The GEF Small Grants Programme
UNDP Uzbekistan

Newsletter
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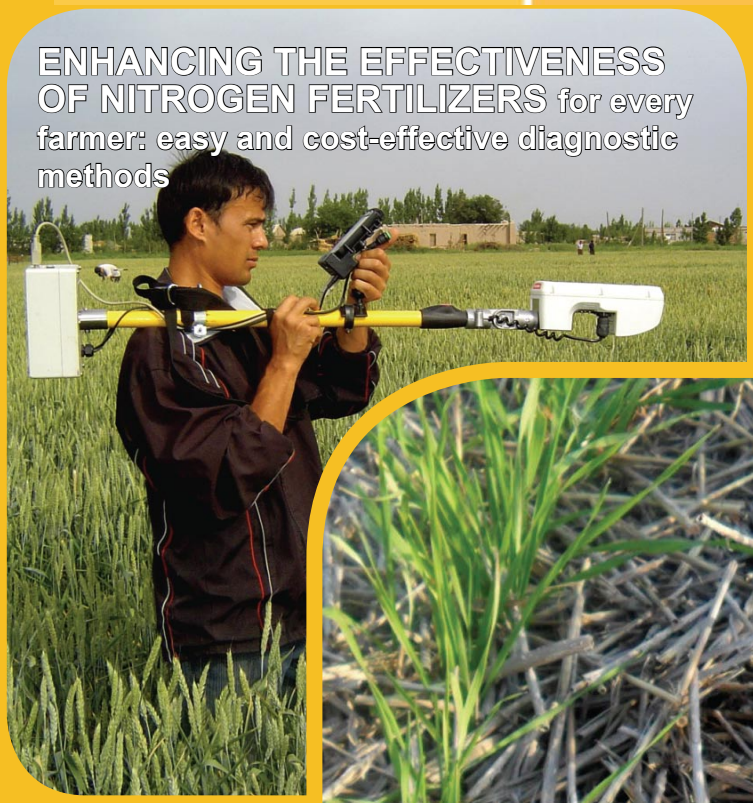
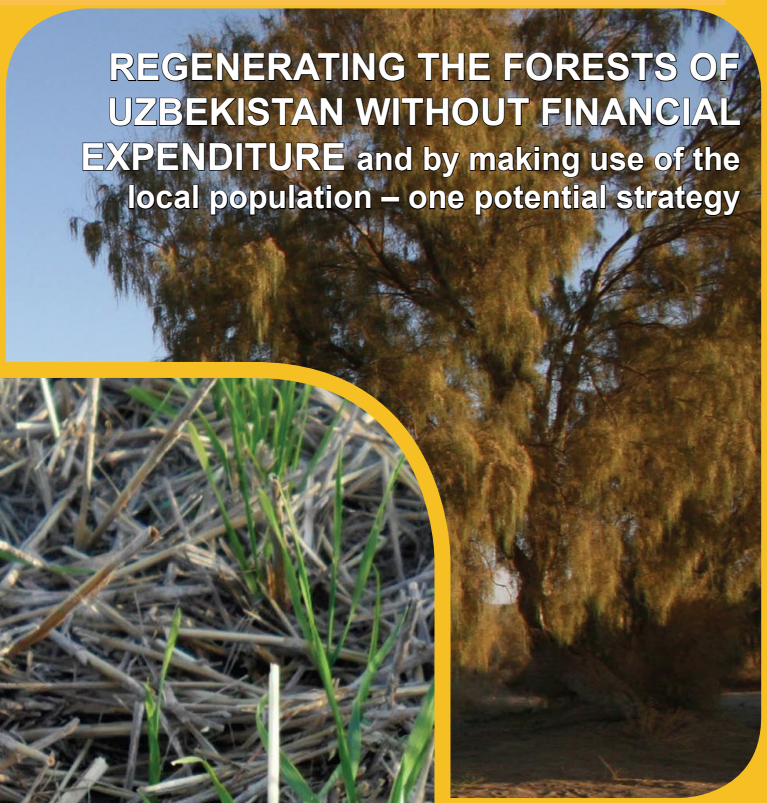
LANDENERGYBIODIVERSITY



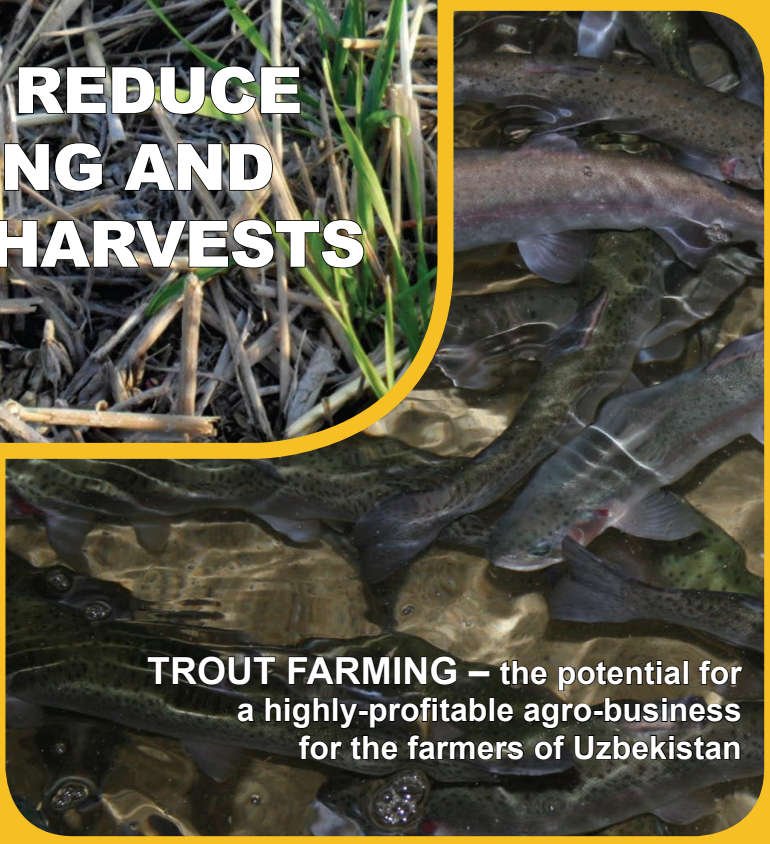
ENHANCING THE EFFECTIVENESS OF NITROGEN FERTILIZERS for every farmer: easy and cost-effective diagnostic methods



REGENERATING THE FORESTS OF UZBEKISTAN WITHOUT FINANCIAL EXPENDITURE and by making use of the local population – one potential strategy

HOW TO REDUCE SPENDING AND IMPROVE HARVESTS

WATERSHED MANAGEMENT IN HILLS to counteract natural disasters and improve the long-term ecological safety of village residents



TROUT FARMING – the potential for a highly-profitable agro-business for the farmers of Uzbekistan

HOW TO REDUCE SPENDING AND IMPROVE HARVESTS

In the agriculture of Uzbekistan, as in any business, the question of reducing business expenditures and improving profits is an urgent one. Farmers, like any businessmen, want to earn more, and to find ways to lower their spending. But this is not always possible. Why?

1. Worldwide fuel costs are rising faster than the price of grain - in agriculture, fuel is one of the most important factors in production because a large amount of machinery is used for tillage. This machinery needs fuel, which is always scarce during the peak season. A high level of demand alongside the limited amount of fuel leads to price rises. But the price paid for agricultural products is not keeping pace. Given this, it can be noted that the availability and price of fuel is a limiting factor.

2. There is not always enough available water to meet the requirements of all farmers - the availability of water is affected by several factors:

a. Climatic - the frequency of droughts is gradually increasing, which is linked to global climate change;

b. Infrastructure - the efficiency of irrigation systems leaves much to be desired and currently almost 50% of water is lost due to infiltration or evaporation;

c. Management issues - water resources can only be used more effectively if the way in which they are managed is improved, as well as strengthening Water Users' Associations and other participants in water management.

3. The soil is becoming poorer - the fertility of soil is decreasing for the simple reason that growing the harvest removes more nutrient-rich substances from the soil than are put back. The average annual use of humus from the fertile layer amounts to one ton per hectare. In order to compensate for this loss, it is necessary to spread no less than 10 tons of dung (one ton of dung produces 50-90kg of humus in normal conditions). In order to improve the condition of the soil and to increase the amount of humus, it would be necessary to add much more dung per hectare than the required 10 tons. Unfortunately, our farmers usually spread no more than four to five tons per hectare.

Thus each farmer must consider:

– How to reduce the amount of fuel required per harvest;

– How to receive, preserve and properly use the required amount of water for an optimal harvest;

How to improve the fertility of the soil for long-term and stable harvests.

There is a solution, and it is one that is being actively and widely spread throughout the world: transitioning to the use of ***conservation farming techniques***.

Photo 1. Farmers of Karakalpakstan are introducing with the sowing machine for direct planting

Over the last 20 years, 10% of all arable lands, or 125 million hectares (as of 2012) have been farmed using these techniques, and this figure is growing year after year.

What is conservation farming? It consists of several fundamental elements:

1. **Minimal disturbance of the soil** - this includes zero tillage and sewing seeds without the use of a plough. The soil is not tilled, and there is no harrowing or flattening. The farmer simply sews his seeds straight onto the soil. All of this is done with the help of special planting machines which have been shown by time and by experience all over the world to be reliable and efficient.

Instead of four or five machine operations, only one machine operation is required. And the effect on fuel use is as follows:

Picture 1. Fuel consumption per hectare of cotton plant cultivation (in litres)

It is possible to gauge the reduction in the amount of fuel required per country for the cultivation of fields

Table 1. Expenditure on cultivating cotton plants using traditional and conservation farming techniques in 2011 (from information from the GEF SGP project on conservation farming in Karakalpakstan)

Name of the activity	Fuel consumption		Material use		Labour	Total expenditure with traditional techniques	Total expenditure with zero tilling
	litres	sum	kg	sum	sum	sum	sum
Ploughing	30	48,000	-	-	80,000	128,000	-
Harrowing levelling	15	24,000	-	-	15,000	39,000	-
Seed planting	8	12,800	30	36,000	10,000	58,800	58,800
Spreading of fertilizer			600	210,000	-	210,000	210,000
Cultivation of middle rows	40	6,400	-	-	75,000	81,400	-
Weeding	-	-	-	-	60,000	60,000	60,000
Watering	-	-	-	-	60,000	60,000	60,000
Total		91,200		246,000	300,000	637,200	388,800

by means of figures. But even the merely theoretical aspects are significant.

2. ***Preservation of the permanent soil cover*** - in other words, the soil should not be left uncovered or “naked” for a single moment. After the harvest, it is necessary to leave mulch on top of the soil: powdered chaff, covering the soil. This can be done with a simple piece of equipment that exists in every location, a KIR-1.5. If this piece of equipment is not available, all that is required is to leave a high stubble. It is possible to sew cover crops right into the mulch or stubble without removing it.

