ISSN 2181-9408

Scientific and technical journal

Sustainable Agriculture

№1(2).2019

Founder: Tashkent Institute of Irrigation and Agricultural Mechanization Engineers
Our address: 39, Kari-Niyaziy str., Tashkent 100000 Uzbekistan , www. sa.tiiame.uz

The journal "Sustainable Agriculture" is registered in the Press Agency of Uzbekistan on the 12th of February in 2018 (license № 0957).

In 2019, the journal is included in the list of recommended scientific publications by the Higher Attestation Commission of the Republic of Uzbekistan.

WATER EROSION MODELING USING GEOINFORMATICS

D. Kendjaeva - assistant, K. Djamolov - Ph.D., associate professor, H.S. Djamolova - assistant
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

In the article three methods of modeling water erosion processes were described, that include field measurements, image processing and spatial explicit modeling. Innovational approaches towards measurements and modeling such as GPS (Global Positioning System) measurements, geostatistics, image processing techniques, and physically-based models bring out new data in studying processes of water erosion. Consequently, it can be strongly grounded that geoinformatics can play a significant role in order to understand erosion processes of water through characterization of space–time dynamics.

Key words: Geoinformatics, GIS (Geographic Information Systems), Geomorphology, Remote sensing, Water erosion.

Introduction. Water erosion is a serious threat all over the world, potentially reducing the ecological functionality and food production capabilities and causing recurring damage to the built infrastructure. Factors such as climate change, human-induced changes in land usage and intensification of agricultural technologies may increase the damage caused by water erosion. Nevertheless, we still have to fully understand to what extent, where, when and how.

The growing utility of geo-informatics that is used for modeling and mapping the properties of the Earth's surface provides an excellent chance for helping in answering the above listed questions by providing high-quality data in a wide range of spatial resolutions from millimeters to continental scale. Spatially explicit data sets can grow the representativeness and accuracy of process modeling, enlarge the space of model parameter, append model parameters based on process that could not be taken into account earlier, and improve approaches to calibration and validation.

Over the past 25 years, the number of research papers in the peer-reviewed literature on the use of remote sensing and GIS for studying erosion has rose dramatically. Publications on the use of geo-informatics for modeling the erosion process show that despite significant progress which has been made, the potential of geo-informatics has not been realized, and some research areas are still not concluded and waiting for answers. For instance, questions arise about the extent to which hyperspectral data can be used to provide maps of soil properties to predict more accurately soil resistance to erosion and how LiDAR (Light Detection and Ranging) data can be used in erosion and sedimentation models of rivers. The crucial question is how GIS can be combined into process-based models to create meaningful spatial and temporal explicit soil erosion modeling to explain the formation of geopatterns, such as rivers and ravines. Another factor that hinders the use of geoinformatics to study erosion processes is the error, which spreads within the layers of the system and increases the uncertainty of the forecast and limits the representation of reality [4,5,6].

Description of modeling methods

This work demonstrates the use of tools and techniques of geoinformatics in studying the processes underlying the water and sediment on the slopes and rivers. These processes include sediment transport, fluvial processes, slope denudation, landslides, coastal erosion, and shoreline migration. Based on the applied methods of geoinformatics, we divided the methods into three groups: field measurement, image processing and spatial explicit modeling.

Field measurements

Devices like differential GPS are commonly used in the field when the observation scale (i.e., spatial resolution) is thin, for example, when the goal is a three-dimensional analysis of soil movement. These studies typically include measuring points in a field that are assigned map coordinates and that are interpolated or processed using geostatistics or related approaches. For a quantitative assessment of the three-dimensional characteristics of the regolith body, a three-dimensional three-dimensional lattice model is used. In addition, models and the change in penetration resistance can be interpolated using a regularized spline tension method. These analyzes will allow us to describe the morphology of the surface and bedrock and to identify breaks in the regolith.

In another example of a three-dimensional analysis, differential GPS can be used to perform a volumetric estimate of eroded material and to calculate the average erosion rate for large periods of time. In addition, the analysis of rainfall time series facilitated the assessment of the role of critical rain phenomena in denudation intensity. The effect of resistance to flow of the jet structure and turbulence in the mountain channel is analyzed using three-dimensional velocity measurements and geostatistical analysis. Detailed three-dimensional velocity measurements can be performed to characterize the spatial variability of velocity and turbulence, as well as potential control of flow resistance.

In the new method, in order to quantify the short-term dynamics in recreational trails, measured paths are used. Measured traces were located in different environments and types of use. Using a high-resolution matrix with an electronic theodolite made it possible to estimate the balance of precipitation on the surface [2].

Image processing

Remote sensing data were used to estimate water erosion using various approaches. In many cases, data from LiDAR and multispectral satellite sensors are used. They are used to predict the extreme flux effect with an artificial balancing system and to determine the terrain shapes from the paleo-streams visible on the multispectral satellite sensor images. Also, these images can outline the modern flow of events in general terms (based on data from the river stage and measurements of the acoustic Doppler current profile) and provide a detailed study of its geomorphological effects on the underwater plate based on aerial photographs and LiDAR data.

Continuous wavelet transforms are also used to study the spatial and temporal patterns of the multi-scale retreat of the river's coastline. The sequence of shots with a deviation along the coastline can be transformed using the Morle maternal wavelet.

It also uses a multifaceted remote sensing and morphometric approach to investigate whether the surface of subplants on Mars reflects geomorphological processes and, in particular, the transfer of sediment by water. Using DEM (Data Encapsulation Mechanism) data obtained using a Mars Orbiter laser altimeter, three nested subgroups can be examined using a set of ground-based geomorphological and hydrological statistics to determine if their shape is within a known range of common catchment properties on Earth [7,8,9].

Spatial explicit modeling

Soil erosion at the catchment scale has been modeled spatially explicitly using various approaches, including fuzzy logic combined with GIS, multi-criteria methods and a very well-known USLE (Universal Soil Loss Equation) for the GIS platform. But among these approaches in the work a lot of attention is paid to two: extraction of a network of channels and the use of physical models based on GIS.

A physically based semi-distributed model is used to study the initial area of suspended sediments and modeled the potential effects of climate change on soil erosion and the release of suspended sediments. This simulation shows a sharp increase in annual rates of soil erosion, although a similar result in the output of the sediment at the outlet of the catchment was not obvious.

Streaming network data is critical for important applications, such as flood forecasting and catchment management. A five-step procedure for taking into account technogenic characteristics, such as tillage lines in agricultural fields, was implemented in GIS and made it possible to improve the accuracy of forecasting modeling of surface flow and water erosion at the catchment scale [1,3].

Conclusion

The movement of soil through water is a very variable and dynamic process in space and time, varying in scale from millimeters to continents and from milliseconds to millennia. Erosion processes can influence society through impacts on agriculture, infrastructure and built-up areas. With advances in measurement methods, including remote sensing, image processing algorithms and computational models, the road is open to expanding the use of geoinformatics by geomorphologists. This work aims to promote this use as a tool for studying the spatial and temporal dynamics of water erosion.

References:

1. Desmet, P.J.J., Govers, G., 1996. A GIS procedure for automatically calculating the USLE.
2. Jabbar, M.T., Chen, X.L., 2006. Land degradation assessment with the aid of geoinformation techniques. Earth Surface Processes and Landforms 31, 777–784.
3. Vrieling, A., 2006. Satellite remote sensing for water erosion assessment: a review. Catena 65, 2–18. http://dx.doi.org/10.1016/j.catena.2005.10.005.
4. JurkinI. G., ShayturaS. V. Geoinformatic systems. – M .: KUDITs-PRESS, 2009. – 272 p.
5. KapralovE. G.,Koshkarev A. V. and others. Osnovygeoinformatiki: v 2 kn.; edited by V. S. Tikunova. – 2nd issue, - M.: Publishing Center “Akademiya”, 2008. – 384 p.
6. MonakhovS. V., SavinyxV. P. Tsvetkov V. Y. Geoinformatics in the public domain. – M.: MaxPress, 2004. – 100 p.
7. ZaychenkoV. Y. Geoinformatikakaksamostoyatelnayanauka I otdelnayanauchnayadistsiplina // Geoinformatika. - No 3. – 2009. – 57-61 p.
8. MironovaYu.N.Geoinfomatsionniesistemy // Aktualnye problem gumanitarnyxnauk. - No 03. – M.: Moslva, 2014. 63-65 p.
9. Djamalov K., Djamalova H.S. “Earth, Water and Natural resources geophasmaticmanagemal problems”. There are materials of the international scientific-practical conference. Tashkent, 2015, 14th-15th of May. 173 p.

PREDICTION OF FUTURE WATER USE BASED ON LANDSAT IMAGE ANALYSIS IN CASE OF SYRDARYA PROVINCE

A.M.Arifjanov - professor, Sh.B.Akmalov - assistant, L.N. Samiev - PhD
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

This article is about using high resolution satellite image analysis. Resend days Remote sensing Data and Software are started to use widely in all branches of science. In this article with using the advantages of these satellites, images of the Landsat generations since 1970 have been taken for every 10 years and analyzed for study the change in land use. Syrdarya region was chosen as a research area. Changes in land use digitized and copied to statistical analysis program. According to the correlation of changes in land use created future prediction of water use for 2025. According to the results, in Syrdarya region in 2025, the water use value will increase in different sectors by an average of 5%. The accuracy of the Landsat image analysis was verified by GPS coordination accuracy and accuracy was 95%. The results of statistical analysis were verified by correlation. The Syrdarya Province which fills water shortage resent time should be ready to grow these water needs 5% in the near future.

Key word: Remote Sensing, Syrdarya, WorldView-2, irrigation, channels, collectors, agriculture, water, GIS.

Introduction. Using Remote Sensing imagery in solution of different questions of different branches started developsyear by year. Spatially in Uzbekistan [1, 2, 3, 4]. In Central Asia, including Uzbekistan, the use of remote sensing images in water management is much more recent than in developed countries. In general, only low and medium resolution remote sensing images are used in water management. The software for image analysis is limited main of them Erdas Imagine[5, 6, 7, 8, 9, 10]. In images with such resolutions, it is impossible to identify bodies of water with a width of less than 250 m. This is the reason why their use in the management of water resources is not frequent. However, in the last ten years this area has changed gradually. Today, the use of high resolution and very high resolution images, and new software for their analysis is becoming more and more interesting for researchers in Central Asia [11]. We have listed 468 scientific works on water management in Central Asia using remote sensing, 58 of these works are done in Uzbekistan, from 2000 to 2015 it has increased by 7 times (5- 35).

In scientific works conducted in Uzbekistan up to 2011, 20 were done using MODIS images;in 7 works used Landsat images; in 3 works were done with SPOT images; and in the rest of the work medium and low resolution images were used. 80% of this work is done in the provinces of Ferghana, Khârezm and Karakalpakstan. A scientific research is conducted in the territory of the Syr Darya region, it is the "mapping of the" land use classification "of two agricultural areas".

Platonov et al. [15] did the Water Productivity Mapping for the Galaba Farm located in the Syr Darya Basin using Landsat ETM + (Enhanced Thematic Mapper Plus) satellite images and thermal imagery. In Nezlin et al. [14] an interconnection model between rain and NDVI was created for the Aral Sea basin. He used remote sensing images from NDVI between July 1981 and September 2001. Conrad [5] created the SEBAL model for the Khorezm region using remote sensing (MODIS images), GIS and hydrological models.

Edlinger et al. [12] analyzed changes in farms cultivated in agricultural areas of the Kashkadarya region of Uzbekistan through the integration of high and medium resolution images. They used Landsat MSS (Multispectral Scanner) and TM (Thematic Mapper) data from 1972/73, 1977, 1987, 1998 and 2009, and MODIS images.

During the growing season of 1987, 2005, 2006, and 2007, scientists studied Landsat TM and MSS images, biomass changes, and plant growth specific to Tim village in the mountainous Karnabschol region of Uzbekistan. and created their diagram. They created the NDVI layer with the Landsat images and learned the degree of plant fulfillment with this layer [16]. Navratil&Wilps[13] studied the degree of wind erosion of the Aral Sea soil using SPOT-5 remote sensing imagery. In this article based on the researche below provided future prediction of water use with using Landsat image analysis. For it provided many yearly Landsat image analyses, detected changes in it, statistically analysed those changes and correlated with water use degree.

Materials and Methods. Research area of the article is Syr-Darya Province of the Uzbekistan Republic. For analyzing future change of water use were collected Landsat images since 1970 and analyzed.For our analysis, we have uploaded images of Landsat TM, MSS, OLI-TIRS. Figure 1 shows the history of Landsat missions since the first launch. Our study to develop the land use maps needed for SyrDariahas therefore benefited from images collected since the 1970 s.

The coordinate system used by Landsat satellites is WRS-2 (Worldwide Reference system). In our analysis, we have collected:

- WRS-2 Part=154 ;
- WRS-2 Row=32.

Note that the Landsat MSS satellites WRS-2 Part equal to 166.

In Table 1.given information of Landsat data which used in analysis, and given some technical characteristics of them [17].

All Landsat images were analyzed with eCognition Developer 9 GEOBIA based image analyze program. Change detection analyze were provided and changes in land use copied in statistical analyze programs. With statistical program analyzed future change in water use.

Results and Discussion. In official information on the

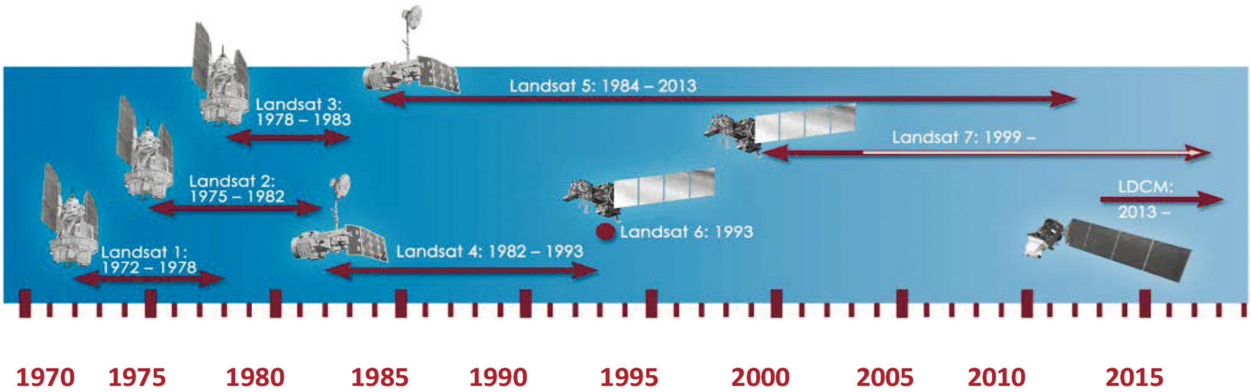


Fig.1. Landsat satellite activity history (https://earth.esa.int/web/sppa/mission-performance/esa-3rd-party-missions/landsat-1-7, Last acces 10.04.2015).

site of the "Landgeodezcadaster", we can see that the agricultural area of the region is over 300000 ha. When we made the classification from the 2014 images, we obtained an accurate estimate of 276963 ha. It is obvious that our results do not coincide with the official data, but it should be noted that in our classification we do not take into account fields plowed as agricultural area, and are thus considered as a non-vegetated area (24,459 ha). In addition, rice fields are classified as part of aquatic areas. If we include these two types of land (fields in plowing and rice cultivation) within the agricultural zones of our classification, the total surface reaches 327758 ha.

It is known that, the increasing number of the population and the rise of the area of agricultural fields brings to the increasing demand for water. The analysis shows that the area ofagricultural fields and the artificial area are increasing (Fig 2-3). It is seen from Figure 2, the agricultural area increases with different changes. Agricultural area is changing very rapidly and has a big difference, but the average line is increasing year by year in this figure (Fig.2).

From Figure 3 on can see that the rise of the artificial

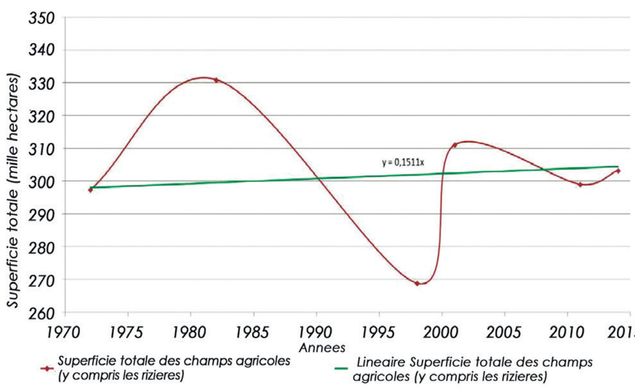


Fig.2. Increasing of agricultural fields between 1972 and 2014

zone is related with the increase of number of people in the province. Both are increasing year by year. During the research has been analyzed the change of the artificial zone. In Figure 3 was analyzed the connection change of population number with change of areaof artificial zone. Both of those changes are similar. Because in the province of Syrdarya urban constructions grows horizontally. We have seen it in field experiments. In the

Table 2.1.

Landsat 8 metadata

ID	Year	Month	Date	Latitude	Longitude	Cloud cover	Day/Night	Quality
Landsat OLI-TIRS								
L8-2014	2014	July	27	40,3	68,8	0	Day	9
Landsat TM								
L5-2011	2011	September	5	40,3	68,8	0	Day	9
Landsat ETM+								
L7-2001	2001	July	31	40,3	68,8	0	Day	9
Landsat TM								
L5-1998	1998	Jun	26	40,3	68,8	10	Day	9
Landsat MSS								
L3-1982	1982	May	11	40,2	68,5	0	Day	9
L1-1972	1972	September	30	40,2	68,5	2	Day	5

cities maximal floor of buildings 5-6. In villages, there are no high-buildings.

The number of the population in the province of Syrdarya was 777100 people in 2015 (http://www.uzbekembassy.org/u/population/,last accessed 25.02.2017), in 2011 was 750000 (http: // tashrif .uz / sirdaryo-viloyati /, last accessed 02.02.2017), in 2005 was 714400 (Tukhliev&Kremensova, 2007), in 1998 was 672200 (https://uz.wikibooks.org/wiki/O%60zbekiston_tarixi_darsligi, last accessed 25.02.2017), in 1982 about 450000 (Information from the Statistical Center of Uzbekistan), in 1972 about 300000 people (Information from the Statistical Center of Uzbekistan). Comparing these data with the magnification of the artificial zone in our analysis, a diagram was created (Fig.3).

The increased of these two values, leads to raise the need of water of Province. According to those two

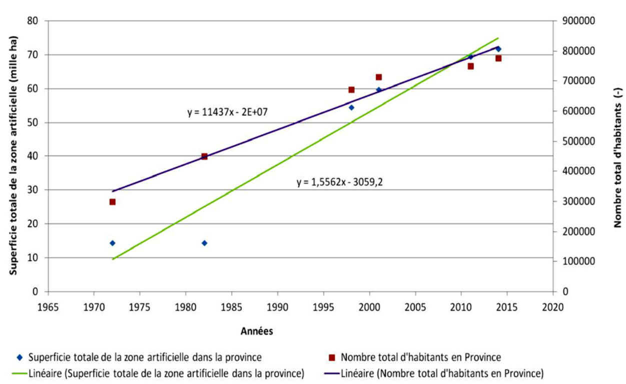


Fig.2. Increasing of agricultural fields between 1972 and 2014

changes with help of statistical analyze tools created prediction of future water use.

Conclusions. Future prediction created for 2025. According to this statistics in 2025 water use of different branches will increase until 5% then now (Fig.4). All the changes in land use which detected with Landsat were analyzed with WEAP model and scientifically predicted future changes in this Province.

According to Fig.4 all branches of water users will develop. Result of this development influence to use of water and water consumption will increase in 2025 for 5%.

Based on analyses on can conclude that Landsat images and eCognitionDeveloper software more resultable for future change detection analysis. In 2025 water use in Syrdarya will increase 5% then resent

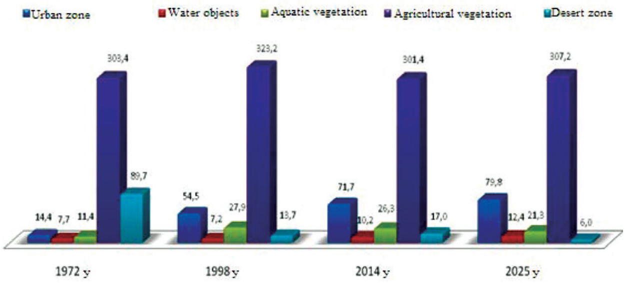


Fig.4. Future change of land use in WEAP model

condition. Even nowadays it is seen water stresses in some part of Province. That future increase requiresbeing ready for water shortage. Rehabilitee of the analyses verified with using different statistical and GPS method.

References:

1. Arifjanov A.M., AkmalovSh.B. Geographic object based image analysis and remote sensing in environment. «Improving efficiency, reliability and safety of hydraulic engineering constructions» Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018.P 24-29.
2. Arifjanov A.M., AkmalovSh.B. Geographic object based image analysis and algorithm description by using eCognition. «Improving efficiency, reliability and safety of hydraulic engineering constructions» Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018.P 29-33
3. Arifjanov A.M., AkmalovSh.B. Remote sensing applied to water and agricultural management in Central Asia and Uzbekistan. «Improving efficiency, reliability and safety of hydraulic engineering constructions» Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018.P 33-37
4. Arifjanov A.M., AkmalovSh.B., Samiev L.N., Apakxo'jaeva T.U. Choosing an optimal method of water extraction for arid region in the case of Beshbulak and Yangiobod villages (Sirdarya Province, Uzbekistan). European science review № 3–4 2018 March–April. Pp-244-249
5. Conrad, C. (2006). FernerkundungsbasierteModellierung Und HydrologischeMessungenZurAnalyse Und Bewertung Der LandwirtschaftlichenWassernutzung in Der Region Khorezm (Ouzbekistan). Thèse de doctorat. Bavarian Julius Maximilian University, Würzburg, Allemande, p. 214 (en langue allemande).
6. Conrad, C., Dech, S.W., Hafeez, M., Lamers, J., Martius, C. &Strunz, G. (2007). Mapping and Assessing Water Use in a Central Asian Irrigation System by Utilizing MODIS Remote Sensing Products. Irrigation and Drainage Systems, 21 (3-4) : 197–218.
7. Conrad, C., Fritsch, S., Zeidler, J., Rücker, G. &Dech, S. (2010). Per-Field Irrigated Crop Classification in Arid Central Asia Using SPOT and ASTER Data. Remote Sensing, 2 (4): 1035–1056.
8. Conrad, C., Dech, S.W., Hafeez, M., Lamers, J.P.A. &Tischbein, B. (2013a). Remote Sensing and Hydrological Measurement Based Irrigation Performance Assessments in the Upper Amu Darya Delta, Central Asia. Physics and Chemistry of the Earth, 61 : 52–62.
9. Conrad, C., Rahmann, M., Machwitz, M., Stulina, G., Paeth, H. &Dech, S. (2013b). Satellite based calculation of spatially distributed crop water requirements for cotton and wheat cultivation in Fergana Valley, Uzbekistan. Global and planetary change (110) : 88-98.
10. Conrad, C., Dech, S., Dubovyk, O., Fritsch, S., Klein, D., Löw, F., Schorcht, G. &Zeidler, J. (2014). Derivation of Temporal Windows for Accurate Crop Discrimination in Heterogeneous Croplands of Uzbekistan Using MultitemporalRapidEye Images. Computers and Electronics in Agriculture, 103 : 63–74.
11. Dubovyk, O., Menz, G., Conrad, C., Thonfeld, F. &Khamzina, A. (2013). Object-Based Identification of Vegetation Cover Decline in Irrigated Agro-Ecosystems in Uzbekistan. Quaternary International, Hydrological and Ecological Responses to Climatic Change and to Land-use/land-cover changes in Central Asia, 311 : 163–174.
12. Edlinger, J., Conrad, C., Lamers, J., Khasankhanova, G. &Koellner, T. (2012). Reconstructing the Spatio-Temporal Development of Irrigation Systems in Uzbekistan Using Landsat Time Series. Remote Sensing, 4 (12) : 3972–3994.
13. Navratil, P., &Wilps, H. (2008). Remote Sensing and Ground Based Monitoring of Afforestation Measures on the Desiccated Aral Sea bed–Inventory and Impact Assessment of a Project Dedicated to the Mitigation of an Ecologic Disaster. Proceedings of the Water Forum. 28-29 Mai, Bichkek, Kirghizistan. p. 15.
14. Nezlin, N.P., Kostianoy, A.G. & Li, B.L. (2005). Inter-Annual Variability and Interaction of Remote-Sensed Vegetation Index and Atmospheric Precipitation in the Aral Sea Region. Journal of Arid Environments, 62 (4) : 677–700.
15. Platonov, A., Thenkabail, P.S., Biradar, C.M., Cai, X., Gumma, M., Dheeravath, V., Cohen, Y., Alchanatis, V., Goldshlager, N., Ben-Dor, E., Vithanage, J., Manthrithilake, H., Kendjabaev, S., &Isaev, S. (2008). Water Productivity Mapping (WPM) Using Landsat ETM+ Data for the Irrigated Croplands of the Syrdarya River Basin in Central Asia. Sensors, 8 (12) : 8156–8180.
16. Rajabov, T. (2013). Ecological assessment of spatio-temporal changes of vegetation in response to piosphere effects in semi-arid rangelands of Uzbekistan. Programme de formation Restauration de terrain, Reykjavík, Islande, 109-144.
17. http://glovis.usgs.gov/

THE ROLE OF GEO INFORMATION (GIS) TECHNOLOGIES IN WATER MANAGEMENT

Sh.B. Akmalov - PhD, associated professor
I.M. Ruziyev - doctorate student
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

This article is based on theoretical review. In this article provides discussion about using GIS technologies in water management. Provides review about history of the creation of GIS and its advantages and disadvantages. Discussed future of using GIS in different sphere.GIS gives possibilities to collect the data, renewing it or use new information in analysis. It requires quick change of GIS information about Earth because procedures in the Earth are dynamically changeable. Periodically changing information in GIS gives us possibility to get new information and analyze it. GIS technologies and techniques started using widely in all sphere of humanity. It is important to know its properties.

