

Land Degradation Problems as a consequence of their irrational agricultural use and the ways of improvement of the situation

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Desertification is a global problem - 70 % of world dry land or about 3,6 billion hectares are subject to the process of degradation. In Central Asia the total area of land exposed to desertification is more than 1073 thousand square kilometers caused mainly by its overexploitation.

Land degradation (LD) is a gradual process of deterioration of physical, chemical and biological characteristics of soil, which leads to diminishing of soil fertility, loss of biological productivity and economic value of agricultural lands in the result of climatic variations or inappropriate use (wind and water erosion, floodings, salination, overgrazing, deforestation, fires, brush cutting, etc.). LD is now present almost in all edaphic-climatic zones especially in regions with prevalent extensive agriculture.

Overexploitation of irrigated land turned once green oasis into saline desert and people inhabiting these lands have to migrate to other places. The problem is that all places are now occupied and they have nowhere to go anymore.

LD causes land recovery dysfunction, which is common for all natural objects. Degradation is mainly caused by human activity and climatic variations. These processes primarily have an adverse impact on sustainable and safe development of countries, first of all agricultural production, as all CA republics economies are largely based on agriculture. Prevention of these negative processes demand close cooperation of states, scientists, civil societies and NGOs in particular.

Specificity of Central Asian agriculture is that its open ground can grow all known crops of the world except such tropical plants as coffee, ananas, banana, etc. Therefore CAR agrarian sector is focused on achievement of strategic goals in providing food, socio-economic and ecological safety as well as expanding of export potential and enhancing of productivity.

Most part of irrigated land in CA region is used for cotton plant, grain growing, rice, potato, etc. Vast arid and semi-arid territories are the main base for Karakul sheep and camel farming. Cotton, grain –wheat, rice, kenaph are basic crops of CAR. Cotton plant is one of the main sources of income in a number of regional states. Therefore scientists and specialists of agricultural sector are now faced with a problem of maintaining production rate and a leading point in the international cotton market.

Possible climate changes and warming of temperature in CA can result in intensification of land degradation processes in future. As a consequence of climate variations there appears a tendency for extension of salinated land area and level of salinity. Reduction of water supply is reflected both on ameliorative state of land and its agricultural productivity.

Today soil degradation is a serious ecological and economic problem. As a matter of fact it concerns soil conservation in arid zones of CAR to provide heavy yield in agriculture and sustainable food of these countries. This problem concerns all 5 countries.

Kazakhstan. Total surface water resource of Kazakhstan is on average 100,5 km³, 56,5 km³ out of which is formed within the territory of the republic, Eastern Kazakhstan oblast being the most supplied with water – it alone accounts for 290 thousand m³ for 1 square km.

If no measures are taken to improve efficiency of agro culture and to restore soil by 2025 Kazakhstan can lose up to 50 % of its agricultural lands due to degradation and soil erosion. At present degradation process affected all regions of Kazakhstan. Moreover it has a tendency for acceleration. At present 180 million out of 272,5 million hectares of land in the country's territory have been affected by desertification, which makes up 66% of land. Wind erosion has largely affected flatlands: more than 20 million hectares of arable and 25 million hectares of pasture land. While water erosion has affected 19,2 million hectares of land. Industrial desertification, loss of humus in soils and salination of irrigated land add up to the seriousness of the situation. Over the last 40 years humus content in soil has decreased by 20-30%, damage caused to RK being estimated at \$2,5 billions.

Mostly affected region of Kazakhstan is Kyzylorda oblast. Reduction of Aral Sea territory led to desertification of vast territory of delta-alluvial flatland. About three million hectares of salinated seabed was stripped forming a desert land, 2 million of which being in the oblast territory. The receding sea has had local effects on climate, and the exposed seabed has become a major source of aerosols contaminating surrounding agricultural land and adversely affecting human health. High level of desertification is observed in Syrdarya River plain and delta area affecting flora, fauna and soils. Desert plants grow instead of riparian woodland and reed, gramineous plant and licorice meadows have completely disappeared. Syr Darya delta area desertification is mainly caused by economic or to be more exact by uneconomical activity of people.

Kyrgyzstan. Total area of the Kyrgyz Republic is about 20 million hectares; 10,8 million hectares (54%) of the total area is used for agriculture. Main part of agricultural lands are pasture land –9,2 million hectares (46%) and arable land accounts for only 1,4 million hectares (7%) including irrigated land which makes up 1,066 million hectares (5,3%). 11,5% of irrigated land area of Kyrgyzstan is exposed to salination.

