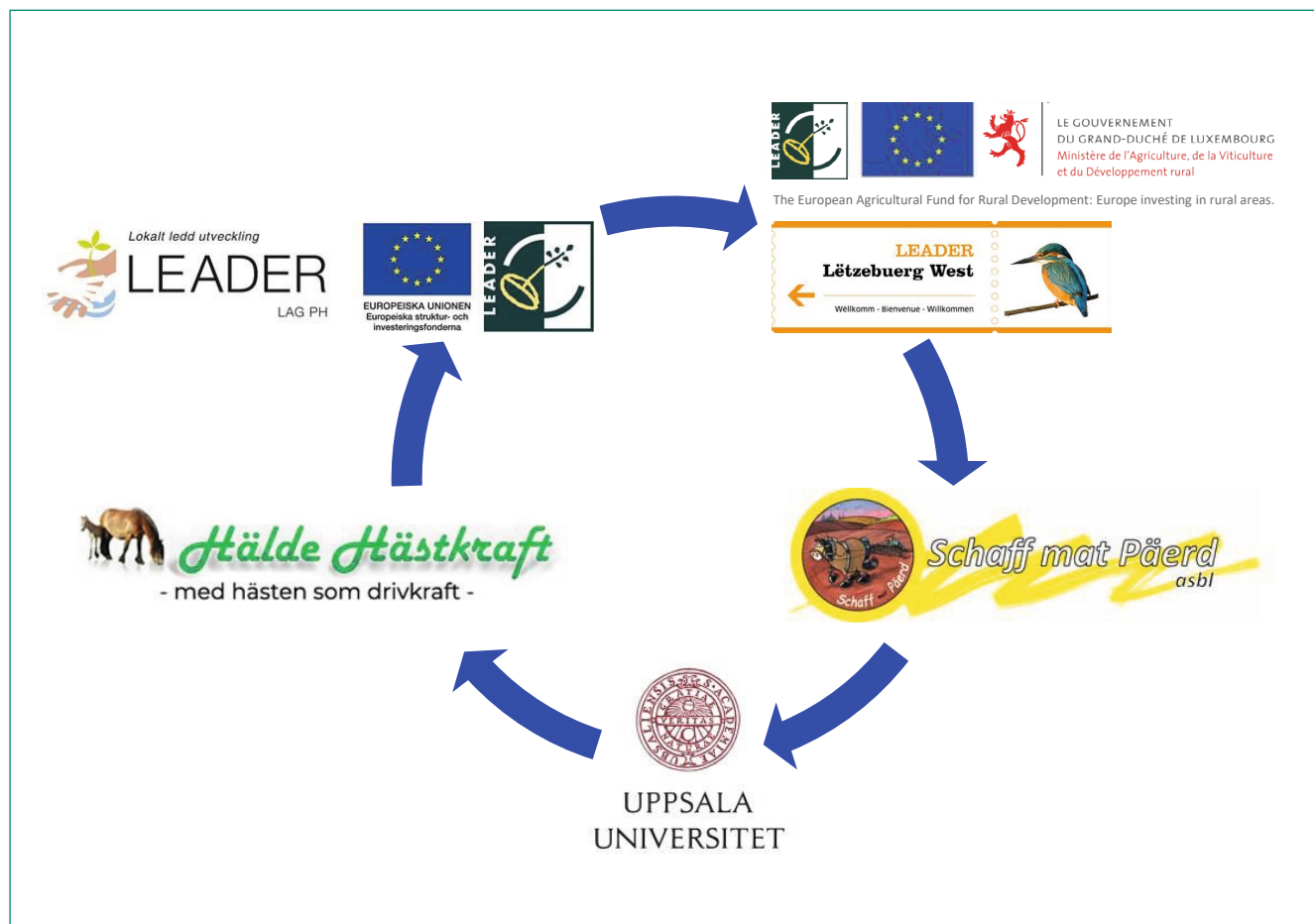


Figure 1 – The project partners



Figure 2 – The hand operated Bolin's dandelion comb from 1924

art horse-drawn equipment for small-scale agriculture and gardening, as well as public outreach with field days and open access publication of the findings.

