Approach for "Climate-adapted Agriculture in East Georgia"

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Situation Analysis

Fertile soils – lack of water and wind erosion

The district of Dedoplistskaro, especially Shiraki Valley, is known as Georgia's "bread basket". The area has very fertile soils with a deep humus layer and, in general, good potential for agriculture. Yields are, however, limited by the lack of water, as the annual precipitation is as low as 400 ml and very unevenly distributed over the year, with humid winters and springs and hot and dry summers. Another limiting factor are the strong winds that cause erosion of the topsoil. Hence, farmers in the region cannot realize the potential of the fertile soils and only harvest 3-6 tons of wheat per hectare. In extreme years, such as in 2014, when a severe drought hit the region, average yields may even be as low as 300-400 kg per hectare.

Climate change in East Georgia

The climate of East Georgia is characterized by very hot, dry summers and windy, moderately cold winters. Climate change scenarios indicate that extreme weather events, such as droughts or heavy storms may occur more frequently in future, leading to increased wind erosion, pest infection and harvest loss due to lack of water.[1] Hence, suitable adaptive measures are needed to secure sustainable yields for local farmers.

2014-2018 – Preview of Climate change?

In 2014, three extreme storms hit the region during winter, blowing away seeds and topsoil, followed by the most severe drought since 1962 without any rainfall between March and September. Most farmers in East Georgia lost their harvest, as in addition to the drought, a viral disease spread by large numbers of aphids infested the wheat fields.

In 2015, devastating fires destroyed 90% of the windbreaks in Shiraki. The fires were set by farmers burning agricultural residues and weeds on their fields. They were facilitated by hot temperature and strong winds.

In 2017, Shiraki was hit by a very hot summer again. Due to the humid spring, the harvest of most crops was still average.

Finally, in 2018 fires again destroyed many remaining windbreaks, including some parts of the test windbreaks planted in 2016.

Non-adapted agricultural practices

Ploughing is a well-known and simple soil management technique used mainly for weed control and loosening the soil. However, there are various negative side-effects, especially in dry areas. Heavy tractors with heavy cultivation and harvesting equipment increase soil compaction. Soil compaction, in turn, affects plant growth, as the pores between soil particles are reduced and limit root infiltration, drainage, and air circulation. Soil compaction decreases the water uptake and storage ability of soil, which results in more runoff and erosion. Another negative effect is the loss of nutrients, such as nitrogen and in the soil. All of this results in reduced plant growth and lower yields, especially during periods of drought.

Ploughing can dry out the soil too much before seeding, because there is strong clod formation after ploughing, even more so in dry soils. The clods increase the surface area leading to greater moisture loss through evaporation. Only even soil with little clods can reduce soil water evaporation. Because of

[1] As stated in Georgia's Second National Communication to the UNFCCC (2009).

the reduced cohesiveness between soil particles, the dry soil is prone to wind erosion and can be easily blown away.

The current mode of soil cultivation was introduced and practiced during Soviet times. It is not adapted to the local climate conditions, especially not regarding projected climate change conditions. These practices have led to high soil degradation and to the loss of soil humidity over the last decades, making farming increasingly difficult in East Georgia. Hence, a new set of techniques and management practices is required to better adapt to the lack of moisture in the region.

Vision and objectives

The vision is to develop a sustainable agricultural farming system that is more resilient to shocks expected to occur more severely and more frequently due to climate-change.

Approach

The approach comprises various elements, including:

- Seed selection and seed treatment
- Soil treatment and weed control
- Crop rotation and fallow
- Wind erosion control measures
- Institutional measures

Seed selection and seed treatment

The specific climatic conditions of Shiraki Valley require drought-resistant crop varieties. In the case of wheat – the major crop of East Georgia – the challenge is to find varieties that ripen early enough to avoid the typical summer drought and heat. Tests in Georgia, Germany and Austria have identified various wheat (and barley) varieties that offer such properties. Autochthonous varieties include “Red Doli” (*Tsiteli Doli*), imported tested ones are JB Asano and Premio.[2]

After more than twenty years of relatively low agricultural production, the fields of Shiraki Valley show a great variety of weeds competing with crops for nutrients and water. In addition, pests such as ground beetles, locusts and aphids – the latter a vector for a viral disease (Barley yellow dwarf virus) – are abundant, and thus, a major threat for agricultural yields. In order to minimize the use of pesticides, systemic seed treatment is required prior to seeding. Suitable pesticides are available in Georgia, although training on application and wise use of pesticides are needed (e.g. avoidance of glyphosate!).