According to “Biom” NGO data, small size farming under these conditions don't promote effective land management and cooperation in this sphere. A single tax for lands of different qualities lead to intensive exploitation of degraded and less productive land, which leads to even more aggravation of degradation process.

According to A.Z. Asanaliev differentiation of all degraded agricultural lands by GosRegister of KR (State Register of Lands) are the following:

Salinated land –1180,8 ha.; alkalinized land –471,2 ha.; marshy land – 118,6 ha.; stony land –4021 ha.; wind eroded land –5689,8 ha.; water eroded land –5626,8 thousand ha.;

Many aspects of land degradation are pre determined with natural factors – mountainous land cause stoniness of land, water and wind erosion, salination and mire formation (soil material, groundwater motion). However there are human induced problems also:

- Failure of collector-drainage systems, regulating ground water levels in arable lands;
- Lack of knowledge and practice of land users about agrotechnics of crop management;
- Lack of financial resource for water and soil efficient technologies;
- Failure of soil, water and plant monitoring and evaluation service;
- Incompleteness of legal base regulating land utilization;

- Lack of knowledge of farmers about ameliorant plants, drought resistant varieties and technologies of crop management;
- Absence of a national strategy (concepts) on sustainable use of arable lands, soil protection service (including plough lands);
- Absence of studies on sustainable land exploitation in transition period and impacts on profitability of farming enterprises in different agro climatic zones.

According to S. Kolesnichenko almost all regulatory legal acts concerning land use and conservation say about rational exploitation of land resources. But there is no regulatory act, which gives interpretation or characteristics of rationality of land use.

Another important problem is – responsibility for irrational exploitation and land degradation. Administrative Code of the KR provides responsibilities for violations of state ownership rights. As for responsibility for private farmland degradation, it is not provided by this law.

Tadjikistan. According to information from Internet, agricultural land (plough land, irrigated, non-irrigated) in Tajikistan accounts for 14255.4 thousand hectares out of total acquired land area of the country and hay fields, pasture lands and planted area make up 4572 hectares.

More than 87 hectares of land are in an unsatisfactory ameliorative state (rising of underground water (47 thousand), salinated land (24.4 thousand), both factors (14.6 thousand);

More than 140 communities in 18 regions of the country are constantly in submerged state and 16% of land is salinated.

A big pressure is made on pasture-lands (increase of non-forage poisonous plant biomass, replacement of deep root forage-plants with annual short rooted plants, loss and washaway of soil (89% of summer and 97% of winter pasturelands are eroded strongly and moderately).

Cotton growing is the main branch of agriculture, and the country itself is ranked third among cotton producers of CA.

Raw cotton production in the country has stabilized over the last few years both in terms of cultivated area, which ranged between 250 and 300 hectares and yield. Gross yield of raw cotton makes up from 450 to 550 thousand tons and yield per unit is 18-19 c/ha.

At present technical state of irrigation, collector-drainage systems, pumping stations and drain wells are in poor conditions. 65% of pumping stations have run out and have become unserviceable. Water supply decreased by 40%. Another important problem is that farming households and farmers lack skills and experience on rational nature management.

Turkmenistan. Almost 4/5 of its territory is occupied by Karakum desert. Its climate is continental and dry. One-half of its irrigated land is planted in cotton, making it one of the world's largest producers. Irrigated cropping is a widely spread occupation and therefore annual irrigation intake reaches up to 12,3-15,5 billion m³, which makes up about 17,5 thousand m³ for one irrigated hectare. Nearly 80% of Turkmenistan land are exposed to degradation. Widely spread are desert sand soils, gray brown desert soil and gray soil. Availability of sufficient thermal resources in irrigated cropping conditions has allowed making cotton growing a leading branch of agricultural production.

Uzbekistan is located in central part of Eurasian continent with total area of 447,4square kilometers. It is the most populous country among CA countries, which is at present more than 25 million people.

