



ABSTRACT BOOK

2nd International Conference on Arid Lands Studies

Innovations for sustainability and food security in arid and semiarid lands

10-14 September, 2014
Samarkand, Uzbekistan



Ministry of Higher and Specialized Secondary Education of the Republic of Uzbekistan



Ecological Movement of Uzbekistan



Samarkand State University



Samarkand Agricultural Institute



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2nd International Conference on Arid Lands Studies

**Innovations for sustainability and
food security in arid and semiarid lands**

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2014

FOREWORDS

We are pleased to welcome you to the Second International Conference on Arid Land Studies (ICAL2) “**Innovations for Sustainability and Food Security in Arid and Semi arid areas**” that is supported by the government of Uzbekistan and hosted by Samarkand State University 10-14 September 2014. This meeting is a logical follow-on to the recent Global Forum on “**Vital Reserves in the Realization of Food Program in Uzbekistan**” organized at the initiative of our country’s President Islam A. Karimov that was held 05-06 June this year in Uzbekistan.

Dryland salinity, deforestation, decreasing productivity of rangelands and reduction of soil productivity are widespread phenomena and primary causes of desertification in the Central Asian region. The government of Uzbekistan is currently implementing effective measures to step up the production of food, draw foreign investments into the sphere, introduce cutting edge technologies, and boost export potential. These activities will ensure food security as a component of socio-economic development and create needed conditions for the dynamic development of a domestic agricultural industry complex that has an enormous production potential, and thus facilitate steadfast enhancement of the well-being, stability and prosperity of the country.

To further the effectiveness of these activities, the ICAL2 conference is bringing together a group of internationally recognized experts, senior scientists from international research organizations, industry representatives, international development aid agencies, governmental leaders, policymakers and other stakeholders to share novel knowledge and experience in combating desertification and innovations in agriculture for ensuring food security and ecosystem resilience in arid and semi-arid regions. The participants will also address a number of research and development opportunities for marginal water resources and lands to prevent salinization and promote sustainable management of natural resources, including conservation of indigenous traditions of the desert and semi-desert zones. It is anticipated that the conference will highlight novel tools for evaluation and utilization of phylogenetic resources of saline dryland ecosystems and suggesting biological approaches and strategies for soil/water reclamation and sustainable use for improving food security and livelihood of people in these less favourable areas around the world.

The overall expected outcome of the ICAL2 conference is increased awareness of the major challenges for agriculture and food security posed by climate change and the establishment of a platform for future international research collaborations in the area of combating desertification and degradation of natural and cultural environments in the desert and semidesert areas.

It is our great pleasure to thank the International Center for Biosaline Agriculture (ICBA), Islamic Development Bank (IDB), International Center for Agriculture Research in Dry Areas (ICARDA), the Food and Agriculture Organization of the United Nations (FAO), the Eurasian Center for Food Security (ECSF), the Eurasian Soils Partnerships (ESP), Japanese organizations and institutions, USAID, UNESCO office in Tashkent, UNDP, as well as chiefs of diplomatic missions, leading experts and scientists from 22 countries of the world for their kind support. Without their contribution, this memorable global event may not have happened.

This Book of Abstracts documents how our improved understanding of drylands provides insight into the health and future prospects of these precious ecosystems that will ensure that dryland communities enjoy a sustainable future.

Professor Ulugbek Tashkenbaev,
Rector, Samarkand State University

Productive and fertile soils are becoming scarce in arid and hyper-arid desert environments globally. These areas usually suffer from fresh water resources, which threaten the region food and water securities. Such complex situations necessitates to understand the ecosystem of arid and semi arid lands and to look at both mitigation and adaptation processes carefully, both from environmental and economical perspectives.

The process of land degradation, specifically because of salinization has spread over 1 billion hectares in more than 100 countries globally. This has encouraged the scientists and researchers to work more on the plant genetics, agronomical management practices and innovations in agriculture to improve food and water securities. The ICAL2 conference is an initiative by the Government of Uzbekistan and the Samarkand State University. The International Center for Biosaline Agriculture (ICBA) being an active international R4D organization is honored to be the co-organizer of the conference. This Forum is built on the outcomes of the research achievements, meetings, workshops and other conferences held in the region in partnership with many national and international organizations, including, USAID, FAO, UNESCO, UNDP, ICARDA and others. The conference is expected to cover different topics related to innovations for food security and will bring many national and international expertise at the event. I wish to sincerely thank Mr. Alisher Vakhobov from the Ministry of High and Secondary Specialized Education of the Republic of Uzbekistan,; Mr Zoir Mirzaev, Khokim of the Samarkand region and Prof. Ulugbek Tshkenbaev from Samarkand State University for their inspiration and respective endeavors to ensure the success of the conference.

Dr. Ismahane Elaouafi

Director General

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Agriculture development under arid conditions through wide introduction of innovative technologies is an important factor of ensuring food security of population in many regions including Central Asia. Today the problems of natural resources utilization are of special urgency as they enable to maintain sustainable development of territories including rational use of agro- ecosystems of arid areas providing their protection as a paramount issue. Organization of the conference once again indicates the importance of solution of these problems at the international level.

It is known, that now, owing to the necessity to intensify agricultural production to provide increasing population with sufficient food, considerable changes in the land tenure system are taking place; therefore, many ecosystems including natural ecosystems of arid territories are subject to degradation. Extremely adverse consequences of unreasonable management of natural resources are changes in floristic structure and disappearance of natural vegetation. It is obvious that the adverse changes occurring due to application of one-sided approaches in management of land-and-water resources ignoring ecological principles have a negative impact on the natural habitat of live organisms, deteriorate the quality and decrease the quantity of soil of the inundated rivers, lakes and wetland ecosystems. Thereupon, at the present stage of development, world-wide studying the mechanisms of the prevention of negative changes in environment, assistance to protection and rational use of natural resources with biodiversity preservation get the increasing value.

Currently, the issues of ensuring stability of agricultural production in arid and semi-arid territories dramatically lack both fundamental and applied scientific research in which ecological aspects are considered along with biological, physical, economic and social problems. Only an integrated and universal approach can create a basis for long-term stability of development of agriculture reflecting interrelation of local and regional eco-systems in arid territories.

Certainly, the conference will give the participants a chance to present scientific results and practical application of the research projects, to take part in discussions concerning the ways to meet the environment requirements. This activity will trigger wide acquaintance with innovative approaches in the domain of conducting agriculture necessary for ensuring food security of the population and sustainable development of arid territories.

On behalf of environmentalists of Uzbekistan, we wish the participants to enjoy the success of the conference work which will undoubtedly render a powerful impetus to further development of the international cooperation of researchers and experts, to strengthen their interaction with the international organizations and foreign research centers, with a view of joint advancement of innovative technologies in agriculture meeting the principles of environment protection and rational use of natural resources.

Boriy Alikhanov and Dilorom Fayzieva

Ecological Movement of Uzbekistan

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Impact of climate change on water infrastructure in Central Asia

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Abstract

The paper discusses impacts on irrigation management infrastructure capacities (from legal, institutional and technological contexts) in arid Central Asia due to climate change projections. Water supply will be challenged by demographics, hydrological alterations and environmental impacts. Two types of technical installations are the main focus of this paper, i.e., electrical pump-lifted irrigation systems and man-made water reservoirs. In Central Asia, approximately, 20-50% of irrigation water is power-lifted, yet the majority of pumped-lifted structures are in very poor technical conditions coupled with ever increasing of electricity tariffs. Furthermore, useful volume capacities of water reservoirs are being severely diminished due to bio-physical processes, improper operational regimes and chronic financing for maintenance. Irrigation sector should internalize its adaptation and mitigation efforts, i.e., integration of renewable energy technologies, energy audit programs and lastly design comprehensive investment prioritization processes and programs. Otherwise, irrigation sector will be at great risk for continued provision of fundamental services to the sustainable socio-economic development of the region and its countries.

Climate change may disrupt/impact operation and maintenance of the hydraulic infrastructures. The methodology for such an assessment is not developed or not fully applied in Central Asia context. To the best knowledge of the authors, specific thematically wise assessment on pump-lifted irrigation and water reservoirs of the Central Asian region in the light of potential climate change impacts have not been conducted. In order to close this gap, this paper attempts to analyze legal, institutional and technical aspects of the impact of climate change on operation and maintenance of two types of hydraulic infrastructure: (i) pump-lifted irrigation systems and (ii) man-made water reservoirs.

The pump-lifted irrigation systems are strategic for delivering water to water users via pumps, diversion structures, vertical drainage facilities and groundwater boreholes. The water reservoirs are storage facilities for seasonal accumulation of water and supplying it to irrigation, generation of hydropower, recreation, industrial and environment considerations.

The first objective of this paper is to briefly outline main transformation stages of water resources governance and management in Central Asia in the process of sovereign state-building process in particular paying attention to the ownership of such infrastructure. The second objective is to highlight important aspects related to development of climate change policies in the region related to water matters. The next objective is to comprehensively discuss institutional, legal and technical aspects most applicable to Central Asian context related to two sets of hydraulic infrastructure, i.e., pump-lifted irrigation and water reservoirs. The last objective to provide systematic analysis of climate change adaptation measures in the region.

Key words: water governance; climate change policy; irrigation infrastructure; Central Asia

Biometrical indexes of the *Tulipa michaeliana* Hoog in different cenopopulations

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Abstract

Central Asia is the centre of the origin and base of the aspectual variety of tulip species. Twenty nine different tulips species and one subspecies grow in the desert and mountain landscapes of Uzbekistan.

One of them is *Tulipa michaeliana* Hoog. *T. michaeliana* is included in the Red Data Book of Uzbekistan.

T. michaeliana was identified in 1902 by Hoog at the behind of Caspian Sea under cultural samples and its homeland was not shown at that time. This species is considered as sparse and it grows on the stony or clayey slopes.

Four cenopopulations (CP) were studied in the sphere of biometrical indexes of the *T. michaeliana*.

The first CP is isolated from Baliqlitau mountain range (N 40° 19.208' E 067°38.457', h-523) and this area 20 plant species are registered. The second CP is around of Kokchatau mountain range (N 40°31.822' E 065°02.387', h-469) and 23 plant species are registered. The third CP is Djizzak province through Dashtobod-Sarmich way (N 39°59.175' E 068°49.621', h-773), 14 plant species are registered. The fourth CP is recorded in the surroundings of villages of Sarmich (N 39°52.475' E 068° 52.105', h-1130).

In each coenopopulation, *T. michaeliana* species was observed to develop four leaves. Those leaves are also marked with violet spots. Flower solitary, bright red to dark crimson, very large, finely shaped, resembling *Tulipa greigi* Regel, but differing clearly from the latter by the crimson color range and the conspicuous wedge-shaped, light margined black blotch on the outside of the inner petals; scentless. *T. michaeliana* blooms in March-April and bears fruit in May.

The highest indexes of leaves were observed only in the IV CP in all studied territories and leaves were up to 197.7±8.09 mm long and 60.2±7.81 mm broad. The less indexes were identified in the II CP, their leaves are up to 132±3.23 mm long and 31.4±0.74 mm broad. Among the plant's stalk longs were studied. According this research, the highest indexes showed in the IV CP (174.5±10.16 mm). The minimum indexes about stems was *T. michaeliana* in the II CP (99.9±3.94 mm). This indexes were 135.8 mm in the I CP and 142.2±10.6 mm in the III CP. Plant bulb showed 46.6±1.33 mm, weight of species was 62.2±5.13 g and reproduction effort (RE) constituted 18.55 %. The RE was 22.17 % in the I CP, 24.8 % was in the IV CP.

The highest biometrical indexes of the *T. michaeliana* were registered in III and IV CPs in all tested CPs. This situation depends on the soil fertility and characterized them to grow in adyrs. Geographical coordinates in all studied CPs play important role in the future monitoring.

Key words. *Tulipa michaeliana*; cenopopulation; biometrical; weight of species

Regulation of biotic and abiotic factors of growth and wheat development

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Abstract

The increase of stability of plants at growth and development stages to external stressful factors is one of the major problems of modern biology. Thus, the essence of the carried out investigations consist on interrelation definition between stability and ontogenetic development of plants. One of the main objectives of certain investigations is to reveal of new physiologically active substances possessing biostimulating properties and connected with increase of efficiency of plants.

Nowadays there are different considerable quantity of the chemical preparations used or carried out in agriculture (stimulators, herbicides, retardants and others). It is known, that in the past few years preparations of the steroid nature, capable to regulate physiological processes of growth and development of plants have been used. Besides, on the basis of the studied research it was revealed, that a very small doses of these substances stimulate growth and development of plants, raise their stability to stressful factors and promote increase of productivity of plants. However, such investigations on wheat are carried out very little. Besides, the questions and problems connected with studying the value of natural and synthetic physiologically active substances in increasing of stability of plants, including wheat, to biotic and abiotic factors, in the conditions of Uzbekistan are studied very little.

The purpose of the study: creation and working out technologies of stimulators of the growth of wheat from the local raw materials possessing fungitoxic properties and revealing synergists from the synthesised five-valency phosphorus for insecticides used against wheat crops pests.

On the basis of the results of investigation peculiarities of complexes glyccerizin acid of licorice as stimulation of growth and development of wheat and effective influence on fungi diseases, it was created a new experimental preparation– stimulator of growth and development of wheat and effective prophylactic preparation against fungi diseases in the conditions of Uzbekistan.

In the result of extension of the preparation in the conditions of salinity, inoculation of fungi, in shoots of wheat, it was revealed that increase of quantity of phenol connections and established one of the mechanisms and their influence on growth and development of rust.

It was revealed that the action of preparation on wheat sorts infected with yellow rust is effective at present in the production such as Tilt, Baileton and Titul.

New data received on the basis of studying of biostimulating properties of glyccirizine acid salts, is a basis for the creation of new generations of growth factors of wheat possessing phytohormonal activities. New preparation which was created on the basis of glyccirizine acid is recommended as a preparation stimulating growth and development of wheat and protecting from fungoid diseases.

Key words: growth stimulators; fungus diseases; glyccirizine acid; wheat production; Syrdarya Basin, Uzbekistan

Control of soil erosion of agricultural land in Jordan with polyacrylamide

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Abstract

Two types of polyacrylamide were used to test their influence on soil erosion and runoff of sloping land in Jordan under natural rainfall conditions. The two PAM used in this study, commercially named as A836 and A870, have different molecular weight ranging qualitatively from high to low and surface charge from 20% to 70%, respectively. Fourteen field plots with 2 m wide by 10 m long having a slope of 11% were constructed in the field. A runoff collection barrels were installed at the end of plots to monitor the amount of runoff and sediment loss after each storm. The PAMs were applied at 2 application rates of 10 and 30 kg/ha plus a control. Experimental results showed that Both types of PAM caused large reduction in soil loss with an average value of 22% compared to control and 70% compared to compacted plots. Application of A836 reduced runoff and sediment loss by 23% and 35%, respectively compared to control. The corresponding average decreases in runoff and soil loss for A870 were lower at 16% and 8%, respectively. Differences in runoff among PAM treated plots at 10 and 30 kg/ha were negligible but soil loss was slightly lower in the 30 kg/ha PAM treated plots.

Key words: PAM; field plots; soil loss; moisture conservation

Restoration and conservation of Artemisia grassland of Central Kyzylkum desert

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Abstract

As a result of geo-botanical studies in different soil conditions we have identified four pasture varieties involving three species of *Artemisia* L. – *Artemisia diffusa*, *A. turanica* and *A. juncea* – common fodder plants in Central Kyzylkum.

Mixgraseta-iriseta-artemisieta diffusae, turanicae pasture variety formed in gray-brown soils in the south-eastern part of Kukchatau; *ephemereta-artemisieta diffusae, turanicae, juncea* variety prevalent in gray-brown stony gravelly soils in southern part of Kukchatau; *ephemereta-ephemerideta-artemisieta diffusae, turanicae* variety is found in the northern and north-eastern parts of Kukchatau in gray-brown soils. The town-village “Zafarobod” located not far from these pasture varieties – in the southern foothills of Kukchatau. On 25 km west of the village on sandy soils *ephemereta-artemisieta-calligonumeta leuocladumae, microcarpae* pasture variety had been formed.

The performance of save and real loads all *Artemisia* grassland variety had been studied.

The results shows that the save load index (SLI) *Artemisia* grassland below the spring and is constantly increasing to autumn at all pasture varieties. The lowest figure recorded SLI primarily in *ephemereta-artemisieta diffusae, turanicae, juncea* (average seasonal livestock 0.6 per 1 ha) and *mixgraseta-iriseta-artemisieta diffusae, turanicae* (0.9) and *ephemereta-ephemerideta -artemisieta diffusae, turanicae* (0.9) pasture varieties. SLI up *ephemereta-artemisieta-calligonumeta leuocladumae, microcarpae* (1.2) with the participation of *Artemisia diffusa*, formed on sandy soils.

Real load index (RLI) test results of *Artemisia* grassland in Central Kyzylkum confirmed the action of anthropogenic factors on vegetation, as near settlements defined inexpedient of hold transhumance. In particular, the rate of RLI above the permissible of pasture variety, which is located, closes to the village. It was noted in *ephemereta-artemisieta diffusae, turanicae, juncea* (average seasonal livestock 1.2 per 1 ha) and *mixgraseta-iriseta-artemisieta diffusae, turanicae* (1.3) and *ephemereta-ephemerideta-artemisieta diffusae, turanicae* (1.3) pasture varieties. Especially on *ephemereta-artemisieta diffusae, turanicae, juncea* pasture variety RLI is 2-3 times more of the permitted and it shows excessive overgrazing of vegetation in the region. Only in sandy soils – *ephemereta-artemisieta-calligonumeta leuocladumae, microcarpae*, which is located far away from the village, the RLI not exceed value was marked (1).

High index of RLI in *Artemisia* grassland of Central Kyzylkum is one of the reasons for the formation of smaller biomass of *Artemisia* grasslands in the pasture variety. It is demonstrates the plant digression of studied area.

Key words: antropogenic loads; *Artemisia* grassland; geobotany; Central Kyzylkum; Uzbekistan

Soil salinization in Tajikistan: modern status and methods for prevention

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Abstract

Salinization of soils is a typical phenomenon and the major problem of irrigated agriculture under continental dry climatic condition of Tajikistan. More than 15% of irrigated lands of Tajikistan are saline. It is a significant damage for the country with small land area (there are only 0,11ha of irrigated lands per head in Tajikistan).

According to the data of large-scale soil inspection of irrigated territory it was revealed that the territory with low level of ground waters (less than 2.0 m with mineralization more than 2 g/l) in the summer-autumn period is increased twice in comparison with the winter-spring period. It usually increases from 70-75 thousands ha in early spring season up to 140-150 thousands ha in autumn respectively. Because of soil salinization Tajikistan annually loses 100 thousand tons of cotton-fiber and a lot of other agricultural productions, raw materials; the grade and quality of agricultural goods have been being decreased. The main causes of soil salinity in the irrigated zones of Tajikistan increasing from foothill toward the plains are both natural and anthropogenical factors.

Water-salt balance of the majority irrigated areas in Tajikistan had been changed in result of big-scale works on hydromelioratory construction were made in 60-70th years.

In this respect Vakhsh valley is a classical example, it became a global standard on soils salinization process. Today the total area covered by drainage is about 310 thousands ha, including 86.8 by closed and 52.8 thousand ha by vertical drainage. The extent of a collector-drainage network has been increased to 11.4 thousands km. However, anthropogenic transformation of natural massifs in complex with expansion of irrigation on foothill and dynamical changes of natural-economic systems, radical alterations of water- and land tenure require a new comprehension of formation and regulation of ecological and ameliorative measures. Therefore the development of innovative technologies on improvement of irrigated agriculture practices is crucially needed.

Key words: Salinity extend; drainage system; hydroameliorative measures; biosaline technologies, Tajikistan

Salinization of irrigated soils of the Aral Sea basin and its environmental and socio-economic impacts

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Abstract

This paper is focused on the discussion of the main reasons of environmental degradation in Central Asia and suggests the possible ways of the transition to the sustainable development of this region. In the beginning of the twentieth century, the wide development of irrigation in Central Asia was based on the concept of the radical changes in hydrogeological, geochemical and soil conditions. This concept predetermined the extensive transformation of automorphic hydrological regime of soils to hydromorphic regime and led to the belief that salinization of irrigated lands was an inevitable result. The consequences of such strategy in irrigation development were secondary salinization of irrigated lands and low effectiveness of the use of water and land resources. At present, the per capita reserves of water resources in the countries of Central Asia are 2300 m³ that is much higher than those in India, Egypt, Syria and the countries of Middle East (800-1900 m³) where the problem of water supply is not so serious if compared with Central Asia. Thus, the problem with water resources in Central Asia mainly results from extremely inefficient use of water and not from its deficit. The effectiveness of agricultural water use in Central Asia is 4-5 times lower than that in the developed countries. The per capita area of irrigated land in Central Asia is 0.15 ha that is several times higher than that in the world (0.035 ha). The data given in the paper allowed us to conclude that the countries in Central Asia have reserves of fresh water sufficient for the solution of environmental, social and economic problems. The trouble is that since independence during the last 20 years no efforts were undertaken to improve water economics and to achieve the sustainable use of natural resources. As it was found out, drainage if used in combination with the re-use of saline drainage water for irrigation, even under percolative regime, restricts the positive effect of drainage and even becomes the main factor of ecological, social and economic crisis in the region. The closed water and salt cycles at the irrigated lands result in the deterioration of surface water quality, progressive salinization and decrease in fertility and productivity of irrigated soils. In this paper we suggest a possible ways of the transition to the sustainable development using the modern concepts of environmental systems functioning and relationship between environmental and socioeconomic factors. The empirical relationships used for the assessment of such parameters as permissible anthropogenic loads on natural ecosystems, ecological harm to the environments, environmentally adapted gross domestic product and standards of well-being are given in this paper. A real opportunity of enhancement of environmental, social and economic conditions up to the level providing for sustainable development of the countries in Central Asia is described in this paper. The actions ensuring for the transition to the sustainable development include: termination of the re-use of saline drainage water for irrigation, reconstruction of existing irrigation systems so that its performance reaches 85%, the use of sprinkling and drip irrigation. The implementation of those actions can lead to the increase in the production of raw materials and crops by several times as well as to recover the environmental framework by 30-40%, including the river valleys and deltas. The level of the Aral Sea can rise by 19-20 m and the area of the sea can reach 5-5.5 million ha. The decrease in the areas of irrigated lands down to 4 million ha (0.074 ha per capita) and inadmissibility of the use of the saved water for the extension of irrigated areas are the compulsory conditions for the effectiveness of the suggested measures.

Key words: anthropogenic loads; water re-use; saline soils; socio-economic impact; Aral Sea Basin

Ontogenetic structure of the cenopopulation of *Lagochilus vvedenskyi* R. Kam et Zucker (*Lamiaceae*) in Kyzylkum (Uzbekistan)

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Abstract

Lagochilus vvedenskyi (*Lamiaceae* Lindl. family) – semi-low shrub up to 20-25 cm high. It is narrow-local endemic of Kyzyl-Kum inselbergs. It is entered into the Red List of the Republic of Uzbekistan with the status 2.

The aim of this work is studying of the cenopopulation structure of this species in the residual mountains of Kyzylkum. Ontogenesis of a species is described as a part of ephemeroïd-wormwood community in the Sultonbibi region of central part Kuldzhuktau. The structure of the cenopopulation have studied by method of laydown the transects. Transects 10 m length laydown along a slope, they shared on platforms on 1m². In each cenopopulation are put from 10 to 15 platforms on 1m². At the characteristic of population structure relied on ideas of a distinctive ontogenetic spectrum. The construction of ontogenetic spectrums was carried out by the technique posed in work. The cenopopulations also were characterized on classification and "delta omega", with use of the following demographic indicators: effective ecological density. Geobotanical descriptions are executed by a standard technique on platforms of 100 m². The structure of cenopopulations (CP) of *Lagochilus vvedenskyi* was studied in options of the petrophyte and gravelly-earthly matter gray-brown soils. The first cenopopulation of *L. vvedenskyi* meets in structure of ephemeroïd-wormwood (*Artemisia diffusa*, *Artemisia turanica*, *Poa bulbosa*, *Carex physodes*), the second CP in the grassy-saltwort-wormwood (*Artemisia diffusa*, *Artemisia turanica*, *Salsola arbuscula*, *Scorsonera gageoides*, *Ferula foetida*, *Alhagi pseudalhagi*) and the third in ephemeral-wormwood communities (*Artemisia diffusa*, *Ferula foetida*, *Tulipa lehmaniana*, *Delphinium camptocarpum*, *Roemeria hybrida*). The general projective covering of herbage fluctuated from 15 to 35%.

Key words: cenopopulation; *Lagochilus vvedenskyi*; ontogenetic spectrums

Salt-tolerant plants for soil salinity control, sustainable fodder and bioenergy production in Central Kyzylkum

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Abstract

Currently observed expansion of salt-affected areas provokes profound concern by loss of the land productivity. Actually the future of agricultural production will depend on capability to grow plants in saline environment with low quality lands and mineralized water. Salt-tolerant plants like *Salsola sclerantha*, *Climacoptera lanata*, *Climacoptera brachiata*, *Suaeda paradoxa*, *Kochia scoparia*, alfalfa, *Glycyrrhiza glabra*, *Atriplex nitens* were cultivated in farmer plots with hot slightly mineralized irrigation water from artesian well and sandy low fertile soils with medium sulphate-chloride type of salinity in Central Kyzylkum.

Growth and development of the plants were observed. It was shown that it is possible to get high yield of halophytic biomass using hot mineralized water and low-fertile soils. Green biomass yield was about 18.95 t/ha for *Salsola sclerantha* ; 23.10 t/ha - *Climacoptera lanata*, 25.45 t/ha - *Suaeda paradoxa*, 44.10 t/ha - *Kochia scoparia*, 13.84 t/ha - *Glycyrrhiza glabra*, and 42.05 t/ha - *Atriplex nitens*.

Chemical composition of the biomasses was analyzed; mineral and organic matter was evaluated. Highest total salt accumulation among investigated plants was revealed for *Salicornia europaea* and *Climacoptera lanata*. Plants grown in farm trial contained less mineral things as compared with the same species from solonchak (for instance, 31.6% ash versus 46.9% for *Climacoptera sp.*). *Suaeda paradoxa*, *Kochia scoparia* and *Glycyrrhiza glabra* accumulated very small amounts of mineral ions in biomass; ash contents in their biomasses were 5.52; 6.39 and 10.45%DM accordingly.

It was revealed that Na⁺; Cl⁻; SO₄²⁻ are mainly accumulated in aboveground biomass of halophytes, not in the roots. It is applied to all real halophytes which accumulate sodium ions selectively to set up certain osmotic pressure in their cells and pump mineralized water; and redundant amounts of Na⁺ are sequestered in cell vacuoles in leaf tissues. Sodium and chloride ions are mostly accumulated by halophytes. *Climacoptera lanata*, *Karelinia caspia*, *Salsola sclerantha* and *Tamarix hispida* accumulated biggest amounts of sulfates in their biomasses. At the same time *Climacoptera lanata*, *Salicornia europaea*, *Tamarix hispida* and *Halostachys belangeriana* contained biggest quantities of chlorides in biomass. Such salt tolerant plants as alfalfa don't accumulate mineral compounds in the biomass. Carry-over indices of main mineral salts from the soil were calculated for some salt-tolerant plant under the investigation.

To assess fodder value of halophytic plants some nutritional compounds (crude fat, cellulose and protein contents) were measured and hay feeding values were calculated. High nutritional value of salt tolerant plant's biomass was revealed. Possibility to use salt tolerant plants as forage/fodder or feed additions was verified by the study. Halophytes contain a lot amounts of crude protein – from 5 to 13 mg/gDM; cellulose – from 10.38 to 20.54 mg/gDM; and fats – from 0.5 to 5.06 mg/gDM. *Atriplex nitens*, *Suaeda paradoxa* and *Kochia scoparia* are recognized as the most nutritional valuable plants and promising fodder.

Biogas productions at anaerobic digestion of halophytic biomasses were studied in batch-test and continuous mode experiments. It was revealed that 200-380 mL of biogas can be produced in anaerobic reactors from 1 g of dry matter of halophytic biomasses at 35°C; and 300-480 mL - at 55°C. Taking into consideration current and possible use of different salt-tolerant plants, their yield and value as fodder etc., it is recommended to use *Karelinia caspia* as the most promising source of biogas.

Key words: salinization; salt-tolerant plants; salinity control; nutritional value; biogas

Sedimentation and storage reduction of flood water reservoirs in Jordan

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Abstract

Jordan is considered on the poorest countries in water resources in the world. With an annual budget of approximately 1 BCM the water deficit may reach up 30% and being compensated by exploitation of groundwater. Due to this reason, the government of Jordan has made wide efforts to use and optimize flood water resources by constructing flood dams and reservoirs with various capacities in most of major wadies in the country. However, sedimentation in dams and reservoirs is a serious problem due to the intense storm nature and susceptibility of arid watershed to erosion that reduces dams' storage capacity. The objective of this paper is to summarize the sedimentation quantities of dams and its annual rates in Jordan and therefore the reduction in surface water resources. There are ten major dams in Jordan with capacities ranging from 2 to 55 million cubic meter (MCM) and total capacity of 275 MCM. Tens of other dams are built in small wadies located in the Eastern part of Jordan for flood water harvesting. Field studies show that the sedimentation of Badia dams are more intense due to poor soil structure and rural nature of watersheds compared to other dams located in urban watersheds. For example, the annual sedimentation in Wadi Alarab dam, having capacity of 20 MCM and located in a relatively urban watershed, was 0.3 MCM. However, a Badia dam named alGhadeer Alabiad, constructed in 1966, had a sedimentation rate of 17000 CM/year and is already filled with sediments. The characteristics of all other dams and their sedimentation rates will be presented.

Key words: sedimentation; flood water; dams; arid land; reservoir capacity

Potential usage of some of the ground-cover vegetation for ecosystem restoration practices in central Anatolia region of Turkey

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Abstract

Long-term animal grazing and agricultural practices have disturbed the vegetation cover and rendered the sites prone to erosion in Central Anatolia Region of Turkey. Soil protection, erosion control and greenbelt plantation practices have been pursued for about six decades in the region. However, tree-oriented plantation practices did not show significant success. Thus, experimental data gathered in the region using new approaches with different species are urgently needed by practitioners. The aim of the current study is to survey some of the ground-cover vegetation and to evaluate their potential usage for ecosystem restoration practices in the region.

Seeds of local species, *Atriplex*, *Peganum*, *Stachys*, *Teucrium*, *Silene*, *Salvia*, *Onobrychis*, *Reseda*, *Brassica* and *Vicia* were collected during extensive field surveys in summer and early fall of 2013. Five sites, Aksaray, Incesu, Emirgazi, Sazlıpınar, Karapınar, scattered on about 3000 km² of the basin and designated as afforestation sites by General Directorate of Forestry were chosen as experimental blocks. This area covers the driest part of the region with less than 300 mm annual precipitation and 11 °C average temperature. Soil texture for the first 20 cm soil depth in the experimental units were ranged from clay to sandy clay loam with more than 30 % lime content. Soils of the experimental sites are not considered salty. Only Aksaray site has shown about 2 dS m⁻¹ EC. Soil has a hardpan at about 70-80 cm profile depth. Therefore, using ripper to unconsolidate the hardpan is the main part of the site preparation practices for successful afforestation in the region.

At the end of summer 2012, the sub-soil was ripped using a caterpillar tractor equipped with a three-shank ripper. Then the top-soil was tilled with a 4 x 4 rubber-tired tractor to prepare seeding beds. In December 2012, for each species three 40 cm by 600 cm beds were leveled using agricultural rakes to expose moistened mineral soil for seedbed. Following the dissemination of the seeds on the beds, seeds were covered manually. In case of stratification problem, the same procedures for each species were repeated in adjacent beds on each site in early spring of 2013.

In spring and summer 2013 sites were visited and germination rates and growth of the species were recorded. Results of the experiment showed that all the species were germinated for both winter and spring sowing. The weakest germination were on the Aksaray site which has higher soil EC than the rest of the experimental blocks. However, with the exception of *Atriplex*, germinated seeds on the sites did not perform well for the growth comparing the wild ones on the area. It was speculated that seeds both in December and early spring may need more time to root growth to explore deeper soil before summer drought stress exposes them. Therefore, sowing early fall after the first rain may allow to germinate and get some growing before winter freeze and seedling can become ready for the proliferated spring conditions to accumulate enough photosynthate before summer. To test our claim we sowed *Onobrychis* and *Vicia* after the first rain in October of 2013. During field trip in December of 2013 seeds were germinated well and started growing.

Results of the experiment implies that *Atriplex*, *Onobrychis*, *Stachys* and *Vicia* are the most promising species to use as ground-cover for ecosystem restoration practices in the region. Early fall sowing may result in better germination and growth rate.

Key words: aridland, restoration, Turkey, ground-cover

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Transformation of the ecological functions of the soil in coal mining regions of the Kuzbass

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Abstract

It is now found that the soil situated at the whole geospheres junction is a unique node of ecological links with numerous global functions. Soil disturbance as an unlinking between geospheres leads to noticeable changing of functioning of the native ecosystems.

It is especially noticeable in regions with intensive development of the mining. In these areas there is a transformation of basic soil-ecological functions and replacing of the native landscapes natural for natural-technogenic complexes. In addition technogenic desertification processes occur over large areas and it leads to a radical transformation of the natural landscapes and ecosystem functioning regimes. Therefore, it is required a very long period to rebuild disturbed functions without reclamation works at the disturbed areas. To restore damaged ecosystems it is necessary to restore the soil, because soil is the basis of any terrestrial ecosystem. Currently tendency to partially restoring economic and environmental damage caused by disturbance of the natural soil takes a place at the practical reclamation. When developing remediation methods it is necessary to provide such range of processing methods, which allows generating soil-like substrates, which have properties as much as possible close to the properties of the undisturbed soil. Soil restoring with creating soil-like substrates must be a general aim of the reclamation. Technogenic landscapes will forever save the technogenic specificity of their functioning. And these landscapes will negatively impact on ecological situation in region for a long time.

Key words: technogenic landscapes; coal mining; soil-ecological functions.

Major and trace elements in transboundary river of Uzbekistan

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Abstract

Introduction

The territory of Uzbekistan is a part of a large region of Central Asia, and surface-stream flows are related to the Aral Sea water basin. Problems of water quality and quantity are extremely important for this region, and the problem of water scarcity causes the ecological crisis in a number of regions. The problem is complicated by the fact that Aral Sea water basin is situated in the territory of five republics of Central Asia such as Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan as well as Southern Kazakhstan. Nowadays, the water from these rivers almost doesn't reach the Aral Sea, which has resulted in the environmental disaster such as almost complete drying of the sea.

According to classification (Meybeck *et al.*, 1992), the Amudarya and Syrdarya rivers are related to large rivers as well as to the rivers such as the Zarafshan river, to small rivers such as Surkhandarya and to streams such as Shakhimardansay, Mailoo-Soo, Sokhsay. The last ones have a small water flow rates but they are important in environmental terms.

Materials and Methods

In 8 points were taken from surface-stream flows of transboundary rivers in 2013-2014 for the analysis of ecological conditions. Water samples were filtered by Millipore filter. In each point of sampling the following work was done: establishing the coordinates of the sampling points (GARMIN Ltd.), determination of water quality (pH, electric conductivity, turbidity and water salinity).

The concentration of major elements in the samples of surface-stream was measured by *Brief chemical analysis* (Method Reznikov *et al.*, 1970) and trace elements by ICP MS method using the equipment Agilent-7500cx (Agilent Technologies).

Results and Discussion

The analysis of major and trace elements in the transboundary rivers of Uzbekistan in spring and autumn of 2013-2014 showed that the total mineralization of the water in large rivers (Syrdarya and Amudarya) is higher in the spring. Sulfate magnesium and potassium ions prevail in the main rivers. The predominance of sodium and calcium ions in water is typical for small mountain streams. The contents of trace elements in the analyzed rivers of Uzbekistan don't exceed MAC (maximum allowable concentration). The comparison of trace element contents in the water of the rivers of Uzbekistan with the data on the average contents in the world has shown that the excess in the amount of strontium and molybdenum in large rivers. Small water streams, which flow down from the mountains, are more exposed to natural and anthropogenic impacts. Thus, the antimony content is increased by 30 times in the Shakhimardansay and Zarafshan rivers as compared to other water streams of Uzbekistan. It is connected with the presence of mining and processing of antimony ore and mercury ore in the upper reaches of the rivers. The tendency to the increase in content of trace elements the water is observed in almost all submontane areas where the sources of these rivers and ore mining enterprises are situated.

Key words: transboundary management; water quality; ions content; trace elements; Central Asian Rivers

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Spatial distribution patterns of cover vegetation in Central Kyzylkum desert related to soil salinity and temperature

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Abstract

The main aim of this article was to understand the trends of spatial changes of vegetation cover related to soil salinity and temperatures under different land use practices in Central Kyzylkum of Uzbekistan. For mapping of spatial distribution of plant communities two main factors as soil salinity and soil surface temperature were recorded to assess transect-ecological zones of cover vegetation in Central Kyzylkum, Uzbekistan. For assessment of ongoing processes of degradation of vegetation cover and its changes were selected several satellite images (Landsat TM, ETM) for wet and drought years within the period from 1990 to 2000. Analysis has been done on large transect zone of about 150km along the topographical and soil salinity gradients including different land use practices: starting from virgin *Artemisia*-ephemers and ephemeroïds desert community across artificial *Haloxylon* forest through an agricultural demo plot towards large solonchaks covered with sparse halophytic plant communities in the Karakata salt depression in Central Kyzylkum. Experimental data was collected during field expeditions mission aimed to understand the main ecological factors of degradation of rangelands desert vegetation reflected in spatial distribution of plants communities; botanic compositions, plant density and seasonal variation of aboveground biomass.

Vegetation Indices (VI), such as SAVI; TSAVI; PVI & NDVI were applied for the evaluation of vegetation cover (VC) changes and biomass values of different plants communities in the target investigated zones. The correlation coefficient indices of NDVI and PVI phytoindication were calculated and applied for each ecological-transect zones. The results showed a good correlation between NDVI and plant fresh weight ($r^2 = 0.58$) and plant green area ($r^2 = 0.55$) during autumn period ($NDVI < 1$). Monitoring of seasonal variations of vegetation (greenness), in particular, ecological scales of transect zones of vegetation have selected on the base of various plant communities. Region of Interest (ROI) was design with concrete and random orientation of plants interpreted for sample size of points (dots) was selected based on ground truth data collected during 10 years (2000-2010). Plants of these zones are typically manifest long periods of dormancy interspersed with brief "greenings" associated with seasonal rainfall, expressed mostly during wet years. During these relatively short productive periods, the characteristics of spectral features of desert plants changes calculated as per total vegetation cover were completed. A computerizing regression for spring and autumn seasons for driving the various factors influenced on plant biomass for different plant communities was analyzed. As results phytoindication indicators for different ecological desert zones in Central Kyzylkum were elaborated. Preliminarily recommendations for sustainable management and stability functioning of desert ecosystems were developed.

Key words: Kyzylkum desert; phytoindication; soil salinity; land surface temperature; Vegetation Indices

Ecological optimization of degraded arid ecosystems by means of surface improvement of annual halophytes

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Abstract

According to the concept of sustainable development of Uzbekistan much attention is paid to the protection of desert ecosystems, the control of desertification and drought.

Currently in Uzbekistan by reason of global warming and salinity, problems of optimization of fragile desert ecosystems are relevant. Questions on drought resistance and salt tolerance of desert plants have been studied by several researchers in Uzbekistan: T. Rakhimova(1997), N. Akjigitova(1982), S. Kabulov (2000), D. Arifhanova, T. Rakhimova, S. Iliakhunova(2013), etc.

The characteristic adaptation features of annual halophytes to droughty conditions of arid zones based on system analysis have been identified by our researchers. Objects of our research: *Climacoptera lanata* Pall. Botch., *Salsola paulsenii* Yitv., *Salsola sclerantha* C.A.Mey.

Studied plants grow in the wild deserts and adyrs zone in Uzbekistan. They are representatives of one ecobiomorphs ; spring -summer –autumn annual halophytes, due to the type of water supply- ombrophytes. By adaptation to arid conditions - hiperxerophytes, to saline conditions - hiperhalophytes.

One of the main indicators of drought tolerance of annual halophytes is increasing of water-holding capacity and the osmotic pressure to the summer dry period, that to be considered as a major factor to maintaining of stable water balance in xerothermic period.

Studied plants are characterized by their salt accumulating feature that defines them as the desalination plants on saline soils. In the Central Kyzyl Kum desert, *Climacoptera lanata* grows well on highly saline soils (salt 5.728% at 0 -20 cm soil horizon).

As a salt accumulation plant, *Climacoptera lanata* draws dissolved minerals from the soil, storing them in itself. By removing these plants in the fall, a certain amount of salt (accumulated in plants) also goes along with the biomass of these plants.

With an annual picked harvest of *Climacoptera lanata*, we can assume a gradual soil salinization. The crop yield of annual halophytes is 3-15 t /ha depending on the meteorological conditions.

To optimize the depleted vegetation desert ecosystems, the studied annual halophytes are promising for improving the soil surface, as well as for desalinization of desert soils. Their biomass can be used in biotechnological processes.

Key words annual halophytes; *Climacoptera lanata*; ombrophytes; ecobiomorphs

Scientific approaches to the rational use and management of saline soils fertility in Ukraine

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Abstract

Saline soils of Ukraine can be conditionally divided into two types - naturally saline and secondary saline. Secondary salinization is often an environmentally negative consequence of irrigation (during soil irrigation with mineralized water and during the rise of saline groundwater above the critical level). Naturally saline and secondary saline soils can be without morphologically indicated solonetzic horizon, their area is 1.92 million ha and morphologically distinct solonetzic horizon (saline - alkaline) – 2.8 million ha. Furthermore, among the irrigated lands 200 thousand ha of secondary saline of soils. The majority of saline soils in Ukraine are ploughed excluding strongly saline types and salt marshes.

Data on areas of saline soils are in the land and reclamation cadasters. Alkaline soils are included in this group of saline soils, but shall be separately accounted, because of the need for special reclamation measures for their evolution and use.

On the basis of data on the area and the degree of soil salinity are planned measures to prevent and to reduce soil salinity - the construction of drainage, saline soils flushing, selection of salt tolerant crops, reclamation, chemical soil improvement, land reclamation plantage plowing. The State Agency for Land Resources of Ukraine has developed and approved Procedure for land conservation.

Main research areas of saline soils in Ukraine: manifestations fixing and revealing patterns of salinization processes dissemination and alkalinization depending on the structure of soil, ecological and ameliorative land condition, irrigation water quality, existing farming technologies, etc.; spatial assessment of land condition and direction for further development of salinity and alkalinity processes on the basis of their mapping and territory typing; development of recommendations for the justification of measures to prevent or eliminate the salinity and alkalinity, protection and restoration of soil fertility; formation of information supporting systems of management solutions in the monitoring and advisory - deliberative service.

For today based on a long-term complex studying soil processes dynamics and regimes in saline soils there are identified common landscape-zonal patterns and spatially differentiated features of orientation, prevalence and rate of soil processes, it is developed differentiated system of agromeliorational measures to protect and improve the fertility of saline soil.

For a more accurate spatial assessment of saline soils condition it is created a series of e-cards. This allows to create a single system of information - mapping support for measures to control environmental and agromeliorational condition of naturally saline and secondary saline and solonetzic soils, to develop principles of their rational use based on technologies adaptability to soil-climatic and social conditions.

NSC ISSAR has created a regulatory framework for the monitoring of saline soils, developed agri-environmental criteria, parameters and system of saline soils diagnostics (using thermodynamic parameters) and irrigation water, which includes agronomic quality criteria on salinity risk, alkalinization, alkalinity and soil contamination with heavy metals and fluorine considering their buffering properties and diagnostic criteria of soil degradation on individual as well as on the composite index.

Key words: saline soils; areas; research; reclamation

Satellite-based observation and modeling of grasslands and croplands in dry areas

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Abstract

Grasslands and croplands in dry areas (semi-arid and arid regions) are sensitive to changes in climate and land use. Accurate and updated information of grasslands and croplands are important for the studies of food security and sustainability of socio-ecological systems as well as water resources and climate. In this presentation, we provide an overview on satellite-based observation and modeling of grasslands and croplands in the dry areas. First, we will highlight the recent progress in satellite-based mapping of croplands (cropping intensity, cropping calendar, crop type). Second, we will present satellite-based modeling of gross and net primary production of croplands and grasslands from the Vegetation Photosynthesis Model. Third, we will introduce the new methods in satellite-based mapping of grassland degradation and desertification. Finally we will discuss the role of community remote sensing and citizen science in monitoring grasslands and croplands in the dry areas. We will showcase the data products at the Earth Observation and Modeling Facility, University of Oklahoma (<http://www.eomf.ou.edu>), and ICARDA Geoinformatics (<http://geoagro.icarda.org/>) including smartphone app “Field Photo”, Global Geo-Referenced Field Photo Library, MODIS data visualization, and ODK based electronic field data collection kit

Key words: MODIS; Landsat; grasslands; croplands; soil moisture; crop types

Conservation of biodiversity of desert rangeland ecosystems in Uzbekistan

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Abstract

In arid zones of Uzbekistan, occupying more than 52% of the total territory, the desert livestock, in particular Karakul sheep breeding is widely developed. Significant part of desert zone is located in Kyzylkum desert. In general, flora of the country is presented by more than 4000 species of higher plants including about 250 fodder plants from different plant families: *Poaceae* (75), *Chenopodiaceae* (40), *Fabaceae* (29), *Brassicaceae* (25), *Asteraceae* (17), *Polygonaceae* (13), *Apiaceae* (10); other 22 families 50 species (Shamsutdinov, 1975). The ecological conditions of deserts and semi-desert are promoted to the formation of the various phytocoenoses – the community of xerophyte semi-bushes, bushes and psammophyte trees, xerophyte long vegetated perennials and annuals, early maturing grasses. In sandy massive, vegetation types are presented by psammophytic -33%, gypsophytic -53%, halophytic -13,9% and tugai -0,1%. The projective cover of soil by such fodder plants does not exceed 25-30% (Gaevskaya, 1971). The eco-biological potential of fodder plants determines the productivity of desert rangelands which ranges between 1800-3500 kg/ha.

The rangeland vegetation of desert zone is the main source of cheap fodder for livestock during whole year.

However, at present under the impact of various anthropogenic and climatic factors deterioration of vegetation cover, explosion of soil surface, infringement of rangeland areas, the appearance of mobile sands are observed. Kyzylkum rangelands can be as a bright example where the species composition is reduced by 4 times, shrubs and semi-shrubs by 2 times, the palatable fodder plants by 2,5 times. Practically, only for the last 30 years 5 semi-shrubs species such as *Kochia prostrata*, *Ceratoides ewersmanniana*, *Camphorosma Lessingii*, *Salsola gemascens*, *Calligonum setosum*, and 4 perennial grasses – *Agropyron desertorum*, *Cousinia decurrens*, *Onobrichis chorassanica*, *Astragalus alopecias* are radically decreased in desert rangelands. Reduction the number of *A. alopecias* and *O. chorassanica* in desert ecosystems appreciably decreases the nitrogen fixation in the soil; desalinization of the soil by *K. prostrata*, *S. gemmascens*, *C. Lessingi*; sand fixation by *C. setosum* and increase of laying for fuel of shrubs and semi-shrubs by *C. decurrens*. So, the disturbance of the vegetation structure of desert ecosystems causes biodiversity loss of native rangelands and negatively influences on the ecological situation. The conservation of ecologically important desert fodder plants is highly important to sustain biodiversity in the region. In this connection conducting of the following work are essential: the collection of seeds of disappearing fodder plants, the creation of nursery and formation of gene pool, the selection of perspective varieties of fodder plants, development of agro-technical methods of plant introduction and seed production of highly productive varieties.

Mobilization of vegetative resources of the arid zone and creation of their gene pool allow preserving the rare disappearing species of plants and comparative estimation of different species, ecotypes and forms according to economical-biological peculiarities which gives the opportunity to achieve restoration of the degraded desert ecosystems.

Keywords: arid ecosystems; fodder plants; degradation; biodiversity loss; conservation

Measurements facilities at the Biological and Chemical Research Center at the University of Warsaw in Poland: study case on the analytical possibilities of modern instrumental techniques for the investigation of metabolism of selected elements in plants

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Abstract

The analytical performance of modern analytical technique towards insight view of the metabolic processes occurring in plants will be discussed. Especially the measurement facilities at the Biological and Chemical Research Center at the University of Warsaw in Poland will be presented.

The influence of the composition of soil on the uptake of various substances by plants become a topic of interest for chemist and biologist. It was found that the chemical form of the element of interest influence its transport and biotransformation in plant's cell. In order to understand the entire process the non-routine analytical protocol should be design towards obtaining complementary information about the localization and chemical structure of various compounds. In our laboratory such a protocol involve the use of atomic spectroscopy for the elemental composition of plant tissues, elemental mass spectrometry for evaluation the isotopic composition of elements of interest as well as molecular mass spectrometry for the evaluation of the structure of unknown compounds. Moreover, various techniques which enable the determination of the distribution of elements on surface and sub-surface domains (XRF, LA-ICPMS, TEM, SIMS) are used for obtaining 3D mapping. Also several microscopic techniques are used, eg. confocal and light microcopy, for the evaluation of mitotic activities of cells as well as localization of selected elements in various plants compartments.

