Vladimer Chavchanidze Institute
of Cybernetics of the Georgian Technical University

Projects financed by the state budget
2018-2023

Name of the Institute:
Vladimer Chavchanidze Institute
of Cybernetics of the Georgian Technical University

Projects financed by the state budget
2023-2027

N	The name of the completed project, indicating the field of science and scientific direction	The year	Head of the project	Project performers
1	""Mathematical tasks of controlling quantum systems and tasks of building the basis of elementary gates of a quantum computer", (Mathematics, Information Technologies)	2023-2027	Grigor Giorgadze	G.Bolotashvili, G.Donadze, V.Jikia, M.Elizbarashvili, G.Pruidze, G.Kakulashvili, V.Zhghamadze, G.Makatsaria, D.Goshadze, N.Chkhikvadze
2	"Projectivity and unification in manifolds of monadic MV-algebras whose MV-reduct	2023-2027	Revaz Grigolia	R.Liparteliani, P.Alshibaya,

	coincides with manifolds generated by Comorian chained MV-algebras." (algebra, mathematical logic, relational systems, artificial intelligence).			
3	"Study of Problems of Stochastic Analysis and Mathematical Modeling". (Theory of stochastic processes and its applications, set-theoretic and combinatorial topology; Study of statistical characteristics of scattered radio waves in the ionosphere, decision-making theory-fuzzy logic)	2023-2027	Revaz Tevzadze George Jandieri	B.Chikvinidze, I.Tsereteli, T.Sulaberidze, T.Tsabadze, I.Skhirtladze, Ts.Kutalia, D.Iobashvili, E.Khurodze, G.Kakulashvili, R.Bakuradze, N.Bekauri, Z.Berikishvili
4	"Study of the effectiveness of using cybernetics methods in the task of mechanization of selective picking of tea leaves"". (Artificial intelligence in practical purpose systems)	2023-2027	Goderdzi Lezhava	I.Kamkamidze, M.Kandelaki, I.Javakhishvili, A.Vardosanidze, N.Bakhtadze, Z.Berikishvili, B.Oglishvili, Z.Mosiashvili, I.Stepnadze, R.Tkhinvaleli, T.Dalakishvili

5	"Digital Image Processing" (Artificial Intelligence, Pattern Recognition)	2023-2027	Otar Tavdishvili, Tamaz Sulaberidze	R.Kurdiani, T. Todua, N.Bakauri
6	“Investigation of the effects of high frequency electromagnetic fields used in 5G technology on insects and small birds". (Biophysics, Biocybernetics)	2023-2027	Besarion Partsvania	T. Zorikov, V. Jeladze, T. Gogoladze, T Sulaberidze, G.Kutelia, D.Abuladze, I. Avalishvili T. Surguladze
7	"Development of new technologies for synthesis of dielectric, semiconductor and metal nanomaterials and nanostructures, research of their properties and use in nanodevices". (Nanotechnology, nanomaterials, nanodevices)	2023-2027	David Jishiashvili	Z.Shiolashvili, A.Jishiashvili, N.Makhatadze, D.Sukhanov, A.Chirakadze, O.Kviciani, T.Gagnidze, KH.Tserodze
8	"In vivo photofeltismography of human biological tissues: development of equipment and theoretical models" (optics, spectroscopy)	2023-2027	Zaza Melikishvili	T.Medoidze, Z.Jaliashvili, V.Kinkladze, G.Kachlishvili, V.Marchilashvili
9	"Molecular Aggregations and Photoinduction of Anisotropy in Organic Compounds" (optics, information technology)	2023-2027	Tariel Ebralidze	N.Ebralidze, G.Mumladze

10	"Synthesis of multifunctional magnetic nanosystem and graphene oxide", (New Materials and Nanotechnologies)	2023-2027	Shalva Kekutia	J.Markhulia, V.Mikelaqshvili, L.Saneblidze, R.Kokhreidze, N.Chkhaidze, N.Maisuradze, M.Chavchanidze
11	"Optically Controlled Processes in Liquid Crystal Structures", (optics, information technologies)	2023-2027	Andro Chanishvili	G.Petriashvili, Z.Vardosanidze, S.Tavzarashvili, Ts.Zurabishvili, N.Fonjavidze
12	"Optically controlled spatially modulated laser generation in dye-doped polymer and liquid crystal layers" (optical information processing, physics of lasers, holography, spectroscopy)	2023-2027	Zurab Vardosanidze	A. Chanishvili, G.Petriashvili, N.Ponjavidze, S.Tavzarashvili, I.Nakhutsrishvili
13	"Radiation characteristics of a light-excited, geometrically regular, laser dye solution layer" (optical information processing, physics of lasers, holography, spectroscopy)	2023-2027	Zurab Vardosanidze	A. Chanishvili, G.Petriashvili, N.Ponjavidze, S.Tavzarashvili, I.Nakhutsrishvili
14	"Thermally stimulated luminescence in irradiated semiconductor nanostructures"	2023-2027	Oleg Gogolin	E.Tsitsishvili, Y.Blagidze, R.Janelidze,

	(Dielectric spectroscopy and relaxation of doped glasses and crystalline nano-powders in quantum systems)			V.Edilashvili
15	"Improving the functional characteristics of new generation thermoelectric cobaltites and high-temperature superconducting materials using various dopants and additives", (Physics of condensed medium, ceramics, thermoelectricity, superconductivity, nanocomposites)	2023-2027	Nikoloz Margiani	I.Kvartskhava, V.Jgamadze, G.Mumladze, G.Kakhniashvili, M.Balakhashvili, L.Shamanauri, Natia Margiani
16	"Light and Heat Controlled Windows for Temperature Regulation, Air Purification and Power Generation in Buildings" (Optics, technologies	2023-2025	Gia Petriashvili	L.Devadze, J.Markhulia, N.Sephashvili, T.Bukia, E.Kalandia, M.Areshidze, L.Sharashidze, Sh.Akhobadze
17	"Solar radiation concentrator" (optics, nanotechnologies)	2024-2026	Gia Petriashvili	L.Devadze, J.Markhulia, N.Sephashvili, T.Bukia, E.Kalandia, M.Areshidze, L.Sharashidze,