Covering the soil means the farmer achieves three important goals:

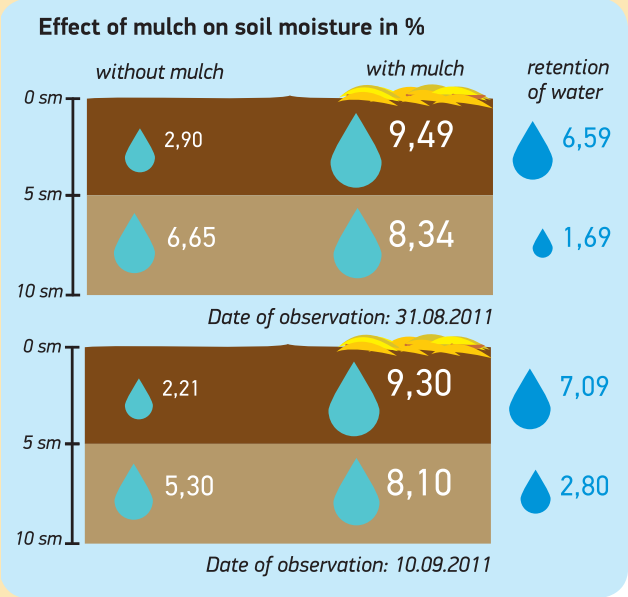
– preserving moisture in the soil which is vital for harvests;

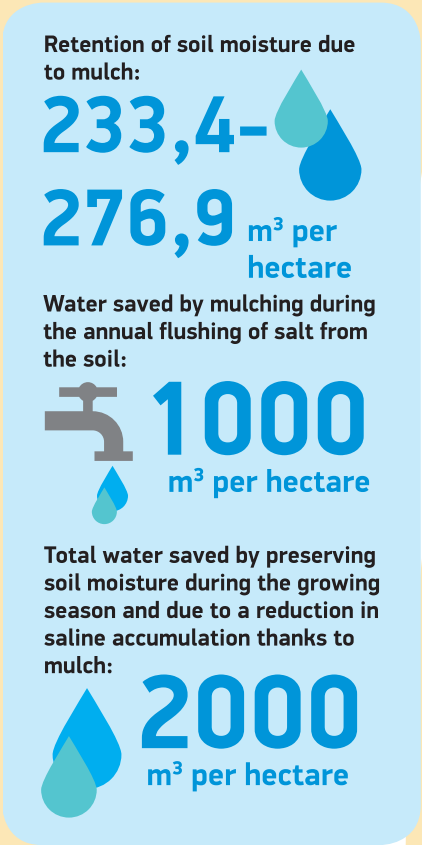
Photo 2. No-tillage experience in Karakalpakstan. A direct mulch seeding

– preserving a habitat for micro-organisms which are so crucial for the formation of humus;

– adding humus to the soil by means of the additional organic matter in the mulch and cover crop.

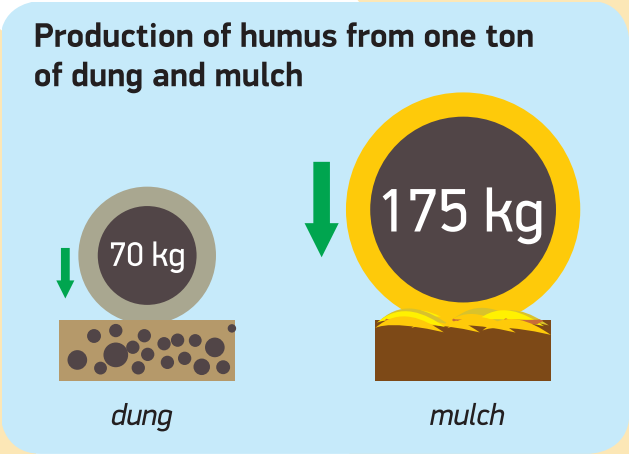
Here is a visual demonstration of how covering with mulch can preserve moisture:

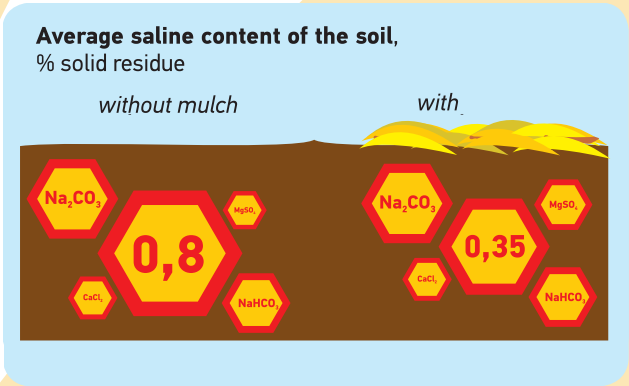




Picture 2. For more details please visit http://sgp.uz/ru/publications/publications/787

As to regards the positive effect of mulch on the fertility of soils, it should be briefly remarked that one ton of chaff produces more humus (170 kg) than one ton of dung (50-90 kg).





Picture 3. For more details please visit http://sgp.uz/ru/publications/publications/787

3. Crop rotation is a crucial practice and is a fundamental premise of agronomy. Unfortunately, it is often neglected by our farmers. At the same time, there is a large number of crop rotation schemes with succeeding crops which are not only particularly profitable for farmers but also improve the soil.

The use of zero till methods enables a reduction in time spent working the land and means that time can be saved to cultivate succeeding crops.

In this way, conservation farming techniques can help farmers to respond to the challenges of making a living from farming, reducing their expenditures, and investing in the fertility of their soil to ensure the long-term stability of agriculture. The country as a whole will benefit from these techniques as they will strengthen its food security and make its national agricultural sector more competitive. Furthermore, these techniques have the substantial benefit of stabilizing agricultural ecosystems and reducing greenhouse gas emissions into the atmosphere that were given off by traditional farming techniques.

The GEF Small Grants Programme is contributing to the distribution of these technologies throughout the country. In the near future, four additional projects

Photo 3. Winter wheat sprouts due to zero tillage

related to this technology in four different regions of the country (Khorezm, Surkhandarya, Jizzak and Fergana) will be launched. In Uzbekistan there are many organizations to help farmers get more information on these technologies. Any farmer who is interested can request information from the following contacts:

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Non-governmental non-profit organization KRASS – Khorezm Agro-Consultative Centre

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International Center for Agricultural Research in the Dry Areas, Regional Office for Central Asia and the Caucasus in Tashkent

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ENHANCING THE EFFECTIVENESS OF NITROGEN FERTILIZERS FOR EVERY FARMER: EASY AND COST-EFFECTIVE DIAGNOSTIC METHODS

Yu. Djumaniyazova, N. Ibragimov, J. Ruzimov, J. Khaitboeva, I. Kuryazov
Non-governmental non-profit organization KRASS

Relevance of the invention

The issue of food security arises again and again in our country. Our agricultural yields must be increased in order to produce more food. But this demand comes against a backdrop of the decreasing fertility of our soil. In other words, farmers must produce more while also taking into account the objective facts of production: soil quality, the amount of water, etc. In this article we will attempt to elucidate how nitrogen is used in agriculture, its influence on harvest yields, and, most importantly, how to regulate the use of nitrogen most effectively in order to get the largest possible harvests.

Every farmer knows that one of the leading measures among the range of agro-technical measures intended to increase the harvest of cotton plants, winter wheat, corn and other crops, is the use of mineral fertilizers, particularly nitrogen fertilizers. Nitrogen plays an important role in nourishing agricultural crops that grow in arid zones. Depending on soil-related, climatic and agro-technical factors, nitrogen fertilizers often deliver an increase in harvest yield of over 50%. Therefore, every farmer makes active use of nitrogen fertilizers in order to give his plants nourishment to grow. However, each plant can only take in as much nitrogen as it needs. Thus the question arises: how can an individual farmer know how much nitrogen each plant requires at each particular moment?

This question is important for several reasons. First of all, nitrogen fertilizer costs money. If a farmer uses nitrogen fertilizer incorrectly, the plant will take as much as it requires but the rest will dissipate into the atmosphere or be washed away. According to calculations carried out by the non-governmental non-profit organization KRASS, no less than 36 million US dollars of incorrectly-used fertilizer evaporates each year from the fields of Uzbekistan. Let us give a simple example. Farmers often apply fertilizer during watering. This leads to more than 40% of the fertilizer being immediately washed away without reaching the plants.

Secondly, if a farmer incorrectly employs nitrogen fertilizer, he/she might not use enough which in turn has affects the harvest. However, plants' growth is also delayed if there is a surfeit of nitrogen: they grow an extremely large amount of foliage and crops and flax produce fewer seeds, tubers and roots. An excess of nitrogen can also cause lodging. Nitrates (salts of nitrogen and oxygen) easily move around in the soil and can be washed away from the root layer by precipitation and drainage. The washing away of nitrates from heavy soils underneath plants is usually negligeable, on average amounting to 3-5 kg per hectare. However, light and especially fallow soils in damp regions, as well as irrigated land, can lead to significant losses of in excess of 30-50 kg per hectare.

Thirdly, nitrogen is an extremely volatile substance and easily forms bonds with oxygen. Nitrogen joined together with oxygen becomes a greenhouse gas, which has exceptionally harmful effects on worldwide climate change. The effect of nitrous oxide on the climate is more than 298 times greater than the effect of carbon dioxide.

These are some reasons why the correct use of nitrogen fertilizers is important for every farmer as well as for the country as a whole and the entire world's population.

The current guideline amounts and time periods for applying nitrogen fertilizer are very general and rarely take into account the particular characteristics of soils and agricultural crops or prevailing climatic conditions. The amount of mineral nitrogen contained in soil can vary enormously depending on many soil-related and ecological factors. This makes it difficult for farmers to correctly assess the nitrogen situation of their plants and make the corresponding amendments to the guidelines for using nitrogen fertilizers so as to obtain a large and high-quality harvest.

Traditional methods to determine the nitrogen contents of the soil and plants require significant amounts of labour and money to take samples and chemically analyse them. In practice, therefore, nitrogen fertilizers are often used without any consideration of the requirements of the crops being grown, which leads to a surfeit or deficit of nitrogen in the soil during the plants' growing period. Therefore, introducing methods to monitor plants' growth is one alternative way of using nitrogen fertilizers according to the needs of the plants.

There are many simple alternative methods which allow farmers to save money on buying fertilizer, increase harvest yields by using nitrogen fertilizer correctly and avoid unnecessary greenhouse gas emissions.

Many countries all over the world make successful use of a range of devices related to nitrogen fertilizer, such as the colour chart, chlorophyll meter, optical sensing device, etc. These devices enable the nitro-

Photo 4. Leaf color chart. Photo 5. Chlorophyll meter SPAD-502. Photo 6. Greenseeker device

gen consistence of agricultural crops and soil to be assessed and allow the necessary dose of nitrogen that should be administered during the growing season to be determined. This substantially enhances the effectiveness of the current nitrogen guidelines and reduces the economic and ecological cost of using nitrogen fertilizers in agriculture.

The **colour chart** is a simple and cheap device (costing around 1 US dollar) that is suitable for use in the field. The colour chart sheet is made out of plastic and consists of six green sections of varying vividness. The amount of nitrogen in the plants is determined according to their colour. During the growing period of winter wheat, measurements using the colour chart are carried out by comparing crop leaves that are fully opened. The nitrogen requirements of the plants are determined according to the "greenness" of the leaves, the type of leaf and the period of growth, and on this basis the necessary amount of nitrogen is calculated.

The **chlorophyll meter SPAD-502**[1] is both compact (it fits in your palm) and light (255 grams). Measurements of nitrogen content are carried out in the field on a fully opened leaf at the top of the stem (see photo). Thus there is no need to tear or cut off the leaf from the plant, which allows measurements to be taken throughout the growing season without causing damage to the plants. The chlorophyll meter is easy to use and it informs the user of the nitrogen consistence of the plant in real time, and if there is a deficit or surfeit. A farmer making use of the indications delivered by the chlorophyll meter could amend the nitrogen fertilizer guidelines during the crops' growing season. One SPAD-502 chlorophyll meter costs 2,500 US dollars. Analysis has shown that a farmer who cultivates an area of 100 hectares could make back his/her investment in a chlorophyll meter in its first year of use, due to the more effective use of nitrogen fertilizers and the money saved on purchasing them.

The next method of assessing the amount of nitrogen in plants is the handheld optical sensing device called GreenSeeker. It not only enables a prediction to be made of the necessary dose of nitrogen to be added during the growing season of crops, but also monitors the development of above-surface biomass and delivers a predicted harvest yield. And it does not harm the plants: there is no need to take living samples from them.

Specialists from ZEF/UNESCO[2] project adapted GreenSeeker to the conditions of Uzbekistan and demonstrated the potential of using it effectively on the staple crops of Khorezm province.

Description of the invention

The GreenSeeker optical sensing device consists of an antenna, a pocket computer, a battery and a handle: it is therefore compact and only weighs around 6 kg. One person can easily handle the device while taking measurements. GreenSeeker emits infrared signals to measure the green parts of the plant, and the sensor picks up the reflected signals from the plant. The indicator displayed on the screen (vegetation index) allows the nitrogen situation of the crop under investigation to be determined. This device also makes it possible to measure how much biomass is above the surface in real time, which allows the harvest to be predicted. Experiments that have been carried out in test fields in Khorezm have demonstrated a high correlation (90%) between the amount of above-surface biomass and the harvest of winter wheat.