The use of above listed techniques and the advantages of the information obtained will be exemplified with selected projects conducted in our laboratories.

Key words analytical techniques; plants; transport and biotransformation of elements

On the quality of measurements results: the role of the proficiency testing and interlaboratory comparison in assuring of the accuracy of the data provided by the testing laboratory

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Abstract

In order to evaluate various process undergoing in environment it is essential to characterize the composition of various environmental compartment. The chemical characterization involve collecting data of the determination of various substance being present at naturally occurring or elevated levels. The decision on the status of environment is strongly based on the data of chemical measurements, thus the quality of obtained results is of a great importance.

On the international scale, it is agreed that the requirements described in ISO/IEC 17025 standard should be used as to assure the quality of the measurements results. Thus it is expected that the laboratory should have the adequate procedures for monitoring the validity of the test results, using inside laboratory evaluation of the results by regular use of certified reference materials as well as participating in proficiency testing (PT) or interlaboratory comparison (ILC) programs.

In this presentation the advantages and limitation of participation in PT/ILC will be discussed. The example of various scores used by the PT/ILC provided will be given, as well as statistical methods used for the evaluation of the performance of the laboratory for given test.

Key words: quality of results; certified reference materials; proficiency tests; interlaboratory comparisons

Biological and ecological diversity of halophytes flora of Uzbekistan

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Abstract

The biology of seed germination of hyperhalophytes, such as *Salicornia europaea*, *Halocnemum strobilaceum*, *Halostachys caspica* and euhalophytes as *Salsola dendroides*, species of genus *Kochia* and *Climacoptera* pre-treated with NaCl and Na₂SO₄ salt solutions of various concentrations 0.5%, 1%, 2%, 3%, 5% in pure or in mixed composition was investigated. Rate of seed germination for these species ranged between 58-100% both on distilled fresh water and saline solution substrates. Seeds of hyperhalophytes were less salt tolerant than euhalophytes, which germinated even at 3-5% NaCl solution. Seeds sown on grey-brown soils at Tashkent Botanical Garden have revealed high capacity of euhalophytes and hyperhalophytes to germinate on non saline soils. Species of *Salicornia europaea*, *Atriplex tatarica*, *Salsola dendroides*, *Suaeda altissima* were undergone full ontogenetic cycle, produced viable seeds and shown good self-seeding (regeneration) under limited irrigation. These species have not experienced the need for salts, but for their successful growth and development requires appropriate soil moisture, despite of in their natural habitats they could survive under 2-3% concentration of soil salinity. These species belong to the stenohydrophyle euryhaline halophytes, i.e. they are able to grow in a wide range of soil salinity, but feel the need in sufficient soil moisture. Perhaps the historical ecology of these species might be associated with littoral marshes and saline wet depressions.

Species of the second group of halophytes like *Halocnemum strobilaceum*, *Kalidium caspicum*, *Halostachys caspica* and *Halimodendron ammodendron* having the unique property of surviving extremely high salinity didn't survive on non saline soils. These species shown low seed germination in distilled water and raised it in the 0.5-2% on salt solutions. These species can be attributed to evrigidrilnym stenohaline, i.e. they germinate at wide range of soil moisture, but for their growing they require permanent high saline environments. Based on these observations we concluded that ecological type of halophytes is quite heterogeneous not only by their tolerance to salt by also in respect to soil moisture content.

Besides species of stenogidrilnoy Euryhaline group (*Atriplex tatarica*, *Suaeda altissima*) are distinguished by their capacity to accumulate a certain amount of mineral ions, regardless of soil salinity, even on non saline substrate through a combination of osmotic pressure and suction force. However, these species under similar amount of mineral ions have differential response to the ratio of accumulated salts in their tissues both at fresh and saline substrates.

Studies of anatomy of vegetative organs and flowers morphology of halophytes revealed a homogenous (streamline) of their adaptation to halophactor, while among others tissues of Kranz cells and vessels were less diverse, that indicate on genetic stability in their phenotype .

Our data suggests that halophytes belong to patients strategic type, when plants growing under stressful saline environments by enduring high salt content need appropriate soil moisture. Stability of species with Kranz structure confirms that the C₄ species are more halophytes than xerophytes. Resistance to halo (saline) and xero -(dry) factors laid, apparently in the genome of species with Kranz structure of vegetative organs , which provides wide ranges of seed germination for halophytes.

In this regard, the selection of plants for reclamation of saline land should be considered a sign of Kranz and belonging to different ecological groups, based not only on soil salinity, but also on moisture content and soil texture.

Key words: halophytes; vegetative organs; flower morphology; halofactor; C₄ plants; Kyzylkum desert

Studies on the grasslands of Manisa-Turkey

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Abstract

The investigations carried out on the plant diversity on the grasslands of Manisa State has shown that these habitats show diverse topography. The state is located in the Aegean Region of Turkey, between the elevations of 50-850 m. Major agricultural products in the State are grapes, vegetables, cereals, olive and fruits. The stock raising too is of importance. The climate is typically Mediterranean, with dry hot summers but mild, cold and snowy winters with an average of 705.8 mm rainfall. In all 13 grasslands were evaluated. A total of 316 taxa of plants belonging to 49 families were collected. Out of these taxa only 34 are of good fodder value, 20 taxa belong to Fabaceae and 14 to Poaceae.

The studies on the above ground parts revealed that energy values range between 112-1360 gm during the first season, in the second season between 144-1264 gm, in the third season between 192-1232 gm and in the fourth season between 96-1232 gm in the unfenced and fenced plots. In the belowground parts the energy values recorded in the first season ranged between 11.4-910 gm, in the second season between 144-640 gm, in the third season between 96-560 gm and in the fourth season between 96-512 gm in the unfenced and fenced plots.

The grasslands belonging to the state are main source of animal feed but have been exploited excessively and unsustainably. There area is decreasing, so is the number of cattle, sheep, goats and horses. This produces a negative impact on the animal husbandry in the region. This presentation therefore tries to put forth information on the plant diversity, the biomass potential and energy values of grasslands in the state of Manisa

Key words: grasslands; Manisa; Turkey; plant diversity

Rock art of Altai within context of archaeological monuments forming the cultural landscape

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Abstract

Rock drawings - petroglyphs - are among the most numerous archaeological monuments. In Eurasia mountain and steppe area were discovered thousands of monuments of rock art belonging to different historical periods. Currently at the territory of Russian Altai more than two hundred petroglyph complexes are known including a large one, with up to several thousands of images from the Bronze Age to the present day.

Monumental "unmoving" monuments of rock art sites are valuable historical sources reflecting the results of development and transformation of the cultural traditions of their ancient creators. The starting point for assessing the historical and cultural significance of rock art sites is the determination of chronology of petroglyphs. Determination of age of petroglyphs is the area of competence of professional archaeologists though other specialists such as art historians, ethnographers, conservationists and others are engaged in rock art studies.

Sites, where rocks with petroglyphs are found are among the most revered, sacred, forming special cultural landscapes. They are considered as sanctuaries having diachronic nature, places of origin of ancient rituals, storage of valuable information. Today methods of scientific research have been developed and action algorithms were proposed by researchers for the preservation of these monuments. They came from the scientific investigation, development of scientific documentation and measures were taken for the monitoring and conservation of petroglyphs. Diverse methods are used to determine the age (chronology) of rock art. Currently the main methods for such purpose are archaeological evidence. Primarily, it is stylistic analysis which is based on the study of rock art iconography; research of the internal stratigraphy, i.e. cases of overlapping patterns; typical picture reproduction techniques. Necessary part of the study is to compare the rock drawings materials with artifacts from burial complexes.

Interpretive methods base on analysis of historical, cultural and ethnographic realities presented at the petroglyphs (weapons, wheeled chariots transport), as well as studies of subjects, their themes and images. Recently, methods of absolute and relative dating based on modern physico-chemical methods is being actively developed and applied to determine the age of the rock art monuments. Many of archaeologists even deem it possible to speak about the occurrence of "poststylistic" era in study of rock art, calling to consider as a reliable merely dating, obtained by means of "direct dating" (i.e. by natural-scientific methods).

Analysis of subject and meaning of drawings, containing information about the household activities of people/artist, who left the image on the rocks, allows carrying out cultural and chronological attribution of the certain art traditions and believes. Traditions of Altai Rock Art have not been interrupted in modern era, but continue to live to nowadays.

Key words: rock art; cultural landscape, chronology, semantic analysis, Altai

Climate-change information days for tourists as a value chain for landscape restoration; the example of Mahalla Kadok (Nurata, Uzbekistan)

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Abstract

Rapid population growth in remote foothill regions lacking good access to fuel caused high deforestation during the last 80 years. Continuous and high load of grazing on slopes additionally reduced semi shrub and grass vegetation and meantime mudflows originating on the degraded slopes endanger orchards, stables and water reservoirs even after slight rains. Livestock production is hampered due to the shortage of forage in degraded rangelands caused by overgrazing; crop production is limited by lack of water specifically in those settlements relying entirely on small springs in the foothills. Villagers invest tremendous shares of their cash income in higher education of their youth as support for a carrier in urban areas.

Years after literally the last tree was cut villagers of Kadok village participatory developed local climate change scenarios. Within this social learning process, villagers originated a local climate change adaptation strategy-identifying reforestation of foothills with native drought tolerant medicinal trees and forage shrubs as highest priority to safeguard livelihoods from devastating mudflows. Besides the strong emphasis on environmental restoration they focused on new income options such as eco-tourism and handicraft. The scenarios showing consequences of inaction for the next generation and the feasibility of adaptation induced overcoming apathy concerning ongoing degradation.

Based on the common purpose that the current generation should take action on climate change adaption a group of reputed elders developed a local environmental governance scheme based on equal tasks and benefits for each household, enforcement and a new system to manage livestock currently fueling degradation. The scheme has landscape approach and also includes arrangements between villages. The scheme does not build on protection by wire fence, but on social agreement. This makes it affordable and replicable by many communities and in large foothill ridges. The village and meantime also other villages under the guidance of the core team of Kadok overcame apathy concerning degradation and started substantial restoration work on slopes within collective action.

On long-term, Kadok aims to gain income from tapchan-tourism (below the forest and from sustainable harvest of medicinal plants (e.g. almond oil, Hawthorn and rose hip) and substantially more fodder from drought resistant shrubs to sustain livestock production. To enable quick revenue the project linked the core team with international tourist agencies, trained villagers to provide "Climate change information days for tourists from abroad" travelling along the Silk Road and trained women in souvenir production. Currently income from Climate change days funds further reforestation.

Key words: reforestation; collective action; climate change adaptation; tapchan-tourism; income generation

Natural resource usage of migratory sheep herders and indicators for migration in Rajasthan, India

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Abstract

Climate change is altering the coping mechanisms of migratory pastoralists in Rajasthan, India. A review of secondary information suggested greater variability in migratory patterns. The state of Rajasthan accounts for 40% of the total carpet wool production in India. To understand better what resources migratory pastoralists depend on and what factors influence migration two sheep flocks were tracked with GPS units and household surveys were conducted. Results suggest that pastoralists depend mainly on: scrubland, cropland, and fallow land. The data indicates that pastoralists do not depend greatly on forest lands and that migration routes are determined by access to water, markets, and forage. Grazing pressure can be reduced by developing new water holes along the migratory routes. For the household survey, a total of 160 household surveys were conducted for sheep herders to determine indicators for migration. The Raika (Dewasi/Rebari), Sindhi Muslim, Jat, Rajputs, and Gujjar are common sheep herders and religious beliefs strongly influence management practices. Household survey results suggest that herders with less education, who are younger, have larger flock sizes, more adult family members, and smaller land holdings are significantly related to migration.

Key words: migratory pastoralists; household survey; sheep flocks migration; Rajasthan; India

Enhancing food security for small holder farmers' in arid environments through scaling-up of adapted resilient crop-livestock models: ICBA's achievements and lesson learnt

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Abstract

The West Asia and North Africa (WANA) region is one of the most water-scarce regions in the world with agriculture consuming over 75 percent of freshwater resources. Renewable water resources are nearly fully exploited, and non-renewable water resources are being rapidly depleted. Water scarcity will only worsen as the growth of populations and economies result in further competition between industrial, agricultural and domestic sectors. Recent changes in climate pattern, such as prolonged droughts, record temperatures, increased rainfall irregularity, intensity and distribution, have all further negatively impacted the natural and agro-ecosystems in the region and increased the vulnerability of the people dependent on such resources for their livelihood.

Many of the groundwater based agro-ecosystems in WANA region and more than 25% of river based irrigated agricultural lands are affected by salinity and waterlogging. Salinity is a major constraint to crop production, especially in the arid and semi-arid agro-ecosystems of WANA. In the marginal areas of WANA the small scale producers make up a high proportion of poor households. They are the most vulnerable to climate changes given their dependency on marginal quality water and land resources, which are the first areas affected by climate changes in arid environments. Poverty/vulnerability is caused mainly by lack of access to productive land and water, aggravated by unpredictable rain, high temperatures and salinity. These agro-ecosystems are also extremely vulnerable to climate change (in particular, drought and high temperatures), as concluded by the Intergovernmental Panel on Climate Change (IPCC) reports (1997, 2001, 2007 and in the recent fifth IPCC report in October 2013) As a consequence, there is wide-spread evidence of loss of marginalized lands from production and the dislocation of poor farmers living throughout the region. To prevent further degradation of such agro-ecosystems and sustain the livelihood of farmers living in marginal conditions, it is necessary to develop and promote the adoption of alternative production and management systems appropriate to the socioeconomic and environmental conditions in the region. Such systems are based on integrated crop/forage-livestock feeding systems that can increase land and livestock productivity, sustainability and resiliency of the farming systems against the impact of climate changes. Such systems will help ameliorate feed scarcity in small scale crop-livestock farms in a sustainable manner and will contribute to the diversifying of on-farm production, expansion of farm enterprises and securing farmers' livelihoods

The International Center for Biosaline Agriculture (ICBA) in partnership with the NARS of at least eight countries in WANA, and several NARS in Ventral Asia has carried out since 2003 several major projects that have (1) targeted the improvement of livelihoods and productivity of poor farmers who only have access to marginal (particularly saline water) resources, and (2) further developed the capacity of both NARS and farmers in the sustainable use and management of such resources. Assessment showed that farm yield severely reduced with increased salinity levels and yield of tolerant conventional crops diminishes at salinity levels of 15 dS/m. At the same time farm income declined by almost 30% at low salinity levels and up to 60% at high levels (above 10 dS/m). The projects identified that the barriers to diversification in the farming system and scaling out of results mainly result from the lack of supportive government policies; unavailability of, or inaccessibility to, the seed sources of better adapted genotypes; irrigation with marginal quality water; and limited extension and capacity building opportunities. Key outcomes have been the development of resilient integrated plant/livestock production systems that are more productive and have enhanced farm intensification and diversification leading to systems that are more stable and adapted to climate change impacts.

Key words: marginal environment; salinity; climate change; farm productivity; sustainable management

Development of new recommendations for soil erosion control in arid zones of Uzbekistan

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Abstract

When the high pastures and hayfields don't have agrochemical support and don't received necessary set of measures for improving the botanical structure of grasses, soil erosion is one of the most hazardous processes that are causing the degradation of fodder lands in arid zones and it is intensifying under low grass thickness, soils' deteriorating agrophysical condition and irrational land use. Determination of the major factors of soil erosion in mountainous fodder lands is the economically and socially important measure under these conditions, because it allows optimization of measures for prevention of development and rehabilitation of deteriorated lands. Optimization of technological techniques is based on rational use of means and human resources. In turn, in order to select the optimization means, it is important to determine the quantitative and qualitative characteristics of erosion and factors that cause it and motivate its rapid development.

The issue of soil protection from erosion is becoming global issue all over the world, and, particularly, in Uzbekistan. Previously conducted studies established heavy erosion of arid zones of Central Asia, and especially those with previously destroyed both woods and bushes and grass vegetation were deteriorated most seriously. They include, first of all, lands with practically washed out humus horizon.

As a result of erosion processes, the soils of arid zones get exhausted catastrophically, because the top, i.e. the most fertile part of the soil degraded, and the erosion processes cause the sharp reduction in productivity of areas covered. Heavily degraded out soils are practically excluded from the agricultural production.

Nature of vegetation also sharply deteriorates in degraded soils. In dispersed condition they are not capable to strengthen the soil. Flow concentration under conditions of crossed relief leads to soil erosion. Surface is covered with a network of forest ravines that grow into furrows and then into gullies, and acquires the heavily slashed nature. Ravine formation deteriorates the hydrogeological regime of the slopes and seriously complicates their further use.

Sharp changes in the hydrophysical properties of the degraded soils and areas even more exhaust the vegetative cover. Heavy heating of areas free of vegetation causes the increased evaporation of moisture residues that infiltrate the soil. Due to extremely unfavorable environmental conditions natural restoration of woody vegetation in the washed out soils is complicated, desertification of the firm soil takes place. Artificial forestry is also difficult in washed out soils. Forest crops here have low adaptation and poor growth. Devastation of such areas is considered a difficult issue without drastic change of forestry conditions, particularly the soil's water regime.

With the view of studying the most effective factors that promote the erosion of soils of pastures and hayfields in mountainous areas, and developing the measures for their prevention, the expedition and laboratory research have been undertaken. As a result of expedition research, the scale, nature and degree of erosion of mountain soils represented in various types of sediments - proluvium, eluvium and alluvium - have been established. Depending on the exposition, type of sediments, steepness and capacity of soil forming rocks, the degree and nature of erosion display, as well as its scale in relation to areas of lands exposed to erosion to total area of lands.

Systematization of existing materials of research on erosion processes in Uzbekistan, organization of research works in order to establish the nature of soil erosion and determine the meliorative effectiveness and erosion control measures with the view of recommendation of the most perfect erosion control methods are the target objectives of this issue.

Key words: soil erosion; ameliorative measures; pastures improvement; mountains mudflows; desertification; Uzbekistan

New environmentally safe resource-saving biotechnology of improving the fertility of saline soils and productivity of wheat

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Abstract

Wheat plants on saline soils are periodically exposed to stress factors that affect the yield and quality. Increased concentration of salts, especially chlorides, can act as disconnecter of oxidation and phosphorylation and thereby violate the supply of plants with phosphorus. Phosphorus deficiency in the nutrition of wheat leads to disruption of photosynthesis in plants, power transmission and hydrogen (respiration), deterioration of root formation, reducing of yields, grain quality and plant resistance. There is a relationship between salinity and mineral nutrition of plants - salinity limits the uptake and accumulation of phosphate in the cultures. On saline soils large concentration of sodium prevents the accumulation of other cations, including those necessary for plant life, such as potassium and calcium, which are responsible for drought resistance, frost resistance, disease resistance, regulation of metabolic processes, water and physiological balance of the cells and plants whole. However, in saline soils, these nutrients are not in the available form. It is known that if phosphorus is poorly absorbed by plants, the nitrogen and potassium and too poorly absorbed.

To eliminate the negative impact of stress factors (salinity, over phosphating, high and low temperature, drought, wrong agricultural technology) on the development of wheat, prevent desertification, increasing the fertility of saline soils and productivity of wheat, we have developed a new environmentally safe biopreparations Rizokom-2 and Serhosil. Biopreparation Rizokom-2 on the basis of salt-tolerant wheat phosphorus mobilizing rhizobacteria intended for pre-sowing treatment of wheat seeds. Biopreparation Serhosil based on the green microalgae intended for foliar nutrition of wheat on phases of vegetation. New biotechnology of partnering the 2 biopreparations for cultivation of wheat on middle saline soils provides the following benefits: increasing of field germination of wheat to 98-99% (50-60% in the control), the normalization of the alkaline pH of saline soils, the normalization of the balance of soil microflora and nutrient elements, the stimulation of root development, growth and development of wheat plants during the growing season due to improved plant nutrition root by macro-micronutrients, reducing the doses of applied mineral fertilizers by 50%, reducing costs of irrigation water by 20-30%, increasing in plant immunity and sustainability to stress conditions, decreasing the incidence of wheat, reducing the degree of soil salinity, increasing fertility and environmental improvement of saline soils, increasing yield of wheat to 4-5 c/ha and shortening of grain ripening for 15-20 days. New biotechnology produces environmentally friendly products. Application of biopreparation Rizokom-2 and Serhosil enables transition to a system of bio-agriculture.

Key words: soil salinity; wheat; biopreparations; soil fertility; yield of grain

Simulating water use and N response of winter wheat in the irrigated soil of Khorezm

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Abstract

Crop simulation models are nowadays widely applied in agriculture to estimate agronomic, environmental and economic interactions of crop management, soil and atmosphere. From an array of models, CropSyst has recently been introduced in Uzbekistan for assessing cotton production. Like all other crop models, the existing CropSyst crop-modules must be parameterized and calibrated for the different crops including winter wheat before a more systematic use can be envisaged. The crop-soil simulation model CropSyst was used to simulate growth, water and N-uptake of irrigated winter wheat (*Triticum aestivum* L.) cv. *Kupava* in Khorezm, in the dry lands of northwest Uzbekistan. CropSyst was calibrated using findings of field experiments of first two years data and validated for the third season results. A relative root mean squared error of 11% proved the accuracy between simulated and observed aboveground biomass and grain yield in third season. Simulation results indicated that despite the prevalence of a shallow groundwater table, full irrigation (580 mm) and nitrogen (180 kg ha⁻¹) supply according to crop demand are prerequisites to achieve high grain yields. An exception may exist when the groundwater table is sufficiently high to overcome irrigation deficits (the case in normal weather years) and N supply is sufficient to produce AGB and root growth that allow water uptake from the water table. The potential N uptake of winter wheat was simulated to be 229 kg N ha⁻¹, which corresponded well with the empirical data. Scenario analyses showed that N-leaching was high and ranged from 63 kg ha⁻¹ to 106 kg ha⁻¹ when irrigated between 749 to 869 mm during the first two cropping seasons. The simulated N leaching was lowest and ranged from 7 kg ha⁻¹ to 15 kg ha⁻¹ when irrigation was only 148 to 395 mm during the validation year. The considerable N losses during leaching and high N-uptakes by wheat together resulted in a negative N-balance even during applications of 180 and 240 kg ha⁻¹ of N-fertilizer. N scarcity in the N-balance was reduced with increasing N-fertilizer amounts and ranged from -29 to -153 kg N ha⁻¹ in two years. Despite a common shallow groundwater table in the region during some time of the year, scenario analysis revealed that only full irrigation-water (580 mm) and N supply according to crop demand (180 kg ha⁻¹) guaranteed high grain yields, unless the water table is permanently shallow to overcome irrigation deficits. Limited irrigation and N application (40% and 55% of 'optimal', respectively) in combination with a groundwater table below 3 m resulted in a 55% yield decline. The cropping system model CropSyst has proven a robust tool for assessing the influence of water and N dynamics and predicting yield of irrigated winter wheat under shallow groundwater tables in the Aral Sea basin of Uzbekistan. The model has a good expansion potential for application in comparable Central Asian regions.

Key words: CropSyst; crop water demand; deficit irrigation; Khorezm

Jerusalem artichoke (*Helianthus tuberosus* L.) as a new source for reclamation and improvement of food security from waterlogged and saline soils in Chuy Valley in Kyrgyzstan

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Since the spring of 2013 activities on introduction of six varieties of Jerusalem artichoke at water logged (marginal lands) were started on the base of "Jany-Jer" experimental site. The research has shown the advantages of "Interest" topinambur variety based on its biological productivity and nutrient quality of tubers in comparing with other varieties. The studied varieties also differ by the transpiration intensity (TI) which is one of the most important indicators of water regime of plants. At the beginning of the vegetation season when air temperature is relatively low and humidity of top soil layers is high, TI has a range of 0.8 to 2.0 g/g of wet weight per an hour. By the end of the vegetation season TI is reduced by 20-30%, which is primarily caused by the leaves aging.

Water-holding capacity of leaves of majority investigated varieties rises by the summer months and reaches up to 20-25% after three hours of exposure of cut leaves in the laboratory. Water deficit in the leaves varies depending on the vegetation, climatic conditions and varieties. Maximum values were observed at midday at the active phase of growth and development, reaching up to 30%. Probably for the Jerusalem artichoke is characteristic a quick response to changing environmental conditions by means of restructuring the internal mechanisms of physiological responses.

We have also analyzed the content of traces of heavy metals, macro and microelements in the tubers, (34 elements using ICP - spectrometry). Results have shown the specific varieties response. Moreover, the analysis on the presence of first risk group heavy metals (Cd, Hg, Pb, Zn, Se, Ba, Ni, Cu) showed that the values do not exceed the MPC standard.

Thus, *Helianthus tuberosus* due to its high salt and waterlogged tolerance may be recommended for the reclamation and increasing food security from marginal lands in Kyrgyzstan by producing high quality tubers, which are not affected by toxic salts or traces of metal pollution.

Key words: waterlogged, environmental pollution; transpiration intensity; tuber quality; heavy metals; Kyrgyzstan

Investigations on the land reclamations to improve agricultural productivity and rural livelihoods in Central Asia

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Abstract

The consequences of climate change have a negative impact on agriculture in the CA region, which has already been affected by the severe outcomes of the recent global economic crisis. In addition projected population growth, particularly of the urban population, will increase demand for food and prices, which in turn will result in even greater use of limited natural resources. Ultimately, these problems are a particular threat to vulnerable groups, including to people with low incomes. Thus, the region faces the challenge of solving these problems, and it is necessary to take action to ensure peaceful, sustainable development and food security in the CA countries. Given these challenges, improving agricultural productivity, increase the quality and quantity of food through intensification and diversification through sustainable land and water management in context mitigating the negative impact of the consequences of climate change and land degradation caused by anthropogenic factors on farming systems are considered as primary goal of the development agenda in the agrarian sector. The agricultural sector is experiencing considerable difficulties in the management of natural production factors, because of soil degradation and salinization.

To create on irrigated land the conditions favorable to agricultural producers in the countries of Central Asia, it is necessary to ensure proper operation of all segments of irrigation and drainage networks, and this requires the large-scale civil work on the reconstruction of the entire drainage system (main, inter-farm collectors and farm drainage network). To implement all these works is practically difficult, as it requires significant investments. However, efficiency and effectiveness of the investment to improve agricultural productivity and increase farm incomes through improving water management and soil fertility, based on a programmatic and systemic approach combining the out-scaling of conservation technologies, identifying and introducing of stress tolerant, high-yielding and improved quality varieties, enhancing rural advisory services, post-harvest technologies and processing throughout the value chain can measured and validated for justification and advocacy of large public and private funds inflows in agrarian sector ensured by mid-term and long-term agricultural development programs. The measuring impact of investments to support those integrated interventions should be based on financial and economic analysis, considering different scenarios “with” and “without” programmatic interventions combined with models to reduce the risk of inefficient utilization of resources.

The paper will describe the approaches based on feasibility analysis of investment and models of investment risk management, and methodological rationale for increasing public and private funds inflows in agrarian sector through programmatic interventions on land reclamation in irrigated systems of Central Asia.

Key words: investments; productivity; risk analysis

Arid lands and combating aridity in Turkey

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Abstract

With a total land of almost 784 thousand km², Turkey lies between 36° 42° N and 26°-45° E, bridging Europe and Asia. Aridity has been significance issue in the Turkish history: A prolonged arid period that occurred in the Middle Asia in 375 BC have forced millions of Turks migrate to different parts of the world, one of which is the Anatolia, an event called the Great Migration in the Turkish history. With 29 and 58% of its land characterized as arid and semi-arid, respectively, aridity still poses a significant environmental and socio-economical issue in Turkey. Most of arid and semi-arid land of the country is located in the Thrace, Inner Anatolia, the inland of the Middle Black Sea, the eastern portion of the Easter Anatolian Regions.

Anatolia has had many different civilizations in its history. Many factors including inappropriate and intensive land use and agricultural practices, disturbance of meadows and forests, and heterogeneous topography put Turkey a sensitive place for erosion: At least half of agricultural, pasture, and forest land is prone erosion. In the face of increasing effects of the climate change, this issue is climbing in the country's priority list. Accordingly, a separate body in the Turkish government – the General Directorate of Combating Desertification and Erosion (ÇEM) - was established in Ministry of Forestry and Water Affairs in 2011 is charged to directly address the issue. The efforts to deal with erosion and desertification in the country have picked up pace with the Combating Desertification National Strategy. The five-year program generally aims to prevent and/or decrease land degradation, to rehabilitate partially degraded lands, and to reclaim desert land on almost 1.5 million ha between 2013-2017. An integrated approach addressing the ecologic, economic, and social issues of desertification is adapted for the program. In this respect, with legal regulations, institutional restructuring, and educational and awareness-promoting activities, institutional capacity was aimed to be enhanced. In addition, many practices including afforestation, rehabilitation, erosion control, and protection of existing forests, rehabilitation of degraded forest sites and pastures, water efficient practices, efficient agricultural techniques, use of renewable energy sources were put in work. Various programs launched within the framework of the Strategy include the rehabilitation of Konya Eregli Watershed, monitoring desertification in partnership with Portugal and Italy, adopting functional forest management in place of that for wood production, putting a soil conservation and land use policy in work, educational initiatives to create a desertification-aware community. Efforts also included use of site preparation (i.e. terraces, plowing, ripping) and growing drought-tolerant native tree species (i.e. Austrian pine, Lebanon cedar, cedar, oleaster, pear, morus, almond, common hawthorn, tamarisk).

Key words: arid land; desertification; organization; rehabilitation

Sustainable diversity of salt tolerant fodder crop - livestock production system through utilization of saline natural resources: a case study from Egypt

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Abstract

Sinai Peninsula, Egypt, is considered one of the main development pillars at the national level. Its ecosystem is fragile where water resources are slightly poor (saline ground water or mixed water) in addition to low fertility soils with high level of salinity. Utilization of these resources in growing salt tolerant fodder crops, cereals and oil plants may contribute to enhance the available natural resources and improve the standard of living of local people. International Center for Biosaline (ICBA), Dubai and Desert Research Center (DRC), Egypt have been cooperating in joint projects to introduce the concept of saline agriculture - livestock system to the local people in Sinai Peninsula since 2008. The paper aimed at introducing and evaluating environmentally and economically feasible forage – livestock systems using brackish water in Sinai. In addition, assessing the impact of technology development and adoption on forage – livestock productivity systems. The studies were conducted at both research and smallholder farmers levels in two regions of Sinai: in South Sinai where groundwater (4000 to 10000 ppm TDS) is the main source for irrigation and soil is calcareous (calcium carbonate ranges from 30-80%). In North Sinai where a mixed water from El Salam canal is used for irrigation and the soil is extremely saline with high water table.

The most important obtained results could be summarized in the following points:

1. Increased the degree of awareness among farmers for seed production technology of fodder crops and selection improved varieties and ensure genotypes purity. Adopting integrated management package for seed production. Adoption of the most salt tolerant genotypes for 3 forage crops (Pearl Millet, Sorghum and Alfalfa), 2 cereal crops (Triticale and Barley) and two oil crops (Safflower, Rap). In addition to Fodder beet, Panicum, Kokhia, Sudan grass, Ray grass, *Medicago arborium* and some nutritious fodder shrubs, e.g., Atriplex, Leucenia, *Sesbania*, *acacia sp.*
2. Active participation of farmers in development of improved management packages to improve irrigation water use efficiency and to raise productivity of forage and cereal crops and improve livestock production.
3. Improve the nutritive values and storage capacity of animal feeds through introducing new techniques (silage and feed blocks production).
4. Economic evaluation of feeding animal on salt tolerant fodders at farmer's levels showed an increase of about 60% in milk production ; reduced feeding costs about 40%. Accordingly, 70%.increment of family income was achieved.

Key words: salinity, fodder crops, animal, farmer participation, Sinai, irrigation

Nutritional evaluation of forage kochia (*Kochia prostrata*) as alternative forage for cattle using a dual-flow continuous culture system

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Abstract

Forage kochia (FK; *Kochia prostrata*) has the potential to be used as forage for cattle due to its high nutritional value and ability to grow well on arid lands. The objective of this experiment was to determine the nutritional value and rumen fermentation characteristics of FK as compared to alfalfa hay (AH) and orchardgrass hay (OH). Diets were randomly assigned to six dual-flow continuous culture fermenters in a replicated 3X3 Latin square arrangement with three 10-d experimental periods consisted of 7-d for adaptation and 3-d for sampling. Fermenters were fed 72 g of DM/d equally divided in 12 portions of 1 of 3 diets: Diets were (1) 100% AH, (2) 100% OH, and 100% FK. Liquid and solid dilution rates were adjusted to 10%/h and 5%/h, respectively. A sample of 500mL from each fermenter was taken on d-8, 9, and 10. Two subsamples of 10ml were filtered through two layers of cheesecloth, and were preserved with 0.2 mL of 50% H₂SO₄ and were centrifuged for subsequent ruminal NH₃-N and VFA analysis. Statistical analyses were performed using SAS. There were no differences ($P > 0.05$) among treatments for total VFA, molar proportion of acetate, propionate, butyrate, and branched-chain VFA. However, there were differences ($P=0.04$) for NH₃-N. Ruminal NH₃-N observed was higher for FK compared with AH and OH, indicating a higher N availability for microbial growth. These results indicated that FK may be a viable alternative for cattle. This is especially important for arid lands such as the U.S. Great Basin.

Key words: forage kochia; Alfalfa hay; in vitro fermentation

Prediction of introduction capabilities of *Pinus eldarica* Medw. by using of geographical information technology

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Abstract

Pinus eldarica Medw. (Eldar pine) is a rare and endemic species of flora of Caucasus inscribed in the World Red Book. This species has high adaptation potential as a drought, wind and salt tolerant able to grow on alkaline low productive soils and other limited climatic variables that was developed during evolution natural selection. These adaptive peculiarities make this species unique for introduction into culture for combat desertification and improve productivity of degraded ecosystems. Our studies are focused on eco-geographical analysis of *Pinus eldarica* and geographical mapping using GIS technologies to forecast optimal model for long term cultivation of this rare species. Based on the data on the ecological limits of *Pinus eldarica* growing in Azerbaijan, obtained by using GIS technology, the territory of introduction of this species is modeled. Ecological amplitudes of this species are selected on the following limiting factors of the environment: the sum of active temperatures, annual precipitation and temperature for January. According to the foregoing as ecological limits of growth Eldar pine for the main limiting environmental factors were chosen: the sum of active temperatures above 0° C from 4500 to 7000° C, annual precipitation from 270 to 1000 mm, the temperature for the month of January > -3.5°, the Hydrothermal Coefficient (HTC) for the summer season is not above 0.85. The data on the environmental limits and the presence of environmental maps allow simulating the area of possible distribution or the introduction of Eldar pine. The obtained model allows pre-identifying the possible areas of introduction and perspective territory for the re-introduction of *Pinus eldarica* under low quality environments described in this article. It is revealed that the Eldar pine is characterized by wide limits of the possible introduction for the growth in the Central and Minor Asia, some parts of Southern Europe, Northern and Southern America, Australia etc.

Key words: GIS; *Pinus eldarica*; Azerbaijan; modeling; prognosis; habitat; introduction; planting

Technical cooperation project for promotion of the Silk-Road industry in Uzbekistan

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Abstract

Technical cooperation project for promotion of the Silk-Road industry in Uzbekistan started at 2013 between The Uzbek Scientific Research Institute of Silk Breeding and Tokyo University of Agriculture and Technology under the Japan International Cooperation Agency (JICA) partnership program. The main targets are the Sericulture and Silk industry in west side of the Uzbekistan (Khorezm region) and the technological transfer model to increase sideline income of remote villages. Silkworm eggs of Japanese races were introduced to the Khorezm region. These animals (Kinshu⁴Showa and Shunrei⁴Hougetsu) were reared in farmers supported with the JICA expert. Comparing with the Uzbekistan races, the excellent quantities and qualities of cocoons obtained in spring and summer seasons. In Uzbekistan, silkworm-rearing in hot season did not because of 1) qualities and quantities of the mulberry leaves are quit low 2) several labors for the cotton are hard. However, prices of the cocoon both seasons increased about 20-30% and the farmers could obtain more income as results. These results indicate there is a high level of the silkworm rearing techniques. To increase the silk industry in Uzbekistan, many problems have to be solved. In our project, focusing following issues (1) the high level of keeping techniques of mother races of silkworm (2) male and female separation techniques for production of the silkworm hybrids (3) the planting and keeping the high quality of mulberry races (4) the establishment of the systems for distribution of high qualities of "Silk-Road Bland Silk", are the mile stones.

Key words: Silk industry; *Bombyx mori*; Uzbekistan; JICA partnership program

Settings and geo-environmental conditions of developing greening soil materials (GSM) for cultivating licorice (*Glycyrrhiza uralensis*) in Mongolian arid region

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Abstract

Desertification is characterized as land degradation, and is one of the most critical geo-environmental problems. The purpose of this research is developing the sustainable and high value-added anti-desertification method, which can accomplish geo-environmental improvement, conservation and utilization of local ecological resource.

In order to establish this method, we developed a pipe-shaped body of Greening Soil Material (GSM). GSM is made of sand and compost which can be taken from Mongolian arid region. Moreover, it is characterized to have high water and nutrient retention capacity to support growing plants. Therefore, it could be made and installed in the ground easily and inexpensively, and it is identified as simple self-watering system without any water supply.

As the suitable plant for greening, we selected licorice (*Glycyrrhiza uralensis*). It is one of the most valuable medicinal plants which natively grow in arid region, such as Mongolia and China. However, the distribution area is decreasing due to human factor, which are over taking and over grazing and lowering of ground water level caused by precarious precipitation. Due to these facts, it was picked up as “precious genetic resource” at COP (Conference of the Parties, Convention on Biological Diversity) 10 because supply shortage as herbal medicine occurs for following reasons. And as a result, land degradation is progressing. Therefore, planting licorice by using GSM could be sustainable and high value-added greening.

Our previous research revealed that the place licorice lives natively had 5 % or more water content in the ground, and non-habitat of licorice had water content less than 5 %. Moreover, habitat of licorice had high saline compounds, especially CaCO₃ contains 10 % in dry soil. Therefore, water and calcium condition in GSM can be the most important factor for cultivating licorice.

In this paper, in order to grasp the effects and functions of GSM for protecting progress of desertification, field cultural experiments were conducted in non-habitat of licorice without any irrigation except before setting for nine months. Then we focused on soil water and calcium condition in the GSM before and after the experiment, setting direction of GSM and outer layer processing. The alive ratio of licorice was researched after nine month from the start of experiment in each condition, at the same time, water and saline content were also researched in GSM before and after testing.

From the results of experiments, suitable geo-environmental conditions in GSM for growing licorice could be suggested.

Key words: desertification; soil water environment; soil saline environment, licorice (*Glycyrrhiza uralensis*)

Biodiversity and occurrence of the parasitic microfungi on walnut trees (*Juglans regia* L.) in Western Tien-Shan

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Abstract

Walnut forests of Bostanlyk district of Tashkent Region are located in the northern area of walnut forests in Western Tien-Shan. They are located on slopes of Karjantau, Ugam, Pskem, Koksus, western part of Chatkal and northwest slopes of Kuramin ranges at a height from 800 up to 2300 m above sea level. Forest stands with walnut are widespread in Uzbekistan up to the area of about 4000 hectares. The walnuts are very sensitive to unfavourable environmental conditions (site factors, climatic factors) and also susceptible to diseases and attacks by pests. Climate change causes changes in phenology and distribution of fungi, mainly, pathogenic fungi. Some climate change research shows that there are several scenarios of these changes such as changing in habitat of individual species and fungal biota; certain ecological adaptation to warming conditions, such as prolongation of breeding cycles, shifts in time of dormancy and arousal, shorter cycles of quiescence foci of particularly dangerous infections. Fungi are very frequent parasites on walnut trees. According to the many literature dates dealing with fungi parasites on walnut trees, which originate from generative reproduced organs. Many of trees notice occurrence of the brown spots on the leaves of walnut. This disease - anthracnose is caused by the parasitic fungus *Gnomonia leptostyla* (Fr.) Ces. et de Not.

During 2013-2014 the health condition of *Juglans regia* L. in the Bostanlyk District of Tashkent region was evaluated in relation to the location of the trees and the assessment of occurrence, spread and harmfulness of parasitic fungi. We detected on stem the following pathogens: *Melanconium juglandinum* Kunze, *Cytospora juglandina* Sacc., *Phoma juglandis* (Preuss.) Sacc., *Nectria cinnobarina* (Tode ex Fr.) Fr. with conidial state *Tubercularia vulgaris* Tode. On branches: *Melanconium juglandinum* (Kunze), *Cytospora juglandina* Sacc., *Phoma juglandis* (Preuss.) Sacc., *Nectria cinnobarina* (Tode ex Fr.) Fr. with conidial state *Tubercularia vulgaris* Tode, *Diplodina juglandina* Hollós, *Dothiorella gregaria* Sacc. On leaves: *Gnomonia leptostyla* (Fr.) Ces. et de Not. And anamorph *Marssonina juglandis* (Lieb.) Magn., *Ascochyta juglandis* Boltsh., *Microstroma juglandis* (Bér.) Sacc., *Microsphaera juglandis* (Jacz.) Golov., *Mycosphaerella juglandis* K. J. Kessler, anamorph *Cylindrosporium juglandis* F. A. Wolf, *Diplodia juglandis*., *Steganosporium compactum* Sacc. and on fruits: *Colletotrichum gloeosporioides* (Penz.) Penz & Sacc. Teleomorph *Glomerella cingulate* Stoneman (Spauld. & H. Schrenk). The degree of leaf damage was determined by *Marssonina juglandis* to *Juglans regia* in Western Tien-Shan.

Key words: fungal diversity and occurrence; parasitic microfungi; walnut trees; Western Tien-Shan

Evapotranspiration and Land use Land cover (LULC) change analyses in Karshi steppe, Uzbekistan for water requirement analysis

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Abstract

Significant land use and land cover change is occurring with increasing demography all over the world. Quantifying LULC change rate is important for improvement of land and water management system, agricultural resources and environmental ecosystems. Today, Remote Sensing (RS) data and Geographic Information System (GIS) is widely used anywhere else of the world to identify changes in LULC. These two subjects are becoming very important also in Central Asia, one with its strength on spatial data analysis and the other being a very good alternative data source in data limited regions such as Central Asia. Therefore this research focuses on estimating land use dynamics and land cover change in Karshi steppe using remotely sensed information. Karshi steppe was selected as a study area located in the southern part of Uzbekistan because huge extension of irrigated area (from 50.000 to about 350.000 ha) for mainly cotton production was undertaken during Soviet Union which had increased water demand in this area. Land cover type analyses in this study were done in two levels. In level one, analyses of land use area dynamics starting from 1972 to the present time was carried out and land cover type classification was carried out in level two. In level 1 detection of land use areas for the years of (1972, 1978, 1987, 1998, and 2010) was computed to get boundaries of irrigated area for the purpose of computing crop type classification within irrigated area. Crop classification was then carried out using supervised classification for recent images where we had ground truth information and Normalized Difference Vegetation Index (NDVI) approaches to identify crop types from old images through phenological development of different crops. Outcomes of this crop classification further applied to calculate actual evapotranspiration for water requirement analyses of different crop types.

As evapotranspiration (ET) is part of water balance and it is a key element for water management and irrigation performance scheduling, the potential and actual ET was computed using Hargreaves and Samani method in one hand. In the other hand spatially distributed ET data from RS (MODIS) was obtained for the region for comparison to station based ET results. The comparison of station based and RS based ET gave good agreement. The time series analysis of RS based ET was also undertaken in this study and the results show that for the last 10 years slight increase of ET could be observed in this region which can be explained with the fact that more and more irrigation area extension is taking place for which irrigation water is necessary. Such ET estimation is a prerequisite to study total water demand for the whole study area using distributed ET information which is an outlook to this research. The outcomes of this study can be a good basis for future resources, water management and water allocation within study area and also for water users associations (WUAs).

Key words: land use; land cover, remote sensing, evapotranspiration, NDVI, classification

Crop modeling as a tool for assessment of climate change impact on crop development and productivity

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Abstract

Stability of food production and food security, particularly in view of climate change and climate variability, is a subject of global concern and an important area of research for agricultural scientists whose work will inform farmers, land managers, policymakers and other stakeholders. This issue is of great importance for arid areas such as Central Asia. Increases of CO₂ concentration and air temperature, changes in precipitation amount and distribution that are predicted by the end of the 21st century will undoubtedly impact the development and productivity of crops. The procedure presented here assesses the effect of climate change on using the freely-distributed CropSyst crop simulation model, capable of simulating the impact of climate change on crop growth in respect to CO₂ response, temperature response, water stress and rainfall variability. CropSyst is also able to account for the impact of shallow groundwater (upward movement of water in the soil), salinity, and evapotranspiration in arid environments as well as consider soil conservation measures such as zero-tillage and surface residue retention. Climatic data for crop simulations under future climate conditions are obtained by two methods: 1) use of the LARS-WG weather generator for disaggregation of downscaled monthly data provided by selected global circulation models; 2) the use of the online MarkSim weather generator application on the CIAT website. Both methods provide statistically-stable weather data predictions. To reflect diversity of land and water management used by farmers, it is proposed to consider three levels, poor, optimal and suboptimal management, created individually for each productive system of a country, and based on results of socio-economical surveys and national recommendations. The method provides assessment of the impact of climate change on aboveground biomass accumulation, yield, length of crop development stages, irrigation requirements and transpiration use efficiency, probability of occurring of stresses caused by change of precipitation amount, and temperatures extremes and variability. Practices aimed at reducing or adapting to the negative impact of climate change can be identified and tested. The method application and results are demonstrated in an example of wheat grown in Central Asia.

Key words: climate change impact assessment; crop modeling; prediction of crop production; wheat

Crop modeling as a tool for improving crop and water productivity in Indira Gandhi Canal Command Area

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Abstract

The Indira Gandhi Nahar Pariyojana (IGNP) is an enormous multi-purpose irrigation and settlement project, implementation of which started in the late 1960s. The goal was to transport and use over 106 billion cubic meter of water annually withdrawn from the Ravi-Beas River in the north of India for large-scale irrigation in Rajasthan. The aim of project stage I, commenced in 1974, was to provide water for irrigation of about 553,000 ha in the north of Rajasthan. This had been achieved in 2000. Stage II followed in 1980 and was completed only in the last decade, with the aim to add another 1.41 M ha of semi-arid and range-land/desert area in north-west Rajasthan, south of the stage I area. Implementation and management of the IGNP had been largely successful. Over the years several million people migrated into the region and were able not only to maintain their own livelihoods but also to produce food surpluses. However, ever since the inception of the IGNP, challenges – partly natural partly anthropogenic – arose: low water productivity, water logging and salinity, low irrigation efficiency, low nutrient-use efficiency, wind erosion on Stage I area, and low land as well as water productivity, unreliable water supply, yield variability from year-to-year, low water and nutrient holding capacity of sandy soils, wind erosion, lack of crop diversification on Stage II area. Due to edaphic conditions and because of major differences in irrigation water availability (abundant in the north, scarce in the south), the cropping systems of stage I and stage II command area are quite different: stage I is characterized by flood- or furrow-irrigated cropping systems with rotations such as wheat-cotton-wheat or mustard/chickpea-cluster bean-mustard/chickpea; stage II is characterized by sand dunes which have been stabilized with shrubs and trees, and interdunal plains where agriculture is practiced.

To improve water and land productivity through better water management, appropriate cropping patterns and optimal cultural practices the biophysical simulation model CropSyst is applied to understand the existing soil-water balance, movement of salts, fluctuations of groundwater, crop growth characteristics etc., as well as to study the effectiveness of various intervention measures such as deficit irrigation, land management, optimization of irrigation scheduling, and others.

During the years 2012-2014 the field data for summer and winter seasons were collected from 20 farmer field of stage I area and the model was calibrated for 5 crops (clusterbean, cotton, mustard, wheat and barley). Calibration for clusterbean, mustard and wheat was subsequently validated using the field data obtained from stage II fields. Besides for the stage II the model was calibrated for cumin, gram, isabgol and groundnut. Observed data on phenology, green area, biological and economical yield, nitrogen-uptake and soil moisture were used for calibration and validation of the model. A number of water management scenarios based on deficit irrigation and optimization of irrigation scheduling was developed and tested using the calibrated model to identify those can be suggested to farmers to improve water and land productivity and save water.

Key words water and land productivity; crop modeling; prediction of crop production

Agrobiological features of the organization of seed farming of potatoes in Uzbekistan

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Abstract

In Uzbekistan quality of seed potatoes substantially depends on an initial material from which it grow up. Therefore in practice are applied various ways of receiving initial virus-free tubers - families of chiefs of elite. However, possibility of repeated infection of these plants isn't excluded by virus and mycoplasma diseases. Crop losses from virus diseases, depending on degree and character of infection of plants, from a grade, soil climatic conditions and an agro technology hesitates from limits of reliable distinctions to his full death. Therefore at all stages is of seed farming necessary observance of the measures directed on preservation of revitalized plants from reinfection.

Researches were conducted on a flat zone of the Zarafshan valley.