				Sh.Akhobadze
18	"Cholesteric liquid crystal mirror-based hyperspectral imaging device for medical use", (optics, photonics, medicine)	2025-2027	Gia Petriashvili	L.Devadze, J.Markhulia, N.Sephashvili, T.Bukia, E.Kalandia, M.Areshidze, L.Sharashidze, Sh.Akhobadze
19	"High optical resolution photosensitive liquid crystal polymer films for harmful ultraviolet radiation dosimetry, anti-counterfeiting and multiple recording of encrypted information", (Optics, information technologies	2024-2025	Gia Petriashvili	L.Devadze, J.Markhulia, N.Sephashvili, T.Bukia, E.Kalandia, M.Areshidze, L.Sharashidze, Sh.Akhobadze
20	"A generator based on the effect of photocatalysis for sterilization of closed spaces, neutralization of harmful pathogens, biochemical pollutants and tumor formations", (photocatalysis, medicine, nanotechnologies)	2026-2027	Gia Petriashvili	L.Devadze, J.Markhulia, N.Sephashvili, T.Bukia, E.Kalandia, M.Areshidze, L.Sharashidze, Sh.Akhobadze
21	"Nanocrystals of group III-V semiconductors and their use in	2023-2027	Tinatin Laperashvili	O.Kvitsiani, D.Laperashvili

	generation III solar cells and information systems devices" (Physics of semiconductors, information technologies)			
22	"Development of new highly efficient polarization-sensitive materials with optimal vector parameters", (Optics, quantum electronics; chemical physics)	2023	Barbara Kilosanidze	G. Kakauridze I. Chaganava I. Mshvenieradze V.Dadivadze
23	"A new system of polarization sensitometry", (Optics, quantum electronics; chemical physics).	2023	Barbara Kilosanidze	G. Kakauridze I. Chaganava I. Mshvenieradze V.Dadivadze
24	"Development of polarization-holographic spectroellipsometer", (Optics, quantum electronics; chemical physics).	2023	Barbara Kilosanidze	G. Kakauridze I. Chaganava I. Mshvenieradze V.Dadivadze
25	"Modification and application of our developed imaging Stokes spectropolarimeter" (Optics, quantum electronics; chemical physics)	2024–2025	Barbara Kilosanidze	G. Kakauridze I. Chaganava I. Mshvenieradze V.Dadivadze
26	"Obtaining polarization-sensitive luminescent recording areas in a wide spectral range; research and optimization of anisotropic-gyrotropic,	2026	Vladimer Tarasashvili	A.Purtseladze V.Shaverdova, S.Petrova

	luminescent parameters of the areas", (Optics, quantum electronics; chemical physics).			
27	**"Application of polarization-luminescent holography methods in scientific and practical tasks", (Optics, quantum electronics; chemical physics)**	**2027**	**Vladimer Tarasashvili**	**A.Purtseladze V.Shaverdova, S.Petrova**

N	The name of the completed project, indicating the field of science and scientific direction	The year	Head of the project	Project performers
1	1. "On manifolds of the Gödel MV-algebra" 2. "Dynamic Lukasevich logic and its application in the immune system". Mathematics, Mathematical logic, Algebra	2018-2022	Revaz Grigolia	R.Liparteliani, P.Alshibaya, V.Meskhi,
2	"Development of algorithms for determination of control realizations, correction of databases in the case of qualitative parameters, and modification of	2018-2022	Nelli Tkemaladze	V.Jikhvashvili, M.Kuridze, G.Mamulashvili, T.Gavrilenko, R.Tkhinvaleli

	Pattern recognition system by learning for prediction of natural disasters". Cybernetics; Pattern Recognition			
3	"Quantum Computing and Mathematical Problems of Quantum Systems Controlling". Mathematics, Information Technologies	2018-2022	Grigor Giorgadze	G.Donadze, G.Pruidze, Val. Jikia Vag.Jikia, M.Elizbarashvili, G.Bolotashvili, V.Zhghamadze, D.Goshadze, N.Chkhikvadze
4	"Study of Problems of Stochastic Analysis and Mathematical Modeling". Mathematics, Theory of random processes, Mathematical modeling	2018-2022	Zurab Piranashvili	R.Tevzadze, G.Jandieri, T.Sulaberidze, B.Chikvinidze, Ts.Kutalia, I.Skhirtladze, T.Tsabadze, Z.Alimbarashvili, D.Iobashvili, N.Bekauri, R.Bakuradze, Z.Berikishvili
5	"Development and Research of a Robotic System for Selective Tea Gathering". Cybernetics. Artificial intelligence in practical purpose systems.	2018-2022	Goderdzi Lezhava	G.Ananiashvili O.Tavdishvili, T.Todua, R.Tkhinvaleli, I.Kamkamidze, I.Javakhishvili, M.Kandelaki,

