The GEF Small Grants Programme

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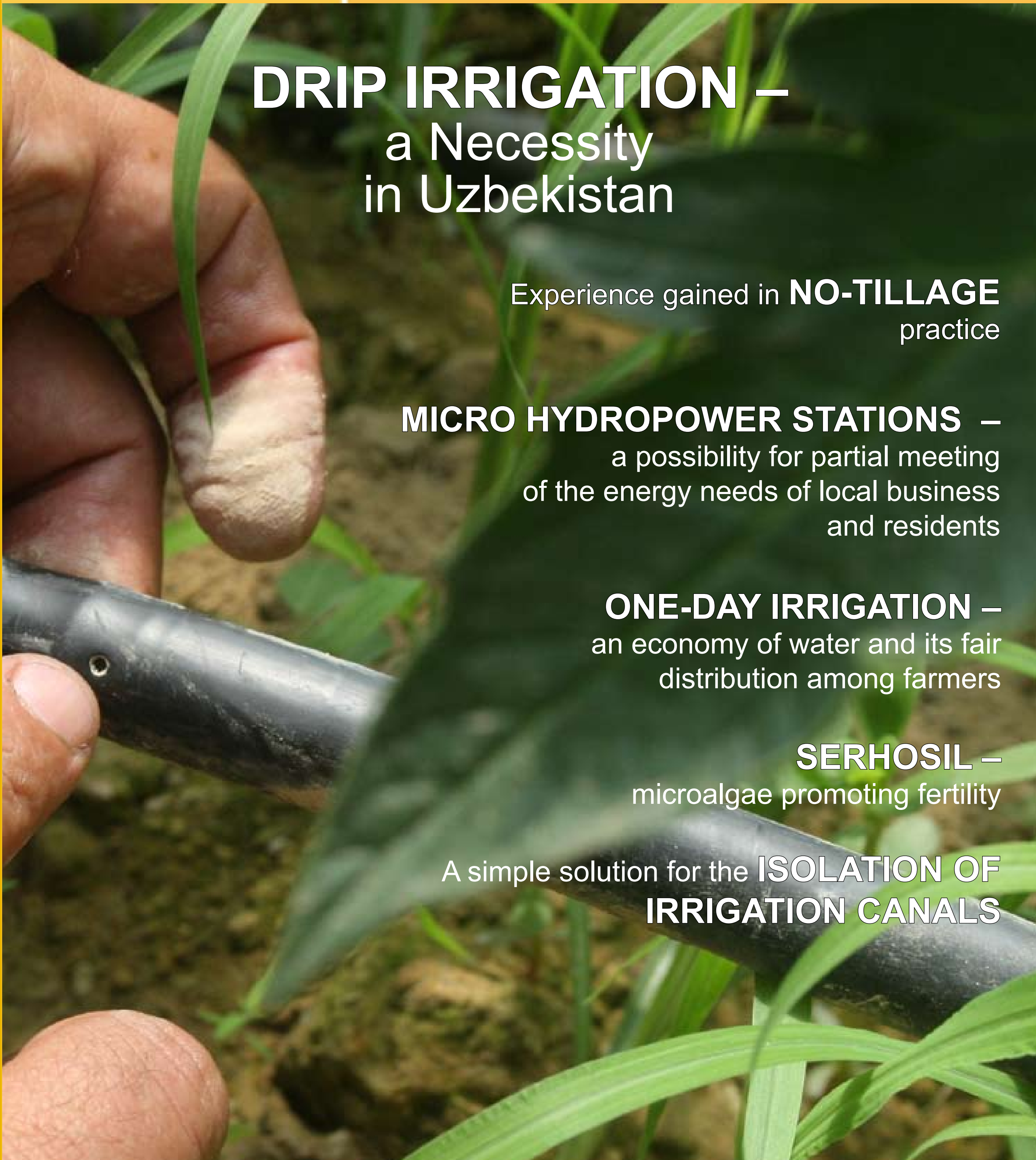

DRIP IRRIGATION – a Necessity in Uzbekistan

Experience gained in **NO-TILLAGE** practice

MICRO HYDROPOWER STATIONS – a possibility for partial meeting of the energy needs of local business and residents

ONE-DAY IRRIGATION – an economy of water and its fair distribution among farmers

SERHOSIL – microalgae promoting fertility

A simple solution for the **ISOLATION OF IRRIGATION CANALS**

LANDENERGYBIODIVERSITY

Dear friends,

As you may know, the United Nations Development Programme (UNDP) implements a number of initiatives in Uzbekistan. All our efforts aim to put people in the center of our focus - by promoting good governance mechanisms, by fostering better livelihoods and by protecting the environment.

Most Uzbekistan citizens live in rural areas, and their livelihoods are directly linked to agricultural production, either on household lots or as part of larger farms. Farming has always been dependent on how healthy the environment is, how productive the soil is, on the quality of the climate and the availability of water, and many other environmental factors that we often forget about. In Uzbekistan's arid conditions, water availability has always been a critical factor for agricultural production. Effective water management and other related practices have a direct impact on the quality and productivity of the nation's soil, and soil productivity is essential for ensuring the food security of the country. Disputes about water use can cause social tension between neighbours, because lack of water can directly impact on the income generation and livelihoods of many rural families. These issues are of particular importance for the sustainable development of Uzbekistan.

GEF SGP has been working extensively in this area, testing and disseminating advanced practices and techniques for better water and soil management, in order to prevent land degradation. There are a number of practices that have proven to be successful, and their wider application in Uzbekistan will certainly help to solve many problems for the nation's rural citizens. This edition of the GEF SGP newsletter intends to spread the word of these practices, including of those that will encourage the best use of scarce water resources while ensuring high yields both now and in the future. And as mentioned, in our work we constantly strive to create better standards of living. As such, the proposed practices not only benefit the environment, and are an essential factor for future well-being, but can also produce direct and tangible economic benefits. Hence, I invite farmers to consider using the good practices detailed in this newsletter with a view to improving their livelihoods and those of their children.

I use the opportunity to extend my warmest greetings to the readers of this newsletter. UNDP is committed to supporting the needs of Uzbekistan's citizens, and to serving them to the best of our capacities.

Sincerely,
Mr.Stefan Priesner
UN Resident Coordinator/UNDP Resident Representative in Uzbekistan

DRIP IRRIGATION - A NECESSITY IN UZBEKISTAN

Niyazmetov D., Rudenko I.
'KRASS' NGO

The inefficient use of water resources is one of the main factors that limit the sustainable development of irrigated agriculture in Uzbekistan. One way to solve the problem is through the use of a drip irrigation system (DIS).

Drip irrigation was developed and implemented for the first time on an industrial scale, as an independent type of irrigation in Israel in the early 60s. Positive results were obtained within a short time, and the system's introduction in Israel led to its rapid adoption in many countries around the world. **Drip irrigation** is based on the inflow of water in small doses to the root zone of plants. The quantity and frequency of the water supply is controlled in accordance with the needs of plants. Water is supplied evenly to all the plants in the same amount, exactly as much as the plant needs, without unnecessary flooding of the soil and water loss. Moreover, huge water losses due to evaporation during the transportation of water to the plant are decreased.

However, land users in Uzbekistan have not yet investigated this technique. There are many reasons for this, the main one being that farmers believe that a drip irrigation system will be expensive and complex. Also, it is recognised that the quality of irrigation water, including its turbidity and clayiness, can limit the use of drip irrigation. However, the farmer Boltabayev from the Namangan province has debunked these myths through his personal example on his own land. Using a tubular drip irrigation system, Boltabayev has harvested 38 centners of cotton from one hectare. His neighbours from the same area, meanwhile, have harvested 15 to 21 centners per hectare. In his case, Boltabayev used three times less water, 50 per cent less fertilisers, and he spent 58 to 60 litres less fuel per hectare for his farm machinery, when compared to his neighbours.

Modern drip irrigation systems can be used for the cultivation of many agricultural and horticultural crops, and have a number of advantages. These include:

- *Significant water savings* - Since only the root zone of plants is moistened with a drip irrigation system, evaporation losses are significantly reduced. Consequently there is no loss of peripheral water flow. In the case of drip irrigation, the space between rows, referred to as 'Aryks', remain entirely dry. This can be compared to conventional irrigation, in which water is usually delivered to plants via the Aryks. The total water savings generated through a drip irrigation system is 11.7 million m^3 per one hectare of cotton, 6.6 thousand m^3 per one hectare of wheat, and 11.4 thousand m^3 of water per one hectare of other crops;

- *Significant savings of energy, labour, petroleum, oil and lubricants (POL) and other materials* – Water for irrigation is usually supplied from canals to fields via pumps. Drip irrigation requires less water,

Drip irrigation of cucumbers in a greenhouse of the Uychi district, Namangan region.
Drip irrigation system works even on hills!

which means that pumps are used less, and less electricity or other forms of energy (diesel fuel for example) for operating pumps. The use of drip irrigation has resulted in significant savings in labour costs, of up to 1.3 to 3 times. Up to 60 litres of POL per one hectare of cotton are saved each vegetation period;

- *Savings of fertiliser by 30 to 40 per cent* - In the case of usual irrigation, 850 kg of nitrogen fertiliser, 150 kg of phosphorus and 100 kg of potassium chloride are used for one hectare of cotton fields. However, with the use of drip irrigation, 250 kg of nitrogen, 150 kg of phosphorus and 50 kg of potassium are used for one hectare. In this case, the fixation of mineral fertilisers is 90 to 95 per cent, compared to only 30 to 35 per cent with conventional irrigation. Dissolved fertilisers are applied directly to the root zone with water during irrigation, where a rapid and intense absorption of nutrients takes place. Consequently, the use of drip irrigation provides the most effective way of applying fertilisers in arid climate conditions;

- *Higher productivity and product quality* – The earlier ripening of crops has been observed when DIS are used. Due to the exact application of moisture to the roots of plants, and the more effective absorption of fertilisers, a yield increase by 30 to 70 per cent is guaranteed when compared with conventional irrigation;

- *Lack of secondary salinity* – As drip irrigation does not require the construction of drainage systems, underground waters and salts do not rise, and the structure of soil can be maintained. This type of irrigation allows plants to be grown in moderately-saline soils, with the use of slightly-salted water for irrigation. With drip irrigation, the intensive desalination of salts takes place near the droppers. The accumulation of salts around the edges of droppers does not have too much impact on the development of plants. Water and nutrients are absorbed by the part of the root system in the leached zone of the soil;

- *The possibility of irrigating strongly-intersected plots of the ground surface with different water infiltration of soils* – In a drip irrigation system, a network of tubes or tapes is located at the base of plants, for example on the beds themselves. Drip irrigation allows the use of irrigation on slopes or areas with complex topography, without special facilities or the transfer of soil. The use of drip irrigation on slopes does not pose any threats of erosion. In addition, drip irrigation is very beneficial to the adyr lands, where gaps and holes can appear with ordinary irrigation, and water can potentially go deep into the ground without irrigating plants;

- *Easy operations in inter-row spacing* – With conventional irrigation the inter-row spacing is filled with water, which makes the movement of vehicles and people difficult. With drip irrigation the canals remain free from moisture and this allows better tillage, spraying and harvesting at any time, regardless of irrigation, as the soil in inter-rows remains dry throughout the vegetation period;

- *Fewer weeds* – There are fewer weeds in fields that use drip irrigation, in comparison with those using other methods of irrigation, since the water is supplied only to the root systems of plants and does not irrigate the surrounding land around. Root systems develop faster with drip irrigation than in the case of the use of other methods of irrigation. The bulk of plant roots are concentrated in the area of drip trays, and consequently the root system becomes more fibroid, with an abundance of active root fibrils. The intensity of water use and nutrients increases as a result.