The horse-drawn machinery will be selected and co-designed with bottom-up participation of farmers and gardeners in field laboratories. The main objectives are optimizing animal-powered tillage for regenerative farming, managing on-farm nutrients under various pedo-climatic conditions, improving the eco-balance by using completely renewable energy sources and restoring of agrarian landscapes to reach Sustainable Development Goals.

Besides the above criteria, the horse-drawn implements will be tested for their optimal working comfort for the draught horse(s) as well as their potential for self-maintenance and adaptation to European on-farm conditions³.

Conception of a horse drawn CombCut

The above-mentioned actions across both European regions during the project preparation phase are currently supported by a study on the implementation of computer-aided design (CAD) and testing in equipment development, using the example of a horse-drawn version of the mechanical and selective weed cutter CombCut for grassland.

In organic farming, weed control is, besides closed nutrient cycles and soil conditioning, of essential importance. For selectively reducing weed in various established crops, the CombCut implement was invented in 2008 on an organic smallholding near Karlskrona, in the South-East of Sweden. By using the physical difference between the plants at the right growing stage, just the weeds are cut, and the crop is spared by a very simple mechanical system of motionless tilted razor-sharp knives.

The principle of weed cutters is not new. In its summer issue 2016, the British Heavy Horse World magazine published an article about horse-drawn mechanical thistle-cutters which were manufactured on either side of the eastern Scotland-England border in the beginning of the 20th century⁴.

Another example of this technology can be found at the Åker exhibition of the Julita Gård open air museum, which is part of the Nordic Museum (Swedish: Nordiska museet) in Sweden. Here, a hand operated dandelion cutter is on display, which was invented by the Swedish agronomist Pehr Bolin in 1924 and sold at that time for 125 Swedish kronor under the name Bolin's dandelion comb (Swedish: Bolins Maskroskam)⁵.

Unfortunately, as many great inventions of the horse and human powered farming era, this technology got somewhat forgotten in the past hundred years. But today,

³ Schmit 2020.

⁴ Powell 2016.

⁵ Blomquist 1995.



the rising interest in sustainable farming methods, led the CombCut to be patented and commercialized all over the world. Formerly known as Just Common Sense, the company has grown into the Lyckegård AB Group with a wide-ranging portfolio of implements for weed control, including machinery concepts from Sweden and Finland.

The fact that other European agricultural implement manufacturers have followed by developing similar concepts, proves that the path was well chosen. A newer implement from the German Zürn Harvesting company not only cuts the weed flowers but collects the clippings for reducing the seed potential on the treated area. However, because of the high complexity of their drivetrains, and finally also the price, these implements are out of the question for most farms using animal traction⁶.

Another – not to be underestimated – reason, for selecting the CombCut for a conversion into animal traction was that the Lyckegård company had supported this idea from the beginning. Advice and assistance were provided during the whole design process, including the complete CAD drawings of the original tractor implement, which enabled enormous time savings in the conception of the horse-drawn version.

After two meetings in May and August 2016 for discussing the technical feasibility, SmP was supplied in December 2016 with a side section of the initially hydraulic operated CombCut implement for tractor use, which is currently available in 6 and 9 m width. The working width of the ground-drive implement for horse use was defined at 1,6 m. From this unit, only the knife bar with its three-dimensional knife angle adjustments and the brush comb were maintained.

The implement’s new tubular frame with spring loaded suspension of the cutting unit, as well as the whole lifting device and drivetrain, had to be redesigned. The double-sided toothed belt drive has a transmission ratio of 1:5,09 to achieve a sufficient rotational speed on the

brush comb, which cleans the blades from the cut material. Finger-type freewheel hubs on both ends of the comb shaft regulate the torque transmission. These parts, which are hard to find in Western Europe, because of the near extinction of ground-driven implements, were kindly supplied by the Mainardi company of Abbiategrosso in Northern Italy. This company still manufactures side-delivery hay rakes with ground drive for the European and South-American market. A plunger-type clutch, integrated into the assembly of the freewheel and secondary toothed belt pulley, allows the brush comb to be disengaged during transport.