Advantages of the invention

The main achievement of the GreenSeeker optical sensing device is that it allows the nitrogen content of plants to be determined and corrections to be made when applying doses of nitrogen. All in all, GreenSeeker has the following advantages:

– simplicity and ease of use;

– great precision and operational measurements of the nitrogen content of plants in the field;

[1] The project tested the chlorophyll meter SPAD-502, although several other models and versions of the meter are used throughout the world.

[2] ZEF/UNESCO project in Khorezm province in Uzbekistan has undertaken various thorough investigations that aim to make the use of nitrogen fertilizers on staple crops grown in the region more effective.

Table 2. Savings on nitrogen fertilizer by using GreenSeeker

Area in hectares	% reduction	Cotton plant				Winter wheat			
		Nitrogen	Ammonium nitrate (34.5% nitrogen)			Nitrogen	Ammonium nitrate (34.5% nitrogen)		
		tons	tons	thousand Uzb sums	US dollars	tons	tons	thousand sums	US dollars
1	1	0.002	0.006	1.6	1	0.002	0.005	1.4	0.9
	5	0.01	0.029	7.9	5	0.009	0.026	7.1	4.5
	10	0.02	0.06	15.8	9.9	0.02	0.05	14.2	8.9
100	1	0.2	0.6	158.1	99.1	0.2	0.5	142.3	89.2
	5	1	2.9	790.3	495.5	0.9	2.6	711.3	445.9
	10	2	5.8	1,580.6	991	1.8	5.2	1,422.6	891.9

**The official exchange rate of US dollars to Uzb sums as of 29.06.2012, when these calculations were made, was 1,595 Uzb sums to 1 US dollar (Central Bank of Uzbekistan);*
**ammonium nitrate was used as an example of nitrogen fertilizer (272.6 thousand Uzb sums per ton);*
**the recommended amount of nitrogen for cotton plants is 200 kg per hectare, and for winter wheat is 180 kg per hectare.*

Photo 7. External view of the optical sensing device and its use on wheat, Urgench district, Khorezm province (I. Kuryazov)

– it allows the necessary amounts of nitrogen to be used during the growing season to be determined;

– it measures above-surface biomass;

– it allows harvests to forecast harvests with an accuracy of up to 90%;

– it saves time and money;

– it brings ecological benefits due to the possibility of reducing the amounts of nitrogen.

Economic effectiveness of the invention

Depending on the model, one GreenSeeker optical sensing device costs between 250 and 7 thousand US dollars. The savings brought by lowering the guideline amounts of nitrogen by using GreenSeeker are in Table 2. In particular, using GreenSeeker can help to determine the nitrogen content of winter wheat and, if necessary, reduce the amount of added nitrogen fertilizer (such as ammonium nitrate) by 50 kg, thus saving the farmer around 14 thousand Uzb sums. Converting this to an area of 100 hectares sewn with winter wheat, the savings could amount to 2.8 million Uzb sums (1,800 US dollars).

The effect of using the invention over an entire province. An extrapolation of the above calculations on the scale of an entire province also yielded impressive results (Table 3). In order to supply farmers in Khorezm province, for example, with chlorophyll meters, an investment of 2.6 million US dollars would be required, which would provide ***a return on investment within two years*** due to savings on the use of fertilizer.

The use of chlorophyll meters in cotton fields in Khorezm province would allow a reduction in nitrates of 2,700 tons if the guideline amount of nitrogen were to be reduced by 5%, and a reduction of 5,400 tons if the guideline amount were to be reduced by 10%,

Table 3. Effect of using chlorophyll meters over the whole Khorezm

Area, hectares	% savings	Cotton plant				Winter wheat			
		Nitrogen	Ammonium nitrate (34.5% nitrogen)			Nitrogen	Ammonium nitrate (34.5% nitrogen)		
		tons	tons	thousand Uzb sums	US dollars	tons	tons	thousand sums	US dollars
Khorezm	1	188	544	148,264	92,956	60	173	47,230	29,611
	5	938	2,719	741,322	464,779	299	866	236,148	148,055
	10	1,876	5,438	1,482,644	929,557	598	1,732	472,296	296,111

**100 hectares of sewn land require one chlorophyll meter*

Photo 8. Use of the optical sensing device in a cotton field, Urgench, Khorezm province (I. Kuryazov)

which would amount to 1.4 billion Uzb srms (930 thousand US dollars). The use of the same chlorophyll meter in wheat fields would permit a saving of 236 million Uzb sums (148 thousand US dollars) if the guideline amount of nitrogen were to be reduced by 5%, and a saving of 472 million Uzb sums (296 thousand US dollars) if the guideline amount of nitrogen fertilizer were to be reduced by 10%. Given that one GreenSeeker optical sensing device is required for 100 hectares, then, as the calculations show, an investment in GreenSeeker at its minimum price of 2,500 US dollars would pay off in its very first year of use, and would pay off in its fifth year of use if it was purchased at its maximum price of 7 thousand US dollars.

As the calculations show, the use of the chlorophyll meter SPAD-502 and the optical sensing device GreenSeeker pay off, both for the individual farmer and for the entire province. Foreign countries have already started to produce cheaper versions of this device which hopefully suggests that Uzbekistan will make wide use of optical sensing in its agriculture. Investing in the acquisition of this device can pay itself off within between one and five years, depending on the initial cost.

Conclusion

Calculations have shown that by using the chlorophyll meter SPAD-502 in farms with an area of 100 hectares a farmer can save up to $1,000 simply by making more sensible use of nitrogen fertilizers. In Khorezm province as a whole, $930 thousand can be saved on nitrogen fertilizers in cotton fields and $296 thousand in winter wheat fields by using the SPAD-502.

In existing alternating crops (cotton-winter wheat/rice) in Khorezm province, greenhouse gas emissions from annual crops on average amount to 6.8 kg of CO_2 equivalent per hectare per day, or 2.5 tons of CO_2 equivalent per hectare per year. Taking this as an average for the entire irrigated area of the country (4.3 million hectares), it is possible to calculate that annual emissions of N_2O and CH_4 amount to 10.5 million tons of CO_2 equivalent. Thus, increasing the effectiveness of how mineral fertilizers are used in agriculture will permit a reduction in greenhouse gases.

In addition, the lack of necessary information, knowledge and contacts among farmers with regards to acquiring and using the different ways of determining the amount of nitrogen and its correct application is an obstacle to using this invention to make progress in agriculture. A possible solution to this problem is to make a centralized purchase of optical sensors by authorized agencies (for example the khokimiyat – local administration – or the headquarters of the Ministry of Agriculture and Water Resources) in coordination with commercial banks so as to choose the best source of financing. It will, thereby, be possible to supply optical sensors in a ratio of one device per 100 hectares, which could then be leased to farmers.

For more information, please contact the non-governmental non-profit organization KRASS:

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REGENERATING THE FORESTS OF UZBEKISTAN WITHOUT FINANCIAL EXPENDITURE AND BY MAKING USE OF THE LOCAL POPULATION - ONE POTENTIAL STRATEGY

Project Manager: Deusheva Gaukhar,
Candidate of biological sciences.

Although this article will deal with the regeneration of forested areas, before we discuss the regeneration strategy in question we would like to spend some time exploring the importance not only of forests, but of woodlands in general.

It is hard to overstate the significance of forests for countries and their populations. Forests:

- are a source of numerous products for human consumption that are used in various different ways. For example: commercial timber, firewood, mushrooms, nuts, medicinal plants, etc. All of this is an indispensable part of human lives and also provides them with income.

– are a habitat for plants and animals. If forests are lost, so is the entire biodiversity of the country, and this brings with it the threat of ecological catastrophe. Expert studies have shown that if the pollinators that live in wooded areas were to be lost, humans would starve to death in less than three years.

– have an amelioratory function: forests strengthen riverbanks and hillsides, guarding against erosion and disintegration; regulate springtime surface runoff by changing it into subsurface runoff; regulate the water cycle of soil and rivers; they also clean water, keeping our rivers, lakes and underground water clean.

– regulate the climate. Forests produce oxygen and absorb carbon dioxide, playing a significant role in the gaseous balance of the atmosphere and in regulating the earth's climate, humidify the air and weaken wind.

– contribute to the beauty of nature and recreation. The social role of forests - whether it be for holidays or health needs or the improvement of human living environment - is ever more significant. The leisure attributes of forests are extremely varied. They produce phytoncides which kill pathogenic bacteria and also have a beneficial effect on the human nervous system.

– produce oxygen which is necessary for our respiration.

– forests (such as woods within cities) absorb noise: the crowns of leafy trees reflect and disperse up to 70% of sonic energy, thereby neutralizing the effect of harmful industrial sonic discharges.

Today's forests all over the world constitute one of the principal pillars of the emergence of a global "green" economy. For example, the use of pellets/briquettes made from vegetable byproducts could easily become a major component of renewable energy and satisfy human needs in this regard. This constitutes a renewable energy with carbon-neutral effects on the global climate, and operates according to the principle: "it grew, it was used, it was renewed in the next cycle". The creation of agroforestry clusters in agriculture helps to maintain fertile soil, but also guarantees stable harvests, which is important for food security. Forests are fundamentally important for many branches of agriculture. It is necessary quite simply to make sensible use of what we gain from nature and agricultural procedures in order to ensure that forests last forever as an inexhaustible source of wealth for a country.

There is a bizarre stereotype according to which Uzbekistan, as a country with extensive deserts, has no significant forests. It is true that Uzbekistan counts among the lightly-forested countries. But it possesses many mountainous, riparian (waterside) and, most importantly, desert forests, which make up the national forested areas. The regeneration, planting and sustainable use of wooded areas in arid regions could solve many of the energy-related problems faced by local populations. The national forested areas include areas covered by forests, as well as areas not covered by forests but set aside for forestry use.

The entirety of the forested areas of the Republic of Uzbekistan **as of 1 January 2009 was 8.7 million hectares**, of which **3.2 million hectares** was covered by forests. Forested areas made up 7.2% of the territory of Uzbekistan.

The government of Uzbekistan is investing large sums in the preservation and regeneration of the country's forested areas. However, the success of

Photo 9. Natural rehabilitation of forests in the Yangiabad mountains, Tashkent province

Photo 10. Timber harvesting in riparian forests of Karakalpakstan

Photo 12. Irrational use of forest

such measures broadly depends on the local population, on awareness-raising work constantly being conducted among the local population by workers from environmental organizations, and on the motivation for individual participation felt by each villager. Currently, even as the state is spending money to regenerate forested areas, the deficit in energy resources is leading to large-scale destruction of forests for timber. During conversations in Surkhandarya province, elders referred to the figure of 1km: the amount by which the forest climbs the hill each year, or in other words, the amount of forest that disappears. The area covered by riparian forest has shrunk threefold since 1980.

The state is therefore expending financial resources on regeneration, but regeneration is not happening because the required amount of regeneration is higher than the actual amount of regeneration taking place. The private sector is a user of forests.

Photo 11. Consequences of unsustainable use of natural capital

Every year, the forestry industry issues statistics on the amount of forest planted. However, there are unfortunately no accurate figures on forested areas for the simple reason that there are no statistics on the areas used. The figures include increases, but no decreases. There is no budget for drawing up an inventory, monitoring or assessing forest resources. This is one reason why there is a lack of reliable information on over **5 million hectares** of state forest areas. There are also no market mechanisms for organizing or planning a sensible use of forests on the basis of an economic assessment of forest resources.

Interesting facts about forests

– In forests, and in city parks, the air is **15-30% more humid** than in streets and areas without greenery.

– The air temperature in forests during hot weather is **4-8 degrees cooler** than in open spaces. *(These two given points are important for our arid climate! And why is it that we prune back trees so aggressively in the city?!)*

– Every hectare of arable land that is not protected by forests or ringed by trees leaks 2.5-7 times more nitrogen, 2-6 times more phosphorus and 3-5 times more potassium than protected fields.

– During periods of dry weather and dust storms, a one-hectare-sized forest belt of a height of 10 metres can protect a field of 25-30 hectares and guarantee, even in difficult years, an increase in the crop harvest of 3-4 centners per hectare, or 75-120 centners over the entire protected area. *(Read our article about field-protecting forest belts on our website and in the next newsletter. Farmers are not planting forest belts because they cannot see the benefits in terms of the increased fertility of the soil and the increase in harvest yields.)*

Photo 14. Pistachio plantations in Jizzak province

– One hectare equals 40 oaks planted in the summer. It emits 14 tons of oxygen and absorbs 18 tons of carbon dioxide. *(This is not currently measured in Uzbekistan because its ecological services do not yet have sufficient funds)*.