				A.Vardosanidze, T.Dalakishvili, E.Mkrtichyan
6	"Using the inductive inference operator in modeling human intelligence functions and engineering tasks". Cybernetics, Artificial Intelligence	2018-2022	Goderdzi Lezhava	G.Ananiashvili O.Tavdishvili, T.Todua, R.Tkhinvaleli, I.Kamkamidze, I.Javakhishvili, M.Kandelaki, A.Vardosanidze, T.Dalakishvili, E.Mkrtichyan
7	“Investigation of information activity of neurons in the conditions of electromagnetic smog”. Cybernetics, Biophysics, Biocybernetics	2018-2022	Besarion Partsvania	T. Zorikov V. Jeladze T. Gogoladze I. Avalishvili T. Surguladze T. Sulaberidze K. Chubinidze
8	"Development of new nanomaterials and their production technologies for use in nanodevices." Nanotechnology, nanomaterials, nanodevices	2018-2022	David Jishiashvili	Z.Shiolashvili, A.Jishiashvili, N.Makhatadze, D.Sukhanov, A.Chirakadze, O.Kviciani, T.Gagnidze
9	"A new technology for obtaining functional magnetic nanoparticles for biomedical purposes". New materials and nanotechnologies	2018-2022	Shalva Kekutia	J.Markhulia, V.Mikelaqshvili, L.Saneblidze, R.Kokhreidze, N.Chkhaidze, N.Maisuradze,

				M.Chavchanidze
10	"Investigation of electrohydraulic discharges on liquids for medical use containing magnetite nanoparticles" New materials and nanotechnologies	2018-2022	Shalva Kekutia	J.Markhulia, V.Mikelaqshvili, L.Saneblidze, R.Kokhreidze, N.Chkhaidze, N.Maisuradze, M.Chavchanidze
11	"Optical reflective skin spectroscopy in vivo"". Physics, Biomedical optics and spectroscopy	2018-2022	Zaza Melikishvili	T.Medoidze, Z.Jaliashvili, V.Tsertsvadze (PhD student), S.Chilachava (Bachelor)
12	1. „Synthesis of doped superconducting material and fabrication&testing of superconducting wire laboratory samples on its basis". Condensed Matter Physics, Superconductivity 2. "Research and improvement of functional characteristics of cobalt-based thermoelectric materials". Engineering and technology, thermoelectric materials	2018-2022	Nikoloz Margiani	G. Mumladze I. Kvartskhava V. Zhghamadze Z. Adamia M. Balakhashvili Natia Margiani N. Mumladze

13	"Molecular Aggregations and Anisotropy Photoinduction in organic compounds". Optics, Anisotropic medium	2018–2022	Tariel Ebralidze	N. Ebralidze, G. Mumladze
14	"Development of a new type of liquid crystal lasers". Physics, Optics	2018-2022	Andro Chanishvili	G.Petriashvili, Z.Vardosanidze, S.Tavzarashvili, M.Aronishidze, N.Fonjavidze
15	"Environment adapted temperature controlled smart windows". Optics, Technologies	2018-2022	Gia Petriashvili	Ts.Zurabishvili, L.Devadze, N.Sephashvili, N.Ponjavidze
16	"Study of the Weigert effect in gelatin layers doped with azo dyes". Physics, Optics	2018-2022	Zurab Vardosanidze	A. Chanishvili, G.Petriashvili, N.Ponjavidze, S.Tavzarashvili, M.Aronishidze
17	"Quantum dot nanostructured material based on group III-V semiconductors". Physics, Physics of Semiconductors, Nanotechnologies	2018-2022	Tinatin Laperashvili	O.Kvitsiani, D.Laperashvili
18	“Modification of the Technology for Obtaining Highly Efficient Polarization-Sensitive Materials for Obtaining Polarization-Holographic Elements”.	2018–2022	Barbara Kilosanidze	G. Kakauridze V. Tarasashvili V. Shaverdova A. Purtseladze I. Chaganava I. Mshvenieradze S. Petrova E. Osepaishvili

	Physical and Chemical Sciences, Optics, Quantum electronics, Chemical Physics			I. Kobulashvili
19	"Stokes spectropolarimeter with innovative imaging for astronomy". Physical and Chemical Sciences, Optics, Quantum electronics, Chemical Physics	2018–2022	Barbara Kilosanidze	G. Kakauridze V. Tarasashvili V. Shaverdova A. Purtseladze I. Chaganava I. Mshvenieradze S. Petrova E. Osepaishvili I. Kobulashvili
20	"A complex method for determining the distribution of birefringence based on a polarization-holographic element". Physical and Chemical Sciences, Optics, Quantum electronics, Chemical Physics	2018–2022	Barbara Kilosanidze	G. Kakauridze V. Tarasashvili V. Shaverdova A. Purtseladze I. Chaganava I. Mshvenieradze S. Petrova E. Osepaishvili I. Kobulashvili
21	"The phenomenon of polarization memory in polarization-luminescent holography: registration areas; multiplex 3D holograms; Perspective of application". Physical and Chemical Sciences, Optics, Quantum electronics, Chemical Physics	2018–2022	Vladimer Tarasashvili	A. Purtseladze V. Shaverdova S. Petrova

22	"Pattern recognition system based on photoanisotropic copies". Physical and Chemical Sciences, Optics, Quantum electronics, Chemical Physics	2018–2022	Barbara Kilosanidze	G. Kakauridze I. Chaganava I. Mshvenieradze I. Kobulashvili
23	1. "A new type of hybrid spiropyrans (spirochromenes) with an additional cycle in the indoline part of the molecule". Organic Chemistry; Physical Chemistry; Nanoscale phenomena 2. "Synthesis of Conjugated Photochromic Compounds Containing Spiropyrans and Diazocenters" Organic Chemistry; Synthesis of photochromic substances	2018–2022	Jimsher Maisuradze	L. Devadze Ts. Zurabishvili N. Sepashvili N. Chkhikvadze Sh. Akhobadze Zh. Urchukhishvili Kh. Meskhidze E. Arveladze G. Sanikidze
24	"Study of the electrophysical properties of polymer and nanocomposite gradient systems". Organic Chemistry; Physical Chemistry	2018–2022	Levan Nadareishvili	M. Areshidze I. Pavlenishvili L. Sharashidze