In 2018, the complete design was advertised as a master-thesis at the Polytechnic University of Turin (Italian: Politecnico di Torino). However, even though animal traction is having a renaissance in Northern Italy, mainly by young people rediscovering the self-sufficient farms of their ancestors, linguistic barriers apparently prevented this master-thesis from getting realized⁷.

With the now developing LEADER project, the realization came true. Furthermore, from September 2020 to April 2021, a part of the development of the horse-drawn CombCut was carried out as a teacher-supervised project in the section of environmental sciences, ending with a technical baccalaureate, at a public secondary school in Luxembourg. Here, the student’s work consisted of computer drawings of basic implement parts and mainly in the mathematical dimensioning of the drivetrain components and the lifting mechanism for the cutting unit as well as strength calculations for the frame. Moreover, in a written project documentation, the pros and cons of the CombCut vs. other mechanical and chemical weed control methods were analyzed. Herein, the later use of the implement was limited to regulating docks, thistles and nettles on grassland.

All in all, 108 working hours were spent in the 3D-CAD drawing and about the same amount of time into the

6 Innovation award 2021.

7 Thesis proposals 2018.

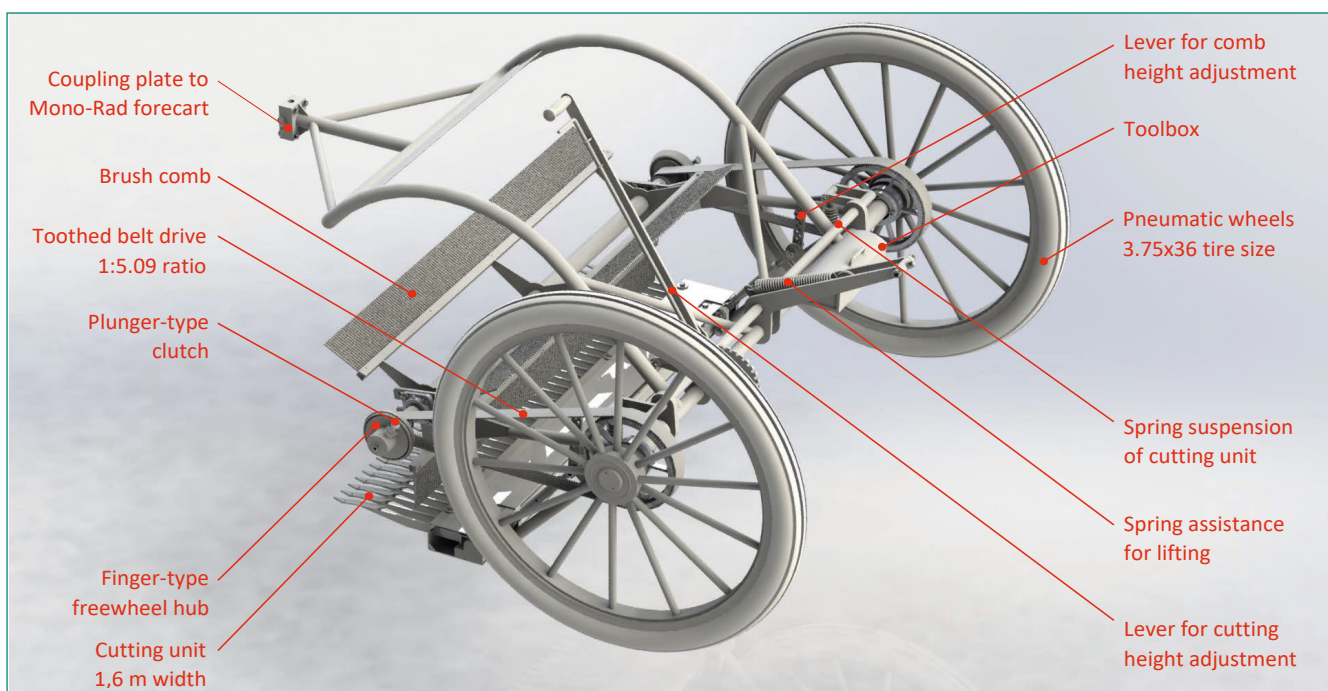


Figure 3 – Overall view with component designation of the horse drawn CombCut

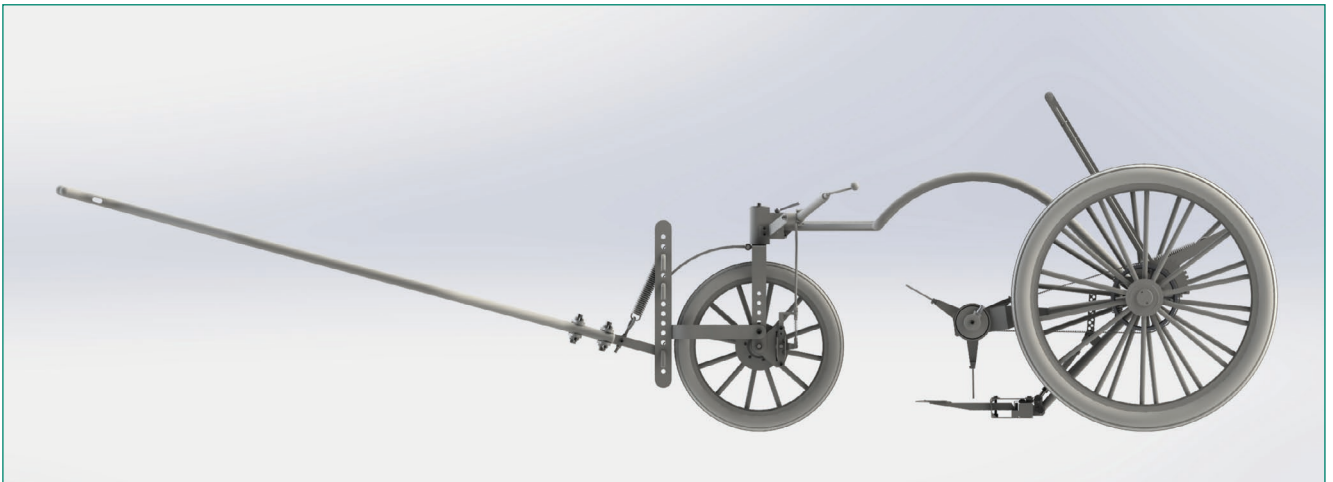


