Technology Fact Sheet

Technology for reduction of water erosion (ULSE method) [i]

1) **Sector:** Agriculture

2) **Subsector:** Soil degradation

3) **Technology Name:** Protection of soil

4) **Recommended option of technology:** The technology represents an assessment methodology, on the basis of which recommendations for the reduction of erosion processes are worked out for the cultivation of arable land and sowing at each concrete plot according to its inclination, environment conditions and climate features.

5) **Scale:** The technology is recommended for the entire territory of Georgia where the inclination of plots under crops exceeded 50 and suitable conditions exist for soil water erosion. Most of all it is recommended for the high-mountain villages in Adjara, where water erosion of soil creates particular hazard to local population

6) **Availability:** This technology has been worked out in the USA. It is not accessible for ordinary peasant or farmer, as it requires various information for the implementation (values of soil erodibility factor, inclination, climate conditions and precipitation measurements), which at this stage is not available for ordinary farmer. For the adoption of this technology it is necessary to create relevant local services in the regions, which will provide local population with specific information and at the same time carry out monitoring both of obtained results and parameters reflecting climate change to guarantee the maximal efficiency of technology implementation.

   In the financial aspect the technology is accessible to peasant and farmer, as it is relatively inexpensive. The assessment method, which is necessary to work out recommendations, is free in Internet. Certain expertise on this subject exists in the country, that requires further development.

7) **Background/notes (short description of the technology option)**

Fig 1. Stripe sowing of crops

Fig 2. Stripe rotation of crops

Fig 3. Narrow buffer stripes

The Technology comprises a number of cultivation methods, serving to protect soil from erosion:

1) **Longitudinal – contour cultivation:** This method is cheapest, but effective measure, in which the soil is cultivated along the contours of an inclined slope, and not in a cross-cut manner. It has been experimentally established that compared to the cultivation along the slope inclination, the longitudinal-contour cultivation 10-15 times reduces the soil surface runoff, increases the water content of 1m deep soil layer by 10-15 mm (100-159 m3/ha) and promotes the rise of cereals productivity by 0.15-0.30 t/ha.

2) **Deep tillage of soil:** The use of this method stipulates the increase in soil water permeability and correspondingly the decrease in slope surface runoff and relevant washing down of the soil. The ploughing at the depth of 20-22 cm is considered to be normal, and at 25-27 cm and more-to be the deep tillage. The deepening of ploughed layer by 1cm results in the lessening of liquid runoff by 0.8-4.0 mm. Such wide range is related with the peculiarities of winter season and the depth of soil cultivation. For the reduction of slope surface liquid runoff, most effective is ploughing at the depth of 27-30 cm.

3) **Deep stripe loosening of soil:** Deep tillage is highly effective, but very energy consuming measure. So it could be carried out once in 2 or 3 years, usually by turns with the ordinary ploughing. At the same time, to save the expenses, instead of deep tillage it is recommended to till with subsequent deep stripe ploughing. During the spring cultivation the width of stripes equals to 1.2-3.5 m, and the distance between them makes 10-15 m. The application of these measures lessens the washing down of soil 1.5-2.5 times and increases the productivity of corn by 4-16%.

4) **Stepped tillage of soil:** The idea of stepped tillage is based upon the use of stepped form bottom of the plough to create the consecutive furrows of different depth at the soil surface, that prevents the formation of intrasoil and surface runoff. Stepped tillage allows to retain at the slope 10-12 mm of water on the average, washing down of soil from 1 ha decreases by 5.8 m3, i.e. about 7 tons per hectare, and the yield of cereals increases by 0.24 t/ha.

5) **Swelling of ploughed area:** It has been established that at slope having the inclination of more than 6-70, the longitudinal-contour cultivation does not provide the reduction of surface runoff to the minimum. Hence, during the ploughing it becomes necessary to create small swells along the furrow. For this purpose a large wing is attached to the ouyward body of the plough, which creates during the tillage small swells of soil at some distance between each other.

6) **Shooting of soil:** Usually this method is applied ring the autumn ploughing. The depth of shoots can vary from 15 to 60 cm, and the distance between them – from 100 to 150 cm. Working bodies are shooting knives, attached to the frame of the plough. This device is particularly effective in the steppe (plains) zone. The described method allows to increase the water content of the soil by 30-35 mm, lessen the soil washing off and rise the productivity of cereals by 0.4-0.5 t/ha.

7) **Arrangement of drainage furrows:** In zones of intensive development of water erosion for the prevention of soil from erosion good results are obtained through the arrangement of draining or anti-erosion furrows in the longitudinal-contour direction to the inclination of the slope. Draining furrows can be arranged parallel to the sowing with mounting of additional body at the external side of the plough, or after the sowing, using ordinary or two-body tractor plough. The distance between furrows depends on the slope inclination and the intensity of water erosion development. The more is inclination and the water erosion development risk, the less should be the distance between them.

8) **Broken furrowing of soil:** This method is conducted to regulate the surface runoff of water flowing down the slope. It is applied during the autumn ploughing, or between rows of chooppered crops, at the rime of their cultivation. This measure reduces the surface runoff by 10-17 mm, the washing down of soil by 4 tons from 1 ha, and promotes the increase of cereals productivity by 0.1-0.2 t/ha.

Parallel to soil cultivation the following methods of sowing are applied:

1) **Cross-cut sowing of crops:** At broken down complex slopes most effective is cross-cut sowing, when the first stripe is sown in the direction of slope inclination, and the second – along the contour. This technology of sowing is reducing by several times the washing down of soil and provides the increase in cereals productivity due to the even distribution of plants.