Soil treatment and weed/pest control

The fertile soils of Shiraki Valley technically allow for high agricultural yields. However, due to inappropriate cultivation techniques, today, the formerly rich black soil is highly compacted. Wind erosion and dehydration have significantly reduced the humus layer on top and led to a loss of nutrients. By shifting from ploughing to low-tillage disc-cultivation, organic matter is brought back into the soil and moisture is retained. In addition, disc-cultivation makes burning obsolete in most years, and, hence, contributes to the protection of windbreaks from fire (see below).[3]

[2] Additional varieties provided by Saatbau Linz are currently being tested in Shiraki Valley.

[3] In exceptional years with a very high amount of biomass (also on long-term fallows), disc-cultivation may not be sufficient and biomass either needs to be removed from the fields or to be ploughed as an exception.

*Capturing and conservation of moisture***:** Moisture conservation techniques can include summer fallow rotation, weed control through frequent tillage and leaving crop residue to shade the soil.

Effective use of available moisture: When moisture is available in the soil, it must be used as efficiently as possible for growing crops. Seed planting depth and timing have to be carefully considered in order to place the seed at a depth at which sufficient moisture exists.

Soil conservation: Any kind of physical soil treatment (e.g. frequent tillage to kill weeds) in dry regions increases the likelihood of erosion, especially wind erosion, while the paramount long-term goal of farming should be the preservation and retention of topsoil. Erosion control techniques to minimize topsoil loss include windbreaks, reduced tillage or no-tillage, leaving harvest residues or spreading straw, and strip farming.

Fertilising: In order to minimise the side-effects of mineral fertilisers, a proper analysis of the soil is needed prior to fertilising. If available, animal manure may be used, especially if the transition to organic farming is intended.

Biological pest control: Although biological predator populations always lag behind their prey populations, supporting these species delivers a significant contribution to pest control. For example, birds-of-prey hunting rodents can be supported by providing sitting poles for migratory birds, while rose-coloured starlings (*Sturnus roseus*) or shrikes (*Lanius* sp.) feeding on locusts could be supported by protecting and replanting windbreaks or establishing woody islands within the agricultural landscape.

Crop rotation and fallow

Crop rotation is an important measure to maintain soil fertility. Especially crop rotation or intercropping with legumes improves the availability of nitrogen in the soil. As water is the limiting factor in Shiraki Valley, suitable crops need to be resistant to drought and heat. Yet, most farmers will only plant additional crops if they can use them economically. In 2015-17, alfalfa (*Medicago sativa*) and sainfoins (*Onobrychis*) were tested in Shiraki Valley. Results were mixed, also depending on the farmers' attention and commitment. Some farmers did not harvest any crops, while others yielded up to 6 t/ha. Farmers who can directly use the legumes as livestock fodder are probably the best target group for introducing crop rotation. Only one farmer with land close to Alazani river continued to grow legumes, occasionally irrigating his field.

Seven farmers grew barley or wheat in the following year on the fields used for testing the legumes. On average the barley yield was 38% and the wheat yield 12.5% higher than on average fields in Shiraki. Although the samples size is small, farmers stated to having noticed the difference.

Leaving a field fallow for a year is another suitable measure for maintaining soil fertility. However, this requires a change of most farmers' mind-sets, as a fallow year is still frequently considered a lost year.