On the basis of these initiatives to implement drip irrigation systems in the Namangan province, a comparative cost-benefit analysis of introducing drip irrigation for cotton, wheat and other crops (in particular apples - see table) was made. The calculations are given for a minimum of 10 hectares for each crop, as it is at this size that minimum economies of scale can be achieved, when the investments begin to pay off. Current prices for 2013 are used, which of course may change over time.

The value of investments for the installation of DIS has been calculated on the basis of the relevant price list of the manufacturer of drip irrigation systems in the Namangan province, particularly at the production plant at the 'Jamoliddin Sardor Hamkor' farm enterprise. Drip irrigation systems are most expensive when they are used with wheat, at 91.6 million Soums per 10 hectares, followed by cotton at 88.4 million Soums. The cheapest and the best is the system of drip irrigation for 10 hectares of orchard, at 50.4 million Soums.

The calculation of benefits is as follows (for one hectare):

- Energy costs are significantly reduced for all crops, as a result of a significant reduction in the time dedicated to irrigation and the use of pumps for pumping water. As a result, drip irrigation can reduce energy costs by 499 million Soums per one hectare of cotton, 317 thousand Soums per one hectare of wheat, and 320 thousand Soums per one hectare of other crops, per season;

- *The cost of diesel fuel and agricultural activities* are reduced, especially for cotton, as cotton production requires of more agricultural activities when compared to wheat or other crops. Drip irrigation will save more than 100 thousand Soums per one hectare of cotton on diesel fuel and 85 thousand Soums per one hectare of cotton for farming activities annually;

- Due to the effective introduction (through the system) and fixation of mineral fertilisers, with the use of a drip irrigation system, *the cost of fertilisers re-*

In such a way, drip irrigation system connects to a plant and then is covered with a ground. The part of a tube, where a dropper (emitter) is fastened, is left outside.

Table #1. Cost-benefit analysis of the introduction of a Drip Irrigation System, compared to the conventional method of irrigation. All calculations were done for 10 hectares					
Title	Unit of measure	Cotton, 10 ha	Wheat, 10 ha	Garden Crops (apples), 10 ha	Notes
Investments	**Soum**	**88,360,000**	**91,560,000**	**50,360,000**	The cost of a drip irrigation system includes the cost of the acquisition of the film for covering the reservoir used to supply water to the drip irrigation system.
Total profit	**Soum/Year**	**26,890,709**	**21,450,729**	**30,104,813**	In comparison to conventional irrigation.
Savings of water resources	M^3/Year	117,600	66,000	114,550	Savings of water resources are calculated based on differences in irrigation technologies (irrigation frequency).
Savings of energy	Soum/Year	4,999,680	3,175,200	3,206,784	Energy consumption per season is significantly decreased by a significant reduction in the time of irrigation and the running of water pumps.
Savings of diesel fuel	Soum/Year	1,087,500	37,500	37,500	Diesel fuel is saved by reducing the number of agrotechnical activities used. The utilised price is an average 2,500 Soums per litre.
Savings due to agrotechnical activities (including cultivation and fertilisation)	Soum/Year	850,000	50,000	50,000	
Savings of mineral fertilisers	Soum/Year	1,143,000	377,500	0	Fixation of fertilisers with a drip irrigation system is 90 to 95 per cent, whereas with conventional irrigation it is 30 to 35 per cent.
Savings on labour resources	Soum/Year	2,000,000	2,000,000	2,000,000	
Benefits from harvesting	Soum/Year	16,000,000	15,000,000	24,000,000	Yield is increased by an average 40 per cent, but this percentage depends on the land productivity class.
Exemption from land tax	Soum/Year	810,529	810,529	810,529	The land productivity class was taken on the average as 60 (6th class of land, with a correction factor 6.78), and the amount of basic land tax of 1st class land is 11,954.7 Soums in the Uychi district of the Namangan province.
Payback period	***Years***	***3.3***	***4.3***	***1.7***	

Magistral and lateral pipes are installed. The outlet tubes for seedbeds are brought out. The only thing we need to do is to connect tubes with emitters installed at the required distance and turn on water drops.

duces by 114 thousand Soums per one hectare of cotton and 37 thousand Soums per one hectare of wheat annually;

- *The cost of labour decreases* by 200 thousand Soums per one hectare for all crops mentioned above;

- The forecasted *increase of yield* is quite substantial, averaging 40 per cent for all crops.

Annual benefits have been estimated based on the average crop yields and average prices:

- *Water saving* for all crops per year, including 11,760 m^3 of water per one hectare of cotton, 6,600 m^3 of water per one hectare of wheat, and 11,455 m^3 of water per one hectare of other crops;

- According to the decree of the President of the Republic of Uzbekistan # УП-4478 of the 22[th] of October, 2012, legal entities that have adopted drip irrigation systems *will be exempt from the payment of the single tax for five years*, for the part of the land where drip irrigation is used (changes to the tax code are not in force yet but are expected in 2013). The approximate calculation of savings from tax privileges is 81 thousand Soums per one hectare, for each crop, per year;

- The *payback period* is the ratio of investment to the annual general benefits. It is estimated that investments in drip irrigation for cotton will be paid off within slightly more than three years and for wheat within four years. The most profitable investments will be made for the orchard crops, for which the payback period is slightly less than two years.

Drip irrigation system is consequently beneficial, not only in terms of the care of natural capital, but also through savings of water resources, the improvement of land soil, energy and fuel savings, and reduced greenhouse gas emissions. The systems are also beneficial in economic terms, not only for garden crops but also for cotton and wheat, in the medium-term future.

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EXPERIENCE GAINED IN NO-TILLAGE PRACTICE

Aybergenov B., Volkov A.

The 'Implementation of soil conservation technologies' project started in 2010 in the Kanlykol district of Karakalpakstan, with the assistance of GEF Small Grants Programme in Uzbekistan. The aim was to test and introduce a no-tillage practice. Within the framework of the project, special equipment was procured, a no-till practice was tested in Karakalpakstan, and an assessment of its influence on soil moisture, yield and economic efficiency of the main crops cultivated in Karakalpakstan was conducted. This paper illustrates the lessons learned from the introduction of this practice.

Background and problem definition:

There are several related causes of soil degradation in Karakalpakstan:

- *A loss of soil productivity due to the depletion of the humus*[1] content in the soil (from 0.4%), which corresponds to a very low content, up to 1%. This is the average degree of humus content in the soil. An average quality score of soil in Karakalpakstan is 41-48 points.

- *An increase in salt content in the soil*, as 95% of the irrigated cultivation area in Karakalpakstan is affected by salinity (Abdullaev, 2011).

- *A loss of productive soil layer due to wind and water erosion*. 1 ha of land affected by wind erosion is loss of 53 to 130 tonnes of fertile soil layer per year. This loss goes unnoticed because it corresponds to only 5-10 millimeters of topsoil. However, the formation of 1 cm of fertile soil layer in these arid conditions requires 70-150 years.

In addition, an increasing number of low-water/drought years has further complicated farming management in the region.

In many cases, farmers are not fighting ***the causes*** of low fertility but ***the consequences***. A few factors have a very negative impact on soil conservation:

Excessive mechanical operations. Each year, farmers carry out 4 to 5 procedures that mechanically interrupt the soil. Plowing, harrowing and leveling accelerate the mineralization process in the upper layers of the soil, and initially have a positive effect on plant growth and thus on crop yields. However, these routine activities to which the farmers are accustomed, and have been using for hundreds of years, have important negative effects on fertility of the soil. Excessive mechanical processing of the bare soil, already exposed to hot air and a drying sun, causes grinding of the soil particles, which are then easily blown away by the wind. As a result, these farming procedures contribute to wind

[1] Report of a consultant 'The practice of sustainable agriculture in Karakalpakstan, affected by droughts' FAO project on soil and land management , 2006

erosion. Moreover, in summer there is a high difference in temperature between the inner and outer layers of the soil and the environment. When the soil is treated after harvesting wheat in summer, the difference in temperature deteriorates its vital functions, and often leads to the death of useful soil microorganisms.

Temperature is not the only factor. Plowing enables air to access the inner layers of the soil. While aerobic microorganisms that require oxygen live in the topsoil, in the lower layer of the soil there are anaerobic microorganisms for whom oxygen is fatal. These microorganisms recycle all plant residue into organic matter, humus. Plowing destroys these microorganisms, and the result is that there are no natural organisms that can produce humus.

No crop rotation. The absence of crop rotation impoverishes the soil, exhausts humus production and promotes the development of harmful pathogens in the soil. GEF SGP partners offer a number of ways to introduce the system of crop rotation, without abandoning the main crops - cotton and wheat.

Gathering crop residue from the fields or burning it. In order to clear out fields, farmers get rid of crop residue or burn it instead of leaving it in the field. In this arid climate, leaving the surface of the soil free of crop residue leads to a fast loss of moisture in the soil. The high temperatures create a dry soil in its surface layers, which leads to the death of the soil's microorganisms. The heat also leads to a collapse in the structure of the soil – it is crushed. This increases the risk of losing the fertile layer through wind erosion, coupled with excessive mechanical tillage.

Excessive use of water. The use of water in the region is problematic. There is a general lack of water in the country, and yet farmers use as much as possible when it is available, even if that means over-irrigating their fields. This leads to unequal water use and has negative consequences for the fields – too dry or heavily watered.