Projects implemented under the 2018-2023 plan financed by the state budget

№	Name of the completed project, indicating the field of science and scientific direction	Year	Project leader	Project executors
1.	Update and operation of the detectors of the CMS experiment, searching for new physics at the CMS experiment. The direction of the project is generally nuclear and elementary particle physics. The project also includes the following directions: theoretical physics, experimental physics, applied physics, engineering physics and computer sciences.	2018-2023	Tsamalaidze Zviad	• Abramishvili Roman • Adamov George • Bagaturia Iuri • Kemularia Otar • Lomidze David • Lomidze Irakli • Iashvili Abesalom • Melkadze Alexander • Mestvirishvili Alexi • Toriashvili Tengiz • Chokheli Davit • Tsamalaidze Zviad • Tsverava Nikolozi • Tsverava Mariam • Khvedelidze Arsen

Projects funded by the Shota Rustaveli National Science Foundation

№	გრანტის დასახელება	ხელმძღვანელი	პროექტის დაწყებისა და დამტავრების წლები	მოცულობა (თანხა)	სტატუსი დასრულებული/ მიმდინარე	გრანტის კოდი
1	A search for new physics through jets registered in the frontal area at the CMS experiment and a study of the radiation stability of silicon photomultipliers of the CMS experiment	Alexi Mestvirishvili	2022 -2024	240000 GEL	Ongoing-	FR-22-985

Abstract:

1. The project is dedicated to the research works related to the modernization of the calorimetric detectors of the ongoing CMS experiment at the CERN Large Hadron Collider and the search for new physics in cases containing jets.
The Standard Model of Elementary Particles, developed in the 1970s, is the most complete theory describing the fundamental interactions in the universe. The completeness of the theory was also confirmed in 2012 with the discovery of the Higgs boson by the CMS and ATLAS experiments. However, at the collider experiment, there are processes that cannot be predicted by the standard model. Such processes are the so-called Soft, i.e. low pt (transverse momentum) processes characterized by jets in the front region (pseudo velocity 2.2 - 5). The mentioned processes have a significant contribution to the final configuration and their experimental study is important. Also, such processes can shed light on physics beyond

the standard model, that is, processes if they exist, that cannot be described by the standard model. By 2023, it is planned to increase the intensity of the collider's proton flows and move to the higher luminosity mode (HL-LHC) phase-2. This will allow the CMS experiment to study the properties of the Higgs boson in detail, increase sensitivity to rare decays, and try to detect possible manifestations of ph ysics outside the Standard Model.

The transition of the LHC experiment to Phase-2 requires the appropriate modernization of the experiment, caused by the significantly increased particle flow and radiation background, especially in the front area of the CMS detector, so called high pseudo-rapidity region. In that region, the existing disk-shaped electromagnetic and hadron calorimeters are planned to be replaced by the so-called high-granularity calorimeter.

1.-Specific result-

2.- Recommendations

Techinformi projects implemented under the 2018-2023 state budget-financed plan

#	Implemented Project Title, indicating the Field of Science and Scientific Direction	Year(s)	Project Leader	Project Officers	Annotation
1	Information support/provision for monitoring and	2018-2025	T. Chubinishvili Co-leaders: N.	I. Bedinashvili E. Misabishvili	**1. Information Support of Research and Innovation Activity Monitoring and Management** **1.1. Formation and updating of research databases, innovative proposals (projects), publications; creation and updating of the**

	management of scientific and innovative activities		Makhviladze M. Kopaleishvili	M. Chkhaidze A. Beridze A. Patsatsia M. Ghogheliani N. Bachilava E. Pawlowicz V. Sarjveladze N. Shotashvili	**electronic catalog (directory) of organizations promoting the transfer of technologies and the spread of innovations** The presented project is part of the direction of the 2018-2025 action plans, which will guide the information and software provision of research and its results. During the years 2018-2023, the traditional work of Techinformi - the formation and updating of the information fund describing the results of the country's scientific and innovative activities - continued. This includes the database (DB) of Georgian scientific publications, the DB of completed and ongoing scientific research projects, the Electronic Georgian Abstract Journal (EGAJ), the electronic funds of abstracts and deposited works of dissertations defended in Georgia, etc. The following databases and electronic funds are especially important for scientific researchers, inventors-engineers and entrepreneurs: The DB of new technologies and innovative proposals developed in the country, as well as the updated electronic catalog (directory) of technology transfer networks and organizations promoting the spread of innovations, which contains 126 entries. Currently, the DB of new technologies and innovative proposals conyttains about a thousand entries. **1.2. Development and introduction of electronic university information systems** **1.2.1 Development of an online registration system of research projects and implementation at the university level** According to Techinformi's 2018-2023 plan, an on-line registration system of research projects was developed, which together with the registration of research projects in the form of a database provides an abstract-bibliographic description of research and the distribution of research results in electronic networks. In 2021-2022, the on-line system of registration of current and completed research projects started to be implemented and operated at the university level. By the beginning of 2023, 2261 scientific projects were entered into the