Key words: GIS, water management, Irrigation, Integrated Water Resource Management (IWRM), Uzbekistan, River basin, Agriculture.

Introduction. In water management GIS has been being used for a long time. According to Awulachew [9] the use of it in water resource management helps to obtain accurate information. Another advantage of using GIS in water resource management is that it helps to maintain a centralized controlling system, which is based on reliable data. Detecting weak chains of management and concentrate all efforts to this part are also an important challenge of water management. GIS can help to execute this task.

At the beginning, GIS was used only for keeping much extended information and to deliver it to the user in a certain format. However, afterwards, points of water objects started indicating in GIS, and at the time, people made the most important models for agriculture and water management with GIS [1, 2, 3, 4].

GIS is used widely in irrigation for the following targets:analyzing devices of database and deliver it in a convenient format to users;making different agricultural and hydrologic model;making climatic models [14]; making run off models;making water delivering and reuse models;maps for using land[11]; water distribution system master planning [5]; population and water demand projections; Subterranean water management/modeling;monitoring water quality [10]; hazardous materials tracking/underground tank management; analyses of sites; water allocation;analysis of water flows;urban storm water- management model.

GIS has big opportunities in irrigation in the future as well. The opportunities and using range of GIS increase in future as well as the development of RS imagery satellite. Because of the following advantages, GIS is used widely in irrigation systems:network analysis,spatial analysis,overlay processes, 3D operations,sub-basin delineation,network tracing,shortest path finding, travel routine, area computation, flow path length measurement, nearest distance determination,visualization [1, 2, 3, 4].

There are many models created in GIS which are successfully used in water management of different countries of the world. Liu inserted EPIC model, which was suggested by FAO, into GIS and created GEPIC model. Stockholm Environmental Institute created WEAP (water evaluation and planning) model by GIS modeling [6]. Fortes et. al. inserted the existing irrigation scheduling simulation model ISAREG (this model, also, calculates the waste water amount of the area by inserting natural and climatic factors) into GIS, and created a GISAREG model based on the above-mentioned GIS. By this model, they predicted the quality of utilizing the Syr Darya basin water in different climatic scenarios. Creating this model in GIS eases the labour. From these models SEBAL is the most widely spread model. Over 30 countries are implementing this model for water resource control.

Methods and materials. The use of GIS in water management and agriculture is expanding every year. This can be observed here. Now, 90% of the USA water agencies work is based on this program [4]. In all the branches, GIS is used for exchanging information, increasing the fertility, predicting the results in advance, developing the branch, utilizing the resources wisely and creating an informational portal. In our research we used the advantage of designing, presenting and saving the data in GIS.

Analysis deals with the use of GIS mainly for storage and exporting of our data. Though, this program is common in water resource management systems, its implementation in arid regions is rare. The main reason is that there are no appropriate organizations that provide licensed GIS software in the region and to get the software from other suppliers is costs expensive. Moreover, there are problems related to data gathering in arid regions. Therefore the use of GIS in arid regions is still increasing.

Using GIS in water management of Central Asia started to develop after 2000, after the implementation of water management in this region. To supply the integrated and regular water management, to create irrigation sets and objects, water users, vegetation type and area database and maps for regional and global scale, and analyze it rapidly was the main problem of water managers. During its long time experiments water management found an answer to this problem. It was using new computer technologies and scientific achievements to water management. This component was added to Central Asian water management plan. As a result the scope of work in this field expands.

Result. From "Scopus" system we found 107 scientific works which have the word "GIS in irrigation of the arid region," in it (Figure 1).

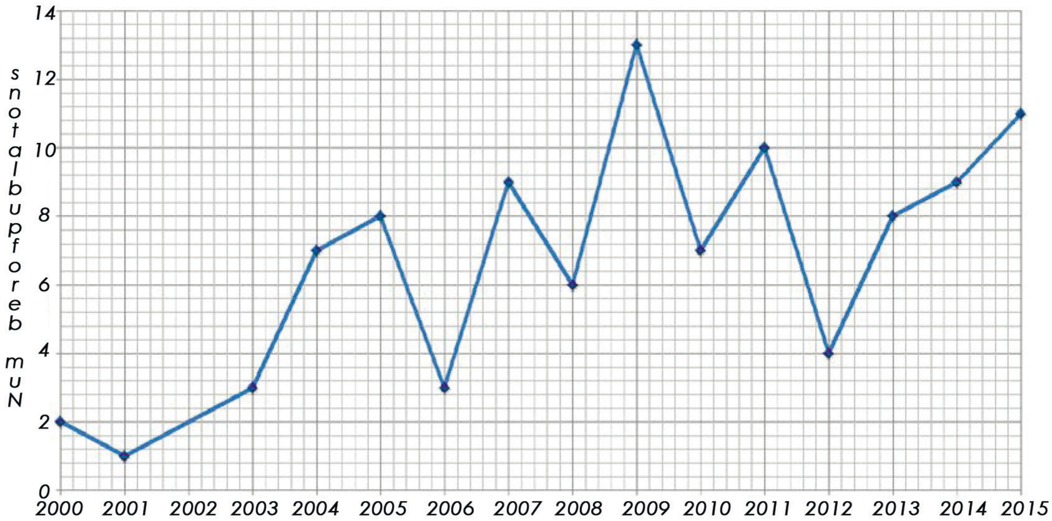


Fig.1. Scopus review for theme "GIS in irrigation of the arid region" (Source: Scopus 18/01/2016).

Basic scientific research works with GIS in water management in Central Asia are the following: Schlutercreated TUGAI model in GIS to monitor and predict the hydrologic and ecologic condition of the Amudarya basin and made a scenario based on this. Fortes created a GIS database for the Fergana valley in Central Asia and inserted all the information, from plants to underground waters. He also calculated GISAREG, an irrigation scheduling simulation model in GIS, for the valley.

Many scientists have created SEBAL models to control the irrigation in the Khorezm region and Fergana valley in central Asia. Here SEBAL models are used with MODIS images [7,8,12]. Especially, scientific research of Conrad is very important in this field. He created the SEBAL model using images of RS, MODIS, ASTER, SPOT-5 and other satellites for the Amudarya basin and calculated the fertility of utilizing water. Besides, he created several hydrologic models for the very area by using GIS [13].

Rueckeret.al. created a Central Asian Water (CAWa) portal based on GIS information, results of research in the field, images of RS, MODIS, SPOT-5, and IRS classifications and results of SEBAL analysis. It includes information of water basins in Asia, their branches, informational maps and schemes. Rueckeret.al. gave much information about their project and its main task, the information includes problems and solutions.

Ruecker researched the quality of soil and water by mapping the area of the Aral Sea in Central Asia by Landsat images from 1998-2000. Here Landsat images were geo referenced and clipped by Erdas imagination and GIS. At the end of this analysis, common available GIS maps have been created. With these maps, scientists observed that in areas where the volume of water is decreasing, the amount of salt is increasing in the soil, which has a side effect on farms. It was the simplest and in PDF formed collection of maps for the Aral Sea's area. If we pay more attention to this research, we can see that the images were turned into clips and placed in GIS. It was a map on which the human eye can see the simplest changes of RS visual images. Here he wrote that the expressing of RS dates by GIS provides accessibility of dates.

In his research, Toniniet.al. collected two types of spatial and non-spatial dates from organizations working on the problems concerning the Aral Sea. He made the format of all the dates available for GIS by MapInfo and created an atlas of the Aral Sea area. Here they used many excel dates, like the composition of water and soil, natural factors as well as RS dates [1, 2, 3, 4].

WARMIS is the only completed GIS database in Central Asia for the Aral Sea basin. But now it is impossible to use this information, because the accuracy and the access for the information are available only for some special organizations.

Conclusion. From the information above it is seen that in water management of Uzbekistan there have been used a lot maps models by using GIS. The problem consists of accuracy and accessibility. There exist two online portals about Uzbekistan's water management, they are CAW and WARMIS, but it contains very old information and it became useless. We know that changes on the earth occur constantly, for this reason it is important to change information as soon as possible. Access to these two portals is admitted only to special organizations. Our scientists created GIS maps and models; these could renew the base with more information and help to update old data. We found only one scientific work which was completed in our field using GIS. This work includes the map "Land surface classification" for one farm. Thus, our territory is completely unexplored area. Introduction of GIS in some arid regions and improve water resource management by this system can be an innovation for some regions. But, GIS is just software and for processing and obtaining solutions one needs to collect data and enter results of analysis, then this program becomes a useful data source for us. Data collection and entering it into GIS are also highly diversified and based on many selections. There are many ways and methods to collect data. Consequently, the types of data are numerous. Filling GIS with unnecessary information causes the user to be lost in a huge information mess. Therefore, it is very essential in research to get only necessary data and choose proper analysis software for it.

References:

1. Arifjanov A.M., AkmalovSh.B. Geographic object based image analysis and remote sensing in environment. «Improving efficiency, reliability and safety of hydraulic engineering constructions» Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018. P. 24-29
2. Arifjanov A.M., AkmalovSh.B. Geographic object based image analysis and algorithm description by using eCognition. *«Gidrotekhnik inshootlar samaradorligi va ishonchliligini oshirish»* [«Improving efficiency, reliability and safety of hydraulic engineering constructions»] Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018. P. 29-33
3. Arifjanov A.M., AkmalovSh.B. Remote sensing applied to water and agricultural management in Central Asia and Uzbekistan. *«Gidrotekhnik inshootlar samaradorligi va ishonchliligini oshirish»* [«Improving efficiency, reliability and safety of hydraulic engineering constructions»] Collection of articles of international scientific-practical conference. Volume II. Tashkent – 2018. P.33-37
4. Arifjanov A.M., AkmalovSh.B., Samiev L.N., Apakxo'jaeva T.U. Choosing an optimal method of water extraction for arid region in the case of Beshbulak and Yangiobod villages (Sirdarya Province, Uzbekistan). European science review № 3–4 2018 March–April. Pp. 244-249
5. Ames, Daniel P., Eric B. Rafn, Robert Van Kirk, and Benjamin Crosby. 2009. "Estimation of Stream Channel Geometry in Idaho Using GIS-Derived Watershed Characteristics." Environmental Modelling& Software 24 (3): 444–448.
6. Assaf, Hamed, and Mark Saadeh. 2008. "Assessing Water Quality Management Options in the Upper Litani Basin, Lebanon, Using an Integrated GIS-Based Decision Support System." Environmental Modelling& Software 23 (10): 1327–1337.
7. Awan, Usman Khalid. 2015. "Coupling Hydrological and Irrigation Schedule Models for the Management of Surface and Groundwater Resources in Khorezm, Uzbekistan." Accessed June 17.
8. Awan, Usman Khalid, Bernhard Tischbein, Christopher Conrad, Christopher Martius, and MohsinHafeez. 2011. "Remote Sensing and Hydrological Measurements for Irrigation Performance Assessments in a Water User Association in the Lower Amu Darya River Basin." Water Resources Management 25 (10): 2467–2485.
9. Awulachew, SeleshiBekele. 2012. The Nile River Basin: Water, Agriculture, Governance and Livelihoods. Routledge.
10. Banerjee, Shweta, VishakhaSakhare, and Rahul Ralegaonkar. 2013. "Application of ArcGIS for E-Governance of Rural Water management."
11. Bhaduri, Budhendra, Jon Harbor, Bernie Engel, and Matt Grove. 2014. "Assessing Watershed-Scale, Long-Term Hydrologic Impacts of Land-Use Change Using a GIS-NPS Model." Environmental Management 26 (6): 643–58. doi:10.1007/s002670010122.
12. Chemin, Yann, Alexander Platonov, MehmoodUl-Hassan, and IskandarAbdullaev. 2004. "Using Remote Sensing Data for Water Depletion Assessment at Administrative and Irrigation-System Levels: Case Study of the Ferghana Province of Uzbekistan." Agricultural Water management 64 (3): 183–196.
13. Conrad, Christopher, Sebastian Fritsch, Julian Zeidler, GerdRücker, and Stefan Dech. 2010. "Per-Field Irrigated Crop Classification in Arid Central Asia Using SPOT and ASTER Data." Remote Sensing 2 (4): 1035–1056.
14. Ficklin, Darren L., YuzhouLuo, EikeLuedeling, and Minghua Zhang. 2009. "Climate Change Sensitivity Assessment of a Highly Agricultural Watershed Using SWAT." Journal of Hydrology 374 (1): 16–29.

REGRESSION MODEL OF THE CORRELATION BETWEEN COTTON YIELD AND THE NORM OF SOWING SEEDS

R.K. Djamolov - Ph.D., Senior Researcher AO "Paxtasanoat ilmiy markazi"
K. Djamolov - Ph.D., associate professor, X.C. Djamolova - assistant
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

The article describes the effectiveness of sowing results in low-cellulose drying technology, for example, dried seeds. In many cases, information obtained as a result of scientific and practical research will be random in nature. In such cases, the methods of mathematical statistics are used to analyze the results of experiments. In practice, it is especially important to check the connection "seeding and seeding rate". This scientific article shows how to analyze the relationship between seed yield and seeding rate based on the results of laboratory experiments. There are two forms of connection (functional and correlation) between the obtained indicators and factors, and they are different. The functional correlation and correlations that led to a change in the argument of the factor "X" led to a well-defined change in the result label «У» (function). A mathematical expression describing the relationship between factors and indicators: a regression equation was constructed and the model's adequacy was proved.

Key words: random variable, functional relationship, correlation, regressionequation, regression coefficient, correlation coefficient, low-frustrated, soil temperature, seeds, denudations, sowing, germination,correlation, coefficient, model, adequate.

Introduction. Development of cotton seeds is one of the top priorities of implementation of five priority directions of the Strategy for development of the Republic of Uzbekistan for 2017-2021[1]. In Uzbekistan, cotton is grown mainly with cottonseed and seedless seeds. For sowing of seeds it is necessary to have optimum conditions, which are enough moisture, soil and air temperature. The sowing of the soil occurs when the soil temperature is 14-16^{0}C and the temperature is 15-20°C [2]. Cultivated seeds are more resistant to adverse weather conditions. However, these seeds are hardly sorted, calibrated, difficult to distinguish seeds and technical fractions, and seeds of seeds are sown in large norms and require joint work.

Scientists have discovered that the use of sowing techniques has been highly effective in curdling them to reduce sowing costs. It is easy to select and clean the size of seeded seeds, but it is recommended that the seeds are susceptible to the seeds, which are recommended to be sown after the heat (soil temperature 16-18^0).

An analysis of the present condition of the case.

Seed cotton seeds are sown in the established amount by using precise planting equipment. "PakhtaAsanoat Scientific Center" JSC has developed a method for the production of low-sown seeds, which combines the best aspects of the cottonseed and seeded seeds. It has a purity of 1.5-2.5%, which is sown with a sowing method such as dried seeds. Cultivation of sowing seeds is carried out by modification of work regimen machines on dewatering machines. High levels of training and low mechanical damage can lead to increased nutrition [3].

Low Density Cotton Seeds are included as seeds in standard DZT 663: 2017 Crop Seeds Technical Specifications (poverty rate - 2.5%). Preparation for sowing is carried out according to traditional technology adopted in farms. The sowing of the seeds depends mainly on soil moisture and moisture, in which the soil moisture content is as follows:

0 ... 5 cm - 13 ... 15%, 5 ... 10cm - 14 ... 19%, and the sowing depth is between 3 and 5 cm.

The temperature of the soil at a depth of 0 ... 5 cm is the same as that of the air temperature, and the air temperature reaches 100 degrees, but the temperature should not be less than 160 cm. Temperature 21 to 250s appears sprouting within five to six days, which is not a basis for choosing the optimal time for sowing. At this temperature soil dewatering due to soil moisture causes dryness of seeds. Therefore, the sowing time should be selected according to the weather conditions of each region [4].

During the day, because of the different temperatures, the seeds stop heating at low temperature at night, and with the heat of the day they begin to grow again. The thickness of low-bearded cotton seeds, which has a moisture content, increases resistance to such weather changes and disease tolerance. In addition, its moisture absorbs its moisture and accelerates its fertilization because it is well covered with soil.

Setting the problem. One of the main factors in getting the number of seedlings in the same way is the selection of an optimum scheme of planting. This includes the amount of planting and the distance between the slots. It is known from experience that seedlings should be 110-140 thousand hectares [5-9] for the seedlings to be sufficient .Extension diagram can be made between a narrow, broad or mixed series.

Methods of extraction. Scientific researches on the optimal scheme of sowing are carried out at the Institute of Chemistry of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan, where the sowing of 1, 2 and 3 seedlings in sockets is 222 thousand hectares. Although the results of regular experiments have changed, the number of seeds to be planted has not been varied to the hectare [10,11,12,13,].

When 90 cm incubation was done, the 90x15-3 scheme (15cm between cells, 3 seeds), 90x10-2 scheme and 90x5-1 sowing scheme were low in the sowing of one seed sow, seeds are difficult to break out of the soil, so it is desirable to plant 2, 3 in the sowing area according to the soil conditions. The full bearded cotton seeds, in the exact sowing method, put 2-3 seeds in each slot at a wider range of 15 cm wide (90 cm), the range of the slots in the range of 20-22 cm to the narrow range range (line O asi planting 60cm) is desirable, but a broken-cell method may be planting seeds 1-2 pieces left in the cell.

The sowing capacity is 25-27kg / ha and the narrow range is 35-37kg / ha, the sowing norm is calculated by the following method: The sowing capacity is 60cm in the range of 100x100 / 0.6 = 16666.7m, line spacing 90 cm at 100x100 / 0.9 m = 11111.1m.

When we consider the spacecraft to be 15 cm, 6,7 sow are sown one meter per hectare, the sown seeds are 6.7x3 = 20.1 spp., When the line spacing is 60 cm, the number of seeds sown in hectare is N = 16666,7x20,1 = 335,000 pieces , 35-37 kg, and the line spacing is 90 cm and N = 1111,1x20,1 = 222 thousand units, which is about 25-27 kg [14,15,16,17].

Results. In order to carry out experimental sowing of low-seed seeds in the laboratory, the following cotton seeds were produced at the Alimkent cotton-ginning plant of Tashkent region: S-6524 breeding stock, second generation: seeds, seeds - 7.5%;

- seeds of cotton seeds -2.3%; - depleted, - 0.4%.

Results of the analysis of the seeded seeds in laboratory conditions are given in table 1.

Table 1

Laboratory analysis results

Option	Weldingforce, %	Uncerti-fied league, %	1000 seedmass, gr	Mechanic traumatic injuries % of total	Tukli league, %
Puppyseeds	89	91	110	4,8	7,5
Low-seededseeds	91	93	104	5,3	2,2
Roastedseeds	89	90	101	7,7	0,4

Testing in laboratory conditions suggests that low bovine seeds can be reduced by 2-3% higher than the pellets and fibrils, and the mechanical damage to treatment can be reduced by 2.4%. The results of data on the yield (U) yield (X) and the seeding rate are shown in Table 2 following the results of experiments conducted at n = 14 experimental areas, for example: 60 cm.

Table 2

Results from experiments

Number of experi-ments	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$x_i$kg/ha	15	20	25	30	35	40	45	50	55	60	75	90	105	120
y_i100k g/ha	33.7	40.5	40.7	41.8	42.2	38.5	39.6	40.5	39.3	38	34	33.4	31	29.4

When studying the link between yield and sowing norms, crop yields (outcome indicators) depend on the amount of seeds. In some cases, the amount of seeds normally is positive, with a large number of crops being negatively affected. Thus, growth or decline of one factor affects change in the resultant values. However, the factor and the resulting values are called non-linearly linked.

Schedule a link between yield and sowing norm

By using experimental points and combining experimental points (using the numerical solution methods of transtsendent equations in the Mathcad package), the experimental fracture line appears (Figure 1).

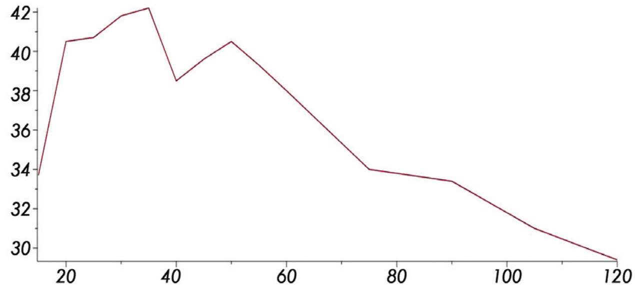


Fig.1. Empirical broken line

Based on the pattern found, we use the following transtending functionality model:

$$y = A + B\ \ln x + Cx \qquad (1)$$

Here are the results: The result of the production, x-factor, A, B, S are unknown parameters, called regression coefficients, these unknown parameters are evaluated by the following (2) - normal system with the least squares method.

$$\begin{aligned} &\sum_{i=1}^{14} y_i = 14\cdot A + B\sum_{i=1}^{14}\ln x_i + c\sum_{i=1}^{14} x_i \\ &\sum_{i=1}^{14} y_i \ln x_i = A\sum_{i=1}^{14}\ln x_i + B\sum_{i=1}^{14}[\ln x_i]^2 + C\sum_{i=1}^{14} x_i \ln x_i \\ &\sum_{i=1}^{14} y_i\cdot x_i = A\sum_{i=1}^{14} x_i + B\sum_{i=1}^{14} x_i\ \ln x_i^{\ 2} + C\sum_{i=1}^{14} x_i^{\ 2} \end{aligned} \qquad (2)$$

This (2) is the coefficient of A, B, C, and the regression equation, and the optimal sowing norm and model accuracy. To solve this system, the following Table 3 is created: [18,19,20].