Figure 4 – Side view of the horse drawn CombCut coupled to the forecart

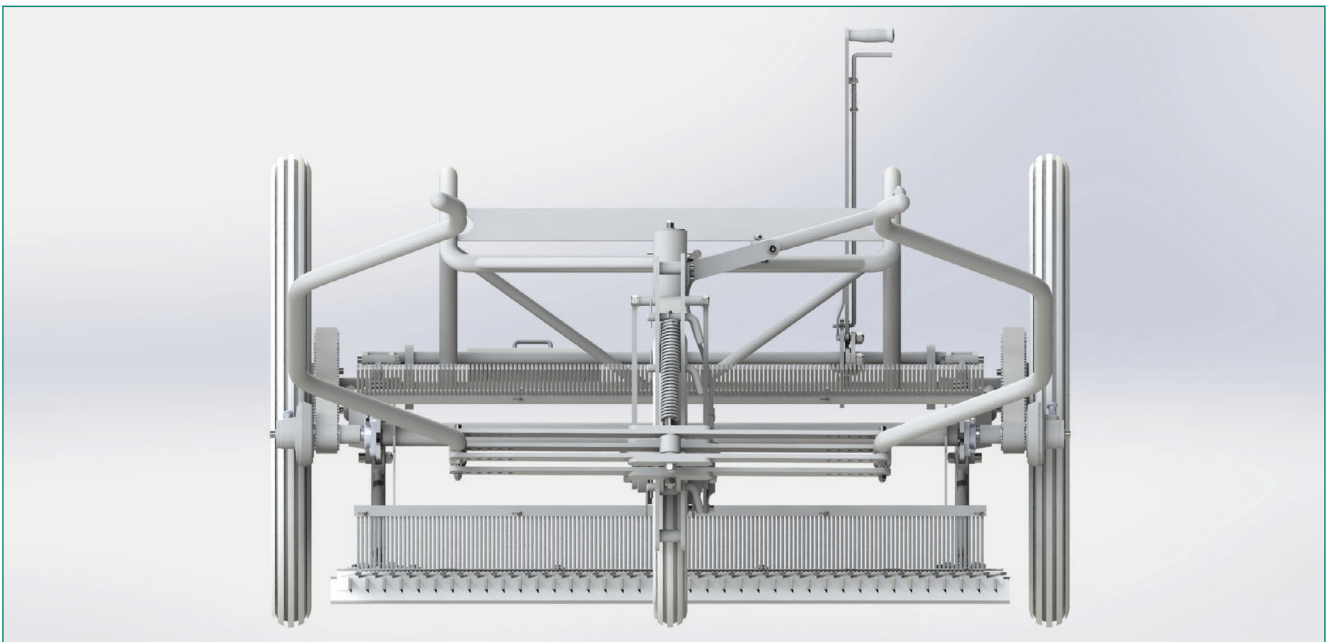


Figure 5 – Front view of the horse drawn CombCut coupled to the forecart

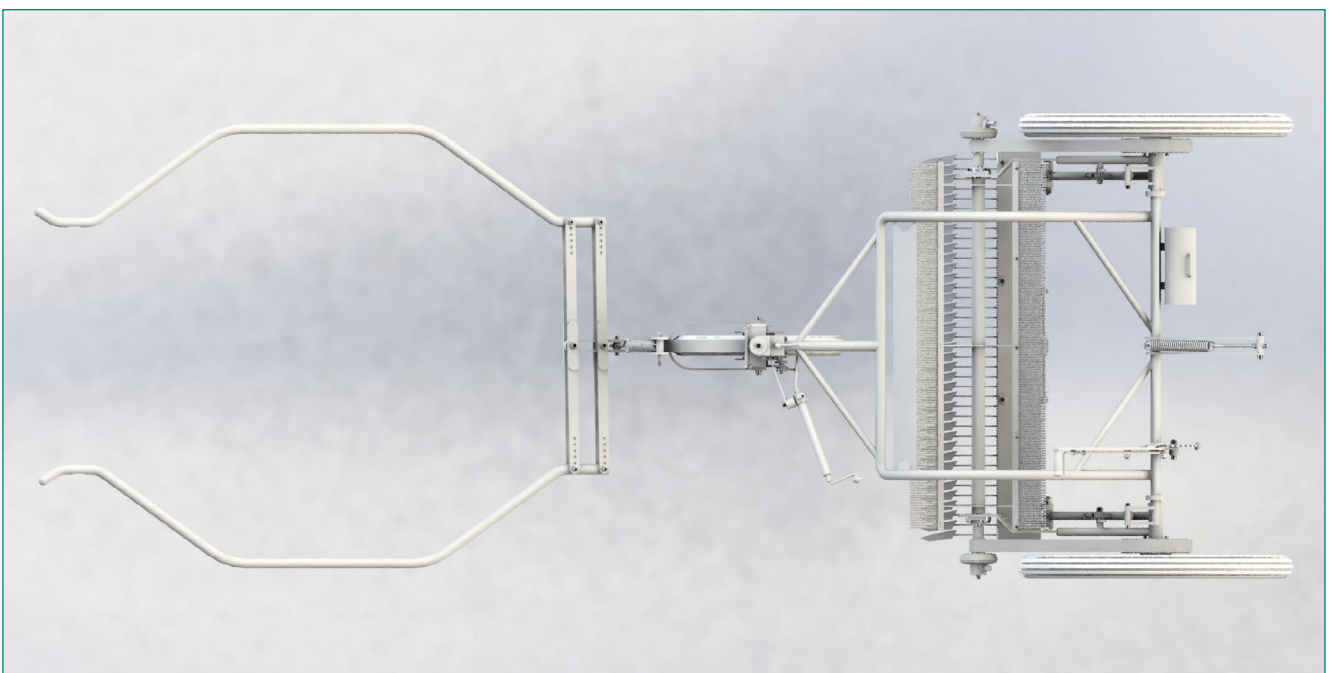


Figure 6 – Top view of the horse drawn CombCut coupled to the forecart



manufacturing of most of the implement parts and the final assembly in the workshop of the SmP association in Tuntange. Since all parts are available now as computer files, some of the more complex parts of the lifting mechanism were laser cut by a metal-working company in Luxembourg. In addition to the high precision of the manufactured parts, this also enabled a lot of manual labor to be saved, which more than outweighs the working time on the computer. In addition, the three-dimensional representation of individual parts and the entire assembly simplified the technical communication between all people involved and allows in a further stage to manufacture market-ready high-quality implements at a competitive price.

The drivetrain components were supplied by the large-scale manufacturer Mädler from Stuttgart in Germany and the wheels were ordered from Dominiak, a carriage manufacturer from Piaski in Poland. The tubular frame is hand- and homemade of thin-walled structural steel. The machine is designed for coupling to the braked SmP Mono-Rad Concept 1.3 single-wheel forecart. An optimum working comfort is guaranteed with the fully adjustable and spring-suspended traction shafts, as well as the forecart's central wheel, which runs in the longitudinal axis of the horse thus eliminating lateral forces. The total budget, excluding the working hours, of the first prototype adds up to € 5.000,- which was co-financed by the LEADER LAG LÉTZEBUERG WEST.