					database. The Georgian Academy of Agricultural Sciences expressed its desire to participate in the mentioned project. Currently, information describing the scientific research projects of the Academy of Agricultural Sciences of Georgia is being processed and loaded into the system. **1.2.2. Creation and commissioning of the electronic depository system** Since 2006 papers deposited in Georgia are no longer considered as materials to be submitted for theses and various scientific competitions. As a result, since 2006, submission of unpublished works for deposition has practically stopped. In fact, scientific gray literature and gray documents represent an important part of the results of scientific research, so they should not be disregarded when evaluating the outcomes of scientific research. Therefore, despite the existing situation, a new version of the registration of deposited papers and a new electronic depository system, together with the regulations of the manuscript scientific paper deposition process and necessary measures for its implementation in practice were developed and established. Digitalization of the scientific works submitted for depositing in Techinformi between 1974-2023 was completed, which made it possible to include unpublished scientific deposited works in the IT-based works (researches). Today, depositing is not required in Georgia (hopefully temporarily). Nevertheless, special attention was paid to the software of the new version of the system. In particular, the following technologies were selected for the system Angular 9, Apollo Graphql client/server, Node.js **1.2.3. Creation of electronic system of portfolio and profile of scientists based on e-Prints** **Published works serve as the information basis for the practical assessment of the results of scientists' activities** Along with this, both unpublished deposited works and various types of informal evaluations shiuyld not be disregarded. For example, the ones used in the

					Altmetriks technology. Obtaining such information is very difficult, sometimes impossible. Only the scientist him/herself can have the opportunity to access such material as the author or as a subject-matter of the document. In this case, the retrieved material becomes the subject of public discussion. Thus, the information component of the conducted research is most likely a set of objects of different types and contents in one information space (published or unpublished materials, presentations, photo, audio, and video materials, etc.) Therefore, the appropriate system for the formation and management of electronic archives – e-Prints - was selected for the software. In 2019, e-Prints software was debugged and implemented under the Techinformi website domain (eprints.techinformi.ge). Along with this, in 2017-2019, the digitalization of the scientific works submitted for depositing in Techinformi between 1974-2006 was completed. Thus, it became possible to create the own portfolio of the academic staff of the university in the e-Prints system. The source of information for the implementation of this process is the creation of an information fund planned for the end of 2023 within the framework of the open science development promotion sub-program: https://institutes.gtu.ge/Institute/2.
2	Assessment of the state and development trends of scientific and innovative fields using statistical-mathematical modeling methods	2018-2025	T. Chubinishvili	A. Chirakadze M. Ghogheliani N. Shotashvili	Creation and implementation of innovative products is currently considered as one of the main factors of rapid and sustainable economic and socio-cultural development. At the current stage, it is highly relevant to accurately identify the main characteristics of the innovative system and to develop reliable and objective methods of their quantitative assessment, to study the correlation of their results and to rank them. The new approach to ranking innovative advantages developed in Techinform is based on the statistical processing of GII (Global Innovation Index) data using the Markov process ("Markov chains") method. Assessing/ranking countries' innovative strengths and potential is an important problem. It is widely believed that the effectiveness and productivity of the innovation process is most

					comprehensively and accurately reflected by the GII. At the same time, according to many researchers, including Techinformi employees, using only or mainly the GII as a criterion of innovation is no longer appropriate at the modern stage, which is substantiated and confirmed by dozens of reliable and critical studies of foreign and Georgian scientists. Among the results obtained by Techinform, it is worth noting the introduction and detailed analysis of a number of new combined indices, which additionally take into account the values of the Sustainable Development Goals Index (SDGI) and the Global Knowledge Index (GKI). An important innovation is also the so-called "Stability index", which characterizes the probability of maintaining or losing the rank determined by the GII index and the reliability of the obtained results, rather than the direct innovative potential. The approach developed by Techinformi significantly changes the assessment of innovative capabilities and the ranking of countries, as well as the picture obtained as a result of forecasting innovative processes.
3	Evaluation of the productivity of scientific-research activities using scientometrics methods	2018-2025	L. Chobanian	P. Tsotskolauri M. Lebedeva A. Patsatsia	The main research direction of the program is the analysis and evaluation of the scientific potential of scientific teams, and the evaluation of the scientific productivity of individual scientists. The research group developed effective collective indices for the assessment of scientific teams and scientists' activity - citation, which became the basis for further research. In the research process, information from international scientific databases and Techinformi-based DBs was used. According to the expansion of the fields of scientific research, the indicators of scientific activity of scientists also change, therefore it became necessary to adjust the methodology developed for measuring the productivity of scientists. Information on the registration of works of scientists affiliated with state universities in international databases was searched and analysed to characterize separate fields of science. The Scopus database provides information on the number of registered works by the university academic staff. According tio the database, 9018 registered documents belong to

					professors and scientists of Tbilisi State University; 2332 works are registered in total. There are relatively fewer works registered by professors and scientists of the GTU, 1042 authors - 3444 documents, Ilia State University - 3618 documents, Tbilisi State Medical University - 284 works, Akaki Tsereteli State University - 201 documents. The most registered publications belong to the field of physics and astronomy - 6975 documents; mathematics - 2912, medicine - 1947, engineering - 2277, etc. According to the Scimago Journal Rank database, the most cited scientific journal articles are in the fields of medicine, mathematics, computer science, biology, genetics, and molecular biology. The average number of citations per document is 2.48 in the field of medicine, 1.25 in computer science, 2.15 in engineering, 1.36 in biology, genetics and molecular biology journals. International DBs differ from each other not only in the number of information sources and completeness of information, but also in their structure. Searching for information in DBs is easy, but the analysis process is complicated by the various classifiers of information. The research group performed the work of interlinking the DB classifiers. In order to monitor and evaluate the performance of the tasks determined by the scientific-research projects, to make decisions in the work process, an information system is needed, which will be an effective information basis for the assessment of scientific potential. The work on creating such a system has started in Techinformi. For this, the information of the Scopus databases is used, which, together with a large number of scientific articles, combines more than 4 dozens of millions of patent documents. Web of Science classifiers provide a complete evaluation of patent documents, visualization of research effectiveness and complete analysis of development trends. Within the framework of the program, it is planned to analyze and evaluate patent information according to the number of citations and prospects to be performed according to the information of Scopus and Web of Science databases.