The number of wingless aphids on plants was determined by the 100 leaves method, and supervision over dynamics of aphids flying - carriers of viruses of potatoes by method "Merike's yellow water vessels". Reservation of viruses defined at plants selected near potatoes crops.

By researches had established that with increase in year of reproduction of an on the meristem plants is going a process of reinfection by viruses. The studied grades differ on intensity of reinfection with a virus infection. It is confirmation of that repeated infection with viruses of an initial material substantially depends on biological features of each grade.

With our investigations revealed some weed plants in which the viruses, striking potatoes can be reserved. Such plants appeared a nightshade black (*Solanum nigrum*), a bindweed field (*Convolvulus arvensis*), a dope ordinary (*Datura stramonium*), a plantain lanceolate (*Plantago lanceolata*), etc. However mechanisms of existence of viruses in these plants and reaction of reservators to viruses aren't clear yet. If to consider that viruses have no own metabolism and therefore can exist only in live organisms, it is possible to assume that viruses in the course of evolution adapted to "owners" or also strike them as potatoes.

It was established that density of population, dynamics of development and specific structure of carriers of viruses- aphids depends on soil and climatic and weather conditions of each region. For example, on a flat zone mass flying of the aphids observed two times in a year: the first mass flying of insects observed in the third decade of the May, the second - at the beginning of October.

However, it should be noted that bulk of the caught aphids made peach (*Myzodes persicae* Sulz) and melon (*Aphis gossypii* Heinse) aphids. The registered low quantity of wingless aphids (15-87 pieces of/100 leaves) apparently, is connected with low relative humidity of air during vegetation of plants.

We consider that in elaborating of the complex of organizational, preventive, agro technical and protective measures directed on cultivation of qualitative seed potatoes it is necessary to consider the above-stated agrobiological factors of each concrete region.

Key words: virus; potato; reservation; farming; aphids

Project finding research on renewal of coal boilers in heat supply stations in Kyrgyzstan

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Abstract

The reliable heat supply system is essential in severe cold areas such as the former Soviet Union in the winter. However, the infrastructures of heat supply system in the Kyrgyz Republic have been deteriorating without being sufficiently updated for over 20years since the collapse of the former Soviet Union. The updating of the aging facilities has become a pressing issue in Kazakhstan. At the same time, there is a growing concern about global warming caused by CO₂ emission from fossil fuel combustion: the environmental factors must be taken into consideration when updating the facilities.

Based on the awareness of these problems, we conducted a survey to find project opportunities associated with the coal boiler renewals of the main heat supply stations in the Kyrgyz Republic. Based on the survey findings, we selected the locations with high feasibility by comparing the potential target locations. Then, we made the preliminary conceptual design, the examination of business plans, and the estimation of CO₂ reduction potentials for the selected locations.

In Kyrgyz, the boilers of the size of the steam generation rate around 20t/h are prevalent, and replacement demands of 9 cans are expected in the heat supply stations at four locations. In addition, we confirmed that modernization of the unmovable power supply stations (power stations) is necessary and the facilities should be completely rebuilt and replaced. There is an intention to convert coal-fired and mazut fired to natural gas-fired facilities, thereby creating potential needs for additional coal boilers. We analyzed the coal samples obtained from the major coal mines such as Karakeche, Sulyukta, etc. as well as samples of the coal imported from Kazakhstan that are currently used, and found out that the properties of the coal used in Kyrgyzstan are extremely uneven by the origins and the types. Thus, we think the Fluidized bed system is suitable for the following reasons: it is capable of stable combustion with the least constraints in terms of properties and shapes of the fuel, and the medium circulation of it can discharge the incombustible articles out of the system even if they are mixed in. The analysis of the coal-ash samples after combustion in Gagarin Heat Supply Plants in Bishkek indicated that the unburned carbon portion in the ash was 45% on average. Hence, the combustion rate of the coal was determined to be 40%. Installation of the new model of Fluidized bed boiler can reduce the percentage of unburned coal ash after combustion to approximately 10%. In this case, the combustion rate is calculated to be 92%, and therefore the improvement of the energy consumption efficiency is expected to become more than double.

We anticipate that assuming the operation of 150 days a year, the replacement of the existing boiler by a fluid bed boiler of the steam generation rate 20t/h would reduce the CO₂ emission of approximately 2,000 tons per year.

Key words: high-efficiency CCT (Clean Coal Technology), fluidized bed, CO₂ reduction, combustion rate

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Rural reconstruction through introduction of the Japanese lines of silkworm *bombyx mori l.* in Fergana province in the Republic of Uzbekistan

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Abstract

The Republic of Uzbekistan is the third-largest silk producer of the world after China and India. However, the production of high-quality silk has declined since the fall of Soviet Union, due to the local and imported silkworm eggs with unstable quality, which undermined the silk production system of the state.

Japan used to be the world's top silk producer from the turn of the 20th century till 1970s, and made the highest-quality silkworm eggs sought for by other countries such as China, with the purpose of improving their domestic silkworms. However, Uzbekistan under the Soviet regime had limited access to those eggs.

In 2009, a project of Tokyo University of Agriculture and Technology (TUAT) funded by the Japan International Cooperation Agency (JICA) began at six hamlets of Yozyovon County (40°39'41" N, 71°44'37" E) in Fergana Province, with the goals of increasing cocoon production and improving silk quality by the introduction of Japanese autumn-breed Kinshu × Showa and spring-breed Shungetsu × Hosho silkworms.

In 2010, the 52 silk-raising farms of TUAT-JICA project produced 4,233kg of cocoons from 1,370g of Kinshu × Showa eggs (ca. 2,342,000 worms), i.e., 8.2% more yield than the average of local farms rearing Uzbek and Chinese breeds.

In 2011, 29 farms produced 2,214kg of cocoons from 717g of Shungetsu × Hosho eggs. Other 23 farms used 970g of Kinshu × Showa eggs again and produced 3,200kg of cocoon, which turned out 18% more yield than the average of local farms.

In 2012, Shungetsu × Hosho silkworms were raised in the Silk Center of Fergana Province, with technical instructions on silkworm rearing, cocoon making, drying and selection, and filature from a TUAT-JICA expert. This resulted in the production of high-quality silk thread equivalent to 3A level by the Japanese five-level rating criteria. The local Uzbek farmers proved their skills in silkworm rearing, and the Fergana fiber industry demonstrated its capability in producing good silk threads. Thus reconstruction of the integrated silk production system, involving silkworm breed development and maintenance, and technical extension to cocoon producers, was found essential for the future of Uzbek silk industry.

Key words: sericulture; T.U.A.T.; international technology transfer; Uzbekistan; Fergana Province

Numerical simulation of the inundation on the flood plain of Senegal River for the improvement of the agricultural productivity in Mauritania

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Abstract

Mauritania is surrounded by Algeria, Mali and Senegal. Its population is 3.1 million, total area is 1.03 million km², but its 90% is Sahara desert. This east end of Sahara desert shows the rapid desertification. In addition, this country experienced drought years in 70's and spontaneous drought happens since it. Mauritanian government revealed the concrete strategy against that situation. That is the direction of industrial change from nomadic stock raising to settled agriculture and fisheries.

On the other hand, Mauritania is Rice-importing country. Its import is very heavy burden in the trading balance and it is hindrance in the economic development. In addition, there are refugees and returners from the surrounding countries to Mauritania in these years because of its political stability. The area along the Senegal River is known as the arable land for rice production. Therefore new rice field development in Senegal River basin is very important issue in this country. However, its water resource is not used effectively and the food productivity has room for improvement.

The agriculture along Senegal River, especially on the right bank of Mauritanian territory side, depends on the flood inundation. The recession agriculture that uses the flood plain of the river after inundation is traditional style but gives unstable productivity. In addition, catastrophic damages on the farm field are given in the big rainy years.

The authors propose that Lake R'kiz, the dry lake located on the right bank of Senegal River can be used as the retention pond for flood control and water reservoir for agriculture in dry season. In this study, we tried to simulate the inundation on the flood plain under the current river system as a first step. Based on this numerical simulation model, the construction of the canal from Senegal River to R'kiz Lake will be considered in the further study.

The digital elevation model (DEM) of the flood plain of the study site from upper Podor to Dhiama dam that regulates the sea water intrusion from Atlantic Ocean to Senegal River was obtained from the free database of Shuttle Radar Topographic Mission (SRTM). The DEM mesh size of SRTM is around 80m, but considering the limited calculation time, the calculation mesh was resized to 500m. The figures of the cross sections of the river channel are unknown, so that the simple rectangular sections are given for the simulation. The hydrological data used as the boundary condition on Dhiama dam and Podor are the observed data in 1999 when there was a big flood. IRIC that solves the 2-dimensional shallow water flow equation was applied to those conditions and result of the simulation was evaluated by the comparison with the water surface area estimated by satellite image analysis. The simulation result and satellite image analysis do not show the perfect agreement because of the assumptions for the unknown conditions of the river channel and hydraulic effect of Guier Lake on Senegal territory.

Key words: water resource, inundation, shallow water flow, Senegal River

Social and economic impacts of salinization – mitigation and adaptation strategies

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Abstract

There is an urgent need to significantly increase the agricultural production to meet the world population's immediate and future demand. In spite of new and improved technologies for producing better varieties of food, feed, fuel and fiber, still the issue of food security is increasing at an alarming rate, with more productive land and water resources turning towards marginal. A combination of increased world population, climate change impacts, scarcity of land and water resources will eventually leave a big gap between the demands and supplies. This demands that alternative physical resources (of land and water) needs to be explored In order to overcome the deficit.

With the alarming increase in land degradation and scarcity of fresh water, both globally and regionally, it is imperative that productive areas and good quality water is used efficiently for food and cash crops. However, this does not mean that marginal lands and water are completely neglected since many other agricultural sectors linked to forage/fodder production, forestry, industrial products, aquaculture, etc. can be partially shifted towards these marginal resources to supplement production.

Among the marginal resources, saline water and land contribute a vast proportion that needs to be used for increasing agricultural production. A number of good researches have been done globally since the last 30-40 years, realizing the problem of salinization and the sustainable use of salt affected land/water in agriculture for growing crops and other products. However, the biggest challenge has been to demonstrate the economical, environmental and social benefits and risks of using saline water and lands for agricultural production. The other challenge is to demonstrate what type of production system(s) are sustainable on long-term bases.

The economics of biosaline agriculture will depend on the extent of marginalization and salinization and water

The economical component of 'biosaline agriculture' is dependent on:

1. If high-value crops can be replaced with traditional crops to improve farm profitability
2. Balance of research between high-tech technologies to produce crops (for food production) and through a *natural selection and adaptation process* (for other agricultural crops).
3. Integration of agricultural production system(s) to be more resource efficient and can be adopted by the farmers.
4. Effective governmental policies to support investments of farmers to move from conventional farming (under saline and marginalized condition) to more of an 'un-conventional' production system(s).

This paper reviews the problem of agricultural production in context to water and land resources, and the potential of using marginal resources (saline water and land) for increasing agricultural production. The paper will provide case studies related to both social adaptation, economical and environmental feasibilities for the following integrated systems:

1. Forage-livestock system under highly saline conditions.
2. Agroforestry systems – for better soil nutrient management
3. Seawater based agricultural production system
4. Integrated aquaculture and agriculture (IAA) systems
5. Produced water (from oil industry) in agriculture.

The paper will also describe some examples of the work that has been scaled-up by country investments and has demonstrated the feasibility of saline agriculture.

Key words: marginal resources, sea water, value crops, mitigation and adaptation strategies, saline agriculture

Usage of certain plants for agro ecological enhancement in Mining Industry dumps

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Abstract

Mining is the backbone of economic development of any country. However, it leads to dramatic changes in the large area landscapes due to dumps and tailings and further environmental consequences:

- Pollution by heavy metals due to extraction, processing and isolating useful ores components in pure form;
- Atmospheric pollution with fine-dispersed emission;
- Contamination of groundwater and others.

The air pollution as well as infiltration to groundwater and surface water can cause increasing respiratory and immunological diseases, cancer as well as hereditary diseases. Reclamation of the marginal lands by tolerant vegetation is considered as one of solution of dispersed emissions as well as surface water flow. Natural overgrowth and ongoing works on the biological reclamation of disturbed lands causes gradual formation of biocoenosis. In this regard, drought-resistant and salt tolerant plants are used to generate biocoenosis in disturbed areas. To understand the mechanisms of this development constant observation is required. It includes understanding and awareness of their components, including animal population, as well as the connections between them.

In this study *Cucurbita foetidissima* HBK, *Helianthus tuberoses*, *Jerusalem artichoke* (*Helianthus tuberoses*) have been successfully used for agro-ecological rehabilitation and remediation in technologically disturbed areas. These plants were grown in the areas with ore, coal and oil extraction; at remediation sites of various kinds of geological works; on soils of reclaimed waste from heat power plants and etc.. Agro-biological characteristics of the pumpkin *Cucurbita foetidissima* HBK was chosen as an unpretentious to agro-technological cultivation, drought-resistant and tolerance to frost (up to -25 ° C). In the first year of vegetation plant leaves can cover up to 20 m² of surface soil. Root system can deepen down to a depth of 2 - 2.5 meters. Immature fruits of these useful plants are edible when boiled. When ripe, its flesh becomes poisonous and peel very durable. During this phase, it is used for manufacturing musical instruments. The seeds contain up to 26% of fats and used to obtain oils. Roots are suitable for preparing starch. Nowadays putting pumpkin stinking into cultivation is in full swing. According to the estimation it will become one of the most important food crops and oilseeds in the future.

Key words: *Cucurbita foetidissim*; *Helianthus tuberosus*; oil seeds; mining degraded lands; Uzbekistan

Adaptation of wheat in the conditions of salinity

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Abstract

The rise of the level of steadiness of different plants on different stages of their growth and development to the outer stress factors is one of the most urgent tasks of the modern science of biology and chemistry. Actual problems of these sciences in this direction, are aimed at the research of phytohormones, which play a significant role in the development of plants.

Analysis of the data obtained during the research allows, first of all, to compare the differences in ontogenesis of hormonal balance to the speed of wheat growing. During the vegetative period the content of zeatin, auxin and cytokinin + indoleacetic acids/abscisic acids ratio is changing according to a single-humped curve with its maximum in the phase of ear formation and flowering. The rise of the level of cytokinins in the first-half vegetation phase can be explained by the increasing mass of root system of the plant.

The quantity of abscisic acids in the organs of wheat in the process of ontogenesis is continuously increasing. Dynamics of hormonal balance to a certain degree fits the changing of wheat growing speed. In the first half of the vegetative period the intensity of growing processes is increasing too. In the second half of the vegetative period while the quantity of the growth-promoting hormones decreases, the increasing mass of abscisic acids follows the decreasing speed of wheat organs' growing. It demonstrates the increasing role of abscisic acids in the process of aging and transferring in the state of resting.

Processing abscisic acids in the variants without injecting NaCl, and on the background of the soil salinization, showed inverse reaction to the physiological activities of the plants. In optimal conditions of wheat growing with introducing abscisic acids the decreasing of endogenous content of cytokinins and auxins, increasing of abscisic acids, and as a result, decreasing of the ratio of cytokinin+indoleacetic acids/abscisic acids is revealed.

The research done by us shows that the changing in physiological processes under the influence of NaCl, at least depends, on hormonal status of the object. We can propose, that the resistance of wheat to the salinization with NaCl directly depends on the changes in the hormonal system. The ability to use exogenous entering phyto-regulators for increasing the resistance of the plants to the salinization is revealed in the research. The processing of wheat with abscisic acids leads to compensation of the effect of NaCl activity. But, the character of the physiological reaction of the plants depends on the rate of salinization and is mediated by the changings in endogenous content of hormones and their ratio.

The study of mechanism and abilities to correct the hormonal balance opens prospects for the regulation of the adaptive process and increasing the resistance of agricultural plants.

Key words: salinity; wheat; phytohormones; hormonal balance

Anti-allergy and melanogenesis regulatory effects of semi-arid and arid land plants

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Abstract

The harsh environment that plants in the semi-arid and arid regions are exposed to induced the plants to adapt in order to survive, and in the process, produce numerous bioactive compounds with therapeutic or medicinal properties. Extracts of arid land plants *Cymbopogon schoenanthus*, *Crithmum maritimum*, and *Rhanterium suaveolens* were evaluated for their effects on immediate-type allergy and melanin biosynthesis using RBL-2H3 basophilic cells and B16 murine melanoma cells, respectively. MTT assay done to evaluate the cytotoxicity of the extracts revealed non-cytotoxic effects at low concentrations. β -hexosaminidase release inhibition assay revealed that the extracts significantly inhibited mast cell degranulation while melanin assay results showed significant melanin biosynthesis regulatory effects in B16 cells. This is a preliminary study to evaluate the bioactivities of arid plants *C. schoenanthus*, *C. maritimum*, and *R. suaveolens*. Further studies are being undertaken to understand the mechanism underlying the observed effects.

Key words: arid land plants; anti-allergy; melanogenesis; RBL-2H3; B16 melanoma cells

Soil salinity assessment using Remote Sensing and GIS techniques in Syrdarya province of Uzbekistan

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Abstract

Soil salinity is a serious environmental problem, especially in arid and semi-arid regions. Sixty nine percent of the total irrigated land in Central Asia and 50.5% area in Uzbekistan are already affected by various degrees of soil salinity. There is near 2 million hectares of high salinity areas. Aim of the research was to test existing techniques of soil salinity assessment using GIS and remote sensing tools and find the best for environments of Syrdarya province in Uzbekistan. This research was implemented on the test site in Syrdarya province of Uzbekistan on Bobur WCA. This is one of the highly salt affected areas in Uzbekistan. Research can be divided into two major parts: analysis of bare soil reflectance and reflectance of vegetation. Landsat 5 and 8 images were used for calculations and analysis in ArcGIS and Erdas IMAGINE software packages. For bare soil several indices, found in literature, were tested and spectral signatures of areas with different soil salinity analysed. For vegetation were analysed relations of two indices, NDVI and COSRI, and spectral signatures of vegetation growing on areas with different levels of soil salinity. Two datasets were used in calculations: data collected especially for thesis and secondary data from the archive salinity. Correlation coefficients between spectral indices, electrical conductivity and total dissolved salts contents of soil were calculated. None of the bare soil indices from literature showed significant correlation, in both datasets. The highest R-value is found between the satellite data of the bare soil versus archive map. Same situation with spectral signatures – no difference were observed between signatures of slightly, moderately and highly saline soils. With vegetation reflectance we receive more promising results. Highest R-value was observed for COSRI index and in dataset with secondary data. Correlation with NDVI was little bit lower. In general, R-values for all indices were higher in dataset with secondary data. From the results of this research, we conclude that using vegetation reflectance as a proxy parameter for soil salinity more promising in environments of Syrdarya province when multispectral images, like Landsat, are used.

Key words: soil salinity; spectral indices; Landsat data; vegetation

Evaluation of some adapted plants species in the degraded lands of Azerbaijan

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Abstract

Soil degradation is one of the most significant stress factors limiting the crop productivity and thereby, representing the threat for the sustainable development of agriculture. Drought, non-appropriate temperature, deficit of nutrients and excess of pollutants (salts, heavy metals, organic wastes etc.) lead to deterioration of the soil fertility. Some agricultural territories of Azerbaijan which are the important source of forage, cotton and grain face multiplicity of ecological problems.

Modern status of vegetation in these territories and distribution of dominant halophytes in the degraded lands were investigated in the phytocoenoses depending on different elevations. It was defined that dominant halophytes here are *Salsola nodulosa* (Mog) Ilin, *Suaeda dendroides* (C.A. Mey) Mog, *Artemisia fragrans* L., *Atriplex tatarica* L., *Tamarix ramosissima* etc., some of which are fodder storage stocks and main components of the pastures, as well as possess food or medical importance. These plants were found to generate a vegetations with different vegetation covers and species abundances not only because of different ecological conditions, but also in accordance with elevation from the sea level. Analysis of the electric conductivity of soil samples collected from the investigated areas revealed the different salinity levels ranging from 3 to 17 mS/sm. Among plant species tested *Suaeda dendroides* and *Suaeda confusa* distinguished to accumulate high concentrations of Na⁺ ions in their shoots. However, the difference between these species was found in their selectivity to anions, while SO₄⁻² ions were highly accumulated by *Suaeda dendroides*, *Suaeda confusa* mostly accumulated Cl⁻ ions.

Physiological adaptations of these plants to stressed conditions can be used as a feasible alternative approach in the management and sustainable development of degraded agricultural lands.

Key words: salt affected lands; cover vegetation, ions composition, halophytes domestication, Azerbaijan

Sustainable management of the restored grassland: effect of chicken farming on environmental sustainability

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Abstract

In the semi-arid areas of north China, sandstorms rank among the most serious environmental calamity, posing threats to both animal husbandry and social sustainability. Years of overgrazing have led to remarkable grassland degradation in north China, causing further ecological disasters such as the blooming of insect pests, and the appearance of sandstorms or light windborne dust clouds in China and neighboring countries, such as Korea and Japan. Although there has been substantial government-allocated funding for the restoration of degraded grassland to projects including tree planting, fencing grassland, or rearing dairy milk cows, most of those efforts are short-lived and ineffective relative to the huge investments on the grassland. Based on the findings of a large-scale (2.667 ha) and long-term (ten years, 2000-2010) experiment in the Bayinhushu village of the Hunshandak sandland in the Inner Mongolia of China, we have proposed a novel alternative strategy which utilizes natural grasslands as an ideal place for chicken farming instead of the traditional model of raising cows and sheep. Compared with traditional sheep grazing, chicken farming significantly improved soil surface water content (0–10 cm), from 5% to 15%. Chicken farming did not affect the soil bulk density, while traditional sheep grazing increased the soil bulk density of the 0–10 cm soil layer. Chicken farming in grassland caused a significant increase in primary production compared to traditional sheep grazing, with the former yielding three times the above ground, and twice the root biomass of the latter. Raising chickens in relatively small areas of land (10 per cent of the total) with a water source, while leaving the other large degraded land areas (90 per cent) for natural restoration. Since soil seed banks in these grasslands are sufficiently large to sustain re-vegetation, no further human efforts were required. Chicken litter also benefits the production and soil quality of the grassland ecosystem, with few side effects on its structure and function. The economic income of local herdsman has risen six fold compared with the traditional practice of raising sheep. Ecologically, such an innovative solution allowed a large area of degraded land to regenerate.

Key words: land restoration; chicken farming; Hunshandake Sandland; income generation; seed banks

Conservation of sea-buckthorn (*Hippophae rhamnoides* L.) populations in the Zarafshan river valley

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Abstract

In Uzbekistan sea-buckthorn (*Hippophae rhamnoides* L.) is used to grow in vast thickets in the whole Zarafshan river valley. For the last 30-40 years the intensive agricultural activities in the area have resulted into destruction of the tugai vegetation, sea-buckthorn in particular. This occurred after long-lasting unsustainable use of wild populations, cutting down trees for timber, unregulated grazing and absence of protection and forest restoration measures. Nowadays only in the unique Zarafshan Nature Reserve, sea-buckthorn thickets are being conserved. The continuous degradation of the tugai-vegetation is yet still affecting the unique genetic diversity of the sea-buckthorn growing in the Zarafshan river valley.

Sea-buckthorn has very valuable applications, which are largely unknown and not fully used in Uzbekistan at the moment. There are several medicinal qualities attributed to sea-buckthorn. Fruits, leaves, cortex and seeds contain valuable substances such as oil, vitamins, sugar, tannin, minerals and serotonin. Sea-buckthorn is hence a valuable raw material for the pharmaceutical and food-processing industry.

Sea-buckthorn forms rapidly extended root systems, which are useful against soil erosion. The anti-erosion properties of the sea-buckthorn are very important, especially when the present situation of destruction the tugai-forests and the intensive use of water from plain rivers is taken into account. Another important biological feature of sea-buckthorn's root-system, is its strong ability to fix atmospheric nitrogen. These properties make sea-buckthorn an ideal candidate for soil and water conservation in extreme and marginal areas, besides its considerable economic potential. To prevent further erosion of sea-buckthorn diversity, further research is needed. As the sea-buckthorn is a valuable, but under-utilized medicinal fruit species, under heavy human pressure, it is necessary to develop a strategy for promoting its conservation and sustainable use. Some important actions are herewith proposed:

- Improve/strengthen the security-system to protect sea-buckthorn populations.
- Carry out eco-geographical and socio-economic investigations on the condition of sea-buckthorn populations, their uses and existing threats.
- Continue to study genetic diversity of sea-buckthorn in Zarafshan river valley and in other areas.
- Collect sea-buckthorn forms for conserving/preserving germplasm, determine which individuals are most valuable in food and medical uses.
- The collection can be used to provide interested farmers with planting material and for selection of perspective species for bring into culture. Also collection samples can be used to carry out biological, morphological, biochemical and physiological studies
- Carry out public awareness, to improve the knowledge of local people on the unique properties and uses of sea-buckthorn
- Promote sea-buckthorn uses in garden landscaping, yards of farmers and investigate on its possible cultivation. This can result in sea-buckthorn serving as an additional source of income for local people, while it will also lower the pressure on the natural population of sea-buckthorn in the Zarafshan river valley and its surroundings.
- Develop measures on how to best use sea-buckthorn in preventing soil erosion.

The sustainable conservation and use of the sea-buckthorn is a very strategic contribution towards the maintenance of the tugai-forest and water-systems, in addition of being an interesting source of income generation for local populations.

Key words: sea-buckthorn, under-utilized species; medicinal plant; tugai forest, Zarafshan valley

Prospects of wastewater reuse for irrigation in Uzbekistan

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Abstract

The development of reclaimed wastewater reuse has emerged as a potential resource to satisfy the continuously increasing demand for water. Expansion of urban population and increased coverage of domestic water supplies and sewage network will give rise to greater quantities of municipal wastewater which can become an additional water source, particularly for agricultural and landscape irrigation. Treated and re-used sewage water provides a viable opportunity to increase traditional water supply. Discharge of sewage effluent into surface water is becoming increasingly difficult and expensive as treatment requirements become more stringent to protect receiving waters such as rivers and estuaries. Therefore, many countries have included wastewater re-use in their water planning.

The re-use of municipal wastewater will require integrated management practices and precise monitoring procedures. Properly managed re-use of sewage waters reduces environmental degradation. Since several activities do not require water of potable quality, reclaimed waters can be used effectively for purposes of non-agricultural irrigation (parks, green areas, etc.), industrial processes (cooling water, boiler feed, and process water), fire fighting, and groundwater recharge. It is a constant water source, and nitrogen and phosphorus in the wastewater may result in higher yields than freshwater irrigation, without additional fertilizer application. Also, the treated wastewater has lower salinity.

There are the following benefits of treated wastewater re-use:

- preserving of the high quality, expensive fresh water;
- preventing water pollution and protecting the environment and public health;
- promotion to sustainable water use by effective management of treated wastewater as a superior source for agriculture.

One of the economic benefits of wastewater reuse in arid and semi-arid areas is the intensive agriculture development that would not be possible without a constant supply of water. Many countries such as Spain, France, Italy, Israel, Greece, Portugal, Cyprus, Malta, Tunisia, and Egypt effectively practice wastewater treatment and reuse. Israel, Cyprus, Tunisia, and Jordan have already included wastewater treatment and reuse to their water management strategies as an integral component.

The western regions of Uzbekistan are characterized by arid conditions and severe water deficiency. At the same time, increased demands for irrigation and domestic water supply have been occurred in the country in recent decades.

Further development of this reliable water resource depends on all elements including infrastructure and facilities planning, wastewater treatment system, treatment process reliability, economic and financial analysis, water utility management, and public acceptance. The methodology of economic analysis of wastewater re-use for irrigation have been developed taking into account current water management conditions in Uzbekistan.

Key words: wastewater re-use; environmental degradation; water management; economic analysis; Uzbekistan

Cultural experiment of licorice in Mongolian arid land focused on the water condition of greening soil materials

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Abstract

In recent years, desertification is rapidly proceeding and it becomes one of the most serious geo-environmental problems in the world. The aim of this study is proposing the high value added greening to prevent desertification. The investigation place focused on is arid land of southern Mongolia because rare plant licorice lives there wildly. But deteriorating land is rapidly proceeding by over hunting licorice in order to use the medical property (Glycyrrhizin) in its root. In 30 years, the biological resource of licorice was reduced to half and the export price have been increasing. These matters need an immediate solution, but many biological properties of licorice are still unknown. Firstly, it is needed to grasp the geo-environment in this arid land and licorice in itself. To clarify the relationships between licorice and geo-environment, cultivation experiments were conducted in southern Mongolia.

Authors investigated the climate, physical and chemical properties of soil in the ground with each depth of ground. In this paper, physical properties mean particle size distribution and the water content, chemical property means pH and electronic conductivity (EC). Investigation place is classified into natural habitat (for licorice) area and non-habitat area. Suitable condition for licorice can be considered by comparing natural habitat area with non-habitat area. As the result of investigation, there was little precipitation (annual amount was around 100-200mm) and the difference of temperature in the daytime was large (around 20 °C). From geo technical view point, the pH of soil was 7-9 and average particle diameter was around 10-150µm. therefore licorice lives in severe climate environment and in alkaline sandy ground.

It was the greatly difference between habitat area and non-habitat area that the amount of water in the ground. The both of surface layers were dry but at the point deeper than 20cm from surface, habitat area had relatively higher water content (5-20%) than that of non-habitat area (1-3%). And the average particle size of natural habitat area was smaller than that of non-habitat. It was anticipated that licorice lives in the ground containing relatively high water content. Therefore water condition is most important factor for growth of licorice in arid land.

Based on the investigation, cultivating field was made and cultural experiments were conducted in the border between habitat area and non-habitat area. This study proposes the planting material due to promoting growth of licorice in the arid land. Planting material is made of fine sand and compost which is superior to retaining water and nutrition. Licorice has a particular feature that even if the root with shoots had been cut, it could grow as new individual if it is returned in the ground suitable for it to grow. By utilizing this particular and planting material, this experiment tried to increase the amount of licorice and green tract in Mongolian arid land.

At This time, it was changed that kind of composts, the amounts and directions of planting materials in the 400m² field.

Key words: Licorice; water content; geo-environment; greening soil materials; cultivation

Marginal lands for afforestation: Farmers' perceptions on land degradation and alternative land use options in Uzbekistan

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Abstract

Land degradation presently affects the production and livelihoods of farming communities worldwide and agrarian Uzbekistan is no exception, where the current land, water and resource use practices invoke the environmental concerns therewith. Among mitigation measures for land degradation the afforestation with suitable tree species stands as a promising solution for degraded croplands in the region. However, whilst the proven multiple benefits of afforestation can be suggested for local farmers, little is known about their awareness on land degradation and ways for land improvement applying the alternative land use practices with trees. Therefore, the capturing of traditional knowledge among the direct land users who are hardly addressed by respective local research, may contribute to better understanding of resource problems and facilitating the promotion of the sustainable resource management in the region.

The qualitative study undertaken in 2009-2010 in the north-western Khorezm province of Uzbekistan was aimed at capturing the perceptions of local farmers about marginal degraded croplands, land improvement options and views on tree planting as alternative land use for degraded croplands. A combination of purposive and snowball sampling techniques was applied to survey 120 crop farmers in seven districts of the Khorezm province. The study identified the local taxonomic names and attributes for classifying the degraded cropland, whilst the status of land 'marginality' could have a 'permanent' or 'interim' status. Farmers connected the reasoning for land degradation to the existing praxis on the one hand and environment-related conditions on the other. From the perspective of surveyed land users soil salinity was mostly considered as the main reason for land degradation. Despite the general recognition of trees for their services and beneficial properties including thus the contribution to improvement of degraded land, the awareness on afforestation as one mitigating measure was mostly lacking. Few reasons refer to the vanishing practices and therefore the disappearing knowledge of proper tree planting or enjoying the multiple benefits from e.g. windbreaks, shelterbelts or woody plantations. Lacking evidences may also stem from the weak institutional and legislative support, as well as incentives for farmers adapting the afforestation practices.

Key words: farmers' perceptions; marginal/degraded cropland; afforestation.

The ^{13}C and ^{15}N natural abundances to characterize soil organic matter associated with clay minerals in Eurasian steppe soils

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Abstract

Introduction

Soil organic matter (SOM) consists of various functional pools that are stabilized by specific mechanisms and different turnover time. Especially, SOM associated with clay minerals has larger organic carbon content and longer turnover time than coarser minerals. This means that this pool plays an important role for sustaining soil fertility and for storing carbon in soil. In Eurasian steppe, wind erosion led to degradation of soil properties because SOM was removed together with fine particles. Therefore, it is necessary for soil conservation to understand the nature of SOM associated with clay minerals in various environments. Particle size fractionation is generally used in isolating SOM associated with clay minerals. Moreover, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values are useful tools to assess the characteristics of SOM pools because these values were different in each SOM pool in many cases. Our objective was to characterize SOM associated with clay minerals in Eurasian steppe soils using particle size fractionation and stable isotopic techniques.

Materials and methods

Surface soil samples were collected from forty-three grassland sites in Ukraine, Kazakhstan, Mongolia and China. The particle size fractions from soil samples were isolated by ultrasonic dispersion in water. After the dispersion, clay (<2 μm), silt (2-20 μm) and sand (>20 μm) fractions were collected by sedimentation. Organic carbon (OC) and total nitrogen (TN) content of clay, silt and sand fractions, and $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of clay and silt fractions were measured.

Results and discussions

The OC in clay, silt and sand fractions accounted for $52.5 \pm 9.0\%$, $40.4 \pm 5.3\%$ and $6.6 \pm 4.9\%$ in total OC, respectively. The distribution of TN in each fraction followed a similar pattern to that shown by OC. These indicated SOM associated with clay minerals played a key role in retaining SOM in Eurasian steppe soils. The C: N ratio were 8.6 ± 1.0 in clay fraction, 11.5 ± 2.0 in silt fraction and 13.5 ± 5.5 in sand fraction. The C: N ratio decreased in the order sand > silt > clay. The $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of clay fractions were from -20.2‰ to -25.1‰ and from 4.1‰ to 12.5‰ , respectively. These values of clay fractions were always higher than silt fractions. The results of C: N ratio, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values were suggested that SOM associated with clay minerals contained more decomposed SOM. Additionally, the $\delta^{15}\text{N}$ values had larger range than $\delta^{13}\text{C}$ values. The $\delta^{15}\text{N}$ value was better indicator for characterization of SOM within particle size fractions in this study sites.

Key words: particle size fractionation; soil organic matter; ^{13}C ; ^{15}N ; Eurasian steppe

Changes in water quality of Amudarya River and ground water in Karakalpakstan, Uzbekistan

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Abstract

Aral Sea Problem is one of the big environmental problems in the world. The decrease in Aral Sea area caused by Large scale irrigated agriculture which started in the 195's, especially in the Aral Sea basin. As the result, many villages were built in the area and people started producing, cotton, wheat, and vegetables (Kawabata *et al.*, 2012).

The gradual climate change over the centuries was accelerated by the Aral Sea ecological disaster of the late 20th century in Aral Sea basin, especially Karakalpakstan. E. PAPA *et. al.* (2004) were researched EC value for effect for salinization caused by large scale irrigation. G. CROSA *et. al.* (2006a) were analyzed pesticides in Amudarya basin. They were informed the compounds with a high risk for contamination were identified.

Ground water or river water is main source of drinking water inn this basin. We researched changed of water quality in water from 2008. In this studied, we compared the trend of EC values of Amu water and ground water until 2011.

Water samples in the lower reaches of the Amudarya River during the period of August 2008–August 2011. The sampling point is located on the Amudarya River basin in the lower part of the riverbed near Nukus (Karakalpakstan, Uzbekistan). Groundwater samples were taken at the same time in the immediate vicinity of Nukus town and the river bed of Amudarya.

The comparison of the total amount of salt in the Amu-Darya River and in the groundwater during the period of researches revealed some interesting facts. The total amount of salt in the groundwater has a tendency to increase. The water quality in the Amudarya River improves and the total amount of salts decreases. It may be explained by the decrease in the inflow of the drainage water into the river bed the Amudarya as a whole.

The water of the Amu-Darya River despite the high content of sodium, sulfate and chloride ions, can be used for drinking purposes due to the absence of other sources of clean water. The ground waters are salty with a high content of sulfate, chlorine and sodium ions and they are not suitable for drinking purposes in the area of studies.

The tendency to the decrease in the amount of salt in the Amudarya river and the increase in the degree of the groundwater salinization has been determined. It can be explained by two factors such as the decrease in the discharge of the drainage water into the Amu-Darya river bed as a whole and the reduction in the amount of the inflow of irrigation and atmospheric water into the soils, which leads to the increase in the amount of salt in the groundwater.

Key words: water quality; Uzbekistan; Karakalpakstan; Amudarya River; ground water

Protective effects of vegetation in Chambi National Park in Tunisia

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Abstract

Change of the ecosystem due to human disturbance contains a problem to be concerned about as the cause of environmental problems. In particular, environmental changes through the use of excessive living resources, has become a cause of desertification in arid areas and semi-arid areas. In case of Mediterranean region, land use by humans has been continued from BC. Most of the plains have been cultivated as olive groves, wheat fields and subjected to grazing of sheep and goats. Excessive disturbance effects caused by human impact such as excessive grazing, deforestation, and cultivation are severe in Mediterranean area. In order to evaluate the impact of protectionist policies, it is necessary to elucidate the impact on vegetation due to differences in management methods. The aim of this study is to clarify the protective effect of natural vegetation by species composition. Tunisia's land, has been used to agriculture since historic times. However, several environmental problems have been occurred by overuse of bioresource. Tunisian government made some protection areas to recover their endemic nature to solve this problem. The investigation was performed in Chambi National Park which is located at mid-western part of Tunisia in November, 2009. Chambi National Park started to protect since 1978. A study describing the dominant species has been done in Chambi National Park but the assessment of the protection effects on species composition level has not been done, making the discussion of the conservation of the species diversity virtually impossible in this situation. We found 28 species in study area. Total coverage of unprotected site was significantly different from of that of protected site ($P < 0.05$). *Rosmarinus officinalis* appeared with high coverage inside the protected site, but did not appear outside the protection site. In addition, a similar tendency was seen in *Globularia alypum*, *Pituranthos scoparius* and *Thymus algeriensis*. The species which are used as medicinal plants, aromatic oils, and as traditional seasoning had a higher coverage in the protected areas. On the other hand, *Echium trygorrhizum*, *Eruca sativa*, *Atractyris serratuloides* and *Cynodon dactylon* had a reverse tendency. Coverage of *Artemisia herba-alba* increased at outside the protection site. We shed light on the protective effect of natural vegetation on the changes in species composition at Chambi National Park. These results indicate that the species composition of the surrounding area around Mt. Chambi has changed because people have used up too much plant materials for medicine and food for livestock feed resources. Our results suggest that the use of the wild plant resources without sustainable management plan alter ecosystem of arid and semi-arid land.

Key words: bioresource; species composition; protection effect; national park; Tunisia

Ecological remediation of abandoned saline soils using *Glycyrrhiza glabra*

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Abstract

One of the major problems for Central Asia and the whole world is the prevention of salinization and soil-and-water pollution, as well as the solution of the problems linked with drainage use for irrigation under the conditions of the Hungry Steppe (Mirzachul).

The most important tasks are to restore the efficiency of saline soils, create a highly productive fodder biocenosis instead of them, involve them into agricultural circulation, improve their land-reclamation condition and enhance soil fertility. This task is being solved with the help of ecological restoration of salty soils with the use of biomeliorative halophytes.

As a result of selection in the Mirzachul oasis, we have established five perspective species and ecotypes fit for being disseminated – biomeliorants for producing power consuming feeding – stuffs and officinal materials on the secondary salinized soils and under the conditions of irrigation with salty water.

Glycyrrhiza glabra L. is considered especially perspective biomeliorant for the effective development of saline irrigated soils, and is, at the same time, a valuable officinal and fodder culture.

Biomeliorant *Glycyrrhiza glabra L.* is a very important and rarely replaced plant for preventing the soil salinity. *Glycyrrhiza glabra L.* is able to grow in wet soils and is resistant to salty dirty moisture. It is proved experimentally that it can grow under natural conditions even with chlorine sulphate salts in the soil.

The main advantage of the malt is that it vaporizes subsoil waters intensively in the period of vegetation and thus prevents bogging up of irrigated areas, at the same time the loosening of the gypsum stratum of soil takes place when whirling the root to 5-6 meters down, it helps to achieve a better effect when washing dissolved salts from the soil.

Proceeding from the obtained results we have decided to multiply *Glycyrrhiza glabra L.* just on salty soils for preserving its quantity and for restoring abandoned lands for agriculture. The results have already attracted the attention of scientists from the international organizations such as IWMI, ICBA, ICARDA and leaders of various government departments.

It is necessary to point out that the approach to implementing this programme and the already established organizational structures would be of extreme value in the successful implementation of the future projects:

- the availability of green plantations of neglected lands containing halophytes: plantations of *Glycyrrhiza glabra L.*; demonstration plantations of perspective species and ecotypes, suitable as plants-biomeliorants for producing power saturated fodder and officinal raw materials on secondary salty soils and under the conditions of irrigation by salt water;
- working out the methods of preserving and extending areas of the perspective species and ecotypes of halophytes – biomeliorants;
- a scientific-producing center for eliminating bogging up and land salinization is organized.

Key words: biomeliorant; *Glycyrrhiza glabra L.*; salinization; restoration

Physical methods for studying the environment objects

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Abstract

High-sensitivity laser methods that as laser resonans-ioninazation spectroscopy in vacuum, atom-ionization in flame, cavity-ringdown laser absorption spectroscopy for identification of ultra-small concentration of atoms in various phase states of substance were used. Subjects of the research were natural water, soil, transformer oil and various aerosols of salts of metals. Gas chromatographic method with electron capture detector was used for identification of polychlorinated biphenyls.

We investigated the atmospheric aerosols using the cavity ring-down laser absorption spectroscopy. A modified cavity ring-down technique is used to investigate the optical extinction of the atmospheric aerosols. The experimental system is composed of a pulsed dye laser pumped by the nitrogen laser ($\Delta\nu \approx 1 \text{ cm}^{-1}$, 10 Hz, 0.100W), optical system, the ring-down cavity, the detection system for the ring-down signal, and clean dry air system. Most measurements were carried out at $\lambda=522 \text{ nm}$. Both mirrors had the reflectivity of about $R > 99.0 \%$ at $\lambda = 532\text{nm}$. The length of the ring-down cavity was 61 cm. Slow flow of dry clean air at 2 L/min was introduced near the mirrors for protection and to minimize the possible contamination by aerosol particles. One round trip of the laser pulse is equal to $2L/c \cong 4\text{ns}$.

The detection system for the ring-down signals consists of a metal shielded photoamplifier (PAF 79). The signal was digitized and averaged over 1000 laser pulses by a digital oscilloscope (Tektronix TDS 2022B) and then transferred to a personal computer for processing.

The effects of non-absorbing aerosols, such as acetone, smoke, ethanol, hot water steam and gas discharge on the cavity ring-down times were investigated experimentally.

Twenty six samples for PCBs pollution in the central Region of Samarkand and Tashkent Region were investigated. Soil samples were collected from around of electricity supply of the Samarkand region and around Chirchik Transformer plant of the Tashkent region. The soil samples were extracted with chloroform mixture (1:1 v/v) for 4 hours. The final extract of 2.0 ml was analyzed for PCBs using a gas chromatograph equipped with 10 mCi ^{63}Ni electron capture detector GC - ECD model 86/30. The retention time for the PCBs standard $C=1\text{mg/L}$ were PCB 2,4,4', 3.683 min; PCB 2,2',5,5', 3.963min; PCB 2,2'3,4,4'5,5', 4.697 min; PCB2,2,3,4,5,5' 5.237 min; PCB 2,3'4'4'5, 5.427min; PCB 2,2'4,4'5,5' 5.67 min; and PCB 2,2'3,4,4',5' 6.290 min. Calibration curves for PCB 7 congeners were obtained, and the detection limits were estimated. We have used the standard solutions $C=1\text{mg/L}$ and 10mg/L of PCB in isooctane for receiving calibration curves and identification for PCB 7 congeners.

The variations of the microelements in soil around Chirchik Transformer plant were analyzed by the method of atomic absorption spectrometer "Saturn". The mean concentration (in mg/kg) of the metals were Ca (416 \pm 19.1) >Na (222 \pm 13.6)>Cu(100 \pm 3.9)>Ni (87 \pm 5,1)>Pb(57.1 \pm 2.9)>Zn (40.0 \pm 2.5) >Co (29.0 \pm 1.9) >Cd(21.3 \pm 1.5) > Fe (18.0 \pm 1.3)> Mn (10.0 \pm 1,2)>Cl-(0.32 \pm 0,02). The variations in the levels of the microelements were in the order Ca >Na >Cu>Ni >Pb>Zn >Co > Cd > Fe> Mn >Cl. Very few sites were found to be contaminated with metals, but the level of metal contamination was very low. There was no significant correlation between the PCBs and any of the metals. The sources of the PCBs and metal were anthropogenic.

Key words: the atmospheric aerosols; laser resonans-ioninazation spectroscopy; atom-ionization; cavity ring-down; polychlorinated biphenyl

Impact of saline environments on the structure of bracts and bracteoles *Climacoptera longistylosa* (Chenopodiaceae)

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Abstract

Long-vegetating *C. longistylosa* (Iljin) Botsch annual crop, pelitic halophyte is common at salt marsh and mottled soils in the plains and foothills. For this study the material was collected in saline soils of Syrdarya and Surkhandarya regions.

In Syrdarya region 90% of the irrigated soil experiences varying degree of salinization - it contains 1-2.5% of dry extract in 0-100 cm of soil horizon (Namozov et al, 2004). In Surkhandarya region in light and typical gray soils dry extract contents 1-1.5% in 0-100 cm soil horizon (Baratov, 2012). *C. longistylosa* flower has one bract and two bracteoles. Bract and bracteoles have a structure similar to a leaf. At transversal section the shape of bracts and bracteoles bowed, semi-equant, with narrowed edges. Type of bract mesophyll in its venter is ventrodorsal. In the lower and middle part of the bract on the abaxial side under central bundle palisade tissue and chlorenchyma are not closed and absent at the glumal edges. The structure of the bracteole is basically similar to that of the bract. The main difference is the smaller number of peripheral conducting bundles, and the presence of palisade and chlorenchyma tissue in the central green fleshy part. The lower part of the bracteoles is represented by water-bearing parenchyma only.

Bract and bracteole of plants growing at saline soils of Syrdarya and Surkhandarya regions have similar anatomical structure, but differ in terms of quantitative index of features. Comparing plants growing at different habitats the characteristic changes were identified in the palisade parenchyma. For Surkhandarya region ekoform the palisade cells in bract are $56.8 \mu\text{m} \pm 0.41$ in height and $8.5 \mu\text{m} \pm 0.29$ in width; in bracteole - $43.8 \mu\text{m} \pm 0.85$ in height and $5.1 \mu\text{m} \pm 0.20$ in width. For Syrdarya region ekoform the palisade cells in bracts are $45.1 \mu\text{m} \pm 0.96$ in height and $4.8 \mu\text{m} \pm 0.10$ in width; in bracteole $34.0 \mu\text{m} \pm 0.62$ in height and $3.5 \mu\text{m} \pm 0.19$ in width. Comparative studies of the Surkhandarya and the Syrdarya ekoform shown that the palisade cells of bract and bracteole were 1.3 times higher and 1.8 and 1.5 wider. However, the water-bearing cells of plants growing at Syrdarya region are larger with the same number of rows. Ash content was determined for two *Climacoptera longistylosa* ekoforms to reflect the amount of minerals which is 44.39% for plants in Surkhandarya region and 49.74% - for plants, growing in Syrdarya region. That is correlated with the salinity degree of soil.

Surkhandarya region plants growing at more arid but less saline soil have the cell size of adaxial and abaxial epidermis in the bracts and bracteoles similar to the Syrdarya ekoform. However, they have higher and wider the palisade cells, but the palisade index is less, kranz cells larger in bract and similar in bracteole. The number of water-bearing layers in the bracts and bracteoles are constant. Thus, enlargement of water-bearing cells of the Syrdarya ekoform plants is caused by the influence of salinity and a high palisade index, which is determined mostly by growth conditions.

Key words: anatomy of flower organs; chemical ions contents; plant tissues; sals salinity; *Climacoptera longistylosa* (Iljin) Botsch; arid zones of Uzbekistan

An overview of DLDD assessment technology and SLM practices for agriculture and rural livelihoods in Uzbekistan drylands – learning from CACILM-I partnership program

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Abstract

Republic Uzbekistan is a double land-locked country, centrally situated in the heart of Central Asia within the Aral Sea basin. Almost 80% of the country area is comprised of deserts and semi-deserts, including Kyzylkum, the largest desert of Central Asia. Agriculture plays a vital role in the national economy of Uzbekistan. Scarcity of water is the major constraint for agricultural development and meeting the needs of the population of 31 million people.