Table 3

Matrix of nonlinear production function

Size given		Calculated magnifications					
x_i	y_i	x_i^2	$\ln x_i$	$x_i y_i$	$y_i \ln x_i$	$x_i \ln x_i$	$(\ln x_i)^2$
15	34	225	3	506	91	41	7
20	41	400	3	810	121	60	9
25	41	625	3	1018	131	80	10
30	42	900	3	1254	142	102	12
35	42	1225	4	1477	150	124	13
40	39	1600	4	1540	142	148	14
45	40	2025	4	1782	151	171	14
50	31	2500	4	1525	119	196	15
55	39	3025	4	2162	157	220	16
60	38	3600	4	2280	156	246	17
75	35	5625	4	2588	149	324	19
90	33	8100	4	3006	150	405	20
105	31	11025	5	3255	144	489	22
120	29	14400	5	3528	141	574	23
$\sum_{i=1}^{14} x_i$	$\sum_{i=1}^{14} y_i$	$\sum_{i=1}^{14} x_i^2$	$\sum_{i=1}^{14} \ln x_i$	$\sum_{i=1}^{14} y_i x_i$	$\sum_{i=1}^{14} y_i \ln x_i$	$\sum_{i=1}^{14} x_i \ln x_i$	$\sum_{i=1}^{14} [\ln x_i]^2$
765	513	55275	54	26729	1945	3180	211

Table 3 summarizes the values found in Table 1 according to Table 1

(2) - the system will create 3 equations of 3 equations, ie:

$$\begin{aligned} 14A + 54V + 765S &= 513 \\ 54A + 211V + 3180S &= 1945 \\ 765A + 3180V + 55275S &= 26729 \end{aligned} \qquad (3)$$

(3), the following equations are determined by A, B, C, and A: A = 13.5, V = 9.7, S = - 0.3 By looking at (1), the expression of the regression equation is as follows: : (Figure 2).

$$y=13{,}5+9{,}7\ln x-0{,}3x \qquad (4)$$

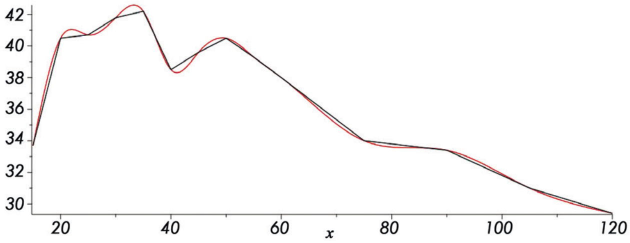


Fig.1. The nearest regression line to the experimental fracture line

In order to find the optimal seeding norm (4), the equation of regression is equated to:

$$y'=(13{,}5+9{,}7\ln x-0{,}3x)'=\frac{9{,}7}{x}-0{,}3$$

$$\frac{9{,}7}{x}-0{,}3=0;\ 9{,}7-0{,}3x=0;\ 9{,}7-0{,}3x=0;\ x=32{,}3$$

Find the found solution in equation (4): is formed.

$$y=13{,}5+9{,}7\cdot\ln 32{,}3-0{,}3\cdot 32{,}3=13{,}5+38{,}8-9{,}69=42{,}6$$

The correlation coefficient for finding the model's accuracy is .

$$r_{xy}=\frac{\overline{x\cdot y}-\bar{x}\cdot\bar{y}}{\sigma_x\cdot\sigma_y};\qquad \overline{x\cdot y}=\frac{\sum_{i=1}^{14}x_i\cdot y_i}{n}=\frac{26729}{14}=1909{,}3\approx 1909$$

$$\bar{x}=\frac{\sum_{i=1}^{14}x_i}{n}=\frac{765}{14}=54{,}6\approx 55;\ \overline{x^2}=\frac{\sum x_i^2}{14}=\frac{55275}{14}=3948{,}2142$$

$$\bar{y}=\frac{\sum_{i=1}^{14}y_i}{n}=\frac{513}{14}=36{,}6;\ \overline{y^2}=\frac{\sum y_i^2}{14}=\frac{19166{,}33}{14}=1369{,}035$$

$$\sigma_x\sqrt{\overline{x^2}-(\bar{x})^2}=\sqrt{3948-3025}=\sqrt{923}\approx 30$$

$$\sigma_y=\sqrt{\overline{y^2}-(\bar{y})^2}=\sqrt{3392-1369}\approx 35{,}3$$

Correlation coefficient

$$r_{xy}=\frac{1909-55\cdot 37}{30\cdot 35{,}3}=\frac{3948-3025}{106}=\frac{923}{106}=0{,}87$$

Summary. In the case of sowing of the seeds, the level of purity in the range of 2.0-2.5% can be reduced, and its mechanical damage can be reduced, which increases the capacity and susceptibility of the seeds to sowing. When x = 32.3 kg, the yield isy= 42.5 cents per hectare. The correlation coefficient determines the nature of the relationship. Correlation coefficient values are from -1 to +1. The coefficient of coefficient (+) indicates that the correct connection (-) indicates the inverse relationship. Ifr_{xy}=1, it is called functional bonding of production factors, if r_{xy}=0, the production process is called a weak bond with the factors. In our opinion, r_{xy}=0.87 the model is adequate.

References:

1. The Decree of the President of the Republic of Uzbekistan of February 14, 2017 "On Organizational Measures for the Implementation of the Strategy of Action on the Five Priorities of Development of the Republic of Uzbekistan in “Toshkent” 2017-2021". (in Uzbek)
2. Djamolov R.K. *«Obosnovanie parametrov i rezhimov raboti visevayuchego apparata dlya tochnogo viseva maloopushennikh semyan khlopchatnika»* [Justification of the parameters and operating modes of the sowing apparatus for precise sowing of low-grown cotton seeds] , Yangiyo’l, 2002.128 p. (in Russian)
3. Djamolov R.K. *Pakhta tozalash zavodlarida kam tukli uruglik chigit tayyorlash va bu chigitlarni khuzhaliklarning ishlab chikarish sharoitida ekilishi tekhnologiyasini tadkik etish va zhoriy etish* [Research and introduction of low-sown seed cotton slaughtering plants in cotton ginneries and the technology of planting these seeds under farming conditions] The final report on research,Toshkent 2003. 25 p. (in Uzbek)
4. *Uzbekiston davlat standarti O’zDSt 663:2006, URUGLIK CHIGIT Tekhnikaviy shartlari*, [State Standard of Uzbekistan UZDt 663: 2006, Technical Conditions of Breeding], “Tashkent” 2006.10 p.(in Uzbek)
5. KurnosovA.P., SukoevI.A. *«Vichislitelnaya tekhnika i ekonomiko-matematicheskie metodi v selskomkhozyaystve»* ["Computing and economic and mathematical methods in agriculture"] Moscow. 1982. 320 p. (in Russian)
6. RyutovaT.I., *«Ekonomiko-matematicheskie metodi planirovaniya na lesopromishlennikh predpriyatiyakh»* [“Economic and Mathematical Planning Methods at Timber Industry Enterprises”] Moscow. 1991. 240 p. (in Russian)
7. Kravchenko V.G. i dr. *Ekonomiko – matematicheskie metodi v organizatsii planirovanii selskokhozyaystvennogo proizvodstva* [Economic - mathematical methods in organizing the planning of agricultural production] Moscow. 1973. 210 p .“Kolos”. (in Russian)
8. Buslenko N.P. *Modelirovanie slozhnykh sistem* [Modeling of complex systems. "The science"]. Moscow. 1968. 340 p (in Russian)
9. Moiseev N.N. *Matematicheskie zadachi sistem nogoanaliza* [Mathematical problems of system analysis. "Science"], Moscow. 1968. 180 p (in Russian)
10. V.E. Alekseev i dr. *Vichislitelnaya tekhnika i programmirovanie* [Computer engineering and programming] Moscow. 1991. 240 p. (in Russian)
11. Plis A.I., Silvina N.A. Mathcad 2000: *Matematicheskiy praktikum dlya ekonomistov i inzhenerov* [Mathcad 2000: A Mathematical Workshop for Economists and Engineers: A Textbook] 2000.120 p (in Russian)
12. Makarov E. G. *Inzhenernye raschety v Mathcad* [Engineering calculations in Mathcad. Training course. SPb .:] Peter, 2003. (in Russian)

13. Koloyarova L.F. *Semenovedenie khlopchatnika* [Seed cotton. Collection and harvesting of seed material.1976.55 p. (in Russian)
14. Mamaraximov B.I.,Shpilevskiy V.N. *Razvitie i perspektivy semenovodstva khlopchatnika v Uzbekistane* [Development and prospects of cotton seed production in Uzbekistan] 2015. 83 p. (in Russian)
15. Ishanov H.H., Dadajonov M. *«Sugorish tarmoklarida suvni hisobga olishdagi ayrim muammolar tugrisida»* ["Some problems of water accounting in irrigation systems"]. Journal of Irrigation and Reclamation, Issue 4, Tashkent, 2016. (in Uzbek)
16. *Dala tazhribalarini utkazish uslublari* [Methods of conducting field experiments]. 2007. 146 p. (in Uzbek)
17. Strona I.G. *Obshchee semenovedenie polevykh kultur* [General seed science of field crops] 1966. 466 p. (in Russian)
18. Ubaydullaev S. *«Chigitni ekish tizimlari va kator oraligiga ishlov berishning tuprok kharorati uzgarishiga tasiri»* ["Effects of sowing systems and line spacing on soil temperature changes"]. Agro Ilm Magazine, Issue 1, Tashkent, 2018. (in Uzbek)
19. DjamolovK., Djamolov R.K. *Modelirovanie tekhnologicheskogo protsessa pnevnomekhanicheskoy ochistki i sortirovaniya semyan* [Simulation of the process of pneumomechanical cleaning and sorting of seeds] XIV Republican Scientific and Practical Conference on Modern Problems of Agriculture and Water Management, 3rd Edition, Tashkent, May, 2015
20. Djamolov R.K., DjamolovK., Abidova A.R., *Kam tukli uruglik chigitni anik uyalab yekish* [Falling low-seeded seeds to a complete shyness] Absolute sowing of low-seed seeds Republican scientifically-practical conference on "Mechanics of deformable solid bodies" 2-volume Tashkent 2018, 178-181 p. (in Uzbek)

HIGH-PERFORMANCE TECHNOLOGY FOR PREPARING THE SOWING OF COTTON SEEDS

R.K. Djamolov -"Paxtasanoatilmiymarkazi" JSC

Abstract

The methods for designing of processing equipment layout with new devices such as machine-operated seed intake, delinters and packaging with a certain weight are described. The results of the development of the state-of-the-art process technique for conditioning of fuzzy and delinted sowing cotton seeds with the justification of the operating principles and experiments to study the modes of operation of the line are presented. The results of experiments showed that the conditioning of fuzzy seeds with the removal of 1,0-2,0% of the linters has an effect on the increase in the seed portion and thus reduces the large process portion. Preliminary experiments under factory conditions of the existing seed treatment shops are carried out, as a result of which the mechanical damage of seeds is reduced to 3,2% and an increase in the weight of 1000 seeds by 2-3 grams.

Key words: Delintering technology, seed, seed sorting ChSA, Metering hopper of fuzzy seeds BDOS, Elevator, Seed peeling equipment OS, Bag stitching machine.

Introduction

Conditions of acceptance, batching, storage and processing of cottonseed cotton of fine-staple and medium-staple varieties, including drying, cleaning, saw and roller cotton ginning, cleaning, moistening and packing of the fiber, as well as linting of sowing seeds had been studied in detail being reflected in papers [1, 2] following the results of comprehensive studies of the cottonseed conditioning process technique which were carried out by "Pakhtasanoatilmiymarkazi" JSC in the period from 1989 to 2002. The regulations also described the conditions for conditioning of sowing cottonseeds, including the conditioning of fuzzy and peeled sowing seeds, methods of single and double mechanical peeling, and pelleting of sowing cottonseeds.

Methods

In order to find out the possibility of obtaining quality indicators of peeled sowing seeds under production conditions in accordance with the requirements of the previously valid standard, commissioning tests of peeled sowing cottonseed processing technique had been performed at the Alimkent cotton plant of the Tashkent region. The test results proved a decrease in quality indicators for mechanical damage upon achieving the required quality indicators for residual fuzziness (0,2%). Experimental studies have also found that when the seeds are peeled to a residual fuzziness of 0,2%, the seeds overheat to 60°C or more, and the mechanical damage increases to 10% or more[4].

It is known that the requirements of the standards regulating the quality indicators of cottonseeds are guaranteed to ensure the adequate seed and sowing properties. At the same time, the requirements for residual fuzziness indicator of peeled seeds are guaranteed mainly to ensure their sowing capability by means of precision seeders with sufficient accuracy.

Studies have shown that when sowing peeled seeds with residual fuzziness to 0,6% and seeds of low fuzziness of 2,0-2,5%, the accuracy of sowing is practically not reduced.

New requirements for the quality indicators of peeled sowing seeds had been developed, which are included in the current standard of the Republic of Uzbekistan O'zDSt 663: 2006 [3] based on the research work.

"Process regulations for the processing of raw cottonseed and the treatment of sowing cotton seeds" had been developedbased on the studies being carried out in 2000-2003[2]. Two-stage peeling method in which the BDOS metering hopper is used in the process by feeding the fuzzy seeds to the suction connection of the seed sorterChSA with required efficiency had been developed following results of these studies. In this unit, the seeds are cleaned, sorted and sent for preliminary peeling to 1LB grate-free linters. These machines delint the seeds with bringing their fuzziness to 3,5-4,0% (lint removal 5,0-6,0%).

Seeds being delinted at the first stage are fed into OS-01 seed peeling machines for the second stage of delintering up to fuzziness of 0,2-0,5%. Delinted seeds are sent to KCM-1-1,5 calibrator for sizing according to thickness and wide.

The sowing part of seeds collected in a separate storage bin is sent for treatment by means of KPS-15, 2OSKh and other treaters.

The conditioning process techniques of fuzzy seeds include the following basic procedures: cleaning from trashes, sorting, treatment and packing into paper bags. Fuzzy seeds were fed manually into the auger, which conveyed them to the seed sorterChSA of pneumo-mechanical cleaning and seed sorting with MChT mechanical cleaner. The sorted seeds were fed into the treater and treated seeds through the neck of treater are packed into 3-layer paper bag which was then sewn up manually by the operator.

Results

"Uzpakhtasanoat" JSC has developed a long-term program for the modernization of specialized plants for 2005-2006, with a view to equipping them with modern equipment for conditioning of sowing seeds, their calibration, treatment and sorting.

According to this "Program" it was planned to dedicate 31 enterprises belong to "Uzpakhtasanoat" for the conditioning of sowing cotton seeds.

According to the Ministry of agriculture and water resources of the Republic of Uzbekistan, the volume of required seeds in general and by types of conditioning (fuzzy and peeled seeds) in all regions of the Republic had been determined. Process techniques for conditioning of fuzzy and peeled sowing seeds, the composition and quantity of process equipment had been determined according to these data. The methods and equipment used in the process technique for conditioning of fuzzy and peeled sowing cotton seeds have changed significantly compared to those used previously and specified in the regulations [2].

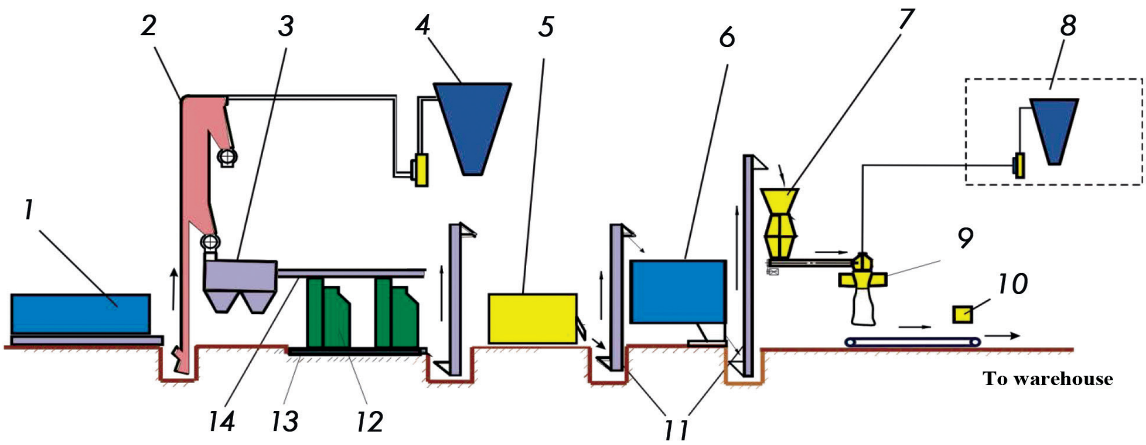
In addition, studies have shown that the proposed methods significantly increase the efficiency of sorting and cleaning, the quality of seed treatment.

The main criteria for assessing the quality of seeds in the conditioning of fuzzy sowing cotton seeds are: to achieve high germination rates, germination power, to reduce trash content and decrease the rate of mechanical damage, by meeting the standard requirements. State-of-the-art process technique for the conditioning of fuzzy sowing cotton seeds was developed (Fig.1) according to this hypothesis.

the weighing and packing apparatus (for example, B-JS-10/S, Yubus, Spain), where they are packed in paper bags with a strictly defined amount, and the necks of the bags are sewn up with a bag stitching machine [5, 6].

Bags with treated seeds are transported to the warehouse of finished products, which consists of several compartments, where they are stored on pallets separately according to grades, reproduction, and batches.

Preliminary experiments were carried out under the production conditions of the existing workshops for the conditioning of sowing seeds of the Alimkent, the Kasan, theGizhduvan, the Kushkupir, the Beruniy and other cotton factories where operation of equipment had been examined. Cleaning and sorting equipment of workshops (ChSA, MChT, L-S-4/L) ensures the increase in weight of 1000 seeds by 3-4 g. B-JS-10/S weighing and packing apparatus packs the seeds in paper bags with



1 - Seed receiving device, 2 - Seed sorter (ChSA), 3 - Mechanical seed cleaner (MChT), 4 - Cyclone, 5 - Seed cleaner, 6 - Metering hopper of fuzzy seeds (BDOS), 7 - Seed treating device, 8 - Suction and filtering system of harmful emissions, 9 - Weighing and packing apparatus, 10 - Bag stitching machine, 11 - Elevator, 12 - Linter (5LP), 13-14 – Auger.

Fig.1. State-of-the-art process technique for conditioning of fuzzy sowing cotton seeds

Cotton seeds being linted at the cotton plant and transported in bags or other means for transportation are unloaded into the seed receiving device UPS, from which they are fed uniformly and proportionally into the seed sorting machine ChSA.

In the ChSA sorter, lighter seeds (process portion) lift up and they are deposited in the upper chamber. Heavier adequate seeds are deposited in the lower chamber of the sorter and through the vacuum valve enter the mechanical seed cleaner MChT, where trashes and small immature seeds are released.

Seeds being peeled in the mechanical cleaner MCh enter the 5LP linters, where 1-2% of lint and free fiber are removed. Then they are transported to the seed cleaner-sorter (for example, l-JS-4/L, Yubus, Spain), in which they are exposed to 4-fold cleaning and sorting process (by air flow, twice on sieves and once again by air flow).

Then the seeds are transported by vehicles to the BDOS metering hoppers of fuzzy seeds from which the seeds are fed evenly and proportionally to the hopper of seed treating device (for example, D-2-VH, Yubus, Spain or PPS-05, Uzbekistan). Treated seeds are fed to

a predetermined weight at least within the range of 20 to 23 kg. Bag stitching machine sews up at least 250 bags per hour.

The results of experimental studies for assessment of the performance characteristics of the entire equipment system at the Kasan cotton factory are shown in Table 1.

Table 1.

Results of experimental studies

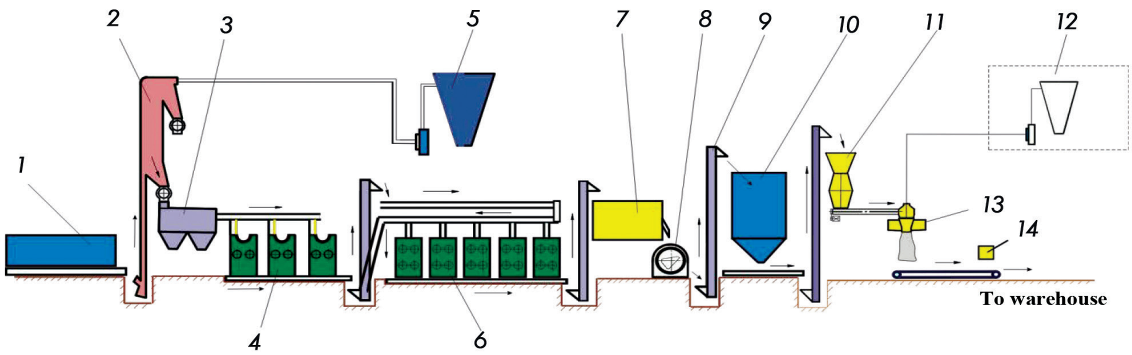
No.	Equipment	Mechanical damage, %	Yield of process use seeds, %	Weight of 1000 seeds, g
1	Seed receiving device UPS	4,3	-	91
2	Seed sorting ChSA	4,8	4,0	94
3	L-JS-4/L sorter	3,2	2,5	93
4	BDOS metering hopper	3,6	-	-

Seeds of the Denov elite variety, R1 reproduction, which had the initial indicators were used for experiments: trash content – 0,25%, weight of 1000 seeds - 92 g., moisture content – 7,4%, fuzziness – 7,8%, degree of damage – 3,9%.

As can be seen from the data of table 1, when sorting seeds on the sorter L-JS-4/L, mechanical damage to seeds is reduced to 3,2% and an increase in the weight of 1000 seeds is about 2-3 grams. Quality indicators of seeds meeting the standard requirements are achieved when the process line is operated.

State-of-the-art process technique for conditioning of the peeled sowing cotton seeds includes the following process operations and equipment (Fig.2).

and once again by air flow). Then seeds are fed to the sorter (for example, T-JS-7/1, Yubus, Spain) in which they are sorted according to length and transported to the storage hopper BNOS. Seeds from hopper are sent to the seed treating device (for example, I-JS-6, Yubus, Spain) for treatment. Treated seeds by means of weighing and packing apparatus (for example, B-JS-10,



1 - Seed receiving device UPS, 2 - Seed sorting machine (ChSA), 3 - Mechanical seed cleaner (MChT), 4 - Grate-free linter (1LB), 5 - Cyclone, 6-Seed peeling equipment (OS), 7 - Seed cleaner, 8 - Seed length separator, 9 - Elevator, 10 - Storage hopper of peeled seeds (BNOS), 11 - Seed treating device, 12 - Suction and filtering system of harmful emissions, 13 - Weighing and packing apparatus, 14 - Bag stitching machine.

Fig.2. State-of-the-art process technique for conditioning of peeled sowing cotton seeds

As in the previous case, delinted seeds are unloaded into the seed receiving device UPS, from which they are fed to theseed sorting ChSA evenly and proportionally.

The cleaned and sorted seeds are distributed by conveying devices to the grate-free linters 1LB, where 5-6% of the lint is removed. After processing by those device, seeds with 3-4% fuzziness by means of collecting transporter, elevator and distribution transporter are fed to the seed peeling machines OS where they are peeled to a required state. Peeled seeds are transported to the seed sizing and sorting equipment (for example, I-JS-4, Yubus, Spain), in which they are exposed to 4-fold cleaning and sorting process (by air flow, twice on sieves

Yubus, Spain) are packed in paper bags and the necks of the bags are sewn up with a bag stitching machine. DelintersUChDMare used in single-stage peeling process instead of seed peeling devices 1LB and OS-01. The remaining process operations are identical with double-stage peeling process.

Conclusion. Process regulations PDI 22-2010 had been developed on the basis of studies of the state-of-the-art process technique, which can be used for the conditioning of sowing cotton seeds at the cotton ginning enterprises, as well as in designing of appropriate process techniques and equipment by employees of design, engineering and research organizations.

References:

1. Process regulations for processing of the raw cotton seeds and conditioning of cotton seeds. (PDKI 44-2002), Tashkent, 2002, p. 35.
2. Cotton cleaning handbook, «Voris-nashriyot», Tashkent-2008., p. 410.
3. O'zDSt 663:2017 "Sowing cotton seeds. Specifications", Agency for standardization, metrology and certification of Uzbekistan, Tashkent, 2017, p. 11.
4. V.G.Rakipov, R.K. Dzhamolov, R. R. Nazirov. "The search for new technology of delinting of cotton seed", research report, 0712, Paxtasanoatilmiymarkazi, Tashkent, 2008 - 35 p.
5. R.K.Djamolov «Two-stage delintering in one machine» digests of scientific and technical achievements in the realm of cotton industry of the Republic of Uzbekistan. 76th Plenary Meeting of the International Cotton Advisory Committee (ICAC) "Cotton in the era of globalization and technological progress" XIII International Uzbek cotton and textile fair, "PAKHTASANOAT ILMIY MARKAZI", TASHKENT-2017.
6. R.K. Dzhamolov. "Finding a new scheme for setting cotton seed seeds" Problems of mechanics, 3-4 / 2014 y.- 163 with

REGENERATION OF WASTE TRANSFORMER OIL

D.T. Yusupov - Scientific and Technical Centre of JSC Uzbekenergo
A.S. Berdyshev - Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

In process of long exploitation of power oil transformers are exposed influence number of factors which are bring to their destruction and failure. One of such main factors influencing for working of this electric equipment is a deterioration electro physical properties of transformer oil. Transformer oil, being used for isolation and cooling, also defines quality of working of oil transformers. As, 85% of breakages of oil transformers happen because of damage of isolation. In this regard more actual task is timely purification and regeneration of oil of power transformers with their long exploitations.

Key words: the regeneration, transformer oil, electrophysical properties of oil, purity class, mechanical pollution, ceramic membrane, silica gel, adsorbent, extent of purification of oil, mobile installation.

Introduction

In exploitation transformer oil contains the water which is contented in the process of aging of oil and cellulose isolation and also the water getting to oil from environment. The insignificant amount of water can have considerable influence to features of exploitation of the transformer. For example, if contents of water in transformer oil are exceeded by 50 ppm, then there can be a breakdown that leads to a transformer exit out of operation [1-2]. The carried-out analysis [3-5] shows that the content of water in transformer oil is the main reason for various type of damage of power transformers.

Depending on content of moisture in transformer oil water can be in three states: free, emulsified and connected.

Free water has the large form, doesn't mix up with transformer oil and easily separates from his structure.

The emulsified water consists of small drops of liquid. Droplets of this water can be besieged or under the influence of electric field to be built in chains and to form the carrying-out bridges [4-8] and as a result of, this type of water, can influence to the puncture voltage of transformer oil. The puncture voltage of oil is the indicator characterizing ability of liquid dielectric to maintain the impressed voltage without breakdown. The carried-out researches [5] claim that increase the emulsified water in content of transformer oil suddenly goes down of puncture voltage as it is given in figure 1. Under the influence of electric field of a drop of the emulsified water in oil are involved to places where voltage of electric field is higher and where begins emergence of breakdown [6-10].

The connected water has very small form, the chemical composition of this water is strong connected with a chemical composition of transformer oil and, it is almost impossible to be exempted from her. She also contains in fresh oil. On the other side, the connected water doesn't render an essential harmful influence on electro physical indicators of transformer oil [7-12].