Excessive water usage leads to a loss of significant mineral substances and nutrients in the soil. Currently, between 3,000 and 6,000 m^3 of water per 1 hectare of land are spent annually to desalinate the soil. Such abundant irrigation leads not only to the removal of salt in the lower soil layers, but also to the loss of nutrients such as nitrogen and potassium, that are necessary for the growth and development of plants. Instead of reducing salinity, the excessive irrigation often pulls up groundwater with a high content of salt. This remains on the soil's surface after the water evaporates. In addition, farmers often use saline water for irrigation. Assuming that the salinity is only 0.5 g/liter, every excessive km^3 of irrigation water brings additionally 500 kg of salt. Soil degradation is a widespread and direct threat to the sustainable development of agriculture and food security in the country.

A working part of a sowing machine with a disc coulter.

Possible solution

One of the best technologies to protect soil and maintain moisture levels, which enhances the soil fertility, is the idea of "no-tillage". It is a new and unusual technology for Karakalpak farmers but this technology is used more and more all over the world.

No-tillage is the direct sowing of the residues saved from the last harvest without any tillage, with the aid of a sowing machine with a disc plowshare. It is aimed at restoring and maintaining the soil's fertility through natural processes in the soil.

The basic principle of no-tillage is a recreation of natural conditions for soil invertebrates and microorganisms that contribute to the gradual recovery of lost soil fertility and its sustainable conservation. The technology is especially relevant to arid areas, where there is a low level of rainfall and the risk of crop failure is high in dry years. No-tillage is particularly relevant today to agriculture in Uzbekistan in general, and in Karakalpakstan in particular, where the soil fertility has been steadily declining, and the risk of crop failure is increasing due to repeated water shortages.

The main advantages of no-tillage are as follows:

Reproduction of soil fertility. No-tillage techniques contribute to the increase of biological activity in the soil. By maintaining conditions for the vital activity of the soil's microorganisms (lack of extreme temperatures and air stresses), soil fertility can recover naturally. Leaving the crop residue creates food for microorganisms, who convert it into humus. Each ton of straw yields 170-180 kg of humus, while a ton of manure yields about 65-75 kg of humus (Lykov A. A., «Agriculture» a textbook for institutes of higher education, M. «Agropromizdat», 1991, p.77). An increase in organic matter helps to increase crop yields.

Retention of soil moisture. One of the main techniques of no-tillage is the preservation of crop residue, or in other words, the creation of mulch on the soil's surface. In arid regions, mulch reduces evaporation from the surface of the soil, decreases its temperature and thus retains the accumulated moisture and allows the plants to use it during the vegetation season. This reduces the need to irrigate the plants, which is important during dry years. Our research shows that covering the soil with straw retains the soil's moisture in the upper 0-5 cm layer by 3,2-4,2 times and in the 5-10 cm layer by 1.2-1.5 compared to uncovered areas. The moisture content of the soil saved due to the straw cover, according to our calculations, is equal to 233,4-276,9 m3 of water per 1 ha. Judging by the amount of soil moisture in the fields with cover, according to our calculations, at least 2 irrigations during vegetation season could be reduced, i.e., at a rate of 500 m^3/h, water savings will be 1,000 m^3/ha.

Decrease of a seasonal salt accumulation. Saved crop residues reduce evaporation from the soil and reduce the seasonal accumulation of salts 1,6-4 times compared with land without vegetation. Crop residues and salinity reduction also decrease the rate of water consumption for washing irrigation. For example, in our case, when mulching with straw, we managed to keep the salinity at a lesser degree (0.2-0.5 % by dissolved solids), while at the same time, salinity level at uncovered area is moderate (0.8% by dissolved solids). At a low degree the water irrigation rate is 3000 m^3/ha and at the average degree – 4,000 m^3/ha. It means that during mulching there is a real opportunity to reduce at least 1,000m^3/ha of water consumed for water irrigation. Thus, by maintaining the soil moisture during the vegetation season and due to reduction of salt accumulation by mulching the overall cost of water could be decreased by 2,000m^3/ha annually.

Reducing cultivation costs for farmers. Monitoring crop capacity and costs for the cultivation of cotton and winter wheat with no-tillage revealed that, despite the relatively low crop capacity, profitability

Table #2. Effect of mulch on soil moisture and evaporation of moisture

Date of survey	Dip of the horizon, cm	Field soil moisture in the field without cover, %	Field soil moisture in the field with straw cover, %	Retained soil moisture due to straw cover
31.08.2011	0-5	2,90	9,49	6,59
	5-10	6,65	8,34	1,74
10.09.2011	0-5	2,21	9,30	7,09
	5-10	5,30	8,10	2,80
Evaporation intensity during 10 days on the horizon	0-5 5-10	0,69 1,35	0,19 0,24	

Table #3. Efficiency in cotton cultivation in the Kanlykol district of the Republic of Karakalpakstan (2011)			
INDICATORS	**FORMULAS**	**CONVENTIONAL CULTIVATION**	**NO-TILLAGE**
Crop capacity, centner/ha	CC	14.2	7.3
Price per 1kg of raw cotton	P	760	760
Gross revenue, in thousands of Soums	R = CC x P	1079.2	554.8
Costs, in thousands of Soums	C	1064.3	490.5
Prime cost	PC = C / CC	749.5	671.3
Net income, in thousands of Soums	N.i. = R - C	14.9	64.7
Efficiency, %	E = N.i. / C	1.39	13.2

was higher compared to conventional cultivation. In 2011, the crop capacity was very low due to a lack of irrigation water. Thus, the yield of winter wheat with no-tillage was 18.9 centner/ha (centner equals 50 kg), and with conventional cultivation it was 23.3 centner/ha. Despite the relatively low yield of winter wheat with no-tillage, profitability was greater by 17.2% compared to conventional cultivation. The crop capacity of cotton with no-tillage was lower by 6.9 centner/ha compared to conventional cultivation but despite this fact, the level of profitability with no-tillage was higher by 11.8% compared to conventional cultivation. The high level of profitability was achieved by reducing material and labor resources for crop cultivation. For example, during the cultivation of winter wheat with no-tillage, fuel consumption was reduced by 62%, and during the cultivation of cotton by 80%.

Not all cultures are suitable for no-tillage. Our research shows that crops such as indigo, fodder beet and some other vegetables and melon cannot be sown by no-tillage. Such cultures as wheat, triticale, corn, sorghum, sunflower, soybean, green gram, sesame and others are especially well suited for no-tillage crops, as they grow and develop well even in the early years of its application. Despite the advantages, farmers have difficulties accepting no-tillage at first. We have tried to compile existing problems that our initiative on the introduction of no-tillage faces:

Attitude issues.

Psychological attitudes towards the issue of cultivation play an important role. Some farmers are unable to give up the familiar, old methods of tillage, that have been used for thousands of years. They find it difficult to give up the idea that tillage and other types of land cultivation may not be the most efficient, and even detrimental to the soil. The negative impacts of mechanical methods have been touched upon. Natural processes have been disrupted and must be restored. Farmers, as well as heads of the agricultural sector, have difficulties accepting the self-regulatory processes of nature, and the fact that tillage should be carried out by natural processes (soil organisms, soil shading by crop residue, freezing-thawing of soil layers, root waste), as it was pointed out by D. Mendeleyev over one hundred years ago. No-tillage is primarily based on these natural processes.

Low crop capacity in the first years of application.

There is a risk of reduced crop capacity by 5 to 10 c/ha during the transition from conventional to no-tillage technology in the early years because the fields have not yet enabled the «loosening» of the soil naturally. As studies of scientists and practitioners in many countries show, loose soil conditions with no-tillage are achieved only after five years of permanent application. Reduction in crop capacity in the early years is compensated for by increased yield in subsequent years, and higher productivity.

Unkempt fields.

Under no-tillage, a field is not always neat, which is an issue for some farmers. A number of them consider this to be a major counterargument. It may defy conventional farming, but the crop residue improves the soil from one year to another, and this is the most important.

The presence of weeds.

There is a risk of infestation of perennial weeds and shrubs when no-tillage is introduced. In many countries, glyphosate herbicides are applied for effective weed control 20 days before the sowing at the rate of 5 liters/ha. As any chemical contaminates the soil and the price of herbicides is quite high, we recommend using other, cheaper, but more labori-

Consequently, after harvesting wheat residues (a straw) are cut with a disc coulter which has two sharp blades, and a grain pipe is placed between them. When the sowing machine passes along the field, a disc coulter cut a straw and simultaneously a grain sowing is conducted through the grain pipe.

ous methods of controlling weeds, hand-weeding. There is also a mechanical method, flat-sectile loosening, which simultaneously loosens the subsoil's indurated layer and cuts the roots of weeds, while the upper layer of crop residue remains whole and undisturbed.

The availability of equipment when needed.

Farmers lack powerful tractors to lift no-tilling drills, which are heavy. Tractors must be rented locally but they are only available during the plowing seasons for wheat and cotton. Tractors for no-tillage are only available after these seasons, by which time it is too late to sow seeds. This affects the yield of a no-tillage field, as cultivation is delayed. This illustrates another obstacle in increasing farmers' willingness to switch to new technologies. It is important to generate a locally-produced supply of no-tilling drills, which would improve the situation.

A technique for mulching.

Harvester combines have no tools for cutting and spreading straw. Straw chopping and an even distribution on the surface of the soil would further enhance the positive effects from the no-tillage usage. This important factor was not taken into account and we need to fix it. Machines for mulching crop residue and their even distribution over the surface of the soil are also necessary in addition to the no-tillage seeders. All harvester combines Case and Klaas were previously equipped with shredders but this is no longer the case. For shredding crop residue, it is possible to use machines such as Polesye, Jaguar, KIR -1,5M, KIP-1,5, Kiwi, that are used for grass siloing. A straw chopper "Kiwi" is multifunctional in use: it implements a selection of the straw swath after any domestic or foreign grain harvester combines, double shredding of straw, spreading the chopped straw along the field. The shredder is designed with the knowledge that straw ploughed into the soil is organic fertilizer which improves soil fertility and contributes to beneficial microflora (the price of a "Kiwi" is about USD 4,000).

Lack of administrative support.

Attempts to maintain even one field in no-tillage for a long period of time were unsuccessful. Farmers have strict, set schedules for ploughing theirs fields after harvesting wheat ("peshma-pesh"), and this is enforced.

The project's results are based on a two year pilot. Results indicate that a gradual transition to no-tillage would be beneficial, as the process reduces the cost of production and the risks of failed crops due to drought. No-tillage saves water resources, an issue of vital importance in the region, and gradually restores soil fertility through natural processes.