It is an issue that the country is spending money on forest regeneration but no regeneration is taking place. This could mean that the approach to managing forest resources should be examined and altered.

Our proposal is to incorporate the private sector (in this case, the local population) in the regeneration

Photo 13. In a shade of a saxaul tree in Bukhara province

Table 4. Comparison of benefits for the state and local residents from short-term and long-term leases of forest areas.

	Short-term lease	Long-term lease
State	Spends money on the regeneration of the forest	Does not spend money on the regeneration of forest areas - funds are freed up for other uses
	Forested area does not increase in size because of destruction by the local population	Forested area increases due to the planting of trees by the local population as rent and the regeneration of natural forest in additional parts of the forested area
	State forestry authorities have the responsibility to: - Regenerate forested areas - Preserve forests from destruction - Monitor lessees	State forestry authorities only have a supervisory function. Duties to regenerate forested areas and to preserve forests from destruction are incumbent on lessees who are responsible for increasing the size of forested areas
	The state receives a limited income from rent	The state receives significant income from the use of leased land as it receives a share of the harvest
Local inhabitants	Do not make significant profits from renting land as there is no encouragement to make investments	Make significant profits from the long-term use of land, investment and the additional harvest from rented land

of forests and to give them every possible encouragement to carry out regeneration work. The private sector does this work more quickly, to a higher standard, and more cheaply. By incorporating the private sector into forest regeneration projects, state bodies will find it easier to carry out monitoring and controls. How is this possible? One possible answer is to ***extend the rights to forested land***.

There have been several previous attempts to examine the possibility of leasing forested land to local population. One example is the effort undertaken within the framework of UNDP-GEF project entitled Establishment of the Nuratau-Kyzylkum Biosphere Reserve. The forest-related element of the project tested the possibility of regenerating forested areas according to a particular model:

Photo 15. A bunch of a sea-buckthorn in the riverside riparian forests by Nataliya Marmazinskaya

– Forestry units leased the forested land planted with fruit and wood trees (i.e. trees in general).

– As rent, the lessee was to give 50% of the harvest or products (the amount could be altered) and also to pledge to regenerate the natural botanical life within the limits of the forested area (the size of which was also be discussed).

Photo 16. Uncontrollable livestock grazing in riverside riparian forests

In this way the leased areas of forest were to be covered by planted trees (for fruit or wood) and the additional forested land would be regenerated at the lessee's expense. In this case, no spending on regeneration work was budgeted, but the land would nevertheless gradually become covered by trees. Forestry units were responsible only for oversight: ensuring that lessees met their responsibilities as set out in the lease agreement.

However, there was one drawback. According to law, forest lands could only be leased on a short-term basis. Previously, it was one year with the right to extend the term. Now this term has been increased so that the lease can be extended for up to 10 years. However, in practice, a long-term lease of forest lands does not last that long. Usually a short-term lease is signed with the possibility of extension. Such an agreement makes the lessee, year after year, directly dependent on the whim of the director of the forest unit. But it is well known that it takes time to make money from trees. Lessees need a firm assurance that, if they invest in planting trees for fruit or wood production, there is a guarantee that they will have a claim to what is produced when the orchard or plantation comes to fruition. This is only possible with a long-term lease. For example, as shown by the GEF Small Grants Programme (GEF SGP) study on the distribution of pistachio plantations in Uzbekistan, pistachio trees only start to yield nuts after six to seven years, and only give maximum yield after 15 years. ***The lack of guarantees given in short-term loans is a significant barrier to the regeneration of forested areas on forest lands***. People simply do not want to invest money without any sort of guarantee. A fundamental recommendation in connection with this issue is, therefore, to increase the opportunities of working within this scheme to a term of up to 49 years, as is the case with lands set aside for forestry industry use.

According to all indicators, the current short-term leases are a lose-lose situation (both the local population and the state lose out), while long-term leases are a win-win situation.

In this regard, we noted above the direct drawbacks and benefits that are associated with the leasing of forest land. It would equally have been possible to conduct a robust analysis and to assess the indirect gains of having private individuals increase forested areas. This category would include the economic profits from such areas as the development of tourism and leisure activities, the production of non-wood forest products (berries, medicinal herbs, mushrooms, etc), the reduction in soil erosion, the improvement of the water supply to the population, not to mention the purely ecological benefits (carbon reduction, oxygen production, increase in local habitats for plants and animals, etc).

Another example of the lowering of state expenditure on the regeneration of forest is provided by the GEF SGP project *The Regeneration of Riparian Forests along the Zarafshan River - the Potential for Preserving a Biodiverse Region* which was carried out by Zarafshan, an ecological non-governmental non-profit organization, in Samarkand province. The goal of the project was to increase the coverage of riparian forest in the Oqdarya district of Samarkand province, working on zones of 10 hectares by involving the local population in actions to regenerate the forest. The following strategy was tested in this case:

– The forest unit offered to lease an irrigated area to the local population for a short term.

– The lessee, as rent payment, was to regenerate the degraded parts of the forest according to certain criteria.

In this case, once again, the state was able to avoid the burden of having to pay for the regeneration of the degraded sections of forest. In this case, deforested areas made up around 50 hectares of the entire area of riparian forest in the Oqdarya district (205 hectares). The local population was able to carry out regeneration of the forest because it could gather seeds and prepare the grafting of oleanders, tamarisks, buckthorns and hawthorns. The regeneration of forested areas that they carried out cost them only their time and the cost of their independent labour. The state was thus able to avoid spending any financial resources. However, the result was the same: the forest was regenerated. In the final agreement,

The project included purchasing and planting 10 thousand poplar offshoots in the project area.

A series of training seminars was conducted on the subject of activities and practical methods to regenerate forests, as well as alternative revenue sources for village residents. The ultimate goal of these workshops was to reduce man-made pressures on riparian forests caused by the villagers (felling of trees and shrubs, livestock grazing, removal of topsoil for individual requirements, etc). The seminars were on the following themes: problems of sustainable animal breeding; using leased land to grow medicinal plants for home use and for the use of pharmaceutical firms; possibility of enhancing feeds for household farms. All of these seminars excited great interest from the villagers who lived closed to the riparian forests.

Understanding that the future of riparian forests is crucially dependent on the next generation of villagers, Zarafshan undertook large-scale awareness-raising efforts in three village schools in Oqdarya district (schools No. 14, 15 and 46). Older pupils of these schools were offered theoretical and practical seminars on methods for producing cuttings and choosing seeds for riparian trees. The seminars on the theme of “Trees - Our Friends” gave pupils the foundations of a balanced attitude towards unique natural areas on the basis of an objective and clear comprehension of their significance and role in preserving a biodiverse region. The seminars were conducted to encourage to form “Friends of the forest” clubs in village schools. In this connection, we developed a set of posters on the biome of riparian forests, the animal and plant world of riparian environments and rules of behaviour in the forest. All of these posters, and other material to be distributed, was given out to three schools to encourage clubs to be established. Furthermore, theoretical and practical seminars were carried out in village schools on how to put together ecological pathways.

Photo 17. A black saxaul in the territory of the Ecocenter «Djeyran» in Bukhara province

lessees from the local population received, rent-free, 0.25 hectares of irrigated land for their own personal use for five years in exchange for the obligation to care for and preserve newly-planted poplar seedlings over an area of one hectare. Thus by giving away land in one hectare sections, the state received four hectares of irrigated land. State expenditure in this case merely consisted of the profits lost from not being able to use the leased irrigated land in a different way. Unfortunately, the project was not assessed in an economically detailed manner to detail all parties' expenditures and profits.

In order to implement the project, Zarafshan selected three project areas in the deforested portions of the riparian forests the Oqdarya district. During preliminary meetings in the villages of Oksulot, Jarbuta and Kholdor, the goals and challenges of the project were presented to participants and the possibility of village residents participating in the process of regenerating the riparian forests was discussed. In order to encourage residents to participate in tackling the aims and challenges of the project, a project of lease agreements between local residents and the administration of the Oqdarya district forestry unit was presented, which testified to the desire to participate in the process of regenerating the riparian forests. The project was approved and signed by eight lessees who were residents of Jarbuta, Oksulot and Kholdor.

Other activities also fell within the scope of the project:

Implementing this project was the first attempt in Samarkand province to involve the village population living close to the riparian forests in work to regenerate these forests, together with corresponding state authorities, such as the regional administration and regional forest units.

In conclusion, it should be noted that there exist alternative methods and approaches to managing forest areas. As seen above, the implementation of alternative approaches such as the introduction of long-term leases of land to the local population or the provision of productive, irrigated land are able to aid efforts to regenerate forests. Given enough political will, these methods can be implemented with evident benefits for the state in terms of:

– an increase in the country's forested areas, along with all the corresponding economic and ecological benefits of this fact;

– a decrease in spending on such activities;

– an improvement in the well-being of local population as a result of their involvement in this work and receiving of real benefits by them from the sustainable regeneration and use of forests.

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WATERSHED MANAGEMENT IN HILLS TO COUNTERACT NATURAL DISASTERS AND IMPROVE THE LONG-TERM ECOLOGICAL SAFETY OF VILLAGE RESIDENTS

This article describes the outline of a possible project that the GEF Small Grants Programme is attempting to establish and trial. If you are interested in implementing a similar initiative in your mountain community, we would be delighted to discuss this possibility with you.

DESCRIPTION OF THE PROBLEM

The development of information technology has enabled the country's population to receive warnings from the Ministry of Emergency Situations (MES) and the environmental monitoring service regarding dangerous natural phenomena. These can include extremely high or low air temperatures, solar activity, severe precipitation, avalanches, mudflows and landslides. Unlike previous years, 2013 was characterized by a high number of occasions where villages in mountainous and hilly regions were in danger. Furthermore, while such events had previously occurred in the seasons of winter and spring, as might be expected, in 2013 these events occurred in the summer.

Mudflows are streams of dirt and stones that flow downhill at great speeds and with incredible destructive force. These flows not only harm the country's economy by causing significant material damage – destroying various communication links, buildings, structures, the blockage of water storage facilities and irrigation and drainage networks – but also claim the lives of livestock and even human beings.

The material damage caused by mudflows is enormous, but the direct damage they cause is not limited to this. As the topsoil, the most fertile layer, is swept off hillsides, the soil is made significantly less fertile which leads to a decrease yield in these areas. The loss of this fertile layer gradually leads to the loss of biodiversity, future aridity and consequently the loss of ecological productivity. This last aspect has a direct impact on the food security of the country. These occurrences thus render the ecological and economic conditions of districts affected by mudflows markedly worse, and these conditions become markedly worse and problematic. In the long run, it is impossible for this not to have a negative impact on the social environment of local communities. Further consequences of mudflows spread from mountainous districts, where they arise, to valleys. Mudflows that flow down hills remove an enormous amount of water which is impossible to use during the long, dry growing season, when the need for water is at its greatest. Furthermore, this moisture is accompanied by sediment which silts up water storage facilities – canals and rivers – reducing their capacity and absorbency and putting them out of service significantly earlier than planned.

Photo 18. A landslide in the surroundings of mountain settlements in Tashkent province

But even this is not the principal damage wrought by mudflows. Uzbekistan is an agrarian/industrial country. A large part of its crop cultivation depends on irrigated land – in conditions like those in Uzbekistan, cultivating plants without irrigation would be practically impossible. Meanwhile, only 9% of the country's river water arises within its borders. The rest of the water arises in neighbouring countries, principally in Tajikistan and Kyrgyzstan. It makes sense that we are essentially unable to regulate the water that rises in other countries. At the same time, ongoing climate change is causing ever more aridity in Uzbekistan, meaning that there is an even greater need for fresh water, principally to irrigate fields, but also for industry and for the population.

Therefore it is ever more important to us to pay close attention to the water that arises in our own country. The amount of water that flows together with mudflows can be considered lost for agriculture.

Deforestation is the principal cause of mudflows, as this leads to the loss of the soil's plant cover. The once-rich plant covering of the mountainous and foothill regions of Central Asia has undergone significant reduction, fragmentation, degradation and depletion. Forested areas in the mountainous regions of the country, according to different assessments, now amount to less than 1.5-2%.