Wind erosion control measures

As initially mentioned, wind erosion is one of the major threats to soil fertility in Shiraki Valley. The issue was identified decades ago, and more than 1800 kilometres of windbreaks were established during the Soviet Union. However, due to the energy crisis following Georgia's independence in 1991, most of the old windbreaks were chopped down and used as firewood. The remaining windbreaks were further destroyed by fire (mainly from agricultural fields and fires set by shepherds to induce grass growth), such as in 2015 when approximately 90% of all windbreaks were burnt in Shiraki. Windbreaks are also destroyed by livestock (sheep and cattle). Rehabilitating and protecting windbreaks is of utmost importance in East Georgia for preserving the valuable topsoil of the region. Besides the technical

approach this requires sufficient political will (e.g. through a state programme) and a favourable institutional and legal framework.[4]

Institutional measures

Most land plots in Georgia are highly fragmented. Hence, agricultural practices, such as the use of (rented) machinery are often not economical. However, coerced collaboration over seven decades during the Soviet era still leaves its traces. Trust and the willingness to cooperate are low throughout most of the country. To create new options for collaboration and such that farmers deem acceptable – be it through cooperatives or associations – is indispensable in order to develop a competitive and sustainable agriculture in East Georgia.

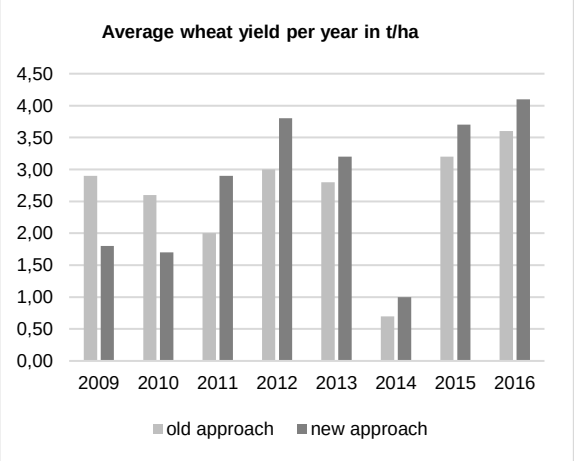
Needs for further adaptation

Despite of promising results (see Box) between 2011 and 2016, several additional elements are needed:

- More drought-resistant, if possible autochthonous wheat varieties
- Suitable crop rotation
- Optimisation of seed treatment
- More woody islands within the agricultural landscape
- Organisational development for cooperatives and associations (incl. AEA)
- Solutions for small-scale farmers

First success (and a disaster)

In 2011, an association of six farmers (AEA) was established in Dedoplistskaro to test modern agricultural techniques supported by German experts. Compared to farmers who did not participate in the project, average yields increased twofold (with the exception of the disaster year 2014). Starting in 2013, more and more farmers switched to low-tillage soil cultivation. As a consequence, their yields approached those of AEA farmers.



In order to improve and promote the concept, various important steps have already been initiated:

1. Lessons learnt are shared in training seminars with farmers, academicians, local administrations, operators of agricultural machines and agricultural extension services from all over East Georgia (started in December 2013).
2. All steps of the (new) approach are documented on teaching videos.
3. The (re)established Agricultural Extension Service (under the Ministry of Environmental Protection and Agriculture) has become the main recipient of training and study tours.
4. Options for introducing more aspects of eco-agriculture[5] are being discussed
5. A consultancy for developing sustainable agricultural cooperation structures is being prepared

[4] The rehabilitation and the conservation of windbreaks is the topic of another concept paper. A specific inter-ministerial policy for the rehabilitation, maintenance and protection of windbreaks was developed with support of GIZ and REC Caucasus, following the disastrous fires of 2015.

[5] See http://www.ecoagriculture.org/. The introduction of organic farming may come too early for most parts of Shiraki Valley, mainly due to the lack of closed animal-plant-systems and the basic lack of agricultural knowhow. It is nonetheless envisaged for a later stage. A concept paper and a policy brief for promoting eco-agriculture in Eastern Georgia were elaborated by GIZ-IBiS.