4	Development of specialized procedures for selection and calculation of bibliometric parameters of scientists and scientific collectives working in various fields of science	2020-2025	L. Chobanian	P. Tsotskolauri M. Lebedeva A. Patsatsia	In order to analyze and evaluate the scientific potential of scientific-research organizations and their research teams, effective collective indices of scientific activity evaluation/citation were developed within the program. As a result of the analysis, it was established that along with the development of science, the indicators of scientific activity of scientists are also increasing. Therefore, updating of the already developed methodology was also carried out. Information on the registration of works of scientists affiliated with state universities in international databases was searched and analyzed. Separate fields of science were characterized. For this purpose the scientific information databases of the Institute Techinformi and the information from international databases Scopus and Scimago Journal Rank were used. The use of the Scopus system for analyzing research effectiveness implies resorting to SciVal online analysis tool in order to visualize research results and identify promising research trends. As part of the research, an analysis and evaluation of patent information according to the number of citations and its perspectivity is planned. For this, information from Scopus or Clarivate Analytics databases (Web of Science, Derwent World Patents Index (DWPI), and Derwent Patents Citation Index (DPCI)) should be used. Since the basis of the international patent information classification (IPC) is to sort the subjects according to the sectoral-functional principle, and the basis of the scientific classifiers is the subject areas of research, therefore the works of interconnection of these databases is rather important.
5	Formation (development) of the information-analytical system for management and information support of the agrarian sphere	2018-2025	N. Makhviladze	M. Razmadze L. Chobanian E. Pawlowicz Ts. Dosmishvili T. Gelashvili A. Patsatsia	An agricultural information/agri-information system can be defined as a system in which all information about agriculture is generated and transferred to agro-entrepreneurs through the use of knowledge. The strategic goal of agri-information systems is to increase access to agricultural research and technology, primarily at the level of practical activities in agriculture, as well as health and environmental protection. To achieve this goal, it is necessary for the agro-information system to function as a set of coordinated organizations, having as its member

					and knowledge dissemination service the leading national center of agro-information system, the scientific research institute Techinformi. Unfortunately, a unified system of concurring organizations has not yet been established in the country. Therefore, it is currently necessary to create an information service system for agricultural managers, scientists and specialists based on the information resources of the international agricultural network within the framework of FAO projects. The importance of agro-information systems for the development of agriculture is discussed. Historical foundations of extension/advisory services and international models of various countries are given, namely: models of Switzerland, USA, Holland, England, Germany, Turkey, Israel and Georgia. Agro-entrepreneurial subjects (farmers, cooperatives, entrepreneurs), extensionists and scientists participating in agrarian research were selected as the target group of the research. The purpose of the research was to study the mutual cooperation between the above target groups on the exchange of information, to identify gaps, using open and closed questionnaires, analysis and synthesis methods. Based on the results of the research and in order to strengthen cooperation, it was recommended that a unified electronic network/system - triangle "researcher-consultant-farmer", through which information will be exchanged/distributed should be created based on internatgional eperience. Exporting works of Georgian scientists to the FAO AGRIS system. In order to increase the availability of publications of Georgian scientists in the agricultural field at the international level, the export of scientific works to the electronic space of FAO AGRIS (International System of Agricultural Science and Technology https://agris.fao.org), as well as the updating of the AGROVOC thesaurus with Georgian terms are under way. Since 1999 Techinformi has been the national scientific center of AGRIS, and since 2020 the national hub in Georgia. To date, the AGROVOC thesaurus contains a total of 30,606 basic and 4,801 alternative terms in the Georgian language, which is 68% of the basic English terms. On the initiative of the FAO information services, an individual website/profile

					of Techinformi was created on the FAO portal AGRIS – https://www.fao.org/agris/data-provider/georgian-research-institute-scientific-technical-information.
6	Reflecting the Effectiveness of Georgian Technical University's scientific publications in Crossref reports	2022	M. Kopaleishvili	I. Bedinashvili N. Makhviladze T. Chubinishvili A. Beridze A. Patsatsia	The effectiveness of the scientific publications of the Georgia Technical University included in the Crossref online scientific research global network is evaluated according to the results of the monthly reports provided by the agency to the publisher and covers a period of more than three years. The reports confirm that correct publication metadata are sent from the GTU to the Agency - in most cases, resolutions attempts and successful resolution counts by document are matching or are close to each other, no duplicate DOIs or wrong DOIs have been reported. The search space of the scientific publications of the GTU was defined, the average monthly number of resolutions was determined. The maximum successful resolution counts is 1,130, the maximum failures make 45. The top-rated publication of the 2021-2022 GTU works was identified; the successful resolution counts by the publication title were determined. GTU publications were looked up by 5,254 respondents in 2021, and by 6,089 in 2022. In addition to the Works of GTU, in the search system there are also registered and DOI assigned 15 thematic scientific periodicals of GTU. In the future, it is planned to identify the publications included in them, which will significantly increase their visibility and popularity.
7	Assessment of the rating of Georgian scientific periodicals and development of relevant recommendations to increase the quality of scientific publications and promote their inclusion in international databases	2020-2023	T. Chubinishvili M. Kopaleishvili	I. Bedinashvili	The work aims to study the bibliographic data of Georgian scientific periodical publications, which to some extent reflects their readiness to be included in international databases of scientific publications. 149 active scientific journals whose ISSN is registered in the National Center of Georgia and confirmed by the ISSN International Center have been reviewed. Information about the publication is taken from the official website of the journal, verified and confirmed by the publisher. It is established that 66% of Georgian scientific journals have a serial number of the printed edition, 14% - of the electronic edition, and 20% - a double number; 76% of publications are thematic, 24% -