In this regard, the purpose of this work is purification of transformer oil from the emulsified water for increase its puncture voltage.

Experimental

The sample of waste transformer oil with long exploitation is received by authors from the specialized repair enterprise JSC "Energotamir" to carrying out of research works. This received transformer oil has been taken from the power transformer, which is working since 1976 year.

Various methods are applied to carrying out regeneration of the waste transformer oil from water. On the basis of the carried-out analysis [18-20] authors

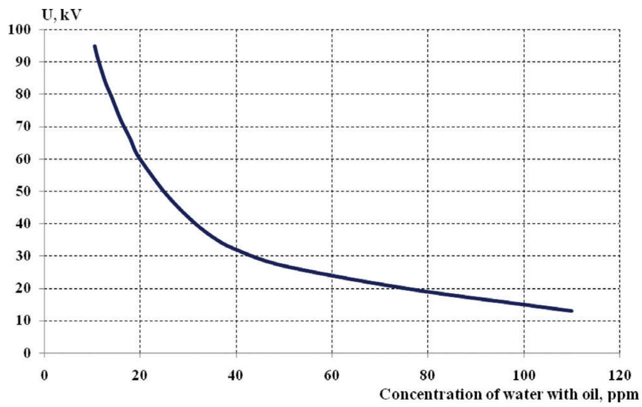


Fig.1. Influence of water to the puncture voltage of transformer oil

offer table 1, where are given efficiency of the existing methods of regeneration of the waste oil from water.

Table 1.

Efficiency of the existing methods of regeneration of the waste oil from water

Name of technology of regeneration	Principle of operation	Efficiency of purification		
		from free water	from the emulsified water	from connected water
Upholding	Is based on natural sedimentation of water, being in a suspension, at quiet standing of oil.	Deletes	Doesn`t delete	Doesn`t delete
Centrifugal separation	One of methods of removal of water of oil is carried out by means of centrifuges. The method is based on division of various fractions of non-uniform mixes under the influence of centrifugal force.	Deletes	Deletes	Doesn`t delete
Vacuum	It is based on vacuum processing of oil in a special sealed chamber for the purpose of decrease moisture in content.	Deletes	Deletes	Deletes
Adsorption purification	It is based on water absorption by various adsorbents on an external surface of granules and on an internal surface of the capillaries penetrating granules.	Deletes	Deletes	Deletes partially

The adsorptive way is applied for purification of transformer oil from the emulsified water. As adsorbents have used silica gel and zeolite.

For deleting of mechanical impurity from transformer oil by authors have developed ceramic membranes with an average size of with porosity 1-3 microns.

Regeneration of transformer oil was carried out according to the closed scheme [11]. The scheme of installation for regeneration of transformer oil by adsorbents and a ceramic membrane is shown. The waste transformer oil heated to 70°C moves to the box with adsorbents (silica gel) in which oil is exposed to percolare (course of liquid through porous material) influence and comes to the block of a ceramic membrane. If necessary oil is outgased by pumping out and goes to the second cycle of cleaning – to the box with adsorbents. Repeated circulation of oil allows to achieving the necessary level of cleaning.

Optimum results have been received when total time of contact of adsorbents with oil made not less than 4 hours. The purified sample oils at a temperature 50-70 °C have been passed through porosity silica gel for deleting of products of aging of transformer oil. After adsorbent oil was filtered through ceramic membranes.

The analysis of the regenerated transformer oil has shown its high dielectric properties, however availability of residual water hasn't allowed to reach the required level of electric durability of sample oil – 51 kV (norm - 60 kV). Availability of residual water found as a result of researches on the laser analyzer (firm "Malvern Ltd.") distributions of particles by the sizes. A part of water in oil is in the connected form (on the left), a part in emulsified form (on the right).

For the purpose of the residual, that is emulsified water and increase the puncture voltage of transformer oil has been subjected to regeneration by zeolite in combination with silica gel and ceramic membranes.

The analysis of the regenerated oil has also shown high dielectric properties (tgδ=0,20 at 90°C, at norm - 1,7%), the electric durability of a sample – 60 kV (at norm of 60 kV), the content of organic acids – 0,018 milligram hydroxide potassium/gram in oil (at norm – 0,02 milligram hydroxide potassium/gram).

The analysis of samples of transformer oil purified through silica gel, ceramic membrane and zeolite, on the laser diffraction analyzer of particles has shown that there is no emulsified water in submicron area.

Results and Discussion

Electro physical parameters of transformer oil before and after purification are shown in table 2.

Table 1.

Efficiency of the existing methods of regeneration of the waste oil from water

N	Electro physical properties of oil	Before purification	After purification (silica gel + ceramic membrane)	After purification (silica gel + ceramic membrane + zeolite)
1.	Electric durability (puncture voltage)	22,8 kV	51 kV (Norm 60 kV)	60 kV (Norm 60 kV)
2.	Water content	Be present	Be present	Be absent
3.	Mechanical impurity	Be present	Be absent	Be absent
4.	Content of the weighed coal	Be present	Be absent	Be absent
5.	Colour	Brown	Yellov	Yellow
6.	the content of organic acids (milligram hydroxide potassium in 1 gram oil)	0,030 (Norm 0,020)	0,019 (Norm 0,020)	0,018 (Norm 0,020)
7.	Outbreak temperature	147°C (Norm 135°C)	151°C (Norm 135°C)	151°C (Norm 135°C)
8.	Dielectric losses Tangent of angle δ at 20°C	2,05%	0,05%	0,05%
	Tangent of angle δ at 70°C	6,86%	0,14%	0,14%
	Tangent of angle δ at 90°C	13,0% (Norm 1,7%)	0,30% (Norm 1,7%)	0,20% (Norm 1,7%)

Laboratory researches on the adsorptive purification of oil with use ceramic membranes have shown high dielectric properties of the purified oil. Apparently from the table 2 oil quite conforms to requirements of normative document RH 34-301-633:2011.

In figure 2 it is given spectral dependences of coefficients of a transmission of transformer oil before and after purification. It is visible from graphics that regeneration has led to essential clarification of transformer oil.

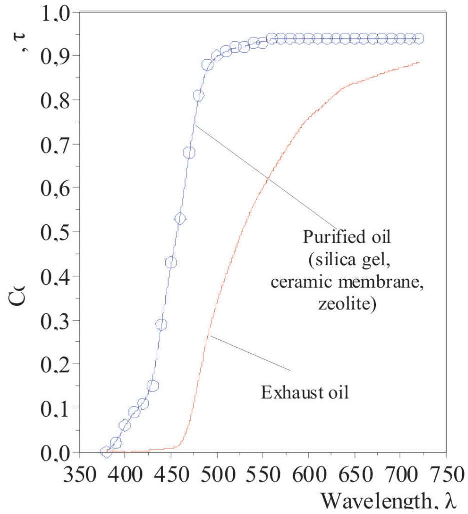
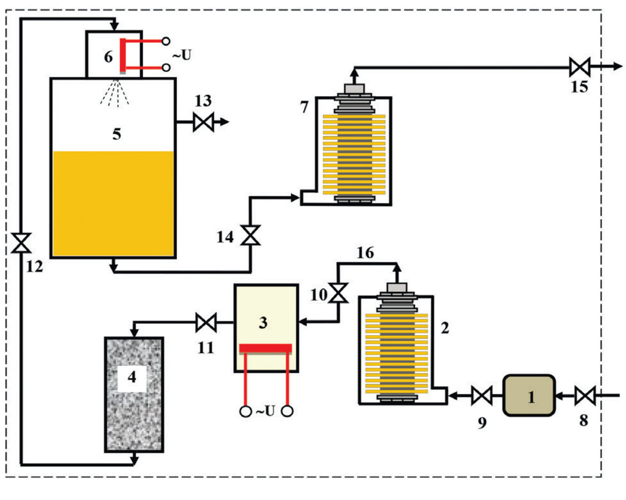


Fig.2. Spectral coefficients of transmission transformer oil before and after purification in comparison

Working capacity of the adsorptive method allows to offer mobile installation for cleaning of the power transformer. In this case the tank of the power transformer joins in the technological scheme and there is a purification of oil in the mode of circulating pumping. This mode allows to use the adsorptive method for washing the isolation and tank. It can be carried out by mobile installation. Considering high cost of zeolite and inability of carrying out full purification of transformer oil of the connected water (table 1), instead of him the vacuum dehumidifier is offered.



1 – circulating oil pump; 2 – the ceramic filter for rough cleaning; 3 – oil electric heater; 4 – adsorbent (silica gel); 5 – vacuum dehumidifier; 6 – oil electric heater; 7 – ceramic thin filter; 8, 9, 10, 11, 12, 13, 14 – locking valves; 16 – connecting pipeline

Fig.3. Schematic diagram of mobile installation

The schematic diagram of mobile installation is given in figure 3 [14]. The waste transformer oil is pumped over by a circulating oil pump (1) from the power transformer and transferred to the preliminary ceramic filter (2) where oil is purified of mechanical pollution. Further oil gets to the electric heater (3) where heats up until temperature of 70°C. Heated oil moves to the box with adsorbent (silica gel) (4) in which oil is exposed to percolare influence and it is cleared of various chemicals. Then oil is passed in to vacuum dehumidifier (5) where after heating to temperature of 60°C by means of the electric heater (6), water is deleted by a spraying method in vacuum. Further oil arrives in the second ceramic filter (7) for thin cleaning of mechanical impurity. Then the purified oil moves in a broad tank of the power transformer. Repeated circulation of oil allow to achieve the necessary level of purification.

Conclusions

Thus, the emulsified water is the most dangerous to life cycle of the power transformer as reduce of puncture voltage of transformer oil. Besides, the emulsified water also under the influence of electric field can be built in chains and form the carrying-out bridges. Using of the adsorptive method with a combination of ceramic membranes for purification of the waste transformer oil from the emulsified water is the most effective, from the economic point of view. Carrying out timely regeneration of the waste transformer oil will allow to increase energy efficiency and reliability of working of the power oil transformer with long exploitation.

References:

1. Pankaj Shukla, Y.R. Sood, R.K. Jarial. Experimental Evaluation of Water Content In Transformer Oil // International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 1, January 2013. Pages 284-291.
2. T. Toudja, A. Nacer, H. Moulai, I. Khelfane, A. Debche. Physico-chemical properties of transformer mineral oils submitted to moisture and electrical discharges// International Conference on Renewable Energies and Power Quality. Santiago de Compostela (Spain), 28 th to 30 th March, 2012. http://www.icrepq.com/icrepq'12/538-toudja.pdf
3. Instruction document RH 34-301-633:2011.
4. Yusupov D.T. Circulating way of cleaning of cellulose isolation of power oil transformers// European Applied Science, #12, 2015, pages 53-56.
5. Krins V., Borsi H., Gockerbach E. Comparison between the breakdown and flashover strength of ester liguid and transformer oil / International conference on electrical insulation. S. - P., 2005 - P. 126 - 127.
6. Bristol E.M. Electrical Insulation treated in oil oil - 2002 - Vol. 6. - P. 475-478.
7. Prevost T.A., Oommen T.V. “Cellulose insulation in oil-filled power transformers: Part I.History and development”, IEEE Electrical Insulation Magazine. Vol. 22. No.1. P. 28-35.
8. Blalock T.J. “A variety of frequencies transformer testing at the Pittsfield plant”, IEEE Power and Energy Magazine. Vol 8. No.4. 2010. P. 75-84.
9. Krause C., “Power transformer insulation – history, technology and design”, IEEE Trans. On Dielectrics and Electrical Insulation, Vol. 19. No.6. 2012. P. 141-147.
10. Kim S.H. “Characteristic tests of a 1 MVA single phase HTS transformer with concentrically arranged windings”, IEEE Trans. On Applied Superconductivity. Vol.15. No.2. 2005. P. 214-217.
11. Lapthorn A.C. “An experimental high temperature superconducting transformer: Design, construction and testing”, Proc. Elec. Eng. Assoc. New Zealand Ann. Conf., Christ Church, New Zealand, 2010, P. 21-29.
12. Lapthorn A.C. “HTS transformer: Construction details, test results, and noted failure mechanisms”, IEEE Trans. On ower Delivery, Vol.26. No.1. 2011. P. 394-399.
13. Bodger P.S. “A low voltage, mains frequency, partial core, hight temperature, superconducting transformer”, Proc. Australasian Univ. Power Eng. Conf., Hobart, Australia, 2005. P.35-45
14. Jin J. “Development of HTS transformers”, Proc. IEEE Int. Conf. Ind. Technol., Chengdu, China. 2008. P. 11-16.
15. Lapthorn A.P. “A 15 kVA high-temperature superconducting partial-core transformer-Part Transformer modeling”, IEEE Trans. On Power Delivery, Vol. 28. No.1. 2013.P. 245-252.
16. Eteiba M.B., “Heat conduction problems in SF6 gas cooled-insulated power transformers solved by the finite-element method”, IEEE Trans. On Power Delivery, Vol.23. No.3. 2008.P. 457-463.
17. Sharifian B.B. “Derating of a distribution transformer for non-linear loads”, Eur. Trans. Elect. Power, Vol. 16. No.2. 2006.P.189-203.
18. Ghofrani M.M. “Mixed derating of distribution transformers under unbalanced supply voltage and nonlinear load conditions using TSFEM”, IEEE Trans. On Power Delivery, Vol.25. No.2. 2010. P.780-789.
19. Edstrom F.A. “Modeling impact of cold load pickup on transformer aging using Ornstein-Uhlenbeck process’, IEEE trans. On Power Delivery, Vol. 27. No.2. 2012. P.590-596.
20. Hilber P.P. “Influence of ambient temperature on transformer overloading during cold load pickup”, IEEE Trans. On Power Delivery, Vol.25. No.1. 2013. P.153-161.
21. ZhanW.H. “Development of a low-cost self-diagnostic module for oil-immersed forced-air cooling transformers”, IEEE Trans. On Power Delivery, Vol. 30, No.1. 2015. P.129-137.

EVALUATION OF THE TECHNICAL - ECONOMIC EFFECTIVENESS OF ELECTRIC PULSE PROCESSING TECHNOLOGY FOR NEUROTOXICOSIS

S.R. Umarov - Dr.Prof., E.O. Bozorov - researcher, A.Sh. Durmanov - researcher
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

This article outlines the parameters of the source of electric power supply for the tomato, cucumber and fruit crops grown under the conditions of the Republic of Uzbekistan, and an electromagnetic pulse treatment device for nematode diseases which damages crop fields. The technical-economic effectiveness of the electromagnetic pulse treatment device for nematode disease was evaluated.

Key words: electric impulse, mobile device, tomato, cucumber, fruit seedlings, nematode disease, electrical energy, processing, technical cost accounting, technical economic indicators.

Introduction

There is an obvious need for an integrated approach to assessing the prospects for the development of an enterprise that is financially indebted. It is not so much the amount of current debt that is important for assessing an enterprise's ability to emerge from a crisis.

With accompanying this process liquidity ratio, solvency, profitability and other indicators adopted in the current arbitration practice, how much the enterprise's potential to retain existing or gain new positions in the commodity market and services.

Vegetable farming plays an important socio-economic role in society, since vegetables are an indispensable food product directly related to maintaining the health, efficiency and life expectancy of the population.

"However, the value of vegetables and fruits, melons and gourds is not limited only by their nutritional properties. Their therapeutic role as the richest source of natural antioxidants (enzymes, beta-carotene, alpha-tocopherol, ascorbic acid, flavonoids, coumarins) and other biologically active substances that are absent in others products. Natural antioxidants neutralize free radicals, carcinogenic substances, heavy metals and radionuclides in the human body, contribute to their removal from the body, its healing, and increase the life expectancy of people. Therefore, there is a significant increase in the production of vegetables and their products in the form of juices, canned goods, fresh frozen vegetables all over the world " [1].

The theoretical, methodological and practical issues of enhancing innovation in Uzbekistan are not sufficiently developed. The problem of organizing innovative production under the influence of abnormal and emergency situations and ensuring the country's food security is investigated. All this confirms the relevance of the research topic [13, 14].

Methods

The theoretical and methodological basis of the study was the works of foreign and domestic scientists in the field of methodology for managing the innovative development of enterprises, forecasting trends in the scientific and technological progress of the economy and innovation activity. The studies were performed using economic-mathematical methods, modern theories, methods of system and comparative analysis, mathematical modeling, theory of probability, etc.

Literature review

A number of economists of our republic and other foreign countries have conducted scientific research on such problems as increasing the efficiency of the vegetable growing industry, increasing the efficiency of the activities of market entities operating in this sector, developing market relations in the industry, modernizing the activities of farms specialized in vegetable growing, implementing advanced methods and innovations in economic activities, improving the processing and marketing of vegetable products, attracting investments in the production and processing system, encouraging exports and increasing their efficiency, having a theoretical and practical value. Theoretical and practical aspects of the problem are studied by such foreign researchers as V.K. Bolshevorskaya, V.P. Vasilenko, V.V. Gorky, V.A. Dobrynin, A.P. Kozlova, V.V. Kuznetsov, M.M. Kulik, M.M. Lomach, V.I. Nazarenko, K.K. Ryabushkina, K.K. Chalbayev.

In our country, significant research results have been achieved on this issue by a number of such domestic scientists and agricultural economists as F.K. Kayumov, R.Kh. Husanov, K.A. Choriev, T.X. Farmonov, S.S. Gulyamov, N.S. Khushmatov, R.D. Dusmuratov, F.Kh. Nazarova, F.T.Egamberdiev, K.A. Kabanova, O.T. Jumaev, O.G. Dilmurodov, D.D. Gafurova, I.I.Hecker, S. Mazurin, A.D. Mamatov, D.G. Umarov, Z.A. Sagdillayeva.

Most of these studies were carried out before independence, that is, in accordance with the requirements of the command-administrative economy, and works carried out on the basis of laws and requirements of a market economy, problems of increasing the efficiency of the vegetable industry have been studied as one of the areas of scientific research or means to achieve the goal of the study. In a market economy and modernization of the economy, it is advisable to continue research work in this area, since the vegetable industry, in particular the issue of improving the effectiveness of greenhouse vegetable farming has not been studied as a separate research subject.

Results.

Due to evaluate the test and efficiency of the high voltage electro pulse device, research works were conducted on the greenhouse in the Yunusabad district of Tashkent and the "Limonchilik" greenhouses in the Kibray district of Tashkent and the Gulistan chocolate plant in Kagan district of Bukhara region, as well as fruit crops in the Jarkurgan district of Surkhandarya region and vegetable crops in Oltinsay district. Biologists and agronomists are involved in the nematode-affected areas of enterprises and determining the degree of morbidity.

To this end, a high-voltage pulsed device (SOPM) was developed to treat infected plants in the field and consisted of the following electrical equipment.

Flammable lubricants can be connected to an external power source by connecting them to the bolts fitted to the AO-10-kr base insulators resistant to high voltage. However, it is desirable to connect the device with an AP - 50 machine in order to prevent and immediately eliminate emergency situations. Therefore, the device is connected to the automatic circuit-breaker in the greenhouse electric shock, which is the source of power supply through a cable with KRPT 4x2.5 mm^2 cable, fibrous copper wire mounted on bumps.

We processed cucumber and tomato root stems, which are the source of nematode diseases, with electromagnetic impulse ranges of 25 centimeters at 3 cm high electrode. Processing parameters were evaluated by biologist and specialist on agrotechnics. The results have confirmed the parameters that were determined during the laboratory research. That is, the optimal voltage level for the cucumber is U=2500 V; for tomato U=3000 V, the processing interval to the plant stem of the treatment electrode, depending on the processing speed of the processing staff is 0.2 second, and the average energy consumed for every herbaceous plant, in cucumber is 0.004 J and 0.0045 J. in tomatoes [1, 2].

According to the results of agrotechnical researches, the land (greenhouse) areas of electromagnetic fields were reduced by 65-68% relative to the land parcels controlling variants of nematode diseases and larvae (untreated). Before sowing crops for the second vegetative period, research results revealed that the quantity of nematode gypsums in content of soil consisted of 15% [1, 2].

Economic effectiveness of the electro-impulse device against nematode diseases, vertebral pelvis (egg), egg, larvaes, and rootstocks of weeds in cucumber and tomato plants. Annual economic efficiency of plants with electro-impulse plugs is estimated by the current method [3, 4, 5].

The costs of existing technology, available to treat with chemical, biological and other methods for eliminating nematode disease have been compared.

In existing technology, the affected soil or plant (crop area) is treated. That is, tomatoes and cucumbers are grown in nematode illicit greenhouses before planting and harvesting. The proposed and proposed methodologies of the proposed methodologies are presented in the preceding chapters, including the technical data of the methodology (regulatory, electrical, technical data, etc.)

The cost of tomatoes and cucumbers in the greenhouse in the Muhammad Mironshoh farm of Oltinsay district of Surkhandarya Province was also analyzed (see Table 1).

Table 1

Economic indicators of the "Muhammad Mironshah" greenhouse

№	Name of indicators	Unit	Size of indicators	
1	Crop area	ha	2	1
2	Yield	c / ha	684,3	342,3
3	Gross product	tons	64,2	34,2
4	Gross Income	thousand sums	106704,0	53352,0
5	Total Cost	thousand sums	74253,0	37126,5
	Including:			
5.1	Employment fees	thousand sums	6000,0	3000,0
5.2	Social Insurance	thousand sums	2040,0	1020,0
5.3	Depreciation deductions	thousand sums	2134,0	1067,0
5.4	Fuel	thousand sums	2640,0	1320,0
5.5	Chemical fertilizer	thousand sums	8512,0	4256,0
5.6	Land tax	thousand sums	2240,0	1120,0
5.7	Electricity	thousand sums	2286,0	1143,0
5.8	Gas	thousand sums	39600,4	19800,2
5.9	Other costs	thousand sums	8800,6	4400,3
6.	Profit	thousand sums	32451,0	16225,5
7.	Profitability rate, %	%	43,7	43,7

Source: compiled by the authors

After using the proposed method, the yield increased by 8 c/ha (centners /hectare) and, as a result, the economic effect is as shown in Table 1 below (see Table 2).

Table 2

The effectiveness of the "Muhammad Mironshah" greenhouse and the proposed method (indicators per hectare)

№	Economic Indicators	Unit	Farm's Indicators	Suggested Method
1.	Yield	c / ha	342,3	350,0
2.	Gross Product	tons	34,2	35,0
3.	Gross Income	thousand sums	53352,0	54600,0
4.	Total Cost	thousand sums	37126,5	37124,5
	Including			
4.1	Hardware value	thousand sums	-	2247,0
4.2	Employment fees	thousand sums	3000,0	1400,0
4.3	Social Insurance	thousand sums	1020,0	476,0
4.4	Depreciation deductions	thousand sums	1067,0	2730,0
4.5	Fuel	thousand sums	1320,0	1320,0
4.6	Chemical fertilizer	thousand sums	4256,0	-
4.7	Land tax	thousand sums	1120,0	1120,0
4.8	Electricity	thousand sums	1143,0	2743,2
4.9	Gas	thousand sums	19800,2	19800,2
4.10	Other costs	thousand sums	4400,3	5288,1
5	Number of employees	The man	5	2
6.	Profit	thousand sums	16225,5	17475,5
7.	Profitability rate, %	%	43,7	47,1

It is economically feasible to use the technology of processing electro-impulse pile discharge technology (1250.0 thousand soums) compared with the existing technology of vegetable, tomato and cucumber vegetation, which is contaminated with nematode disease.

For increasing the productivity of damaged tomatoes and cucumber plants, it is important moment when electro-impulse processes with regard to the infected plants, as a result, the yield increases and it is defined as following:

$$С_й = С_и + С_к$$

In this case, $С_й$ – annual economic efficiency, UZS

$C_и$ – initial product value, UZM

$C_к$ – value added, UZS

$$C_к = D - X_к$$

In this case, D – additional income, soums

$X_к$ – costs incurred

$$D = T \cdot T_x$$

In this case, T – Average price of 1 centner, c/ha (the price of 1 kg tomatoes) 1 kg - 1560 soums

T_x – added crop, c/ha

T_x = 8 c/ha

Annual economic efficiency of electric pulse processing technology.

$$C_й = \frac{К}{Ф} = 1{,}8$$

In this case, К - capital expenditure, UZS

Ф - profit, UZS

The findings of the research show that the calculation of the economic efficiency of the processing technology using electromagnetic pulse has no impact on social efficiency, chemical contamination and growth cycles [9,10,11,12].

When we compare the actual situation with the proposed method, in 2017 the selling price of 1 kg tomatoes was 1560,000 soums, and the production cost was 37124,500 soums. The capital expenditure has increased to 8 c/ha due to use of new equipment, and the cost of its implementation recorded to 2247,000 soums. The amount of reimbursement of the spent funds is about 1.8 years, and in the next few years its effectiveness will increase.