As mentioned before, within the LEADER project, the conception of this newly developed implement is part of a preliminary study, analyzing the benefits of computer aided design during the development process. The next step consists of field trials in Luxembourg and Sweden. Besides the design process, the testing will also be computer-assisted, using multiple sensors like draft force, torque and movement gauges, offering the possibility to analyze the required tractive effort, the drivetrain efficiency and the horse's working comfort. As part of another school project, the effectiveness of the CombCut system for grassland maintenance is to be analyzed through targeted assessments. Here a cooperation with Sweden's workhorse driver education at the National Horse Center in Wången is envisaged. A joint-venture which could be financially supported by ERASMUS+, another EU-program in the educational sector.



Figure 7 – Minimum tillage seeding of perennial rye in a silvorarable agroforestry plot

Shaping the future together

Detailed information about the whole design process and the testing will be published on the project's webpage www.drafthorses.eu. With this networking and cross-border cooperation, the aim is to contribute to the further development of modern farming and gardening technology.

An international symposium is planned for November 2022 in the LEADER region Luxembourg-West. Keeping with the times, it will be an online event with specialist lectures and farm presentations. Thanks to a synergy with the Lauresham Open-Air Laboratory from Lorsch in Germany, this symposium will be a follow-up event of the very successful virtual conference "Draft animals in the Past, Present and Future", which was organized in the beginning of May 2021 with participants from 30 countries worldwide.

For two days, the contemporary use of draft animals in eco-friendly and low-input vegetable growing and agroforestry, will be discussed. Possible future strategies will be worked out with practitioners and experts in soil science, alternative cultivation methods and landscape design.

Low Input Farming Systems (LIFS) seek to optimize the management and use of on-farm resources and to minimize the use of production inputs as off-farm resources, such as purchased fossil fuels, chemical fertilizers, and pesticides. Long-term sustainable solutions need renewability, this in a holistically approach, closing on-farm cycles again in climate-friendly and regenerative agriculture⁸.

According to the "European Climate Law", which was negotiated between the EU's 27 member countries and the European Parliament and adopted in April 2021 within the "European Green Deal", the EU is to become CO₂-neutral by 2050. Carbon-dioxide is the most significant long-lived greenhouse gas in the Earth's atmosphere since the Industrial Revolution, resulting as anthropogenic emission caused by the mankind, primarily from the use of fossil fuels and deforestation⁹.