It is estimated that more than 2.100 Mha or 49% of the cropland in the country have suffered from serious secondary salinization and 73% of grasslands are presently undergoing degradation. Productive ability of irrigated soil, estimated on land fertility rate, has decreased on the average from 3 points to 7-10 points, which cause decrease in productivity of crops, and in crop production per capita. Annual losses of agricultural productivity are estimated to be approximately \$31 million USD, and economic losses due to land abandonment, because of high salinity, are estimated about \$12 million USD. Dangerous phenomena, such as drought, becoming frequent in conditions of the climate change, increase of instability of an agricultural production, and threaten rural livelihoods.

The paper describes current state, cost and assessment of the DLDD technologies and results of mainstreaming sustainable land management (SLM) approach and practices in the framework of the Initial phase of Central Asian Countries Initiative for Land Management (CACILM) Program (2007-2010). CACILM Partnership Program is addressed to meet two target tasks: stabilization / improvement of ecosystems integrity, and improvement of vital rural living standards in the country. Achievements and assets of CACILM-I confirm a high efficiency and acceptability of the GEF programmatic approach for all UNCCD stakeholders in Uzbekistan and other CA countries. Knowledge of spatial and temporal assessment of desertification, land degradation and drought (DLDD) is gathered through application of the FAO LADA approach and mapping tools. MODIS Vegetation Indices Dataset (MOD13Q1, 250m) and LANDSAT TM has been the primary data source for interpreting historical and seasonal changes of NDVI and establishing the baseline information on land degradation, hotspot and bright spots analysis and impact on rural livelihoods in Uzbekistan. The most successful SLM approaches and best practices have been selected, documented and integrated into global WOCAT knowledge base, including: 4 technologies (*Pasture rotation in desert areas, Agro forestry reclamation of degraded lands, Pistachio plantations and Use of mineralized artesian water*) and 2 approaches (*Community based forestry and FAO Farmer Field School*) [www.wocat.net]. The findings highlights that technical interventions need to be accompanied by institutional changes and SLM policy frameworks that recognize needs and benefits of rehabilitation and mitigation of DLDD impacts for agriculture and food security.

Key words: land degradation, cost and assessment of DLDD, SLM practices, FAO LADA approach, change of NDVI, sustainable land management

Adaptive evolution of species of family Elaeagnaceae Juss

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Abstract

Primitive forms of Elaeagnaceae, apparently, were mesoxerophytes. We, together with other researchers (Vasilchenko, 1981; Khaydarov, 2003), reveal xeromorphic signs such as dense pubescence above epicotyle and on the first pair of leaves what suggests mesoxerophyllic nature of the Elaeagnaceae ancestors. Pubescence on leaves and sprouts is an ancient sign characteristic for all the family. We think that dense felt or velvet pubescence of asteroid trichomes is considerably more progressive than jelly-fish or shield-form trichomes; it lowers intensity of transpiration much better and besides protects leaf plate from direct sun rays and heat, i.e. improves regulation of temperature regime.

We think, that low height, dense prickles on branches, narrow leaves as well as abundant silver scales on shoots, leaves and generative organs developed in Elaeagnaceae during natural selection under conditions of water deficiency and high insolation.

Evolution of nectary and ways of nectar excretion were connected closely to general evolution of the flower. Nectary genesis was related with the process of entomophilia and resulted from mutual adaptation of the flower and insect. Nectary disc also protect ovary and developed fruit from drying under arid conditions.

It is possible, that remote ancestors of Elaeagnaceae had bisexual flowers. Transition from bisexual to unisexual flowers is considered as a way to increase efficiency of cross-pollination due to limiting self-pollination. Some authors (Pervukhina, 1970; Takhtadjan, 1970) believe that a transition from entomophilia to anemophilia occurred in different lines of evolution at different levels of their specialization. The main cause of the transition was deficiency of pollinator insects.

Transition to dioecious reproduction in the family Elaeagnaceae also suggests, to some extent, prevention of excessive use of energy for production of excessive pollen and not only helped cross-pollination but also raised its economy.

Thus adaptive evolution of species of the family went mainly by the way of genesis of generative and vegetative organs: from rather big trees to big bushes, from mesophyllic (broad oval) leaf to xerophyllic (narrow) one, from shield-like scales to medusa-like and asteroid scales, from bisexual flower to unisexual one (Hippophae), from upper ovary to lower one with reduction of endosperm and increase of germ size, from primary xerophyllization to secondary xerophyllization (Khaydarov, 2003, 2005).

So, in spite of parallel development of the genera Hippophae and Elaeagnus, the last one is more adapted and evolutionally advanced (Khaydarov, 2004, 2006).

Key words: Elaeagnaceae; mesoxerophytes; genesis; evolution; adaptive

Reconstruction of ancient fauna and flora from Ajakagytm (Uzbekistan, Kel'teminar, 7th-5th millennia cal BC)

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Abstract

Ajakagytm is a Neolithic lake shore site located in the central Kyzylkum desert of Uzbekistan. New excavations conducted since 2005 by the French-Uzbek field expedition missions evidenced several successive Kel'teminar occupations dating from the end of the 7th to the 4th millennium. They provided more than 50 000 microlithic artefacts, and smaller series of degrader pottery, animal and plant remains. Animal bones materials were documented in three main categories: wild animals; domesticated animals with the traces of domestication well marked on the skeleton and animals, which could be tamed and used by men, but bearing no visible traces of domestication on the remains of their skeleton. They also provided more than 2000 faunal remains. Most of them are very badly preserved, due to the much contrasted climate (heating and cooling and wetting and drying). However, 580 specimens could be attributed to a taxon, and more than 200 of them could be identified at the level of genus or species. They provide a clear image of the wild large mammals which lived in this area and which were hunted by the Kel'teminar people: the goitered gazelle (34%), aurochs (16%), onager (11%) and the wild camel (11%). We also find 15% of Caprini but, due to the poor preservation of the material, it was impossible to tell if they were hunted wild bezoar goats or early domesticated sheep or goat. Conversely, 13% of the specimens clearly refer to very small size bovinds. This site represents the earliest evidence of domestic cattle in Central Asia. We can partly compare our observations from Ayakagytm site with the archaeological identification of the animal images on the prehistoric petroglyphs from Sarmishsay Gorge, southern slope of Karatau Mountain Chain, not further than 80 km East of Aykagytm Saline Depression. A part of petroglyphs, which is thought to belong to Neolithic period, often presents aurochs or domesticated cattle. High frequency of the cattle images emphasizes its important role in the prehistoric economic and land use development in the area.

Additionally in the Aykagitma site enigmatic set of nearly 600 shark teeth, 80% of them being concentrated in less than 6 sq. meters have been found during excavations. Most of them were of small size (crown height comprised 4.5 to 20mm). Taxonomic identification of the best preserved teeth evidenced the presence of an association of six to seven species, all of them being known from the Paratethys Sea during the Middle Ypresian (Early Eocene). Test excavations and intensive surveys around the site evidenced that it was settled not only near one of the rare flint source of the area, but also right on a vast Early Eocene marl outcrop with rather abundant shark teeth. The analyses of the frequencies of the species and sizes of the teeth accumulated in the archaeological site suggest that the kel'teminar intensively collected shark teeth around the site. This unique massive use of shark teeth was discussed with reference to the microlithic characteristic of the Kel'teminar culture (Vigne et al., 2013). Paleobotanical studies compared with modern geobotanical survey done nearby the Aykagitma site and its surroundings shown a diverse flora represented mostly by desert tamarisk and saxaul trees, shrubs and perennial chenopods, grasses and legumes, which continue to colonise this area still today.

Key words: archaeozoological survey; domestication; Kel'teminar culture; paleobotany; Kyzylkum Desert; Uzbekistan

Conservation of cultural and natural heritage of Sarmishsay

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Abstract

Sarmishsay is a river gorge on the south slope of the Karatau mountain ridge (latitude 40° 15' 47'' N, longitude 65° 35' 09'' E and 708-891m above sea level), located about 30km northeast of Navoi in Uzbekistan. Sarmishsay must be recognized as an integrated cultural and natural landscape well preserved until the present. The human use of the area stretches through several thousands of years and it left its traces in the shape and motifs of more than 5000 of petroglyphs and more than 140 archaeological monuments. The monuments of the Sarmish Gorge constitute a whole cultural complex, i.e. the system of the archaeological sites of several types (petroglyphs, paleolithic flint processing workshop sites and mines, medieval settlements, barrows and burials of prehistoric and medieval nomads (from the 1st millennium BC up to the 19th century AD) settlements, etc.), interconnected by the territorial and functional unity, characterizing the important aspects of the social and cultural life of its inhabitants from Neolithic until contemporarily.

The natural landscape of Sarmyshsai belongs to piedmont, desert, and semidesert types. Older writings, particularly from pastoralists, traders and travelers, clearly indicate much more mature, even forest-like vegetation as they passed through the Kyzylkum desert and its foothill semi-desert surroundings. About 34 species are described as endemic, rare and endangered, such as *Acantholimon nuratavicum*, *Dianthus helenae*, *Dracocephallum nuratavicum*, *Allium stipitatum*, *A. suvorovii*, *Bryonia melanocarpa*, *Cicer grande*, *Corydalis severtzovii*, *Juniperus zaravshanica*, *Jurinea zakirovii*, *Cerasus amygdaliflora*, *T. sogdiana*, which make the natural landscape of Sarmyshsai very unique. This fact turns Sarmishsay into a site of the utmost importance both in Central Asia and in the world. Preservation of the beautiful landscape and the archeological monuments and rock art of Sarmishsay is a task for the Government and the society. Therefore, in 2004 by the resolution of regional khokim of Navoi region Sarmishsay Archaeological and Natural Landscape was recognized. In 2008 Sarmishsay Archaeological Complex was inscribed in the Tentative List of Cultural Heritage of UNESCO. Uzbek-Norwegian project collaboration in 2003-2010 between the scientific group "Sarmish" at the Institute of Archaeology of the Academy of Sciences of the Republic of Uzbekistan and Norwegian experts led to increased activity within systematic documentation and recording of the Sarmishsai petroglyphs. Today archaeologists and researchers continue to investigate Sarmishsay with the purpose of preservation for future generation and use of a site of world heritage value. The experience of and co-operation with scientists from Norway, Finland, Russia, Kazakhstan and other Central Asian countries, is priceless in the effort of preservation of the environment, the petroglyphs, and the other archaeological monuments from future damage. However, all safe and sensitive preservation measures and efforts would be in vein if the physical and spiritual values of the cultural and natural heritage are not protected from "vandal enlightenment" – present time over-use and misuse. The great management challenge is to ensure a sustainable balance between long-term preservation and enjoyment for visitors to and users of Sarmishsay.

The cultural context of the Sarmishsay Archaeological and Natural Museum Reserve refers to a certain life situation, which contents can be partly reconstructed on the grounds of data obtained from the archaeological, ethnological and historical sources. In respect for cultural heritage environments, awareness rising is important to create a more careful treatment of the heritage of Sarmishsay. The recognition of the world value of the monuments creates a platform for their stable conservation and careful and sensitive use. Sarmishsay must be understood as a unique and prominent center of the ancient spiritual life of our ancestors. It is a challenge and an obligation to preserve this and other valuable monuments of archaeology and history, art and culture for present and future generations.

Key words: cultural and natural heritage, petroglyphs, conservation, endemic plants, Sarmishsay Rock Art, Uzbekistan

Multi-factor objective modeling for water resources management in Zeravshan river

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Abstract

Zeravshan river basin has been one of the focal points in the argument of river basin efficiency between upstream Tajikistan and downstream Uzbekistan. The snow-glacier fed river 90% of which originates in mountains of Tajikistan currently is fully utilized in the heavily irrigated valley of Uzbekistan, when Tajikistan claims to use only 4%. Transboundary conflict over efficiency of the irrigation and low impact of the river in the place of the origin, causes Tajikistan consider more heavy investments on the river usage. Recent plan for the hydropower dam construction in the upstream is an evidence of changes to come. Such construction could at the same time have negative or positive impacts depending on operation schemes applied. Investigating possible solution of the positive outcome for both countries comes in solution of the multi-factor objectives policy dependable on the economic, social and environmental and political parameters.

In this research we modeled objectives of the irrigation, hydropower income and environment flow, water quality and return flow factors to define optimal water management policy. The research includes calculation of the current and future conditions by integrated hydrological model and modeling outcomes of the different objective for analysis. Optimization of the irrigation efficiency and using dam storage for the optimal release for irrigation is important, however producing less economic outcome for the upstream. Crop combination or the change in seasonality to the earlier months could become solution under future climate condition however environment flow and possible water quality deterioration becomes an important question. This research contributes in providing analytical decision framework to address river basin efficiency and water management policy for both counterparts.

Key words: Zeravshan river basin; multi-factor objectives; water policies; water resources management

Prerequisites for using SWAP model to calculate the optimal cycle irrigation of cotton in the delta of the Amu Darya (Karakalpakstan)

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Abstract

The central part of the Aral Sea region - the Amudarya river delta is a low plain with rare relict hills. In general territory of the Aral Sea region covered by gray-brown, taky, hydromorphic, deserted sandy soil, salt marshes. The Amudarya river delta is covered by hydromorphic soils such as meadow floodplain alluvial soils, bog-meadow, meadow taky, saline and non-saline, the old and the newly irrigated.

During the Soviet period in the Aral region was watering 7.5-12.5 thsd. m³/ha. For watering spent 15 thsd. m³/ha, some fields Karakalpakstan 20-30 thsd. m³/ha and rice fields Karakalpakstan passed 30-50 thsd. m³/ha. Optimum water requirements for cotton in Karakalpakstan may be 3.5-4.4 thsd. m³/ha with yields of 25-30 t/ha.

This article is focuses on use of SWAP model to develop the optimal cycle of cotton crop irrigation in conditions of water scarcity, to optimize management strategies in agriculture, as well as for the evaluation of regional water resources. It is necessary to carry out a field experiment in irrigated lands in the Amudarya river delta areas with cotton cultivation on the soils prone to degradation due to lack of water, changes in the salt regime of soils, salinity changes, the depth and the chemical composition of groundwater.

For such experiment in these particular circumstances it's necessary to select 3 sites (cotton crop fields) with different irrigation regime - from low to high level; here it's necessary to allocate areas where for three years to get the results of conducted seasonal testing pits to a depth of 1 m. Sampling conducted 3 times a year - before watering, during irrigation (growing season) and after watering. Testing provides a sampling of soil, groundwater and irrigation water, cotton (leaves, stems and roots). Also atmospheric parameters are measured. Sites locations are selected according to topographic and irrigation features of researched area. Samples were analyzed by chemical and physical methods in the laboratory to identify the level of major and trace elements, as well as to determine the humus content, water and salt balance, physical-chemical properties.

The obtained data will be entered into the SWAP application, which gives the opportunity to build a model (profile) of the distribution of groundwater in the soil throughout the year and make a forecast for the necessary and sufficient irrigation. Modeling with application of mathematical methods is an alternative way to determine the water balance components, so it provides the most accurate assessment of deficit of irrigation, needs of crops in the water, the dynamics of groundwater and underground water conditions in agriculture on degraded soils of the Amudarya river delta. SWAP model can be used as a powerful tool for the calculation of irrigation cycles of cotton crop in the present conditions in the delta of the Amudarya River allowing conservation of water for irrigation in the Amudarya basin.

Key words: Karakalpakstan; SWAP model; irrigation cycles; cotton; ecology

Transformation of olive related customs and olive-growing farms in North Africa

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Abstract

North African region with a peculiar climate of arid and semi arid, has much common with Southern part of Europe and Middle Eastern regions both geographically and culturally. Meanwhile, however they are accounted as Muslim countries since 7th century of Muslim invasions it is not so simple to define it only from Qur'anic and Arabic influences. Since it has been the crossroads of multiple cultures, not only Pre-Islamic but Pre-Roman, Pre-Punic cultures must be considered for understanding the universality and peculiarity of this region.

Traditionally, the cultivation of olives and the extraction of oil are the major livelihood in the Mediterranean basin. Since the period of Phoenician colonization, the cultivation of olives has been developed among North African regions. It is widely seen in our history and prehistory that an indispensable element of basis of life is bestowed the symbolic meaning under their existential situations, so the olive is no exception. Through their sensitivities, it has become the connotation that olive itself has the crucially important power so it becomes certain symbolic meanings inseparably connected with their usages. The core values of olive which could be common to the North African and Mediterranean regions, have been expressed in customs, beliefs and rituals which can be seen with certain act or symbols in required occasions. According to their sayings and customs, olive (olive tree, branch and oil) possesses a strong power of saints, jinn and itself so sometimes it becomes a mediator of these beings. It is even bestowed the power to control the weather. Also it is often used in ceremonies or customs for fecundity. The narrative cases in the early literature of European scholars on North African customs represent the comprehensible image and significance of olive which has survived through animistic, polytheistic and monotheistic cultures of North Africa. Although these beliefs seem to be so called sympathetic magic or just superstition, surely they are derived from the fact that olive has symbolic meanings of durability and fertility and that their customs are associated with primordial metaphysics.

However, these customs face to be perished since their style of life and farming has changed during the modernization, the process of modernization is not extensive. According to the sample survey on olive-growing farms implemented in 2011, the level of modernization of production as well as the productivity vary across region. The cultivation technology is still labor-using and village women take a major role. The olive sector continues to provide a main source of employment and income for rural population; however the process of transformation shows somewhat different. This paper presents traditional and modern aspects of olive growing farms based on the sample survey.

Even though their customs has lost the substance through modernization, it is still true that olive is elemental for the life of North African people. The significance of olive, decreasing on its religious aspects, gains on the contrary the new meaning as cultural resources, such as national or regional identity at the strategical request under globalization.

Key words: olive; North Africa; tradition; transformation; modernization

Site selection and environmental effect evaluation of large scale plantation using arid area runoff model

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Abstract

The main cause of global warming is the increase of atmospheric CO₂ gas. Currently, a sustainable carbon fixation system with large scale afforestation in arid land is established for the mitigation of global warming. We have set a research place near Leonora (mean annual rainfall is about 200 mm, mean annual evaporation is about 3,000 mm), Western Australia. In arid land, the most important problem is lack of water for afforestation, because of the small amount of rainfall and large amount of runoff water without using by plants. We have so far developed an original runoff model for understanding of water behavior and selection of afforestation site. This model involves three processes of penetration, evaporation and runoff, with two independent fitting parameters. One is corrective coefficient of penetration (PR), and the other is equivalent roughness coefficient (N). The best parameters have been determined by using water level data of the collecting pond of a closed hydrographic basin of 6 km × 4.8 km, named Jim's pool. In this study, we extend this model to the large area of 43 km × 52 km. Then we evaluated quantity of penetrated water in each mesh with a horizontal resolution of 30 meters, before and after the "afforestation" assuming that penetration rate of the bare ground will change from that of bare ground to that of forest area by the afforestation, while the impermeable hardpan layer is assumed to exist below surface soil layer of 15 cm depth throughout the area, and is not changed by the afforestation. Finally we evaluated the effect of "afforestation" on penetrated water amount by comparing the calculated results of large area, before and after the afforestation.

From calculation results, it was found that the penetrated water amount was increased by the "afforestation", namely by the increased in penetration rate, in the large area of the bare ground. In addition, this increase was mainly observed in the peripheral portion of the bare ground conditions, not at the relatively central area. The present results indicate that the some of run-off water will penetrate into the soil in large area where originally most of the run-off water did not penetrate, if we introduce soil penetration improvement technology, such as afforestation. On the other hand, it was thought that reduction of water penetration at the place where the original vegetation was forest, hardly occurred by afforestation. Namely, the amount of water flowing into the salt lake and evaporating in vain is decreased. In conclusion, it was confirmed that the afforestation with the soil penetration improvement will increase the amount of water penetrating into soil and used by the trees and reduce the amount of water flowing into the salt lake.

Key words: afforestation; arid land; runoff model; hydrologic simulation; carbon fixation

The regularities in the formation of solonetzic complexes in the northern part of the Caspian Lowland

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Abstract

The Caspian Lowland is the country of soil complexes formed in the conditions of high aridity and continentality, when even insignificant redistribution of precipitation and water runoff leads to formation of contrasting soils such as saline solonetztes, light chestnut soils and chernosem-like meadow chestnut soils. The origin of soil complexes in the Caspian Lowland is related to the stages of desalination of strongly saline solonchaks with shallow ground water table formed at the bottom of the sea after its transgression. The deepening of ground water table induced the formation of solonetztes and local suffusion of the surface. The increased moistening of suffusion microdepressions due to redistribution of spring melted water runoff led to the formation of chestnut and then meadow chestnut soils in them. As a result, a well-known solonetzic complex typical of the Caspian Lowland and consisting of solonetztes, light chestnut and chernosem-like meadow chestnut soils formed. Meanwhile, it is known that the areas with similar soil complexes but without well-pronounced microtopography are found in the Caspian Lowland wherein depleted from salts fertile meadow chestnut soils are located at the different positions of nanotopography (with relative elevations of less than 10-15 cm) including those at nanoelevations which contradicts the theory of the formation of solonetzic complexes. The formation mechanism of the soil complex characterized by the present absence of pronounced microtopography but having the fertile nonsaline meadow chestnut soils is not clear. To address this issue, the soils in the areas of different ages in the northern (with loamy sediments) part of the Caspian Lowland within the Volga-Ural interfluvium were studied. The study sites are located at different elevations above sea level and are related to different stages of marine transgression of the Khvalyn (ancient Caspian) Sea. The “Aral-sor” site is located at the level of 0-10 m a.s.l. with the age of 14,000 years; “Muratsai”, 20-25 m a.s.l., 15,000 yr.; “Dzhanybek”, 25-30 m a.s.l., 16,000 yr.; “Akoba”, 35 m a.s.l., 16,000-17,000 yr.; “Borsi”, 40-45 m a.s.l., 17,000 yr.; “Tau”, more than 50 m a.s.l., never was under the water of the Khvalyn Sea. At the sites, soil and vegetation cover was studied, the measurement of elevations and soil bulk density was conducted. Our study has shown that the sites are characterized by different pattern of soil cover and different amplitudes of microtopography. The youngest sites (Aral-sor and Muratsai) have a poorly pronounced microtopography and are characterized by the absolute predominance of solonetztes; the portion of steppe soils (light chestnut and meadow chestnut) is less than 5% of the area of soil complex. Older sites (Dzhanybek, Akoba and Borsi) have a very well pronounced soil pattern with the portion of meadow chestnut soils reaching 25-50% of the area of soil complex, but microtopography is pronounced only at the “Dzhanybek” site. The study of soil bulk density has shown the soils at the “Akoba” and “Borsi” sites (more than 35 m a.s.l., early khvalyn stage) don't have subsolonetzic pseudosandy horizon with low bulk density (1.1-1.3 g/cm³) typical of the areas with well pronounced microtopography. We suppose that due to soil evolution and centennial-scale fluctuations of ground water, the subsolonetzic horizon compacted at the old-aged areas leading to the relative sinking of microelevations with solonetztes and to the correspondent leveling of microtopography.

This study was supported by the Russian Foundation for Basic Research (grants Nos. 14-04-31436 and 13-04-00107).

Key words: soil formation; sodic soils; Caspian Lowland; arid lands

Analysis of long-term changes mineralization of precipitation on the territory of Uzbekistan

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Abstract

The purpose of the study - to assess the dynamics and distribution of mineralization flux density amounts of mineral components falling with precipitation for the period 1990 - 2010 years in Uzbekistan.

The chemical composition of atmospheric fall-out is characteristic of air pollution. The main part of the chemical composition of the precipitation is form in the troposphere and lower layer near the surface of the earth. Component composition of precipitation depends on the thickness of atmospheric scavenging layer, the presence of gaseous air pollutants, as well as the intensity of precipitation. Concentration and the ratio of different components in precipitation depend essentially from the entire preceding development of the air mass in which they fall. Atmospheric transport of pollutants in the global and regional scale also affects the formation of the ionic composition of precipitation. The precipitation impact on the environment can be quite varied in depending on their component composition and the effect of their acidity.

Ecological catastrophe of the Aral Sea and the Aral Sea region has led to a change in the hydro meteorological regime and, as a consequence, the desertification of large areas and increase the transfer of soil and salt dust. Processes eolian transport of sand-and soil-salt aerosol with shrunken Aral Sea in the regional scale have been insufficiently studied. In arid zones, the presence of dust-salt particles in the atmosphere affects the chemical composition of the precipitation and salts sedimentation to the underlying soil surface.

Regular observations of the chemical composition of precipitation conducted on the territory of the Republic of Uzbekistan from the early 80-ies of the last century.

Currently Uzhydromet network monitoring of precipitation component composition includes 14 stations. According monitoring program the main mineral components, some heavy metals, indicator pH are determined, total mineralization are calculated. Simultaneously by meteorological parameters are measured.

These studies produced the following results:

- database of component composition of precipitation and its quantity has developed,
- the statistical analysis of precipitation mineralization values has carried,
- the total flux density of mineral components has calculated,
- maps of the flux densities of the amount of mineral components of precipitation have presented for the territory of Uzbekistan for different observation periods,
- dynamics of precipitation mineralization has identified over the past decades (1990 - 2010 years),
- the peculiarities of the distribution and mineralization changes of precipitation over the past decade in the Republic of Uzbekistan has identified,
- the possible impact atmospheric circulation processes on the flux density deposition of mineral salts with precipitation during the study period has assessed.

Key words: precipitation; mineralization; dried-up Aral Sea bottom; flux density

The interaction between land use and regional climate in Central Asia

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Abstract

Meteorological data shows that the Aral Sea basin has experienced strong temperatures warming over the last 30 years, melting snow earlier in spring and causing water shortages in summer. Some local researchers reported extensive land cover changes caused by both human impact and temperature warming. To clarify this problem, we used long-term hydrological data (discharge data; 1936-87), meteorological data (precipitation and air temperature; 1936-90, 1990-2006) and the NDVI time series (1982-2000) from the Pathfinder Advanced Very High Resolution Radiometer (AVHRR) Land dataset.

Six-hourly (1936-1965) or 3-hourly (1966-1990) meteorological data is provided by Carbon Dioxide Information Analysis Center (CDIAC) in former Soviet Union countries (Razuvaev et al., 1998). Air temperature and precipitation data from 25 meteorological stations is used for long-term analysis. Local researchers reported that air temperature warming averages 0.9-1.0 degree for 100 years and 0.4-0.5 degree for 25 years in Uzbekistan – values are relatively higher than global averages. Air temperature and precipitation data are analyzed using the least-squares and linear approximation method. All 25 stations show a positive trend in precipitation and 24 stations show positive (increasing) trends in air temperature from 1936 to 1990. No marked trends were seen for precipitation, but only the Ashabad station indicates negative trends in air temperature. Cinbaji, located at the mouth of the Amu Darya has the second strongest positive trend among the 25 stations. Judging from these results, Ashabad's climate has become wet and Cinbaji's dry due to the Karakum Canal transporting water from Amu Darya to Ashabad since 1962. For the two highest altitude stations, Naryna has the strongest and Horog a relatively strong trend in air temperature, possibly related to differences in latitude and mean air temperature. Almost all daily discharge data for 140 stations available in the hydrological year books from 1936 to 1987 shows a negative (decreasing) trend mainly due to human water use.

NDVI has been widely used for vegetation remote sensing and its time series indicates vegetative activity. Land cover types are classified using NDVI data and thresholds, but "solar zenith angle variations", "satellite orbital drift", and "sensor degradation" influence NDVI values (Gutman, 1999), so a more stable index, Maximum NDVI date, is applied to detect land cover variations in this study. The Pathfinder AVHRR Land (PAL) dataset from 1982 to 2000, consisting of maximum 10-day NDVI composites data at 8 km spatial resolution, is applied to land cover variation analysis. To minimize clouds effects and atmospheric contaminants, the best index slope extraction (BISE) (Viovy and Arino, 1992) is applied to NDVI time-series data. The target research region (38-46 N, 58-70 E) is defined to include the lower Amudarya, Syrdarya, and the Kyzylkum Desert, because arid and semi-arid vegetation are highly sensitive to climate conditions. A clear difference between the two exists due to vegetative activity and soil moisture decreasing until summer without water. The 19-year PAL dataset is divided into three periods – P1, 1982-1987, with no data for 1983; P2, 1988-1993, with no data for 1989; and P3, 1995-2000. "Maximum NDVI date" consists of a 30-day moving average for PAL/NDVI data. The 6-year averaged "maximum NDVI date" in the water-supplied region along Amu Darya and Syr Darya is July or August, and that in the without water supplied, this period came earlier, moving from April 21-30 to April 1-10 for 3 periods. Arid vegetation photosynthesizes under high enough air temperatures and soil moisture. Air temperature warming promotes earlier vegetative activity and soil moisture being exhausted by early April, with both promoting local air temperature warming.

Key words: climatic trends; hydrological regime; NDVI series; Central Asia

Eurasian Soil Partnership: challenges for action

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Abstract

The Eurasian Soil Partnership (EASP) was formed as a component of Global Soil Partnership that gathers together all the stakeholders interested in sustainable management of soil resources. The EASP is considered to include countries, which face similar challenges in soil management, degradation, and reclamation. The common feature of all the Eurasian countries is that they are supposed to have somewhat excessive soil resources, and thus historically the agricultural development has been extensive rather than intensive. An illusion of richness in soils was one of the reasons why the productivity of agricultural lands was relatively low in spite of the presence of extensive areas of Chernozems, which are believed to be the most productive soils in the world. Of course, there were also socioeconomic reasons (planned economy) and natural limitations (severe climatic conditions in Russia and some other countries) that caused the gap in agricultural production between the most developed European states and the countries of the Eurasian region. After the revolutionary transformation of the Eurasian space in the 1990th the agriculture in most of the post-Soviet countries suffered a shock: it failed to compete with intensive agriculture of Europe and other developed countries. In Russia the total area of lands transformed to fallow during 1990-2005 was 48 million ha, i.e. the area that almost equaled the area of Spain. Actually the area used for agriculture is growing in all the countries, including Russian Federation. Actually there are two possible ways for the development of agriculture in the Eurasian region. One of them is to follow the Western intensive technologies, increase the doses of fertilizers, and use advanced agricultural machinery. The other way is to use an opportunity given by the presence of vast areas of unused fertile land in Eurasia and to practice organic agriculture. The intensive and organic agriculture may be developed simultaneously in different parts of the region; for example, intensive agriculture in the areas with the best climatic conditions, and the organic agriculture in marginal lands. Also combined techniques may be developed, like landscape-adaptive agriculture. Soil scientists should take part in the discussion on the perspectives for agricultural development in the region, and give an advice to the decision-makers on the regional planning for the development of agriculture. In the case of the intensive agricultural development soil scientists should ensure sustainable intensification, soil conservation and environmental protection by developing rational system of soil use and management. In the case of organic agriculture soil science can help in the increasing of soil productivity and in the application of soil-friendly technologies. The regional soil partnership in the Eurasian region should be aimed at trans-boundary studies, intensification of the technology transfer and encouraging the dialog between the farmers and soil scientists. The nearest goals will be the formation of a bank of ideas and a marketplace of agricultural technologies adapted to the natural and socioeconomic conditions of the Eurasian region. Soil salinity was considered to be the priority for the development of the implementation plan for the next few years.

Key words international cooperation; soil management; soil salinity; soil degradation

Molecular identification of species of the family Protostrongylidae from Caprinae in Uzbekistan

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Abstract

Pulmonary nematodes of the family Protostrongylidae are economically important pathogens capable of infecting domestic and free-ranging ungulate and leporid hosts throughout the world. Approximately 60 species belonging to 13 genera and 6 subfamilies have been described. Protostrongylids are prominent globally among the nematode faunas of Artiodactyla with considerable diversity in caprines while lower species diversity is observed among antelopes and cervids. Morphological and molecular analysis of lung nematodes collected among caprine hosts (Bovidae) from Uzbekistan resulted in identification of 5 species of Protostrongylidae: *Protostrongylus rufescens*, *Protostrongylus hobmaieri*, *Protostrongylus sp.*, *Spiculocaulus leuckarti* and *Cystocaulus ocreatus*. Molecular identification, based on sequences from the internal transcribed spacer region 2 (ITS-2), provides a consistent and unequivocal means to distinguish species of endemic protostrongylids. Evaluation of molecular diagnosis using adult parasites identified through robust morphological criteria is a prerequisite for the establishment of reliable genetic tools for the identification of larvae in definitive and mollusk intermediate hosts. Phylogenetic analysis reveals that the genus *Protostrongylus* is paraphyletic and correctly identifies the subfamilies erected within the Protostrongylidae using morphological criteria.

Key words: protostrongylidae; larvae; *Caprinae*; *Xeropicta candacharica*; ITS-2

Haloaccumulation effect and salt tolerance of pearl millet introduced firstly on salt affected soils in Syrdarya River basin

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Abstract

Soil salinity is one of major problem for agricultural and socio-economic development in many countries, located in arid and semiarid zones. It affects the development of agricultural industries, in that usually leads to decreasing of crops yield. The appropriate approach to combat salinization in these areas is the introduction and promotion of genetic potential of new varieties of salt-and drought crops. These salt-tolerant crops by providing stable agronomic potential (forage and grain production) are also able to reduce soil salinity due to salt accumulation peculiar features. This study is dedicated on analysis of haloaccumulation effects by dual purpose promising salt-tolerant species and crops varieties, firstly introduced on medium saline clayey soils under sharply dry climatic conditions of Syrdarya region in Uzbekistan. It should be noted that among the salt-tolerant forage plants millet - *Pennisetum glaucum* being a C₄ cereal shown a great potential for reclamation of marginal lands and possible great economical benefits for diversification of farmer incomes in the Syrdarya region. Our studies during last 5 years on evaluation of agronomic parameters of three varieties of pearl millet (Hashaki-1, Raj-171 and HHBVC-Tall) shown an insignificant desalinization effect, calculated per amount of toxic salts ions accumulation from the soil. In the above ground green biomass of pearl millet varieties mainly accumulated bicarbonate anions (HCO₃⁻ 1.109-2.871% per 100 g oven-dry weight) and sulfate (SO₄²⁻ 1.987-2.378%), the average number of observed accumulation of chloride ion (Cl⁻ 0.405-0,639%) were observed. The amount of cations (0,608-1,320%) of alkali ions (Na⁺ + K⁺) is greater than the calcium and magnesium ions (0.602:0.701% respectively). Greater accumulation of alkali ions indicates adaptive capacity of pearl millet varieties, as far as the ions Na⁺ and K⁺ prevent dehydration plant tissues under saline environments. Varieties of pearl millet grown on saline soils of Syrdarya region produced in average 252 t/ha of green or 110 t/ha of dry mass calculated for three consecutive cuttings. Thus, by taking into consideration the accumulation ability of pearl millet (average 5.2% per 100 g of oven-dry weight), it can uptake in average an amount of 58 kg/ ha of salts from the soil.

Key words: desalinization; ions content; *Penisetum glaucum*, forage biomass; Syrdarya region; Uzbekistan

Mechanization preseedling preparation seeds for improvement of deserted pastures

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Abstract

Desert and semi desert pastures occupy vast areas of the Republic of Uzbekistan. They provide the main grazing forage for Karakul sheep, the primary economic outcome in the rangelands. Dietary diversity and a relatively high nutritional value of plants helps to use them as a year-round grazing. However, productivity fluctuations and low productivity of natural grassland over the years and seasons is one of the main issues in further expansion. Irrational use of pastures, technological impact, cutting for household needs, determine the need for systematic maintenance of fodder production of (arid) pasture by seeding and reseeding forage plants. As such it is important to harvest seeds with the highest yielding forage plants.

Seeds of forage plants are usually harvested in late autumn in the form of seed heap, including a significant (70-80%) content of the hard separable trash (generative sprouts wings, defective and shriveled seeds). Additionally presence of a vegetative impurity and high probability of hitting seed tree under deposits can cause increased humidity of the seed container. Freshly harvested seed pile of the desert forage plants can increase moisture content sometimes up to 40%. It is important to timely dry seeds to prevent spoilage as wet seeds in self-heating heaps quickly lose their germination. However, increased content of impurities complicate the drying process and increases the cost of energy and equipment. Cleaning and drying seeds are important measures of postharvest treatment of seeds. The need to produce a large amount of seeds of desert forage plants, determine the proper economic relevance and significance of the work to develop such technical means for cleaning and drying.

Tashkent State Technical University project ITD-9-45 "Development of ways to improve the efficiency of dryers for drying seeds of desert forage plants" research is underway to develop a vacuum drying machine with liquid coolant and infrared radiation using and local raw materials as a source of energy. Development and introduction of technical means for cleaning and drying processes allow to mechanize the postharvest treatment of seeds and seedbed preparation desert forage plants, which in turn saves germination and improve their crop quality at the lowest cost of labor and resources.

Key words: seed dryers; desert forage plants; drying plants; seed pile

Diversity of soils chemistry under *Tamarix*-stands on marginal lands and its feasibility for biomass energy production in the downstream of Syrdarya River region

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Abstract

This paper evaluates the soil-water-vegetation communities links under *Tamarix*-stands, grown on different agricultural degraded desert landscapes in the lower stream of Amudarya River region. For this purpose soil chemistry, water mineralization and growth patterns of *Tamarix* species influencing on biomass production on marginal lands were assessed. The shrub vegetation communities consists mostly of *Tamarix* stands, which in the lower stream of Syrdarya River basin is frequently represented by *Tamarix ramosissima*, *T. androssowii*, *Tamarix elongata*, *Tamarix hispida* in pure stands or mixed with other annual halophytes and salt tolerant grasses. These species colonize and grow well on marginal lands within wide range of soil salinity (19.29 - 58.97% calculated for root zone (5-10 cm) soil profile and withstand a different content of toxic salts (sodic alkaline, chloride, sulfate-chloride or chloride-sulfate). *Tamarix* species belong to crinohalophytes (salt excretion ecological group of halophytes) The scanning electron microscopy (SEM) analysis of leaves of *Tamarix*, collected through field expedition Uzbek-Russian mission in 2013 shown that predominantly ions are sodium chloride, while sodium sulfate and calcium ions are representing in small quantity. Salt glands, which are abundantly developed on epidermis of leaves, play a major role in salts excretion. Texture and elements of microfeatures analysis showed that the *Tamarix* grows on layered depositions. However, a prerequisite for its optimal growth and reproduction (re-growth) is growing in the lower parts of meso- or macro-slopes. This position of *Tamarix* plants on the relief was noted in all the studied sites and is due to desalinization of soil crust (10 cm thickness), and that is the main prerequisite for good seed germination or vegetative propagation of *Tamarix* species. It was found that 3 weeks non saline surface soil solutions are required for good seed germination and vegetative propagation (Rusanov, 1944). In nature *Tamarix* "chooses" lower slopes for getting non saline (or slightly mineralized) water, which is flowing to the lower slopes or ravine in the spring after snowmelt. And they prefer to grow near the artesian water spills. The flushing of salts the upper soil horizons with spring waters and discharge of water on the slope determine the best soil and environmental conditions for growth of *Tamarix*.

Key words: *Tamarix*; saline soils; chemical composition of soils; halophyte; marginal lands

Plant diversity and management practice of traditional Uygur home-garden in arid area of Xinjiang, China

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Abstract

The Uygur people among the 56 Chinese nationalities have inhabited in Xinjiang of China for more than 1,000 years ago. The Uygurs have accumulated a wealth of traditional knowledge and practices in utilizing plants in arid environment, developed unique home-garden vegetation in oasis ecosystem of Xinjiang. This paper presents results from a case study on plant diversity and management practice of traditional Uygur home-garden in Turpan prefecture of Xinjiang Uygur Autonomous Region for the first time.

Studies show that the intimate interactions between the Turpan Uygurs and the plants in arid environment, on the basis of which an integrated traditional knowledge was built for the use and management of garden plants. The Uygurs' home-garden involves cultivating both native wild plants and exotic domesticated horticulture ones in a space connecting their houses, the total number of home-garden plants is as high as 143 species in the case study area that demonstrated in traditional agro-ecosystem management practice a strong capacity in the integrated use of a rich diversity of home-garden plant species, for ornamental, food, aromatic & medicinal plants, timber & fiber, fodder and eco-protective plants in adaptation to the arid environment in Xinjiang of northwest China.

Key words: ethnobotany; oasis; traditional knowledge; plant diversity; management practice

Application of artificial rainfall by the aircraft seeding of liquid carbon dioxide for utilization of water resources and prevention of desertification

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Abstract

In order to apply of an artificial rainfall by an aircraft seeding of liquid carbon dioxide (LCD) for security of water resources and development of desert, and against prevention of desertification, the authors experimented at several times.

Experiments of artificial rainfall by an aircraft seeding operation of LCD were carried out on February 27, 2012 (1), March 14, 2013 (2), December 27, 2013 (3) near Miyake and Mikura Islands of Izu Islands in Tokyo, on May 28, 2013 (4) near the 60 km south area from Shima Peninsular of Mie Prefecture, on December 26, 2013 (5) near Karatsu in Saga Prefecture, and on December 27, 2013 (6) near Saijo to Niihama areas in Ehime Prefecture in Japan.

Several successful results were obtained in these two years. The results of (1) and (2) were shown as in the papers, but the others were not yet. These results will be presented near future. The experiments except (4) were carried out in a cold period. The experiment of (4) was carried out in a warm period as a first time, but the result was also succeeded. These clouds for experiment were mainly convective cloud but some cases were stratiform cloud. We can get a water of 1 to 5 million ton by 1 time experiment by amount of 5 kg LCD of CO₂. As these are experiment, use of LCD, developed cloud and amount of rain by the seeding period were small. If we need more water, we seed every cloud on time to time continuously. On that case, we can receive amount of water as 10-100 million ton pretty easily. The charter fee of aircraft is high however the amount of water reserved is large. So it can pay finally.

Then, it is presumed that the LCD technique can use for security of water resources, for developing of desert, against prevention of desertification, and so on. We presume that this technique can spread to all over the world.

Key words: artificial rainfall; cloud; desertification; liquid carbon dioxide; water resources

Nutritional value of forage biomass of sorghum and pearl millet under dry climatic condition of Uzbekistan

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Abstract

This article is focused on field evaluation of salinity tolerance, yield productivity and nutritional value of sorghum and pearl millet varieties, introduced from world collection of the Russian Institute of Plant Husbandry and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, India) and International Center under dry and medium saline conditions of Uzbekistan. Experiments and field trials were established at Uzbek Corn Station during last years. Average threshold salinity levels for examined pearl millet varieties ranged from 2.60 to 8.5 dS m⁻¹; and from 2.4 up to 4.6 dS m⁻¹ for sorghum entries respectively. New released variety Hashaki 1” has an intermediate position, while the lowest plant density (467 plants/ha) was observed for Raj171. New local released variety named Hashaki1 was resistant to moderate soil salinity and low quality water with grain yield 2.96 t/ha.

High nutritional value of biomass and grains of Hashaki-1 was certified experimentally depending of soil salinity level, developmental stage and cuttings practice. Preliminary data has shown medium content in protein and energy and low in fiber and lignin concentration in dry matter biomass of pearl millet Hashaki1. Crude protein calculated for dry matter biomass ranges from 6.06% to 9.68% in unfertilized soils to 10.8% to 12.0% under nitrogen-fertilized conditions.

Additionally, laboratory analysis on chemical content of main nutritional parameters of forage samples of pearl millet and sorghum from world collection was conducted during 2012-2013. Samples were collected at different stages of their development starting from insertion of panicle till full flowering stages. As results the average content of crude protein at first cut growing stage was 13.59 %, in the second - 11.22 % and 10.40 % after third cutting, i.e. the content of protein of green forage is gradually decreasing from first towards second to third cuttings. The contents of fat accordingly on hay crops have made 3.35; 2.48 and 1.80 %; nitrogen free extract was observed 40.16; 43.12 and 49.56 % for three cuttings respectively

Six sorghum varieties were distinguished before flowering stage by the following average fodder value contains ((% DM) : protein 7.96; fat - 2.29; cellulose - 24.29 and nitrogen free extract as 48.90. The apparent metabolisable energy (AME) of 1kg of sorghum hay was 15.91MJ after first cutting and 16.23 MJ for the second once. A insignificant high fodder value was revealed for pearl millet as in average 16.63 MJ. Nutritional value of forage of sorghum and pearl millet taking as main crops or as summer seed planting (CES) as second crop after harvesting of winter wheat have proved itself the equal to maize silage when cut at 8 to 12 weeks (full flowering), when dry matter yield compares favorably with maize. Forage of pearl millet can be ensilage alone (taking the whole plant or only tillers or leaves) or mixed with other grasses and legumes. We come to recommendation that these two WUE crops may be cultivated on marginal poor resources lands and can play a significant role in filling gaps in the crop-livestock feeding systems in the dryland areas of Central Asian countries. However, since it is a relatively new grain crop in Central Asian countries, there are no readily available markets. Therefore, although the grain is well-suited to both human and animal consumption, producers should secure a market prior to large-scale cultivation.

Key words: C4- cereals; water use efficiency; salt tolerance, nutritional value; alternative forage production; Uzbekistan

A feasibility study on the anaerobic fermentation of salt-accumulating plants after phyto-remediation of arid land in Uzbekistan

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Abstract

Various kinds of salt-tolerant plants naturally grow in Uzbekistan, and some species are capable of extracting salts from the salinized soil into vacuoles in their cells. Such plants may be utilized for the phyto-remediation of arid land. In addition, by feeding the harvested plants into an anaerobic fermentation reactor, the salt and methane gas can be recovered. An anaerobic fermentation process with a solid-liquid separator allows to separate the salts in the liquid portion from the digestate, which can be further isolated using a subsequent low-cost process (e.g. sun-dry bed).

In this study the anaerobic fermentation of plant biomass in a single-stage reactor under gradually salinized conditions was investigated. First, to estimate the digestibility of the plant biomass, a lab-scale completely mixed mesophilic reactor of 4 L was fed with artificial plant biomass (158 g-COD-grass/kg-wet *Panicum coloratum* with 70 g/L NaCl) and operated for 280 days. The volumetric organic loading rate (OLR) of artificial plant biomass was controlled between 0.2 and 3.4 kg-COD/m³/d. The attained methane conversion efficiency based on overall COD was 66 %. The particulate COD and soluble COD in the reactor gradually increased to 45 kg-COD particulate/m³ and 9.0 kg-COD soluble/m³ at 280 days. The soluble COD concentration rapidly increased after 56 days with no detection of volatile fatty acids, which suggested the inhibition on acidogens due to a high salt concentration. Second, the experimentally obtained methane production rate, particulate COD and soluble COD were dynamically simulated using a developed mathematical biochemical model composed of sequential processes for disintegration, hydrolysis, acidogenesis and methanogenesis.

While disintegration of the plant biomass in a the reactor, biodegradable carbohydrates, proteins and lipids were produced in stoichiometric manner, which were further hydrolyzed by corresponding microorganisms (e.g. carbohydrate degrader) to produce soluble low molecular substrates (e.g. sugar). These substrates were converted to hydrogen and acetate with the growth of five acidogenic groups. The hydrogen and acetate were eventually converted to methane by hydrogen utilizing methanogens and acetate utilizing methanogens respectively. In the model, partial solubilization of lignin in the plant biomass was also included. The other batch biological tests helped to identify the unbiodegradable soluble fractions in the digestate, which was used to estimate (i) the production of soluble lignin (unbiodegradable) from the hydrolysis of the plant biomass and (ii) inhibition kinetics from Na salt on acidogenic microorganisms.

Based on the above results, a steady-state calculation at the given operating conditions of the reactor was performed. When the particulate concentration in the reactor was fixed at 75 kg-COD/m³, the methane conversion efficiencies (\approx plant biomass digestion efficiencies) of 72 % and 63 % could be expected with OLRs of 0.5 and 3.0 kg-COD/m³/d respectively. Also, the effluent soluble COD increased with an increase in the loading rates where 76 - 81 % was the biodegradable soluble fraction. This suggested that more biogas production and digestion could be anticipated if the remaining biodegradable soluble fraction was successfully degraded.

Key words: anaerobic fermentation; salt-accumulating plant; Phyto-remediation; acidogenesis

Managing human and natural threats to the productive soils in Kuwait, the case of Al Wafra Agricultural Area, southern part of Kuwait

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Abstract

Al-Wafra Agricultural Area (about 17,000 hectares) is located at the southern fringes of Kuwait, close to Saudi Arabia border. Farms of this area supply Kuwait with a wide variety of vegetables and fruits. Al-Wafra agricultural area is dominated by sandy soils underlain by an impervious horizon at shallow depth rarely exceeds 2m from ground surface. The mentioned agricultural area faces two threats, a human induced and natural. The human induced threat is represented by water logging/ soil salinization, while the natural threat is the severe sand encroachment. These two threats have negative economic, social and environmental impacts. Soil salinization is caused by misuse of irrigation water. This phenomenon results in depletion of crop yields and loss of productive lands in at least 20% of the Al-Wafra farms. The groundwater (main irrigation source) is exploited from two aquifers. A shallow one consists of sands and gravel (Kuwait Group) and a deeper fractured limestone aquifer (Dammam Formation). The total salinity of the groundwater of Kuwait Group ranges between 4,000-10,000 mg/ L while that of Dammam formation varies between 5000-7000 mg/ L. Farms and villages at the northern fringes of Al-Wafra area are severely encroached by shifting sands. The shifting sands are derived by the prevailing northwesterly winds from severely degraded sandy terrains, few kilometers upwind of the farms. Sustainable measures for managing soil salinity and controlling shifting sands are not applied at any level. The main objective of this study is to propose an action plan for managing the threats to Al-Wafra agricultural area. To realize the objective of this study, the soil salinization and sand encroachment phenomena were monitored and assessed based on remote sensing and field measurements. Scenarios for managing the two threats are proposed. It is highly recommended to establish two green belts at the transportation zone between the source area (degraded sandy soil at the upwind side) and the settling area (farms and villages at the downwind side). To overcome soil salinization/ water logging phenomenon, several measures including biological drainage are proposed.