Conclusion. One of the ways to strengthen the solvency and profitability of greenhouses is to improve the management of implementation of vegetables based on a marketing approach. Effective management of the production and sale of greenhouse vegetables in the unstable conditions of the agricultural market implies the organization of agricultural enterprises specialized marketing services involved in the production, as well as the organization and improvement of sales of vegetables. Properly chosen marketing approach allows you to provide: improving product competitiveness, increasing market share, choosing the most efficient distribution channels, increasing profit margins and profitability, and generally improving the company's financial position.

References:

1. Litvinov S.S. Russian vegetable and its scientific support (state, priorities, prospects). - m. : VNIIO, 2003, 35 p.
2. Toshpulatov N.T., Bozorov E.O. and others. AS The method of electric pulse treatment of plants. The decision to grant a patent for an invention. Application IAP 2003 0429 04/02/2003
3. Muxammadiev A., Bozorov E.O. Parameters of electro impulse processing for destruction of illnesses nematode. European Science Review. № 1 – 2, 2018 January – February. ISSN 2310 – 5577, Premier Publishing. Vienna – 2018. 213 – 216 p.
4. Abduganiev A., Abduganiev A.A. Agricultural Economics. Publishing House of the Union of Writers of Uzbekistan. Tashkent, 2004 304 b.
5. Murtazaev O., Axrorov G.V. Agricultural Economics. Tashkent-Science Intelligence-2017. 204-288 b.
6. Avarskiy, N.D. Role of wholesale market in ensuring russian food safety under conditions of innovative economy / N.D. Avarskiy, M.Y. Veselovsky, S.U. Nuraliev, A.V. Fedotov, I.S. Sandu// Journal of Applied Economic Sciences. – 2015. – T. 10. – № 3. – C. 417-425.
7. 195. Online monitoring of Russia's economic outlook Zubarevich N., Kaukin A., Mamedov A., Pavlov P., Uzun V., Khromov M., Shagaida N.I. Trends and challenges of socio-economic development № 3(21) February 2016 / Moscow, 2016. № 3(21).
8. 196. The Eurasian wheat belt and food security: global and regional aspects. Keyzer M.A., Merbis M.D., Halsema A.M., Heyets V., Chaian P., Goez y Paloma S., Mary S., Langrell S., Lerman Z., Sedik D., Meyers W., Shagaida N., Uzun V.Ya., Saraykin V., Yanbykh R., Pugachov V., Schroeder K., Petrick M., Oshakbaev D., Wandel Ju. et al. IPTS JRC, Seville, European Union. Berlin, 2017.
9. Umarov, S. R. (2017). Innovative development and main directions of water management. Economy and Innovative Technologies, (1). Available at: https://goo.gl/eEHSJK. (in Uzbek).
10. Umarov, S. (2018). Scientific-theoretical basis of innovative development water resources of Uzbekistan. Bulletin of Science and Practice, 4(12), 409-415. (in Russian).
11. Umarov, S. & Durmanov, A., (2018). Economic-mathematical modeling of optimization production of agricultural production. Asia Pacific Journal of Research in Business Management, 9(6), 10-21.
12. Durmanov, A. (2018). Cooperation as a basis for increasing the economic efficiency in protected cultivation of vegetables. Bulletin of Science and Practice, 4(8), 113-122.
13. Durmanov, A. Sh., & Khidirova, M. H. (2017). Measures to increase the volume of exports of fruit and vegetable products. Economics, (9), 30-34 p. (in Russian).
14. Durmanov, A. Sh. (2018). Foreign experience the organizational-economic mechanisms of improving the activities of greenhouse farms. Economics and Finance (7), 20-28 p.
15. Chandler A. D. Jr. Strategy and Structure: Chapters in the History of the Industrial Enteфrise. Cambridge, Mass.: MIT Press, 2002.
16. Hylleberg S. Seasonality in Regression. London: Academic Press, 2006.-214 p.
17. Norton D., Kap/an R. The Balanced Scorecard: translating strategy into action. Harvard Business Press, 2006.
18. Turkey: Tomatoes and products, semiannual report 2005, Ankara, Turkey.

THE IMPACT OF DEVELOPMENT IN AGRICULTURAL LABOR MARKET ON POPULATION EMPLOYMENT

A.M. Maksumhanova - PhD in Economics
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

This article examines the socio-economic nature of the labor and employment market, the current state of labor and employment in rural areas, identifies the impact of various forms of agricultural management on employment, develops the development of the labor market and employment, and develops employment recommendations. Promotion of small and private entrepreneurship in rural areas and potential ways of employing the population, ensuring the rural labor market and population to improve the system of state regulation of scientific and practical recommendations.

Key words: labor market, urban population, rural population, economically active, population, employment, economic reform, product.

Introduction. The economic reforms implemented in the country are aimed at liberalizing the labor force at the expense of unemployment and employment of the working population and providing social protection through increasing the material interests of the population, effectively using the productive potential, and increasing labor productivity.

There was said in the petition of our president: "During the year, the issue of creating new jobs, which are of great importance to us, was at the center of our attention. In 2017, over 336,000 new jobs were created thanks to the construction of new industrial enterprises, the commissioning of facilities, the development of small business and private entrepreneurship[1].

It is clear that, while maintaining employment of the population, we must pay special attention not only to quantity, but also to quality.

Methods and materials. The strategy of actions in the five priority areas of development of Uzbekistan for 2017-2021, including the State Program "Year of Support for Innovative Entrepreneurship, Innovative Ideas and Technologies", is a key task of economic activity[2]. Therefore, the preparation of competitive personnel in the labor market is extremely important. In this regard, the main task of our country is "the creation of new jobs and the provision of employment for graduates of the population, first of all, secondary specialized and higher educational institutions, ensuring the balance of the labor market and infrastructure, as well as reducing unemployment. Employment in our country has always been one of the most acute socio-economic problems. President Sh. M. Mirziyoev noted that "only 248 thousand people were employed in the employment service centers, or 16.5% of the previous year. The main reasons for this are outdated forms and methods of doing business and formalities in solving employment problems" [3]. The standard of living of the Uzbek people is largely dependent on the development of rural infrastructure and raising the standard of living of the rural population. As a result, raising the economic and social infrastructure in rural areas to a qualitative level does not have a positive effect on the development of the country. In our republic every year, the majority of the country's labor resources in rural areas have difficulty finding work. The main reason for this is the quantitative and qualitative disparity between the demand and supply of labor in rural areas. In addition, due to ongoing reforms in the agricultural sector, an overabundance of other labor and optimization of land for farmers has led to further employment problems in rural areas. Therefore, the development of scientific market proposals and recommendations for the development of the labor market in rural areas and employment is one of the most important and urgent problems of our time.

Over the years of independence, Uzbekistan has achieved stable economic growth, stabilized macroeconomic and financial stability, increased the balance between the economy and certain sectors; market mechanism components were created, and its infrastructure was developed and developed[4].

President of the Republic of Uzbekistan Shavkat Mirziyoyev delivered a speech at an event dedicated to the 26th anniversary of the Constitution of the Republic of Uzbekistan.he said : "It is necessary to take immediate measures to ensure employment and reduce unemployment. The question arises: how many are unemployed in our country? What percentage of the population is employed in the informal economy? Are you looking for a job abroad? We have to understand one thing: one unemployed means ten problems. If we consider that these problems are harmful for the unemployed, for family and society, for society, it will be clear how serious the problem is. "

The process of renewal and democratization of society, modernization and reform of the country is closely related to the development and prosperity of our villages. As it is known, reforms in the agrarian sector have led to radical changes in economic management, along with the establishment of corporate properties for a market economy. As a result, the formation of these relations has led to the need to transfer excess labor in a number of sectors of the economy, especially in agriculture, to other sectors of the economy. In the conditions of Uzbekistan, the population and labor resources are one of the most important factors for sustainable economic growth. The population of our country at the beginning of 2018 was 32.6 million people .The population in the country is mainly due to natural growth in the high birth rate. At the same time, the demographic situation in the country has improved significantly as a result of the decline in mortality. This leads to an increase in the rural population and excessive labor [7].

According to the statistics of 2017, the rural population was 15 869.7 thousand people. The urban population was 49.4%. This is especially true for the Khorezm region (67.8%), Surkhandarya region (64.4), Samarkand (62.4) and Bukhara (60.5) regions (Table 1).

Chart 1 shows the dynamics of the resident population in Turkey. As this can be seen from this chart, the population tends to increase from year to year.

In figure 2 above, the permanent population of the Republic of Uzbekistan in urban and rural areas is reflected in years. The diagram shows that in recent years the rural population has decreased, and the number of urban residents has increased.

Turkey is one of the countries with large and young labor potential. The new employment model provides for the rapid

Table 1

About the permanent population of the Republic of Uzbekistan INFORMATION (thousand people)

№	the Republic of Uzbekistan	2017 year			
		total	*of which:* urban population	rural population	Rural population (the share of total population) %
	the Republic of Uzbekistan	**32656,5**	**16532,7**	**16124,0**	**49,4**
1.	Republic of Karakalpakstan	1842,3	905,5	936,8	50,8
2.	Andijan region	3011,7	1576,0	1435,7	47,7
3.	Bukhara region	1870,2	698,6	1171,6	62,6
4.	Jizzakh region	1325,0	622,2	702,8	53,0
5.	Kashkadarya region	3148,4	1357,5	1790,9	56,9
6.	Navoi Province	958,0	467,6	490,4	51,2
7.	Namangan region	2699,6	1743,7	955,9	35,4
8.	Samarkand region	3720,1	1390,8	2329,3	62,6
9.	Surkhandarya region	2514,2	893,3	1620,9	64,5
10.	Sirdaryo region	815,9	350,0	465,9	57,1
11.	Tashkent region	2861,2	1411,5	1449,7	50,7
12.	Fergana region	3620,2	2049,9	1570,3	43,4
13.	Khorezm region	1805,0	601,2	1203,8	66,7
14.	Tashkent city	2464,9	2464,9	-	

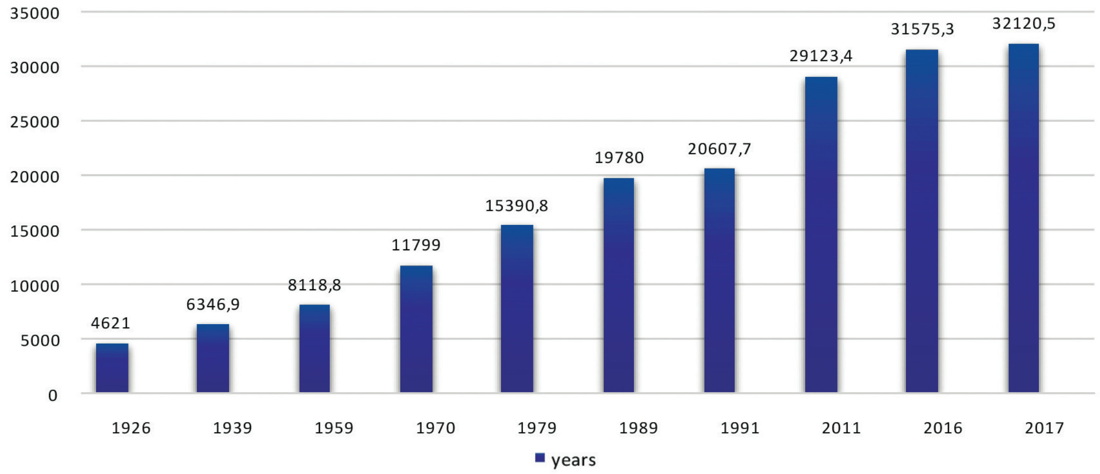


Fig.1. Number of permanent residents in the Respubic of Uzbekistan (thousand people)

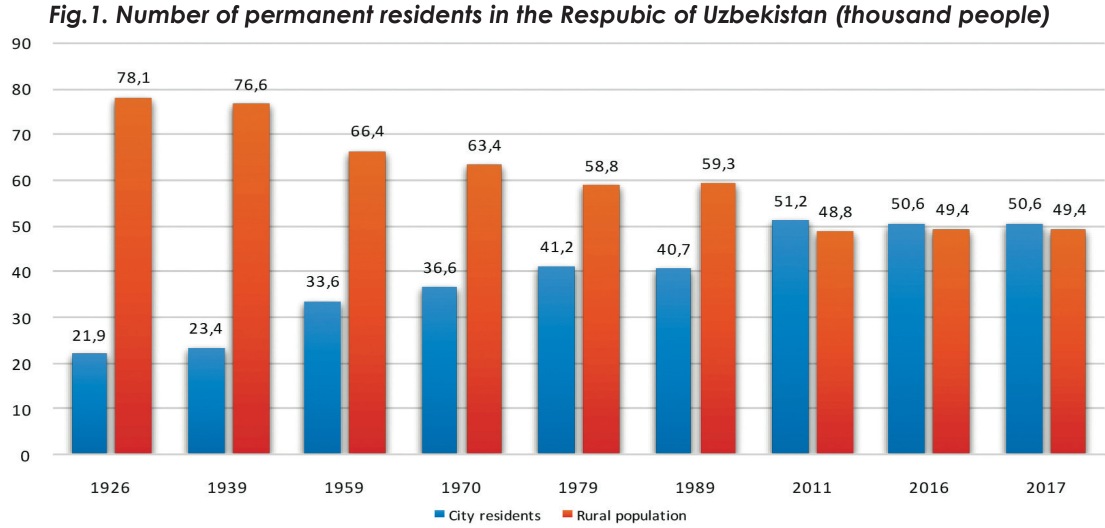


Fig.2. Distribution of Permanent Population of Republic of Uzbekistan by Regions (%)

growth of jobs, improvement of the socio-economic development of the republic, demographic improvement and improvement of the living conditions of the population. The share of the population in the total population growth is constantly increasing. This is due to the development of the economy, entrepreneurship and business development. Today, the growth of employment potential creates a number of problems with employment. The shortage of jobs is growing not only in cities, but also in rural areas. This has a negative effect on employment and the distribution of labor. The average annual growth of the rural population in the republic in 2010–2017 was 26%. Proper and complete accounting of labor resources in a market economy is one of the most important factors in the study, assessment, rationalization and increase the efficiency of agricultural enterprises [6].

According to the State Statistics Committee of Uzbekistan, the number of labor resources in the country in January-December 2017 amounted to 18,672.5 thousand people or 57.7% of the total population.

The personnel structure of the economically active population is 14357.3 thousand people (out of the total labor resource 76.9%), as well as the number of the economically inactive population - 4315.2 thousand people (23.1%). The total number of economically active population was 44.3% of the population. Labor resources, and the average annual number of economically active population and economy figures by region, depending on the result of the comparison, the analysis of the role of labor relations will help to determine (Table 2). According to the table, the Samarkand region (1672.1 thousand people), the Fergana region (1667.2 thousand people) and the Tashkent region (1478.0 thousand people) took the third place. The distribution of labor resources in relation to the total population by region is also significantly different. In general, the share of labor in the total population of the country is 54.6%, in the Fergana region - 53.7%, in the Andijan region - 54.4% and in the city of Tashkent - 63.6% [7].

Results. The results of reforms in the country for the development of small business and private entrepreneurship are reflected in the employment indicators. In the Republic of Uzbekistan in 2017, the labor force amounted to 18,672.5 thousand people and increased by 183,600 people, or 1.0%, compared to 2016. In 2017, the share of small business and private entrepreneurship in the total number of employed was 78.3%. The share of people employed in the public sector in the total number of people employed in the country was 17.3%, and in the non-state sector 82.7%. In the structure of the labor force, the economically active population was 14,357.3 thousand people (76.9% of the total labor force), and the economically active population was 4,315.2 thousand people (23.1%). The number of people employed in the republic was 13,520.3 thousand. People and increased by 1.7% compared with the corresponding period of 2016. A forecast of the parameters of the state program called "Job creation and the role of employment in the country" which is in the field of total and the regional employment needs for work, especially for young people entering the labor market for the first time, whose production requires many structural changes in the modernization of the economy and labor as well industry, agriculture and other sectors of the economy, services, private business and entrepreneurship. The resulting transfer is determined based on the demand for labor. The number of people employed in the country increased by 1.7% compared with the corresponding period of 2016. The share of small business and private entrepreneurship in the total number of employed was 78.3%. In 2017, the number of people employed in transport and storage is 2.6% with high growth rates in 2016, 2.4% in finance and insurance, 2.1% in construction and 1.9% in trade. The main share of people employed in agriculture, forestry and fisheries

Table 2

Labor and employment in the country (2017)

Regions	Total population (thousands)	labor resources	The share of labor resources in the total population %	Economically active population	The share of the economically active population in relation to the labor force %	Employment in the economy	The share of employed people in the economy of labor force %
The Republic of Uzbekistan	**32656,5**	18666,3	57,2	**14357,3**	76,9	**13520,3**	72,4
Republic of Karakalpakstan	1842,3	1054,6	57,2	688,8	65,3	647,2	61,4
Andijan	3011,7	1722,2	57,2	1404,1	81,5	1319,2	76,6
Bukhara	1870,2	1073,1	57,4	874,6	81,5	826,5	77,0
Jizzak	1325,0	756,2	57,1	492,6	65,1	468,2	61,9
Kashkadarya	3148,4	1784,6	55,5	1296,6	72,6	1218	68,2
Navoiy	958,0	547,2	57,1	445,7	81,4	422,4	77,2
Namangan	2699,6	1549,5	57,4	1099	70,9	1034,9	66, 8
Samarkand	3720,1	2079,6	55,9	1629,8	78,4	1523,1	73,2
Surkhandarya	2514,2	1423,9	56,6	1062,7	74,6	991,7	69,6
Sirdaryo	815,9	475,2	58,2	371,9	78,3	353,1	74,3
Tashkent	2861,2	1623,9	56,8	1360,9	83,8	1289,6	79,4
Fergana	3620,2	2031,1	56,1	1630,5	80,3	1525,7	75,1
Khorezm	1805,0	1000,6	55,4	773,3	77,3	729,3	72,9
Tashkent city	2464,9	1544,6	62,7	1226,8	79,4	1171,4	75,8

(27.3%), industry (13.5%), trade (11.0%), construction (9.5%) and education (8.2%) of the sectors accounted for . The share of economically active population in the total population was 44.3%.

The most economically active population in the regions was observed in the Fergana (1,630.5 thousand) and Samarkand (1629.8 thousand) Provinces. According to preliminary data, the number of people employed in the economy in 2017 amounted to 13,520.3 thousand

(with an increase by 1.7% compared with 2016) .

The lowest economically active population was in Syrdarya (371.9 thousand) and Navoi (445.7 thousand) provinces.

If we analyze the dynamics of the number of economically active population, employed and unemployed, in recent years the level of economic activity of the population has increased from 71.3% to 73.5%. The unemployment rate increased from 5.1% in 2014 to 5.8% in 2017 [5].

Conclusion. In our opinion, it is necessary to take measures in the following areas of development of the labor market in the country, taking into account the diversity of labor resources in the country:

- implementation of the competences and competitive capacity of local staff and the formation of a new economic ideological and ideological thinking;
- promote the role of the regional distribution of proposals to improve the efficiency of the regional economies;
- Improving the quality of the workforce, encouraging the hiring of personnel at the expense of budget funds, the development of relevant subsectors of the non-agricultural sector, which requires little money in rural areas;
- Strengthening links between vocational colleges and local enterprises and organizations in the training of qualified personnel.
- Providing existing workplaces through the development of cities and infrastructure development and the development of infrastructure enterprises, such as light industry, cultural and service providers, research and production centers, taking into account the natural and economic opportunities of urban and urban areas;
- Development of various centers of agricultural productivity in areas remote from urban and regional centers, the creation of new jobs based on industrial processing of agricultural products;
- The all-round development of cotton, grain and fruit and vegetable clusters should be supported by the state and thus create new jobs.

References:

1. Sh.M.Mirziyoyev Addresses to the Parliament. -T.: Uzbekistan. 2017 y.
2. Uzbekistan's Development Strategy for 2017-2021 has been adopted following public consultation. 2017. President of Uzbekistan Sh. Mirziyoyev Signed a degree "On Uzbekistan's " Development Strategy.
3. Main results of social-economic development of the country in 2016th and priority directions of economic programs, considered on 2017th.On the considered assembly of Cabinet of Ministers. "National Word", 2017.
4. Abdurahmonov Q.H. Labor economics. Textbook. – T., 2013. – 763 p.
5. A.M. Maksumhanova/ The ways of employment through development of labor market in rural areas./ Monograph /– T.: TIIAME, 2019. –143 p.
6. www.gov.uz.- Government site of Uzbekistan Republic
7. Uzbekistan State Committee on Statistics. http:// www.stat.uz

ESTIMATION LAND SURFACE TEMPERATURE MAPSIN ARCGIS MODEL BUILDER USING LANDSAT 8 SATELLITE DATA:CASE STUDY ORTA CHIRCHIK DISTRICT, TASHKENT REGION, UZBEKISTAN

F. Abdullaev - UCAS,Xinjian Institute of Ecology and Geography
R. Ermanov - Junior Researcher, Irrigation and Water Problems Scientific Research Institute, Uzbekistan
S.Gaffarov - Irrigation Engineer, Irrigation and Water Problems Scientific Research Institute, Uzbekistan

Abstract

Land Surface Temperature (LST) one of important component Climate Change, Hydrology, Agricultural, Land Use Land Cover Change studies. Data used calculation LST maps Landsat 8 data. Red (R), band 4, Near Infrared (NIR) (both R and NIR optical bands 30 m spatial resolution), band 5and Thermal Infrared (TIRS),band 10 (100 m spatial resolution) used for input data. We chose Single Channel Method (SCM) for build Landsat 8 LST model. Estimation LST maps current study chosen Orta Chirchik District of Tashkent Region. Because this District neighborhoods with the capital Tashkent city, which is urban area clearly and we can easily identify remaining land cover patterns. LST Model created on ArcGIS Model Builder follow which are given Methods in chapter 2. Validation of results used Moderate Resolution Imaging Spectroradiometer (MODIS)day time data (MYD11A1), which is 1 km spatial resolution. Through MODIS data checked accuracy of Model Estimated LST maps.

Key words: SCM, LST, ArcGIS Model Builder, Landsat 8 data, Optical bands, TIRS band, validation, MODIS data.

INTRODUCTION

At Remote Sensing field LST described as a digital representation skin temperature of the ground. LST is one of the important factorsin Earth Observation studies such as hydrological, environmental, land use land cover change, climate change and agricultural studies. There some methods which are determined by some scientists. Some of these methods are Split-Window Algorithm (SWA) [1, 2, 3, 4 and 5], Single Channel Method (SCM) [6, 7, 8] and Radiative Transfer Equation Based Method (RTEBM) [9, 10, 11].

Based on Single Channel Method we developed a model in ArcGIS software Model Maker tool. On any program derivation, LST map takes more time for time series analysis. ArcGIS Model can help take more results reduce process time and will be done automatically with the developed model. LST estimation map we can develop Model on any software like ERDAS IMAGINE, ENVI or QGIS. Most researchers use ArcGIS software, so it will be easier for most part of users.

We will determine LST map and Model using Landsat 8 data. The model developed using three bands: B4 (Red-0.64–0.67 micrometres) and B5 (Near Infrared-0.85–0.88 micrometres) for developing NDVI map and B10 (Thermal Infra Red-10.60–11.19 micrometres) for derivation Land Surface Emissivity (LSE) and LST map.

DATA AND METHODS

The model created in ArcGIS software only can use estimation LST by process Landsat 8 30 m spatial resolution data. Because model included Landsat 8 sensor characteristics: rescale factor, reflectance and so on. LST Estimation methodology given below in Figure 1, which we had processed and checked results and developed with the help of Model Maker Tool ArcGIS software.

Landsat 8 satellite image free available on Earth Explorer website (https://earthexplorer.usgs.gov/). In this case develop ArcGIS model we used 2015 Landsat 8 data 154th path, 31st row – Uzbekistan, Tashkent Region. The metadata used of the satellite images in this algorithm is presented in Table 1. Study area given in Fig.2.