Human and his economic activities constitute the main reason for the loss of plant cover in the moun-

Photo 19 and 20. An example of the destruction of hillside plant cover by grazing livestock

tainous regions of the country[3]. As an example, pistachios and juniper trees were enormously depleted due to fuel requirements related to the development of a local metallurgical plant, and so that trees for timber could be planted and felled. The ploughing of arable land in the dry lands of the foothills also led to the destruction of large areas of forest. The development of distant-pasture livestock-raising and the unregulated grazing of ever-increasing quantities of livestock led to the depletion and degradation of not only natural mountain pastures but also of tree-covered land due to the trampling and destruction of the undergrowth of forest trees, jeopardizing the natural renewal of the tree cover.

Deforestation and the destruction of grass cover on hillsides deprives the soil of the protection of the trees, the ground layer and turf. The top layer of soil remains basically exposed, unable to absorb precipitation and take it underground. The unregulated grazing of livestock has an ever greater effect on the structure of the topsoil and loosens it, making it liable to be washed away even by not particularly intense precipitation.

The reason for mudflows might also reside in another unreflective human activity undertaken in mountainous regions (ploughing, road-construction, etc). If no action is taken to preserve hillside plant cover, then after the topsoil has been washed away, gullies will form, something which is even more complex to counteract.

Human activities that are destroying the plant cover of hillside soils are aggravated by the damaging effects of climate change. According to climatologists at the environmental monitoring service, the imbalance of climatic systems constitutes one form of climate change. Such imbalances, in turn, increase the risk of natural disasters occurring due to the loss of plant cover. Predicted climatic phenomena include:

– An increased number of days with severe precipitation and more changeable precipitation patterns, which will also contribute to the washing away of the topsoil and the formation of mudflows;

– More frequent droughts and longer hot and dry periods, which will also hinder the regeneration of topsoil;

Thus an increasing population, human activity and climate change are the principal reasons for the significant degradation of plant cover, a natural component of mountainous landscapes and one that guaranteed their stable existence. The degradation of plant cover significantly increases the risk of an increase in mudflows and landslides. We must, therefore, be prepared to face up to an increased risk of mudflows.

The most fertile, top layer of soil on hillsides, once stripped of its plant cover, is degraded in the following way:

– soil has certain properties, such as draining water. The soil allows water that has fallen on it as precipitation to flow through itself, and retains a certain amount of water as groundwater. The drainage of water depends on the composition of the soil, its structure, the presence of humus and many other factors. The more the soil is degraded, the less water it will absorb, and vice versa. Furthermore, the more intense the precipitation, the longer it falls for and the steeper the slope on which it falls, the less of this precipitation will be absorbed by the soil. Water that has not been absorbed forms surface runoff. The less water is absorbed by the soil, the more will be available to form surface runoff. It is surface runoff and sedi-

[3] At the end of 1913, the population of Uzbekistan within its present-day borders was 4.33 million people. By the end of 2013 the population exceeded 30 million people.

[4] There were 1.4 million head of cattle in Uzbekistan in 1916 and 4.3 million sheep and goats; in 2008 there were more than 8 million head of cattle and 13.6 million sheep and goats.

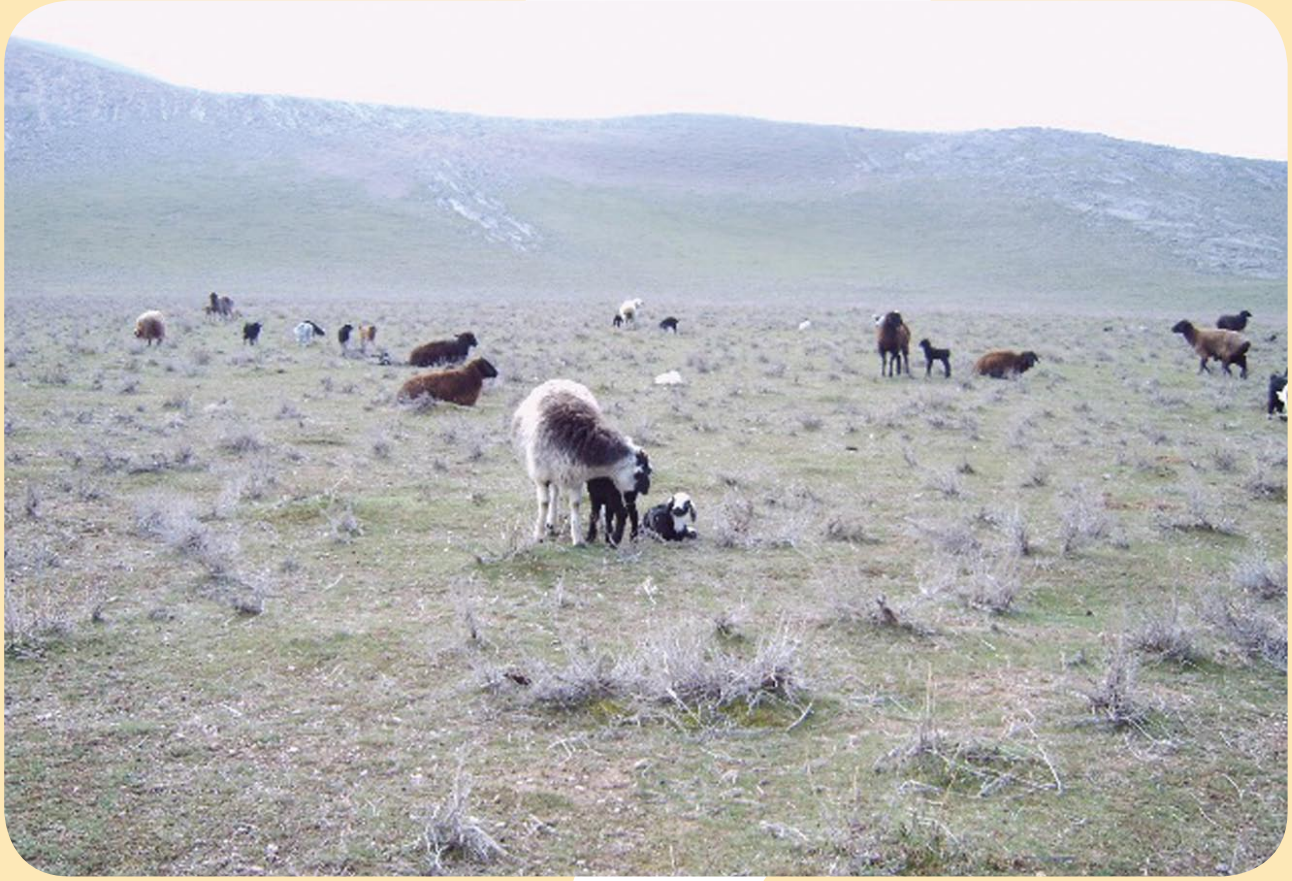

Photo 21. A grassland degradation made by a livestock

ment made up of soil particles that is the main component of mudflows.

A SOLUTION TO THE PROBLEM

Preventing mudflows is cheaper than cleaning up the damage they cause. Furthermore, this method of counteracting mudflows can also bring potential benefits. It is possible to prevent the formation of mudflows by preserving and regenerating the plant cover.

It has been shown by both international and domestic forestry practices that preserving forest cover and the reforestation of hillsides is a crucial factor in stabilizing mountain landscapes and also in producing a significant decrease and even elimination of mudflows:

– on hillsides that are covered by forest, the tree cover itself retains a large amount of precipitation, thereby reducing its quantity and intensity, a process that is also helped by needles, leaves and other plant remains under the trees that form a so-called litter layer: a layer covering the top of the soil made of organic plant residues and which is able to absorb a large amount of moisture. Dissolved particles of this litter layer, mixed with ground, not only enrich the ground with humus but also improve the physical/mechanical properties of the top layer of soil, increasing its porosity and structure, which leads to a significant increase in its ability to filter water through the soil. Furthermore, the litter layer provides food for soil-dwelling animals such as earthworms and rodents which, by means of their movements through the soil, also significantly improve the speed at which moisture can be absorbed;

– Exactly the same role is played by a living layer on top of the soil made up of grassy plants, which at times create quite a thick turf, thereby also contributing to the storage and absorption of water.

Soils with developed forest and grass plant layers are able to absorb practically all precipitation that falls on them, thus transforming surface runoff into underground runoff. In these circumstances, there is a marked increase in the depth to which the soil is soaked, corresponding to the increased amount of water stored in the soil. Some of this moisture might be used during the plant-growing season, increasing the soil's productivity due to its improved capacity to provide water. However, a significant amount will leak out from the soil in different ways during the summer months, like water leaking from a sponge, and end up in the hydrographical network, maintaining the flows of mountain rivers. In this case, surface water, and also the degradation of hillside soils, substantially decreases or stops entirely.

However, as noted above, population growth and its resulting requirements – principally the grazing of livestock and the felling of trees – are the main cause of the destruction of forests and the degradation of hillside soils. Therefore, simple reforestation

in the mountains cannot solve the problem of mudflows, since this problem is essentially caused by humans. This means that problems must be solved by addressing social needs and engineering and forest-related challenges.

In worldwide science and practice in the field of transforming surface runoff into underground runoff in hilly areas and combating mudflows, we find the term ***"watershed management"***. This includes a range of measures for the sustainable management of forested areas, pastures and other categories of land, including agricultural activity in hilly areas. In this regard, it is important to understand that a mountain catchment area consists of small watersheds, each of which demands its own particular procedures. A small watershed is the name given to a mountain formation bounded by drainage divides made up of two abutting ridges with their own draining depressions. That is, it is a territory bounded by drainage divides from which surface runoff and underground runoff flows into a given river or watercourse.

If the problem were to be approached in a systematic way, then watershed management ought to consist of interconnected components:

a) creation of forest on hillsides vulnerable to mudflows;

b) management of pastures;

c) social support measures;

d) creation of integrated infrastructure;

e) engineered structures to divert mudflows into river channels;

We will focus on the three initial and most important components.

a) Creation of forest on hillsides vulnerable to mudflows

The most important thing to prevent mudflows is the presence of as rich as possible plant cover on hillsides. For this, it is necessary to counteract the erosion of forested areas around small watersheds - in water catchment zones in the forest belt around the catchment area, particularly in its higher and middle sections.

Growing forest, particularly in arid conditions, is a long-term undertaking that demands a thorough approach and special measures in connection with the accumulation of moisture in the soil in the early stages of the trees' life so as to improve the survival rate of the forest cultures and to permit their successful growth. However, rapid improvements cannot be expected, even with cultures with a good survival rate

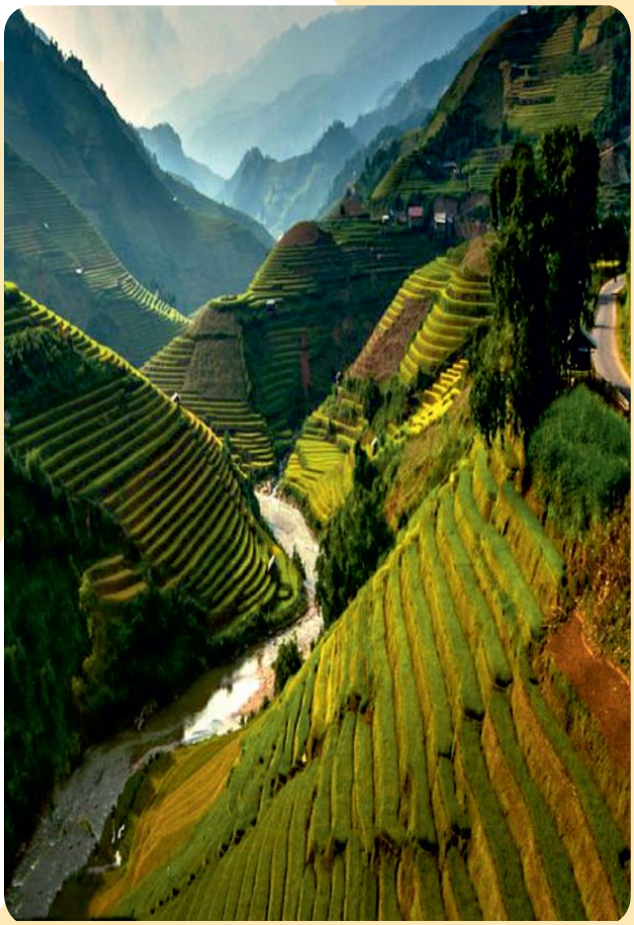

Photo 22. Terraces in Nepal

and good signs of growth: it takes a long time to create a forest environment.

