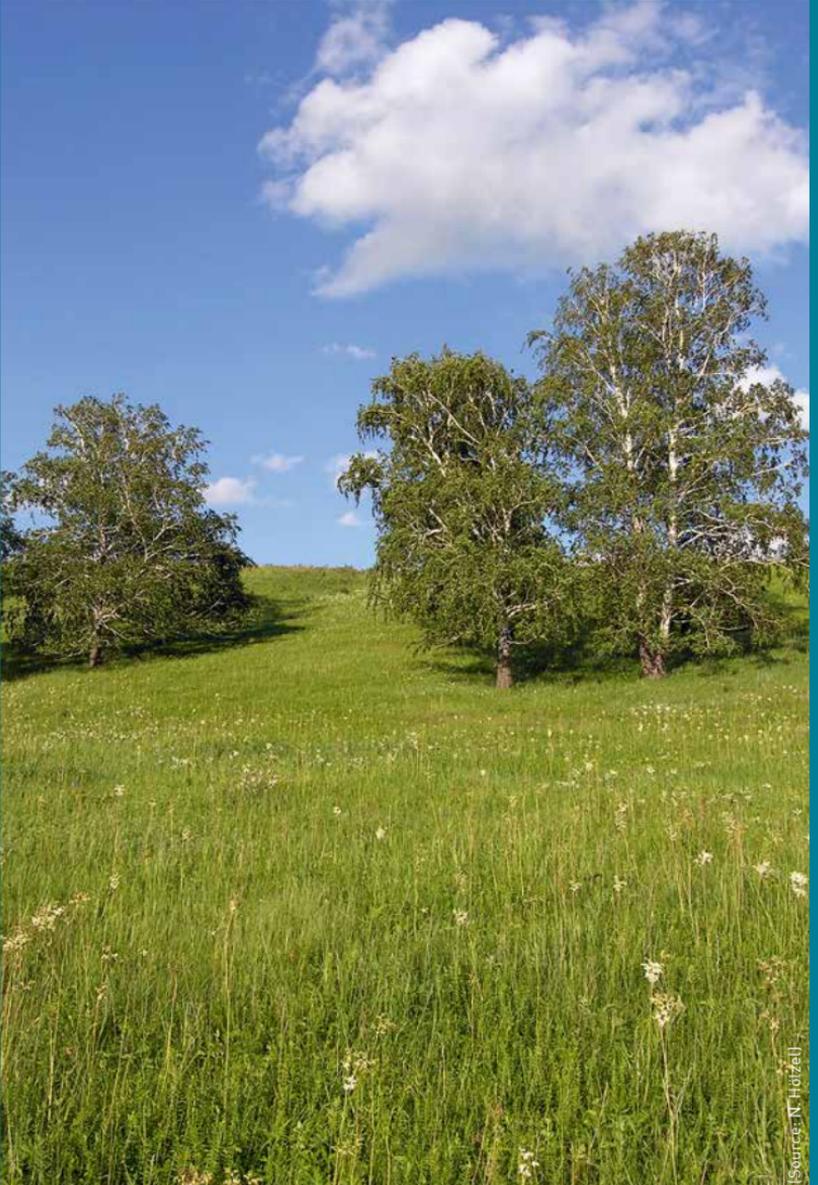




# SUSTAINABLE LAND MANAGEMENT

## NEW STRATEGIES FOR THE FOREST STEPPE





Siberian birch grove in the forest steppe (summer).

- The wetlands, forests and steppes of Western Siberia are among the most important carbon sinks in the world. As the need for arable land in the region increases there is a risk that the carbon will be released. This could accelerate climate change. Scientists from Germany and Russia now want to provide facts in order to shape changes in land use sustainably.**

**B**lack-tailed Godwit, Yellow Wagtail, Corncrake – species such as these send ornithologists into raptures. In Germany these birds are seen increasingly rarely as wet meadows and pastures are drained, fertilized and converted into arable land. In the Russian province of Tyumen, deep in Western Siberia on the border with Kazakhstan, the meadow birds' habitats are still intact in many places so their numbers are significantly higher. »The birds are as common there as they were in Germany in the 1950s« reports Professor Norbert Hölzel with delight. There are good reasons for this: after the Soviet Union made tremendous efforts to plough up millions of hectares of the steppe to grow wheat in the 1950s, many grasslands were then left fallow after the political and economic collapse of the 1990s. Today rare waders thrive there. But the biodiversity is under threat: »If in the future the meadows and pastures are turned back into arable land and agricultural use intensifies, this will have negative effects on the bird fauna«, says Hölzel, who works as an ecosystems researcher at the Institute of



Wheat fields as far as the eye can see.