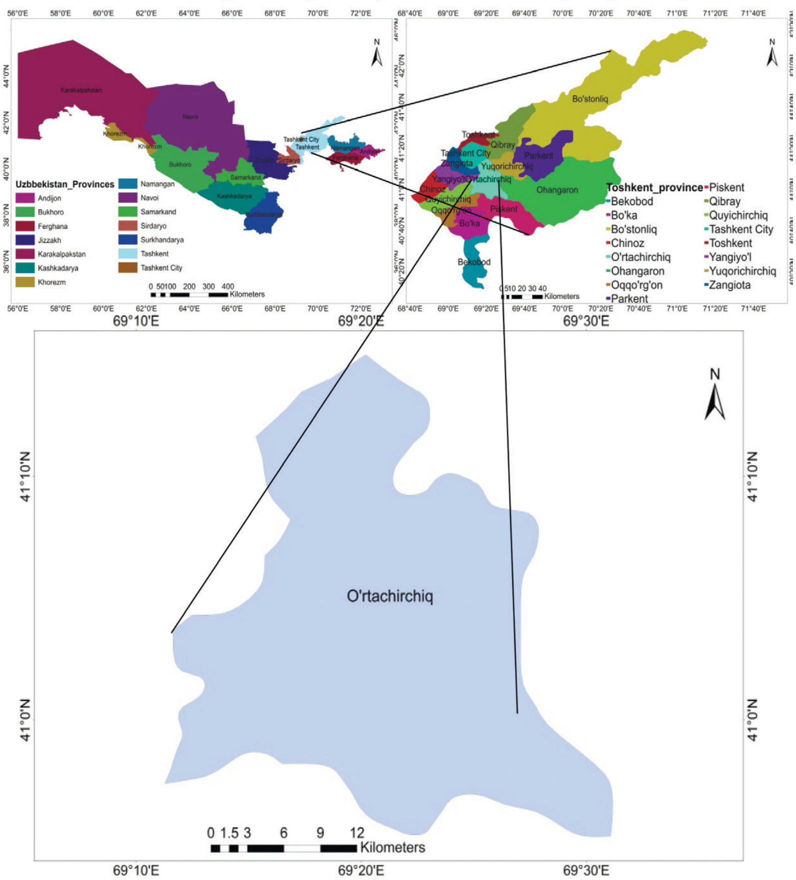


Fig.1. Location of Study area – Orta Chirchik District, Tashkent Region

DN to Radiance. The first part of the model determines the Band 10. After put input band 10 used formula taken from the USGS web page for retrieving the top of atmospheric (TOA) spectral radiance (Lλ):

$$L\lambda = M_L * Q_{cal} + A_L \quad (1)$$

Where M_L represents the band-specific multiplicative rescaling factor, Q_{cal} is the Band 10 image, A_L is the band-specific additive rescaling factor.

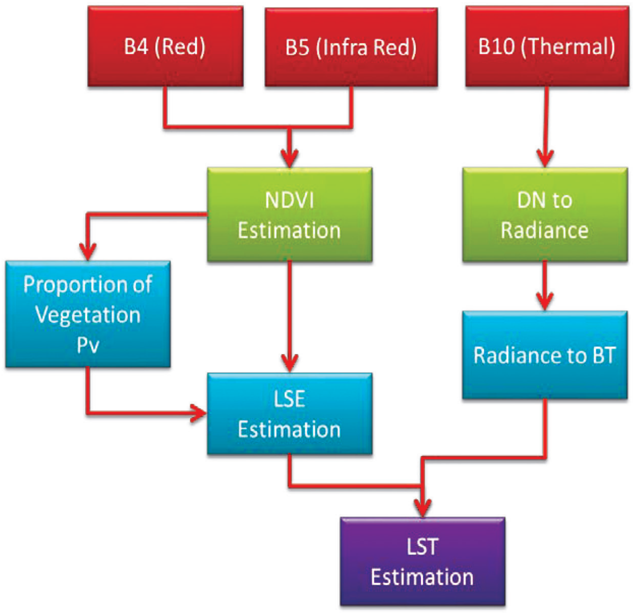


Fig.2. LST Estimation flow chart

Table 1

Landsat 8 metadata

Thermal constant, Band 10	
K_1	1321.0789
K_2	774.8853
Rescaling factor, Band 10	
M_L	$3.342x10^{-4}$
A_L	0.1

Convert Radiance to Brightness Temperature. After describingdigital numbers (DNs) to radiance, the TIRS band converted from spectral radiance to brightness temperature (BT) using the thermal constantstakenfrom the metadata file. With the following equation given belowweused algorithm to convert reflectance to BT [16]:

$$BT = \frac{K_1}{\ln\left[\left(\frac{k_1}{L\lambda}\right)+1\right]} - 273.15 \quad (2)$$

Where K_1 and K_2 stand for the band-specific thermal conversion constants from the metadata.

For obtaining the results in Celsius, the radiant temperature is revised by adding the absolute zero (approx. −273.15°C).

NDVI based Emissivity Calculation

NDVI Calculation. Landsat 8 satellite image Red and Near Infrared bands we used for calculate the Normal Difference Vegetation Index (NDVI). NDVI is shown vegetation health condition for the satellite passed time over that area. The calculation of the NDVI is important because, after this, the vegetation proportion (P_v) will be calculated, and they are highly related with the NDVI, and Pv should be calculated, which is related to the emissivity (ε):

$$NDVI = \frac{p5 - p4}{p5 + p4} \quad (3)$$

Where p5 and p4 represents reflectance ofband 5 and band 4.

Calculationof the Vegetation Proportion. P_V is calculated following to (4). The method for calculating P_v suggests using the NDVI values for [12, 13, 14 and 15]:

$$P_v = \left[\frac{NDVI - NDVI_s}{NDVI_v - NDVI_s}\right]^2 \quad (4)$$

Where the NDVIS is minimum and NDVIV is maximum NDVI representation values.

Calculating Land Surface Emissivity. The land surface emissivity (LSE) must be known in order to estimate LST, since the LSE is a proportionality factor that scales blackbody radiance (Planck's law) to predict emitted radiance, and it is the efficiency of transmitting thermal energy across the surface into the atmosphere. The determination of the ground emissivity is calculated conditionally as suggested in:

$$\varepsilon_\lambda = 0.004 * P_v + 0.986 \quad (5)$$

The last step of retrieving the LST or the emissivity corrected land surface temperature T_S is computed as follows [17]:

$$T_s = \frac{BT}{\left\{1 + \left[\left(\frac{\lambda BT}{p}\right) * \ln(\varepsilon_\lambda)\right]\right\}} \quad (6)$$

Where T_S is the LST in Celsius (°C, (2)), BT is at-sensor Brightness Temperaturein Celsius (°C), λ is the wavelength of emitted radiance (for which the peak response and the average of the limiting wavelength (λ =10.895) [15] will be used), ε_λ is the emissivity calculated in (5), and

$$\rho = h\frac{c}{\sigma} = 1.438x10^{-2} mK \quad (7)$$

Where σ is the Boltzmann constant (1.38×10^{-23} J/K), h is Planck's constant (6.626×10^{-34} Js), and c is the velocity of light (2.998×10^8 m/s).

LST RESULTS AND VALIDATION

LST Estimation Results. Landsat 8 images for July 30 and September 16 for 2015 downloaded and processed in ArcGIS software. In Model maker Tool developed different products models and finally they are combined into the single flowchart. Therefore, after completed flowchart we run Model given below in Fig.3.

Results LST maps for 30/07 and 16/09 given in Fig.5. LST validation estimated by the MODIS (MYD11A1) data, which is NASA Land Data Products and Services provide by AQUA and TERRA daily LST Product. Validate Landsat LST map used AQUA 1 km spatial resolution daytime LST Product. First MYD11A1 data downloaded from http://earthexplorer.usgs.gov/, after that converted through MRT MODIS Tool to TIFF from HDF-EOS format. Daytime 1 km LST images clipped for Orta Chirchik District, rescaled and converted from Kelvin to Celsius.

Validation of LST Results. To compare LST maps results two different satellite images from same dates in Orta Chirchik District Tashkent Region was chosen.

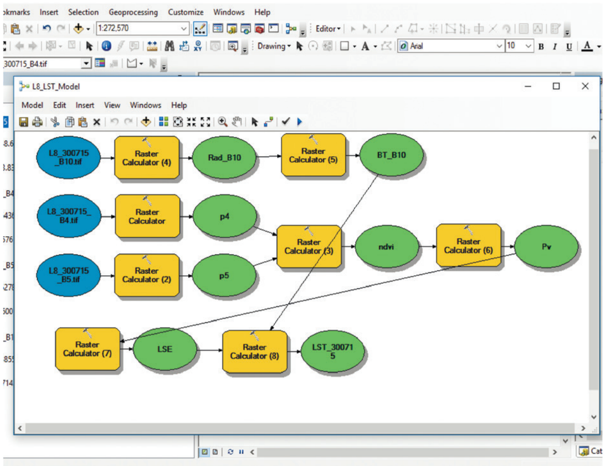


Fig.3. Derived LST Model in ArcGIS

On 30/07/2015 date derived LST by Landsat 8 map shows 23.8 to 48.65°C, which is highest temperature in Uzbekistan. LST map shows lowest temperature for irrigated areas and water body features, highest temperature for bare lands and built up area features, which is close to Tashkent city. On 16/09/2015 date LST map shows 13.7 to 38.8°C (Figure 5), which is summertime is changing to fall.

MODIS LST map for July 30 shows 32.8 to 48.9°C for different features, including croplands, built-up areas, bare lands and water bodies. LST map for September 16 shows 27.7 to 42.1°C (Figure 6).

Validation Landsat 8 LST map we used MODIS LST map with the scatter plot in MS Excel software. At this scatter plot X-axis used for Landsat 8 LST and for Y-axis MODIS LST. Data validation MODIS and Landsat 8 for July 30 scatter plot match 90.57 % and September 16 match 91.5 % given below in Figure.

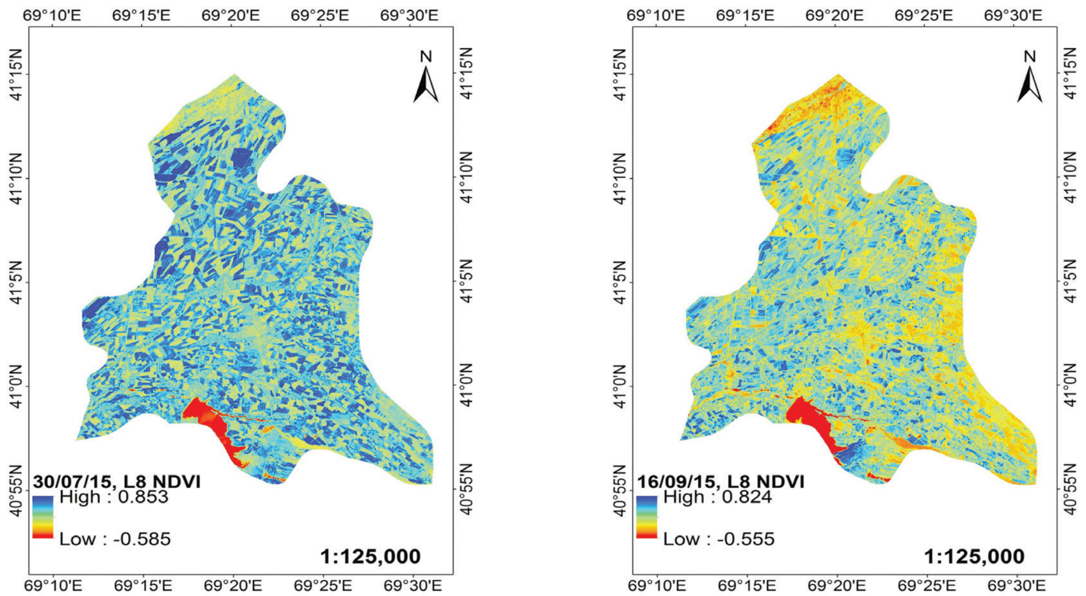


Fig.4. 30 m resolution Landsat 8 derived NDVI maps from July 30 and September 16, 2015

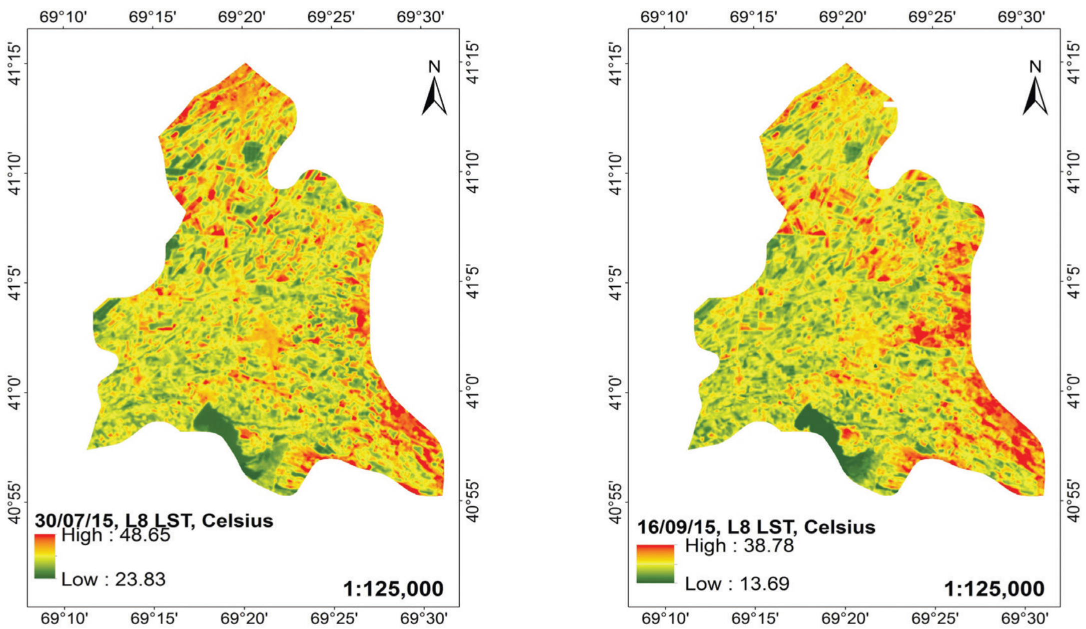


Fig.5. 30 m resolution Landsat 8 derived LST maps from July 30 and September 16, 2015

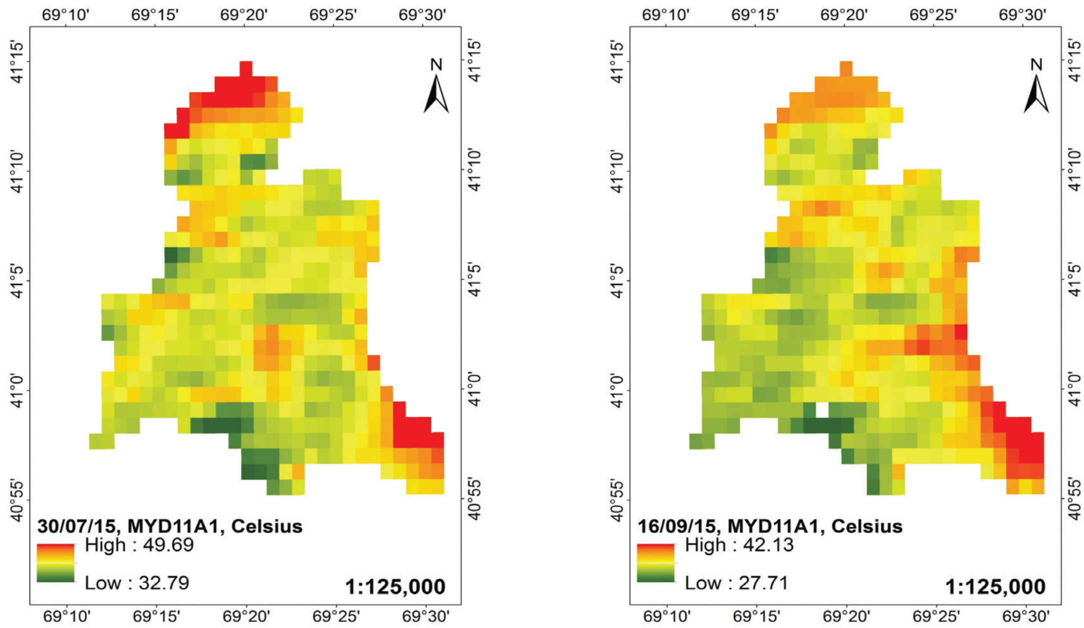


Fig.6. MODIS 1 km resolution LST maps from July 30 and September 16, 2015

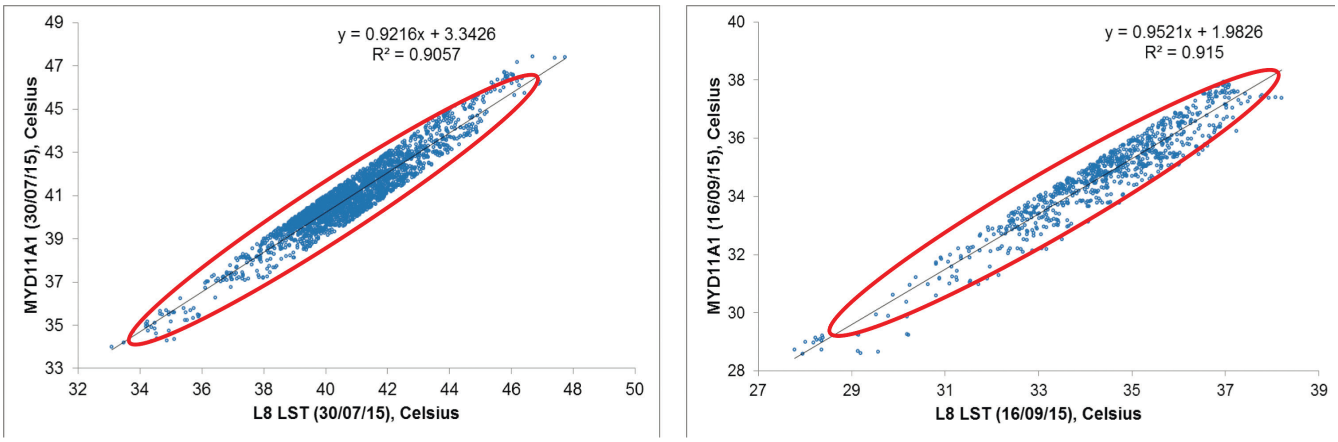


Fig.7. Scatter plot validation of 30 m resolution Landsat 8 LST and MODIS 1 km resolution LST maps from July 30 and September 16, 2015

CONCLUSION

The paper presenting complete Model in ArcGIS model maker for derived Landsat 8 LST map use bands Red, Near Infrared and Thermal. Landsat 8 satellite passes for path 153, row 031 every day on 11:06 local time.Final estimated LST maps give low to a high temperature for a land use first water body, irrigated croplands, agriculture fields and last one is built up areas close to the city.

On NDVI maps showed almost same value results. On June 30 NDVI maps shows irrigated areas. Because in Uzbekistan vegetation period from April to October, which is the pick time growing seasonof agriculture lands. On September 16 irrigation almost finished and agriculture lands shows water scarcity.

Validation of results has done by MODIS LST map. Because site measurement station we did not consider. In scatter plot by the MS Excel on X (Landsat 8 LST) and Y (MODIS LST) axis. For further studies, the tool can be used for LST Estimation. Validation of results can be determined with the MODIS LST, which is not available in-situ measurement data.

ACKNOWLEDGEMENT

Farkhod Abdullaev acknowledges the funding support of the CAS TWAS Presidents Fellowship.

References:

1. F. Becker and Z.-L. Li, "Towards a local split window method over land surfaces," International Journal of Remote Sensing, vol. 11, no. 3, pp. 369–393, 1990.
2. Wan, Z.; Dozier, J. A generalized split-window algorithm for retrieving land-surface temperature from space. IEEE Trans. Geosci. Remote Sens. 1996, 34, 892–905.

3. Rozenstein, O.; Qin, Z.; Derimian, Y.; Karnieli, A. Derivation of land surface temperature for Landsat-8 TIRS using a split window algorithm. Sensors 2014, 14, 5768–5780.
4. Mao K.; Qin, Z.; Shi, J.; Gong, P. The research of split-window algorithm on the MODIS. Geomat. Inf. Sci. Wuhan Univers 2005, 30, 703–707.
5. Qin, Z.; Dall'Olmo, G.; Karnieli, A.; Berliner, P. Derivation of split window algorithm and its sensitivity analysis for retrieving land surfacetemperature from NOAA-advanced very high-resolution radiometer data. J. Geophys. Res.: Atmos. 2001, 106, 22655–22670.
6. Jimenez-Munoz, J.C.; Cristobal, J.; Sobrino, J.A.; Soria, G.; Ninyerola, M.; Pons, X. Revision of the single-channel algorithm for land surface temperature retrieval from Landsat thermal-infrared data. IEEE Trans. Geosci. Remote Sens. 2009, 47, 339–349.
7. Coll, C.; Caselles, V.; Valor, E.; Niclòs, R. Comparison between different sources of atmospheric profiles for land surface temperature retrieval from single channel thermal infrared data. Remote Sens. Environ. 2012, 117, 199–210.
8. Jimenez-Munoz, J.C.; Sobrino, J.A. Error sources on the land surface temperature retrieved from thermal infrared single channel remote sensing data. Int. J. Remote Sens. 2006, 27, 999-1014.
9. Xiaolei, Y., Xulin. G., Zhaocong. W. (2014). Land Surface Temperature Retrieval from Landsat 8 TIRS—Comparison between Radiative Transfer Equation-Based Method, Split Window Algorithm and Single Channel Method, Journal of Remote Sensing, Volume 6 issue 10, 9829-9852.
10. F. Wang, Z. Qin, C. Song, L. Tu, A. Karnieli, and S. Zhao, "An improved mono-window algorithm for land surface temperature retrieval from Landsat 8 thermal infrared sensor data, "Remote Sensing, vol. 7, no. 4, pp. 4268–4289, 2015.
11. P. K. Srivastava, T. J. Majumdar, and A. K. Bhattacharya, "Surface temperature estimation in Singhbhum Shear Zone of India using Landsat-7 ETM+ thermal infrared data," Advances in Space Research, vol. 43, no. 10, pp. 1563–1574, 2009.
12. Tucker, C.J. Red and photographic infrared linear combinations for monitoring vegetation. Remote Sens. Environ., 8, 127–150, 1979
13. Tarnavsky E., Garrigues S., Brown M.E. Multiscale geostatistical analysis of AVHRR, SPOT-VGT, and MODIS global NDVI products. Remote Sens. Environ., 112, 535–549, 2008
14. Li P., Jiang L., Feng Z. Cross-Comparison of Vegetation Indices Derived from Landsat-7 Enhanced Thematic Mapper Plus (ETM+) and Landsat-8 Operational Land Imager (OLI) sensors. Remote Sens., 6, 310–329, 2013.
15. Ke Y., Im J., Lee J., Gong H., Ryu Y. Characteristics of Landsat 8 OLI-derived NDVI by comparison with multiple satellite sensors and in-situ observations. Remote Sens. Environ., 164, 298–313, 2015.
16. USGS, 2013, http://landsat.usgs.gov/Landsat8 UsingProduct.php
17. Li Z.L., Tang B.H., Wu H., Ren H., Yan G., Wan Z., Trigo I.F., Sobrino J.A. Satellite-derived land surface temperature: Current status and perspectives. Remote Sens. Environ. 131, 14-37. 2013.

IMPROVING ORGANIZATIONAL AND ECONOMIC MECHANISMS OF THE GREENHOUSES IN UZBEKISTAN

A. Durmanov - Senior Lecturer
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

The article discusses the improvement of the organizational and economic system of greenhouses of the Republic of Uzbekistan. The priority directions for the development of greenhouses were studied, and measures of the state regulation in this sphere were considered. Currently, greenhouse farms in Uzbekistan actively develop due to state support measures. Export of fruit and vegetables grows, and this has a positive effect on the development of the country's economy as a whole.

Key words: organizational and economic mechanism, greenhouses, hydroponics, export.

Introduction

The population of the planet grows steadily and causes the problem of food security. Demand for food has a positive growth trend, thus evoking the development of agriculture. The branch of agriculture of the Republic of Uzbekistan has prerequisites for rapid growth in the near future. One of the branches of agriculture in Uzbekistan is greenhouse facilities [1, 2, 3].

Greenhouse is a farm for growing plants and mushrooms in protective buildings. For efficient growth, plants need water, sun and heat, so the climatic conditions in Uzbekistan contribute to the development of greenhouses.

The free trade zone of Uzbekistan and Kazakhstan allowed to increase the volume of agricultural products by 17% in 2017, which was a prerequisite for the development of greenhouses in Uzbekistan.

The main directions of development of agriculture in Uzbekistan are:

- development of greenhouses for growing fruits and vegetables;
- construction of new vegetable storehouses;
- construction of enterprises for packaging and processing of fruits and vegetables;
- introduction of new technologies in the country's agriculture.

Due to the key priorities of the development of agriculture in Uzbekistan, many large and small greenhouses have recently appeared in the country. These farms are engaged in the cultivation of vegetables, fruits, flower products, which brings significant profits due to climatic conditions. But it should be noted that there are a number of problems the owners of greenhouses face [4].

Objectives and methods

Theoretical and methodological foundations of forming organizational-economic mechanism of competitiveness management are the object of the research. During the research the following scientific methods have been used: analysis and synthesis (for revealing the problems of forming the mechanism of providing competitiveness), theoretical search and abstract-logical (for the characteristics of the essence of competitiveness components), modeling (for constructing the model of organizational-economic mechanism of competitiveness management).

One of the most urgent issues is the problem of increasing the efficiency of labor. The use of greenhouses heating systems increasingly results in increased resource costs, and consequently in reduced profitability, and this may force the owners to use non-standard, and sometimes illegal methods.

Analysis and Results

In present-day Uzbekistan, only 15 percent of cultivated fruits and vegetables is processed, only 8 percent are exported. These figures do not correspond to the potential of Uzbekistan. There is a need to make farms able to grow fruits and vegetables, provide quality delivery to the population, and further intensify activities on processing and export.