Bakhitbay Aybergenov, a specialist on conservation technologies, evaluates the quality of sprouts of a winter wheat.

A simple example of no-tilling's advantages can be seen on the edge of fields, where the soil is not ploughed. Wild plants grow strongly there, and if a few seeds of cotton are sown, they grow and develop quickly. If one compares this to the ploughed fields, it is obvious that no-tilling presents obvious benefits. A field day for farmers was organized during the pilot project, and participants were able to see better growth and development of plants in areas that had not been ploughed. Many people were surprised and impressed. A number of them agreed to try no-tilling in their own fields as a result.

The following conclusions can be drawn thanks to this pilot project on the implementation of no-tillage practices in Uzbekistan:

- It is important to continue the transition towards using this technology but it is necessary to showcase the benefits to convince the farmers of the process'success. A no-tillage practice on the same field for at least five years is important, until the soil fertility is restored by natural processes. ***We kindly appeal to district and regional municipalities.*** If you have any interest in this technology, and you want to support its introduction, GEF SGP is ready to help.

- Every 5-6 years it is desirable to implement a deep loosening of the soil with a flat-sectile cultivator that does not affect the top layer of residue and straw. It will enable the destruction of weeds and loosen the packed soil underneath.

- It is desirable to use additional equipment to mulch and distribute the mulch on the surface of the fields to enhance the effect of soil cover with crop residue.

- It is important to demonstrate the effectiveness of this technology in a stressful environment - in dry years, toenhance the public's trust in no-tillage.

- It is necessary to promote and increase support for the practice among farmers and decision-makers (employees of municipalities, ministries and departments). It is also important to continue improving the skills of workers in the agricultural sector, hold trainings on this practice for young scientists and review the experiences of other countries.

- It is desirable to continue involving business entities in no-tillage technology – trading firms in the sale and leasing of equipment for no-tillage, mulching equipment, as well as manufacturing entities, and the possibility of local production of such equipment.

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MICRO HYDROPOWER STATIONS - A POSSIBILITY FOR PARTIAL MEETING OF THE ENERGY NEEDS OF LOCAL BUSINESS AND RESIDENTS

A stable supply of energy is one of the fundamental factors required for the development of local economies. Small and medium businesses can plan their business processes and operational performance with more confidence, only if they have sustainable access to energy. Disruption in the supply of energy leads to failures and unplanned interruptions in production processes, failure of contracts, loss of market and competitive advantage, and eventually a loss of profits. In the worst scenario, disruptions in energy supplies can lead to business failure and bankruptcy. At a national scale the total losses in small and medium-sized businesses result in losses for the whole country and in unfavourable social processes. These can include the loss of jobs, reduced living standards for those involved in the small and medium-sized business sphere, and labour migration. This is why access to a stable and reliable source of energy is crucial for business organisations throughout the regions of Uzbekistan.

However, it is possible to achieve a stable supply of energy through using an integrated approach to solving the problem, and by exploring all possible options in terms profitability and management capabilities. For example, energy can be saved by implementing energy efficiency management schemes everywhere. We will describe it in our next issue.

Of the many other features of improved power supplies, the possibility of independent producers generating electricity is becoming very real. If we are talking about satisfying our own needs, in this regard the most attractive solution is the possibility of producing biogas. Biogas can fully meet the energy needs of agricultural producers, and it is being actively developed in our country.

Another feasible and commercially-attractive area of development is the production of energy with the help of micro hydropower stations.

There are more than 170,000 km of irrigation canals in Uzbekistan, excluding drainage canals. There are plenty of opportunities to use this network for the production of electricity, including supplying electricity to nearby communities and business units. Unfortunately, we have no data regarding the technical potential of electricity generation through the use of the existing network of waterways.

There are already numerous examples of the use of such stream flows for the needs of the population.

The development of solar energy - as an alternative to traditional energy production

Currently there are a lot of discussions about the development of solar energy in Uzbekistan. Indeed, in Uzbekistan we have a great potential for obtaining energy from the sun, an estimated total of 1,550 to 1,950 kWh/m2 per year. This amount of energy is really enormous. In fact, the country can sufficiently provide itself with energy only at the expense of the sun. However there is another question, specifically the price of the production of this energy.

With the current export price of gas, we can say with certainty that the introduction of solar collectors for heating can be a cost-effective investment. If a cost-benefit analysis will be conducted on the basis of existing prices in the country, the widespread transition to mixed heating systems, with the use of solar collectors, is not currently profitable for domestic heat producers.

The development of solar energy for generating electricity, with the use of photoelectric stations, is very expensive for the time being and can be afforded only by big investors. The average cost of photoelectric station ranges from $5 to $12 for 1 watt of energy produced. In fact, the individual installation of 1 kW on average costs more than $4,000. The market for such systems is very narrow, and includes only individual households who wish to have stable energy for their own use, and some types of business which have a small but steady need for electricity. For example, shepherds or horticultural farms may need a stable source of electricity for small water pumps. That being so, the need of the majority of small businesses exceeds the productivity of small photoelectric and hybrid (e.g. wind) stations. Simple sewing shops or shops that process vegetables and/or fruit that require refrigerators, will not be able to work with such a small amount of energy. Meanwhile, large photoelectric stations are very expensive.

For the production of electrical energy from the sun, heavy investments by large investors and the full support of the state are required. This is a goal for the future. When the technical performance of photoelectric stations increase, their prices will drop, and laws and regulations that encourage the production and consumption of energy from the sun will be passed.

Rahmatullo Shodiev and the excavation works.

For example, many residents of the Gilan village, in the mountainous areas of the Kashkadarya region, install micro hydropower stations to meet the needs of their households. The Chosh village is located in the Uzun district of the Surkhandarya region, which is situated in the mountains at an altitude of two thousand metres, where about a thousand people are living. Local residents had built a micro hydropower station at the village, with the support of the GEF SGP, which can produce 12 to 15 kW per hour. This output is sufficient for the stable operation of the local mill, where the villagers can grind wheat into flour if necessary, without going to the district centre which is located a hundred miles away along a difficult mountain road. People of five nearby villages can also take advantage of the mill's services.

One of the projects has been implemented in the Ok Machit village, of the Uzbekistan district in the Fergana region. In this village, entrepreneur Rahmatullo Shodiev is striving to both develop his business while also helping his neighbours. In 2002 he built a wool-combing shop that employed 15 local residents, and in 2010 he organised a rice mill and provided jobs for 10 people more. He also has an idea to create a sewing shop, where more than a dozen women could work. However, Mr. Shodiev's business development is limited by a lack of a reliable supply of electricity. Currently the entrepreneur is constructing a micro hydropower station with a 25 kW per hour capacity, on the canal flowing near the village. This energy should be sufficient to ensure the smooth operation of his businesses. As a result of the stable energy supply, 35 people will have permanent employment. The businessman and the community has agreed that half of the energy generated by the installed micro hydropower station should be directed to the needs of the local hospital and school, which are also suffering from constant power outages.

When asked about the benefits of installing a micro hydropower station in the village, Rahmatulla has a clear perspective:

"The implementation of the project is beneficial to all villagers. Firstly a steady power supply can improve the situation in the local hospital, making sure that all the equipment operates smoothly, and that high quality medical services can be provided to the public at any time. Secondly the electricity will be provided to schools and kindergartens, which will also improve conditions for their normal operation. Thirdly, small businesses can be developed in the village, increasing the number of jobs and consequently the standard of living and income of the local population."

"By the end of this project, I plan to do fish farming. I have already constructed a concrete irrigation ditch, but it is better to call it a small canal. Then you need to prepare a place for the future pond - in other words to dig a pit for it. By that time, after gaining the required experience, I plan to construct another micro hydropower station with the same power for personal use, and consequently do pond fish farming and provide the local population with fish products. Fish is very good for human health, especially in our environment," Mr. Shodiev summed up.

Another example is Rustam Tashmatov, an entrepreneur from the Andijan region who is making considerable efforts to create a power station capable of generating 200 kW/h, which will be able to continuously supply his whole village with energy. This work is being done in the Zavrak village of the Andijan region. Here is his story:

The construction of the canal for the micro hydropower station led by Rahmatullo Shodiev in the Ok Machit village.

- Rustam, what kind of work did you have to do to implement your idea of restoring and modernising the existing hydro power station in Zavrak?

'I must say that my idea has been supported by the local municipality which allocated me the site. In the shops of the Andijan industrial enterprises I personally constructed a turbine. Then we built a canal branch, with a water discharge height of eight metres. We then installed the equipment and started it up in test mode. Taking into account the fact that the turbine power is 200 kW and the generator is only 63 kW, we decided to install a more powerful generator. We found and temporarily installed new equipment

Rustam Tashmatov, standing near the canal which supplies water to the turbine.

A turbine of a microhydro power station that Rustam Tashmatov independently established in the Zavrak village.

and tested it. We worked all winter and received good results. Earlier almost all facilities next to the micro hydropower station did not work due to power cuts. After the power station was installed there was light in houses and at the local school.'

'Currently GEF SGP is working on the task of purchasing a generator for our 'Zavrak-1' hydropower station with a 200 kW power capacity. The introduction of micro-energetic technologies causes many difficulties regarding its adaptation to the terrain and to the people themselves, including decision-makers. The development of micro hydroenergy, and the existing problems with the electricity supply in the region, cause a lot of questions from others. We try to share our experiences.'

- What benefits do you think the introduction of this technology and the launch of a 200 kW hydropower station would give?

'In Uzbekistan, more than 50 per cent of the population live in rural areas. Previously this figure was 68 per cent, then 65 per cent, then 62 per cent, and now it is said to be at about 50 per cent. Everyone knows that we are losing people from the village - we are experiencing the 'brain drain'. People go to work in cities or in other countries. Elderly people and women stay in the village. There are a growing number of so-called 'straw' widows, whose husbands are earning elsewhere and they stay at home in the village with their children. Consequently there could be a number of problems in the future. Nothing good comes of children growing up without their fathers. Soon there won't be anybody to take care of the old people, because all people are moving to the cities.'

- In your opinion, what is the reason for these problems?

'There could be many reasons, but one of them is the lack of a stable, reliable source of energy. Maybe people would like to do something, to open a small shop, a sewing, shoe-making or milk processing shop or something else, but how can they do it if there is electricity in the village for only a few hours a day?'