Landscape Ecology at the University of Münster. As the leader of the German-Russian research project SASCHA, the 49-year-old knows all about the Siberian hinterland. The project scientists are working until 2016 to gather basic data and prepare monitoring instruments to help them develop strategies so that regional land users can better adapt to the effects of changes in the land-use and climate change.

The German Federal Ministry of Education and Research is supporting the project with funding of 3.8 million Euros. Besides the scientists from the universities of Münster, Osnabrück, and Kiel, other participants on the German side are the Humboldt University in Berlin, the Osnabrück University of Applied Sciences, and the remote sensing company EFTAS, and on the Russian side the Tyumen State University and the Tyumen State Agricultural Academy.

**»There is a growing need for arable land to grow cereal crops for food and bioenergy.«**

Hölzel's fears for the diversity of bird species are not without foundation. »There is a growing need for arable land to grow cereal crops for food and for bioenergy«, he reports. Cultivation mainly of wheat, but also of rapeseed, sunflowers, and potatoes will increase significantly in Western Siberia. The trend in land use is driven by climate change. »Because



Blue Argus butterfly.

of the increasing aridity of the steppe regions in Kazakhstan and Southern Siberia, cereal cultivation will shift further north into the forest steppe zone and the pre-taiga«, says Dr Johannes Kamp, a landscape ecologist from Münster University, who is coordinating the project. Such a shift carries risks because the wetlands, forests, and steppes of Western Siberia are some of the world's most important carbon sinks. The wetlands alone cover 600,000 km<sup>2</sup> and store a quarter of all carbon stored in terrestrial ecosystems. »If these carbon stocks were released, they would contribute massively to global warming«, Kamp explains.

**»If the carbon stocks from peatlands are released, they contribute to global warming.«**

For Hölzel's research teams, however, eight sub-projects are not just about investigating the consequences of land-use change for the climate. The researchers also want to find out how this change affects biodiversity, soil fertility, and the water table. To allow them to model these consequences, the researchers are diligently gathering basic data which were not available previously. Zoologists and botanists for example are counting how many butterflies, grasshoppers, birds, and plants occur in the three study areas, which together total an area of 1,200 km<sup>2</sup>. »This was a blank spot in biodiversity research until now«, says Hölzel. The scientists have



Black-tailed Godwit, still widespread in wet meadows.

also derived a land-use classification for the area. They wish to show how land use has changed following the collapse of the Soviet Union through comparisons with earlier maps. From this basis they then intend to develop spatial models showing how farming could change and crop yields develop in the future.

#### **Accurate climate data from the steppe**

The scientists are also treading new ground in their quest to establish the amount of greenhouse gases emitted from the grasslands. »There are measurements for the coniferous forests of the taiga and for the tundras of the sub-polar regions, but no one knows precisely how much carbon dioxide and methane are released into the atmosphere across the forest steppe region with its carbon-rich black soils and degraded peatlands east of the Urals«, says Hölzel. The findings of the SASCHA project are therefore of great interest to climatologists; until now they have had to rely on estimates in their climate models for Southern Siberia. The central task of the bi-national project is also to work out scenarios to show how farming in this region could look in the future. The requirements are clear: agricultural use should be sustainable. In other words, it should protect soil, water, and biodiversity while also ensuring an income for those employed in agriculture. The most important thing here is for the farmers to secure their guarantee of successful cereal cultivation: the fertile black soil. »The humus-rich black soil is the capital that



Stubble fields before sowing.

allowed the farmers to profiteer here for many years«, says Hölzel. But meanwhile the soils have been degraded in many areas by their use for intensive monoculture. One of the SASCHA sub-projects is therefore aimed at investigating in particular how to stop the depletion of the humus layer in order to restore soil fertility.

### Slurry as organic fertilizer

Soil scientist Professor Gabriele Broll, who conducts research at the Geographical Institute of the University of Osnabrück, wants to set up a regional material flow management system. The idea is to take nutrients that are produced in the form of manure and slurry from the cattle, pig, or poultry farms and to use these on arable fields as organic fertiliser. »This will increase the organic matter and thus the biological activity in the soil«, says Broll. Plenty of animal matter will be available for this purpose in the future: »The agricultural enterprises are substantially expanding animal husbandry«, says the scientist. Awareness of such use of livestock waste is still lacking on some of the farms. In many areas, excrement from poultry farms for example is piled up in heaps on open fields, and lakes of slurry are not uncommon. Nutrients then seep down into the ground as nitrates and pose a risk to groundwater. Broll therefore wishes to change the farmers' attitudes towards dealing with livestock waste through training courses and workshops. »The agricultural enterprises must handle the animal products as sustainably as possible



Ploughing in August.