Land reserves used in agriculture are divided into three categories: irrigated land (9,7%), boharic land (1,7%), natural pasture (50,1%). Forest territories occupy 3,2 % of total land area of the republic. Unused and other lands make up 35,3 %. **Total area of degraded land in Uzbekistan is more than 70 %.**

Water resources include surface and underground waters of natural origin and return waters. Uzbekistan's own water resource is 9-11%, main water resource used in Uzbekistan being formed beyond the country's limits. At present there are 95 underground water deposits. Main consumer of water resources is irrigated agriculture, which uses more than 90% of all resources. Surface waters of Aral Sea basin are used by all CA countries. Cotton growing is a major technical culture in all CA countries and subsequently has a big importance in their economies. For the last 10-15 years there haven't been a growth of cotton production, in opposite, there is a tendency to its reduction. One of the main reasons is obviously aggravation of land degradation processes.

Thus share of cotton production in CIS countries has dropped in by 11% and 8% 1991-1995 and 1996-2000 while overall production fell by 7%.

At present cotton growing countries of Central Asia are taking all necessary measures to increase yield productivity per unit, targeting at a new system of work organization through transition to farming households, which showed positive results in cotton economy all around the world.

This transition was especially obvious in agricultural field, which plays important role in the food production economy as well as in providing the most part of population with jobs. Farmers' cooperation and individual farmers replaced kolkhozes and sovkhoses. These changes including legal actions led to introduction of new ways of agricultural production.

Central Asia spends 89-92% of its water resources for irrigated agricultural land. Efficiency of irrigation systems, i.e part of water that reach fields make up on average 37% all over the world. To prevent soil degradation and save water for CA, it is necessary for them to start practicing drop irrigation.

Salinated soils are prevalent in dry regions of the world and unsatisfactory irrigation system was observed in all natural zones. Soils are considered salinated if they contain more than 0,10 toxic salts and 0,25% dissolved solid salts. For instance, yield capacity of cotton decreases by 20-30% even at a weak salination, maize – by 40-50% and wheat – by 50-60%.

There are some farming households that looking to market conditions sow cotton throughout the years to make profit. Practicing monoculture is an exception in the world practice.

System of cotton crop rotation of the USA widely practices introduction of **doura and short 5-6 year scheme of crop rotation.**

Loss of organic matter in soil is connected with 2 opposite processes: concentration of nutrition for plants on one hand and physical deterioration of soil on the other hand. In this connection **short schemes of crop rotations, provided that 1/4 -1/3 of all lands are allotted for Lucerne, are recommended for soil fertility maintenance in hot climate conditions, not saying about increase and stability of cotton yield.**

Soil salination is observed mostly in arid zones and are often a cause for plant diseases. Only a weak salinity of soil decreases cotton plant productivity by 20-30% and wheat by 50-60%. Cotton plant productivity is halved in medium salinated soils and as for wheat it often dies in such depressed state.

Uncontrolled exploitation of irrigated land turn vast areas of land into infertile deserts. About 30% of Earth area is under threat of desertification; this process has already affected 70% of dry land used in agriculture. According to estimates made in 1990 annual rate of land loss due to desertification made up 50 thousand square kilometers. According to UNEP estimations annual damage caused by desertification reaches 42 billion USD.

Conservation of fertility and "health" of soil must be a priority in agricultural production, therefore agro meteorology initiated conduct of various studies of "soil-plant-atmosphere "system" to improve efficiency of agricultural productivity. Soil is primary in this system due to its role and significance in agricultural eco system.

Land degradation processes in arid and semi-arid zones caused by different factors including climate change and human activity are part of general desertification process.

In natural conditions these processes take place in an arid zone characterized by extreme climate situation. Most important climatic factors of desertification are: drought, dry hot wind, dust storm and strong winds. Climatic variables (air temperature and humidity, atmospheric precipitation, winds, etc.) determine evaporating rate, degree of soil wetting and subsequently deflation and erosion processes.

Droughts significantly increase evaporation of reservoirs surface, irrigated lands and watered rangelands and strengthen plant transpiration. Regular occurrence of such effects cause concentration of salt in soil, high level of mineralization of ground waters, drying up of topsoil. As result physiological functions of plants deteriorate, some parts of plants are damaged and even die out.

Degradation of irrigated land in Central Asia is mainly caused by secondary salination of soil, irrigation and wind erosion, loss of humus and organic matters, pollution of soil with chemical substances used in agriculture, mire formation, development of pathogenic fauna, phytophagous organisms and agricultural pests.