'The countryside throughout Uzbekistan, including in our region, is experiencing difficulties with electricity,' Mr. Tashmatov continues. 'The existing facilities are not sufficient in the face of population growth. As for the winter period, even in general conditions, there is often no electricity. If we launch a hydropower station here with a 200 kW capacity, with financial support, we will be able to provide support to the nearby Zavrak and Yangi Tulkin villages. Infrastructure will be improved, new job places will be created, and the problem of 'brain drain' and the outflow of young people from the villages could be solved. Young people from these villages will not leave to other places searching for work, because there will be noticeable changes in the villages. It will be obvious that life is getting better and improving, that new jobs are being created, and young people will not look for employment in other locations. They will begin to settle down, and live and work for the good of their families and our country.'

'It is necessary to make sure that people have a stable, reliable, steady source of energy. This will help in many ways.'

'And we must go forward. We need not just one random example, but it is necessary to do something that could become a small model for the country. We have discussed the details of what we can do, and how we can solve the problem. Of course, a micro hydropower station is not a panacea, but there are a lot of opportunities for its introduction across the country.'

'The figures that show what the development of alternative energy gives to Europe make us think. In

Sweden, 48 per cent of energy costs are covered by alternative sources. In Germany, where industry is highly developed and energy needs are probably the highest among the developed countries of Europe, 18 per cent of the energy is already derived from alternative sources.'

- What could we do now in this country?

'Basically, now there are opportunities for independent power producers. The conditions are not good and you could work on it, but still they are available. Alternative energy producers can produce energy and sell it to 'Uzbekenergo'. 'Uzbekenergo' is a natural monopoly, and it is the only government agency which can sell energy to consumers. That is, 'Uzbekenergo' serves as a network for the 'retail sale' of energy. However, alternative energy producers can provide electricity to 'Uzbekenergo' if it is certified, for instance if it is generated by certified equipment. Generators are unfortunately not made in our country, but they can be purchased in Russia, while asynchronous generators are produced in Tiraspol. If energy is produced using such equipment that has quality certificates, standard certificates and other required documents, it will be possible to produce electricity and sell it as a product.'

'In this case a separate feeder could be used, which will feed the nearest settlement with a micro-hydro power station, through the existing network. People will pay 'Uzbekenergo' for electricity, and 'Uzbekenergo' will buy this energy from the manufacturer. This is a model which could be replicated in other regions,' Rustam said.

It is too early to talk about what other problems may appear, but we agreed that we will work together. Our help is very minimal, and if Rustam had not have applied to GEF SGP, there wouldn't be normal loans with a long-term payback period.

Then he gave an example:

'In 1926 it was a hard time, but a micro hydropower station was built nearby regardless, and it still works. It has already paid for itself many, many times over. And it is still working. I am often asked 'How many job places will you create?', and I say 'Maybe I will create only a few jobs, but the energy that I give will create hundreds of jobs, and people will work and produce something. It is wrong to think only in one direction. This sector needs the support of the state, because many other things are connected to it.'

- What kind of benefits can you tell us about, as a specialist, after launching the 200 kW generator?

'Speaking of the indirect benefits from the generation of electricity, I can say with certainty that the creation of conditions for better life and work will promote the intellectual development of the local people and young people. Where there is electricity, there will be development!'

Currently R. Tashmatov has introduced the technology of manufacturing hydro turbines with power equal to 10 -80 kW.

- What are your future plans?

'The available system of power stations is a cascade system. They are built one after another. In Uzbekistan, there are many places with such stations. However, we have another task ahead. We have the 'Zavrak-2' hydropower station, which is five times more powerful than the previous one. It also should be launched now, and we are 'tightening our belts' as the saying goes and aligning ourselves towards the task of launching this plant. If 'Zavrak-2' will be launched, all the villages in the neighbourhood will be supplied with electricity on a regular basis.'

"This will in turn contribute to the improvement of the environment and life in general. Such technology will provide clean energy to the population, there will be no need to burn fuel to produce energy, to cut down trees for firewood, and people's lives will improve. The running of this hydropower station will be key to a healthy life, a healthy environment and the improvement of the local population's living standards." Mr. Toshmatov concluded.

'We sincerely hope that the initiative of the Andijan professionals, with the support of GEF SGP, will at the end show what benefits can be gained, and that a model micro hydropower station can be offered to the Government for further development.'

'Based on the information available today, it can be assumed that the micro hydropower station is one of the real and cost-effective solutions to the need for a stable energy supply in settlements and industrial facilities.'

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ONE-DAY IRRIGATION – AN ECONOMY OF WATER AND ITS FAIR DISTRIBUTION AMONG FARMERS

Alimdjanov A.A., Horst M.G., Pinhasov M.A.

In recent years, existing irrigated areas have been divided into many farming enterprises with relatively small irrigated plots. Considering the use of furrow irrigation from gravity-fed irrigation systems which is widespread throughout the region, the division of irrigated land has complicated the management of water resources at the local level, the level of Water Users Associations (WUAs).

The main purpose behind the creation of WUAs as institutions has been the equitable distribution of water among water users, and the efficient use of this water. Currently, however, neither equitable nor efficient water use takes place. One of the reasons behind this is the approach to the management of water within the WUA system, between water users.

How is water distribution currently organised within the WUA system?

Currently, water users rely on the conventional method of the decade planning of water distribution. This technique focuses on larger units of water consumption (50 to150 hectares), when the water supply for a user (typically this was a group) was planned on a continual basis. Based on the accepted norms of irrigation for crops in specific areas (hydro-module regions), a certain amount of water use was calculated for a certain period of time – the decade ordinates of irrigation hydro-modules measured in litre/s/ha. Today the calculations are made in the same way, considering the total land area of the plots of each WUA and the number of hectares occupied by different crops, to which the rate of water consumption for each crop is added, and the amount of water needed for a single WUA is determined. The calculations should then be reconciled with the Administration of Channels, and a reconciled seasonal plan for water use should be accepted, which takes into account the predicted water content. This method takes into account the total amount of water required by all water users in a WUA.

This method, however, does not take into account the fact that in modern WUAs there are many farming enterprises with relatively smaller-sized irrigated plots, and that each of the farming enterprises is actually an independent unit of water use. Therefore the principle designed for the large plots of large enterprises is equally applied to the small plots of farming enterprises.

However, this method is extremely inefficient for many individual farming enterprises. There is a problem regarding the dispersal of small flow of irrigation water along the plots of farming enterprises to multiple branches in a farming enterprise. Simply put, a limited amount of water flows to the WUA, originally designed for a large plot by direct flow. However, since water is dispersed through many irrigation ditches within the WUA, a limited amount of water goes to each branch (see Chart #1). This means that each individual farmer receives a limited amount of water. Should the amount of water be sufficient, a farmer could irrigate his or her field in one or two days, while if the amount of water is little the irrigation period could take ten days or more.

As a result of such a dispersion of water supplies, water loss between the irrigation plots in an inter-farm irrigation network can be many times increased. Such a scheme of water supply also results in each farmer trying to gain access to water by any means possible. This means they open

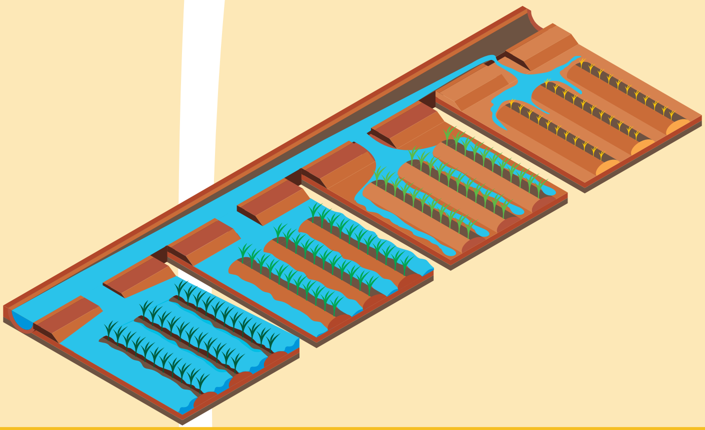


Chart #1. A method of conventional (decade) irrigation.

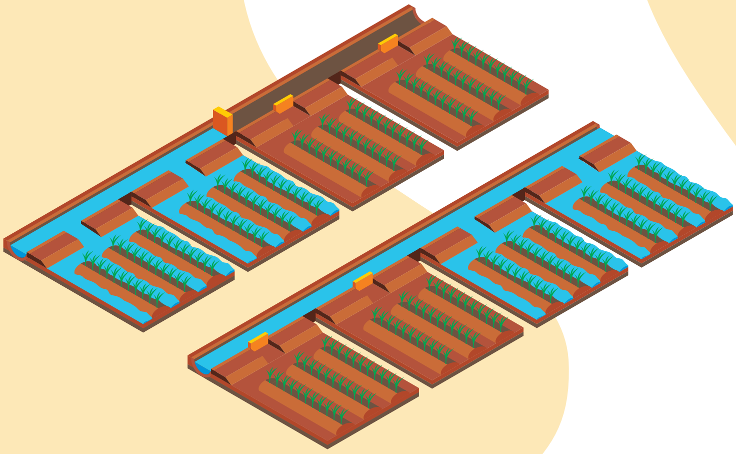


Chart #2. An alternative method of irrigation through one-day planning.

the water gates without permission, steal the water passing by his/her outline at any time when there is water in the channel, or pump the water out of the channel at night. Such unauthorised use of water leads to the excessive consumption of water by some farmers (at the beginning and in the middle of the canals), and shortfalls in water supplies for other farmers (at the end of the canals).

How could irrigation be organised in an alternative, more efficient way?

The shortcomings of the traditional method of irrigation can be overcome by adopting a method of the daily planning of water distribution through focused water supplies to final water users. This method was developed, tested, and has been offered for further distribution at the Scientific Information Centre of the Interstate Coordination Water Commission (SIC ICWC).

In the case of daily planning the calculations of water consumption remain the same, but the water is supplied to each water user in turn, in accordance with the earlier application registered by each user. Technically, this can be achieved quite simply. Within a WUA irrigation network, a Mirab (hydrometer) closes or opens irrigation channels for supplying water to one or two farmers. Then the water is supplied to the other pipe bends, cutting off the water supply to all the others. That is, water is sequentially supplied to all farmers/water users in the needed amount, in accordance with applications. Thus, farmers, regardless of their location along the WUA canal and the size of the field according to their sequence (based on applications), they can obtain water based on the size of the irrigated area. WUA employees and water users who know in advance to whom, when and how water will be delivered are quite satisfied with this mode of water supply. Here, the role of the WUA 'Mirab' (hydrometer) increases, who must observe the sequence of water supply (see Chart #2).