Key words: water logging /soil salinization; degraded sandy terrains; shifting sands; biological drainage

Evaluation of an artificial capillary barrier as a means to control infiltration and capillary rise to improve root zone condition

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Abstract

In many arid and/or semi-arid regions where water is scarce, it is critical to avoid root zones to be affected by soil and to reduce deep percolation below root zones. One of the approaches to achieve such goal is to introduce an artificial capillary barrier (CB), which consists with a layer of gravels, just below the root zone. CBs occur at an interface of two soil layers with different hydraulic properties because of differences mainly in pore size distributions. For example, when a fine particle layer is over a coarse particle layer, water cannot penetrate into the coarse layer from the fine layer until the soil water pressure at the interface is high enough. The concept of CBs has been used in many engineering applications, such as landfill covers. It is still not fully understood how CBs can improve root zones for crop cultivation in arid and/or semi-arid regions. The main objectives of this study were 1) to evaluate the effectiveness of CB on suppressing capillary rise of saline water to the soil surface, and 2) to investigate whether or not the introduction of CB can lead to reduction in water application during cultivation.

Suppressing capillary rise of saline water is necessary to avoid salts to accumulate near the soil surface when saline shallow groundwater exists. It is however still not known which gravel size works the best and how thick the gravel layer needs to be for the purpose of capillary rise suppression. In this study, column experiments were conducted to investigate the effect of gravel particle size and gravel layer thickness on suppressing capillary rise and salt accumulation at the surface. Results show that depending upon the thickness and the composition of the gravel layer, the effect of CBs varies.

In many arid and semi-arid regions, as surface soils have very low water retention ability, much of water applied to the root zones can be lost due to deep percolation. Therefore, it is difficult to practice water saving cultivation in such regions. In this study, cultivation experiments were conducted by introducing CBs as means to improve water retention ability of the root zones. Komatsuna (*Brassica rapavar*), one of the common leafy vegetables, was cultivated in planters with different soil layers in a phytotron located in a campus of Tokyo University of Agriculture and Technology. From our experiment, it was found that artificial CBs can increase or decrease yields depending upon irrigation rates. Further investigations and experiments are needed to evaluate CBs effectively.

Key words: capillary barrier, infiltration, capillary rise, gravel

Prospects for payment for ecosystem services in the context of integrated pest management of the Baluchistan melon fly in arid and semi-arid regions of Central Asia

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Abstract

Central Asia including the Aral Sea Region is considered to be the centre of origin of musk melon. The region harbours an extraordinary diversity of the most delicious varieties, once renowned all over the Soviet Union. An invasion of the Baluchistan melon fly at the turn of the new millennium caused tremendous losses and put melon diversity and livelihoods in arid and semi-arid regions of central Asia at risk. Today, production is increasing again following the introduction of regional Integrated Pest Management (IPM) schemes.

The abstract provide baseline information about the biology, damage and control of the Baluchistan melon fly in arid and semi-arid regions of Central Asia. It address the prospects of Payment for Ecosystem Services for Integrated Pest Management to enable melon farmers and plant protection practitioners to take appropriate, environmental sound measures to reduce losses to melon crops and shows, that a combination of cultural and chemical measures usually provides maximum protection.

Origin of the melon fly:

- The Baluchistan melon fly was first described in the Baluchistan provinces of Iran and Pakistan, hence its name.
- The fly was originally distributed from Syria to the Caucasus and from Turkey to Southern Afghanistan.
- At the turn of the millennium, it moved further north into Central Asia where it was not known before but now causes widespread damage to melon crops.

Life circle of the melon fly:

- Flies emerge May/June from puparia overwintering in the soil.
- Females lay eggs into melons. Maggots feed on the fruit.
- Maggots emerge from the melon and burrow into the ground.
- Maggots pupate in the ground about 5–10 cm deep.
- Up to three generations are produced per year.
- Last generation overwinters

Identification and Diagnosis

- How to recognize the melon fly
 - The melon fly is easy to recognize because of its orange body color, metallic red or green eyes and black-on-white patches on the back.
 - The melon fly is 4.5–6.0 mm in length.
 - It is most easily detected in the morning whilst resting on the upper side of melon leaves.
 - The fly is harder to detect during the day as it hides below the leaves.
- How to diagnose an infestation
 - The melon fly prefers musk to water melon.
 - Early infestations are indicated by the presence of flies already during the flowering stage.
 - Infested melons are often deformed. Maggots can be found by cutting the fruit open.
 - Damaged melons show maggot emergence holes. They often rot owing to secondary infection by fungi and bacteria.

Cultural Control

- Do not grow melon within 500 m of a previous melon crop.
- Plough deeply in autumn and irrigate to expose pupae during winter.

- Inspect crop daily and remove infested melons.
- Use plastic mulch under melons to prevent maggots penetrating the soil.
- Bury infested melons at a depth greater than 55 cm.
- Cut open infested melons and place on plastic to kill larvae/pupae or feed to livestock.
- Clean fields of all melons after harvest.
- Keep field margins free of potential hosts of the melon fly.
- Select less susceptible varieties. Early varieties are often more vulnerable than late ones.
- Use bags to protect melon, but avoid damage by overheating.
- Plant early with early varieties using plastic film (1.4 m wide) to avoid main period of attack.

Chemical Control

- Only registered insecticides and dose rates must be applied. Consult national plant protection services for the latest list of products.
- Insecticides must be applied according to label instructions, using appropriate and well calibrated sprayers and protective clothing.
- Timing is crucial to melon fly control. The first treatment should be done already during flowering if an infestation is evident.
- Pyrethroids but possibly also other insecticides may cause secondary infestations by mites and aphids when used as cover sprays.
- Do never apply more than 4 treatments per season with at least 10 days apart.

Effectiveness

- Increase of production and net earning from melons,
- Decrease of expenditures for pesticides

Summary and recommendations

- Combination of measures to increase the overall effectiveness
- Payment for ecosystem services to facilitate knowledge transfer and adaptation of international standards in advanced Integrated Pest Management

Key words: Baluchistan melon fly, Integrated Pest Management (IPT); ecosystem payment; knowledge transferring

Contribution to business human resource development in Africa: new challenge for Japanese Universities

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Abstract

Recent exploration of natural resources and rapid economical growth of Africa has been attracting enterprises in the world as a great opportunity of their business extension. As well, around 400 Japanese companies extend their activities on Africa (As of May 2014, data from External Representation Office for Asia, African development Bank). The trend brings about demands for development of human resources who play a role of a bridge between the field and home country of enterprises. In addition, high unemployment rate of higher educated youth has been one of the serious issues especially in North Africa. Therefore, higher education as well as vocational education is expected to develop human resources who meet demands of labor market.

As a solution of the issue above, in the occasion of the 5th Tokyo International Conference on African Development (TICAD V) held in June 2013, Japanese government stated to assist capacity building of human resources for business and industry, according to one of the key items of Japanese basic policy of assistance of Africa, that is, to boost the growth of Africa through trade and investment of private sector. As a concrete measures, “African Business Education Initiative for Youth (ABE Initiative)” was launched. ABE Initiative aims to provide opportunities for competent African youth to study in Japan and intern at Japanese enterprises through public private partnerships and build networks among the alumni to foster future leaders for business between Japan and Africa. The training program consists of study in master courses provided in English at Japanese universities and internship at Japanese enterprises. For the first batch students dispatched in September 2014, 67 universities offered 105 courses, whose specialties cover engineering, ICT, agriculture, science, marine science, commerce, economics/business administration, medical science, social welfare, tourism, political science and public administration.

As conventional Japanese graduate school education is research oriented and aims to develop researchers, it is a challenge for Japanese university to implement program courses for ABE Initiative. However, at the same time, Japanese societies, governments, and enterprises also expect the universities to play a leading role to develop human resources, so-called Global Human Resources, who extend their activities globally and lead economical and social growth.

Here I introduce recent trends of extension of business activities of Japanese enterprises, needs for human resources in Africa, recent measures of development of labor market-oriented human resource development, ABE Initiative and Go Global Japan Project. I also discuss opportunities, perspectives and issues for Japanese universities to play an important role and benefit from the trends.

Key words: Africa; business human resource development; ABE Initiative; global human resources

The rising challenge of water resources management at the urban fringes – evidence from Ferghana District of Uzbekistan

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Abstract

With the global expansion of urban areas, competition over both land and water resources is steadily increasing, especially within developing countries (FAO 2012; Kuslu 2007; CER 2009). The expansion of urban areas into agricultural areas, such as in Uzbekistan, has created competition for water between farmers and non-farmers (FAO 2002, 2005). Subsequent growth of urban and peri-urban areas envisages new and expanded demands for water resources, entailing both reproductive and productive uses especially by the poor (Drechsel et al. 2006; van Koppen et al. 2006). The integration of these other, competing uses into the planning or proper design of water provision and management systems has been lacking (van Koppen et al. 2006).

The agricultural sector, being the former most dominant sector in the Uzbek Soviet Socialist Republic (SSR) was the core provider of employment and basic livelihoods. After independence in 1991, Uzbekistan experienced a political and economic transition, which resulted in transformation of water land as well as water management and social and institutional challenges, particularly for the agricultural sector.

Here a case study on the urbanizing Ferghana district in Uzbekistan is presented which highlights rising competition for water and the associated gender dimensions of the changing water management structure. While traditionally Water User Associations (WUAs) are set up to govern and manage water resources for farmers, the urban expansion into agricultural areas means that WUAs now must integrate the concerns of non-farmers and multiple water uses in peri-urban communities. Given the expansion and increased importance of kitchen gardens for the majority of the rural population for livelihood security, it is necessary to reprioritize on their respective water needs and towards better integration in WUAs. Donors as well as the government have to adapt their policies, project and recommendations to these changes.

Key words: multiple use of water; water users; gender; peri-urban; Uzbekistan; Ferghana Valley

Monitoring and assessment of land desertification in Aktau semi-arid rangelands using remote sensing and geographical information systems

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Abstract

Historically, the rangeland vegetation of Aktau foothills in Uzbekistan used to be rich and diverse, serving as a basic natural resource for the livelihood of local people, and at the same time acting as a protection against land degradation. Vegetation of this region has been under ever pressure of human activities due to an increased need for food and feed. As common in many places, during past decades the poor management of rangeland resources had led to severe vegetation degradation and even desertification. At present expanding desertification processes are particularly threatening the precious biodiversity and the livelihood development in the region. Thus, there is an urgent need to evaluate the present condition of the rangelands to accurately recommend appropriate practical measures to improve their natural condition and management systems. The aim of this study was to assess the state of rangeland vegetation structure and its dynamics under different type of factors using GIS and Remote Sensing (RS) techniques. Satellite image data derived from Landsat 5 TM and Landsat 7 ETM+ is used to detect changes in rangeland vegetation of Aktau foothills (40°09'N, 66°39'E). Pristine rangeland of study area is dominated by perennial semi shrub (*Artemisia diffusa*) species associated with understory vegetation of *Carex pachystylis*, *Poa bulbosa*, *Bromus tectorum* and other species. Ground truth seasonal measurements of vegetation parameters (phytomass, density, vegetative cover) were conducted during the period of 2008-2010 at three different sites by their degradation level. Then obtained data were incorporated into GIS and RS for further analysis. In total 9 Landsat images from study period were preprocessed and Normalized Difference Vegetation Index (NDVI) values were calculated to detect plant community changes caused by anthropogenic disturbance.

Extensive rangeland areas around villages and winter grazing lands are well represented in NDVI images exhibiting signs of degradation and erosion. NDVI results expressed different values depending on level of degradation present in selected three sites: slight degradation – 0.26; moderate – 0.25; high – 0.20 of NDVI. Remotely sensed data of the study area is well corresponded with plant parameters of point measurements and the existing natural condition of the studied rangelands. However, rangeland monitoring using RS methods still needs to be continued and also refined for the purpose of long-term monitoring and the management of fragile environment of Aktau foothills. This and future RS monitoring can be an important step towards preventing desertification processes and supporting the formulation of a strategy for restoring desertified areas in arid rangeland ecosystems of Uzbekistan.

Key words: land degradation; rangeland monitoring; Remote Sensing, NDVI; Aktau

Activity of extracellular enzymes hydrolyzing the carbohydrate in irrigated soil

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Abstract

The soils of Uzbekistan with low humus content (0.8-0.5 %) under irrigated agriculture, especially are liable to dehumification risk, because of their very high biological activity. Due to activation of microflora, the enzymatic mineralization of soil organic matter enhances significantly. It was established, that the use of mineral fertilizers (like the ammonium phosphate, ammonium nitrate, superphosphate, etc. with high content of available macronutrients) contributes the repeatedly increases of microbial growth rate, metabolism, respiration, energy, etc., and bring to the regrouping of the microbe communities with predominance of microbe - r-strategists. In the process of mineral compounds assimilation the soil organic matter involves into mineralization too. Therefore, all new agricultural chemicals should undergo a testing of their action on soil biological activity. For agriculture the preference should be given to the chemicals or fertilizers, which have no significant stimulative effect on the hydrolytic enzymatic activity of soil.

The purpose of the reported studies was to investigate of the phosphorus fertilizer's effect on activity of carbohydrase enzymes in typical sierozem under cotton crop.

The subjects of our 3-years field experiment were three types of phosphorous fertilizers: bacterial (PhBF), organic (OMF) and mineral fertilizers (MF), which synthesized at the Institute of General and Inorganic Chemistry (Uzbekistan Academy of Science). We compared the impact of these fertilizers with different contents of organic matter or organic-free on the extracellular enzymes, participated in cellulose, hemicellulose and chitin hydrolysis by microbes.

The results of the research had shown that application of the new fertilizers PhBF, OMF and MF under cotton-plant leads to moderate decrease in activity of carbohydrates enzymes.

In 3-years field experiment of the PhBF (with high C content) application the glucosidase activity decreased by 28-35 %; cellobiohydrolase activity - 2-4.5 times; xylanase activity 2 times. On the contrary, the chitinase activity increased by 14-40%.

The impact of OMF to glucosidase and chitinase activity was not significant, however, cellobiohydrolase and xylanase activity are reduced by 14-25%, due OMF-10, in contrast OMF-20 increased their activity by 16-18 %.

Mineral fertilizers MF have no significant effect on the activity of glucosidase, xylanase and chitinase, whereas, the cellobiohydrolase activity decreases by 11-15%, compared to the soil with common mineral fertilizers.

We hypothesize that this phenomenon may indicate to the reduction of microbial mineralization of cellulose, xylane and other carbohydrates in a typical sierozem and to positive C- balance by the regular use of the new phosphorous fertilizers.

Key words: soil; carbon; enzymes; carbohydrates; mineralization

Some aspects of bioindication of the degraded soils of pastures of the Nurata district, Navoiy region

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Abstract

Rational use and protection of pastures soils take a special place in a common problem of protection and use of natural resources. Soil resources are limited in respect of the area and quality. Their state causes trouble because for the last 70-80 years in this territory the factors destabilizing ecological equilibrium and affecting normal phytocenosis development: in connection with climate change, more frequent droughts; strengthening of influence of an anthropogenous factor because of an overload of the present square with too many sheep; insufficient phytomeliorative measures. For this period the share of the degraded pastures extremely increased, and efficiency of fodder grounds decreased. The increase of degradation was accompanied by that fact that soil of pastures becomes impoverished of both humus and nutritional elements, underwent salinization, a water and wind erosion. A consolidation, somewhere alkalinization, deterioration of physical properties of soils occur, its biological activity falls, and eventually fertility of the soil decreases.

Depending on biotype of vegetation, mechanical structure, a high humus content and exposure to salinization, some locations of soils degrade slightly, others locations - moderately, the third locations- strongly. These processes end in almost full degradation of soils and disappearance of a vegetable cover i.e on the landscape processes caused by natural climatic changes the processes of an anthropogenous transformation connected with pasturable loading are superposed

In this regard we are faced with a problem of rational use of land resources of pastures and strengthening measures for their protection. In Navoiy region in the basis of desertification processes are such natural factors specific to this territory, as geomorphology, a relief, the general dryness of the climate, withering winds and saliferous soil-forming materials

Ecological types, a variety of soil climatic conditions have significant effect also on formation of a vegetation cover.

Stationary researches on key sites of Nurata district showed that in a soil cover a light gray soils with different salinization degrees, light loamy soils, loamy soils and loamy sand prevail. As a result of researches the links of degradation processes with morphogenetic properties, humic substances indicators, agrochemical, physical and chemical, agrophysical, microbiological, fermentative properties of soils were revealed.

Bioindicators of the degraded soils, integral indicator of their biological state (IIBS) are defined. Features of profile distribution of biological parameters of the degraded soils depending on hydrothermal factors, a humus content, mechanical structure, salinization, density and other physical properties are revealed.

The problem of reduction and degradation of land resources as a result of strengthening anthropogenous pressure upon environment demands comprehensive study combining biotic and abiotic factors. Pasturable conditions are characterized in the xeromorphous conditions by vegetation digression, reduction of aboveground and underground bioproductivity of a humus reserves, density of the soil and physical evaporation, insolation, temperature increases, somewhere secondary salinization is observed. These degradation processes can't but affect biological activity of the soil.

So, researches showed that in pasture soils being in a stage of a slight degradation the indicators of a biota in the top horizons of soils were 1.2-1.3 times less, and on sites of an average degradation they made 1.4-1.6 times less in comparison with sites with moderate pasturable loading. With depth of soil profile these differences are smoothed out a little due some increase in humidity, temperatures optimization and increase of values of physical clay. But these indicators can change with the appearance of salinization, disturbance of soil and other adverse factors.

Materials of researches showed correlation of the obtained data with results of decoding and degradation of a soil cover on the basis of the comparative analysis of multitemporal soil thematic maps. Satellite image of the studied territory is processed by a method of the controlled classification, using way of maximum likelihood. By results of classification 12 classes are extracted, of them 8 classes show a vegetable cover of different growth and density, other 4 classes correspond to desert territories.

The obtained results of complex and multiplanar researches allow complementing the system of indication of soils properties changes and monitoring and evaluation on this basis of dynamic and evolutionary transformations of a soil cover of arid pastures by the example of soils of Navoiy region in the conditions of anthropogenous loadings and desertification.

Key words: GIS technology; pastures soil mapping; vegetation cover trends; Navoi region

Integrated membrane system for polyphenols recovery from olive mill water

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Abstract

Food wastes are today considered as a cheap source of valuable components since the existent technologies allow the recovery of target compounds and their recycling inside the food chain as functional additives in different products. Olive mill water (OMW) is the main liquid effluent of the olive oil production process. It represents a precious resource of potentially valuable molecules, especially polyphenols. These latter have been identified as one of the potent natural antioxidants, and have been proven to be very effective in the prevention of diverse diseases. For that reason, the selective recovery of polyphenols from OMW provides the double opportunity to obtain valuable molecules and to reduce its phytotoxicity.

In this work, we have proposed to analyse the potentialities of an integrated membrane system for the valorization of OMW through the selective recovery and concentration of valuable polyphenols. The proposed system included pressure-driven membrane processes, such as microfiltration (MF), ultrafiltration (UF) and nanofiltration (NF). The preliminary centrifugation of raw OMW was used for the removal of the oily phase with the reduction of suspended solids (< 45%). Thus, obtaining a partially clarified liquid that is then submitted to subsequent MF treatment. MF was used as a pre-treatment step to produce a permeate stream containing overall polyphenols of the feed stream. The pre-treatment of OMW by a selected flat-sheet MF membrane (cellulose acetate with a pore size of 3 µm) produced a total removal of suspended solids and a permeate solution which was submitted to an UF treatment with a polysulphone flat-sheet membrane having a molecular weight cut-off of 100 kDa. In the UF permeate, overall polyphenols content was almost recovered, due to the low polyphenols observed rejection compared to the other organic solids. In the following step, UF permeate solution was submitted to an NF treatment with a polydimethylsiloxane flat-sheet membrane having a molecular weight cut-off of 250 Da. In the NF concentrate, a rich polyphenols solution was obtained by the simultaneous removal of low molecular organic solutes, namely minerals and mono-saccharides. In particular, the proposed integrated system allows the recovery of 88% of total polyphenols in the NF concentrate, with hydroxytyrosol and oleuropein representing about 50% of low molecular weight polyphenols.

Experimental results supply useful indications about the possibility to use membranes in a sequential design for obtaining valuable products from OMW, of interest for food, cosmetic and pharmaceutical applications.

Key words: olive mill water; polyphenols; integrated membrane processes; recovery

Effects of camel browsing on the growth of *Avicennia marina* (Forssk.) Vierh. in coastal dry climate mangroves

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Abstract

The purpose of this study is to clarify the difference of growth biomass and shoot in *Avicennia marina* under different intensities of browsing pressure along the Red Sea Coast. From 21st June to 16th July 2012, we measured the direction and height of the main trunk or equally sized “large” branch on the selected 22 trees in the mangrove at the south of Port Sudan, Sudan. Next, we counted the shoots of all selected trees which were either live, dead or eaten by camels. Measurement of the following five items were further conducted, 1) length, 2) diameter, 3) number of live shoots, 4) number of dead shoots, 5) number of eaten shoots. Trees were further separated into 4 “levels” of browsing pressure according to the rate of eaten shoot number; non-browsed level, light level (less than 30% browsed), middle level (30-60% browsed) and excessive level (over 60% browsed). And, from 28th of February to 16th of March 2012, we investigated more detailed morphologies, 1) leaf area, 2) number of leaves, 3) leaf thickness, 4) leaf greenness, 5) leaf and shoot dry weight, 6) nodal length, 7) number of nodal, 8) shoot length on the same “large” branches. The results are as follows. (A) Live shoot rate at light browsed level was higher than other browsing levels. (B) The “large” branches under browsing pressure by camels became shorter and thicker. (C) The amount of live shoots in large branches increased at light browsed level. (D) The amount of shoots and amount of live shoots in comparison to direction of large branches was compared. Amount of live shoots and shoots in upward large branches were more than other directions. (E) Air dry matter was heavier at light browsed level at the bottom of trees, below 200cm height. (F) Air dry matter per leaf was heavier at non-browsed level at the bottom of trees. (G) Leaf area per leaf was larger at non-browsed level at the bottom of trees. (H) Number of leaves increased at light browsed level at the bottom of trees. (I) Leaf thickness increased at excessive browsed level at the bottom of trees. And, leaf thickness increased at light browsed level at the top of trees (above 200cm). (J) At the top, browsing pressure did not affect shoot growth, however there was a difference in leaf thickness. The result in this study, 20~30% of browsing pressure by camels is good for the growth of *A. marina*. We also consider that such other good effects like the changing of division of moisture content in a tree with reduction of leaves by camel browsing is possible.

Key word : mangrove; *Avicennia marina* (Forssk.) Vierh.; camel browsing; Red Sea coast

Projection of the impact of climate change on irrigation water requirement in the downstream of Zeravshan River

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Abstract

Zeravshan is a transboundary river originating in Tajikistan mountains and flowing to Uzbekistan with the size of the catchment about 30365 km². The main source of the river flow is the glacier-snow melt; the most of the runoff is generated in the upstream part (Tajikistan). The climate of the downstream part (Uzbekistan) is mostly arid and semi-arid, here 94% of water is consumed mainly for cotton farm irrigation. Previously, the river was a tributary of the Amudarya river, however nowadays it disappears in the Kyzylkum desert due to intensive irrigation use.

This study aims to physically analyze the available water resources of the Zeravshan river basin for the past and future climate condition and provide the scientific basis to the water resources development plan in this river basin in lights of possible dam construction in the upstream of the river. Touge et al. (2011) analyzed historical change of the water balance of the Aral Sea Basin with inclusion of expanding irrigated area using SiBUC model, and reproduced the shrinking of the Aral Sea successfully. Here SiBUC model is applied for land surface process simulation, and global products (SRTM, H08, GLCC and others) are used for land surface parameters and meteorological forcing data.

The water balance is calculated for the whole Zeravshan river basin. The catchment has been divided to upstream and downstream at the Dupuli station point (lon:39.45[°], lat:68.14[°]). The whole size of analyzed basin is 11842 km² of which 5526 km² is irrigated. The analysis of the downstream is done using GCM data for 1979-2099 period and 1961-1985 observed historical data. Present (1979-2003) and future (2075-2099) scenarios calculated by GCM data are analyzed. According to simulation results evapotranspiration will significantly increase in future due to temperature rise and high water demand for irrigation. The annual average volume of evapotranspiration in the downstream is equal to 9.20Gt (1979-2003), it will increase to 9.89Gt in the future (2075-2099). At the same time precipitation volume will increase from 8.10Gt to 8.36Gt. That is not enough to compensate increased irrigation demand of water from 6.04Gt to 6.81Gt (2075-2099). However, increased runoff from 5.02Gt to 5.82Gt in the upstream of the Zeravshan river will contribute to the inflow. It is highly likely to compensate water balance in the region, however distribution of the water during the season is still not clear. As such possible dam in the upstream with appropriate operation could have even positive outcome for both countries in the future.

Key words: climate change; water balance; Zeravshan river basin; SiBUC; GCM

New biogrotechnology of cultivating cotton plant on saline and arid lands

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Abstract

The increasing frequency of dry periods in many regions of the world and the problems associated with salinity in irrigated areas frequently result in the consecutive occurrence of salinity and drought which lead desertification of cultivated land. Salinity and drought disturb the mineral-nutrient relations in plants through their effects on nutrient availability, transport, and partitioning in plants. Soil salinity reduces the germination and emergence, decreases cotton shoot growth, and may finally lead to reduced seed cotton yield and fiber quality. Salinity lead to soil degradation and reduction the yield of cotton plant, because in saline soils decreases the number of beneficial soil microflora, reduces the number of microorganisms-destructors of xenobiotics, varies cation-anion composition of SAC (soil adsorbing complex), which changes the response of the soil's environment to alkaline (pH - 8-9) in which the imbalance of nutrients and as a result of breaks assimilation of macro-and micronutrients by plants.

In the department of soil microbiology Institute of microbiology AS RUz have developed a new environmentally safe biogrotechnology which based on the joint applying the 2 biopreparation Rizokom-1 and Serhosil. Biopreparation Rizokom-1 with complex action for pre-sowing treatment of seeds of cotton plant on saline soils includes 4 active strains of rhizobacteria of cotton plant with the following polyfunctional properties: resistance to high concentrations (15-20%) of toxic salts (NaCl, Na₂SO₄, MgCl₂, MgSO₄), phosphorus mobilizing activity (the dissolving of tribasic calcium phosphate and mineralization of phytin) destructive activity to organochlorine pesticides, antagonist activity against phytopathogens of cotton plant, root formation and growth stimulating activity. Biopreparation Serhosil for foliar nutrition of plants on phases of vegetation based on the green microalgae, which improves photosynthetic activity of leaf of cotton plant.

To help the plant to survive the stress and not to disturb the natural rhythm, it is necessary to provide a very high quality, affordable and metered power through the root system and foliar system. Therefore, the development of anti-stress biotechnological methods for optimizing the growth and productivity of cotton plant on saline soils through the introduction of efficient strains of microorganisms that enhance plant nutrition, is an urgent task.

Increasing of biodiversity and improving the balance of the soil microbial community in favor of beneficial microflora are observed when applied a biopreparations Rizokom-1 and Serhosil on cotton plant on saline soils. Agrochemical parameters of the saline soil are improved compared to the control: pH of the soil solution decreased from 8.8 to 7.4 and phosphate mode of soils. The content of mobile forms of available nutrients was increased, the amount of toxic salts decreased during the vegetation. Rizokom-1 and Serhosil increase the tolerance of cotton plant to salinity, drought and other stress conditions by optimizing the balance of soil microflora and plant nutrition by macro and micronutrients, improving immunity. New biogrotechnology on saline soils enhances productivity of cotton: it reduces the incidence of cotton, reduces the time of ripening for 15-20 days and costs of irrigated water, increases the yield of cotton to 5-7 c/ha with improving fiber quality.

Key words: soil salinity; cotton plant; biopreparations; soil fertility

Soil erosion and sedimentation studies at south-western spurs of Zarafshan Range using gamma-spectrometric technique

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Abstract

Changing economical conditions and increasing anthropogenic influence on the environment and the resulting soil erosion represent a serious threat of land degradation in Central Asia and all countries world. Brown reports that annually the world is losing 23×10^9 tons of soil from croplands in excess of new soil formation.

Besides on-site problems, soil erosion can also cause off-site negative effects, for example, increased sediment transport in rivers. Mahmood has estimated the world's reservoirs are currently losing 50 km^3 of storage capacity per year due to sedimentation (equivalent to storage loss of approximately 1% per year). Resulting reservoir replacement costs are extremely high and, besides, new sites to replace lost storage are difficult to find.

Based on that, our nuclear physics laboratory has developed a new cost effective method "Estimation of soil degradation using fallout radionuclide Cs-137". Fallout radionuclide techniques have been successfully used to estimate soil erosion and sedimentation in the USA, Europe and Australia using ^{137}Cs and, more recently, $^{239+240}\text{Pu}$.

Out of the latter ones, ^{137}Cs has received the most attention. This radionuclide ($T_{1/2} = 30.2 \text{ yr}$) was introduced into environment by atmospheric testing of thermonuclear weapons from the mid-1950's to the mid-1970's. ^{137}Cs was distributed globally and deposited as fallout. After deposition ^{137}Cs is rapidly absorbed by soil and sediment particles. Subsequently, redistribution of ^{137}Cs occurs in association with soil erosion and sedimentation.

When we obtained soil samples from selected sites, we paid most attention to find a place that did not have erosion. (so called Reference point). By consulting with biologists we chose a site which has likely had no erosion. As a test, we collected soil samples from multiple locations at this site and determined that the inventory of cesium changed little between samples, which further suggests that little erosion has taken place and the site can be considered a reference (background) point.

It is very important to compare the current inventory of cesium at various sites to the reference inventory, so when:

- Inventory in site less than inventory of the reference point, this indicates that erosion has taken place
- Inventory in site greater than inventory of the reference point, this indicates that sedimentation has taken place

Key words: tracer; caesium-137; erosion; sedimentation; gamma-spectrometry

How does Japanese people image and understand deserts: Based on questionnaire survey results at National Museum of Nature and Science, Tokyo

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Abstract

The purpose of this study is to clarify how Japanese people image and understand deserts, based on questionnaire survey results at National Museum of Nature and Science. National Museum of Nature and Science, Tokyo and Research Institute for Humanity and Nature (RIHN), Kyoto had the exhibition “*Surviving in the Desert: Strategies of Humans, Animals, and Plants*” from November 2013 to February 2014. We organized twenty-seven gallery talks, symposia and lectures to communicate with Japanese citizens. More than hundred thousand visitors have visited the exhibit in sixty-six days (117,874 persons: 1,786 person/day). Research materials and results collected mainly through the RIHN project “A Study of Human Subsistence Ecosystems in Arab Societies: To Combat Desertification for the Post-Oil Era” (Project Leader: Hiroshi Nawata, 2008-2013) were on display including a book called “*Desert History: Strategies of Humans, Animals, and Plants for Sharing Water*” (Tokai University Press, 2014), illustrating the relation between humans and nature focusing on strategies of humans, animals, and plants use to share water. The book was full color and more than 450 pages long. This helped a wide range of Japanese to understand nature and culture of deserts. In order to include display materials which matches visitors’ interest before the exhibition, questionnaire survey was planned by National Museum of Nature and Science. It set three questions for visitors: 1) What kinds of thing do you imagine when hearing deserts and arid lands?, 2) What kinds of topics do you want to know about human livelihood of deserts and arid lands?, 3) What kinds of topics do you want to know about nature of deserts? between 11 and 16 July, 2013. I received eighty-one valid responses. For example, regarding first question, they points thirty topics to imagine when hearing deserts and arid lands: 1. camels (22 responses), 2. hot (18 responses), 3. oases (15 responses), no water or no rainfall (14 responses), 4. Africa & Middle East, including Egypt (10 responses), 5. sand including dust, dust storm, & sand dune movement (10 responses), and so on. When I make a sentence by choosing these top seven topics, it becomes “Deserts are places with no water or no rainfall on hot sand lands, some of which have oases and camels, particularly in Africa and the Middle East regions”. I analyze all responses by categorizing into following topics such as a) about physical environment, b) about particular living creatures, c) about areas, d) about history, civilization & religion, e) life, culture & society, f) desertification problem and environmental issues, g) about issues related to Japan, and h) others. Based on these analyses, I summarize three points of understanding of deserts and arid lands by Japanese citizens, especially who are highly motivated to visit a science museum, in contrast to academic understanding. Firstly, concerning physical environments of the atmosphere such as climate and weather conditions, they are not aware of cold climate and day and night difference in temperature, but little precipitation and hot climate, because they seem to be ignorant of academic standard definition of aridity with precipitation and potential evapotranspiration. 2) Secondly, concerning physical environment of water, they clearly recognize that deserts are lack of water, and oases have water, but do not know how human use and manage water. 3) Thirdly, they easily image biological and physical environments of deserts, but do not come to realize that people have lived in deserts and have developed life, culture, society, history, civilization and religion.

Key words : desert understanding; desert history; Japanese image; desert exhibition; questionnaire survey

Desertification and knowledge management for sustainable land management in Tajikistan

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Abstract

Tajikistan has a wide distribution of degraded lands (97.9%), which leads to high rate of desertification processes, unsustainable economic and social development. Agriculture is the dominant sector in the economy of the country. The majority of rainfed cropland and pastures occupied the mountains and foothills slopes, while only 7% from total territories of the country is allocated to irrigated agriculture. The traditional land use system, according to mountain condition consist of several vertical agroecological zones with specific climate, landscape elevation and land use). Unsustainable agricultural is the main cause of intensive development of the soil degradation on all zones. The main type of degradation of arid valley zones with irrigated croplands and winter pastures are - water erosion (irrigation erosion, gully off-site erosion), wind erosion, secondary salinisation, waterlogging and pastures degradation, mostly by overgrazing.

The low mountain agroecological zone during the last 20 years as results of economical instabilization were used as rainfed croplands and all the year round pasture and soil degradation developed more intensively, which intensify the surface erosion, severe gully erosion, landslides, pasture degradation, deforestation. The middle zone, which is used as spring-summer pasture currently is taken under irrigated agriculture, which induce decreasing of the pasturelands and maximum index of runoff and soil loss are observing here

The high mountain agroecological zones are a summer pasture, thus causing the intensive development of pasture degradation. Natural desertification is more intensively going here than in the lowlands/plains zones. For each agroecological zone complex of erosion control measures (suitable soil and water (SWC) conservation technology) was elaborated and recommended earlier, but most of them are cost labour and needs time. Poor resources farmers cannot afford this cost. For sustaining the existing land management it was necessary to collect and analyzed best land use practices. Tajik Soil Science Institute which is a partner organization of WOCAT since 2000, jointly with other Institutes, NGOs and international projects by using WOCAT tools collected and documented successful SWC practices from scientific researchers, land management innovations which come through the international projects and existing local traditional knowledge of farming for different land use type and ecological zones of Tajikistan. Up to now more than 100 SWC technologies and approaches described on Tajikistan are listed in the WOCAT database. The dissemination of this knowledge can help farmers of arid countries on increasing soil fertility, food production, to prevent or at least mitigate land degradation and desertification, to improve the ecological situation and simultaneously decrease the vulnerability to climate change.

Key words: WOCAT database; soil erosion; secondary salinization; conservation agriculture; afforestation; Tajikistan

Measures for improvement of rangelands productivity in the Karakum desert under ongoing climate change conditions

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Abstract

Climate variability, drought and temperature extremes above global average will be exacerbated in the desert zones of Central Asia. There is a need for multi-step approaches to combat desertification, prevent loss of biodiversity, to improve productivity of saline and degraded lands and identify measures for reclamation of salt affected lands and water quality deterioration. Central Asian countries that are already experiencing water shortages and increasing food imports, should given much attention on evaluation and promotion of biosaline technologies through mobilization of salt tolerant crops with wide range of salinity tolerance able to give high forage production and produce viable seeds under saline environments. The utilization of low quality water for irrigation will have a key role in near future; it will become a single source for irrigation agriculture in the downstream of Central Asian rivers deltas. Our studies have shown that the increasing of rangelands productivity through creation of cultural agrophytocenosis from mixed shrubs and semi shrubs species that has been practiced for last decades, today are not effective due to low rainfall (150-200 mm / year) in the desert areas. Therefore, sustainable use of drainage water for creation of cultural pastures should be considered as one of the reliable solution for creation of stable fodder basis in the Karakum desert. The main criteria for the use of drainage water are texture of the soil, drainage of irrigated field, the degree of mineralization and the composition of the salts of the drainage flow, the salt tolerance of cultivated crops, technical and economic performance of irrigation.

Our field experiments on usage of drainage saline water for increasing biomass production of natural desert vegetation were conducted near Dasoguz branch of the Turkmen Lake "Altyn Asyr" on the 1.25 hectares. The type was predominantly sandy desert soils with a permeable filtration index as two-meter zone of 3.5-5.0 m/day. Ground water table was about 9-10 m depth with mineralization of 20-25 g/l. The cover vegetation in the experimental plot was mainly formed by *Haloxylon aphyllum*, *H. persicum* and woody species of genus *Salsola* (*S. Richteri*, *S. rigida*), *Artemisia* and others. Additionally dense stands of *Alhagi pseudoalhagi*, annual halophytes, and different grasses are presented under trees-shrubs plant communities. Different options for pastures irrigation were used: I - without irrigation (control); II - 1500-3000 irrigation rate, irrigation - 500 m³/h; III - 3000-4000, respectively, and 1000 m³/ha; IV - 6000 and 1500 m³/h; V - sowing irrigation norm in March 3000 m³/ha, in two steps of 1500 m³/ha. In all variants, except control the irrigation has been done watering from May 15 to August 20: first - May 15-17, in a period of rapid growth of *Alhagi*; second - June 11-16, during the mass flowering and seed maturation; third and fourth - July 13-19, respectively, and last irrigation was made on 13-20 of August. Water from the Dashoguz branch of the Turkmen "Altyn Asyr" with mineralization of 3-5 g/l was used for irrigation. As it was shown by our experiments the water was dangerous for low and medium salinity tolerance crops. The highest average yield of dry biomass of desert vegetation set under variant IV and V varied from 53.25 to 69.5 t/ha, which was about 22.25 t/ha more than under control.

We have concluded that the optimal time for irrigation by brackish drainage water stimulating the increasing of rangelands vegetation production is early spring season. Watering technique is similar to its holding estuary irrigation. It is based on single or double moisture irrigated field norm 3000-4000 m³/ha by flooding interdunes depressions.

Key words: drainage mineralized water; desert halophytes; rangelands improvement; fodder production; climate changes; Karakum Desert; Turkmenistan

Introduction and micropropagation of some *Juno* species and their preservation *in vitro* collection

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Abstract

Conservation of rare plant species as the most valuable and vulnerable biodiversity of our region is now regarded as one of the priorities of the Botanical Garden. The introduction is one of the methods of preservation of rare species and increasing their numbers. The seeds of *Juno* species were taken for our experiment. *Juno warleyensis* (Foster) Vved., *Juno vicaria* Vved., *Juno nicolai* Vved., *Juno orchioides* (Carr.) Vved., *Juno kovolkovii* are growing in Surkhandarya region of Uzbekistan.

The identification of seedage features of *Juno* species and plants development in open ground under Botanical Gardens conditions in Tashkent, showed the problem, as physiological seed dormancy (2-3 years duration) and necessity to break it. The culture *in vitro* reduces the dormancy period, using embryo and corcule unique property - autonomy.

The features of germinant formation, depended on primary explant type were studied. Explants were cultured on basic Murashige-Skoog medium supplemented with phytohormones at 22-24 °C, with 16 hour photoperiod. Activation of growth processes in isolated embryos marked on 4-th day of culture. At the same time the embryos increased in size, changed the configuration. Formation of single germinant revealed in 6-7 day. In the case of mature seeds the germinates noted in much later date (60 days of cultivation).

Thus, the using of traditional introduction methods in conjunction with technology *in vitro* allows to create, maintain and enhance the live plants collections more effectively, which, in our opinion, contributes the realization of biodiversity strategy of rare and endangered plants.

Key words: introduction; micropropagation; *Juno* species; collection *in vitro*

Desertification in foothill territories of Uzbekistan and the measures to combat it using alternative sources of energy (in case of Nurata mountains)

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Abstract

Mountain areas occupy 21,3% of the total territory of Uzbekistan of which more than fifty percent belongs to arid and semi-arid mountains. Nurata mountains are typical of arid mountains covering the most west ranges of Pamir-Alay mountain systems. Despite the rich biodiversity of Nurata mountain ecosystems, natural resources of the region have been currently facing serious anthropogenic load of various origins. Overgrazing and uprooting of natural vegetation are major factors of land degradation and deforestation in Nurata mountains. Rising the number of population increases the need for food and fuel to support livelihood of local people. In such conditions, combating land degradation and preventing further deforestation is a major concern in the region. Alternative sources of energy may enable reducing anthropogenic load on natural resources of Nurata mountains.

Nurata mountains are rich in solar energy. Annual sunny days comprise of 320 days in west plain part and 300-310 days in east part. In this territory each square santimeter surface receives 145-140 large calories. If this amount is transferred to electrical energy then it becomes 1 kilowatt electrical energy per hour from 1 square meter area. This amount of electrical energy is sufficient for average need of the single household to electrical energy.

Wind resources are one of the next abundant natural resources in Nurata mountains. According to the data of Nurata meteorological station, average annual wind speed is 3 m/s. Wind with 5 m/s or more consists of more than 100 days per year. As known, wind generators produces electrical energy when wind speed exceeds 3 m/s. Taking into account existing natural resources in Nurata mountains it is worthwhile to establish solar panels and wind generators together in a certain area. When solar energy gets scarce during winter period wind generators support to produce energy.

The territory of Nurata region is rich in resources for biogas. According to Eshbekova and Atabaev (2012) 1 kg/DM manure of cattle produces 0.250-0.340 m³, of poultry 0.310-0.620 m³, of sheep 0.300-0.620 m³, of wheat straw 0.200-0.300 m³, maize straw 0.380-0.460 m³ biogas. As seen from above given figures, manure of poultry, sheep and straw of maize is rich in biogas which can be found in enough quantity in each typical household. Due to the absence of individual and collective biogas producing equipment and absence of experience of people this type of alternative energy has not been developed.

Use of alternative sources of energy opens a way for sustainable management of natural resources in the territory of Nurata mountains. Taken electrical and heat energy from solar, wind and biogas sources significantly reduces logging and uprooting of trees and shrubs in mountain areas and it gives a way for self regeneration of the natural vegetation. Moreover, use of alternative sources of energy gives an opportunity for better and consistent use of rangeland vegetation through providing of additional watering points for livestock in remote rangeland areas.

Keywords: land degradation; deforestation; alternative energy; Nurata mountains

Litter production as a proxy for aboveground productivity under elevated atmospheric CO₂ at the Nevada Desert FACE Facility

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Abstract

Over the past 150 years, atmospheric CO₂ concentration ([CO₂]) has increased steadily from 270 to 378 μmol mol⁻¹, largely due to increasing use of fossil fuels and land use changes. At current rate of increase, [CO₂] is expected to reach ~565 μmol mol⁻¹ by the end of this century. In addition to predicted changes to global climate, increasing atmospheric [CO₂] directly affects the earth's autotrophs, primarily plants. For plants, increased [CO₂] often increases photosynthetic CO₂ assimilation rates and primary productivity. However, biomass accumulation by perennial plants is offset to some degree by biomass shed, which is usually called litter production. Using Free-Air CO₂ Enrichment (FACE) technology at the Nevada Desert FACE Facility (NDFF) in the Mojave Desert of southwestern North America, we examined litter production over 9 years of experimental treatments to determine if litter production would change in concert with aboveground productivity in a desert ecosystem. Results indicate that the evergreen shrub *Larrea tridentata* was the only species that had significant [CO₂] effects on litter production, but those significant effects only occurred in 1998 and 1999. When summed over the entire 9-year period of observation, *Larrea* again was the only microsite that had significantly greater litter production under elevated [CO₂]. Litter production for the drought-deciduous shrub *Ambrosia dumosa* under elevated [CO₂] tended to be greater than the other treatments in most years of observation, and cumulative litter-fall for *Ambrosia* was numerically greater for the elevated [CO₂] treatment, but differences were not significant in any one year or when summed over all years. Litter-fall for the other microsites was usually very similar, both within each year and when summed over the 9-year period. These litter production results are consistent with shoot production results, although temporally delayed, and thus is an appropriate proxy for aboveground productivity response to elevated atmospheric [CO₂].

Key words: dryland ecosystem; global change; plant productivity; litter-fall; shrub microsites

Effective use of the salted lands of rice systems of Kazakh Priaralya

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Abstract

Climate change, degradation of soil and natural resources, desertification, deficiency of irrigation water and frequent droughts threaten food and energy security in the Kazakhstan Priaralye. However, there are several opportunities for further development of irrigated agriculture and pastoral animal husbandry. One of the options is introduction of the drought-resistant highly productive cultures capable to grow in arid territories, and in particular on the marginal and salted lands. In this study sorghum, African millet was used to develop resource-saving agro-technologies to create steady base for intensive development of animal husbandry and production of biofuel.

The research was conducted under the support of the ICBA (International Centre for Biosaline Agriculture) Central Asian office. Salt-resistant 10 of sorghum and 17 the pearl millet improved lines from world germplasm collection were received and evaluated under saline environments in the Kazakhstan Priaralye. All (10) sorghum had quite high seed germination rate, seedlings survival and performance. Field samples of the sorghum ICSV 112, Orange 160 and ICSV 25275 were distinguished as 70%, 71.3; 70.6 and 70.3% growth plants rate. Definition of survival of the plants, one of the main parameters of adaptability of cultures to stressful conditions showed rate of 87.3-92.3% for sorghum (Orange 160 and ICSV 25275) by the time of the first cutting despite high salinization of the soil. The pearl millet viability was lower, than at sorghum, it fluctuated within 53.6-66.3% rate. Viability of IP 19586, Rai POP, IP 13150, HHVBC Tall were 66.3-64.1%. However, the African millet was steadier against salinization, showing survival rate of 90.6-95.8%. From a sorghum ICSSH 28, ICSV 25279, ICSSH 58 varieties , Orange 160, SPV 1411, ICSV 25280 which given 37.5-46.6 t/hectare green forage biomass at the end of harvesting stage. The pearl millet determination of productivity of green material showed that samples of HHVBC Tall, GB 8735, Sudan POP 1, IP 22269, WRai POP, IP 13150, IP 19589 formed the highest biomass production of 34.5-48.0 t/hectare. The results of the study show steady development against biotic and abiotic stressful conditions of the region of the cultivation of salt- and drought-resistant sorghum and pearl millet on the salt affected soils of the paddy fields of Kazakhstan Priaralye.

Key words: pearl millet; sorghum; salt affected soils; biomass production; Kazakhstan

Characteristics of soil under the forest steppe in Mongolia

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Abstract

Introduction: The forest steppe in Mongolia lies between the taiga forests and the steppe grasslands, in moister conditions than steppe grasslands. Forest steppe encompasses both coniferous forests and grasslands, each with a unique distribution pattern. This geographical diversity supports biodiversity, giving the forest steppe great value. Although there are many studies of the vegetation of forest steppe, few studies relate vegetation to soil properties. The objective of this study was to clarify the characteristics of soils under the forest steppe in Mongolia.

Materials and methods: The study was carried out at four sites in Gorkhi Terelj National Park (TER) and at two sites in Hustai National Park (HUS), Mongolia. We investigated the soil profiles under grassland on a south-facing slope (TER-G) and on a ridge (TER-T); under forest on a north-facing slope near a ridge (TER-F1) and under dense forest on a north-facing slope (TER-F2); and under grassland (HUS-G) and forest (HUS-F) on an east-facing slope. Soil samples for chemical analysis were collected from each horizon of each profile. Undisturbed soil core samples for physical measurements were sampled with a 100-mL core sampler. We measured soil total organic carbon, total nitrogen, pH (H₂O, KCl), exchangeable bases, CEC, bulk density and saturated hydraulic conductivity.

Results and discussion: The soil profiles of TER were characterized by dark A horizons, a high content of rock fragments, and the absence of a calcic horizon (Bk horizon), which is usually presenting semi-arid areas in Mongolia. The A horizons under grassland (40–56 cm) were thicker than those under forest (4–39cm). The TER soils were characterized by high saturated hydraulic conductivity and high levels of organic carbon and nitrogen in the A horizon. The base saturation of all horizons in TER-F2 was the lowest among profiles in TER. The soils at TER-G, TER-T, and TER-F1 were classified as Phaeozems, and that at TER-F2 was classified as an Umbrisol according to WRB (FAP/ISRIC/ISSS, 2007). These results suggest that the high productivity of the grassland vegetation and the relatively high precipitation in this area are responsible for the dark A horizon and for leaching out of CaCO₃ from the soil. Both the thickness of the A horizon and base saturation are relevant to vegetation type. The HUS soils were characterized by dark A horizons, high levels of soil organic matter, and high base saturation in the surface. Although pH (H₂O) and total exchangeable bases were the same in the A horizon of each soil profile, those of HUS-F were lower than those of HUS-G in the B and BC horizons. The differences may be due to vegetation or to water conditions. The soil at HUS-G was classified as an Umbrisol and that at HUS-F as a Cambisol.

