Agroforestry for sustainable agriculture

Agroforestry systems can provide effective protection against soil erosion caused by wind and water. They can also contribute to stabilising and improving the yield of annual plants. In addition, strips in fields planted with shrubs and trees form living spaces and areas to which plants and animals can retreat. In the AUFWERTEN innovation group, the Fraunhofer Institute for Industrial Engineering IAO is working with other German research institutions and organisations to set up agroforestry systems in Germany.

In a bioeconomy, agriculture is not conceivable without sustainable land management. This is because land is a resource that can be used for growing produce as well as providing habitats for animals and living space for humans. Conflicts between different land-use requirements are therefore inevitable. These vary between using land to make the shift towards renewable energy systems, or for housing, agriculture or transport networks. According to the German Federal Environment Agency, the proportion of land used for agricultural purposes in Germany fell from 53.5 to 51.7 percent between 2000 and 2014. The German Federal Ministry of Education and Research (BMBF) is therefore providing funding up until 2019 for nine innovation groups that are seeking to develop practical solutions for dealing with land as a resource.

The AUFWERTEN innovation group, which has been funded by the BMBF since November 2014, is involved in agroforestry and finding out how agroforestry can make a significant contribution to more sustainable land use in Germany. Agroforestry is a land-use management system in which trees and shrubs are grown either on arable land along with crops or on pastureland. Different basic agroforestry systems exist, where the age of the trees and the distribution and arrangement of shrubs and trees differ considerably between the different systems. They range from orchard meadows, boundary systems such as windbreaks, forest farming and strips with energy crops.

Agroforestry as modern land-use management system
Agroforestry systems are not completely new. Forests were previously used for pig fattening, and orchard meadows are traditional agroforestry systems that can still be found in Baden-Württemberg. In addition to using grassland for cultivating fruit trees, it is also used as pastureland or for making hay. The AUFWERTEN innovation group has shown that agroforestry systems can benefit agriculture, municipalities and consumers alike. The group’s name AUFWERTEN stands for "Agroforestry for Environmental Services, Energy Production and Added Value".

The project partners use an area in southern Brandenburg as their study area, and are hoping to establish a sustainable agroforestry system and a regional supply network with bioenergy sources. In addition to the seven project partners (BTU Cottbus-Senftenberg, TU Munich, the Leibniz Institute for Agricultural Engineering in Potsdam-Bornim, Bayreuth University, Biomasse Schraden e.V., the Domin farm and the Kleine Elster municipal federation), AUFWERTEN also involves the Stuttgart-based Fraunhofer Institute for Industrial Engineering IAO. “In future, we want to give the overall concept specific formats so that we can establish the agroforestry system in other areas in Germany by adapting it to the specific requirements of each particular area,” says Georg Nawroth, innovation manager at the Fraunhofer IAO.

The objective of the AUFWERTEN innovation group is to use the findings to develop an innovation concept that will show how the various agroforestry systems can be implemented and effectively integrated into agricultural practice. Agroforestry systems are beneficial for farmers, municipalities and landowners as well as environmental and nature conservation. Farmers, especially those in low-yield areas, can expand the type of produce they grow by using agricultural timber and thus increasing their income. Studies on crop yields in areas with shrub strips have shown that yield increases of up to 50 percent can be achieved. The usage of agroforestry wood as a material and for energy production can also be improved. Trees that take longer to grow can be used by farmers as timber; they can also be used for producing honey and fruit (material use). In terms of using plants for energy generation, the group’s work is focussing on fast-growing trees/shrubs that can be harvested in just a few years. The advantage of agroforestry is that it reduces the erosion of depleted soils and dislocation of substances.

However, Georg Nawroth has found that farmers do not always have an equally positive reaction to agroforestry. “We therefore need to develop a concept that demonstrates what can and must be changed in the future in order to make the establishment of agroforestry systems even more successful. We also have to bring certain research issues to public attention,” says Nawroth. For municipalities, the cultivation of woody plants leads to a more varied landscape, which can also reinforce tourism in the area. “In terms of landscape protection and nature conservation, agroforestry has the advantage that shrub and tree strips that are grown in between agricultural land create habitats for birds and other animals,” says Nawroth.

Bringing different parties together at the same table
Agroforestry systems are characterised by reduced material discharge into groundwater and surface waters. In addition, the consumption of pesticides and fertilisers can be reduced considerably.

Recent reports from the Domin farm in the city of Senftenberg in southern Brandenburg show that agroforestry can be productive and profitable. Brandenburg is exposed to wind erosion, which makes it particularly suitable as a study area. However, Georg Nawroth is very well aware that each region, Baden-Württemberg for example, has to be specifically assessed in terms of its suitability for implementing agroforestry. All regions are different and not equally suitable for this purpose. Other hurdles include political context, which also differs from one region to another. “All-encompassing agroforestry funding is not possible, as funding can basically only be provided for the cultivation of arable land. Farmers cannot apply for funding for an entire field,” says the expert. The AUFwERTEN project is therefore attempting to come up with a definition for agroforestry that would make it easier for the authorities to make a clear decision as to which areas fall under the category and thus decide whether to provide funding or not.

The problem for the research partners involved in the project is that they have to turn their research into application. “For example, when the research results obtained for a geo-information tool are not applicable, all the work we will have done might be in vain,” explains Nawroth. “We are therefore developing a concept that can be adapted to the requirements of different partners and clients.”

Working with clients to achieve application

In addition, the project brings together partners with completely different interests. "We have partners from the engineering sector, as well as service providers, purchasers, sales organisations and nature conservation organisations. Many of these have opposing positions," says Nawroth. "So we have to try and bring them all together to find compromises and set priorities." The Fraunhofer IAO would like to be able offer solutions to these issues in the form of guidelines, events and different online formats, with the overall objective of making agroforestry systems suitable for broad application.

The experience of the Fraunhofer IAO shows that smaller agricultural businesses are more open to trying something new. In addition, it is important that what is produced can be used on a regional basis, as is the case with the biomass heating plants in the city of Massen-Niederlausitz. The plan is for the heating plant to use wood from regional agroforestry systems and provide heat to the local gym, school, an office building and the administration building of the Kleine Elster municipal federation. The project partners hope to design the innovation concept to make it possible to transpose ideas from the study region to other parts of Germany, so that agroforestry areas will once again be prevalent in Baden-Württemberg.

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