The effect of the transition to the alternative daily planning of water distribution

In most cases, all internal irrigation networks of WUAs have unlined canal. The losses resulting from infiltration and irrigation techniques, according to various calculations, are between 20 and 51 per cent of all water. Through the traditional method of irrigation the water is supplied at the same time to all bends of WUA's irrigation network. Under the proposed alternative, the water flows only through the opened pipe bends, leaving the rest of the network free of water. In other words, through the alternative daily planning method, the water flows through the shorter length of canals within the network. This means that losses through infiltration are significantly lower.

The testing of this method has been conducted on the 'Singir-1' channel, which is located in the 'S. Kasimov' WUA in the Bulakbashi district of the Andijan region. In the case of the daily planning of water distribution the average length of the irrigation network in the growing season, through which the water was supplied, was 55 per cent of the total length of the irrigation network. Data regarding the results are shown in Table #4.

When comparing the two options for ***water distribution, the water supply to crops under the concentrated water supply will be higher*** than that under the traditional one.

The average water availability at the level of water outlets to the irrigated fields of crops is determined by the ratio of the volume corresponding to the rate of water use (the irrigation net requirement according irrigation mode) to the volume of water supply, carried to the terminal level gates of the irrigation network.

According to the data shown in Table #4, 1,632.1 thousand m^3 of water were carried to the water plots of the 'Singir-1' field through a dispersed water supply, being the volume corresponding to the irrigation net requirement. This volume included:
- 6,200 m^3/ha of water for cotton;
- 5,300 m^3/ha for winter wheat.

Under the concentrated water supply system, 1,850.5 thousand m^3 of water were carried to the water outlets to the 'Singir-1' field, representing a volume greater than the irrigation net requirement and equalling to:

Table #4. Indicators of Water Distribution under Dispersed (Ten-Day) and Focused (Daily) Water Distribution along the 'Singir-1' Canal System

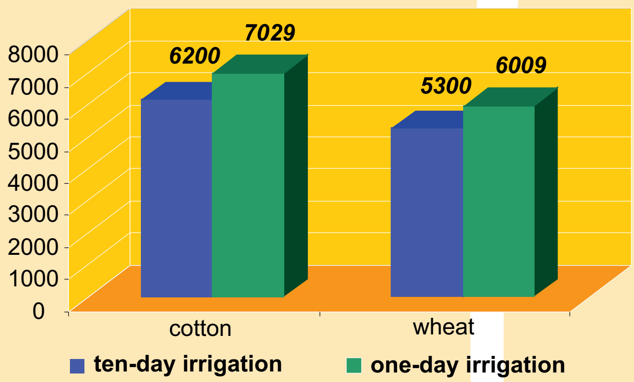
#	Indicators	Unit of measure	Types of water distribution planning	
			Ten-day method	One-day method
1	An irrigated area	ha	291.7	
2	The length of the irrigation/distribution network of the 'Singir-1' Canal System	km	3.38	
3	The volume of water corresponding to the net irrigation requirement of agricultural crops, irrigated through the 'Singir-1' Canal System	Thousands of m^3	1,632.1	
4	Water supply point from the South Fergana Main Canal to the bend of the 'Singir-1' during the vegetation period (according to the plan of water distribution calculated by Accounting Information Systems)	Thousands of m^3	2,068.8	
5	The average length of the irrigation/distribution network, through which water is supplied to the 'Singir-1' Canal System during the vegetation period	km	3.311	1.907
6	Total water losses	Thousands of m^3	436.7	218.3
7	Reduction of losses during the transportation of irrigation water under the focused water supply (through the one day planning of water supplies)	Thousands of m^3	-	218.2
8	The volume of water which is carried down to the water outlets of the farming enterprises of the 'Singir-1' Canal System	Thousands of m^3	1,632.1	1,850.5
9	The coefficient of the efficiency of the transportation of irrigation water through the irrigation/distribution network of the 'Singir-1' Canal System	%	78.9 %	89.5%

- 7,029 m^3/ha of water for cotton (representing an excess of irrigation net requirement for 825 m^3/ha);
- 6,009 m^3/ha of water for winter wheat (representing an excess rate of irrigation net requirement for 709 m^3/ha).

Assuming that the average coefficient of efficiency of furrow irrigation in the Fergana Valley according to our data is 70 per cent [1], then the average water availability for crops cultivated in irrigated fields was as follows:

- In case of the dispersed (*ten-day planning of water distribution*) water supply, 70 per cent;
- In case of the concentrated (*daily planning of water distribution*) water supply,- 79.4 per cent for cotton – (7,029 m^3/ha)/(6,200 m^3/ha) * 70% = 79.4% and for wheat – (6,009 m^3/ha)/(5,300 m^3/ha) * 70% = 79.4%

Comparison of water supply crops with traditional and alternative method of water distribution (in m^3/ha)



For establishing the dependence of the yield on the norms of irrigation, as outlined by V.R. Schroeder [2] the method of expressing values of crop capacity and irrigation rates in relative value has been applied. The maximum crop capacity and the corresponding value of irrigation norms are accepted as '1'. The ratio of irrigation net requirement to the irrigation gross requirement at the level of fields with the crops is equivalent to the availability of water.

The dependence of the yield on the water supply, on the basis of studies in the Central Asian region, is represented by VR Schroeder in the form of Table #5.

For the area where the 'S. Kasimov' WUA is situated, the values of the maximum yield are known (*according to the field indicators of the 'IWRM Fergana' project*) [3]: for cotton - 40 centner/ha, for winter wheat - 50 centner/ha. With regard to this information, and based on the values from Table #5, calculations were conducted to determine the yield based on the actual water availability (see Table #6).

An economic efficiency analysis of the daily planning of water distribution was also conducted at a farm level, taking into account the effect of increasing water supplies for major crops, including cotton and winter wheat, as an example of the irrigated lands of 'Singir-1' canal (Table #7).

The daily planning of water distribution provides an important opportunity for arranging irrigation. It is an important opportunity to start and finish the water supply to the furrow, and to keep switching

Table #5. Dependence of the Crop Capacity on Water Availability

Water availability, %	100	95	90	85	80	75	70	60	50
Y/Ymax	1	0.98	0.96	0.94	0.91	0.87	0.83	0.75	0.64

Table #6. The Results of the Calculations of Growth of Major Crops Capacity by Increasing Water Availability, Relative to the Option with Dispersed Water Distribution (Ten-Day Planning)

Crop	Type of water distribution	Average water availability of crops WA (actual)	Crop capacity	Increase of crop capacity, relative to the option with dispersed distribution
		%	centner/ha	tonne/ha
Cotton	Dispersed (ten-day planning)	70.0	41.72	
	Focused (one-day planning)	79.4	45.13	0.3408
Winter wheat	Dispersed (ten-day planning)	70.0	33.43	
	Focused (one-day planning)	79.4	36.13	0.2703

the costs for irrigation of the following irrigated plots only during daylight hours.

Therefore, the results of introducing the daily planning of water consumption indicate the possibility of:

- Increasing the coefficient of the efficiency of the inter-farm irrigation network of the WUA, by 10 to 15 per cent;
- Thereby, increasing the availability of water for main agricultural crops, without an additional intake of water from main canals;
- Increasing crop capacity due to growing water availability;
- Increasing profits by 69.8 Dollars/ha on average (96.2 Dollars/ha for cotton, and 43.1 Dollars/ha for winter wheat).
- Reducing water intake from the main canals by 25 to 35 per cent;
- The uniform and timely allocation of water resources among all water users;
- The reduction of the social tension between water users and the WUA staff, as related to the late delivery of water, and its unequal distribution between water users of WUAs;
- Maintaining and expanding the reproduction of soil fertility.

Presently, a project regarding the dissemination of this technology is being prepared. Upon the successful completion of the project, GEF SGP will be happy to promote this method in other areas of the country.

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Table #7. Results of the Economic Efficiency analysis of the Daily Planning of Water Distribution (the focused water supply to farms)

	Index	ha	Cotton	Wheat	TOTAL
1	Irrigated area	t/ha	124.4	123.4	247.8
2	The growth of crop capacity, due to an increase in water availability	Tonnes	0.2703	0.3408	
3	Additional production	Thousands of Soums /1 tonne	33.63	42.05	
4	Average procurement prices (2011)	Dollars /1 tonne	780	280	
		Thousands of Soums	440.9	158.3	
5	Price of additional production	Dollars	26,227.7	11,775.3	38,003.1
		Thousands of Soums /1 tonne	14,823.9	6 655.4	21,479.3
6	Expenses for gathering additional production	Dollars /1 tonne	150	56	
		Thousands of Soums	84.8	31.7	
7	Overall expenses for gathering additional production	Dollars	5,044	2 355	7,399
		Thousands of Soums	2,850.8	1 331.1	4,181.8
8	Additional net effect from the growth of crop capacity, due to an increase in water availability	Dollars	21,184.0	9,420.3	30,604.2
		Thousands of Soums	11,973.2	5,324.3	17,297.5
		Dollars /ha	170.3	76.3	123.5
			96.2	43.1	69.8

Note: According to data from the Central Bank of the Republic of Uzbekistan for the 15th of November 2011, One US dollar is equivalent to 1,769.285 Uzbek Soums

SERHOSIL – MICROALGAE PROMOTING FERTILITY

At the present time, GEF SGP is providing gratuitous financial aid to support an initiative of the Institute of Microbiology, Academy of Sciences of the Republic of Uzbekistan in establishing a low-tonnage production of the new biological preparation ‘Serhosil’. This preparation has been prepared in order to substantially improve microbiological and biochemical processes in soil, and to help increase the productivity of our land. Through this article, farmers and employees of the Department of Land Resources Management will be able to learn about the preparation in detail, including its benefits and possible uses.

Agriculture is suffering hard times everywhere. Politicians and land resources managers around the world are facing the problem of providing food for the planet’s increasing population despite having only a fixed amount of land and water resources, and facing the on-going processes of degradation and reduction of fertility. This problem generally results in a number of specific objectives for agricultural development:

- How to increase crop yields?