by using them as organic fertilizer«, she explains. To avoid large quantities of excrement being left lying on nearby fields, transport facilities must be set up and waste utilised in ways that cause less harm to the environment. »Our aim is ultimately to come up with recommendations as to where and

**»We want to show that grassland does not always have to be ploughed up to increase agricultural productivity.«**

how the nutrients occurring in farming can be used most efficiently«, she says. But the SASCHA scientists do not just want to make recommendations on the management of nutrients and organic carbon. »We also want to show that grassland does not always have to be ploughed up to expand arable farming«, Hölzel stresses. Yields from the land already under cultivation could certainly be further improved. For example: farmers in the Tyumen region harvest on average 20 double centners of wheat per hectare, while yields in Germany are three to four times higher.

»By sowing rows closer together, using methods that conserve the soil better and fertilizing more extensively, yields can be further increased«, he says. The experts now have to provide scientific evidence that expanding into ecologically precious grassland also makes little sense from an economic point of view. »The aim is to be able to assess and



Grain drying – often the limiting factor during harvest.

plot the areas in which agricultural use of the land makes economical sense, taking account of biodiversity, water quality and quantity, and carbon storage«, says Hölzel. He believes that this model could also be successfully transferred to other continental steppe regions in China, Mongolia, and Kazakhstan.

The German-Russian research project has come at just the right time for the farmers in the Tyumen region. Hölzel reports from his discussions with locals that soil degradation is becoming a serious problem for many of them. The agricultural enterprises also feel the first effects of climate change as the dryness of the region increases. Insa Kühling

**»The aim is to suggest areas that would primarily be used for agriculture, whereas others could be retained as protected areas.«**

from the Osnabrück University of Applied Sciences is working with local agricultural businesses in a further SASCHA sub-project to investigate how different farming methods affect soil water content and fertility. »On many farms the land is still ploughed, while in other parts of the study area the soil is not tilled but only scarified«, she says. Neither method is ideal, as erosion and other problems can still occur. The agricultural scientist therefore wants to experiment by sowing seed directly onto the soil. With this method the seed is



Daily milk collection – subsistence farming in remote villages.

drilled into the stubble of the previous crop without tilling the land to any depth. Kühling also wants to try changing the seed used to grow wheat, barley, and oat crops. Until now the farmers have retained part of the harvest from previous years for resowing. This does not produce optimum results however: »Germination rates are not particularly high«, explains the scientist, who is studying for her doctorate. The extensive field trials should show whether yields can be increased through the use of certified seed and modern technology. This form of sustainable intensification would remove the need to plough up more land. Kühling also wants to develop an instrument to provide the managers of the agricultural enterprises with figures from which they can work out how sustainable their production is and how well they preserve soil fertility.

#### **Experiments with soya**

Professor Dieter Trautz, also from the Osnabrück University of Applied Sciences, is working on an alternative way for farmers to react to climate change. The agricultural scientist experiments with soya. The plants have certain advantages: »Soybeans are an important protein source. Some varieties are less thermophile and could grow well in the Tyumen region«, Trautz affirms. He believes that soya could be marketed very well as animal fodder or tofu. In a pilot scheme at the university and through field trials his team is currently investigating how soya can be integrated into a crop



Wood strawberries are gathered by the bucket in the forest steppe, as here in Ishim.

cycle in rotation with rapeseed, maize, and wheat. »Soya is a legume, so it fixes nitrogen. This actually makes it very attractive for farming«, he says. In the experiments Trautz examines how well the soya plants withstand competition from weeds and how they can be protected against sudden drops in temperature in the spring, particularly during the susceptible early growth stages. If the experiments go well, prospects for beginning soya cultivation are favourable, because Trautz knows he has the backing of the region's politicians.

#### **Government wants to impose organic farming**

The general political situation could also be advantageous to the scientists' proposals for a change of land use. In August 2012 Russia joined the World Trade Organisation (WTO). The Tyumen region now wants to lead the way in organic farming. »The Governor and Parliament see the future of agriculture in organic farming«, says Nataliya Stupak, who analyses the underlying institutional and political conditions affecting land use in the Tyumen Oblast in a sub-project. This would make the region unique in Russia. Organic farming could be implemented here, with the regional government introducing funding programmes comparable to the European Union's agri-environmental programmes. »In this way the Oblast could subsidise farming in the future and thereby satisfy WTO requirements«, says the agricultural economist. This would be likely to benefit plant and animal species, and would help meadow birds such as the Black-tailed Godwit.



Production systems that are being investigated in the region are: agricultural systems (intensive and extensive), bioenergy, livestock

#### ■ **SASCHA** [www.uni-muenster.de/SASCHA/en/](http://www.uni-muenster.de/SASCHA/en/)

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