Key words: forest steppe; steppe; Mongolia; morphological characteristics of soil; physico-chemical properties of soil

Current status and problems of drainage system in Uzbekistan

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Abstract

Agricultural productivity in Central Asia increased through the development of irrigated land in the middle of the 20th century. This led the government to dedicate energy and resources to improve the conditions of agricultural lands. In some parts of the region, continual use of agricultural land over time caused groundwater levels to rise and soil to become salinized, because of the application of large amounts of water on the fields with inadequate maintenance of drainage systems. The salinization level of farmland can be changed by controlling groundwater. Measures against salinization in Central Asia are mainly to lower high groundwater levels through facilities of drainage system. There are three types of drainage system, 1) open drainage, 2) sub-surface drainage and 3) vertical drain. This study shows the current status and problems of these three systems in Syrdarya region, Uzbekistan that has serious salinization. Firstly, the open drainage, topographic survey in the study sites showed that, in some sections, the drainage water has stagnation because of inadequate gradient or obstacles parts in drainage canal, even though some being cleaned up several years ago. Sedimentation and overgrown weeds impede adequate water flow and result in reducing discharge of groundwater. Secondly, regarding the sub-surface drainage, the purpose of sub-surface drainage is to lower groundwater level in the study area. The water can be discharged from the field with salt. There were three pipes in the study site. The study showed that two outlet of pipes inside of the open drainage could not be observed visually because of being covered with soil by collapsed side slope. It was hard to observe water flow from the outlets. After removing the soil at one outlet, sedimentation was also observed in the pipe but little water flowing was observed from the pipe. Other outlet was visible under the water in open drainage. The water flow of this outlet could be observed. The difference of outlet condition caused a different salinization even in one field. As compared with another outlet being above the surface water of the open drainage at near the study site, the amount of water flows of those malfunctioning sub-surface drainage was between quarter and twelfth part. Finally, regarding to vertical drain, it can control groundwater by pumping up water from deep depths through special wells equipped with pumps. The number of vertical drain drastically decreased since 1995 in the region. The current operation data was collected and analyzed in a district of the region. The percentage of less or no operating vertical drain is 46%. The main operating period differs in the areas due to request of supplemental irrigation water. In conclusion, above current status could lead to deteriorate salinization. It is important to promptly evaluate malfunction and implement the maintenance works effectively for the open drainage and sub-surface drainage. The operation system of vertical drainage has to be reviewed for the new circumstances.

Key words: drainage system; groundwater; salinization; Sub-surface drainage; vertical drain

Compressed biomass as mulches in no-till farming

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Abstract

With the increasing pressure on agricultural water supply in many regions coupled with soil and nutrient loss from intensive farming practices, many farmers are now compelled to the shift to on-farm techniques that require the use of organic amendments without tilling. Many researchers, international organizations, government agencies, NGOs, etc., recommend soil organic amendments without tilling the land. Unfortunately, organic residue, especially in the form of chips is likely to be easily washed by runoff or strong winds before decomposition. There is therefore the urgent need to develop a ground-cover material that can ensure the conservation of both soil and water, prevent on-farm nutrients from escaping, improve soil infiltration, reduce the labor cost of weeding, and most importantly increase crop production. In this paper, we conducted a study to test the use of compressed biomass mulches in a no-till corn production farming system. The compressed mulches were obtained from forestry residue and converted into boards by the pressurized steam and compression technology without using any chemical adhesives. Our investigations also revealed that the moisture retention capacities of the mulches were relatively high and could be used to reduce soil moisture losses. By impregnating urea into the mulches, we also obtained other benefits such as improvement in their durability, moisture retention capacities, and increase in yield. Our findings further suggest that these compressed mulches can play a major role in non-till farming systems particularly in semi-arid regions by improving yield improvement, saving costs on irrigation, elimination of weeding or herbicide application, erosion control, hill slope stabilization and an overall improvement in other ecological services.

Key words: compressed biomass mulches; pressurized steam technology; forestry residue; no-till farming, soil and water conservation

Content of soil organic matter in various soils of Zerafshan valley in Uzbekistan and its agrotechnological efficiency

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Abstract

Main determining organic substance of the soil is humus. Reduction of soil fertility, deterioration of its properties, decreasing the efficiency of agrotechnological cultivation of crops, first of all, are caused by reduction of soil organic matter and deterioration of its quality. Therefore, all measures directed to increase humus content and its quality improves ecological condition of soil and efficiency of agrotechnological cultivation of crops. The research carried out by us showed that humus content and its quality strongly depends on the type and sub-type of soil, on its mechanical composition and soil horizon, location of soil on certain elevation, water table, relief, exposition of slope, type of crop rotation, ways and amount of irrigation and number of other factors. In all types of soil, humus content decreases gradually on top horizons and then sharply on the deeper soil profiles. With increase of elevation above the sea level, in most cases, humus content is increased. In general, humus content and its qualitative structure strongly depend on the durability of irrigation. So, in old irrigated soils of Vobkent and Gijduvan districts of Bukhara province, despite of low elevation, the content and thickness of this horizon is higher than of the same soil in Samarkand province. Because of the long-standing irrigation and agricultural practice, soils of Bukhara province are well generated, soil horizons are precisely separated, humus content is rather high even in the lower horizons. Humus content is strongly influenced by mechanical composition of the soil. With increasing the heaviness of mechanical composition of soil the humus content is increased even to the direction of lower horizons. Therefore, sometimes in lower soil horizons the content of organic matter could be more than on top horizons, where mechanical composition of soil is relatively light. With reduction of water table soil is well moistured which promotes increase of the content of soil organic matter. Natural condition of Uzbekistan strongly influences on humus content regardless of agricultural land use, types of crops and crop rotation, application of fertilizers, irrigation and soil processing. With the increase of elevation, rainfall, grass richness and with reduction of water table the humus content and its quality is increased. Humus content is essentially influenced by anthropogenic factors connected to cultivation of land under agricultural uses and application of agrotechnological cropping. In most cases, all these factors reduce humus content of the soil and worsen its quality which is visible in the global tendency of the reduction of humus in world soil. The research showed that the cultivation of wheat, cotton, tobacco, maize, beet reduce humus content as these crops leaves little root material in the soil being the main organic material for formation of humus. Application of chemical fertilizers, especially nitric fertilizers in high dozes results in strengthening the decomposition of soil organic matter by microorganisms. The organic fertilizers, on the contrary, raise the content and quality of humus. When humus content is increased in the soil, the soil ecosystem is improved, the functioning of soil is optimized, and also many important mechanical and physical properties of soil are enhanced. In soils with high humus content nutritious substances and soil moisture is well kept and saved. Reduction of the humus content due to the mineralization of organic matter causes release of soil carbon into the atmosphere as carbon dioxide (CO₂) which increases the green house effect. Except this on the background of reduction of humus content, efficiency of all types of agrotechnological cultivation of agricultural crops are reduced. Thus, the content of organic matter depends on a number of natural and anthropogenic factors and at the same time humus content strongly influences on efficiency of agrotechnological activities and ecological condition of the soil.

Key words: soil organic matter; humus content; decomposition; cropping; Zerafshan valley

Groundwater recharge and salinity problem in south-western Mauritania

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Abstract

The south-western Mauritania characterized by semi-arid environment, located between the Senegal River in the south, the Atlantic Ocean to the west. The objective of this work is to combine the groundwater recharge and salinity problems for identifying the groundwater recharge in response to current and past environmental changes. The field survey carried out from 2010 to 2012 monitoring the water level and salinity in the study area.

Results show that the water table levels appeared quite stable. However, combining groundwater recharge and salinity revealed that the dynamics of the aquifer is influenced by many changes particularly when Diam dams constructed and now regulating the river flow. The main source of the aquifer recharge is lateral infiltration from the Senegal River, and precipitation to a lesser extent. The important effect of evaporation on surface waters before and during their infiltration is strongly marked salinity signature. We found some seasonal fluctuations in the water (about 0.5 m) that could be related to the infiltration of rain but these points deserve to be tracked more accurately. The study has also been studied near the Senegal River, where the delta of Senegal River, local rise and smoothing fluctuations of groundwater has been recorded.

Keywords: groundwater recharge; Trarza; Mauritania; salinity

Effects of rhizobium inoculation on nodulation and yield of soybean in the arid area of China

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Abstract

Recently desertification is said to be expanding in semi-arid area of Xinjiang Uygur Autonomous Region, Northwest of China. One of the possible causes is over grazing by herders. Herders can reduce the number of their cattle, goats, and sheep if they get money from other products through settlement. Those people can be called agropastoralists who get income from agriculture and livestock farming. Soybean is an important cash crop in the region because of its high demand. However, in the land just after reclamation, organic matters in the soils are usually very low, which may result in low fertilizer efficiency. Density of rhizobium that is useful for nitrogen fixation in the soil is usually low. In such case, even if leguminous crops are cultivated, it is not expectable that nitrogen fixation increases immediately. The objective of this study was to determine the effects of Rhizobium inoculation on nodulation and yield of soybean in the region. Experiments were conducted in two kinds of fields. One was in the field in the extension station (on-station, N48°03', E86°24'), and the other was in the fields of agropastoralists (on-farm, N47°44', E88°05'). Soybean (cv. Heihe 5) was sown in late May of 2004 manually in the on-station experiment and by machine in the on-farm experiment. In China, "First Nodule Bacterial Medicament of Leguminous Crops" made by "Qinhuangdao Leading Science & Technology Development Co., Ltd" is available as a rhizobium inoculant. Before sowing, the inoculant was dressed onto the soybean seeds. Soybean was grown under fully irrigated condition, and was harvested in early September both from the on-station and on-farm fields. Nodules were observed even on the roots of non-inoculated soybean plants, but inoculation increased nodule numbers especially in the fields that soybean cultivation was newly started. Inoculation increased soybean yield significantly in the on-station experiment. However, in the on-farm experiment, inoculation increased soybean yield slightly but not significantly. Yield increase was higher in the fields with lower yield level, therefore, inoculation is considered to contribute to yield stabilization of soybean. It is concluded that Rhizobium inoculation can increase soybean yield through increased nodulation in the region especially in lower fertility fields with lower yield level or fields with less history of soybean cultivation. Rhizobium inoculation is recommended when farmers start to grow soybean in a newly developed land in the arid area of China.

Key words: arid, inoculation, nodule, soybean, yield

Plant diversity of the drylands in upper Mesopotamia (Turkiye) and their role in food security

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Abstract

The two of the gene centres namely the Mediterranean and the near east meet in Turkey, which is divided into the Irano-Turanian, Mediterranean and Euro-Siberian phytogeographical divisions. The country is situated on the crossroads of important migratory routes and has been home to several civilisations, later therefore increases its importance. It is accepted as the centre of origin for several plants like pea, wheat, flax, lentil, chickpea, beet, tuberous species, herbaceous species like clover, medic, oats, together with woody species like pistachios, pear, vines, apple, plum and pomegranate. The wheat and barley are said to have been first cultivated in the fertile crescent. Very recent studies have revealed that wheat was cultivated for the first time at Karacadağ and its environs located in the southeast Anatolian part of Turkey. In this study we have therefore included Diyarbakır, Gaziantep, Kahramanmaraş, Mardin and Şanlıurfa States from the upper Mesopotamian region. The plants distributed in the region were evaluated for their role in the food security. The references available on this topic were fully surveyed and current use by the local inhabitants was recorded together with the way they use these species. The plant taxa distributed in the region and their potential as animal feed was evaluated. Generally these belong to the families of Poaceae and Fabaceae. Our investigations showed that the taxa like; *Allium scorodoprasum*, *Anethum graveolens*, *Capparis spinosa* var. *spinosa*, *Crataegus monogyna* ssp. *monogyna*, *Geranium tuberosum*, *Glycyrrhiza glabra*, *Gundelia tournefortii* var. *armata*, *Lepidium sativum* ssp. *sativum*, *Malva sylvestris*, *M. neglecta*, *Mentha pulegium*, *Morus nigra*, *Nasturtium officinale*, *Nigella sativa*, *Olea europaea*, *Orchis coriophora*, *Ornithogalum narbonense*, *Rheum ribes*, *Rhus coriaria*, *Pistacia khinjuk*, *P. vera*, *Portulaca oleracea*, *Rubus sanctus*, *Rumex acetosella*, *R. pulcher*, *Thymbra spicata* var. *spicata*, *Thymus* sp., *Trigonella foenum-graecum*, *Urtica dioica*, and *U. urens* are used by the locals as food, salad, spices and also consumed as tea. In addition to these the taxa like; *Capparis ovata*, *C. spinosa*, *Cerasus mahaleb*, *Glycyrrhiza glabra*, *Pistacia khinjuk*, *P. terebinthus*, *Rhus coriaria* and *Thymbra spicata* are collected from nature and sold in the country and at the same time a part is exported. Many taxa distributed in the region are used in the traditional folk medicine. These are given alphabetically with their botanical name, part used, ailment treated and information on the preparations used. The taxa used as dye plants too were recorded. This investigation is expected to serve as a basis for the future food security questions in the region.

Key words: Mesopotamia; Turkey; plants, food security

Inter-country comparison of food security schemes: lessons learnt

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Abstract

Eradication of hunger is one of the important goals listed out in Millennium Development Goals (MDGs). Most nations identified as vulnerable have taken some action against malnutrition and food insecurity. This paper tries to compile the food security schemes initiated by 12 such vulnerable nations and their impact on food security. The nations (India, Pakistan, Bangladesh, Nepal, Sri Lanka, Cambodia, Vietnam, China, Mongolia, Myanmar, Indonesia and Thailand) have been taken from East, South East and South Asia – mainly because their economies and economic history have some commonalities like legacy of colonial era, freedom after the second world war, large population living below poverty line, absence of wild price volatility yet in between periods of double digit inflation, high debt burden but no history of debt crisis, etc.

Most of these nations have large tracts of semi-arid tropics and hence many face problems of low agriculture productivity. Yet some have been able to achieve very low levels of malnutrition and hunger in their countries while some have been struggling to feed their masses. This paper gives a critical look at what has worked for the successful nations and what have been stumbling blocks for the struggling nations, by taking the case studies of government schemes of these 12 nations. The paper includes debates on cash transfer vs. food transfer, import vs. self sufficiency in food, direct feeding programs vs. economic growth as tools for achieving food security for the citizens. The reasons for lack of direct feeding program in some nations could also be found in lesser extent of landlessness – they use agricultural growth as a solution. The paper examines whether such strategy has worked. The paper also looks at the extent of government spending on such schemes and then comparing their impact to check the effectiveness of the money spent. Such situations are also highlighted in the paper.

The progress in achieving food security has been determined by reduction in the critical indicators of food security like underweight children, extent of anemic mothers and infants, and the like. The paper concludes with the lessons learnt from these 12 nations' experiments with food security policies.

Key words food security schemes; trends in indicators of malnutrition; cost of food security schemes

Chenopod cultivation increases the forage base for domestic grazing animals in Turkmenistan

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Abstract

Rapid increase of livestock numbers urgently demands ways of improving and increasing the forage base for domestic livestock in Turkmenistan. Progressive technologies and new innovations are needed to provide necessary increases in forage production and quality. Currently, extensive areas of saline and sodic soils as well as mineralized tailwater from large irrigation projects are underutilized. Halophyte species development offers the potential to increase forage productivity on saline affected lands in Turkmenistan and other Central Asian countries. In this study, *Salicornia europaea*, *Suaeda acuminata*, *Climacoptera turcomanica*, *Atriplex micrantha*, and *A. ornata* showed potential as cultivated forage species on irrigated, salt affected soils.

Key words: chenopod cultivation; halophyte forages; Turkmenistan irrigation

Using satellite images for multi-annual soil salinity mapping in the irrigated areas of Syrdarya province, Uzbekistan

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Abstract

Salinity of the agricultural land in the Central Asian countries is among the most important factors of extensive land degradation. Identification and mapping of salinity-stressed agricultural areas is a first step to cope with soil salinity. Since traditional method of soil salinity mapping is costly and of low precision, an alternative, remote sensing based approach to identify and map the spatio-temporal changes in soil salinity has been developed. From the seasonal Landsat images during 2000-2011 of 154/32 path/row, which cover the whole area of Syrdarya province, Uzbekistan were calculated the radiance, reflectance and Normalized Difference Vegetation Index (NDVI) raster layers. From seasonal NDVI were calculated the maximum annual NDVI and mean NDVI for 3 periods: (2000-2003), (2004-2007), (2008-2011). Based on observed correlation between multi-annual vegetation condition (maximum NDVI) and collected during (2005-2006) inside two farms (Gafura Gulyama and Galaba), located in Syrdarya province, the ground truth data of soil salinity measurements by traditional methods (soil sampling with chemical analysis and bulk electrical conductivity measurements, using EM-38 device), was created the soil salinity maps with four classes (no salinity, low, moderate, and high salinity) of Syrdarya province area for mentioned 3 periods of years. The statistic of Syrdarya province's area, occupied by each classes in (2000-2003) and (2008-2011) years indicates the regular expanding of area with highly saline soil (from 10.48 to 11.39 %) and moderately saline soils (from 40.70 to 45.42 %), mainly due to decreasing of areas with low soil salinity (from 39.99 to 34.39 %).

Key words: soil salinity; satellite images; vegetation stress; NDVI; Syrdarya province

Sorghum and pearl millet for crop diversification and improving livestock feeding system in Central Asia

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Abstract

Ecosystems of marginal borderline areas, located between old irrigated and Kyzylkum Desert zones are vulnerable in term of climatic extremes and availability of water resources, characterized by saline ground water or mixed water quality. In addition soils are affected by secondary salinization being difficult to be managed by using conventional methods. Therefore reclamation of these marginalized resources is growing salt tolerant fodder crops, cereals and oil plants to enhance the natural resources management, improve food security and diversify income of agropastoralists in these remote desert areas. International Center for Biosaline (ICBA) and Uzbek Institute of Karakul Sheep Breeding and Desert Ecology in Uzbekistan have been cooperating in joint projects on development and promotion of innovative low cost technologies biosaline agriculture in the region. This paper aimed at evaluation environmentally and economically feasible dual – purpose crops for improvement of forage production and livestock feeding system using artesian hydrothermal saline water for irrigation. One of the promising research areas was the diversification of agro-biodiversity of crops by use of alternative well adapted salt and drought tolerant crops, such as sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*). Diversification provides for replacement or alternating of traditional crops (e.g. cotton, wheat, corn, rice), growing of which on marginal land is difficult or not possible. Adaptation to local conditions and cultivation of sorghum and pearl millet has two main advantages: first, it creates a stable grain production and fodder supply necessary for the development of local livestock feeding system, and secondly, their cultivation will help prevent erosion and improve soil productivity.

Nutritional value and palatability of forage of Hashakil (new released early maturing local variety) and ICSV 93046.sorghum improved lines from ICBA germplasm in summer seed planting (CES) as second crop after harvesting of winter wheat were analyzed. Nutritional advantages of sorghum and pearl millet hay was determined based on the chemistry composition of forage before panicle insertion, as well as by direct feeding balance experiments with one year old karakul sheep reaches 12.6% of crude protein at 25.12 % of cellulose content. Hashakil silage has proved itself the equal to maize silage when cut at 8 to 12 weeks (full flowering), when dry matter yield compares favorably with maize. Forage of pearl millet can be ensilage alone (taking the whole plant or only tillers or leaves) or mixed with other grasses and legumes. The fresh forage of Hashakil variety as it was demonstrated in our experiments done with tested small ruminant animals has fairly good digestibility and palatability with DMD being about 66-69 % with an value of 0.58 fodder units (FU) and 68.9g of digestible protein in 1kg of DM and total 7.21 MJ metabolisable energy, while one kilogram of sorghum ICSV 93046 variety contains 0.56 feed units at 62.9 g of digestible protein and 6.76 MJ metabolisable energy. Thus, pearl millet and sorghum are regarded as innovative measure for reclamation of salt affected lands and also as an alternative source of high quality rough forage for large cattle, sheep and goats. Hashakil variety produced a good quality seeds/grain, which was successfully used for small ruminants in the lactation and lambing periods, as well as for poultry feeding.

Key words: reclamation of marginal lands; C₄ sorghum and pearl millet; nutritional value, palatability, Kyzylkum desert, Uzbekistan

Potential of some plants for phytorehabilitation of marginal lands of Kur-Araz lowland

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Abstract

Unregulated land use for agricultural purpose and intensive irrigation as well as climate change and desertification process in the dryland ecosystems lead to the increase of salinity and environmental pollution. In its turn, it reduces the soil fertility and affects on plant diversity and productivity in extended areas. Historical intensive exploitation of chemical and petrochemical industries, development of agro-technical approaches in Azerbaijan resulted a sharpening of the situation, especially, soil salinization and pollution in Kur-Araz lowland. The problem is on the agenda in arid and semi-arid areas of lowland and significance of the territories for the economy and agricultural industry of the country dictates an improving of a quality of the marginal lands for their utilization. Considering that agro-technical, chemical and meliorative approaches are costly and time-consuming, the evaluation of potential use of halophytes for soil rehabilitation, forage and food supply is gaining wide acceptability. In this aspect, an appropriate selection of new plant genetic resources with the specific evolutionarily developed protective mechanisms, successfully growing and producing seeds under strained conditions and possessing potential to remove pollutants from soils is assuming priority.

As a result of survey, *Salsolium nodulosae* (desert vegetation), *Salsolium dendroides* (semi-desert vegetation) and *Artemisia fragrans* (semi-desert vegetation) are mainly revealed in marginal lands of Kur-Araz lowland. The investigation of caloric values of these plants which is accepted as the energy allocation within individual organisms and measurements of ecological performance revealed the highest value for *Artemisia* shoots (4262 cal/g). This value for the shoots of *Salsola* spp., *Suaeda* spp. and *Strobilaceum* spp. distributed in these areas also was found to be high, ranging from 3644 cal/g to 3989 cal/g.

Considering the great and diversified value of native halophytic and tolerant plants, their reproduction is rational for their utilization in the rehabilitation of marginal lands and improvement of livelihood of population.

Key words: soil pollutants, phytoremediation, halophytes; plant communities, Kur-Araz lowland, Azerbaijan

Integration of grazing gradient concept and remote sensing to detect rangeland degradation in Uzbekistan

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Abstract

Grazing-driven rangeland degradation became most common anthropogenic phenomenon throughout arid zones of Uzbekistan. Overgrazing of livestock has standed as the most serious disturbance, comprising of about 44% of the total degradation. At present, ecological state of rangeland ecosystems from one side, and spatial extent of degradation from other are largely unknown. Lack of application of up-to-date research tools and integrated ecological concepts in rangeland studies considerably inhibits understanding and forecasting of the current trend of vegetation changes in a timely manner.

At present, integration of so called grazing gradient methods with sophisticated remote sensing (RS) technologies has been offering substantial number of advantages in fine-scale detection of vegetation alterations. Thus, we applied these integrated approaches to assess rangeland condition of Karnabchul semi desert where vegetation degradation of *Artemisia* dominated rangelands is widespread due to poor localized grazing management. This study demonstrates the potential of ecological concepts and RS techniques for understanding of the spatial and temporal behavior of the rangeland ecosystems in the condition of livestock grazing. Field measurements were conducted in two different rangeland sites in term of edaphic conditions and grazing regimes: extended grazing regime in gypsoous grey brown soils (39° 40'N; 65° 46'E, 460 m a.s.l.) and radial grazing regime in sandy sierozem soils (39° 38'N; 65° 31'E, 334 m a.s.l.). Biophysical variables (plant density, biomass, vegetative cover) of dominating vegetation (*Artemisia diffusa*, *Cousinia resinosa*, *Iris songarica*, *Poa bulbosa*, *Carex pachystilys*) were measured on previously selected subplots along the grazing gradient in order to understand the response function and interaction of individual species to a range of grazing intensities.

Radial attenuation of grazing pressure from the watering points resulted in rapid changes of vegetation pattern the character of which were directly corresponded to soil types and grazing regime. Pristine vegetation was replaced by native pastoral invaders (e.g. *Peganum harmala*, *Hordeum leporinum*, *Vulpia ciliata*) eventually at the immediate adjacent areas. Grazing gradient has well revealed to detect considerable changes of community structure of understory dominating vegetation (*P. bulbosa*, *C. pachystilys*) caused by increased level of grazing elements, particularly trampling of livestock. Signs and level of vegetation degradation were apparent as a function of distance away from watering points.

Documented qualitative and quantitative plant data of key species were related to RS systems to understand the spatial patterns of vegetation changes derived from Landsat imagery. Integration of obtained ground truth data, particularly seasonal phenological changes, species composition and green biomass production of dominating vegetation in remote-sensing based assessment well promoted to distinguish specific spectral characteristics of desired vegetation (*A. diffusa*) from undesired ones (e.g. *P. harmala*) during different growing seasons. Seasonal spectral response of dominating vegetation was one of the key indicators in remote sensing based predicting of vegetation state in larger scales. Thus, combination of grazing gradient concept and remote sensing is ideal system to assess actual pastoral value and current ecological state of vegetation in vast rangeland territories, and subsequently to provide better framework for sustainable management of rangeland resources.

Keywords: overgrazing; rangeland vegetation; monitoring; remote sensing; Karnabchul

Role of the flavonoids in salt tolerance of Chenopodiaceae halophytes growing in semi-arid zones of South Urals

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Abstract

Salt tolerance of halophytes depends on controllability of absorption and compartmentation of Na^+ , K^+ and Cl^- ions, as well as the synthesis of organic "compatible" solutes. One of the well-studied osmolytes is proline, which biosynthesis is species-specific in halophytes. Proline has different protective functions, acting as an antioxidant or osmolyte. The antioxidant compounds, including flavonoids, are also involved in protection of subcellular structures and macromolecules from oxidative stress induced by ions toxic effect. We studied the content of proline, flavonoids, and cations (Na^+ , K^+) in shoots of four Chenopodiaceae halophytes along salinity gradient in South Urals. Ratio proline/flavonoids were used to characterize the role of these two compounds in salinity adaptation. The greatest value of this ratio (4.9) is shown for *Atriplex tatarica*. In this species proline was the main protective compound, which high content determined the intensity of dry biomass accumulation. For *Bassia sedoides*, *Atriplex verrucifera*, *Kochia prostrata* this ratio was 0.2-0.9. In these species flavonoids play a major role in the protective mechanism because their concentrations were higher (compared with proline) and correlated positively with the K^+ ions content. In these species high content of flavonoids and K^+ indicated high adaptive potential to these environmental conditions. Thus, we found various biochemical protective strategies of salinity tolerance among halophytes in their natural habitat in South Urals. The flavonoids comparing with proline can actively participate in protective mechanisms of salinity tolerance in halophytes.

Key words: flavonoids; proline; salinity; adaptation.

Regulating water-salt regime of irrigated soils under water short conditions

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Abstract

Sustainable agriculture on lowlands of the Aral Sea Basin is not possible without irrigation which is often associated with salinization of the irrigated land. Increasing water shortage increases a risk of soil salinization and degrading environment of old and newly irrigated land. In spite of intensive drainage system, the area of secondary salinized land is increasing. The experience of Central Asian states of exploitation of deep pipe drainage indicates complexity of maintaining of groundwater table below 3m. This trend is especially obvious in the middle and the downstream of the Syrdarya River and the Amudarya River. From 1970 to 2010, the area of medium and highly saline soils in Karakalpakistan is increased from 38.5 to 56.3%, in Khoresm from 22.4 to 46.9%, in Kashkadarya from 5.4 to 14.9%, in Bukhara province from 26.2 to 36.4%, in Syrdarya province from 25.7 to 36.6% of the total irrigated land. In the upstream of the river these processes are very slow, thus in Fergana province the area of highly and medium saline soils is reduced for the same period from 22.1 to 17.6%.

Under increasing water short conditions limited water use permit system was introduced in 1982. According to the Scheme of Multi-objective water use (1984), limit for Uzbekistan from two rivers, Syrdarya and Amudarya, is 72.4 km³, including 61.1 km³ for irrigation. These days water diversions reduced to 59.2 km³, including 48 km³ for irrigation. In water short years, available water resources are even less. For example in low water years, Karakalpakistan located in the downstream receives 56-59% of the limit and Khorezm 35-39%. Under such conditions, groundwater table reduces below 2 m from the ground surface. However, the available data indicates needs for increasing irrigation water applications to obtain the same yield. For example for Khorezm region, under groundwater depths at 1-2 m to receive cotton yields at 4-4.5 t/ha, irrigation applications vary from 2,200-4,700 m³/ha, while under groundwater depths at 1-1.5 m below the ground surface irrigation requirements to obtain the same yield irrigation requirements are in range of 1,500-2,500 m³/ha. Similarly for Karakalpakistan, under groundwater conditions at 1.5-2m, irrigation requirements to obtain cotton yield at 4-4.5t/ha vary from 3,200-4,000 m³/ha, while when groundwater table is in range of 1-1.5m depths, irrigation requirements to obtain the same yield are in range of 1,600-3,300 m³/ha.

The experience of the states with arid environment shows that soil salinity levels could be maintained at optimal levels under groundwater depth conditions at 1-2 m using horizontal drainage. For example, groundwater depths in many parts of Azerbaijan are at 1.3-1.5 m and in India, Pakistan and China are in range of 1.5-2 m. The above presented data indicates needs for reducing the intensity of the existing drainage system and maintaining groundwater table at 1-1.5m depths. The objective of the drainage is not lowering the water table but lowering salinity of the upper part of the groundwater, which will reduce expenses for soil leaching.

Key words: salinity; drainage; groundwater depth; water shortage; Central Asia

Use of ecologically pure polymer preparations for cotton sowing in arid region of Uzbekistan

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Abstract

Polymeric coverings of seeds enable to dose the number of picklings with high exactness, to reduce their crumbling, considerably improve sanitary and hygienic conditions of labor. Presence of growth stimulators in composition provides intensification of spare substances inclusion in plants metabolism under unfavorable weather conditions (drought, high humidity) at earlier stages of ontogenesis. The laboratory experiments showed that polymeric preparation increase rate of growth of sprouts of cotton seeds. It allows to suppose their further influence on the development of plants at later ontogenesis stages. The sowing with bare capsulated seeds processed by UZHITAN preparation allow to accelerate the rates of plant development, cotton opening and increasing yield.

Key words seeds; growth; plants development; polymer; UZHITAN

The role of weed plants in reduction of the grain harvest in irrigated lands of Samarkand area

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Abstract

The weeds reduce not only the harvest, but also they spread many diseases and pests. *Agropyrum repens* and other wild plants serves the carrier of the incitant yellow and stalk of the rust, mealy grow, root rotten. Weed plants exist in great number in croplands of Uzbekistan. There are about 400 species of annual and perennial weeds on irrigated lands. Coming from their accessories of certain family, their noxious is classified differently by their cracking a hard nut.

All harmful weeds have their main background factor. But there is a fact that any weed plant is capable in receiving of mineral fertilizers in 4-5 times greater than usual plants or crops; presence of *Cannabis arvense* in the area of 1 square meter makes a loss of 5-6 kg of grain, whereas *Capsella bursa-pastoris*, *Chenopodium album*, *Artemisia absinthium* - 2-4 kg. But particularly the species as *Avena fatua*, *Lolium multiflorum* and wild barley (*Hordeum spontaneum*) belonging to *Poaceae* family represent the most threat.

According to the literature data, the reduction of the harvest of the corn crops due to *Avena fatua* in Saratovsk area (Russian Federation) reaches 40%. One single plant of *A. fatua* produces about 1000 seeds. As of its south-east habitat, on certain area number of seeds per plant rises 2500 seeds, but in the soil – more than 9400 seeds on 1 square meter, but this signifies that 700 kg of seed production is found on 1 hectare. When these figures are re-calculated and seeding rate is fixed as 200-220 kg/ha, seed of *A. fatua* in the soil exceeds the rate in 2,5 times.

There are few types of techniques and ways to control and stabilize community of *A. fatua*. Liquidate is possible only by using the protection system during continuous 5-7 years (the period of the conservation the blubbering seed of *A. fatua*), including complex agrotechnical and chemical application under each crop. The control facilities with weed must exclude formation and hit of its seed in the soil.

There is a positive experience of the control of *A. fatua* in the condition of our republic. According to this experience repeated irrigation should be applied on strongly littered soil surface, and plowing of the land is required before flowering of *A. fatua*. For complete removing of *A. fatua* from the land this method is required to apply during 4-5 years, but here appears another question – is this way is sustainable in the condition of water scarcity in the region?

As per herbicide, several types of herbicides are used in Uzbekistan: ovsyugen, topic, treflan, dual and others. Positive effect can show using on dispensed from the main crop (corn) herbicide from glifosat group (the hurricane forte, glifos, raundap and others), but they have very little application among people. Besides, all above herbicides, except glifosats, give only insignificant effect.

Key words: weed control, harvest loss, herbicide, cropland, *Avena fatua*

Strategies of the rural population in Uzbekistan towards improving livelihoods and coping with degradation of land and water resources

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Abstract

Rapidly growing population especially in rural areas of Uzbekistan, Central Asia, exerts an increasing pressure on available agricultural land and water resources. On the other hand continuing degradation of the agro-ecosystems enhanced by extremes of drought and wet periods due to climate change-related uncertainty make these resources and rural communities even more vulnerable. Agricultural production, both crop cultivation and animal husbandry, given deteriorated soil quality, strong salinization, unacceptably shallow and saline groundwater, erosion, poor land and water management, provides limited economic return, which threatens food security, wellbeing of the rural population and further sustainable development of the region. Due to the complexity of the existing problems, a search for solutions must follow a system approach and should be based on a thorough knowledge and understanding of these factors.

A socio-economic survey of rural households has been conducted in the Khorezm region of Uzbekistan to identify their perceptions with regards to environmental and degradation problems, their current management practices and development strategies, the need of the population in innovative technologies for sustainable agricultural production and most importantly, the level of readiness and acceptability of such technologies by the vulnerable rural population. The survey showed that local population does recognize the existing environmental and degradation problems and does understand a high need to reverse this negative trend and do something to restore the degraded land and water resources. The paper provides insights on the current resource management practices and wellbeing strategies by the rural population in the areas prone to soil degradation, lack of knowledge on innovative technologies and sustainable agricultural practices. The paper describes the requirements towards alternative innovative agricultural technologies, which: (1) should aim at altering the reasons of land and other resource degradation, but not always for mitigating or coping with consequences; (2) should be grouped according to the land degradation degrees – classes, so site specific technological packages should be developed, which would include the set of measures instead of standalone technological recommendations; (3) should be not worse compared to the current practices and (4) should not negatively affect other aspects of wellbeing of the rural population. For example, land improvement options through planting salt tolerant crops should not threaten the food security or income opportunities for the local population. Last, but not least institutional frame conditions are important to study and consider since a change in land use policies of marginal land may be necessary to implement some options. The institutional settings must be screened for their role in providing direct economic benefits to rural households, income for the government via taxes, and lead to an overall improvement in ecological conditions in the region.

Key words: sustainable development; agricultural innovations; rural population; wellbeing strategies; environmental degradation

Numerical evaluation of alternative ground source heat exchanger configuration and operation

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Abstract

Heat energy stored in shallow ground and groundwater known as ground source heat or shallow geothermal heat is viewed as one of the renewable energy sources. Ground source heat pump systems (GSHP) then use ground or groundwater as heat sources/sinks. GSHP can achieve much higher coefficient of performance (COP) than conventional air source heat pump systems because the temperature of the ground is generally much more stable than that of the air. GSHP has been receiving great interests among countries in North America and Western Europe, as well as some developed countries in Asia because it can potentially reduce energy consumption and greenhouse gas emission. While GSHP can inject heat from the buildings to the ground for cooling during the summer, it can pump heat stored in the ground for heating during the winter. However there have been few studies investigating the potential of using ground source heat energy at arid or semi-arid regions, for example, for air conditioning of greenhouses.

A typical closed-loop type GSHP system uses a U-shaped vertical-loop heat exchanger in which an anti-freezing solution is circulated. This type of the heat exchanger is referred to as a U-tube. In the closed GSHP system, a heat pump is combined with the heat exchanger. The authors have developed a numerical model to simulate heat exchange processes between the fluid inside the U-tube and the ground by combining one-dimensional convective heat transport model with three dimensional conductive heat transport model. The main objective of this study was to thus evaluate numerically the effect of the heat exchanger configuration and the condition of GSHP operation on heat exchange processes. This study used data collected during the thermal response test (TRT) using a 50-m long U-tube installed at Tokyo University of Agriculture and Technology. A numerical study was carried out first by varying diameter and material of the U-tube. Then the velocity of the circulating fluid was varied to investigate the effect on heat exchange efficiency. This study demonstrates that the numerical model developed by the authors can be used to evaluate the performance of the ground source heat exchangers especially at arid and semi-arid regions.

Key words: ground source heat pump; numerical model; heat exchange

Modeling halophytic plants for sustainable agriculture and water resources

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Abstract

A major problem for irrigated agricultural production in arid and semi-arid environments is salinization of land. Irrigated land accounts for about one third of the world's food, but nearly one fifth of irrigated lands are salt affected and suffer from reduced yield due to soil salinization. Most cultivated crops suffer from reduced yield when subjected to salt stress. However, about 1% of the world's flora are known as halophytes, or plants that are capable of completing their life-cycle in higher saline soil or water environments. Halophytes are not commonly cultivated, but may be useful for human consumption, biofuel, or animal consumption. As a first step to assessing the potential of halophytic plants for salinity management, the Agricultural Policy/Environmental Extender (APEX) model was updated with a module to simulate plant-water-soil salinity dynamics using electrical conductance. The halophytes *Atriplex nitens*, *Climacoptera lanata*, and *Salicornia europaeae* were parameterized in the APEX model's plant database. Plant, soil, and water data from field sites in the Central Kyzylkum and Khorezm regions of Uzbekistan were used to set up APEX models for two field sites. Measured data collected from the two field sites in 2013 were used to assess model performance. Although APEX ran with the salinity module and produced output, analysis of the output indicated that further work is needed to produce a model that will be useful for assessing salinity management with halophytes. Suggestions for model improvements include enabling the modeling of individual salt ions because plants may experience toxic effects of different ions, and modeling detrimental effects of salt on conventional and halophytic plants. Additionally, future iterations of this project will benefit from more field data and experiments to measure plant parameters.

Key words: salinity management; food production; APEX model

Sustainable water management in Central Asia and the role of foreign donors: case study of JICA's "Water management improvement project" in Uzbekistan

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Abstract

The purpose of this study is to present a case study of a third party's role in water management improvement in Central Asia through an analysis of JICA¹'s "Water Management Improvement Project" in Uzbekistan. Water allocation has been the dominant task of the central government. But as water scarcity has grown into a crucial environmental issue at both the high-political level and the low-grassroots level, inclusion of water users is becoming more and more important to achieve sustainable water management.

The framework of WUAs² was established with the government's contracting of the SANIIRI³ in 1996. Although originally conceived as farmers-only organizations, today WUAs are increasingly expected to incorporate different water users and uses⁴ in Central Asia. But due to a shortage of financial resources and knowledge of WUA hydro-engineers, the associations have not been functioning well. In the ICWC⁵, hydro-scientists have also frequently pointed to the problem of water loss at the grassroots level due to inadequate water management.

Wegerich Kai made several studies regarding water management issues in rural areas of Uzbekistan, as well as regarding WUAs⁶. But as far as the author knows, even though many projects for WUAs have been carried out, the performance of international aids and interactions between farmers and international organizations have not been investigated so much by researchers, except for Christine Bichsel's work (2011).

According to the IWMI, USAID, World Bank, SDC, JICA and other agencies have conducted or conducted assistance projects toward WUAs in Central Asia. In March, August, and September 2013, the author accompanied JICA staff and conducted field work on their project. The author made interviews and gathered information about WUA activities and their performance, as well as their contributions to the project.

This work tries to contextualize JICA's project with respect to previous studies. JICA's project focused on training for both the local elite and WUA engineers, and also organized workshops to spread the role of WUA among farmers. According to Johnson et al, to adapt assistance schemes, it is important to consider local customs and traditional rules⁷. Thus, the author's assumption is that JICA has a very efficient approach toward the local leaders of farmers' organizations which is interrelated with the Japanese international cooperation principle.

Additionally, this paper refers to the interrelation of Japanese international cooperation strategy and practice in the field. Capacity building in many areas and levels has been one of the main subjects of JICA's activities in Central Asia⁸. Through the case in Uzbekistan, this study attempts an empirical analysis from the aspect of constructivism in international relationship theory.

Key words: sustainable water management; international cooperation; Water User's Association; constructivist approach; Japan-Central Asian relationships

¹Japan International Cooperation Agency

²Water User's Association. In Uzbekistan, when the water code changed, the name of WUA was changed to "Water Consumer's Association (WCA)".

³Central Asian Irrigation Research Institute.

⁴Poster presentation of IWMI, 20-21th August 2013 in Dushanbe.

⁵Interstate Commission for Water Coordination of Central Asia.

⁶2003, 2004, 2005, 2006, and 2013 et al.

⁷*Institutional Reform Option in the Irrigation Sector*, Agriculture and Rural Development Discussion Paper 5, 2004.

⁸This often called *kusanoneenjo*(grass roots assistance).

Salt-affected soil amelioration with low-quality coalbio-briquette ash in northeastern China

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Abstract

Sulfur dioxide (SO₂) emissions have increased remarkably during the last decade following the dramatic growth of the economy and energy use in China. SO₂ is a major air pollutant and has significant impacts upon human health. Therefore, it is necessary to make the desulfurization technologies to widespread across China. In addition, China has become a major emitter of carbon dioxide (CO₂). The sustainable utilization of biomass contributes to the decrease in CO₂ emissions. So we proposed the use of coal bio-briquettes that were made with coal, biomass, and a desulfurizer such as calcium hydroxide by a high-pressure briquetting process in China. The household use of coal bio-briquettes in rural areas of China also has merit owing to the potential for desulfurization and their ability to use low-quality coal and biomass. In addition, the amount of salt-affected soil is increasing due to the increase in the evaporation rate and excessive cultivation in China. The reclamation of salt-affected soil involves the replacement of exchangeable Na with Ca. Because the coal bio-briquette ash included the Ca compounds such as gypsum, calcium hydroxide, and calcium carbonate, we have been investigated the utilization as soil amendments. Concretely, we have investigated the corn growth and soil chemical properties on salt-affected soil amelioration with low-quality coal bio-briquette ash in northeastern China.

Salt-affected soil amelioration tests were performed in 2008 in a semi-arid area at Kangping (42°70'N, 123°50'E), which is located about 130 km north of Shenyang in northeastern China. Test field was divided into 60 plots (3.6m×3.6m each). Two types of bio-briquette (BB 1 and BB 2) were made from low-quality coal (sulfur content = 2.1% (BB 1) and 4.1% (BB 2)), biomass (corn stem), and desulfurizer (Ca(OH)₂). Two bio-briquette ashes were added to four experimental plots (Fields 1, 2, 3, and 4) of salt-affected soil at the application rate of 0wt%, 0.5wt% (1.16kg/m²), 1.0wt% (2.32kg/m²), 2.0wt% (4.64kg/m²), and 3.0 wt% (6.96kg/m²) in three replications. Their soil amendments were incorporated into the plow layer of the soil by mixing with a scoop, and were added to all plots at the same time as the seeding in the first year. Moreover, an ammoniacal fertilizer was added to all plots and a pig manure as the organic fertilizer was added to two test plots (Fields 2 and 4). Corn (*Zea mays*) has been grown in test field. Consequently, the corn production increased with the increase of the application rate at all test plots. BB2 ash containing higher S in Field 3 indicated better effect on corn production than BB 1 ash in Field 1. In addition, with the increase of application rate of bio-briquette ash, the pH, ESP and Na, CO₃, and HCO₃ concentration of soil solution decreased. These results show that an increase in pH and ESP with an increase in Na compounds such as Na₂CO₃ and NaHCO₃ give the adverse effect on corn production. In conclusion, the effectiveness as salt-affected soil amelioration of bio-briquette ash from the low-quality coal could be confirmed.

Key words: China; coal bio-briquette; salt-affected soil; soil amelioration; sulfur dioxide

Registered representatives of flora and fauna of Kyzylkum reserve

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Abstract

The creation of protected areas is one of the many activities of the Government of the Republic of Uzbekistan to address environmental challenges; minors left humanity in an era of scientific and technical progress. In this regard, the Kizilkum reserve in the South-Western Desert is of particular importance in maintaining floodplain biodiversity of ecosystems of the middle stream of the Amudarya River and adjacent sandy deserts.

The natural environment of reserve allows the enrichment of species of flora and fauna, as it is not similar between the two ecosystems: flood planetugai and sanddesert. Since the passage of the migratory bird path runs along the River Valley, the world bird sanctuary is particularly rich in spring and autumn. Here you can find, including the rarest species listed in the red books of various levels. Migration of some species is associated with sand-pustyn'ej. Total list of families of higher plants consists of 182 species, and list of vertebrates-356 species, endangered species is of interest. In the reserve there are two types-NIKA-*Tulipa korolkowi Regel* and *Calligonum matteianum Drobow*. Typical of that found in the nature reserve Mattea kandym anywhere else in the protected areas of the Republic.

Within the reserve ecosystems are influenced by two powerful factors of own ecological resources is the Aral Sea and the Nurek reservoir. Degradation of the Aral Sea basin clearly affects primarily at intermediate and lower currents of the fish fauna of the Amu Darya. On the River are 8 species of fish: Red Book *Pseudos caphirhynchus hermanni*, *P. Kaufmanni*, *Abramis sapa aralensis*, *Aspiolucius esocinus*, *Barbus capito*, *Barbus brachycephalus*, *Capoetobrama Kuschakewitsh* and *Sabanejewia aurata*.

Because the reserve stretches along the floodplain of the Amudarya bordering the desert zone, with its great variety of avifauna, Only 32 species of birds listed. This is *Pelicanus onocrotalus*, *Pelicanus crispus*, *Egretta zeta*, *Ardeola ralloides*, *Ciconia ciconia*, *Ciconia nigra*, *Platalea leucorodia*, *Plegdis falcinellus*, *Phoenicopterus roseus*, *Cygnus olor*, *Cygnus cygnus*, *Anas angusrirrostris*, *Aythya nyroca*, *Pandion haliaetus*, *Haliaeetus leucoryphus*, *Haliaeetus albicilla*, *Gyps fulvus*, *Aegyptius monachus*, *Circaetus gallicus*, *Circus macrourus*, *Aguila rapax*, *Aguila clanga*, *Aguila heliaca*, *Aguila chrysaetos*, *Falco naumanni*, *Falco cherrug*, *Falco peregrinus*, *Chelamydotis undulate*, *Chettusia gregaria*, *Larus ichthyaeus* and *Columba eversmanni*.

Rare and endangered species of mammals are of 4 types: *Hemiechinus hupomelas*, *Caracal caracal michaelis*, *Cervus elaphus* and *Gazella subgutturosa*.

As seen from the Faunistic materials, geographical location the reserve allows a wide variety, including rare and endangered animals. Among them are many spans of birds that are feeding and rest on the way. Food of the rodents in the sandy part of the primeval forest, attract birds of prey. Of particular interest the finds of the Turkmen karakala, inhabitant of deserts of Kyzylkum disappeared over the last half century.

Key words: floodplain; Red Book: rare and endangered species; Kyzylkum Reserve; Uzbekistan

Nevada (USA) range management school – adapting an American, grazing management curriculum, to other continents

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Abstract

In the state of Nevada (286,367 km²), USA, about 80 percent of the State is Federal (public) rangeland administered by either the Bureau of Land Management or the United States Forest Service. Livestock that graze public rangelands are privately owned, and grazing occurs under a fee-based permit system, in which livestock grazing is one of many allowed uses. Contention about what constitutes good or acceptable grazing management often occurs between livestock owners and government officials employed by the federal agencies. To reduce conflict between livestock owners and government officials, the University of Nevada Cooperative Extension, the outreach component of the University of Nevada, Reno, established the Nevada Range Management School (NRMS) in 2005. This education program combines peer reviewed science with common logic to improve the sustainability of grazed rangelands for not only livestock grazing, but also wildlife habitat, watershed values, and other land uses. The published science provides a foundation upon which livestock producers and government natural resource specialists can begin conversations that will improve grazing management. The full curriculum was initially composed of eight technical modules: 1) the growth, development and physiology of plants, and their response to grazing; 2) the interaction of plant growth stage (timing) and duration of grazing; 3) grazing plan strategies; 4) considerations for riparian area grazing; 5) monitoring of livestock grazing; 6) animal nutrition; 7) livestock behavior; and 8) the grazing response index – a tool to assess the effects of grazing during the grazing season. As grazing and vegetation management issues evolved in Nevada, information about targeted grazing and drought management were added to the curriculum. The modules can be presented as stand-alone sessions or as a comprehensive curriculum. In Nevada, over 670 individuals have received training through the NRMS. In 2011, the United States Forest Service International Program (USFS-IP) invited the NRMS cadre to teach the curriculum to six individuals from Morocco, for evaluation of the material as a tool to address grazing issues in the Middle Atlas Mountains. Four modules were selected and modified into a Moroccan Range Management Training (MRMT). Since 2011, the MRMT has been used to teach government agency staff, livestock owners, and subsistence herders the basics about plant growth and grazing, the influence of timing and duration of grazing on plants, the importance of monitoring management outcomes, and the role of animal behavior in grazing management. One behavioral change in Morocco was the switch from season-long grazing to a deferred rotation grazing system on over 12,150ha². Positive outcomes in Morocco resulted in the USFS-IP including components of the NRMS as part of their two-week International Rangeland Seminar in the United States, in June 2014. Components of the NRMS were taught to 17 individuals from 11 countries on four continents. Discussion will include the process of adapting the curriculum to other countries and common outcomes across participants, which have included an improved understanding of complex plant-animal interactions and how to apply the newly acquired knowledge to improve grazing management.