					polythematic; more than a third of scientific journals cover natural sciences; the subjects of the most numerous publications are economics (40), law (33) and medicine (30). It was studied to what extent the criteria necessary for inclusion in international scientific databases are respected: peer review of publications, periodicity of publication, independent website of the journal, international composition of editorial boards, assignment of digital object index, state of indexing in scientific databases, etc. The research results confirm that a significant number of scientific journals do not meet the necessary requirements for inclusion in international scientific databases.
8	Promoting the inclusion of Georgian scientific publications in international databases based on the open access system	2017-2019	T. Chubinishvili	M. Kopaleishvili I. Bedinashvili	The principles of creating and selling electronic scientific journals, the options for presenting them in the Internet space and the feasibility of using each option were studied and analyzed; the main requirements for the electronic journal were formulated. Selection of materials and their processing for the creation of the open access scientific portal www.openscience.ge are under way.

Institute "talga"

Projects implemented under the 2018-2023 plan financed by the state budget

№	The name of the completed project, indicating the field of science and scientific direction	year	Project leader	Project executors
1	Radon monitoring and dosimetry in Tbilisi and data standardization for integration into European systems. **Abstract:**	2022-2027	S. Pagava	K. Gorgadze, M. Metskhvarishvili, I. Kalandadze, Kh. Lomsadze, Sh. Dekanosidze.

	The project aims to determine and monitor the concentrations of naturally occurring radioactive gas - radon in the urban environment of Tbilisi (in residential, public and industrial buildings, in their surrounding areas); Assessment of radon-induced risks to human health, provision of appropriate information to the population and education of young specialists. Within the framework of the project, maps of areas containing radon risks will be created in Tbilisi. Compilation of electronic maps of the risk caused by radon, which will be available to the population of Georgia, foreign organizations and other interested persons. On the same site, individuals and public and private organizations will be able to fill out an electronic application and request a radon level assessment in their living and working places. Research objects have been selected for measurements and the results will be presented in a scientific journal next year. 2023 we have presented a review article by M. Mechvarishvili, S. Fagava, K. Gorgadze, M. Beridze. Radon exposure and lung cancer. Georgian scientists. *V.5, No.1, 2023. pp.219-222.* https://doi.org/10.52340/gs.2023.05.01.18			
2	Determining the precise temperature range of martensitic transition in multicomponent alloys of single-nickel titanium with shape memory effect designed for medical use **Abstract**: The great interest in titanium alloys as a biomedical material is primarily related to their high strength and corrosion	2022-2027	K. Gorgadze	M. Metskhvarishvili, I. Kalandadze, Kh. Lomsadze, V. Vachadze.

	resistance, non-toxicity and excellent biocompatibility compared to other metallic biomaterials. It was found that the presence of Ni, Cr and Co in titanium alloys can cause allergic reactions. Titanium alloys with Nb, Zr, Ta, Mo and Sn substances were found to be the most favorable for living organisms. Binary Ti-Ta and multi-component alloys doped with Mo, V and Zr based on them were chosen as the objects to be studied. The phase composition of the tempering alloys from the β phase was investigated; Determination of the temperature intervals of direct $(M_s\ M_r)$ and reverse $(A_s\ A_r)$ martensitic transformations, as well as the influence of deformation in these alloys on the formation of $\beta \leftrightarrow \alpha''$ martensitic transformations; Determining the role of these transformations in shaping the shape memory effect; Persistence study of shape memory effects of metastable structures. As a result of the conducted studies, the value of the reactive voltages generated during martensitic transformations was determined and the conditions for the maximum manifestation of the shape memory effect were determined.			
3	Application of the investigation of radiation stimulated by the inverted transition of the spin triplet states coupled to the resonator in various scientific and technological purposes **Abstract**	2022-2027	N. Fokina	M. Elizbarashvili

	Many axially asymmetric physical objects have spin triplet states (STM), i.e. states with a total spin angular momentum quantum number equal to one and three possible energy levels in a zero permanent magnetic field (Nv). Materials with STM electronic spins, especially photoexcited organic molecules, find wide application in science and technology. An STM application is the creation of room-temperature masers (devices for generating and amplifying microwaves (mt) by stimulated emission of radiation). The widespread use of lasers (devices for the generation and amplification of light by stimulated emission) in science and medicine is well known. The use of masers has been held back by the fact that they require the temperature of helium to operate, making them bulky and expensive. At the same time, it is precisely the maser that is used for deep space research, because the area of penetration of mt is much wider than that of light waves. Because of this, the development of room-temperature masers is an extremely important subject. Maser's group at HCL London was able to use a photoexcited pentacene STM containing a p-terphenyl crystal as dopants to create a maser operating in a pulsed mode at room temperature.			
4	Extraction of kinetic energy from mountain rivers with a floating multiturbine and its transformation into thermal energy through	2020-2025	K. Gorgadze	K. Gorgadze Kh. Lomsadze, V. Vachadze.

	a wind generator. (thermal phenomena, electricity and magnetism). **Abstract** The energy system envisaged by the project was produced, which was created by combining a river motive multiturbine, a multiplier, a motor generator, and a water gyratory heater. This system will be installed at a pre-selected site on the bank of a water-rich river with a relatively high slope. It will serve local residents. The success of the project will be the basis for the further implementation of the factory production of the system. This is the start of our organization in the field of energy, and a successful start will pave the way for us to implement other projects in the same direction. Within the framework of this project, the use of the system obtained by combining the river multiturbine and the eddy water heater will significantly reduce the energy costs required for heating the greenhouse buildings.			