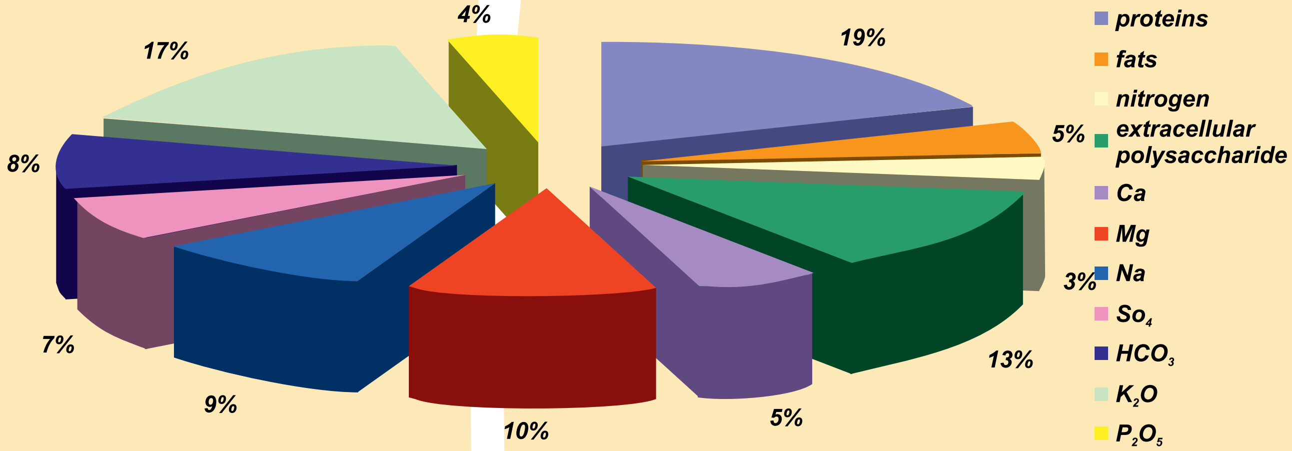
- How to improve, or at least not lose the quality of products?

- How to reduce costs and improve the profitability of agricultural production?

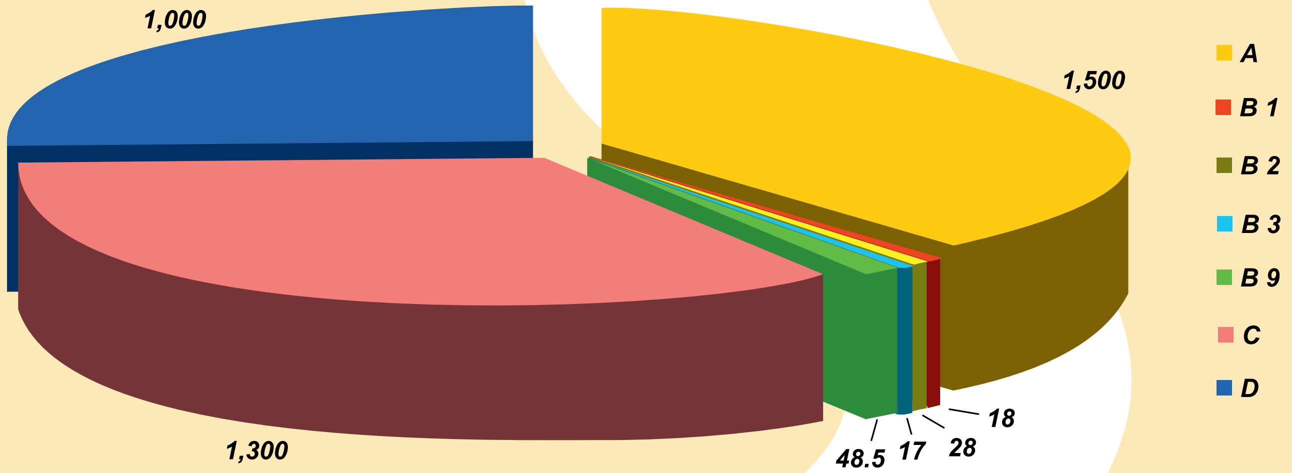
Agricultural specialists have conducted a search for new resource-saving technologies, and they are facing the following issue - how to produce maximum amounts of food, and how to produce environmentally-safe products today, at the lowest cost and with a reasonable reduction of human impact on nature?

It was surprising to know that one of the means to solve the above-mentioned issues faced in agriculture is through the use of algae. To be more precise, they can be solved through the use of a new environmentally-safe growth-promoting biological preparation, based on the ‘Scenedesmus’ green microalgae.

The biological product has been developed within the laboratory of soil microbiology of the Institute of Microbiology, within the Academy of Sciences of the Republic of Uzbekistan. The biological preparation can be used for the pre-treatment of seeds and roots, through irrigation, and as a foliar feed, through leaf spraying, for all kinds of crops. As an important advantage of the biological preparation, ‘Serhosil’ is totally harmlessness to humans and animals, and is of great value to the living soil microorganisms which in fact create soil fertility.



Picture 1. The chemical composition of the 'Serhosil' biological preparation, %

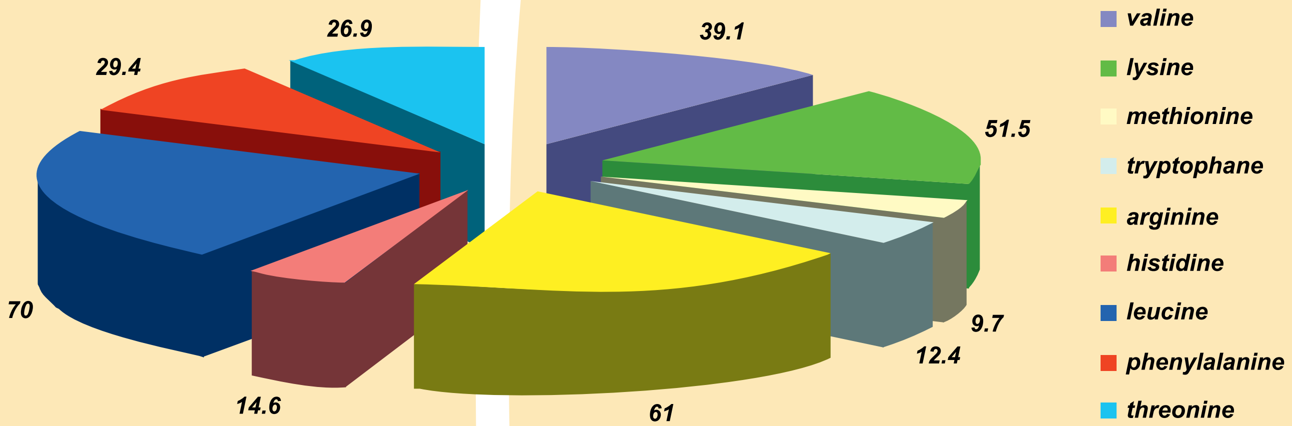


Picture 2. The content of vitamins in the 'Serhosil' biological preparation, mcg/kg

How does the preparation work? The main concept behind the use of the 'Serhosil' preparation is to apply additional green microalgae to the soil. Micro-green algae can be an additional source of biologically active substances and mineral elements for the root and leaf feeding of crops. In addition, when they are applied to the soil, green microalgae begin to breed, consequently increasing the humus content in the soil and creating favourable conditions for the development of useful soil microorganisms involved in the circulation of nutrients. The application of microalgae thereby increases the number of naturally-useful soil microflora, which become dominant over the harmful soil microflora. As a result of the microalgae life activity, the applied and natural useful soil microorganisms emit biologically active substances, including vitamins, enzymes, amino acids, proteins, lipids, carbohydrates, organic acids, plant hormones, and antibiotic agents against harmful pathogens, which enrich the soil with food elements easily available for plants, and makes it more fertile. The 'Serhosil' preparation includes all the nutrients, vitamins and amino acids that are necessary for the soil microflora and fauna, as well as for plants.

As a result of the application of the 'Serhosil' preparation, crops are well provided with complete organic and mineral nutrition, the immunity of plants increases, and they become resistant to diseases and to various stressful situations. These situations can include adverse weather conditions including drought, frost, heavy rain and winds, and soil conditions including salinity, erosion, pH and temperature differences. In this case fertilisers are not applied in the pure state (only in combination with organic ones), and neither pesticides nor other chemicals for plant protection are needed. With the use of 'Serhosil', agricultural production becomes more environmentally-friendly and completely safe for humans.

In practice, we have received evidence that the application of the 'Serhosil' biological preparation leads to an acceleration and increase in the percentage of field germinating capacity, an acceleration of ripening for 10 to 15 days, and an increase in harvesting. After the use of 'Serhosil' the harvest was healthy, the quality of cotton fibre and grains of wheat improved, and the content of harmful nitrates in vegetables decreased by 3 to 4 times. In addition, the crop did not rot and deteriorate. The 'Serhosil' biological preparation was also tested in the preparation of vegetable seedlings, on the seedlings of various fruit, and on ornamental trees, vines and flowers. Good results regarding the growth, development and bearing of plants have been achieved.



Picture 3. Amino acid content in the 'Serhosil' biological preparation, g/kg

The use of the 'Serhosil' biological preparation on different agricultural crops ensures:

- A reduction in the consumption of irrigation water for the cultivation of crops by 20 to 30 per cent, through the reduction of the process of leaf transpiration and evaporation of water from the soil, and due to the development of microalgae on the surface of the soil. This microalgae forms a solid green deposit, and improves the water-retaining capacity of leaves;

- A reduction of doses of applied mineral and micro-fertilisers by 25 to 50 per cent depending on the content of the soil;

- A gradual reduction in the degree of soil salinity, as a result of the use of microalgae applied to the soil as a source of food for the soil salts, and through the reduction (by 20 to 30 per cent) of the irrigation of crops by salt water;

- The possibility of a gradual complete renunciation of the use of a number of expensive chemical pesticides that target diseases and insect pests, due to the increased immunity of plants;

- The restoration and conservation of the biological diversity of agronomically - important and helpful species of soil microorganisms, the increase in soil fertility due to the gradual increase of humus content, and the improvement of the ecology of the environment by reducing the anthropogenic load;

- An increase in the yield, taste and preservation of crops. The harvest of raw cotton has been increased by 8 to 10 c/ha, of winter wheat by 7.5 c/ha, of cucumbers by 3 to 4 t/ha, of potatoes by 5.2 to 5.9 t/ha, and of sugar beet by 45 t/ha, when compared to yields gained with the use of conventional methods of crop cultivation;

- The reduction of emissions of nitrous oxide (NO_2) into the atmosphere by 25 to 50 per cent in saline soils, by reducing the standards of applied mineral fertilisers, and by restoring useful soil micro flora and microbiological processes within the nitrogen cycle;

- The opportunity to re-orient a number of farms to the more cost-effective production of new products, with eco-friendly approaches. As a result of in-field experiments, the nitrates in cucumbers were reduced by 10.3 per cent while vitamin C increased by 2.9 per cent, and the nitrates in potatoes reduced by 10.6 per cent while vitamin C increased by 1.2 per cent and starch content increased by 2 per cent, when compared to produce harvested after the use of conventional methods of cultivation of vegetable crops. The profitability of raw cotton production has increased by 52 per cent, of wheat by 45 per cent, and of vegetables by an average 44 to 90 per cent;

- A reduction of the anthropogenic load on the environment, while achieving maximum productivity at the lowest costs of material and labour resources;

- An increase in the sustainability of crops to diseases and weather conditions;

- An increase in drought resistance and the hardiness of plants.