To date, 445,000 hectares of the most fertile land have been transferred to the population as household plots. However, the use of these sites is low. It is necessary to erect compact greenhouses for growing citrus fruits on homestead plots, to arrange harvesting of seedlings of hazel, unabi, etc [7].

Relevant is the problem of improving the state of agricultural machines. Of the 146,295 units of agricultural equipment in Uzbekistan, 38 percent is completely outdated. Areas specializing in the production of fruits and vegetables are provided with machines for processing orchards and vineyards, planting, growing and harvesting vegetables by 34 percent only. This resultsin decreased labor efficiency and yield.

One of the serious problems is the gap between the science, focused on the development of greenhouses, and the needs of the time. In this regard, there is a need for a sharp increase in the role and participation of research institutes under the Ministry of Agriculture and Water Resources in the development of agrarian science and breeding, the development and implementation of advanced agricultural technologies, the development and planting of crop varieties in compliance with the soil and climatic conditions of each region [5, 6].

The currently available material and technical base of the scientific institutions does not allow for modern research. There is a shortage of personnel in the sphere who have deeply mastered latest scientific achievements. In the livestock, poultry and fish farming industries, the need for veterinary specialists is particularly high [6].

It is also necessary to increase the responsibility of managers at all levels, especially of 4 sectors in the regions, for increase of efficiency in agriculture. All managers must demonstrate the initiative, and achieve efficient performance in everything related to agriculture and food security.

Due to certain reasons, small greenhouses, experiencing the difficulties identified, are forced to abandon the winter period of cultivation, and work in autumn and spring. However, growing crops in conventional film greenhouses, even without heating, has many problems [16].

In August 2017, the draft decree of the President of the Republic of Uzbekistan "On measures for the further development and creation of greenhouse complexes using hydroponics technology" came into force. According to this document, modern greenhouse complexes will be created for the rational use of rain-fed (non-irrigated) land in Uzbekistan with implementation of the hydroponics technology and energy-saving technologies.

Alongside the general provisions for approving the parameters of the program for 2017-2021, monitoring its implementation, coordinating the creation of complexes and generating statistics for this sector, the draft resolution gives instructions for developing a targeted program for the construction of future greenhouse complexes, identifying funding sources, initiators and construction timelines. One of the sources of financing of the new program will be special credit lines in the National Bank for Foreign Economic Activity of the Republic of Uzbekistan, Uzpromstroybank JSCB and Asaka-Bank JSCB [7, 8].

An important factor in the success of the program will be the exemption of hydroponic greenhouse complexes established under the program from paying a single land tax for a period of two years, as well as the release of equipment imported for the creation of such complexes and components from customs charges (except for customs duties) for the period up to January 1, 2022.

A separate point of the program is a prescription to introduce educational programs for training personnel for greenhouse facilities in higher and secondary specialized educational institutions, starting in 2018.

The implementation of this project for the introduction and development of hydroponics in Uzbekistan is associated with the further rational use of the rain-fed land, creation of top-notch greenhouse complexes, and the use of energy-saving technologies based on the broad attraction of investments, including foreign ones, and increased production of fresh fruits and vegetables.

The development of greenhouses directly contributes to the increase in domestic production of fruits and vegetables, thereby having an impact on the development of export.

Hydroponics

Hydroponics is a modern way of growing plants without using the soil, during which the plant receives the nutrients from the solution in the right quantities and exact proportions. In this case, the roots of the plant are not in the ground, but in a substrate – a soil substitute.

When the hydroponic substrate method is used, the seeds of the plant are planted in dried coconut stalks, which will be supplied with water and essential nutrients by special equipment. This ensures the strength of a seedling, the even development of the plant and the early ripening of the fruit.

Hydroponics and other energy-saving technologies will be used for the rational use of rain-fed lands. To finance these projects, it is planned to attract foreign investment. Another source of financing in this area will be credit lines opened at the National Bank for Foreign Economic Activity of the Republic of Uzbekistan, Uzpromstroybank JSCB and Asaka Bank JSCB.

As part of the project to create greenhouse complexes using hydroponics technology, negotiations were held between Urgut Agro Vet Service LLC and the Netherlands companyAmmerlaan Construction, during which the construction of a modern greenhouse in the Samarkand region with the use of Dutch technology was discussed. The statement of intent for the construction of a greenhouse farm for growing tomatoes and cucumbers for 2 million euros was signed.

ECO greenhouse block

According to the resolution of the Cabinet of Ministers of Uzbekistan dated October 4, 2018, the financial and economic department of the Presidential Administration of Uzbekistan establishes a greenhouse and cattle-breeding complex in the Tashkent region and improves a hotel in the capital of Uzbekistan.

The document notes that the Agro Service state unitary enterprise reconstructs a greenhouse based on a greenhouse farm in Kibray district, which consists of a glazed block for growing tomatoes and cucumbers (3 hectares), constructs an advanced greenhouse ECO block (1.2 hectares) and a greenhouse for growing flowers (0.5 hectares). Besides, Agro Service establishes an advanced cattle-breeding feeding complex and a dairy farm for growing goats in Tashkent region. The sources of financing for the ECO greenhouse block and the greenhouse for growing flowers are the state budget funds, while the reconstruction of the greenhouse in Kibray district, the new cattle-breeding feeding complex and the dairy farm for growing goats are financed by loans from commercial banks.

It should be noted that these measures already show positive trends: in the period January – June 2018, the physical volume of exports of fruits and vegetables from Uzbekistan amounted to 590.6 thousand tons, which is 74.7% more than the same period last year. Out of the total volume of fruits and vegetables, the number of fruits and berries was 118.5 thousand tons (increased by 21.7% compared to the same period last year), vegetables – 429.2 thousand tons (2.1-fold increase), grapes – 27.8 thousand tons (a decrease of 17.9%), peanuts – 11.9 thousand tons (6-fold increase), fresh melons and watermelons – 3.2 thousand tons (2.3-fold increase). Uzbekistan exporters of fruits and vegetables are shown in the figure below (Figure 1).

Uzbekistan develops new markets and strengthens its presence in traditional ones. Trend.az news agency reports that Uzbekistan plans to arrange direct deliveries of vegetables and fruits to Irkutsk region of Russia.

Currently, cars with vegetables and fruits from Uzbekistan arrive in Novosibirsk, where customs clearance takes place, then they come to the

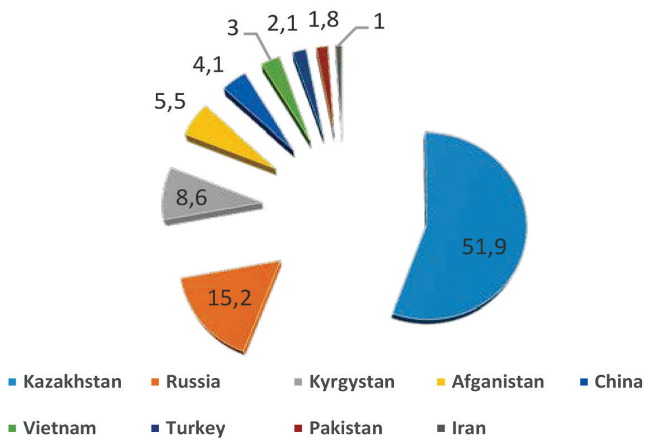


Fig.1. Export share of Uzbekistan in 2018, %

wholesale market, where products are purchased by Irkutsk enterprises. It is assumed that direct contacts with Irkutsk consumers would allow more efficient delivery of fruits and vegetables.

Previously, direct deliveries could not be established due to a weak transport and logistics infrastructure, the lack of terminals for storing perishable goods and a lengthy customs clearance procedure that took up to three days. Now it is reduced to 24 hours, transport and logistics problems have been solved. Customs in Irkutsk is also able to carry out clearance of supplies from Central Asia [18].

To further improve the organizational and economic mechanism the President signed a decree dated October 17, 2018 "On additional measures aimed to increase the efficiency of fruit and vegetable promotion to foreign markets". The document was adopted in order to expand the country's export potential, eliminate barriers to the full development of fruit and vegetable exports, improve state support for export activities, and create a comprehensive system for promoting domestic fruit and vegetable products to foreign markets.

This document simplifies the mechanism of export of fruits and vegetables in the following positions:

- legal entities can now export them without prepayment, opening a letter of credit, issuing a bank guarantee and having a policy for insuring an export contract against political and commercial risks;

- theexnterprises that did not ensure the timely receipt of the proceeds from the export will get into the Register of unfair exporters of fruits and vegetables. They will be subject to the requirement of receiving a 100% prepayment upon export;

- business entities have the right to export fruits and vegetables without a license for wholesale trade. Proceeds from the export of fruits and vegetables of individual entrepreneurs will be charged with a unified tax payment.

- exported fruit and vegetable products are not subject to customs inspection, except in cases of revealing signs of a risk of violation of customs legislation. The exporter is responsible for the accuracy of the information contained in the documents, as well as the illegal movement of goods across the customs border.

-business entities are allowed to construct light structures on the land plots allocated to them for the construction of infrastructure facilities for irrigation, harvesting and storage of fruits and vegetables directly in the places of their production. The specific order will be approved later.

The Ministry of Foreign Trade will coordinate the export of fruits and vegetables, assist exporters in finding markets, and hold monthly meetings with them. Exporters and producers of fruits and vegetables will unite in the Association of Exporters of fruits and vegetables in Uzbekistan. The Chamber of Commerce and Industry, the Ministry of Justice and the business ombudsman will help them in this.

By March 2019, it is planned to launch the Information Portal of exporters of fruits and vegetables on the Internet. It is integrated with the TradeUzbekistan.com electronic trading platform, the state tax and customs information systems. The portal will provide information on producers and exporters of fruits and vegetables, potential importers, etc., as well as track all stages of the export process in real time.

Within the framework of the decree "On additional measures aimed to increase the efficiency of fruit and vegetable promotion to foreign markets," UzStandard agency, together with the Ministry of Foreign Affairs of Uzbekistan, was instructed to establish cooperation with internationally recognized certification organizations for compliance with the requirements of the Global GAP, Halal and Organic standards within three months. UzbekistonTemirYollari JSC and UzbekistonHavoYollari NJSC are instructed to take measures to introduce advanced logistic management mechanisms to promote the export of fruits and vegetables, including:

until January 1, 2019, UzbekistonTemirYollari JSC is tasked:

- to arrange work on the registration of railway documents on the export of fruits and vegetables on the one-window principle at stations of departure;

- to revise tariffs and services when shipping and loading fruit and vegetable products aimed at their simplification, taking into account the specifics of products;

- to develop and introduce a mechanism for transferring information at the request of shippers and cargo owners on the timing of cargo delivery and locations of freight wagons en route;

- to introduce a procedure for allocating wagons for exporters of fruits and vegetables in a period not exceeding three days from the date of receipt of the corresponding application.

It should be noted that there is a new, unconventional, inexpensive and very effective method of growing vegetables, both in closed and open ground, covered with a special grid. This technology is called Nethouse or in the literal translation of 'House of the grid'.

Nethouse greenhouses

Nethouse greenhouses are constructions of protected ground, ideally having a metal rather than a concrete or wooden frame, the details of which are fastened with galvanized steel cables. They are covered with a special synthetic mesh, the density of cells of which is 40-50 threads per inch. The structure of greenhouses provides for maximum sealing and optimally tight connection of the grid with the ground around the perimeter in order to prevent the penetration of the parasites and harmful insects. The service life of such a synthetic phytocell is at least five years [17].

The cultivation of agricultural products in Nethouse is done during the warm period and make is possible to achieve yields that are very close to yields in conventional traditional greenhouses, but at significantly lower costs for their construction and heating.

Replacing a conventional film with a special net will solve a number of important problems and start growing vegetables on a completely different agro-technical level with an unusually high yield [9, 10, 11].

The technology achieved by natural evolution has proven to be very effective and acceptable for use in many countries. Every year nethouses gain increasing popularity among farmers in many countries. For example, Israel grows over half of greenhouse vegetable products in such greenhouses [15].

Unfortunately, this remarkable technology has not yet received proper development in Uzbekistan. Moreover, the main reason for this was not the absence of desire or funds, but the lack of awareness of farmers. Indeed, taking into account the fertility of local soils, climatic conditions and the duration of the summer period, Uzbek farms can expect very high yields. And selling most of them to processing enterprises, it is possible to help implement the state program for the development of the food industry for 2018-2021 [8].

Conclusion. Summing up, it should be noted that the full-scale work aimed to improve the organizational and economic mechanism of greenhouses, caused by the growth of exports of fruits and vegetables, and being the basis for the growth of the economic system is carried out in the Republic of Uzbekistan.

References:

1. Umarov, S. R. (2017). Innovative development and main directions of water management. Economy and Innovative Technologies, (1). Available at: https://goo.gl/eEHSJK. (in Uzbek).
2. Umarov, S. (2018). Scientific-theoretical basis of innovative development water resources of Uzbekistan. Bulletin of Science and Practice, 4(12), 409-415. (inRussian).
3. Umarov, S. &Durmanov, A., (2018). Economic-mathematical modeling of optimization production of agricultural production. Asia Pacific Journal of Researchin Business Management, 9(6), 10-21.
4. Arimov B.A., Lyan E.E., Mavlyanova R.F. The study of tomato rootstocks for protected ground in Uzbekistan // Actual problems of agricultural technologies of the XXI century and the concept of their sustainable development. 2016. Pp. 21-23
5. Asanbekova A.A., DzhumashevaZh.A. Economic justification for the development of greenhouses in Kyrgyzstan // Bulletin of the Kyrgyz-Russian Slavic University Publishing house: Kyrgyz-Russian Slavic University. 2017. No. 11. Pp. 16-19
6. Sulimin V.V. State support in ensuring food security in Russia: economic mechanisms in solving the problems of the greenhouse complex // Bulletin of the Moscow Humanitarian-Economic Institute Publishing house: Moscow Humanitarian-Economic University. 2018. No. 2 Pp. 103-109
7. Durmanov, A. Sh., &Khidirova, M. H. (2017). Measures to increase the volume of exports of fruit and vegetable products. Economics, (9), 30-34 p. (inRussian).
8. Durmanov, A. Sh. (2018). Foreign experience the organizational-economic mechanisms of improving the activities of greenhouse farms. EconomicsandFinance (7), 20-28 p.
9. Chandler A. D. Jr. Strategy and Structure: Chapters in the History of the Industrial Enteprise. Cambridge, Mass.: MIT Press, 2002.
10. Hylleberg S. Seasonality in Regression. London: AcademicPress, 2006.-214 p.
11. Norton D., Kap/an R. The Balanced Scorecard: translating strategy into action. HarvardBusinessPress, 2006.
12. Turkey: Tomatoes and products, semiannual report 2005, Ankara, Turkey.
13. L.V. Balabanova, V.V. KholodMarketing Management of Enterprises' Competitiveness – Strategic Approach Donetsk National University of Economics and Trade, Donetsk (2006), p. 243 (in Russian)
14. D.V. Krisanov, Innovation factor of developing food industry of UkraineEcon. Ukraine, 4 (2007), pp. 71-82 (in Ukrainian)
15. L.I. Mikhailova, T.V. KhvorostThe Formation of Goods' Competitiveness on the Example of the Manufacturers of Milk Processing Industry, the Latest Tendencies and Strategies of the Development of Foreign Trade, Kyiv (2007), Pp. 25-29 (in Ukrainian)
16. The Management of Financial Reorganization, The Center of Educational Literature, Moscow (2008), p. 400 (in Russian)
17. A.A. Sadekov, I. PrudnikovaThe Analysis of Strategic Changes of Enterprise's Activities, Necessary for Effective Implementing the Strategy of Production Diversification, the Strategy of the Enterprise in the Context of Raising its Competitiveness: The Materials of the International Scientific-practical Internet –Conference, 2012, February, 12–15
18. Donetsk National University of Economics and Trade, Donetsk (2012), Pp. 3-5 (in Ukrainian)

CURRICULUM DESIGN UNDER THE HIGHER EDUCATION FOR ECONOMIC DEVELOPMENT PROGRAMME

Ian Crawford - Associate Professor Dr., PhD, School of Management, University of Bath, Bath, UK
Stephen Pavelin - Professor Dr.,PhD, School of Management, University of Bath, Bath, UK
Azamjon Tulaboev - Associate Professor Dr., PhD
Tashkent Insititute of Irrigation and Agricultural Mechanization Engineers (TIIAME)

Abstract

In this paper presented the main aspects of a project devoted to curriculum design under the Higher Education for economic development programs. The project was commissioned by the British Council and addresses a core developmental area of structural improvements in tertiary education in Uzbekistan. The project is developed a series of principles which key the objectives of this project to the imperatives of change initiated by the recent legislation. The initiative is directed at studying and integrating advanced national and international practice and describe all the most important processes of the necessary interaction between education, the employer and the labor market. As the result of the project, there have been recommendations for developing an internationally fit curriculum. The project also involved consultations with academics in 29 Uzbek universities in Tashkent, Samarkand and Bukhara.

Key words: Internationalizing, curriculum development, higher education, economics, Economics curriculum.

INTRODUCTION

This work addresses a core developmental area of structural improvements in tertiary education in Uzbekistan. There has been a growing realization of the need for reform across all aspects of Uzbek tertiary education. The World Bank Report "Uzbekistan: Modernizing Tertiary Education" published in June 2014 identifies as one policy target of thoroughgoing reforms the need to develop curricula and promote student and faculty exchange [1]. The Uzbek government has issued a series of decrees aimed at initiating such reforms. The Presidential Decree on Higher Education of April 2017 [2] and the Presidential Decree on further engagement of industry and spheres of the economy in improving the quality of higher education of July 2017 [3] create a landscape in which change in higher education may be effected. Moreover, the lack of flexibility in curriculum development identified in the World Bank report, the drive to increase enrolment to higher education, and a desire to develop a greater fit between Uzbek tertiary education and international standards and to promote greater engagement between higher education and employers and the needs of the labour market as required by the recent Presidential Decrees provide the backdrop and motivation for this work.

The project locates these changes within the current context of higher education in Uzbekistan and critical changes anticipated to have impacts in the tertiary education sector [7]. The report then identifies the key challenges faced in developing a new curriculum in economics and makes a series of recommendations to curriculum reform in the light of those challenges.

CONTEXT FOR ECONOMICS CURRICULUM DESIGN IN UZBEKISTAN

The academic environment

Curriculum approval process

The current Economics curriculum in Uzbekistan has been developed to satisfy the needs of several core stakeholders; employers (in particular state-owned enterprises), the Ministry of Labour (in terms of provision of graduate numbers to meet employment predictions) and students (in terms of providing them with marketable skills). The drive to satisfy these three constituencies has meant that the tertiary education sector is populated with universities which are industry-specific, aimed at providing graduates to meet the skills and labour needs of particular industries [4]. As a result, the universities have little autonomy in the development of the curricula which they will deliver if they are not designated a base university in a particular discipline.

The approval process for the Economics curriculum (as in the case of all curricula) is a top-down process in which development of the core curriculum which will be taught in all universities offering an Economics degree is vested in the designated base university. However, the number of hours of study and the division of those hours between lecture time, seminar time, practical work and self-study is the product of the decision by central government. The development of the curriculum over which the base university has control is the content which may be taught in the core section of the curriculum provided that it is line with the relevant State Educational Standard (SES) [5]. The aspect of the curriculum over which the delivering universities have control is the content of non-core courses which are relevant to their particular specialist discipline (again with the proviso that it is in line with the pertinent SES).

On successful completion of the 4-year Bachelor degree study, the student is awarded the degree and a state certificate (Bakalavr) which gives them entry to professional employment and isalso the entry qualification for further study of two years for a Master's degree (Magistr). In order to enter a Magistrprogramme a student must have a Bakalavr in the same subject area. The SES specifies that that on successful completion of the Bakalavr a student should be able to work independently in their specialisation at an appropriate level or progress to the Magistr degree. On completion of the Magistr degree (50% of which is spent on research and practical work for a thesis), the student should be able to carry out independent academic research, teaching activity or professional employment in the relevant speciality.

There is a potentially competing dynamic within a curriculum. The objective of an Economics degree is both to make the graduate employment ready and at the same time provide the skills and competencies which would support a largely research-based higher degree. Some 40% of Economics graduates are ultimately employed in SOEs, large corporates and the banking/finance sector. It is feasible that the skills required to work independently in a professional capacity and those required to undertake research activities may in some part be mutually exclusive.

Subject-area knowledge among university teachers

The minimum requirement of a university teacher is possession of a Magistr degree in a relevant discipline. A new university teacher will work for 3-5 years as an "assistant lecturer". In this capacity they cannot deliver lecture material but can only support seminar teaching. After 3-5 years the assistant lecturer may be promoted to lecturer and be able to develop (within boundaries) their own course material. What they teach is a decision made by the relevant department. Assistant lecturers are required to begin PhD study and this runs consecutively with their teaching duties. The topic of the PhD does not necessarily have any bearing on their teaching since the content of the modules they may teach is centrally determined. There is no provision for lecturers to teach specialisms related to their PhD study. In the past few years all lecturers have been actively encouraged to engage in research activity and to publish their work. Again there is no necessary connection between research output and what they teach to students.

Pedagogic skills among university teachers

Lecturers are required to undergo "attestation" every three years. This is carried out at the base university for the subject. The intention of the attestation activity (which lasts 2 months) is to upgrade the subject specific knowledge of the lecturer and to introduce new ICT and pedagogical developments. The attestation takes the form of a series of final exams, thesis and defence. The SES indicate that a wide range of pedagogical techniques may be employed to deliver subject content. However, the mechanism by which content is delivered is ultimately the choice of the lecturer. The SES indicates that lectures should not take up more than 50% of the allocated student hours in any week and resources are likely to constrain the methods available for content delivery. In addition the course content is the product of the base university syllabus as approved by the Ministry of Higher and Specialised Secondary Education (MHSSE). This, in itself, is likely to dictate in large part the means by which content may be delivered.

The current Economics base curriculum and variation across universities

The current Economics curriculum has little flexibility. The base curriculum is constructed of 8 Humanities and socio-economic sciences courses which are compulsory for all degrees and cannot be changed. Apart from these courses common to all degrees, there are 4 Mathematics and 18 Professional courses which are compulsory for all Economics degrees and 5 Additional courses which are compulsory for all Economics degrees but may change from year to year. In addition, there are 11 Specialisation and Selection courses which can be chosen by each delivering university and which are relevant to that university's specific industry. The breakdown in terms of hours is as follows:

Table 1

The allocation of study hours in the current curriculum

	Total	Class time	Self-study
Humanities	968	648	320
Professional & Maths	4,636	2,694	1,942
Additional	450	264	186
Special & Selection	1,128	650	478
TOTAL	7,182	4,256	2,926

Approximately only 20% of the taught curriculum is under the control of a delivering university and the total hours (and percentages of teaching and self-study) are determined centrally. Students have no flexibility to undertake electives, thus with the exception of industry-specific Special and Selection and Additional courses the Economics curriculum is the same for all students in all universities. As such there is no option for specialists to teach their specialisms nor for the curriculum to respond to employment needs except through negotiation and the centrally agreed change of the curriculum. The responsiveness of the curriculum to industry and international economic changes is greatly curtailed.

The business environment

Established links between universities and industries

The current university structure in which individual universities service a particular industry sector lends itself quite readily to establishing and maintaining links with key employers in the particular industry. There is a requirement in all degrees to undertake a period of time within an organization and to produce a report based on that work experience. Universities play an active role in securing placements for their students and this establishes links with key employers. In addition, designatedkey state-owned enterprises are required to formally approve curricula before they can be delivered. This positions major employers as signatories to the taught content of degrees, as providers of practical content and as leading consumers of the end product of the degree courses. Running alongside these formal interventions, employers hold recruitment fairs at universities and in some cases engage in the provision of advice and guidance to students on employment skills and prospects. However, the nature and extent of these additional activities is variable and largely occurs through the efforts of individual university teachers.

Industry demands for economics capability

The Uzbek Centre for Economic Research reports that the national economic goal is for Uzbekistan to join the upper-middle income group of countries by 2030. This objective is predicated on an increase in the industrial and service sectors which will take place in an environment of a rapidly increasing population. A World Bank staff report argues that a key pillar of this vision is increased access to high quality tertiary education to support the structural changes required in the economy and to stimulate entrepreneurial activity. A further World Bank report notes a widening skills gap in the labour market and, furthermore, in January 2018 the government announced plans to increase university admissions by 20% in the next year. In a period of rapid economic change it would seem likely that the call for increased numbers and quality of economics graduates is likely to become more strident in the immediate future.

CHALLENGES

In order to discuss the key challenges addressed in curriculum design, we will draw upon the principles illustrated in the following figure:

These principles fall into two categories [7]. The first set of three – adherence to international standards; business relevance; business engagement – directly including internationally leading universities. This is mainly due to two reasons: first, in each academic discipline, a set of knowledge and skills is commonly understood to be core to an acceptably complete disciplinary training; second, in order to be mobile - across institutions, and internationally - a disciplinary training should be consistent with curricula elsewhere. So, these points are complementary, as the first implies that academic disciplines naturally evolve a commonly understood core curriculum for disciplinary training (e.g. an undergraduate degree curriculum in economics), and the second implies that, if disciplinary training adheres to this core curriculum, those trained will be widely understood to be well-trained (e.g. economics graduates will meet expectations of other universities and other organisations, at home and abroad). If, in contrast, curricula depart significantly from international disciplinary standards, graduates face the risk that their training will fail to meet the requirements for admission to further study and/or the expectations for recruitment to private and public sector organisations.