Getting carbon-neutral requires a 'reverse' carbon footprint, which means that at least as much carbon is sequestered above and below ground as is emitted. You may see this as unrealistic, but you can also see it as a chance, an opportunity to sustainably change our society, including our food production. Here, we should acknowledge that there is still, in the 21st century, no other emission-free and low-cost power source than the work horse, which can even reproduce itself, and on a local level.

Agroforestry systems (AFS), a combination of woody plants and grass or arable crops on the same field, will be the second main subject of the first symposium within this LEADER project. Restoring a structurally rich landscape, and habitat diversity, offers high value creation potential. Reducing wind and water erosion, nitrate leaching, and temperature fluctuations can help to reach a more climate-resilient agriculture. Furthermore, with a suitable selection of trees and shrubs, natural nectar,

⁸ Low input farming systems 2007.

⁹ 2050 long-term strategy 2021.

honeydew, and pollen sources are created, which contributes to better biodiversity protection¹⁰.

In order to make European smallholdings relying on animal traction fit for the 21st century, not only the challenges of the future have to be faced, especially climate change, but the current social changes as well. The LEADER project is thus linked to a study, as a master thesis at STOCKHOLM UNIVERSITY, on the contemporary use of workhorses in Sweden, Luxembourg and Italy, which will also be carried out in 2022.

Furthermore, both project parts, the LIFS as well as the AFS are planned to be realized as so-called citizen science (CS), also known as crowd-sourced science. Herein a part of the research and data collection is planned to be conducted with a public participation under the direction of professional scientists. This monitoring will be based on an initiative for AFS of the University of Münster in Germany, an approach that fits perfectly into the philosophy of the LEADER projects¹¹.

Co-designing new farming systems is a multi-dimensional and complex process, in which changes in knowledge and technologies must take place. For these reasons, it is necessary to use a participatory approach, which is the basic LEADER philosophy. Exploration of the initial situation, which identifies local stakeholders potentially interested in being involved in the process, existing farming, and gardening systems, as well as their specific constraints, will be the first step within this project. Creation of an innovation platform, as a core of this process for generating a broad knowledge on viable small scale farming practices, will follow. Watch out for more information on www.drafthorses.eu!

¹⁰ Agroforstwirtschaft 2021.

¹¹ Agroforstmonitoring Projekt 2021.

Bibliography

Agroforstmonitoring Projekt 2021

URL: www.agroforst-monitoring.de [30-06-21].

Agroforstwirtschaft 2021

URL: www.agroforst-info.de [30-06-21].

Blomquist 1995

T. Blomquist, Maskin för Landbruket. Ekipage, 3-1995, 17.

Innovation award 2021

URL: <https://en.simaonline.com/Events/SIMA-Innovation-Awards/SIMA-Innovation-Awards-2021-roll-of-honour> [02-07-21].

Junge 2021

J. Junge, About LEADER. URL: www.drafthorses.eu [25-06-21].

LEADER/CLLD 2018

URL: www.enrd.ec.europa.eu [25-06-21].

Low input farming systems 2007

URL: www.fao.org [07-07-21].

Powell 2016

B. Powell, Borders' thistle cutters. Heavy Horse World, Summer/2016, 64-65.

Schmit 2020

P. Schmit, The Project. URL: www.drafthorses.eu [25-06-21].

Thesis proposals 2018

URL: www.didattica.polito.it [02-07-21].

2050 long-term strategy 2021

URL: www.ec.europa.eu/clima [11-07-21].

List of Figures

Title (Cover-cropping after the food crop season in a silvoarable agroforestry plot) – C. Laroche.

Figure 1-6 – P. Schmit.

Figure 7 – C. Laroche.



Author info

Schaff mat Pærd asbl

Paul Schmit

27, rue de Brouch

L-7481 TUNTANGE

E-Mail: schaffmatpaerd@pt.lu

Web: www.schaffmatpaerd.com

Digital paper: https://www.youtube.com/watch?v=_aJ1dzoq8AA