2) **Stripe sowing of crops (Fig. 1):** Plants sown in stripe are more resistant to soil erosion processes than usually sown plants. They provide the reduction of liquid runoff by 20-30% and of solid runoff (losses of soil due to erosion) – by 25-50%. At the same time the crop-capacity of cereals increases by 0.15-0.20 t/ha. The following methods are applied as well:3) Stripe rotation of crops (Fig.2) is used for protecting soils from water and wind erosion. In case when the width of buffer stripes and the distance between stripes is equal, this represents another anti-erosion technology – the stripe disposition of plants and contour-stripe farming. In this case the width of stripes usually varies in the range of 30-40 m.4) Arrangement of buffer stripe (Fig.3) at plots under hoeing plants after harvesting the perennial and annual plants (winter wheat, rye, mix of cereals with leguminous plants). This measure is conditioned by small size of tilled land areas in mountains, and hence farmers avoid to apply technologies that restrict maximal use of the plot. The offered soil protection technology does not lessen the useful area of cultivated land and it promotes even the increase of the yield. At the same time the soil will be protected from degradation and the decrease in fertility. Furthermore, this technology does not require any additional expenditures from the farmer.5) Sowing of interim crops. In the foothill and mountain zones of Georgia, particularly in Western Georgia, after harvesting plants in autumn, interim crops are sown to protect the soil from erosion. In early spring the biomass of these crops is tilled down into the soil, and later on the major plant is sown at the plot.The combination of above discussed methods allows to work out recommendations according to features of the plot and environmental conditions. The selection of recommended methods is conducted using the USLE equation.

8) **Implementation assumptions (how the technology will be implemented and diffused across the sub-sector)**

For the introduction of discussed above technology it is necessary to create locally special service to protect agricultural lands from erosion, which will provide farmers with recommendations. At the same time it would be necessary to make the land-use legislation more rigid to transfer more responsibility to the owner of the land. The monitoring of the land quality should be introduced. Indeed, all these activities could not be taken simultaneously; hence the action plan must be worked out on the basis of a pilot project implementation, undertaken through the voluntary participation of farmers. The optimal scheme of service centers should be elaborated as well. Extensive work should be carried out to raise awareness on the problem among farmers and to demonstrate the technology results.

9) **Impact statements**

- **Social development priorities:** One f the priorities of country's social development is the poverty reduction. Main result of land degradation is the aggravation of poverty among indigent part of population, resulting from the significant decrease in soil fertility. Hence, it's obvious that the offered technology could make important share in implementing the priority direction of country's social development.

- **Economic development priorities:** The progress in agriculture always has been one of major priorities for the Georgian government. In the last years this traditional sector of economy has drown particular attention, resulting in the realization of different serious projects. However, in these activities less consideration is given to the problem of land degradation and to technologies of its prevention and holding up, getting particular importance at the background of climate change in Georgia.

- **Environmental development priorities:** The combat against adverse results of climate change is one of priorities of Georgia's Environmental Action Plan. One of the most important resources endangered by climate change is the agricultural land.

- **Other factors:** The technology is accessible in general and is known in country's scientific circles, but it has not been yet valuably introduced in full scale. However, some attempts in this direction were undertaken in the Soviet period. Those attempts predominantly had research profile and were less valuable for actual practice. One of the paramount conditions for the implementation of offered technology is consultations and awareness rising among stakeholders. At the same time, for the elaboration of recommendations it is important to provide monitoring on necessary parameters, that is not being carried out at present.

10) **Costs (US$)**

- **Capital costs over 10 years:** Without considering the monitoring, research and service expenses, necessary to work out the recommendations, capital investments related with the implementation of specific activities does not exceed ??? USD, and in most cases is almost free of charge.

- **Operational and maintenance costs over 10 years:** Annual expenses are different for various technologies and vary in the range of ???? USD.

- **Other costs over 10 years:** These are mainly the population and farmers service expenses, consisting of expenses on the monitoring of different parameters and kinds of soils, as well as on the research activities.

- **Effectiveness of technology:** The use of recommended technology will sharply decrease or completely halt the soil erosion processes at tilled lands, resulting in the improvement of soil physical, chemical and biological properties, as well as in the amelioration of ecological state of arable lands. The biological activity of soil will increase, bringing the rise in its fertility, and subsequent growth of crop capacity and reduction of cost price of produce.

- **Barriers:** The legislation does not exist on the protection of agricultural lands and on retaining of their fertility, which determines the rights and obligations of land owner in respect of soil protection.

  The monitoring is not being conducted of parameters, which are necessary for the assessment of soil erodibility and other quantities. Hence, the creation of this system requires additional expenses, that should not burden the land owners.

  The application of offered technology requires the determination of historical and projected trends of climate parameters (precipitation,temperature), the reliable forecasting of which using regional climate models is so far not possible. The resolution of regional models is higherthan that of global models, but is still insufficient to assess the local trends, especially in high-mountainous regions. Models often producecontradictory results, that complicates to convince the decision makers of problem's urgency.* The adaption of this technology requires to create additional local services, which will elaborate recommendations for each particular plot according to climate conditions and soil parameters. The climate change trend should be considered as well.

  The awareness rising of population, farmers and local officials on the economic efficiency of this technology and on the possible aggravation of climate change adverse of this technology introduction and its further sustainability.

  It would be necessary to train local expert

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[i] **This fact sheet has been extracted from TNA Report - Adaptation for Georgia. You can access the complete report from the TNA project website http://tech-action.org/**