The imperative for flexibility across institutions

A countervailing effect limits the benefits from

Fig.1. Principles for curriculum design towards the achievement of internationalisation, businessrelevance and engagement

relate to the objectives of this report. The second set of seven principles — the items listed in the second column - relate to key drivers of success in curriculum design. Thus, curriculum design that seeks to build the first set of principles should be informed by an understanding of the roles of the second set of principles in driving change in learning outcomes and the university sector as a whole.

The imperative for consistency across institutions

For each university, there is some dividend from differentiating curricula from those of competitors, because such differences can provide the basis for competitive advantage - a unique selling point, even. However, despite this, there is an overriding tendency for consistency in curriculum design across institutions, consistency in curriculum design. This is because universities differ. Most relevantly, there is variation across universities in: the capabilities of students; the career objectives of students; and the within-discipline specialism of faculty. Thus, there is a dividend from some measure of cross-university flexibility in curriculum, as it enables an efficient fit with such contextual variations. In addition, it is worth noting that one would expect such flexibility to bring an additional benefit from its tendency to encourage faculty to engage with the curriculum design. Faculty that feel utterly constrained by an externally-determined curriculum are likely to feel disenfranchised from pedagogic development and quality assurance processes. Incontrast, faculty that feel empowered to marginally tailor curricula to fit their student cohort and/or their own disciplinary expertise can strive to make significant contributions to the learning experiences and outcomes of students.

Taking this point and the previous point together, there is the greatest benefit from broad consistency in curricula that adheres to established international norms, but with marginal cross-university flexibility that reflects local context yet maintains graduate mobility. It is worth noting that the benefits outlined here expectably accrue to all interested parties — students enjoy improved mobility and prospects of employability; faculty can express their disciplinary expertise and pedagogic approach; universities benefit from efficiencies in curriculum design; and employers' expectations are expectably met with respect to not only core skills (through core consistency) but also particular industrial contexts (through marginal flexibility).

The imperative to facilitate further study

As briefly mentioned previously, there is a link between curriculum design and the ease with which graduates can access further study (e.g. access a Masters degree following an undergraduate degree; access doctoral studies following a Masters degree). In this connection, it is worth noting that this progression implies potential knock-on effects from undergraduate curricula to Masters curricula to doctoral studies and faculty quality. The quality of faculty, with respect to the skills and knowledge associated with disciplinary excellence, is determined by the overall quality of training they have received. The quality of doctoral studies is affected by the knowledge and skills acquired prior to entry onto the doctoral programme. The greater are the knowledge base and skill set, the better able are doctoral students to excel. Similarly, the quality of masters studies is affected by the knowledge and skills acquired as an undergraduate, where the greater are the undergraduate knowledge base and skill set, the better able are masters students to excel. Thus, there is a link from undergraduate curriculum design through to the quality of faculty.

If undergraduate curricula fail to provide an excellent grounding in the discipline, students will be relatively poorly prepared for Masters Studies. To fit with student progression from undergraduate studies, this will likely result in Masters curricula that similarly fail to meet expectations for disciplinary excellence (as Masters curricula must devote space to material that might otherwise have been covered by undergraduates). If Masters curricula fail to provide an excellent grounding in the discipline, students will be relatively poorly prepared for doctoral studies. Again, to fit with student progression from Masters studies, this will likely result in doctoral processes that are less demanding, and fall short of expectations for disciplinary excellence (as, to be functional, doctoral studies must fit with the standard of training held by Masters graduates). The point here is: by meeting standards for disciplinary excellence in undergraduate curricula, one can better build disciplinary strength through further study to research training, and thereby strengthen faculty quality.

The imperative for international mobility

As briefly mentioned previously, there is a link between curriculum design and the international mobility of graduates. In particular, the ease with which graduates can access international study opportunities and international labour markets is expectably improved through the consistency of curricula with international norms. In this connection, it is worth noting that one would expect such international mobility to bring benefits to not only graduates who avail themselves of international opportunities, but also the home economy, government and education system through the repatriation of the knowledge and skills gleaned from international study and work. As graduates study and/or work abroad, they broaden their experience and can acquire distinctive knowledge and skills. Thus, providing there is a reasonable tendency for repatriation, opening opportunities for talented graduates to gain international experience likely brings human capital dividends at home. If, instead, curriculum design acts to minimise international opportunities for graduates, such benefits for economic and institutional development are foregone.

Building relevance to business

Enhancing the relevance of curricula to business brings benefits for firms and students alike. By achieving a fit between curricula and the knowledge and skills that business demands, one not only drives direct dividends to those businesses that are better able to recruit effectively, but also benefits graduates through enhanced employability and prospects for promotion. In this connection, the key demands commonly held by business are competences which notably include: logical thinking; problem solving; time management; information analysis and interpretation; and teamwork [6]. First, let us note that this implies a focus on skills rather than knowledge, including no priority on knowledge of the firm and its business environment. Instead, business demands a mix of skills, some of which are expectably built through the analytical focus of disciplinary training (such as logical thinking, problem solving, and information analysis and interpretation). The other key skills relate more to work practices (such as time management and teamwork), which can be fostered through tailored pedagogical practices (e.g. a portfolio of assessment methods that include a mix of individual and group work, and shorter- and longer-term deadlines).

Building engagement with business

In addition to the business relevance of curricula, there is potential for direct engagement with business to be built into curriculum design. Such engagement can take various forms, which require varied types and degrees of input from business. Three forms of business engagement are most commonly achieved: engagement with curriculum design (wherein business representatives are consulted to directly inform curriculum design); engagement with content delivery (wherein business representatives participate in teaching and/or provide students with within-curricula work placements in business); and engagement with assessment (wherein business representatives participate in the design and/or grading of student assessments). It is worth noting that, far from being mutually exclusive, these different forms of engagement are likely to work synergistically.

For example, business engagement with curriculum design can facilitate opportunities for collaboration between faculty and business in not only the delivery of on-campus teaching but also the integration of work placements into the curriculum. Similarly, such collaborative inputs also facilitate business engagement with assessment of tasks that are somewhat grounded in business decision-making.

It is also worth noting that this point and the previous point are complementary. That is, the business engagement outlined here likely facilitate the business relevance outlined previously. Business representatives' inputs expectably guide curriculum design towards key business demands, which are focused upon graduate skills. For example, one would expect business engagement with content delivery to emphasize problem solving in corporate strategy to ensure that disciplinary training is well-grounded in business decision-making. In a similar vein, one would expect business engagement with assessment to emphasize not only problem solving skills but also the development of those time management and teamwork skills that business prioritise.

Many of the arguments outlined in this section are illustrated in the following figure:

In Figure 2, we illustrate the connections between many of the principles previously listed [7]. Moreover, we do so with reference to a key trade-off implied by our arguments: the trade-off between consistency across institutions and flexibility across institutions. Indeed, our arguments imply an imperative to balance consistency and flexibility, rather than maximise one and minimise the other. This is because both drive benefits for graduates,

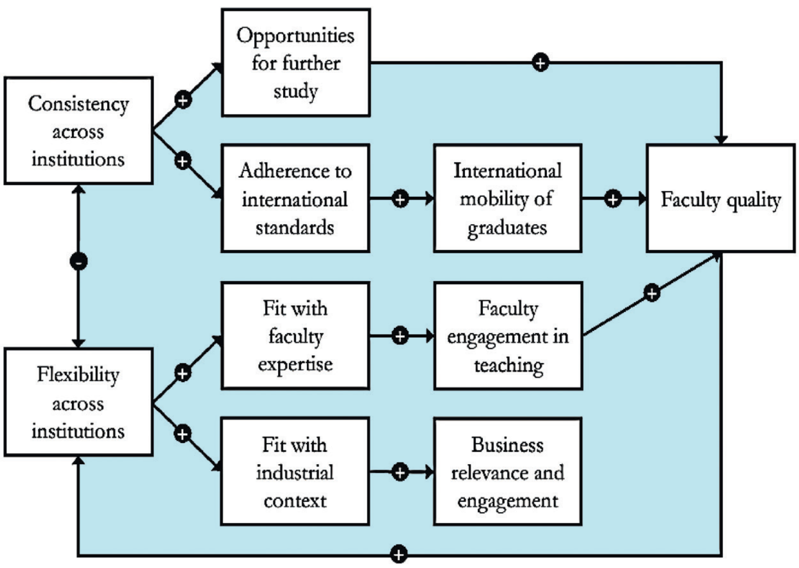


Fig.2. The drivers of internationalisation, business relevance, business engagement and faculty quality

faculty, universities and national development. While consistency drives benefits relating to opportunities for further study, international mobility and faculty quality, flexibility drives benefits relating to faculty engagement, business relevance and engagement and, again, faculty quality. Thus, by unduly prioritising one (consistency or flexibility) over the other, one would forgo the valuable returns of the latter. Consistent with this, our recommendations seek an appropriate balance between consistency and flexibility across institutions.

RECOMMENDATIONS

To promote adherence to international standards in a manner that, in turn, promotes the international mobility of graduates across both further study abroad and the international labour market, there is an imperative to shift the focus of the curriculum from across-subject breadth to within-discipline depth. That is, to ease graduates' access to international opportunities, it is useful to match the depth of disciplinary training that is expected among graduates internationally, which is built through disciplinary progression across each year of study. The current focus on non-economics content diminishes the progression in core economics - Microeconomics, Macroeconomics and Econometrics — achieved and leads to a mismatch with the greater progression typically achieved internationally. Therefore, our first recommendation is as follows:

The curriculum design should ensure progression across all years of study in each of Microeconomics, Macroeconomics and Econometrics.

In economics, mathematics is used for the exposition of core ideas and techniques. To best ensure that students are provided with the skills necessary to understand and apply the economics studied, seminal mathematical techniques should be taught early in the programme. If taught towards the end of the programme, students will lack the necessary skills at the point that their understanding should be emerging and progressing. If taught early, these fundamental skills can accompany the student throughout their study, facilitating progression in their disciplinary expertise. Therefore, our second recommendation is as follows:

• The curriculum design should ensure that mathematics training is provided relatively early in the programme.

The application of economics ideas and tools requires a working knowledge of the context to which it is to be applied. To best ensure that students are provided with the necessary knowledge of such contexts, a relevant grounding in contextual factors should be taught early in the programme. If taught towards the end of the programme, students will, as their studies progress, lack the knowledge necessary for the accurate and informative application of their discipline. If taught early, students are, throughout their studies, better able to explore economics via the application of key ideas and tools. [It is worth noting that, as illustrated in Figure 3, the delivery of training in the national context relatively early in the programme provides space in the latter stages of the programme for the preparation of the thesis.] Therefore, our third recommendation is as follows [7]:

• The curriculum design should ensure that the national context is provided relativey early in the programme.

The tailoring of key economics ideas and tools to the needs and demands of specific industrial sectors requires a working knowledge of the key economics ideas and

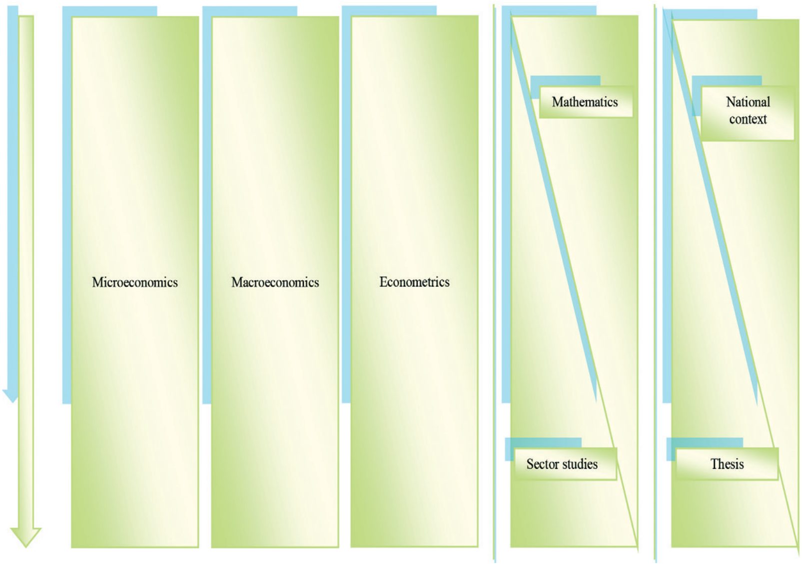


Fig.3. A simple schematic diagram of the recommended curriculum structure

tools that are to be tailored. Thus, it is appropriate for this tailoring to be taught relatively late in the programme, after students have achieved a sufficient grounding in core economics. If taught at the beginning of the programme, students would lack the disciplinary expertise to specialise in the economic analysis of any given sector. If taught later in the programme, students are given an opportunity to amass the necessary competence in economics that can then be tailored to fit with a target industrial sector. Therefore, our fourth recommendation is as follows:

• The curriculum design should ensure that sector studies are provided relatively late in the programme.

In addition to sector studies' tailoring of economics to specific industrial contexts, business relevance can be the means to more generally promote an understanding of economicsthat is grounded in business problem-solving and decision-making. To this end, there is an imperative for business relevance to be integrated into not only sector studies, but also disciplinary training. If business relevance is sought only in sector studies, there is great potential for the study of core economics to be unduly abstract and detached from the decisions faced by corporate managers. If business relevance is additionally sought in the delivery of core economics — Microeconomics, Macroeconomics and Econometrics — students are provided not only greater opportunities for the promotion of business relevance, but also an understanding of economics that, rather than being abstract and unusable, is strongly embedded in its relevance for business problem-solving and decision-making. Therefore, our fifth recommendation is as follows:

• The curriculum design should ensure that business relevance is promoted in sector studies anddisciplinary training.

Business engagement is an additional means to promote an understanding of economics that is grounded in business problem-solving and decision-making. To this end, there is an imperative for business engagement to be integrated into not only sector studies, but also disciplinary training. In a similar vein to business relevance: if business engagement is sought only in sector studies, there is great potential for the study of core economics to be unduly abstract and detached from the decisions faced by corporate managers. If business engagement is additionally sought in the delivery of core economics — Microeconomics, Macroeconomics and Econometrics — students are provided not only greater engagement with business, but also an understanding of economics that is directly embedded in business problem-solving and decision-making. Therefore, our sixth recommendation is as follows:

• The curriculum design should ensure that business engagement is promoted in sector studies anddisciplinary training.

One role of both sector studies and the integration of business relevance and engagement into disciplinary training is to fit the curriculum to the needs and demands of a specific industrial context. To this end, there is an imperative for flexibility across institutions in not only the contents of sector studies, but also the manner in which business relevance and engagement are integrated into disciplinary training. As different institutions tend to target different industrial sectors, such flexibility enables curricula to be tailored so as to maximise the fit with those business problems and decisions that are most relevant. Doing so expectably maximises the benefits to students arising from business relevance and engagement. Therefore, our seventh recommendation is as follows:

• The curriculum design should ensureflexibility across institutions in sector studies and the integration of business relevance and engagement into disciplinary training.

SUMMARY

If we summarize, our seven recommendations, they will be as following:

1. The curriculum design should ensure progression across all years of study in each of Microeconomics, Macroeconomics and Econometrics.

2. The curriculum design should ensure that mathematics training is provided relatively early in the programme.

3. The curriculum design should ensure that the national context is provided relatively early in the programme.

4. The curriculum design should ensure that sector studies are provided relatively late in the programme.

5. The curriculum design should ensure that business relevance is promoted in sector studies and disciplinary training.

6. The curriculum design should ensure that business engagement is promoted in sector studies and disciplinary training.

7. The curriculum design should ensure flexibility across institutions in sector studies and the integration of business relevance and engagement into disciplinary training.

References:

1. World Bank (2004), Uzbekistan: Modernizing Tertiary Education. Report No. 88606-UZ. June 2014. URL: http://www.worldbank.org
2. The Presidential Decree on “Measures for future development of the system of Higher education”. Tashkent city,April 20, 2017, No. PP-2909.
3. The Presidential Decree on “Measures for further enhancing participation of industries and spheres of economy in improving the quality of training specialists with Higher education”. Tashkent, July 27, 2017, number PP-3151.
4. Statistical report by the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan.
5. State Educational Standard (SES) developed by TSEU and verified by «UZSTANDARD» agency
6. Marzo-Navarro, Mercedes, Marta Pedraja-Iglesias, and Pilar Rivera-Torres. "Curricular profile of university graduates versus business demands: Is there a fit or mismatch in Spain?." Education+ Training 51, no. 1 (2009): 56-69.
7. Curriculum review Road Map. Road Map presentation in English. URL: https://www.britishcouncil.uz/en/education/curriculum/review/road/map

REQUIREMENTS ON REGISTRATION OF ARTICLES FOR PUBLICATION IN THE JOURNAL "SUSTAINABLE AGRICULTURE"

• There are published original experimental scientific articles in the journal "Sustainable Agriculture"They are about the sustainability of agriculture during a period of significant decline in water situation and increase of water sources pollution in anthropogenic climate change in the short and long term.

• There are not published articles that expound individual stages of research, which do not allow us to draw certain conclusions.

• All articles are published in English.

• All data must be accompanied by covering letter, which consists of 500 or fewer words, a summary of the significance of research, author's consent to publication, a number of pictures and tables, support for manuscripts (articles) and additional information. In addition, it should be indicated the current telephone and fax numbers, postal address and e-mail address of the respective author to keep in touch.

• For submitting documents (articles), you must send an electronic version to the editorial office, Brussels classification is necessary. The data should follow the recommendations "requirements for registration…" The authors are fully liable for the originality of the article and its subjective and formal correctness.

• Articles are presented carefully edited, typed in Microsoft Word and Times New Roman Font (Eurotimes font will not be accepted). (*.doc or *.rtf files) in the font size of 12 Times New Roman with A4 sheet format, after 1.15 interval, the size of the text restrictions: the margins at the top and bottom are 2.0 cm, on the left is 3.0 cm, on the right is 1.5 cm. Manuscripts of articles must be signed by authors and have a stamped reference from the institution where the work is done. It confirms that the materials are published for the first time. Moreover, all authors must submit a certificate (from each scientific institution in which the research was carried out).

• Abstract (summary) is a brief overview of all work, including the scheme, objectives, methods, result, and conclusions from the article. It should describe all significant facts of a scientific article and basic numerical data, including any statistical evaluation.

• Abstract (summary) should not exceed 300 words (1-1.5 pages), it should be used as the standard nomenclature. There are not recommended to use any abbreviations in the title of the article or in the abstract. Keywords should be included.

• When you prepare articles containing experimental data, the following scheme should be adhered to literature review, research objective, methodology, results, and conclusions. A Capacity of experimental articles is 15 pages, including a list of references, pictures, photographs, and tables. The title of the article should be short and understandable.

• About the text: the introduction should contain the main reasons for research, review and analysis of the appropriate literature on the subject of research and the proposed approach or solution.

• The title of the section should be accompanied by some text preceding any heading of the subsection. All headings and subheadings in the article should be on the same level. There should be short headings for each section and subsection. Section headings should be in bold, subsections - in italics.

• Data and methods. There all preliminary data, conducted experiments, their degree and conditions of carrying out should be described in detail in this section. All original procedures that were used for the processing of experimental material and all analytical methods used for the evaluation should also be detailed. The whole methodology should be described if it is original. In other cases, it is sufficient to show the author of the method and mention some special differences. You should also indicate the methods of statistical processing, including the used software.

• Results and discussion. The results obtained from the experiments, including their statistical evaluation and commentary, should be presented graphically or in tabular form, the author must comment on the results and compare them with data published at other places (other authors), results should be written in the past tense. Results and discussion can be combined or given in a separate section. Detailed interpretation of the data should be included in the discussion section, not in the results section.

It is necessary to clearly use capital (uppercase) and lowercase letters and also upper and lower indices in formulas, equations, dependencies, etc. This prevents errors. Mathematical formulas are created as separate objects in the formula editor and placed on center. Formulas referenced in the text must have continuous numbering. The formula number is placed in parentheses near the edge of the right margin. The size of the symbols in the formulas is normal is 14 pt, large is 18 pt, small is 7 pt, small index is 5 pt.

• References: only published or accepted manuscripts (articles) should be included in the list of references. Do not refer to abstracts, conferences or documents that were submitted but have not accepted yet. References should be listed and numbered in the order in which they appear in the text. Also, they should be indicated by a reference number in square brackets, multiple references in one set of parentheses must be separated by commas, for example: [1,5,7,28]. The list of references must be at least 20 names. It should be indicated the surnames and initials of all authors separated by comma. After they follows the year of publication in parentheses, the title of the article, the full title of the journal, the volume and page numbers. The names of the author (s) and year of publication should be listed by including them in the text directly, for example: "… as published by Chertovitsky A.S. (2017) or indirectly with the reference on the name (names) and on the year of publication in brackets (Chertovitsky A.S. and Ramazanov A. 2017), (Mirsaidov M.M. and others 2016). Below you can observe the rules and examples of the design of the list of literature in English. The list of references at the first time serves for tracking the authors' and journals' quotations. A correct description of the used sources at the list of literature is a guarantee that quoted publication will be taken into account at the assessment of its authors' scientific activities, and therefore organization, region, state. By quoting, the journal there is determined its scientific level, credibility, the effectiveness of its editorial council, etc.

The structure of the list of literature n English differs from that prescribed by the Russian GOST. A dash, as well as a symbol // are not used in the description in English.

• Tables and pictures should be presented separately to the text, on a separate page at the end of the article, including their names and used units. The units of physical quantities are given in accordance with the International SI system. The names of chemical compounds, taxonomic names are given in accordance with the international nomenclature. Enables should be made in MS Word format (format. Doc), graphics in MS Excel files (data files, xls), photos in jpg / .tiff format (resolution is not less than 300 dpi), all graphics and photos must be numbered, according to the order in which they are included in the text, using Arabic numerals. If any abbreviations are used in the articles first time, they should be explained accordingly.

Each table and picture must have a legend. It means the name along with a description that the reader can find useful for understanding the content. The legends for the tables are placed at the top of the table, the legends for the pictures are at the bottom. The headings of the tables and pictures should be completely descriptive, hidden to the left and bold. For the legend of the table, the first letters in each main word are written with the capital letter, for the legend of the picture the capital letters are written only for the first letter of the first word together with own nouns and adjectives. For example Table 1. Total natural river runoff in the Aral Sea basin (average annual runoff, km3 per year is SIC ICWC estimate) from 2001 to 2016. Picture 1. Areas of irrigated land suspended from the South Fergana Channel. In the text, there are used a small letter for the words "table" and "figure" if they do not appear at the beginning of the sentence.

Tables should be numbered according to the order of the reference and refer to them in the text. The tables should not contain empty graphs, dashes or abbreviated words. The digest of the table is typed in Times New Roman font is 9 pt, the head of the table is 8.5 pt. The digital material in the tables is printed at double intervals, the text of the head and outset is with a single one.

• Footnotes for tables. There are used small English letter for attaching footnotes to certain elements of the table, footnotes are placed below the bottom line of the table in the form of a paragraph (without indents). For general explanatory notes, you must use the "Note" header.

The parameter "Note" can identify the use of an asterisk (for example, one asterisk (*) is in the Syrdarya region (1970) and a double asterisk (**) is for some notations according to CANIIRI (Central Asian Research Institute of Irrigation), from 1980 to 1983.

Color images, figures can be played only in color mode (with a black and white printed version). If during the presentation of the article the author knows that color on the Internet is the preferred method of publication, in this case, there must be presented two files with figures: the black and white version must be marked for printing, and the color version must be marked online in the picture name file.

• Through separate application, there must provide information about the full names of all manuscript's authors, address (telephone, fax, and e-mail), the official name of the institution. The editorial staff reviews all received articles and the period of consideration of the article is 6 months.

• It is expected that the article is written in literate and well readable English. If it is necessary, authors should consult with the interpreter before sending an article. The article will not be checked in detail by the editorial board for the existence of linguistic mistakes. At the same time, the editors reserve the right to reject the article if there is a great number of linguistic mistakes.

• Each article that comes to the editorial office of the journal is sent for consideration to experts of the appropriate profile. As a rule, two experts are appointed for each article. The experts report their conclusions and assessments to the editor-in-chief of the journal, besides that, at least two conclusions must come to every article. Remarks and suggestions of experts are brought to the attention of the article author, after that he makes all necessary changes.

• A copy of the journal with the published article is not sent to the authors and this journal is distributed only by subscription, the fee is not paid.

Editorial address: 100000, Tashkent, Kary-Niyazov Street, 39. Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, building "B", the 230 th room, telephone number is (998 71) 237-19-78. E-mail: admin@tiiame.uz, tohir-zs@mail.ru.