But time waits for no man and we have to obtain results from our actions as quickly as possible. One thing that can help to obtain improvements is ***creating terraces***, as a way of preparing the soil for the subsequent planting of protective plantations. A system of terraces is created in such a way so as to completely trap surface runoff. In order to do this, it is essential to guarantee the absorptive properties of the terraces and their density in relation to the unique properties of the location. These two attributes depend on the quantity of precipitation falling on a particular location, how intense it is, the steepness of the slope and certain other criteria. The creation of a system of terraces on slopes steeper than 13-15 degrees guarantees not only that surface runoff will be trapped, but also that it will be transformed initially into underground runoff and, consequently, will provide a water supply in places where planting is to be carried out, which will guarantee the establishment of the new cultures in the arid conditions of Central Asia.

In slopes of the same steepness, and also on those inaccessible by tractor, and on even steeper slopes,

the soil for the planting of forest cultures is prepared in small areas with opposing slopes which are also intended to absorb water.

On less steep slopes soil is prepared by ploughing in rows, or by ploughing horizontal terraces.

After construction is complete, it is time to start planting the forest. The long-term plan foresees the forest, when the terraces will possibly silt up, that will guarantee that all of the surface runoff is trapped and is transformed into underground runoff. An establishment of forest environment within these formed planted trees and, above all, the creation of a litter layer, a powerful root system and the development of soil-dwelling plants and animals will be a base for the underground runoff. All of this will guarantee that the topsoil will be protected and regenerated.

The selection of forest cultures depends on the altitude, on the orientation of the hillside in relation to the sun, on the steepness of the slope, on the biological characteristics of the forest species, and other factors.

b) management of pastures

The creation of forests on hillsides in order to regenerate plant cover (grass, shrubs and trees) presupposes that livestock be banned from grazing in order to avoid damage to the young plants in the area in question. A range of examples has clearly shown how a ban on grazing on hillsides led to the rapid regeneration of grasses, first of all, and then of forested areas. Mudflows stopped after 1-2 years. If we wish to limit mudflows, it is crucial to limit the grazing of livestock so that plants can recover. The grazing of livestock can resume after the creation of forest, albeit in a strictly controlled manner.

However, limiting grazing leads to losing profits by the local population arising from pastures, which, of course, provokes the displeasure of animal owners. In connection with this, the question of the sustainable and profitable use and management of the remaining pastures becomes pressing.

In order to mitigate this, certain measures must be introduced:

– outreach and the implementation of pasture rotation;

– introduction, at the very least partial introduction, of keeping livestock in barns;

– less productive animals must be replaced with purebred livestock, thus permitting a significant reduction in the number of animals kept by local residents without leading to a loss in their production levels;

– productive feed plantations on irrigated land must be created and a cluster of measures implemented to improve the productivity of current pastures.

It should be noted that some feed can be obtained from forested areas.

But the most important factor in limiting the risk of mudflows will be the application of strict controls on impermissible livestock in the forested areas under regeneration and subsequently the strict enforcement of rules regarding livestock on hillsides. If this monitoring were to be carried out by the MES, alone or together with the inspection division of the state department for natural monitoring, the risk of mudflows could be effectively reduced.

It is impossible to regenerate grassy vegetation on the highest elevations, where forests cannot be regenerated, without strict enforcement of livestock rules.

c) social support measures

In order to avoid the future illegal felling of growing trees, it is important to establish mechanisms to make it beneficial to local residents to preserve and regenerate forested areas. This can be achieved in several ways.

The first way, which is directly connected to the challenge at hand – preventing mudflows – consists of creating a business linked to growing trees. This can be achieved by instituting certain practices and frameworks.

The first mechanism is to assign responsibility for the creation of forested areas to the relevant population group. It is necessary to lease out land on hillsides in order to create forests, and to encourage current lessees to create forested areas. In order to do this, forested areas must bring a direct benefit to the lessee. Forest industry can be profitable for lessees by means of various management practices. A high level of support will be necessary here from forestry workers, who must be ready to present and teach farmers such practices.

In many cases, practices will depend on many factors, but possible versions include:

– creation of fruit-tree orchards in accessible high-altitude regions;

– creation of pistachio and almond plantations on sites with a southern exposure and with little water flow;

– creation of walnut plantations on slopes with a northern exposure;

– creation of commercial timber and firewood plantations.

There are many technologies that would allow lessees to make the maximum amount of profit from a well-managed forested area. Furthermore, it is essential to provide support so as to enable the smooth and profitable sale of the products of the planted forested area.

However, it is also important to regenerate hillside vegetation, both trees and grass, at high altitudes that do not allow direct profits to be made from trees. Putting the responsibility on lessees in accordance with the amount of irrigated land given to them lower in the valley is one possible way to regenerate forest cover at such high altitudes. One similar variant was trialed in Samarkand province, where in return for being responsible for regenerating one hectare of forest according to established standards, the lessee was given 0.25 hectares of irrigated land. It is impossible to institute such a scheme without the firm desire of local authorities to do so.

It is also impossible to prevent trees being felled without an additional set of measures to improve everyday life among the local population. This means, primarily, that the population will get what they chop down trees for - namely, energy. The main reason trees are felled is to provide energy to prepare food and heat homes. It is possible to take a range of measures to satisfy these energy needs:

– introduce measures to increase energy efficiency: distribute simple home insulation technology and energy-saving stoves to prepare food and heat homes;

– introduce alternative heat sources: set up briquette presses for producing heating briquettes, install simple solar cells to heat water for everyday use, distribute simple biogas installation for individual household use.

PROPOSED PROJECT ACTIVITIES

At the present time, confirmations of the effectiveness of lowering the risk of mudflows by regenerating plant cover – watershed management – is entirely based on scientific foundations and trials that have been carried out in a world community. In Uzbekistan, there has been no demonstration of the effectiveness of this work in watershed management.

In order to demonstrate the effectiveness of combating the formation of mudflows by improving watershed management, it is essential to:

A. Select watersheds in locations where mudflows are currently frequent;

B. Develop and implement measures for each location according to the aforementioned points: regeneration of forests, regulation of use of pastures, measures to improve social and living conditions, etc.

C. Carry out an analysis of the effectiveness of the measures, including an analysis of the lower risk of mudflows, as well as an economic analysis - how much damage is done by mudflows, how much was spent to combat them or repair the damage, and how much it was necessary to spend in order to counteract mudflows by means of watershed management and the benefits of this approach;

D. Prepare recommendations for the MES on the possible extension of this experiment to other areas of the country in danger of mudflows.

The success of these efforts depends on the motivation of local population to stop mudflows, and the involvement and total support of local authorities in this work. The fundamental idea of this project is to move responsibility and spending on the regeneration of plant cover away from the state and its financial resources and onto potential lessees of hillside areas, in exchange for the benefit that they receive. State authorities must take upon themselves an accompanying, coordinating and supervisory role.

It is vital to note that watershed management to combat mudflows is complex. The success of one element depends on the successful implementation of the others. For example, the regeneration of forest cover is impossible without the proper management of pastures, but this, in turn, is impossible without measures to lessen the impact of traditional livestock-raising. At the same time, the lack of measures to meet energy needs will increase the risk that trees will be felled, rendering all the efforts to restore forested areas less effective, or entirely ineffective.

Thus the neglect or insufficient implementation of any of the measures in the aforementioned list of systemic measures for sustainable watershed management can jeopardize the effectiveness of the entire system. It is therefore logical that these efforts depend on coordinating the actions of specialists from many state agencies, professions, and local residents. In our country, there has been no previous instance of such a multi-functional, interdisciplinary, environmental project with a clear social orientation being executed. However, rapidly-changing natural and social conditions emphatically demand urgent action.

If this idea has interested you, please contact the office of the GEF Small Grants Programme at the following address:

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TROUT FARMING - THE POTENTIAL FOR A HIGHLY-PROFITABLE AGRO-BUSINESS FOR THE FARMERS OF UZBEKISTAN

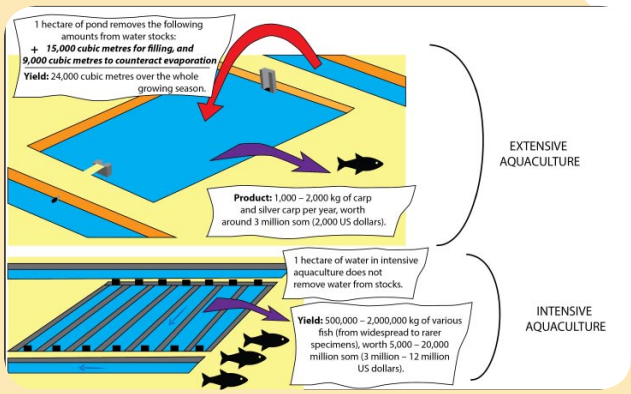
B.G. Kamilov, I.I. Khalilov

Every farmer knows that producing food is a sustainable business if the product is in demand, and the technology for producing this food is profitable. After all, customers and their families have to eat every single day. Fish are among the most useful and valuable food products. In Uzbekistan, fish production is particularly attractive and has great potential. Why? Because fish are such a useful product that without them it would be impossible to have a healthy population. Medical science has established that the minimum necessary consumption of fish is 16 kg per person per year. Since the population of our country is approaching 30 million, that means that Uzbekistan requires more than 400 thousand tons of fish each year. How much is currently being produced? Scarcely more than 30 thousand tons per year! There is, therefore, a fish deficit.

The worldwide importance of aquaculture for the global food market, and particularly for developing regions, was clearly stated by Árni M. Mathiesen, the Assistant Director-General of the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations. “Given that the global population is set to rise to 9 million by the year 2050, aquaculture, particularly in regions that suffer the most from food insecurity, could make a singular contribution to global food security and economic growth,” he noted.

There is objective evidence for this. Uzbekistan is at the centre of the world's largest landmass, with no access to the sea where fish could be acquired by fishing (i.e. catching fish in the wild). However, fish can be farmed. This is called aquaculture. But aquaculture also makes demands on farmland. During the planned economy of Soviet times, the farmlands of Uzbekistan were used for cotton and other crops which benefited from its southern location. Fish were primarily shipped in, and older people still remember that Thursday was fish day. However, the break-up of the USSR meant that the delivery of fish practically ground to a halt. A fish deficit opened up, and the government had more important tasks on their hands in the early years of creating a new state. Seeking to resolve the most pressing challenges, the government is paying attention to questions of food, including fish. And the government now considers aquaculture to be a priority area for developing agro-

Photo 23. A rainbow trout is ready for sale



Picture 4. The use of water resources in extensive and intensive aquaculture

business. It is in the interest of individual farmers to produce a most important foodstuff – fish – just as it is in the interest of the state to promote the development of this kind of production.

However, there is a problem: there is a limited amount of irrigated land in Uzbekistan. And all types of agro-business are competing for this land. There are a range of tangible advantages when it comes to growing cotton, fruit and vegetables, and livestock. These forms of agriculture have been well known and well regarded for millennia. Technology has been developed to enhance them, and business networks are well established. However, aquaculture is a new orientation and is unfamiliar in this country. Aquaculture currently consists of rearing fish in small ponds with low production rates: 10-20 centners per hectare, or 0.1-0.2 kg per cubic metre. Global practice uses technology to attain production rates of 40-200 kg per cubic metre. In Uzbekistan, the extensive or semi-intensive system is used.

As an example, we can list very general figures. In order to fill a one-hectare pond (of an average depth of 1.5 metres), 15 thousand cubic metres of water are needed. In order to compensate for evaporation from the pond during our hot growing season, another 9 thousand cubic metres of water are needed giving a total of 24 thousand cubic metres of surface water used (Picture 4). In Uzbekistan, there is an area of around 10 thousand hectares of active ponds, with a collective volume of around 240 million cubic metres during the growing season. What kind of return on investment does this water provide? In good years, ponds in Uzbekistan produced 30-40 centners per hectare, which greatly exceeded the other ex-Soviet republics. Currently, due to a sharp reduction in the use of compound feed and the degradation in aquaculture stocks, productivity is down to 10-20 centners per hectare. The market price of the fish farmed (predominantly silver carp) amounts to around 10,000-20,000 Uzb sums per kilogram. Thus one cubic metre of water provides 600-1,200 Uzb sums per year (or 0.20-0.40 US dollars). Given our arid climate, is it really sensible to use water like this? But we should also note that aside from the water they use, ponds also take up enormous amounts of land, and in areas with irrigation and drainage systems. Thus the efficiency of using land resources in this way is also dubious. In Uzbekistan there is an urgent need to look into the deficit of water and land resources.