How to use the drug? The 'Serhosil' biological preparation is available either as a liquid suspension or a concentrated paste-type biomass, which should be diluted in water at a ratio of 1:300. After dilution, the resulting working fluid can be used in three ways:

1. For the pre-plant treatment of seeds, for which the seeds can be steeped in the working fluid for three to five hours depending on the hardness of the seed;

2. For root feeding (irrigation), for which the plants are irrigated in the working fluid to the roots, instead of water, one time after the emergence of seedlings;

3. For the forming of leaves, foliar feeding (spraying the leaves) can be undertaken. The spraying of plants is implemented three to four times during the growing season, at an amount of 600 to 800 l/ha. This allows for the reduction of the cost of fertilisers by 25 to 30 per cent, and of irrigation water by 20 to 30 per cent, due to the improvement of the processes of photosynthesis, the additional leaf feeding of plants, and the improved water-retaining capacity of the leaves.

The integrated application of the biological preparation, through the treatment of seeds and roots, and foliar plant feeding, has resulted in the best effect.

The 'Serhosil' biological preparation has passed field tests, and was introduced within the framework of six state, and applied in one international and two innovation projects. These have been undertaken in two branches of the Uzbek Research Institute of Vegetables and Gourd Crops and Potatoes of the Ministry of Agriculture and Water Management of the Republic of Uzbekistan (in the Tashkent and Samarkand regions), in four branches of the Uzbek Research Institute of Cotton Growing of the Ministry of Agriculture and Water Management of the Republic of Uzbeki-

The spraying of wheat and tomato leaves with the 'Serhosil' biological preparation

stan (in the Tashkent, Djizakh, Bukhara and Andijan regions), the Uzbek Research Institute of Breeding and Seed Growing of Cotton, at the cotton fields at farms in the Tashkent, Sirdarya and Kashkadarya regions, and in Khorezm and Karakalpakstan.

Currently, works undertaken towards installing and launching the small-tonnage production of the preparation have been implemented on the basis of the Institute of Microbiology and the Academy of Sciences of the Republic of Uzbekistan, with the assistance of the innovation grant of the State Committee for Science and Technology И5-ФА-0-19521 'Development and Mastering of the Technology of the Small-tonnage Production of the 'Serhosil' biological preparation', and the GEF SGP. After starting production, the Institute will be able to provide the preparation for 12,500 to 15,000 hectares of land per year. In addition, each farmer will be able to produce such algae at their own premises. Farmers can be educated in this regard within the framework of the project, through its trainings, or directly at the Institute. However the best option would be an opportunity for farmers to apply to the Institute for the purchase of a concentrated paste.

We hope that the new development of local production will significantly improve the fertility of the lands of our country.

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The spraying of cotton leaves with the 'Serhosil' biological preparation

A SIMPLE SOLUTION FOR THE ISOLATION OF IRRIGATION CANALS

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More than 98 per cent of inter-farm and in-farm canals in the Khorezm region were built during the period of intensification of agricultural production on the open ground, and have no anti-filtering coverage. As a result, the degree of efficiency of the canals is very low, and a large amount of water is lost during the movement of water from the source to the field, due to filtering.

From 2009 to 2012 the staff members of the Urgench State University (USU), with the support of GEF SGP, tested the technology of isolating the bottom and edge of a canal with PE film to reduce the infiltration processes in a single Water Users Association (WUA). The 'Navruz-yap' canal, located in the Yangiaryk district of the Khorezm region, with a length of 2.6 km, was selected for the implementation of the works.

Before anti-filtration activities the canal provided 400 ha of irrigated lands, and supplied more than 2,500 people living in the surrounding area with irrigation water. The canal capacity was 1.5 to 2 m3/sec, but due to filtration the water did not reach the fields at a sufficient quantity and this led to a constant shortage of irrigation water. The efficiency coefficient of the 'Navruz-yap' canal changed seasonally by months from 0.43 to 0.52, and during the growing season it was at an average 0.49. In other words, 51 per cent of irrigation water in the canal was lost uselessly through filtration, and fed ground water.

Within the framework of the project, cleaning and insulating works were undertaken by an excavator on the 'Navruz-yap' canal, while the canal bottom and edge were manually prepared. In this regard, the slope of the canal, its bottom and the canal acclivities were prepared so that they could provide the gravity flow needed to move water to the irrigated fields. Next, the 10 to 15 centimetres layer of sand was under-laid for the preparation of laying the PE film, with a thickness of 100 microns. A 10 to 15 centimetres layer of sand covered the film on the canal bottom and edge, in order to avoid damaging the film (Fig. 1 and 2). Finally, soil up to one metre thick was laid over the sand on the bottom of the canal, and 0.5 to 0.6 metres over the canal edges.

The conducted measures for isolating the canal bottom produced impressive results. The average efficiency factor rose to 0.89. It was possible to save a lot of water and use it for the irrigation of additional hectares, which meant obtaining more yield and more profit. Figures are given below in the economic calculations.

NGO 'KRASS' specialists carried out the cost-benefit analysis of the conducted measures. Within the framework of the project they calculated the expenses and payback period, as well as the direct and indirect benefits of anti-filtering activities. For convenience, calculations were carried out for 1 km of the canal, with the perimeter of the bottom and the sides equal to 5 metres.

Total costs for the isolation of one km of the canal bottom with plastic coverage were 32.2 million Soums (see Table #8). As a result of this anti-filtering activity and the increase of the efficiency coefficient of the canal, about 4 million m^3 of water was saved in one year (based on estimations for one kilometre

Excavating works on cleaning and preparing works of 'Navruz-yap' canal.

Arranging an isolated tape at the bottom of the canal.

Table #8. The cost-effectiveness of isolating the canal bottom with PE film, for 1 km length of the canal and the 5 metre perimeter of the canal		
	Indices	**Figures**
1.	Project cost, in Soums	32,181,169.9
2.	Additional irrigated area, ha	276.3
3.	Total irrigated area, ha	476.3
4.	Water savings, m^3	4,019,593.8
5.	Downsizing of water delivery, in Soums	20,097,969.2
6.	Reduction of energy used for pumps, kW	90,000
7.	Downsizing of energy costs, in Soums	9,396,000
8.	Increase in yield, tonne/ha	0.15
9.	Profit from excess yield (in the case of 15 per cent profitability)	7,500,938
At the level of the farming enterprise		
10.	Total benefits from the isolation of the canal bottom	16,896,938
11.	Net profit, in Soums for one year (10-1)	-15,284,232. 4
12.	Payback, in years (1/10)	1.9
At the level of the Water Users Associations		
13.	Total benefits from the isolation of the canal bottom, in Soums (5+7+9)	36,994,907
14.	Net profit, in Soums (10-1)	4,813,736.9
15.	Payback period (1/10)	0.9
**- price of one kW of energy is 104.4 Soums*		

of the canal). Taking into account the price for delivery of one m^3 of irrigation water, which is equal to five Soums, **the costs for delivery of irrigation water** were reduced by 20.1 million Soums. After the installation of additional hydro-constructions, the water now flows by gravity, which helps to eliminate the large number of pumps that consume huge amount of energy. As a result, **energy costs** were reduced by 9.4 million Soums.

The conducted activities have allowed the fields to be supplied with irrigation in a timely and sufficient way, and have increased yield in the first year by 1.5 centner per one hectare, and in subsequent years by two to three centners. The calculations of income from the additional yield were produced on the basis of cotton, which is the main crop in this region. The profitability of the raw cotton grown on the fields adjacent to the canal is 15 per cent, and the additional yield will be 71.5 tonnes (from 476.3 ha). If the average price of one tonne of raw cotton is 700 thousand Soums, **the total income from the additional yield** will be 7.5 million Soums (estimated for one kilometre of the canal). Taking into account the growth of the yield in the following years, it can be assumed that the income will gradually increase.

The cost efficiency of the project can be considered under two scenarios, the first at the farm level and also at the level of both WUAs and farms. The costs of the delivery of irrigation water to the field are not taken into account when making the calculations for the first scenario, as the farming enterprises pay a fee to WUA based on the amount of irrigated area, regardless of the volume of received water. In this case, the **total benefits** after the implementation of anti-filtering activities will be 16.9 million Soums (as can be seen in the table), which will **allow the complete coverage of costs** within two years, and in later years in order to generate additional income. Additionally, when calculating benefits in the second scenario at the WUA level, savings resulting from the delivery of irrigation water to the farm fields are taken into account. In this case, the total annual benefits from the use of this technology will be 37 million Soums, which will completely compensate for costs within the first year.

In conclusion, it can be said that the project for the isolation of the canal bottom with PE film, within the framework of anti-filtering activities, is justified from both environmental and economic points of views. A wide application of technology throughout the country will save millions of dollars of state budget for concrete insulation, save millions of cubic meters of water and that will be a good base for making an agricultural production more stable and profitable.

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BRIEFLY ABOUT THE PROGRAMME

The Global Environment Facility's Small Grants Programme (GEF SGP) operates in Uzbekistan to ensure nature conservation in our country for future generations through the introduction of innovative technologies that help to use the land, water, energy and other types of the natural capital in our country more rationally.

GEF SGP provides free financial support for such technologies. Grants are awarded on certain conditions, which you can find on our website - www.sgp.uz in the 'Procedures' section - 'Project development'.

The aim of the GEF SGP is to test various technologies and determine how they can positively impact the environment, how to make a use of natural capital the most stable and profitable for people and their welfare, and for nature itself. However, our goal is not to make individual projects, but to tell more people, and, most importantly, government structures which economic and social benefits of such technologies can be obtained if successful technologies are widely disseminated. A widespread dissemination of successful technologies is the most important result of our work.

We welcome ideas from branches of government authorities on testing new or forgotten, but effective technologies by farmers, communities that utilize natural resources (land, water and energy), all stakeholders. We can repeat successful applied technologies and practices in other regions.

PROGRAMME ANNOUNCEMENT

Infographics on technologies of GEF SGP in Uzbekistan

GEF SGP is preparing a series of infographics on advanced technologies, that will be presented for your attention in the calendar for 2014. 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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More that 7 mln m³ of water is saved every year.

More than 18 mln m³ of water has been saved since the beginning of the GEF SGP operations in Uzbekistan

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