Key words: grazing management; extension education; herders

The ecology of halophytes of the Issyk-Kul region in Kyrgyz Republic

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Abstract

Halophytes -environmentally, physiologically and biochemically specialized plants that can function normally and produce under saline environment and / or salt-water irrigation. In the world there are flora 2000-2500 halophyte species, including 900 species of Central Asia and in arid regions of Russia more than 500 species.

Material for research was collected in Biosphere territory "Issyk-Kul" in stony rubbly desert at an altitude of 1650-1750 m above sea level near the village "Akulen". We mention only some of the features of the area: the combination of a relatively small area of different soil types, sand, sandy loam soil, clay, saline, rocky, urticular and wet salt marshes, variegated with gray-brown soils of the general predominance of gypsum platform. All this creates a mosaic of edaphic environment and provides a variety of plant communities using numerous ecological niches; concentration in this region xerothermic whole complex of factors: extreme dryness of the air and soil, the minimum rainfall, high summer and relatively low temperatures in winter, accompanied by strong winds, abundance of species of halophytes, thorn, with a predominance of xerophyticshrubs, subshrubs, shrubs, dwarf shrubs and perennial polycarpous and monocarpic herbs, biennials, annuals at relatively low participation and ephemera ephemerooids in addition phytocenoses data and the typical flora for Western Issyk-Kul region.

In characterizing the water regime of plants under natural conditions is very important to know the degree of undersaturation leaves with water, their real water deficit (RWD), which is one of the most reliable indicators of water exchange. This indicator is defined in plants in typical habitat for them, reveals the close relationship between the state of water in plants and environmental conditions of the environment.

When comparing the average daily or most frequently occurring values of these differences are still great. Therefore, species which evolve the same RWD may have different values of SWD. Irreversible inhibition of the ability of turgor recovery occurred at different times. The other halosucculent drainage rate was in the range of 21 to 26 hours of exposure.

With respect to real sublethal water deficit can be judged on the potential dryness (drought intensity), ie what degree of dehydration plants can tolerate. Lower values of this index indicate more severe plant adaptation to extreme environmental factors. Thus, the water balance is strongly in tense *Caragana leucophloea* (75.6%) and *Ceratoidea papposa* (69.3%). Do tsenoobrazovately community potential dryness decreases from 53.7 to 35%. The lowest values (28.2-30.3%) were found in the leaves and *Cleistogenes squarrosa* *Ephedra intermedia*.

In general, the definition of water deficit showed that the investigated ecobiomorphs during growing seasons not encountered such undersaturation their tissues, which can cause irreversible damage to the assimilating organs, indicating that large supplies of drought resistance of plants. Thus, among the complex ecological-morphological and eco-physiological methods adaptation of plants to extremely arid conditions fell field of the Western Issyk-Kul region main role belongs to the nature of balancing water management.

Key words: phytointication of halophytes; halosucculence; water deficit; Issyk-Kul, Kyrgyzstan

Experience on control of matrix and osmotic soil moisture potential under conditions of saline soils of Uzbekistan

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Abstract

Soil salinization is typically wide-spread on plains and in desert areas and it can lead to significant yield losses. Presently, about 50 % of irrigated land in Uzbekistan is saline, 16.9% of which are in medium and strong degree. Out of 13 provinces only in three provinces, namely Tashkent, Samarkand and Andizhan salinization has limited distribution. Almost all provinces of the Amudarya River basin have medium or strong saline irrigated land. The downstream of the river the number of degraded land increases. In Khorezm and Autonomous Republic of Karakalpakstan reaches amount of saline soil almost 50 % of the total irrigated area.

Processes of soil salinization have a severe impact on the productivity of agricultural crops; e.g. cotton crop losses from salinity ranged from 15% over 30-40% to 60-80 % (low, medium and strong salinity respectively).

Soil salinity combined with low moisture is mostly dangerous. Under such conditions plants suffer double stress: Hindered moisture withdrawal by plant roots (soil suction, which is determined by lack of moisture, available to plants), and presence of salts in the soil solution create an additional negative pressure of soil moisture, so-called osmotic pressure.

According to Uzbek researchers total pressure in the root zone in the period between first and forth phases of the cotton development should not exceed 4 atm. For reduction of total pressure is recommended to irrigate. Duration of irrigation for agricultural crops should consider influence of both moisture and soil salinity. In order to monitor these indicators and to determine irrigation based on maximal value of osmotic potential, a simple and user-friendly methods and devices, which indirect take into account both indicators need to be developed.

Application of electrical conductivity for soil salinity monitoring allows determination stress state of plants in practice and initiation of prompt action for reduction of crop losses, by irrigation at the right, to plants, time.

Matrix and osmotic potentials (total negative pressure) in saline soil can be determined based on measurements of moisture and salinity. We have calculated and analyzed results of such observations for concrete cases in Khorezm and Karakalpakstan.

Calculating method of osmotic potential is quite simple. For this, electrical conductivity of the soil suspension should be measured, multiplied by the experimentally determined factor of 3.5 by getting the value of electrical conductivity of saturated soil extract - E_{Ce}. Afterwards, moisture content (in parts of the FC) should be determined and divided by E_{Ce}. In such a way, actual soil conductivity at a time will be calculated. An osmotic potential in the atmosphere is determined by the multiplication of this value by 0.36. For calculation of the capacity of the matrix potential two determinants are needed: a pF curve and the actual soil moisture.

With the proper equipment for real-time measurement of electrical conductivity of soil solutions and soil moisture, a monitoring of the situation on saline fields is possible; stress of plants could be prevented by regular and necessary irrigation schedule.

Key words: soil salinity control; electrical conductivity; osmotic and matrix potentials; irrigation schedule

Production of high quality potable water for sale from atmospheric moisture in coastal areas of semi-arid north-west India

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Abstract

Shortage of potable water is chronic and widespread in Kutch - a hot semi-arid region in north-west India. It is especially acute in villages near the coast where groundwater is not potable. They get water on tanker-trucks daily from long distances. Residents are all increasingly resorting to RO filtration to produce potable water from brackish groundwater. Potable water obtained from RO process is about 50%. The rest is disposed off in the surrounding leading to accelerated degradation of top soil and groundwater. The RO process, although efficient and increasingly less expensive, is not a sustainable solution of drinking water problem in the long run.

Greater use of atmospheric moisture - dew and rain water - can reduce dependence on RO process. The Kutch region gets ~ 300mm of rain over 15 to 20 days during the monsoon season, June to September. Dew occurs from October to May with 100 to 115 dew-nights and 20-25mm of dew water over the season. Thus, a suitably designed plant can potentially harvest of 320-325mm of atmospheric moisture during the year. Collecting rain water is simple, but harvesting dew is very challenging. We have designed and developed a novel dew condenser and field-tried here in the recent years. Condensers are planar panels made of high emissivity plastic film insulated underneath. These get cooled by re-radiation at night and can harvest 15-20mm of dew water in the season. Throughput of these condensers is comparable to plant leaves, blades of grass. While the condensers are specifically engineered to condense dew, rain is routinely harvested using the same surface.

In this paper we describe details of a drinking water production plant designed to harvest atmospheric moisture and process it into drinking water for local sale. Plant is rated to process on an average 500 liters of water daily. It consists of three main components - condenser field or catchment to harvest moisture, raw water storage, and filtration equipment. Condenser field is made of 30 rows of condenser panels, each 18m long and 1 m wide. Panels are 'sandwiches' with 25mm thick styrene foam board in the middle and special plastic film wrapped around. Panels are mounted on angle iron frames at a height of 1.5m from ground. The film is 300 μ m thick polyethylene mixed with small amount of TiO₂ and BaSO₄. Panels are mounted on angle iron frames inclined at 30° from horizontal. Two adjacent panels drain into a common gutter running longitudinally in the middle. Condenser field has 540m² surface areas. Raw water storage is made of masonry with 70,000 liter capacity. Filtering equipment has sediment filter (5 μ m), granular activated carbon filter (5 μ m), UF membrane (0.1 μ m) and UV light cartridge followed by post-carbon filtration to produce 200 liters per hour of product water meeting WHO guidelines.

The aim of the project is to demonstrate that atmospheric moisture can be harvested and processed into safe drinking water comparable in quality and price to RO processed water available in the market.

Key words: dew harvest; rain harvest; drinking water; coastal arid areas; dew condenser

Investigation of salt and dust transfer processes using passive dust traps in Uzbekistan

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Abstract

Natural geographic and climatic features of Uzbekistan, limited water resources determine the fragility of arid systems and induce processes of their degradation. The eolian erosion is one of these processes, which leads to a decrease in soil fertility and crop yield losses.

The article discusses some experimental results obtained in the framework of the international project CALTER to study the eolian erosion in Uzbekistan in the period 2007-2010. Dry atmospheric fall-out (DAF) can serve the important environmental indicator of eolian soil erosion. Dry atmospheric fall-out - is the coarse fraction of particulate matter (particle size > 100 micron), which are fall out from the atmosphere by gravity on the underlying surface. Quantitative characteristic of DAF is the flux density (P) (kg / ha • month, kg / ha • year), which characterizes the total mass of the substance, falling out per unit time per unit area of underlying surface.

As part of research the methodology for monitoring eolian soil erosion using passive traps in Uzbekistan had been developed; ground observation network had been organized at 10 stations Uzhydromet; the qualitative and quantitative analysis of dry atmospheric deposition based on monitoring data, composition of the soils, related meteorological data has been conducted.

To assess the dynamics of process of salt and dust transfer in Uzbekistan for the period 1980-2010 years was determined DAF flux density (monthly, seasonal, annual, perennial), was investigated the particulate composition of the surface layer of soil for every monitoring points, was carried out zoning flux densities of dry atmospheric deposition for Uzbekistan territory.

To assess the influence of meteorological parameters on the quantitative characteristics of the DAF was created database containing basic monthly averages of meteorological parameters. Comparative analysis of the data series of the DAF quantitative characteristics and meteorological parameters showed that the changes in the flux density of the DAF due to the different meteorological situation during the year.

Experimental studies have shown that dry atmospheric fall-out are closely associated with topsoil blowing processes and can be used to assess its deflationary compliances. During the study, estimates of the mechanical and particulate (particle size) of the surface layer of soil sampling points were made.

Studies of the chemical composition and quantity of samples DAF in Uzbekistan led to the following conclusions:

- quantitative characteristics of the DAF (total flux density and flux density of water-soluble components) have a pronounced annual dynamics;
- dry deposition total content of soluble salts is much higher than their content in soils at all sampling points. The ratio of water-soluble components are also markedly different for the soil and for the DAF;
- the highest values of the relative content of soluble salts obtained at stations Takhiatash, Bukhara, Fergana and Chatkal;
- the composition of dry deposition varies throughout the year. The maximum amount of salts in the DAF recorded in the period April-June, the minimum - from December to February;
- obtained DAF flux densities comparable to conventionally used to determine the intensity of the flow of wind erosion. The developed method is cheap and easy to use, allows you to cover large areas.

Key words: dry atmospheric fall-out, flux density, eolian erosion, soils

Institutional transition for sustainable management of dryland pastoral systems in Uzbekistan

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Abstract

This paper contributes to the ongoing discussion of the post-Soviet agricultural transformation reforms in the dryland pastoral systems. The authors emphasize on the current institutional and governance challenges of pastoral management of Uzbekistan from a demand and supply perspectives. The paper highlights the results of participatory mapping analyses conducted in selected districts of Navoi (desert) and Jizzah (semi-desert) provinces.

Our analysis shows that pastoral transformation s has largely been lagging behind in spite of major agricultural reforms in the past decades. The state retains the large scale Karakul cooperatives (*shirkat*) for genetic conservation of the Karakul sheep, to maintain district-level social-infrastructure services, and to ensure food security in the drylands. *Shirkats* still participate in state-induced procurement for Karakul pelt, meat and even cotton or wheat that have to be supplied annually at fixed prices. It is observed that *Shirkats'* pastures are also being used informally by local households for livestock grazing, and since the past two decades its ratio reached 2/3 of the total animal population in rangelands. This has led to unsystematic grazing practices and caused regular conflicts among resource users, and service provision institutions have failed to monitor and serve them effectively.

Obviously, these policies hardly reflect the present needs of emerging regional market demands for livestock products. In addition, economic feasibility of such top-down procurement system has not been considered. Moreover, the current practices and corresponding institutions barely meet environmental and socio-economic demands of the resource-poor communities in the drylands. Thus, there is an urgent need to develop viable political/economic incentives both at the decision-making and community levels to replace the present inefficient structures with sustainable pastoral management practices.

The authors suggest that political/economic incentives should be created through payment of ecosystem service from the national land reclamation fund, from agro/eco-tourism industry, as well as from the newly emerged financial schemes of soil carbon sequestration in large-scale pastures. As a step forward, the authors discuss an enabling environment for community-driven pasture management, whereby formal rangeland-user rights are granted to household groups either by *Shirkats* or directly by district *Hokim's* Office. Traditional community leaders would be helpful in better communication, facilitation, monitoring and pastoral resource-use planning. The current practice of seasonal pasture lease implemented by the Forestry Department is one example for feasibility of such a scheme in the present regime conditions. Economic valuation of pasture degradation, mapping of depleted zones and livestock value chain analysis would also be vital to improve demand and supply side communication and respective policy-level decision-making.

Key words: drylands; institutions; pasture degradation; state-procurement; transition reforms

Frothy bloat potential (primary ruminal tympany) and nutrient content of Forage Kochia (*Bassia prostrata* L.)

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Abstract

Forage kochia (*Bassia prostrata* L.) has been extensively used by grazing animals for millennia in central Asia. It has high crude protein content during the critical fall/winter grazing period, non-toxic levels of oxalates, acceptable digestibility, and is highly preferred by grazing animals. Forage kochia was introduced into the U.S.A. in 1966 from a planting in Stravopol Botanical Gardens (USSR), and released as a cultivar (Immigrant) in 1984. It has been included in fire and rangeland rehabilitation seed mixes and planted on at least 200,000-400,000 ha in the USA. However, in central Nevada (USA), it has been linked to cattle mortality by frothy bloat (primary ruminal tympany) under specific ecological site conditions. In order to assess its potential to cause frothy bloat in free roaming cattle, we investigated the nutritive value of forage kochia across a grazing season (September-January), measured *in vitro* gas production compared to fresh alfalfa, and assessed foam production and strength with respect to fresh alfalfa. Crude protein values were highest in October and November (23.3 and 21.5%, respectively), while neutral detergent fiber (NDF) was lowest during the same period (38.8 and 39.3% respectively). Gas and foam production were both higher for alfalfa than for kochia over a 12 hour incubation period. In general, alfalfa produced twice as much gas and foam as forage kochia ($P<0.001$). However, foam strength (gDM) was twice as much for forage kochia ($P<0.002$), and by 6 hours of incubation time the foam height of forage kochia was twice that of alfalfa ($P<0.001$). Forage kochia does have the potential to cause frothy bloat in cattle. Although fresh alfalfa digestion is likely to create more gas in the rumen, the foam strength and persistence of forage kochia is likely to be retained over longer periods of time, creating rumen conditions that would lead to frothy bloat and eventual mortality.

Key words: *Bassia prostrate*; frothy bloat; foam strength

Preliminary results of chemical analysis of the soil of dry seafloor of the Aral Sea

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Abstract

According to the latest scientific data, more than 5 mln hectare areas of Aral Sea water disappearance were recorded. The dried areas of Aral Sea mainly contain variety level of soil salts and sands. Within typical salt-marsh, over existence of salts and based on high mineralization level of underground waters, vegetation of the annual halophytes are becoming more complex.

The reason, chemical composition of soils in current territory contains following minerals, such as: sulfate, chloride, sodium, magnesium, which are increasing from year to year. It is important to note that, the improvement process of soil in current territory is still being continued.

According to the our research, the water released territories of the southeast Aral Sea (2006-2014 years) adaptation of variety of plants to the current natural environment was identified. First of all, this phenomenon of soil types and its mineral structure in direct association with specific policy will be improved. At the moment, the main water released territories was identified halophytes, which consists of variety level of salted soils.

The variety parts of water released territories of Aral Sea were obtained soil samples during chemical analysis, firstly the concentrations of 36 chemical elements was identified. The majority of these elements were found in plant examples as well. The foundation of the soil micro elements is the parent rock. The high concentrations of Ca, Cl, Fe, K, Mg, Na, Sr, Ti, Ba, Cu, Mn, Ni, Rb, Zn and other elements were identified. The clay, salted-marsh in the cost of sea is salted mainly with sulfate-chloride salts.

The highness or lowness level of each element's concentration depends on soils geographic characteristic and typical features is one of the important index of it. The concentration of majority of microelements analyzed in different soil samples depends on humus level of soil, pH composition of granulometry and surely studding areas, following: in ecotope biological diversity level is directly associated.

Content of chemical elements in plants varies considerably. For example, the defined high sodium content in *Kalidium capsicum*, *Climacoptera aralensis*, *Halostachys belangeriana*, *Haloxylon aphyllum* and other large concentration of chlorine was detected in *Kalidium capsicum*. Magnesium concentration lowers in comparison with other elements, especially in *Kalidium capsicum*, *Climacoptera aralensis*, *Halostachys belangeriana*. It was also found that in *Salsola richteri*, *Tamarix hispida*, *Haloxylon aphyllum* calcium, potassium, magnesium, and *Halostachys belangeriana*, *Tamarix hispida* chlorine concentration corresponds to an average characteristic of these plants.

The micro flora of ecosystem, plant and animal types and in association with their life style cycle, in microelements of soil composition might change seasonal or over the years. The elements of soils types and in association to geographic areas in variety of level found, soil-geochemical studding current areas regionalization and it gives a lot of possibilities to use in geological search.

Our findings contribute to a better understanding of the fundamental mechanisms of plant adaptation to stress environmental factors, as well as to develop a strategy periodic seeding promising forms and plant species in the area of the seafloor of the Aral Sea.

Key words: Aral Sea: soil; plants; chemical elements

Salt-accumulating indicator plants on the dry seafloor of the Aral Sea

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Abstract

The biosphere is the environment with a dynamic equilibrium at both the macro- and micro-level. For elements in the biosphere it is typical for intra- or extracellular space distribution. Biological role of chemical elements are very diverse and numerous, and the elements being considered are much enough that's why it is a challenge to cover such a large and controversial material.

Dry seafloor of the Aral Sea – an open, deserted and unique "laboratory" emerged in Central Asia. Due to the current ecological condition of the dried bottom of the Aral Sea, comprehensive study of biological objects of Aral Sea region has a great scientific and practical importance not only in science and technology, but also in the country's industry.

The variety parts of water released territories of Aral Sea were obtained soil samples during chemical analysis, firstly the concentrations of 36 chemical elements were identified. The majority of these elements were found in plant examples as well. 37 trace elements of the periodic Table were identified in plants for the first time. Content of chemical elements in plants varies considerably. For example, the defined high sodium content in *Kalidium capsicum*, *Climacoptera aralensis*, *Halostachys belangeriana*, *Haloxylon aphyllum* and other large concentration of chlorine was detected in *Kalidium capsicum*.

Our findings contribute to a better understanding of the fundamental mechanisms of plant adaptation to stress environmental factors, as well as to develop a strategy periodic seeding promising forms and plant species in the area of the seafloor of the Aral Sea.

Key words: Aral Sea; soil; plants; indicator; elements

Dam gate operation for turbid flood water venting in the reservoir in Tunisia

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Abstract

The amount of water resource in a high dam is visible as its storage capacity, while the groundwater resource amount has the difficulty of volume estimation. Therefore, the water resource in dams is most reliable water resource. However, in the arid area, due to the low vegetation land cover, the land erosion from the catchment area is quite serious. The eroded soil enters to reservoirs, then, it is settled as sediment and reduces the water storage capacity of the dams.

There are some countermeasures against the sedimentation, such as dredging, sand discharge bypass and sediment flushing etc. However, due to the financial reason, these countermeasures are not carried out in a lot of cases, especially in the developing countries. One of the inexpensive ways to reduce the sediment amount is density flow venting. The high turbidity water with high density forms a bottom density flow and reaches to the dam body without high rate mixing with the clear reservoir water. By opening the gate on the dam timely, the turbid flood water discharged to the downstream with little amount of sedimentation. Whether the flood water forms the bottom density flow depends on the difference of the density which is defined by the temperature and the concentration of suspended solid. Therefore, in order to optimize the open/close gate and reduce the loss of water resource, the standard for decision making is required.

In this study, Joumine dam located in the north of Tunisia is selected as study site. First, sediment traps were fixed at 3 points in 3 depths during the rainy seasons of (1) December 2011- March 2012 and (2) December 2012-March 2013. Two rainy seasons gave the different raining scale and different run-off of the river. The observed behavior of the turbid flood water in the reservoir was also different. The first term had big flood and high turbidity water enter to the reservoir as bottom density flow was observed. On the other hand, the second term, there were only small scale runoffs and the entered flood water was dispersed to the middle layer of the reservoir. Under the situation of the second term, if the gate was opened for aiming bottom density flow discharge, the efficiency is very low, while we can expect the very effective venting for the case of the first term.

Then, the numerical experiment with the hydraulic computational simulation model was carried out. The water temperature of inflow river and flooding scale which defines the concentration of the suspended solid; these parameters that decide the density were varied as experimental condition for finding the threshold between bottom forming density flow and dispersing in the middle. As a result, the influence of the change of the water temperature on the form of flood water is not so strong. It is defined by the scale of the flood and its maximum concentration of suspended solid mainly. In the cases that the maximum flow rate is above $70\text{m}^3/\text{sec}$ shows forming of the bottom density flow.

Key words: reservoir; sedimentation; density flow venting; numerical experiment; suspended solid

Water conflict resolution in rural Central Asia: a historical perspective

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Abstract

Although irrigation and the issue of water management in Central Asia is a well-researched and popular topic in the social sciences, historical research on the same, based on primary sources written in Persian and Chaghatay Turkic languages, remains undeveloped. This study is a preliminary survey of the settlement of water disputes in Khorazm, one of the major oases regions of Central Asia.

The Khorazm oasis, situated in the lower basin of the Amu Darya, has had extensive irrigational networks since the ancient period. Even under the nomadic Uzbek rule from the 16th century to the first decade of the 20th century, the networks were maintained, though a series of political crises in the eighteenth century caused a temporary destruction of irrigation facilities. In the first decade of the 20th century, the *yasavulbashi* – originally a supervisor of *yasa* (the laws of Chinggis Khan) – came to control a part of judicial procedures that included water disputes in Khorazm. This was according to the reform initiated by Sayyid Islam Khoja, the Grand Vazir of the Khanate of Khiva (1512-1920), during the reign of Isfandiyar Khan (r. 1910-1918). In 2012, Uzbekistani historian Ulfat Abdurasulov was the first to reveal the importance in the involvement of *yasavulbashis* in judicial procedures.

This presentation aims to contextualize Abdurasulov's new findings with my intensive research on over 100 documents connected to the issue of irrigation from the *yasavulbashi* documents. Following this, I will show the process of settlement of water disputes under the *yasavulbashi* and then compare them with the 'traditional' customs of irrigation practiced before the 20th century, as described by Western and Russian Orientalists, scholars, and irrigation technicians as well as the local court chroniclers.

The presentation will offer a concrete picture of the settlement process of water disputes before Russian Revolution and the establishment of the Soviet regime in Central Asia, which brought about serious environmental crises in rural Central Asia on the one hand, and the modernization of water management on the other.

Key words: water conflict resolution; arid region, Central Asia; Khorazm Oasis; documents in Chaghatay; Turkic language

Impact of reduced water supply for irrigation in dry years on hydrogeological measures and soil salinization in the lower reaches of the Amudarya River

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Abstract

In Khorezm region, located in the Amu Darya River lower reaches, changes in the water management and reclamation situation were observed from 1984 to 2012:

- reduction of specific annual water intake from 27 to 15 m³/ha;
- decline in cotton yields average for the region from 35 to 20 t/ha;
- stable quantity of moderately and highly saline land in the region came to: 36.4 % of the irrigated area (at the very beginning of the period), 46 % of the monitored over a relatively long period up to the present time), and over 50 % in some periods.

2000, 2001, 2008 and 2011 were water shortage years on the Amu Darya River; water shortage was most profound during the growing season 2001. The lowest specific annual intake observed in dry years: 8.6 m³/ha in 2001; 10.7 m³/ha in 2008; and 9.1 m³/ha in 2011.

Based on the statistic processing of long-term data by water organizations, including data on intakes, location of groundwater, salinity distribution over irrigated lands, and crops, the tendencies of low water impact on them under real conditions of Khorezm region were determined by statistic processing. It was found that water shortage most affects groundwater depth as well as harvest.

The tendencies of low water impact on them under real conditions of the Khorezm region are as follows:

1. Given slight slope and geomorphology, the groundwater level is steadily shallow: in medium water availability years, average groundwater level varies from 140 to 170 cm. Based on long-term data it was found that depending on water availability, groundwater level lowers when growing cotton: for example, during the average water availability period, the groundwater depth ranged within 119 ... 140 cm, while in dry years it dropped to 157-166 cm. By processing the long-term data for each of the 11 districts, an equation of the effect of specific water supply volume on groundwater depth was derived.
2. Effect of dry years on change of the distribution of irrigated land areas with varying groundwater salinity (at widespread shallow groundwater with their prevailing salinity of about 3 g/l) was not observed.
3. Nor significant dependence of cotton crop on groundwater depth was observed: apparently, at their close bedding, irrigation regime has a greater effect on crop yield.
4. Low effect of water availability on salinity distribution in normal years is probably due to inadequate drainage conditions of particular areas and consequently stagnation of groundwater. However, expanding of the saline land areas with decreasing water availability was revealed by the example of water shortage in 2001. The quantitative values and relations of the effect of specific water supply volume on groundwater depth, which were obtained in this study, can be used for simulating and forecasting processes with expected changes in water availability at water scarcity and, in long-term forecasts, related to supposed climate change.

Key words: water shortage; lower reaches of the Amu Darya River; water availability and water scarcity; hydrogeological measures; soil salinization

Genetic basis for the reintroduction of *Haloxylon aphyllum* (Chenopodiaceae) on degraded pasturelands in Kyzylkum desert

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Abstract

Haloxylon aphyllum (Minkw.) Iljin (Chenopodiaceae) is a tree-like stem succulent xerohalophyte characterized by high edaphic plasticity allowing to occupy various ecological niche (Nikitin 1966; Gintzburger et al. 2003). In pure or mixed with others woody desert species is largely used for creation of artificial windbreaks and forest shelterbelts plantations. In Kyzylkum desert *H. aphyllum* populations are representing mostly as artificial (agropopulations, 20-40 years old). The main purpose of our studies was to assess the genetic diversity in agropopulations and self-regenerated populations of *H. aphyllum*, grown under Central and South-West Kyzylkum desert environments.

Mean level of genetic polymorphism ($P_{95} = 30\%$, $A = 2.09$), except observed heterozygosity ($H_o=6\%$) in *H. aphyllum* populations are comparable to mean level of genetic polymorphism in perennial anemophilous cross-pollinated species (Hamrick et al., 1992). Significant deficiency of heterozygotes in *H. aphyllum* (61%) was found that is uncommon for anemophilous cross-pollinated species (Hamrick et al. 1992). Such deviation in the genetic structure of populations due to inbreeding has serious effect on reduction of genetic variability and adaptive potential. We used model “agropopulation—self-regenerating population” to understand how genetic structure (level of genetic polymorphism, heterozygosity, deficiency of heterozygotes) is changed in self-renewing population. It was found that in self-regenerating population level of genetic polymorphism (P_{95}) decreased by 50%, and observed heterozygosity increased in 4.3 times compared with agropopulation. Moreover deficit of heterozygotes has changed to excess of heterozygotes, that indicate to the selection in favor of heterozygous genotypes. The heterozygous genotypes of *H. aphyllum* have shown significant advantages in their productivity and sustainability under moderate and high salinity (Shuyskaya et al., 2014). Thus, taking into consideration the inherent ability of *H. aphyllum* to tolerate salinity there is comparatively easier and more practical option of screening and selection of suitable populations from the already available germplasm attempting to carefully use them for rehabilitation of salt affected lands. Cultural practices were recommended for improving growth of woody species, *H. aphyllum* inclusive, for utilization of degraded pasturelands in Uzbekistan.

Key words: genetic polymorphism; deficit of heterozygotes; salinity; desert

Spatial distribution of salts in Solonetz complexes of arid zone of the Caspian, using field data and remote spectral data

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Abstract

The area of distribution of the saline soils in European part of Russia (Caspian lowland) is characterized by complex structure of the soil cover and, as a result, extremely variegated soil salinity. Assessment of the direction of the processes of salinity-desalinity due to the climate aridity and the processes of desertification in these conditions is complicated, since in the limits of small areas (100x100 m) there are all variants of saline of soils - ranging from non-saline, gradually passing through any intermediate variants to very strongly saline Solonetz. In order to move forward to solving the problem of assessing the impact of climate on the salinity of soils of the South part of Russia, it is necessary to develop approaches to areal operational assessment of distribution of soils of various degree of salinity.

In existing publications (Konyushkova, Kozlov, 2010) were shown that in the South part of Russia using remote information it is possible to allocate only two categories of saline soils: non-saline and the all others (i.e. saline in different degrees). Such a drastic distinction is not enough to identify the dynamics of soil salinity in the South part of Russia. To separate the soils of various degree of salinity it is necessary, in addition to the analysis of spectral data, also carry out analysis of the structure of soil cover, because according to the data for the study of heterogeneity of soil salinity in different natural zones and under different anthropogenic impact (Zimovets (1991), Pankov, Soloviev (1992)), was shown that it was natural related to the dimensions of spots non-saline and saline soils. A schematic representation of the spatial distribution of salts within the topsoil shown that, it likely will take the form of "salt body" with highly saline core and with gradually decreasing salinity from the centre to the periphery. And there is the following pattern: the larger the size of salt body, the higher the average value of its salinity.

On the soil transect, located on Solonetz complex in the zone of Brown semi-desert soils (Ustinsky district of Republic Kalmyk), the collection of samples with step of 1-3 m (depending on the linear size of the elementary areas of soils) was conducted. Values of pH, pNa, pCl were determined in soil pasta using ion-selective electrodes. In the aqueous extract 1:5 the conductivity was determined using the conductometer HANNA.

In parallel, an analysis of detailed space images GeoEye (resolution 2 m) was conducted. Comparison of field data and remote spectral data confirmed the previously identified regularity (Konyushkova, goats, 2010), which is based on the spectral space imagery data it is possible to allocate non-saline soils. They were automatically highlighted on the image; as a result a map of the distribution of non-saline soils of the area of study was made.

It was further analyzed how the parameters of soil salinity (pNa, pCl, EC) change depending on the distance from the border area with non-saline soil, and depending on the space area with saline soils. Based on the obtained patterns a map of the salinity of the research area was made

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Work was recommended by Leading Researcher, Dr. M.V. Konyshkova.

Key words: soil salinity; the Caspian; climate change; arid landscapes; mapping

Halophytic and Salt Tolerant Feedstuffs and livestock performance

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Abstract

Halophytes (salt loving plants) occur naturally in a wide range of habitats ranging from arid inland regions to coastal locations. Halophytes are being grown in many places ranging from coastal deserts to inland regions where soils and/or water are saline. We attempt to quantify the amount and type of halophytic or salt tolerant fodder/forage/browse that is available for incorporation into livestock diets. To be a viable proposition for commercial users there must be both sufficient quantity of feedstock (straw, oilseed residues etc) and continuity and reliability of supply. We attempt to quantify the amount and location of fodder sources from halophytic and salt-tolerant plants.

Much irrigable land especially in Central Asia and other places in the former Soviet Union and western China has been abandoned. Halophytes can rehabilitate these lands and provide a resource for livestock and a cash flow to improve household income. Salt-tolerant species are also important because in terms of the sheer bulk of feedstuffs there will be more that is from a non-halophyte source. Salt tolerant plants can be watered with saline waters or grow on saline soils. They have lower salt content in the fodder but are still way above the "normal".

Much literature exists on the physiology of halophytes under regimes ranging from inland playa lakes to coastal deserts where they were irrigated with sea water. Our emphasis is on the animals, and their performance, when fed salty foods either "straight" or, more likely, in mixed rations. The potential value of halophytes as feedstuffs for livestock has been recognized for decades and incorporation of halophyte feedstuffs into mixed rations has been advocated as a way to increase intake and mitigate the anti-nutritional compounds that reduce palatability and food value. The interactions (nutritional, physiological and reproductive) between halophytic feedstuffs and both ruminant and non-ruminant livestock have been studied to a greater or lesser extent by researchers from a number of regions(Australia, Southern Africa, the Gulf Arab region, North Africa and Central Asia.

Much data has accumulated now on the response of both ruminant livestock (sheep, goats, cattle, camels) non ruminants (rabbits etc) and poultry to rations containing halophytic ingredients. We illustrate this with selected examples. In Egypt, and elsewhere, camels are fed on halophytes without much dilution with other fodders. There is a range of tolerances among livestock species and between breeds within a species.

We summarize years of experience from work in Egypt, Australia, USA, Mexico, Pakistan, North Africa and the Middle East and shed light on the problems and prospects for increasing the utilization of halophytes as animal feed and for rehabilitation of saline lands throughout the world

Key words: fodder; browse; mixed rations; camels; diet

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The availability of moisture as the indicator of pastures productivity of Kyzylkum desert

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Abstract

The main part of karakul sheep of the Republic of Uzbekistan is located in Kizilkum desert. Presence on karakul pastures of Uzbekistan various on growth conditions, fodder properties and productivity of groups of plants allows to graze a livestock within all year.

Stocks of forages on pastures are formed during the spring period. The development, growth and formation of a crop of pasturable vegetation is entirely defined by the conditions of the weather which have developed in autumn, winter and spring months. During this period (October-May) in territory of pastures the most part of precipitation (85-95 %) drops. Precipitations of the fall-winter-spring period is a unique source of a moisture for pasturable vegetation.

Total amount of precipitation in this period that supplies the territory with rain is a traditional agrometeorologic indicator. The average long-term quantity of precipitations for this period on territory of pastures fluctuated from 81 mm in Buzaubay to 144 mm in Mashikuduk.

The availability of moisture on pastures depends on concrete meteorological conditions which are a consequence of synoptic processes observed over given territory. It is observed that in formation of damp conditions exits southern and western cyclones which bring a moisture on territory of plains of Uzbekistan. Repeatability of this process in those wet years is much more to 5% compared to the dry years. Formation of damp years is brought on also wave activity on cold front both northwest and western cold intrusions at which repeatability excess make, respectively by 2,8 % and 1,7 %.

On formation of dry years is highly influenced by anticyclonic processes, smallgradient fields of the high and low pressure and northern cold intrusions. In dry years their repetition is much more to 6.2 %, 2.3 %, 1.3 % and above, than in the damp.

Nowadays research an new agrometeorological indicator for an estimation of conditions of growth of pasturable vegetation during the spring period and formations of stocks of forages is conducted. The thermohygrometric coefficient of dryness of air (THC), closely connected with heat and availability of moisture territories can become one of such agrometeorological indicators.

On the average long-term THC increases from 26-39 ‰ (promile) in the beginning of March to 70-74 ‰ in the end of May. Factor variations on territory will be co-ordinated with distribution of precipitations in these areas: the drier area, the above value of thermohygrometric factor.

Key words: pasture productivity; thermohygrometric coefficient of dryness; moisture factor; Kyzylkum desert

Some data on wood decay fungi in Zarafshan Reserve of Uzbekistan

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Abstract

Zarafshan Reserve, located along the right channel of the Zarafshan River, is of particular importance. Mainly riparian vegetation, represented by trees, shrubs and herbaceous plants grows here. In this study, fungal fruit bodies were collected. The fruit body samples were identified with their morphological characteristics. Through the investigation, 25 species belonging to 10 genera, 7 families were found so far and 20 species were identified into species level. Most of the species belonged to Polyporales followed by Hymenochaetales. In Polyporales, most species were from Polyporaceae and Meruliaceae. Most frequent genera of recorded are *Laetiporus*, *Bjerkandera*, *Fomes*, *Inonotus*, *Phellinus*, *Stereum*, *Trametes* and *Schizophyllum*.

Key words: fungal diversity; wood-decaying fungi; Zarafshan Reserve

Productive improvement of soil by the application of phosphoric fertilizers

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Abstract

Phosphoric fertilizers in the first year of action are usually used on 10-15 %. The low operating ratio is connected not with transition of the brought phosphates in indigestible form plants, but with the limited item availability of reactions of fertilizer and soil, possessing weak ability to movement in a soil solution. Fastening of phosphates by soils prevents their washing away; this is an account part of phosphoric balance that can have some value only on sandy and highly saline soils which is available in set in our republic.

Interaction of phosphoric fertilizers with soil goes by the way of formation of the steady mineral connections, the structure of which is defined by genetic features of soil and the reaction of the soil environment. In sour soils phosphates of one-and-a-half oxides, in neutral and carbonaceous soils - calcium phosphates are formed basically. Formation of the most stable forms of soil phosphates is very slow process accompanied by accumulation of intermediate metastable products of reactions, keeping rather big solubility in a soil solution and is considerably the best availability to plants in comparison with natural soil phosphates. Character of transformation of fertilizer introduced in soil is also defined by its chemical compound. This explains the effectiveness of different forms of phosphate fertilizers in the first years after their introduction. At longer influence of fertilizers with soil all readily soluble phosphoric fertilizers make about identical impact on soil fertility. Therefore at entering of phosphoric fertilizers it is necessary to consider quantity of brought fertilizers and type of soils. It is known that the basic type of soils in our country is grey soil. An optimum level of the maintenance of mobile phosphorus on such types of soils is 3-4 mg/100 g of soils. For increase in the maintenance of mobile phosphorus at 1 mg/100 g soils is required to be brought P_2O_5 over carrying out of 100-130 kg/hectares, but on grey soils of a new irrigation these expenses can increase considerably. One of such phosphoric fertilizers is precipitate (hydro phosphate of calcium) which can be made from local waste. At present, at processing of Kyzyl-Kum phosphorites on the washed burnt concentrate, about 40-42 % P_2O_5 goes in sailings in the form of mineral mass and slime phosphorite with the content of 12-14 % P_2O_5 . One of such decisions is the way of processing of such poor phosphate raw materials on the qualified unary (single) phosphoric fertilizers like precipitate. Therefore we develop a way manufacture precipitate from such phosphorite with the simplified technological scheme. As the fertilizer, precipitate possesses many advantages: high concentration of indigestible P_2O_5 , high agrochemical efficiency on all types of soils and for all cultures. Precipitate is neutral, therefore it does not break natural structure of soil microbial communities. Increase of efficiency of phosphoric fertilizers, including precipitate and their ratio of use promotes also optimum spatial distribution of phosphoric fertilizers in soil to decrease their fixing and increase of concentration of phosphorus radical zones that is to increase the coefficient of use.

Key words: productivity of soil; phosphoric fertilizers; precipitate

Response of wetland ecosystem developing to climate changes in the cold alpine and desert biomes of east Pamir region: a pilot study of multi proxy analysis

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Abstract

Due to their geographical location, extreme climatic conditions, isolation and exceptionally short growing season, high-mountain wetlands of Pamir developed a unique landscape and soil properties. Because of the extreme conditions in the Pamir mountains (cold desert biomes), lake-side and riverine wetlands play crucial role for many species of plants and animals and, from the biogeographical perspective, can be treated as isolated islands.

Isolated river valleys surrounded by inaccessible mountain peaks, extreme weather and water shortage resulted in sharp filtering from the geographically available plant species. Hence, floristic analyses of occurring vegetation will enable us to test hypotheses on geographical and ecological filters, that shape the species pool of high-mountain wetlands. . The high mountain vegetation is generally considered to be particularly vulnerable to climate change. Therefore, this vegetation can be used as a sensitive "ecological indicator" for climate change effect.

The main purpose of this pilot study was to use these wetlands as model ecosystems in ecological studies on wetlands habitats.

This study is also a part of the international cooperation for scientific research, conservation and sustainable development in the Central Asia region. Thanks to this project we will provide documentation on the Pamir wetlands' biota, explore wetlands' potential and prepare recommendations for collaborative conservation of key species, habitats and high altitude ecosystems in the Central Asia region.

Key words: desert biomes; ecosystem resilience; Pamir wetlands, biodiversity conservation; climate change

Production of water filter from reservoir sediment in Tunisia

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Abstract

Reservoir, that dams river and retains water, is mass intensive water resource with high reliability of stable supply of water. However, suspended solids in river water settle down and cause sedimentation. This sedimentation decreases capacity of reservoir so that is anxiety factor of sustainable use of reservoir. On the other hand, some regions cannot construct new reservoir due to suitable area for constructing is limited. In such area, adequate reservoir management for existing reservoirs must be practiced.

The study site reservoir locates in Tunisia. Despite reservoir management is necessary for Tunisian reservoirs, due to the management such as dredge is costly, suitable management haven't been practiced so far as similar as other developing countries.

In this study, way of effective utilization of sediment which is waste substance in the process of dredge will be examined. Due to the diameter of sediment is in micro meter order, the possibility to exploit sediment as water filter is conceivable.

Feasibility of sediment as ceramic material had been reported by Iriete et al.¹⁾, but only the hardness of the ceramics made from sediment was examined because the ceramics targeted the use as construction bricks. The permeability and porosity which are the important parameters for the use as filter were not discussed.

First the author pictured SEM image of the ceramic sample in order to confirm if it's porous ceramic or not. The sample was made of only sediment with the water content of 45 % and sintered at 850°C. The SEM image showed a porous surface of the ceramics. However, it got cracked and broke down when it was left into water bath. The cracks were due to the expansiveness of the clay in water and lack of vitreous matter that functions as bond. The sample made of sediment and Toyoura sand didn't get crack in water bath.

Optimum proportion of sediment and sand discussed from perspective of strength and porosity. On the other hand, the porosity and porous size can be controlled by the specific additives. In this study, availability of this technic to enhance quality of water filter is shown. In addition, potential of the ceramics filter was examined by the water permeability experiment.

Prospect of water filter is not only financial assist for dredge, also water filter may help environmental problem caused by contaminant water by providing natural material filter with low cost.

Key words: ceramic; filter; sedimentation

Reference:

- 1) Mitsuteru, I, et. Al: *Feasibility of Exploitation of the Sediment in the Reservoirs for the Sustainability of Surface Water Resource in Tunisia*: J. Japan Society of Civil Engineering Ser.G, 68, 6, II41-46: 2012

Restoration for ecological functioning of degraded terrestrial ecosystems: case example from Kuwait

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Abstract

As a result of Iraqi invasion to Kuwait in 1990 significant damages occurred to the terrestrial, marine and atmospheric environmental compartment of Kuwait due to the military activities in the desert as well as due to degradation effects from the detonation of oil wells by Iraqi forces resulting in the release of over 1 billion barrels of crude oil into the environment. These environmental disturbances manifested themselves in accelerated soil erosion, increased sand movement, increased incidence of sand storms and dust and damages to natural vegetation and wildlife. Kuwait submitted environmental claims for compensation for expenses for measure to remediate and restore its ecosystems. The United Nations Compensation Committee (UNCC) awarded Kuwait US \$2.9 Billion for this purpose.

For the purpose of this paper we will only focus on research and development efforts geared towards Kuwait Environmental Restoration Program (KERP). Emphasis will be given to terrestrial ecosystems where large scale revegetation of almost 1600 km² is currently being planned in different ecosystems of major plant communities, *Rhanterium epapposum*, *Haloxylon salicornicum*, *Cyperus conglomerates* and *Panicum turgidum*. Simultaneously, a comprehensive Environmental Monitoring Program will be carried out to ensure that ecological functioning is moving towards restoration of environment to pre-invasion of Iraq in 1990. This will be achieved through planning of well designed monitoring protocols supported by various indicators for ecosystem structure and functions. The implementation for KERP will take place between 2014 to 2026 and will be coordinated among different stakeholders. This project represents the largest restoration program of dryland terrestrial ecosystem ever carried out in recent times in arid zones.

Key words: detonation; crude oil; environmental restoration

New records for north-west Kyzylkum

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Abstract

North-west Kyzylkum (Karakalpakstan) bordered on the north of the Aral Sea in the west and south by the area of irrigated agriculture, on the east by the Central Kyzylkum. Occupy more than 5 million hectares.

Paramount problem of animal industries of the Central Asian republics is the problem of security the forages which decision depends on presence of representatives of one of typical deserted families of Monocotyledoneae. The families of Monocotyledoneae in the flora of north-west Kyzylkum occupies special important position and represents huge scientific interest, as the largest families of the flora of this region.

According to their literary (Korovin et al., 1983; Sherbaev, 1988) was including 4 species *Juncus* L., 6 species of *Gagea* Salisb. and 1 species *Rhinopetalum* Fisch ex Alexand.

During floristic study (2011-2013), the collection and study on plant specimens (herbarium of TASH) in the north-west Kyzylkum, interesting species were found. Among them 5 species (*Juncus compressus* Jacq., *Gagea deserticola* Levichev., *Gagea gagea x ovastia* Levich. (f. ova x stipitata), *Rhinopetalum gibbosum* (Boiss.) Zosinsh et Vved., *Henrardia persica* (Boiss.) Hubb.) were provided for the first time for the flora of north-west Kyzylkum. The database was established for Monocotyledoneae (TASH) of the Karakalpakstan.

Specimens were identified primarily using the "Flora of Uzbekistan" (1941), "Flora of Kazakhstan" (1956), "Flora of Turkmenistan" (1932), "Conspectus Florae Asiae Media" (1968) "Illustrated determinant of the plants of Karakalpak and Khorezm" (1982).

Juncus compressus Jacq. Jacq. Enum. Stirp. Vindob. (1762)60.

Specimen seen TASH: Kyzylkum of Karakalpakstan: Aktau. Atamtay guzhumdy. Muravlyansky K. 27.04.1934. №377, 378, 379.

Others specimens seen TASH: Experimental field of Chimbay. Alfalfa field of at the bottom of the ditch, rare. A. Moskvina 07.06.1928. 31183.; Karakalpakstan. Kungrad district. At the bottom of the old duct. Maylun Z.A 05.30.1952. Navikom V. 02.75.; On the south side of the lake. Khodjakul, the coastal zone of Kipchak. Taubaev. 25.09.1975. det. Navikom V. 02.75.; Karakalpakstan. Kungrad district. Dumzak count (flow Kyzsovma). Ashirova A. 08.24.1954.

Gagea deserticola Levichev.

Specimen seen TASH: Kyzylkum of Karakalpakstan. Muravlyansky K. 04.08.1934. det. Levichev. 10-13.06.1983; 09.06.1983. №49, 93, 95, 99.

Gagea gagea x ovastia Levich (f. ova x stipitata).

Specimens seen TASH: Kyzylkum of Karakalpakstan. Tamdy Muravlyansky K. 04.08.1934. det. Levichev. 10.10.1986. Number 102.; Kyzylkum of Karakalpakstan. Aktau soft sediments. Muravlyansky K. 17.04.1934. det. Levichev. 13.10.1986. №218, 219.

Rhinopetalum gibbosum (Boiss.) Zosinsh et Vved. in Fl. URSS. 4(1935)297.

Specimen seen TASH: Kyzylkum of Karakalpakstan. 8 km south of Dzhetimtau. Muravlyansky K. 25.03.1934. №15.

Henrardia persica (Boiss.) Hubb. in Blumea. Suppl. 3(1946)15.

Specimen seen TASH: Kyzylkum of Karakalpakstan. Oh-chemen, broken sands. Muravlyansky K. 04.34.

Thus, in the present time in the territory of Karakalpakstan are grow 5 species of *Juncus* L., 8 species of *Gagea* Salisb., 2 species *Rhinopetalum* Fisch ex Alexand. and 1 species *Henrardia* Hubb. Also the genus *Henrardia* Hubb. was included first time for the flora of Karakalpakstan.

Key words: north-west Kyzylkum; Monocotyledoneae; new record; genus; species.