But how much fish grows with intensive aquaculture? First of all, we must note that silver carp is not farmed in this way, but rather higher-quality fish such as catfish. The catfish costs around 14 thousand Uzb sums per kilogram. Thus one cubic metre of water would produce 560,000-2,800,000 Uzb sums. And what about one hectare?

Therefore, it becomes a question, indeed a pressing concern, to develop intensive aquaculture alongside extensive aquaculture in the country's fish farms in order to get the maximum amount of food and profit by making use of natural resources. But it is quite easy to do this. First and foremost, we need to know how.

Aquaculture technology is needed. This allows many fish to be farmed with very minimal land and water use, so that water is not wasted and spoiled, and is immediately directed to another user. This technology has only become available during recent decades (from around the start of the 1990s).

Table 5. Classification of aquaculture technology according to intensiveness*

No.	Technology	Description	Productivity
1	Extensive	Fish grow by eating natural organisms which can be stimulated by means of fertilizer	0.13 kg per cubic metre
2	Semi-intensive	Fish grow by eating natural organisms as well as artificially-introduced compound feeds	0.2 kg per cubic metre
3	Intensive	Fish grow by eating only artificially-introduced highly-productive feeds.	Minimum 40 kg per cubic metre

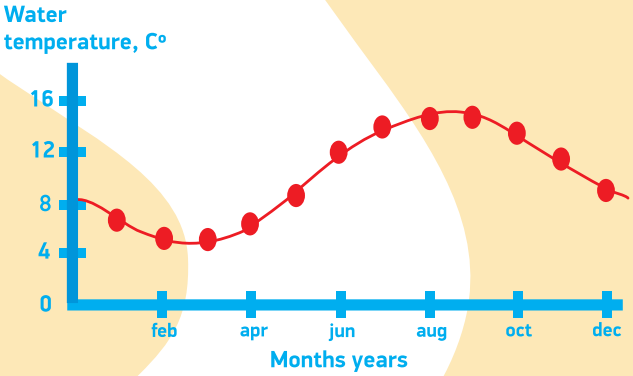
** Bakhtiyor Ganievich Kamilov - Candidate of biological sciences, Senior scientific officer of Institute of Flora and Fauna Gene pool of the Academy of Sciences of the Republic of Uzbekistan*

What is intensive aquaculture? It is the creation of optimal conditions for keeping fish so that they have the optimal amount of feed and the right temperature for the fastest possible growth. It is called intensive because the fish grow entirely due to the feed that they are given. This is the same as in intensive methods of raising livestock and poultry. Experience has shown that feed is the greatest expense, at 50-70%. The better use of feed is made, the more profitable will be the breeding of fish. Balanced feed is needed - it must contain all the necessary nutrients for life and growth (proteins, fats, carbohydrates, vitamins, minerals). There are no compound feeds known to us that are suitable for this kind of use in ponds. They contain very little protein and do not contain many crucial components. As a comparison, the protein content of compound feeds is 12-18%, while intensive aquaculture requires feeds to have a protein content of 30%, or ideally 35-45%.

When artificially feeding fish, the most important thing is to define the optimal ratio (the amount of daily feeding), which depends on a range of factors, primarily the water temperature. The optimal water temperature for growth is different for each species of fish. The closer the water temperature is to the optimal temperature for growth on a particular day, the lower (to a certain extent) the amount of feeding can be and the faster the fish grow. For example, carps at a temperature of 15 degrees Celsius are fed balanced feeds at a rate of 1% of the biomass of the fish, but are given 3% at 24 degrees Celsius. It is clear that there is a threefold difference, and fish grow three times faster or slower in water of different temperatures.

There are several extremely interesting conclusions to be drawn from what has been said. In conditions like those to be found in Uzbekistan, carp, silver carp and grass carp can grow well for only three months of the year (when standing water on plains reaches a temperature of over 22 degrees Celsius), have reasonable growth for another 2-3 months (18-22 degrees Celsius), grow very slowly for 1-2 months (temperature above 14-18 degrees Celsius), and do not grow at all (i.e. hibernate) for 5-6 months. Thus, open bodies of water for growing carp, silver carp and grass carp are not “in operation” for half of the year! This is simply a fact.

Are there types of fish whose optimal temperature is closer to the temperature in our waters? The answer to this question leads us to another interesting conclusion. The water temperature in the rivers and canals of the mountainous and hilly regions of Uzbekistan has not exceeded 18 degrees Celsius during the course of a year for several years. This is understandable: the rivers in the Aral Sea basin start in the high mountains and are fed by ice and snow melt (precipitation has little effect on river flow), and our rivers have a strong flow rate. Even at the height of summer, the average river and canal simply has no chance to heat up. As an example, we have provided the yearly temperature fluctuation of the water in the Chirchik river in the town of Chirchik (Picture 5).



Picture 5. Temperature fluctuation of the water in the Chirchik river

What types of fish would be suited to a water temperature of 18 degrees Celsius? Cold-water fish! Trout! With the correct feeding, trout can grow all year long, and can grow rapidly for 6-7 months. This is certainly a big difference to how much carp and silver carp are able to grow. Around 75% of the population of Uzbekistan lives in hilly regions, which make up around 25% of the country’s area. This population needs food, and it must be of high quality to improve the health of the population. This area includes all parts of the Fergana valley, and Tashkent, Samarkand, Kashkadarya and Surkhandarya provinces.

But for now we will examine lowland ponds including lakes and ponds with standing water that heats up well in the summer. These are in the rest of the country. In these ponds, the water temperature falls under 18 degrees Celsius as early as October and only climbs above 18 degrees Celsius in the second half of April or in early May. Therefore, these ponds could also be used to grow trout for 6-7 months per year, with a rapid growth rate during three of those months. In the lowlands, the length of the growing period for trout over the course of a year is very like those for carp, silver carp and grass carp. In other words, it is possible to grow trout in lowland ponds over the whole of Uzbekistan just as effectively as growing carp.

It is possible to draw the audacious conclusion that trout is currently the most promising form of aquaculture in the conditions of Uzbekistan!

However, there is one significant reservation: there is little expertise related to trout farming in Uzbekistan. The country’s fish farmers have studied how to raise carp, which is a form of warm-water aquaculture. For these purposes, they studied extensive and semi-intensive methods. But the maximum rate of fish production, as we noted above, is 0.13 - 0.26 kg per cubic metre of water (10 - 30 centners per hectare). Meanwhile, global aquaculture, including the trout farming, easily attains at least 40 kg per cubic metre - 100 times more. Our fish farmers,

farmers, educators, their assistants, researchers and specialists on fish diseases, and others, all need to change their focus and cross a significant psychological barrier: to study (and not be afraid of) how to raise fish in such concentrations.

The barrier must be crossed, firstly because this is a very promising area, secondly because there is a lack of water in Uzbekistan, and thirdly - because it is not very difficult. This was shown quite strikingly by the experience of fish farmers and the authors of a textbook on breeding trout. The textbook was published as part of the GEF SGP project. We (the authors) found information in the literature, analysed it, gained a theoretical grounding and, on empty land near Tashkent, helped to build some trout farms with a fish nursery by means of basin techniques. As part of the GEF SGP work, we arranged a regularly supply of impregnated roe from Seattle (in terms of timezones, the most distant city on earth from Tashkent, on the other side of the planet). It takes 6-7 months to incubate the eggs and then raise marketable fish. Another GEF SGP trial was a project to create a trout farm at Gazalkent. At the time of publication of this article, two additional trout farms have been built and several more are under construction.

The global profits from the export of fish and fish products came to 136 billion US dollars in 2013.

One cubic metre of water can produce over 40 kg of marketable fish. Broadly speaking, the economical calculations are as follows: spending on fish, depending on their breed, will be 7,000-10,000 Uzb sums (according to prices from summer 2014), which includes all material costs, and very good salaries paid to fish farmers. The largest part of these expenditures (6,000-9,000 Uzb sums) will be for feed. But how much do fish cost straight from a fish farm? For carp, the figure is 12 thousand Uzb sums in autumn and more than 15 thousand Uzb sums during the rest of the year. Other fish are more expensive. For example, the rainbow trout costs more than 30 thousand Uzb sums per kilgram. So, the profit will be at minimum (for small carp weighing less than 1 kg) 5,000-6,000 Uzb soms for 1 kg of fish, and a lot higher for other fish. Therefore every cubic metre of water can produce at least 40 thousand Uzb sums in profit. But what size of ponds is needed for intensive aquaculture? Whichever size can be built. You can easily create a fish farm with a capacity of 100 cubic metres.

What is necessary to get involved in aquaculture? First and foremost: financial resources and knowledge. It

Photo 24. Trout farm in Kibray district, Tashkent province etablished within the framework of GEF SGP project

Photo 25. Trout farm in Yuqori-Chirchiq district, Tashkent province established within the framework of GEF SGP project

is 21st century now. Fish farming on a global scale is a highly advanced branch of economics which invests large sums into developing its own branch of science: ichthyology. As a result, extremely varied technologies have been developed for every type of pond, for a wide range of productivity levels (from 0.1 to 400 kg of fish per cubic metre of water) and for raising more than 100 types of fish and water-dwelling animals. From the year 2000, aquaculture became the biggest source of animal protein for humans, followed by livestock and fishing.

Why did we write all of this? So that it would be instantly understood that it is quite wrong to consider that anything at all in modern aquaculture can be achieved without expertise! You will not be able to raise fish through intensive aquaculture simply because you are able to graze cattle or grow vegetables. Aquaculture involves much more technology. You will not be able to raise fish quickly simply because you are a good businessman and you have substantial financial means (although you can easily lose great sums of money due to a lack of expertise). However, if you have the means, you have worked out (or commissioned) a good project, you have gathered enough information and you diligently implement the project, then you will create the most profitable and sustainable form of agro-business.

Where can you gain this expertise? Consultations with specialists (if you want a good result and responsible consultations, these must be paid for) and self-study. Self-study involves reading the necessary literature. It a hard work to find the necessary literature and tailor the information to local conditions, and only specialists are able to do this. And now our Small Grants Programme is offering you, dear reader, a unique opportunity. Renowned specialists in the field of aquaculture in Uzbekistan have carried out this kind of work with regards to trout farming and have compiled a textbook. The book contains a synthesis of worldwide experiments as well as personal activities to create small trout farms in the conditions of Uzbekistan. A practical textbook is currently being published for all farmers who want to start raising trout. Anyone interested can contact the GEF SGP to receive a free copy of the book, or can download it at www.sgp.uz. Get your own copy, read it, think about it, and you will have taken an important first step towards mastering intensive aquaculture.