At present salinated land area in Uzbekistan makes up 52% of total irrigated land, 18% of which is over and medium salinated. The mostly salinated land is the territory of Karakalpakstan (90-95%), Buchara (96%), Khoresm oasis (95-10%). Unfavorable salinated soil conditions in Karakalpakstan led to substantial diminishing of yield.

Expansion of salinated area comes from inappropriate irrigation system and practice of CAR.

Degradation of soil is caused by loss of 50-60% humus in soils as a consequence of cotton plant monoculture, insufficient organic fertilizer treatment, reduced crop rotation, Lucerne and other plants crop area, toxic effect of nitrate nitrogen residue in all layers of soil and ground waters (after their excessive treatment in periods of agricultural intensification).

Thus at present there is an increase of land degradation level and fall in irrigated land productivity due to climatic and ameliorative reasons, which complicates the situation in Central Asia.

Central Asian states were the first to suffer socio-economic consequences of unreasoned human interference into natural processes. One of them is Aral Sea crisis, which has become one of the topical problem of modern times.

At the same time extensive use of limited water resources for monocultural agriculture decreased demand for high natural economic potential of Priaralye.

In our opinion the following activities should be carried out for sustainable development of agriculture in Central Asia:

- Support of the farming and peasant households development;
- Develop the existing technology of livestock and Kara-Kul sheep pasturing in Kyzyl-Kum and Kara-Kum deserts;
- Establish quantitative relations between soil fertility and unrecorded population income;
- Pay more attention to agricultural problems;
- Soil degradation issues should be coordinated with economic and social development of the region.

Phytomeliorative activities play a big role in prevention of rangeland degradation. They are aimed at creating artificial ecosystems with higher productivity compared to natural phytocenosis on different types of rangeland.

Considering the level of pasture pressure farming enterprises should carry out activities on more rational use of rangeland territories. Thus pressure on rangelands to the northwest of Kyzyl-Kum, where intensive degradation of pasture herbage is observed, shouldn't be increased despite it has a weak pressure. Pressure of rangelands in western part shouldn't also be increased where load is normal but herbage conditions are worsening.

Forests prevent water and wind erosion of agriculture and other lands and warn flow of mud and bind the loose sand.

It is a well-known fact that according to soil-protecting technology of agriculture at least 30% of topsoil is supposed to be covered with dead plant material.

A desert of 4 million ha is formed now in Priaralyie, where only halophytic vegetation can grow. Introduction of halophytic vegetation is now studied in Australia, Syria, Iran, Israel, Egypt, Pakistan and India. However, such activities are not practiced properly in CA. USA gets from 1 hectare of such plants 200 centners of dry hay and from 20 centners of its seeds one can get 600 kg. of oil. So in our opinion Central Asia should also domesticate halophytic plants.

We can't say that international and national efforts on prevention of soil degradation in CA were futile. UN Combat Desertification Convention in countries suffering serious drought or desertification, especially in Africa, Sub regional Action Plan to Combat Desertification in Aral Sea (2000), Sub Regional Action Plan to Combat Desertification in Central Asia in the context of Convention to Combat Desertification, Aral Sea Basin Programme (1994, World Bank), Aral Sea Program (1998, World Bank, UNDP, UNEP), International project on Western Tyan-Shan bio-diversity conservation (1998), Implementation support of Central Asian Regional Action Plan on Environment (UNEP) – these and many other conventions, programs and projects have been prepared and are implemented now, but full fledged implementation mechanism of them haven't yet been developed. Therefore to make them more effective implementation mechanisms should be developed as soon as possible.

Summing up, it should be noted that land degradation in CA has resulted in decline of agriculture and live-stock-raising, reduction of land for grain and cotton plant. This is conditioned by low technology of agriculture, scarcity of fresh water for irrigation, insufficient use of mineral fertilizers, low content of humus in root zone of soil, slow development of new agricultural technology, deficiency of high-yielding varieties and severe deformation of environment (pollution, soil salination/ aridization of climate). Based on the above-mentioned reasons it follows that increase of cotton and grain and other cultures production output is

possible only at a comprehensive approach to studies in the frame of the whole region and available mechanism of soil degradation prevention consolidated by legislation.

In conclusion I would like to note that this problem is very complicated and has many controversial aspects. As there are no ready answers it demands wide discussions of this issue at round table of CA agricultural ecologists, soil scientists, agricultural climatologists including stakeholders sociologists and political scientists.