The chemical elements of species of the genus *Artemisia* L. of Ustyurt

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Abstract

Salinization is one of the major environmental and production problems currently agricultural sectors in the countries of Central Asia. The Ustyurt presented all known types in the Central Asian desert - sand, gypsum, saline. Desert area covers the territory of Kazakhstan, Uzbekistan (Karakalpakstan) and Turkmenistan. In these Republics are focuses on the development of scientific bases of reproduction, rational use of natural and including plant resources. Providing with fodder problem, the solution of which depends on the presence representatives of one of the dominant genus of desert - *Artemisia* L. in the flora Ustyurt are occupies a special and important provision represents a huge scientific interest as the largest genus of deserts of the Central Asia. According to their literary (Adilov et al., 1993; Sarbaev, 1994) was including 16 species of the flora of Ustyurt.

During floristic study (2010-2013), the collection and study on plant specimens (TASH, AA) were found 1 (*Artemisia campestris* L.), new records for the first time for the flora of Ustyurt. Among them were provided 2 species were new locality for the flora of Ustyurt. The 20 species belonging of the genus *Artemisia* L. had been registered from Ustyurt. The database was established for *Artemisia* L. (TASH and AA) of the Ustyurt. Specimens were identified primarily using the "Flora of Uzbekistan" (1941), "Flora of Kazakhstan" (1956), "Flora of Turkmenistan" (1932), "Conspectus Florae Asiae Media" (1968) "Illustrated determinant of the plants of Karakalpak and Khorezm" (1982).

Artemisia campestris L. in Sp. Pl. (1753) 846 et (1763) 1185.

Specimen seen AA: North of Ustyurt. 3 km north-east from Sam. The hilliest sand. 17.06.1987, Kudabaeva GM Nelina N. Kyzylkum of Karakalpakstan: Aktau. Atamtaguzhumdy. Muravlyansky K. 27.04.1934. №377, 378, 379.

Others specimens seen TASH: Karaganda region. Mountains of Orta. Gravelly hills. 28.08.1935, B. Mironov, Pazy B. 797; River valley. Sarysu. To the west from the Myng-adyr. Plain. 06.24.1937, V. Pazy. 740.

A study of chemical composition of some dominant species of *Artemisia* (*A. terrae-albae* Krasch., *A. turanica* Krasch.) revealed that the species studied contains 38 chemical elements. In the composition of microelements in aboveground dry matter field grown plants Ustyurt 16 transition metal (Re, Ag, Au, Co, Cr, Cu, Fe, Hf, Hg, La, Mn, Mo, Ni, Sc, Ta, Zn), 2 semimetal (As, Sb), 4 alkaline earth metal (Ba, Ca, Mg, Sr), 4 alkali metal (Cs, K, Na, Rb), one nonmetal (Se), 2 halo (Br, Cl), 7 rare earth (Ce, Eu, Lu, Sm, Tb, Nd, Yb) and 2-radioactive rare earth (Th, U) elements. Re of them as part of rare plants. Using rhenium (Rhenium) in major productions lamps, photographic flash, and thermostats. It is also used as a catalyst in some chemical reaction. This metal is added to the alloys used for medical instruments and jewelry. Re additive compounds has been recently used in some cancer patients.

Key words: *Artemisia* L.; Ustyurt; new records; species; chemical elements

Projection of future change in aridity index and evaporation ratio in the arid and semi-arid region

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Abstract

Annual evapotranspiration approaches annual precipitation in arid and semi-arid regions where the available energy greatly exceeds the amount required to evaporate annual precipitation. Evapotranspiration is a key information for water management in the region where available water resources are limited. This study aims to estimate the impacts of climate change on the aridity index (AI) and evaporation ratio (ER) using climate model and land surface model. Surface energy and water balance is calculated by the land surface model (SiBUC). The super high-resolution global climate model (MRI-AGCM3.2S) with 20km resolution provides the present (1979-2003) and future (2075-2099) climate conditions. By analyzing the 25-year average value of precipitation, available energy (net radiation), and evapotranspiration, AI and ER are calculated for each climate condition. In general, ER is expressed by the monotonically increasing function of AI. Then, the climate change signals for AI and ER are generally same. This tendency can be seen in Atacamadesert, Sahara desert, Namib desert, Arabian Peninsula, Aral Sea, and Australia. On the other hand, some regions such as California, Tibetan Plateau, and Gobi desert, have negative impact on AI and positive impact on ER. Negative impact on AI is consequence of the increased precipitation. In those regions, not only the total amount of precipitation, but also snowfall ratio will be affected from the climate change. Positive impact on ER can be explained by the decreased snow-covered period.

Key words: aridity index; evaporation ratio; global climate model; land surface model

Seasonal development of indicator-saprob in the middle flow of the Zarafshan River

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Abstract

Indicator-saprob organisms present ecological conditions of their living place. By searching spreading, biomass, biologic-physiologic changes of the algae in the open water fields we can conduct ecologic monitoring of ecotop.

Algae 5 section which including 331 types were found in the middle flow (from 1st May water reservoir to Hatirchi region Samarkand province). From these 97 types, in other words, 29, 30% consists of indicator-saprob algae. They are: 20 types are xenosaprob, 18 types are oligosaprob, 51 types are beta-mezosaprob, 5 alfa-mezosaprob and 3 types are polisaprobs.

59 types of algae were found in spring: from searching place: *Merismopedia elegans* A.Br., *Stephanodiscus dubius* (Fricke) Hust., *Stauroneis anceps* Ehr., *Navucula cryptocephala* var. *intermedia* Grun., *Diatoma hiemale* (Lyngb.) Heib., *Synedra ulna* (Nitzsch) Ehr., *Cocconeis placentula* Ehr., *Gomphonema clevei* Fricke., *Euglena gracilis* Klebs, in summer 45 types (46.39 %): *Microcystis aeruginosa* Kutz.emend.Elenk., *Gomphosphaeria lacustris* f. *compacta* (Lemm.) Elenk., *Nostoc verrucosum* Vauch., *Oscillatoria nigra* Vauch., *Fragilaria virescens* Ralfs., *Peridinium cinctum* (O.F.M.) Ehr., *Ulothrix zonata* (Web.et Mahr.), 50 (51.54 %) types were found in autumn: *Fragilaria capucina* Desm., *Synedra berolinensis* Lemm., *Trachelomonas hispida* (Petry.) Stein. emend. Delf., *Euglena acus* Ehr., *Pediastrum duplex* var. *cornutum* Racib. 29 (29,89 %) types were found in winter: *Ceratoneis arcus* var. *amphioxys* (Rabehn.) Brun., *Synedra ulna* (Nitzsch) Ehr., *Achnanthes lanceolata* (Brev.) Grun., *Euglena gracilis* Klebs., *Spirogyra tenuissima* (Hass.) Kutz. were mostly found.

In spring the index of saprob is much more than other season (1.67), in winter (1.22), in summer (1.47), in autumn (1.52). The fact that, the limit of saprob is beta-mezosaprob in spring, and other seasons in of oligosaprob. Medium index of saprob is equal to 1.47 in other words beta-mezosaprob.

Under the influence of spring rains the index of saprob increased because of the increase of falling organic elements and decreasing temperature to the river.

Increasing temperature of the water compared to other seasons in summer brought increasing of the algae in the river. Increasing temperature and sun shine support producing much oxygen in the water by algae. It brings about to increase speed of the split organic elements. As a result organic elements become less in the water. In autumn the increase of the rains and decrease temperature of the water brought about to become less number of indicator saprobs and increasing of index of saprob.

Low temperature in winter limits developments types of the indicator-saprobs.

Key word: algae; types; indicator-saprob types; beta-mezosaprob

Risk assessment of health of the population relating to the pollution of the environment

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Abstract

Origination and growth of the number of diseases of the cardiovascular system, respiratory, oncology, endocrine and other diseases largely depends on pollution and unfavorable environmental conditions, the negative effects of human impact on natural resources. An important place in securing and maintaining the capacity of health is the identification of risk factors and conditions of their occurrence.

The emergence and growth of a number of diseases of cardiovascular system, respiratory, oncology, endocrine and other diseases depends largely on pollution and adverse environmental conditions, the negative consequences of anthropogenic impact on natural resources.

Influence of water quality on human health is directly related to the effectiveness of existing preventive measures for the protection of water basin from pollution and ways to clean drinking water. Study of the influence of water quality on human health need for direct prediction of real consequence of pollution of water sources for human health for the near and distant future. Health status is a reflection of a complex set of phenomena in the environment. The process of its formation are influenced by a number of biological, socio-economic, anthropogenic, climatic and other factors. Thus, according to the World Health Organization, human health by 50-60% depending on the conditions and lifestyle, 15-20% of the state of the environment and for 10-15% of the quality of care.

Slow and chronic exposure to low concentrations of the chemical components of the water, oppression protective functions of the body by the respective degree reduce the overall resistance of the organism to other damaging factors and are promoting increase overall morbidity, including incidence of infectious diseases by reducing the of the immune confrontation.

In many studies, the development of cancers associated with the detection of underground water sources is carcinogenic organic compounds of anthropogenic origin. Special attention at pesticide contamination of surface waters. In particular, as the Republic of Karakalpakstan, Khorezm region, and Bukhara region, the impact of underground water on population health is very high. The reason for these consequences is the ecological condition and salinization of lands. The above-mentioned regions remain the leading diseases such as kidney and urinary tracts diseases. In this case we consider only the diseases associated with surface water and underground water. As the Karakalpakstan Republic and Khorezm region is situated in the lower reaches of the Amudarya river, which is becoming a cause of the spread of infectious diseases. The population does not attend enough attention to hygiene, boiling before using water from wells and irrigation ditches watershed that is the cause of the highest rates of infectious intestinal diseases.

Thus the whole chain of the water cycle way or another will render its direct impact on the environment as a whole and the person is fully dependent on it: "Soil -> Drinking Water -> person." Keeping in mind the environment, we mean the interconnection of all the components of nature together, landscape and soil and surface water and underground water air, etc Subsequently anthropogenic influence in the river basin are affecting to the quality of water downstream.

A large number of works devoted to the dangers of anthropogenic chemical and biological pollution of groundwater. In many studies with pesticide pollution of groundwater and surface water is associated risk of increasing the level of cancers.

There was conducted an inventory of the existing system of observations over the surface water quality, and a retrospective and spatial analysis of the quality of watershed of the republic, the identification of impacts of anthropogenic sources of pollution on the ecological status of natural waters in Uzbekistan.

Key words: risk factor, underground water, pollution of the environment, chemical components.

Crops diversification and agricultural use of marginal water adaptation measures to climate change

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Abstract

Marginal water (brackish, drainage and hydrothermal artesian water) can become an effective source to cope with increasing deficit of freshwater and low rainfall in the arid and semi-arid areas. The water collected from drainage system after applied in irrigated fields is mostly highly mineralized in downstream of the rivers of Central Asia. Usage of such waters can decrease water stress in the area and provide additional strategy for the basin development under increased water demand in the downstream areas. There are several strategies available that include: mixing marginal and fresh water to extend water supplies and to save fresh water when possible, rotation of the high-value crops and lower-value salt-tolerant; diversifying water-intensive crops towards salt-tolerant crops; rotations of crops with livestock forage production, promotion of dual-purpose crops withstanding marginal waters irrigation.

This article includes original data collected during implementation of Desert Ecosystems and Livelihoods project (DEL) within the period 2011-2014 on reclamation of marginal lands (abounded or salt affected lands) in a downstream of Zeravshan river delta being high saline (186-200 mS/m 0.5m). We have identified opportunities for agricultural demand into a model of closed river water systems management instead of open canals that are largely practiced today. Virgin desert sites, characterized by several halophytic shrub-grass, perennial halophytic-xerophytic grass and annual halophytic grass communities were turned into an agroforestry, dual-purpose crops and halophytic pastures improvement trials. Hydrothermal artesian low mineralized (2000.8200 mg l⁻¹.) water was serving as a single source of irrigation in these desert ecosystems.

Despite of regional climatic disadvantage lower Stream of Zarafshan River in Uzbekistan it still has very high agricultural water productivity compared to similar downstream areas of Syrdarya and Amudarya Rivers Basin. Also any measures to increase yields (e.g. crop breeding towards salt-drought and heat tolerant varieties, changed/or shifting sowing dates and fertilizers regime and/or to reduce crop losses from different biophysical stress impact) simultaneously reduce unproductive water flows and increase overall water productivity. Therefore, crop diversification systems based on salt-tolerant plant species are likely to be the key to future agricultural and economic growth in the regions where salt-affected soils exist, saline drainage waters are generated, and/or saline aquifers are pumped for irrigation. Incentives for farmers and agropastoralists to invest in the rehabilitation and increasing productivity of marginal lands and to establish small alliance (cooperatives) and investments in market outlets has to be considered as an important step in promotion of *adaptation measures to climate change*. Our research on improved management of drainage water quality for reuse, would address an urgent need in climate change adaptation, given the strong reliance of downstream users on drainage water from upstream. The DEL project conducted by us in the downstream of Zarafshan River basin provides an example which aims at sustaining natural resources and ecosystem services and livelihoods through rangeland rehabilitation, utilization of low quality water for biosaline agriculture (tree-farming, pond aquaculture, agroforestry, crop-livestock associations, silvicultural practices) and other income diversification for rural communities.

Key words: marginal water; biosaline agriculture; ecosystem services; climate change adaptation; Aral Sea Basin

Developing water circulation model in the Aral Sea basin based on in situ measurement in irrigated area

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Abstract

In the Aral Sea Basin, serious drought has been induced as a result of irrigation projects. For sustainable development, water resource and demand are required to be estimated from the past to the future as basic and scientific information. However, accuracy of statistical estimation, which is popular in this basin, is uncertain to estimate impacts of climate change or future irrigation projects.

Therefore, authors have tried to develop physical water circulation model in the Aral Sea Basin, which is mainly composed of land surface model SiBUC. Through water and heat balance analysis, hydrological processes, such as evapotranspiration and infiltration, can be physically calculated in the whole target area. However, strong regionality in irrigation water management makes modeling process difficult. Thus, in situ measurement was started from 2011 in two testing farms, which are Kyzylkesek and Bayavut sites located in arid and semi-arid region, respectively. Since both sites are highly salinized, salt leaching is important operation in seasonal irrigation cycle. Soil moisture and electric conductivity are measured at two depth by WET-sensor (Delta-T), and DL/N70 (Koshin) was used to observe ground water level.

As a result, by comparing two sites, soil moisture in arid farm sharply fluctuated because of high intensity of evapotranspiration and infiltration, on the other hand in semi-arid farm, it moderately changed since water is supplied from high ground water level. By comparing with model output, fluctuation of analyzed soil moisture was relatively higher especially in semi-arid farm since ground water level was not considered in the model.

Key words: soil leaching; soil moisture; evapotranspiration ; water salinity; water calculation model; Aral Sea Basin

Soil and hydrological survey for retrieving the characteristics of surface runoff on Kourtimalei reservoir watershed in Djibouti

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Abstract

Djibouti is located in the north-eastern part of Africa and the most of the land is covered by desert area. Although Djibouti is a country with little rainfall, the high intensity rainfall, which may cause flood runoff, sometimes occurs. When such rainfall occurs in the closed watershed, rainfall water accumulates in a basin and the ponding area stays for several months. However, ponding water is lost by evaporation and infiltration to ground in a few months later without utilizing it. In order to secure irrigation water in Djibouti, we attempted to find a way to make use of the surface runoff water effectively.

We selected the Kourtimalei reservoir watershed as the target area of this study. We started to record the weather data near the Kourtimalei reservoir and the water level data of the reservoir from August, 2012. We also set up the rain gauges and pressure type water gauges at three places within this watershed area in June, 2013 for observation of precipitation and temporal surface water distribution. Furthermore, we have done the field experiments on the infiltration capacity, the soil texture, and saturated hydraulic conductivity of the soil where the rain gauges were set.

The relation between the rainfall and water level at the observation point was insignificant. The result suggests the localized runoff was occurred by torrential rain within this watershed. We are in the process of collecting data, and trying to clarify the regional distribution of the rain and the relationship between rainfall amount and the water level of the reservoir.

Key words: surface runoff; reservoir; infiltration capacity; soil texture

Integrated research approaches to increase resilience and improve well-being: launching the CGIAR Research Program on Dryland Systems in Central Asia

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Abstract

The agricultural sector in Central Asia is experiencing considerable difficulties in the management of production factors, specifically owing to soil and water salinity. The Soviet-era plan for development of irrigated area around the Amu Darya and Syr Darya rivers caused irreversible damage to the environment around the Aral Sea: ecosystem degradation, water quality and health issues, waterlogging and salinization of agricultural and pasture lands. With the subsequent low productivity, the lives of the farmers are significantly impacted. Climate variability, drought and extreme heat and cold stress exacerbate the situation in the Aral Sea Basin, which comprises the largest area of persistent severe droughts in the world. In addition, people in mountainous areas are eking their lives due to meagre agricultural and livestock production during short growing season, mudslides, poor accessibility to agricultural inputs and markets, lack of access to credit and agricultural extension, land degradation, lack of clean drinking water and heating in winter. Conversely, there are areas, such as the Fergana Valley, where irrigated agriculture has been very productive. However, due to high population density, lack of crop rotation, deteriorating state of irrigation and drainage infrastructure, inadequate market conditions, sustaining the profitability of irrigated agriculture is becoming an issue. The factors influencing agricultural production are inter-related and should be addressed through systemic, integrated research. And the solutions need to be based on a multi-disciplinary approach in identifying, testing, customizing, implementing and out-scaling relevant technology and innovation.

Following a two-year inception phase, the CGIAR Research Program on “Integrated Agricultural Production Systems for Improving Livelihoods in the Dry Areas” – or Dryland Systems in short was launched in October 2013. The research agenda was developed by an inter-disciplinary research team composed of ICARDA as the lead center and the partner international centers in close collaboration with national agricultural research partners, policy makers, farmers’ associations and development organizations. The results of the inception phase can be found at <http://cac-program.org/projects/crp>. The Program aims to pursue new technology, institutional and policy options for enhancing productivity and managing risks through diversification, sustainable intensification and integrated agro-ecosystem approaches in three selected Action Sites. These are the Aral Sea Region, Fergana Valley and Rasht/Kyzyl-Suu Valley.

The presentation will provide background information about key factors in agriculture and opportunities to address them through integrated research approaches; goals and expected impact pathways of the Dryland Systems Program. Results of studies carried out to date, and projected joint research activities will also be highlighted. They will lead towards (i) more resilient livelihoods for vulnerable households in marginal areas and more sustainable; and (ii) higher income and well-being in the areas with high potential for intensification in the Action Sites.

Key words: drylands; integrated research; marginal areas; irrigated agriculture; Aral Sea Basin

Comparison of grazing behavior of sheep between different herders in steppe region of Mongolia

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Abstract

Democratization in the early-1990s in Mongolia was one of trigger to change the systems of animal husbandry. Demising collectives which called a *negdel*, and livestock privatization were some of the factors of transition that management style of herders was changed from cooperatives to individuals. Specific skills based on collaborative work were dispersed into each individual household, herders technique was differed individually. The difference of this technique effects not only livestock productivity but also resistance against to the natural disaster such as *Dzud*, which is animal loss by severe winter. And the difference of technique of each household may affect herder's livelihood, especially to the small herders. The objective of this study was to compare the difference of grazing behavior of sheep on two different herder's households. The experiment was conducted on September 2012 at steppe region in Uvrkhangai province, Mongolia. Experimental animals were wether of two years old and selected one sheep from two different herders (herder-A and herder-B) respectively. The major difference between two experimental herders was the number of working person of household. Small GPS device (iGot-u) was attached on the experimental sheep before start grazing of the first day and removed after grazing of fifth day. Latitude, longitude and the time were measured. Distance was calculated from latitude and longitude and grazing speed was calculated from distance and the time. Then 30-point moving average of grazing speed at each time was calculated. Start time of grazing of each day was almost same in herder-A. But in herder-B, the start time was different on each day. In herder-A, grazing speed exceeded 1.5 km/h was seen only in the morning, but in herder-B, grazing speed exceeded 1.5 km/h was seen not only in the morning but also in the afternoon. The length of transferred periods will affect time of forage intake. This means the sheep of herder-A seems to be transferred first to the suitable area then start grazing. But the sheep of herder-B seems to be grazing with searching grassland.

Key words: grazing behavior; grazing speed; nomadic sheep, Mongolia, steppe

Evaluation of interpolation methods for spatial modeling of reference evapotranspiration using modified Hargreaves equation

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Abstract

Accurate estimation and interpolation of reference evapotranspiration (ET_o) is very important in arid and semi-arid environment. This is often problematic reasoning insufficient of full climate data set and scarce of meteorological stations especially in developing countries. Reliable ET_o are required for sustainable water management in agricultural water management, improving crop water productivity and other hydrological analyses. The Hargreaves semi empirical model only requires temperature data to estimate ET_o but calibration is needed under the local climatic condition for acceptable prediction accuracy. This paper introduces the procedures of generation of accurate ET_o surface from a locally calibrated Hargreaves semi empirical model for Tashkent province, Uzbekistan. In this study the Hargreaves model was calibrated under climatic conditions of Tashkent province. The meteorological data was obtained from 14 weather stations within Tashkent province for 2009-2012 and the original empirical coefficient (0.0023) of the Hargreaves equation was modified using standard Penman Monteith FAO 56 (FAO-56 PM) model estimates for every month of the years. The FAO-56 PM model is considered to be the most accurate model to estimate ET_o under a variety of climatic conditions (Allen *et al.*, 1998). For that reason FAO 56 PM model was selected to calibrate the Hargreaves model in this study.

Statistical comparison was made in ArcGIS platform (ver. 10, 2 ESRI, Redlands, Cal) among deterministic (inverse distance weighting, spline and natural neighborhood), geostatistical (Kriging and Co-kriging) and regression (Ordinary Least Square and Geographically Weighted Regression) methods to evaluate the performance of interpolation methods, concerning suitability for spatial prediction of monthly average ET_o. The best interpolation model of ET_o was obtained from Co-kriging methods using elevation data as an auxiliary secondary variable. The results revealed that the incorporation of elevation improved spatial prediction of ET_o in Tashkent province. The spatial distribution maps of ET_o indicated that the ET_o value decreased from southwest to northeast as the altitude increased in the study area.

The modified Hargreaves model provided the best performance to estimate ET_o in Tashkent province as an arid and semi-arid climate. Over and under estimations of ET_o with the original Hargreaves model were significantly reduced by 80 % as an average using new empirical coefficients for all 14 weather stations.

New monthly empirical coefficients were very sensitive depending on spatial and temporal changes. The variation coefficient of new monthly adjusted empirical coefficients for 2009-2012 were estimated to be very small particularly in vegetation periods (March-September).

Key words: arid; interpolation; geostatistics; reference evapotranspiration

The spatial distribution of C₄ chenopods of Kyzylkum Desert flora along a salinity and relief gradients

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Abstract

This collaborative study suggests soil salinity and soil moisture regimes that further understanding of on distribution of C₃ and C₄ plants is by landscape elevation. It was determined that halophytic flora of Kyzylkum Desert comprises mostly by C₄ species that occurring mostly in salt depression and saline plains. There is a strong positive correlation between soil salinity and moisture and botanic diversity of plants in the sandy desert soils. Low soils salinity content of high elevation landscape in Kyzylkum Desert is accompanied by a sharp decrease of halophytes occurrence. During the summer extremely dry and hot period C₄ pathway could give plants an edge in the competition with C₃ plants for occupation of plots with low soil salinity and water content. Though, the distribution of C₄ chenopods also decreases with elevation in Kyzylkum Desert. The natural occurrence of plant associations with C₄ chenopods achieves 80% at the lands with elevation in the range from 50 to 200 m and falls to 20% from foothills towards medium mountains landscapes with the elevation higher than 200 m above sea level. The positive correlation between soil salinity and soil moisture, change of ratio of C₄ chenopods in the plant associations along landscape elevation support the hypothesis that Chenopodiaceae C₄ syndrome presents an evolutionary response of the C₃ chenopods to topographical soil desalination and increasing aridity of Kyzylkum Desert.

Key words: C₄ photosynthesis; Chenopodiaceae; landscape; soil salinity; adaptation

A methodology to assess the carbon sequestration potential of semiarid regions in Central Asia

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Abstract

The semi-arid regions of Central Asia have long been neglected by policy makers by being misperceived as being degraded marginal areas, offering poor returns on development investment. In view of existing and upcoming regional- and international financing mechanism, the potential of the vegetation cover of the semi-arid areas of Central Asia is increasingly being recognized as an important sink for the sequestration of atmospheric carbon.

A methodology is being offered whereby - following the estimation of a baseline - the net GHG removal as a result of the rehabilitation of grass- and shrublands can be estimated based on the specific characteristics (coefficients) of grass- and shrublands. Respective coefficients have been used for the estimation of CO₂ sequestration in national communications to the United Nations Framework Convention on Climate Change.

The suggested methodology assumes that the project area is not tilled and that the survival rate of the newly planted grass- and shrublands accounts for approximately 70%. Hence, during the rehabilitation efforts it is assumed that an additional 30% of the area is being re-rehabilitated.

The yearly net greenhouse gas removals is:

$$\Delta C = \Delta C_{LB} + \Delta C_{DOM} + \Delta C_{Soils}$$

where,

ΔC –the annual change in carbon stocks in the rehabilitated lands, tC/year;

ΔC_{LB} –the annual change in carbon stocks in living biomass (includes above- and belowground biomass) in the rehabilitated land, tC/year;

ΔC_{DOM} –the annual change in carbon stocks in dead organic matter (includes litter) in the rehabilitated land, tC/year;

ΔC_{Soils} –the annual change in carbon stocks in the soils of the rehabilitated lands, tC/year.

Because of the different age of the newly rehabilitated areas, the removals will be calculated for each year and for each additional rehabilitated area separately and only then added up in order to calculate total effects.

i) *Change in carbon stocks in living biomass*

$$\Delta C_{LB} = \sum_{t=1}^n (G_W * t * (1 + R) * CF * A_t)$$

where,

t – presents the age index of the rehabilitated grasslands respectively shrublands in number of years;

G_W –the average annual aboveground biomass increment in the newly rehabilitated areas in tonnes of dry matter per hectare per year (tdm/ha/year);

R – the growth increment ration, which is dimensionless;

CF –the carbon fraction of the dry matter in tC/tdm;

A_t - project activity area covered with forests of age in t per ha.

ii) *Change in carbon stocks in dead organic matter*

$$\Delta C_{DOM} = \Delta C_{DW} + \Delta C_{LT}$$

where,

ΔC_{DW} is the annual change in carbon stocks in the dead wood of the rehabilitated shrublands lands in tC/year;

and

ΔC_{LT} – is the annual change in carbon stocks in litter in the rehabilitated grass- and shrublands in tC/year.

iii) *The yearly change in carbon stocks in soils.*

Following the IPCC (2003), no change in soil carbon in rehabilitated lands as well as in all managed forests is assumed. This is consistent with the assumption that annual transfers into the soil are the same as transfers out.

Key words: climate change; NAMA; carbon sequestration; Tajikistan; semi arid areas

Transfer and localization of sericulture technology for redeveloping silk industry in Central Asia - an integrated effort of research, education and extension by Tokyo University of Agriculture and Technology

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Abstract

Tokyo University of Agriculture and Technology has been collaborating with Ministry of Agriculture and Water Resources (MAWR) of the Republic of Uzbekistan and Uzbek Research Institute of Sericulture (URIS) in two projects, under the partner-type grassroot technical cooperation scheme of the Japan International Cooperation Agency (JICA). The initial project was titled “Revitalization of the Silk Road Silk Industry in Uzbekistan - Developing a Rural Income Generation Model by the Improved Sericulture in Fergana Valley” (September 2009-August 2012), and the second one is ongoing “Technical Cooperation Project for Promotion of the Silk-Road Industry in Uzbekistan - Developing a Technical Transfer Model to Increase Sideline Income of Remote Villages” (March 2013-September 2015). After successful conclusion of the first project in the favorable environment of Fergana Basin, the University and local counterparts planned its subsequent step in one of the harshest climate of the country to test nationwide applicability of introduced sericulture technology in Uzbekistan. In 2013, the second project was launched at four farming hamlets, namely Shavat (15 families) and Buyrachi (1 family) Townships, and Beshmergen (10 families) and Hitoy (6 families) Rural Citizens' Assemblies of Shavat District (41°39'36" N 60°17'24" E) in Xorazm Province. The Japanese Kinshu × Showa autumn-breed and Shungetsu × Hosho spring-breed silkworms (*Bombyx mori*) were distributed to cocoon producers, and experts were dispatched from Japan to cooperate with Uzbek counterparts (government administrators, researchers, sericulturists, textile manufacturers, and cloth-goods producers and retailers) for facilitating reestablishment of local silk industry. All participating farmers received regular technical visits, and were asked about their impression and evaluation of the introduced silkworm breeds and rearing systems. Participant farmers of the project were satisfied with the increased cocoon harvests, and expressed their interest in acquisition of Japanese mulberry (*Morus alba*) cultivars which may better feed the voracious Japanese silkworm breeds. Besides, a laborsaving technique with plastic net for removal of leftover mulberry branches and silkworm feces on the rearing bed received special appreciation of farmers. The Uzbek government adopted a policy to promote sericulture nationwide, and requested continuous technical cooperation from the University on silkworm foundation stock and improved lines.

Key words: T.U.A.T.; outreach; international technology transfer; Khorezm Province; silk thread

Soil salinity and gypsum content in soils of piedmont plain of Turkestan ridge (Uzbekistan)

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Abstract

The digital maps of soil salinity, gypsum, and gypsum pedofeatures in soils (gypsic calcisols, gypsisols, and solonchaks) of the Dzhizak experimental station (Uzbekistan) are compiled from the results of soil survey conducted during 1980 and 2008, using digital elevation model (DEM) and remote sensing data. The study area represents a part of the Golodnaya Steppe piedmont plain to the north of Turkestan ridge. The macro- and micromorphological descriptions of gypsic horizons made it possible to distinguish three different morphotypes. The morphological features of gypsic horizons were classified, and their distribution map was prepared using GIS tool. The spatial distribution of different morphotypes of gypsic horizons showed distinct correlations with the soil salinity, the groundwater level, and the character of soil water regime. It was established that the presence of different gypsic horizons should be taken into account in the new substantive-genetic classification of Russian soils at high taxonomic levels. Studies completed after 20 years, when the groundwater level dropped by about 1 m, confirmed that the gypsum content decreased in soils; however, the major morphotypes were preserved. The micromorphological investigations demonstrated that certain changes took place in the microfabric of gypsum pedofeatures. Thus, fine dispersed crystals of gypsum disappeared from the soil profiles, and the number of pseudomorphic substitutions of calcite for gypsum crystals increased significantly attesting to the progressive calcification of soil profiles.

When comparing the results obtained to determine the gypsum content in the horizon of its maximum accumulation in the same soil pits described in 1987 and 2008 it seemed reasonable to conclude: the gypsum content showed changes being practically decreased in all the soil pits under study; its decrease varied in a wide range: absolute decrease accounted for 2.5 to 70%, relative decrease – from 5 to 50%; there is no linear correlation between the initial content of gypsum in 1987 and its content in 2008 ($R^2=0.0002$); at the same time, there exists a clearly expressed dependence between the decrease in gypsum and its initial content ($R^2=0.82$ for absolute and $R^2=0.56$ – for relative decrease).

It gives the possibility to assume that the gypsum decrease resulted from dropping the groundwater depth may be described by using the following exponential dependence:

$$dX/dt = -kX, \text{ a } X = X_0 * \exp(-kt) + C,$$

where X_0 – initial content of gypsum, t - time, k and C – constants determined empirically.

Based upon the data obtained in 1987 this equation allows not only compiling the map of gypsum content in soils for 2008 but also forecasting its content for the next 20 years under the unchangeable conditions (climate, groundwater depth, land-use regime).

Soil salinization is closely related to the behavior of gypsum.

Key words: digital mapping; gypsum; micromorphology; soil salinity; Uzbekistan

Teleconnection of rainfall in inland Mongolia with global sea surface temperature

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Abstract

While Mongolia is located in inland Asia, there are effects of teleconnection of rainfall time series. Significant cross-correlations of precipitation time series with Southern Oscillation Index (SOI) and Arctic Oscillation (AO) are found out. Both correlations with SOI and AO are negative as shown in Fig. 1.

Summer rainfall of various areas in Mongolia indicated significant correlations with sea surface temperature (SST) of some regions over the Oceans. Some sea regions indicated positive correlations and others indicated negative correlations. There are positive and negative correlation of summer rainfall in various areas in Mongolia with the southern Pacific and northern Atlantic Ocean respectively. Examples of positive and negative correlations are shown in Fig. 2. Summer rainfall at almost all of area in Mongolia indicates positive correlations with SST over the southern Pacific Ocean and that at most of Mongolia indicates negative correlations with SST over the northern Atlantic Ocean. Difference of SST time series of some pairs of sea regions with positive and negative correlation indicated higher correlation with the summer rainfall. So, these pairs of sea regions suggest the dipole effect.

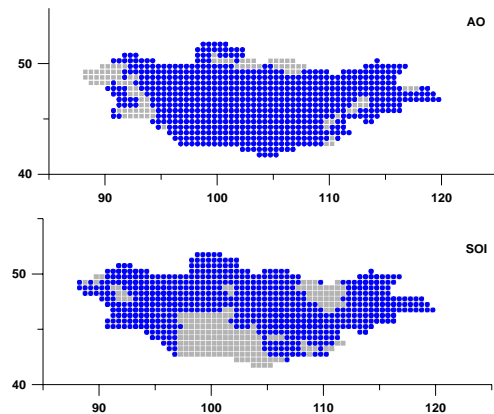


Fig. 1 Link of precipitation with AO and SOI (significance level < 0.05).

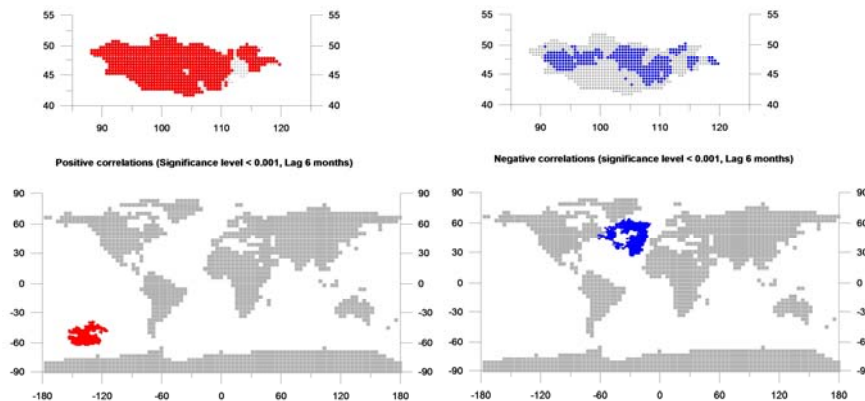


Fig. 2 Significant correlations of SST with summer rainfall in Mongolia.

Key words: Mongolia; precipitation; sea surface temperature; teleconnection.

National action plan on afforestation mobilisation in Turkey

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Abstract

The problems evolving due to climate change and global warming as a result of greenhouse gases released into the atmosphere are increasing day by day. Our country is among the countries that would be affected severely by these problems. In order to re-establish the greenhouse gas balance in the atmosphere, greenhouse release should be decreased as well as the carbon sinks should be increased.

Our greatest aim is to increase the forestlands, which are important carbon sink areas, in order to have a balance in the greenhouse gases in the atmosphere. On the soonest occasion, forest assets should be increased, degraded forests should be rehabilitated, soil loss through lakes, dam reservoirs and seas should be prevented by combating erosion. Therefore, we must mobilise resources of our country and accelerate the works in order to achieve this aim as soon as possible.

Between 2008 and 2012, Turkey conducted a national action plan depending on voluntary actions held by various partners, ranging from individuals to public institutions, private sector, schools, universities, NGOs and so on. With the action plan, afforestation and rehabilitation of 2.3 million ha area was aimed. The need for coordinated work among the public bodies and institutions as well as all the parties of the community is prescribed. First seedling was dibbled by the President. Within the scope of the action plan, many projects were put out suitable to the social structures and needs of the country; some projects can be listed as follows; "15 million seedlings for 15 million students" campaign organized and seedlings were planted in all provinces. Private sector (companies, banks etc.) gave great importance to private afforestation activities and they have been increased as much as 5.5 times. Companies promoted their members and gave them seedlings. Government promoted farmers for guaranteed purchase seedling production. Turning out to become a race, targets were exceeded and 2,42 million ha area is rehabilitated. After this action plan, public awareness on afforestation has increased.

Key words: desertification; afforestation; rehabilitation

International training on land degradation in Turkey

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Abstract

General Directorate of Combating Desertification and Erosion is considered as the educating country on the Combat Desertification, Afforestation, Erosion Control, Integrated Watershed Rehabilitation techniques, especially by UN and other international organizations. To share these experiences with other countries, especially the Developing Countries, Turkey regularly arranges training programs.

The Regional Technical Cooperation Project about Land Rehabilitation/Combat Desertification and Forestry prepared with TIKA, put into practice to the 20 developing countries (Albania, Afghanistan, Pakistan, Syria, Palestine, Senegal, Ethiopia, Sudan, Bosnia Herzegovina, Macedonia, Montenegro, Kosovo, Moldova, Ukraine, Georgia, Azerbaijan, Turkmenistan, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Mongolia). In 2009 a training course on Watershed Rehabilitation Techniques was given to the 211 experts from 17 countries' participants. After the training, certificates are given to the participants.

In the evaluations the participants stated that the training was intense but very useful, the theoretic courses and field works are completing each other. The participants from Africa told that they specially want to benefit from Turkey's experience in combating wind erosion. The participants from the Balkan countries expressed that they want to cooperate with Turkey on these edling production and land rehabilitation subjects and if they apply these trainings in their countries they would done an important job, and want these trainings to continue.

Among the countries of the region, exchange of information shall be carried out for the role of nongovernmental organisations in seed and seedling production, erosion control, afforestation, developing seedling techniques, participatory and integrated watershed management and land rehabilitation; experience shall be gained, there will also be some indirect contributions of development of regional cooperation and in the long term the project will be helpful in reducing the effects of climate change and desertification.

Keywords: cooperation; desertification; erosion; capacity building

Preliminary results of experimental arid land afforestation in the Central Anatolia region of Turkey

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Abstract

The study is conducted as an experimental aridland afforestation practice in Aksaray, Incesu, Karapınar and Emirgazi located in the step region of Central Anatolia. Russian-olive, locust, ash and black-pine are used as tree species in the experiment. These are the most promising ones for aridland afforestation practices in the region. Seeds are collected from the region and seedlings are grown in Ereğli and EskişehirForest nurseries. In three of the treatments, *Amygdalusorientalis*, *Calligonumpolygonoides* and *Spartiumjunceum* are included as shrub species. *Onobrychisviciifolia*, *Vicia sativa* and *Atriplexhortensis* were selected as herbaceous to include into two of the treatments.

The study areas are scattered in the region from the vicinity of TuzGölü (Salt Lake) Aksaray and extended through to southern part of the plateau in Incesu, Karapınar and Emirgazi. This area covers the driest part of the region with less than 300 mm annual precipitation and 11 C⁰ average temperature. Randomized block design is used for the experiment. Treatment are included; 1-Only tree, 2-Tree + shrub, 3-Tree+shrub + herbaceous, 4-Shrub+herbaceous. Tree control units without any plantation or seeding are scattered in each block.

At the end of summer 2012, sub-soil down to 80 cm depth were ripped using a caterpillar tractor equipped with three-shank ripper (220 HP). Then the surface soil was tilled with a 4 x 4 rubber-tired tractor equipped with two shank ripper to prepare beddings for planting. In December 2012, 1+1 (for broad-leaved) and 2+1 (for pine) seedlings were planted using 3 x 3 spacing. At the beginning of the experiment soils were sampled for the first 20 cm depth at 5 randomly located spots in each experimental unit. Two sets of soil sample were taken at each spot. The first set of the soil samples were used for bulk density measurement. The second set were used for physical and chemical analysis.

Soil texture for the first 20 cm soil depth were ranged from clay to sandy clay loam with less than 1 % organic matter content. Average bulk density were 1.2 g cm⁻³. Soil pH were around 8. CEC were 35 Cmol_ckg⁻¹. Lime concentration of soil is more than 30 %. Soil moisture throughout summer of 2013 were less than 2 % by volume across all the treatment sites.

At the end of the first vegetation season the highest survival for the tree species with 85 % rate were measured for Russian-olive. The same figure for locust was around 76 %. For the shrubs, almond were the most successful species with more than 90 % survival rate. Spartium were the second successful shrub species with 70 % survival rate. Calligonum had the lowest survival rate with about 30 %. Germination rate for *Vicia sativa* was around 70 %, but it was declined to 50 % for atriplex. The growth performance of these species will be evaluated for the next several years for their potentials usage in afforestation practices in the region

Key words: aridland; Turkey; afforestation; Anatolia

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Evaluation of the ecological role of seed gum in the germination of *Prosopis* under drought stress conditions

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Abstract

Mesquite (*Prosopis juliflora* (Sw.) DC.), native to South to Central America and Caribbean, has been introduced repeatedly into arid and semi-arid regions of the world to solve the problem about desertification. Recently, however, this species spreads widely and invade into agricultural fields rapidly, inducing a threat to human subsistence. In arid regions, rainfall occurs in irregular and intensively, and soil desiccates immediately after a single rainfall, such as 'wet-dry cycle' of soil. To access and control the invasion of *Prosopis* under such fluctuating condition, we focused on the establishment process of *Prosopis* seedling, especially the property of seed germination. *Prosopis* seed has 'seed gum', composed mainly of polysaccharide such as galactomannan (GM). The purpose of the present study was to evaluate the ecological role of this saccharide for seed germination and seedling establishment.

Germination tests of *P. juliflora* were done under eight osmotic potentials using PEG solutions (0, -1.0, -1.5, -1.6, -1.7, -1.8, -1.9 and -2.0 MPa: 20 seeds per osmotic condition, with three repetitions), which simulated different drought stresses, during eight days in 30°C incubator. All these conditions were common in the following three experiments. Experiment 1: Intact seeds were soaked into the eight PEG solutions, and recorded the number of germinated seeds. Experiment 2: After been imbibed enough in distilled water, intact seeds were divided in two groups and GM of the imbibed seeds in one of them were removed. Intact and GM-removed seeds were soaked into three PEG solutions (-1.5, -1.7, -1.9 MPa), recorded the germination rate and radicle length. Experiment 3: Other sets of intact and GM-removed seeds (both imbibed) were dried up in wind for one or two weeks, and soaked again into PEG solutions (-1.5, -1.7, -1.9 MPa), then germination rate and radicle length were recorded.

Germination rates of seeds in 0 and -1.0 MPa treatments were 100%, that in -1.5 MPa condition was slightly lower, and the rate decreased according to much lower osmotic potentials. Generally, -1.5 MPa is a wilting point and fail to germinate for many plant species, thus the former results indicate that *Prosopis* seed is highly drought tolerant. Intact seeds showed higher germination rate than GM-removed seeds in -1.5 and -1.7 MPa treatments, and the germination rate between the intact and GM-removed seeds was not significant in -1.9 MPa treatment. Radicle length of intact seeds was longer in -1.5 MPa than in -1.7 or -1.9 MPa treatments, which suggest that GM might act as substrate for root growth in moderate drought stress condition. Both after one or two weeks desiccation treatments, intact seeds kept germination rates similar to those of no-desiccation seeds in every osmotic conditions, and higher than those of GM-removed seeds. These results suggest that seed gum (GM) has some role to keep germination ability of *Prosopis* seeds through wet-dry cycle in rainy season of arid environments.

Key words: imbibitions; *Prosopis*; seed gum; wet-dry cycle

Adaptation of soybean in the condition of continental climate of Uzbekistan

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Abstract

Among the numerous problems occurring in the period of consolidation of sovereign Republic of Uzbekistan, one of the important problem is ensuring the requirements of the national economics of vegetabbling of protein and oil. Accumulative information's don't give permission for making a generalization about possibilities and expedience's growing of soya at the dry and hot climate of Uzbekistan and other republics of the Middle Asian region.

In 1976, sorts were landed at a different zone of USSR with the purpose of revealing the most suitable place for growing in our condition. There were a lot of sorts of soybean, which were 60 sorts, of Krasnodarskiy krai were 18 sorts were landed, in Ukraine 10 sorts, in Moldavia and Georgia 8 sorts, in Amur region 12 sorts, at another region there was gathered 12 sort from native people.

For receipts of contrast information collection of sorts except the drain age-basin of the Zarafshan River, with the relatively hot climate soya was sowed in the district of Kasan, in Kashkadarya region, where in Summer maximal temperature rises up to 50°C. Climatic characters of regions researching was shown at the table 1.

Sorts of Krasnodar, Ukraine, Moldavia and another regions prolonged time are growing under the temperature in Summer about 35°C. The humidity of air also doesn't put down lower 40-50%.

In the Valley of Zarafshan River temperature of air in the mother after sowing in May reached to 30°C and in the middle of May frequently reached up to 38°C. In June when soya blossoms, it rises higher, in several days it reaches to 40°C and higher there.

In the Karshi steppes the district of Guzar was selected, as one of the hottest regions.

By the middle of June the temperature was higher than 30°C. In July it was marked higher than 45°C and even it reached to 50°C. The humidity of air was lower about 20%.

Investigation shows, that all of the sorts, independently of the other, where they were sowed earlier, in the condition of Uzbekistan remarkable is accelerated ripening. Even ultra precocious sort of Amur region was accelerated ripening in 30-35 days during spring, and in 22-25 days in summer sowings. In the sorts at periods of the vegetation in 70-80 days shortening periods of the vegetation in 2-3 days didn't play an essential role; but in the sorts at periods of the vegetation more 90 days; seeds are ripen in 10-12 days earlier and it would be of much importance and etc, after harvesting soybean even in July-August didn't allow to cultivate reaping cultures.

Consequently, in the sorts of soya, ripening in Karshi steppes was limited by only thermal regimes and humidity of soils, although elements of technologies of growing were identical.

Key words: soybean; drought tolerance; Karshi steppes; deficit of irrigation; Uzbekistan

Genetic diversity of Gray Mangrove (*Avicennia marina* (Forssk.) Vierh.) growing on the Red Sea Coast

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Abstract

From the survey of satellite image, 248 mangrove stands were identified on the Red Sea Coast of Egypt, Sudan and Saudi Arabia. Size of these stands ranged from 0.05 to 450 ha and about 30ha in average. Coastal dry hinterland of the Red Sea was dotted with such small stands at a mouth of wadi and/or in small lagoon. Average distance between adjacent stands was 20km, which was long enough to be a barrier of propagule dispersion. They can grow under severe environmental conditions with heavy destructive pressures including overgrazing by livestock, overuse by local people, coastal line development by government and global climate change. To analyze the changes of genetic diversity in regional scale, leaf samples were collected from 3368 trees in 60 stands on 1600km coast of the Red Sea from Egypt to Sudan. Genetic structure was analyzed by six microsatellite markers and allelic richness of each stand was calculated. Because of the low possibility of genetic exchange among stands with longer distance, significant trend of gradual decrease in genetic diversity was detected from south to north. Two types of genetic group were detected by the structure analysis and these genetic groups showed rather discrete distribution in northern and southern part of the coast, respectively. Compared with the northern group, genetic composition of the southern group was more ancestral which suggested the direction of gray mangrove extension along the African Red Sea coast from south to north. The effect of current direction on the expansion was discussed.

Key word : forest structure; genetic diversity; Gray Mangrove; *Avicennia marina*; Red Sea Coast

Conservation agriculture: a sustainable system to improve sorghum yield in rainfed areas Southern Gedarif State, Sudan

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Abstract

Rainfed agriculture in Gedarif state, Eastern Sudan represents the main producer of sorghum, the stable crop. The conventional farming system (CFS) for sorghum is achieved by the use of Wide Level Disk (WLD) for seedbed preparation and broadcasting seeds and no use of fertilizers besides hand weeding. The resultant is low sorghum yield compared to potential. Conservation agricultural system (CAS) was tested elsewhere and proves its efficiency. This system could be accomplished by seeding crops directly in previous crop residues via special planter concurrently with applying fertilizers and herbicides. However, the integrated effects of the technical packages used in CAS were not studied collectively yet. Sustainable improvement of sorghum yield is necessary to secure food for the growing population this could be attained through implementing a new adaptive cropping system. The objective of this study was to assess the performance of rainfed sorghum under CFS and CAS in rainfed areas. The CAS was conducted during two seasons (2012/2013 and 2013/2014) in 21 ha in farmer's fields Southern Gedarif State and compared with the neighboring CFS fields. The soil is heavy cracking clay soil. The effective rainfall occurs during July to September, with annual rain amount of 600 mm or more. Data on machines performance, soil moisture, and sorghum yield were taken simultaneously from each system. Economic evaluation including partial budget and sensitivity analysis was also implemented. The results indicated that the required time to established one hectare was 0.65 and 0.86 hour for CAS and CFS, respectively. CAS conserved 25% of fuel consumption. Visual assessment showed that CAS field was free of weeds compared to CFS field. CAS significantly out yielded CFS by four folds. Economic and sensitivity analysis showed the profitability of CAS. The breakeven point was 964 kg/ha for CAS and 375 kg/ha for CFS. Farmers in rainfed areas can obtain higher and economic sorghum yield by practicing CAS. The effect of CAS on environment and soil need more experimentation.

Key words: dry land farming; conservation agriculture; sustainable sorghum production; Gedarif- Sudan