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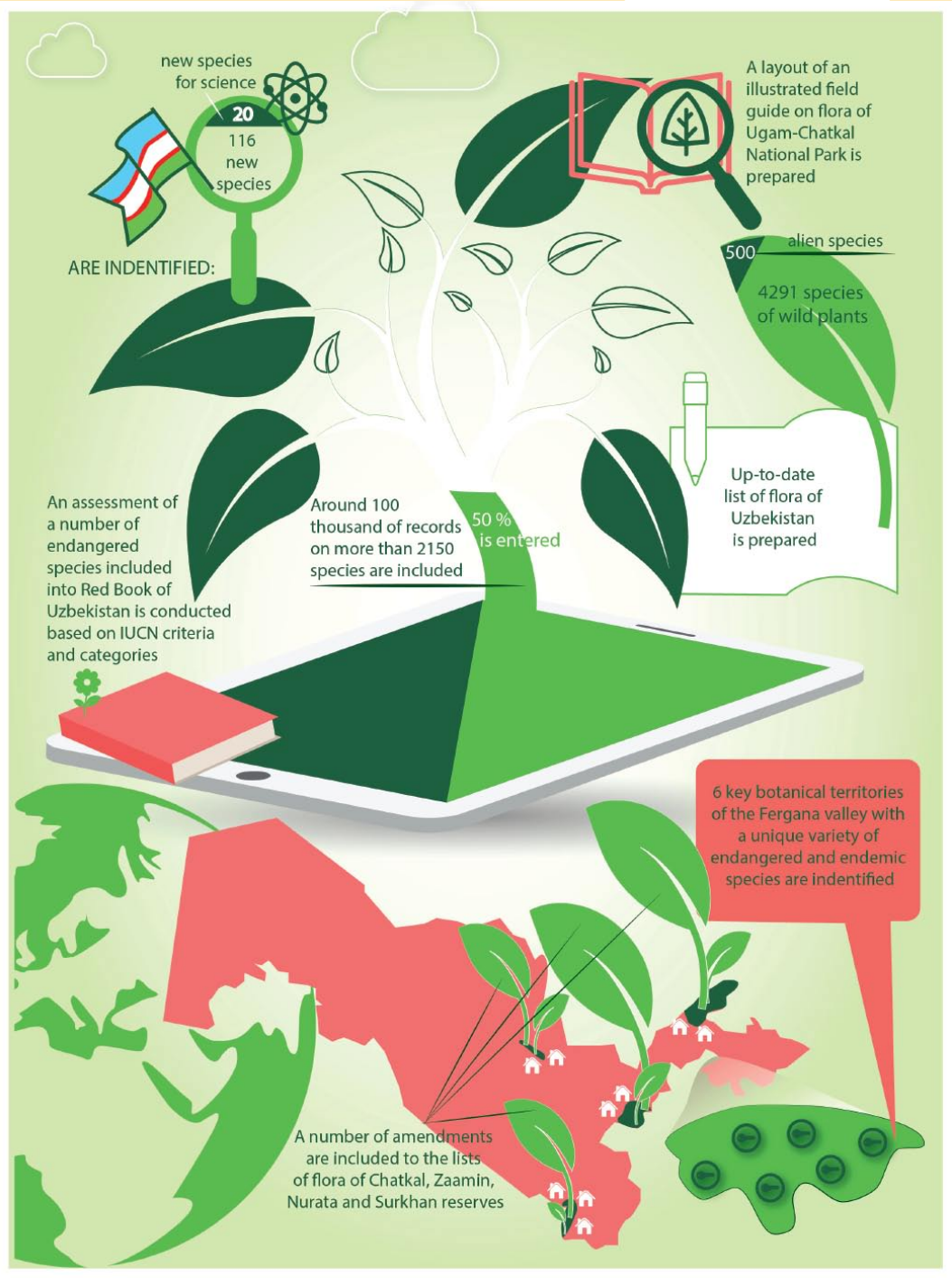
DEVELOPMENT OF THE DATABASE OF PLANTS DIVERSITY OF UZBEKISTAN



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Growth point for pistachios in Tashkent province

On 24 February 2014, an open seminar for farmers took place in Tashkent and run jointly with the Michael Succow Foundation from Germany. Its subject was “How to create a plantation of pistachio cultivars - a new, economically-profitable solution for effective land use in the dry-land zone of Tashkent province”. Besides an acquaintance of participants with technology related to starting pistachio plantations, the main goal of the seminar was to find candidates among the participating farmers who were interested in the potential creation of a “growth point” for pistachio cultivars in Tashkent province. The “growth point” is a centre for distributing pistachio-planting and grafting material, for conserving pistachio material gathered by specialist forestry workers in Uzbekistan, and for disseminating knowledge about pistachios.

Photo 26. Participants of the seminar - farmers from Tashkent province assessing a potential of their lands for establishing a «point of growth»

Currently, farmers from Tashkent province have been selected and the project has been finalized; work on establishing the “growth point” will start in Tashkent province from 2015, with the assistance of the Michael Succow Foundation.

* * *

22 May - Biodiversity Day in Uzbekistan

This holiday gives us renewed cause to reflect on and ponder the question of why biological diversity is so important for human survival. The celebrations included a successful series of events dedicated to the subject of biodiversity.

The series began in April with the announcement of a national competition for biology teachers entitled “Activities on national biodiversity for students”.

Фото 27. A forest dormouse. The photo from materials of GEF SGP database «The Fauna of the Nuratau mountains, the south-eastern Kyzylkum and the Aydar-Arnasay system of lakes»

According to the rules of the competition, the activities and tasks for students were developed and prepared by making use of resources from the database “The Fauna of the Nuratau Mountains, the south-eastern Kyzylkum and the Aydar-Arnasay system of lakes” which was established during one of the GEF SGP’s projects. The competition was successful. Taking all categories of the competition together, more than forty submissions from all over the country were received.

* * *

The next initiative in the series was a successful national competition for photographers and nature-lovers called “Photo Hunt”, held in May. Winners were nominated in five competition categories and were awarded prizes in a final event. You can find out more about the Photo Hunt competition and the winners’ work on our website, in the News and Gallery section.

Photo 28. A photo submitted for the contest «Photohunt» in the nomination «Life is everywhere» by Nataliya Shulepina.

* * *

Another good way of making people aware of the subject of preserving local biodiversity was an excursion that acquainted participants with two subjects: horticulture and fruit-growing in Uzbekistan; and forest trees and shrubs. This event was held in the place in the Research and Development Unit of the Horticultural, Viticultural and Vinicultural Institute of Uzbekistan named after M. Mirzaev (previously Shreder), and in the Republican Scientific-Production Centre of Ornamental Horticulture and Forestry. Both excursions aroused a great deal of interest. Participants suggested that similar encounters with nature should happen more frequently. Given the high level of interest, we are planning to organize an excursion to one of the forest areas that are in the mountains of Tashkent province.

Photo 29. Reproduction of fruit cultures by leaf cutting. The greenhousr (during summer) in one of the plots of Uzbek research institute of horticulture, viticulture and wine-making named after academician M. Mirzaev

* * *

Finally, the series of events was capped by a final informational seminar dedicated to celebrating the International Day for Biological Diversity 2014. UNDP, the GEF SGP, and partner projects in the area of the conservation of biodiversity were presented at the seminar dedicated to the International Day for Biological Diversity 2014. Participants in the seminar were able to discuss various topics related to biodiversity, including: bees and wild pollinators and the role of pollination in producing foodstuffs; the importance of increasing our efforts to preserve animals and plants in protected natural zones; involving private tour operators in protecting ecosystems and biodiversity; developing aquaculture as a way of combating fishing in natural bodies of water; and many, many other topics.

Фото 30. The informantional seminar dedicated to the World Biodiversity Day

* * *

On 21 June, the SGP team, together with the Institute of Flora and Fauna Gene pool of the Academy of Sciences of the Republic of Uzbekistan and the Council of Farmers of Uzbekistan conducted a practical training course in Tashkent on the topic of “Trout farming - a potential business for the farmers of Uzbekistan”.

“There is a pond aquaculture in Uzbekistan that where carp, silver carp and grass carp are bred. Average multi-year yield is 1 tonne per hectare (or 0.07 kg per cubic metre). This technology can be improved if more carp are added and they are fed compound feed. In this case, yield can rise to an average of 2 tonnes per hectare (or 0.13 kg per cubic metre). We have intensive technology, and when we breed trout we can be certain to achieve 20-40 kg per cubic metre. Good ventilators are required to improve yield. This can lead to 40-50 kg per cubic metre,” according to the specialist working on the trout-farming project, ichthyologist Bakhtiyor Kamilov.

Photo 31. Participants of the training on trout in the hatching room

Download a guide on starting a trout farm on our website.

* * *

A seminar for farmers took place on 11 July 2014 in the town of Andijan. Its title was: "How to create a plantation of pistachio cultivars - a new, economically-profitable solution for effective use of dry lands in the Fergana Valley".

Ibodat Yuldasheva, a participant in the seminar, shared her success story: "I realized the possibilities of cultivating pistachios after reading a journal article.

Photo 32. A practical part of a seminar in Andijan. Demonstration of inoculation of a young pistachio

Three years ago I planted 560 pistachio seedlings over an area of two hectares. I was afraid of losing the soil in the container which came along with the delivered seedlings, so they were planted right in their plastic containers. Of course, there were some losses, and many seedlings didn't survive on the 'big ground' but anyway I managed to conserve and grow 437 young pistachio seedlings, and now they are almost as tall as a person. Recently, specialists from Tashkent conducted budding work on my plot and I now have 17 different types of pistachio growing on my plantation. In future, my farm can become a 'point of growth' where various farmers will be able to receive high-yield pistachio cultivars".

* * *

Projects under consideration

1. "Using photo-electric sub-surface pumps to create a five-hectare pilot plot of pistachios and almonds in dry land making use of drip irrigation as an alternative to cattle".

This project will provide a successful example of how it is possible to use the arid plains typical to Uzbekistan in a way that is naturally sustainable and profitable to the local population, in this case by planting trees.

2. "Establishing a biotechnology centre to create seedlings of endangered and rare trees in the conditions of in vitro for the farmers of the Fergana Valley".

In vitro conditions are a method of acquiring a clonal generation of chromosomes from certain growth organs (apical buds, leaves, stems, roots) by using special laboratory apparatus.

The goal of the project is to create a biotechnological laboratory which, by making use of in vitro technology, will soon produce and distribute high-quality seedlings of species of tree, taken from trees that have not fallen ill, with instilled immunity to locally-occurring diseases.

3. "Introducing planting techniques that do not involve tilling the soil for multiple crops after winter wheat in irrigated lands in the lower Amu Darya river".

The project intends to demonstrate a non-traditional method of cultivating multiple crops (without the traditional tilling of the soil) with the following fundamental features: preparing a bio-humus by composting agricultural by-products and sewing crops without working the soil.

4. "Launching a renewable fund to carry out anti-filtration measures in the Yangiaryk district of Khorezm province in order to reduce water loss, to resalt soils and to adjust to water deficit conditions in a world affected by climate change".

This project intends to show how minor investments by state agencies or financial entities can heighten the effectiveness of irrigation, reduce the cost of agricultural production and increase its production capacity and yield. Furthermore, it will be demonstrated that the services of Water Users' Association in delivering water can be and are a fundamental factor in agricultural production.

5. "Demonstrating and introducing soil-preserving technologies for managing agricultural crops in the conditions of salty soils of Fergana province".

This proposed project is intended to demonstrate and introduce soil-preserving technologies to manage agricultural crops and implement them on a large scale, including the use of green manure, minimal and zero tillage of soil, thus guaranteeing that land is used more effectively and improving the structure of salty and impoverished soils, such as in the farms of the Yazyavan region of Fergana province.

www.sgp.uz

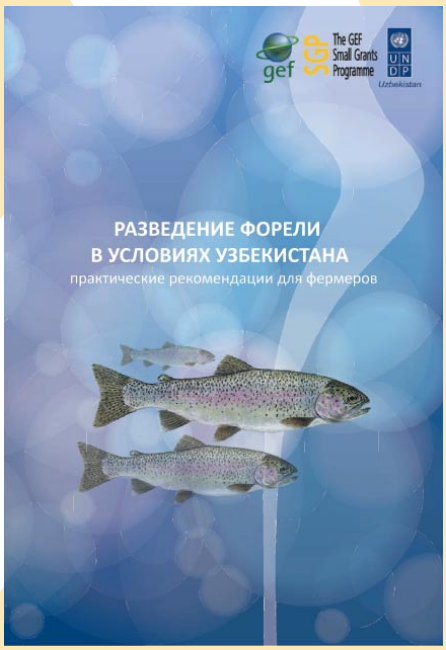
* * *

Three publications/manuals for farmers on technologies promoted with the assistance of the GEF SGP have been prepared and published, including:

1. “Seven steps to independent use of laser equipment to plan irrigated land”;

2. “Beekeeping for dummies” and

3. “Trout breeding in the conditions of Uzbekistan”.



You can download all our publications on the GEF SGP website: www.sgp.uz

PROGRAMME ANNOUNCEMENT

Infographics on technologies of the GEF SGP in Uzbekistan

The GEF SGP is preparing a series of infographics on advanced technologies, that will be presented for your attention in the calendar for 2015. Infographics will also be published on the programme’s website. Stay tuned!

All the contact information is on our website - www.sgp.uz

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