Sensoruli

Georgian Technical University

I.Zhordania Center Studying Productive Forces and Natural Resources of Georgia

Projects implemented under the 2018-2023 plan financed by the state budget

№	The name of the completed project with indication of the field of science and scientific direction	Year	Head of the project	Performer
1	**Research on the potential of natural and human (labour) resources of Georgia and sectoral and regional problems of its rational use** Scientific directions: Earth and related environmental sciences (geology; environmental sciences; water resources) (1.5.); Environmental engineering (mining and mineral processing) (2.7.); agriculture, forestry and fishing (4.1.); Economy and business (5.2.); Sociology (demography) (5.4.); Social and economic geography (environmental sciences) (5.7.); Natural sciences (7.1.) ; engineering and technologies (7.2.); Agricultural	2015-2021	**Z.Lomsadze**	All scientific staff

	Sciences (7.4); Social Sciences (7.6).			
1.1.	**Problems of rational use of land (agricultural fields) (main directions of increasing efficiency)** Field of science: Agrarian sciences; Scientific directions: Soil science, agriculture, economy	2018-2019	**N.Chitanava**	Responsible performers: **T.Urushadze** **K.Makharadze** **G.Magalashvili** **Z.Lomsadze** **N.Patarkalashvili** **A.Sakhvadze** Performers: **J.Machavariani** **D.Gamezardashvili** **V.Geladze** **R.Pirtskhalava**
1.2.	**"Study of carbonaceous argillites and clays of the Tkibul-Shaori coal deposit in order to determine the possibility of production of clay, refractory and various construction materials".** Field of science: Environmental engineering, Scientific direction: Mining and mineral processing	2018-2019	**G.Magalashvili**	**J.Kakulia** **D.Kupatadze** **A.Dvaladze**
1.3.	**"Prospects of the development of the heating and energy complex of Georgia using non-traditional renewable energy resources and energy-saving technologies**". Field of science:	2018-2019	**Ir.Zhordania**	**N.Mirianashvili** **K.Vezirishvili-Nozadze** **A.Dvaladze**

	Engineering and Technology (Energy). Scientific direction: Renewable energy resources and energy-saving technologies			
1.4.	"**Regional features of human (labor) potential of Georgia**" Field of science: Social sciences Scientific directions: Demography, economy	2018-2019	**A.Sakhvadze**	**A.Sakhvadze**
1.5.	**Main directions of effective use of tourist and recreational resources: assessment and forecasts** Field of science: Social sciences Scientific directions: Economy and business, tourism, recreation, ecology	2018-2019	**L.Kvaratskhelia**	**L.Kvaratskhelia**
1.6.	**"Forest protection strips Current situation (analysis)"** Field of science: Forestry, agriculture, economy Scientific directions: Agricultural Sciences Agriculture, forestry, fishing	2018-2019	**T.Patarkalashvili**	**I.Akhalbedashvili**

1.7.	**"The modern state and prospects of the melioration of agricultural land beds in Georgia"** Field of science: Hydrology, water resources Scientific directions: Natural sciences Scientific sub-direction: Earth and related environmental sciences	2018-2019	**K.Makharadze**	**Z.Lomsadze** **V.Geladze** **D.Gamezardashvili** **R.Pirtskhalava**
1.8.	**Development of an electronic information platform of productive forces and natural resources of the parties of Georgia** Field of science: Natural Sciences (1), Computer and Information Sciences (1.2), Engineering and Technology (2), Information Engineering (2.2).	2020-2021	**Z.Lomsadze**	**O.Paresishvili -** Responsible Performer **G.Talakvadze** **N.Chitanava** **K.Makharadze** **T.Patarkalashvili** **G.Magalashvili** **N.Mirianashvili** **K.Vezirishvili-Nozadze** **L.Kvaratskhelia** **A.Sakhvadze** **V.Mirzaeva**
1.9.	**Measures to promote the rationalization of internal consumption of drinking water resources of Georgia and increase the export potential of drinking water** Field of science:	2020-2021	**K.Makharadze**	**V.Geladze** **R.Pirtskhalava**

	Economy Scientific direction: Food and beverage products			
1.10	**Main directions of effective use of tourist and recreational resources: assessment and forecasts** Scientific direction: Studies of Georgia Scientific sub-direction: medicine and health sciences	2018-2021	**L.Kvaratskhelia**	**N.Grdzelishvili**
1.11.	**Prospects for use of renewable, alternative energy resources in the country in the context of the association agreement concluded between Georgia and the European Union** Field of science: Engineering and technologies (2.); Energy	2020	**N.Mirianashvili**	**K.Vezirishvili-Nozadze** **A.Dvaladze**
1.12	**Economic-ecological approaches to the development of highlands - world experience (mountain problems)** Scientific directions: Social Sciences Subfield - Social and Economic Geography (Environmental Sciences)	2019 - 2020	**M.Tsitskishvili**	**A.Dvaladze**
1.13	**Trends and perspectives of labor resources development of Kakheti region** Field of science:	2020	**A.Sakhvadze**	**A.Sakhvadze**

	Social sciences Scientific directions: Demography			
1.14	**Processing of the combined technological scheme of beneficiation of primary and stacked copper-zinc ores of the Madneuli ore deposit.** Scientific directions: Engineering and Technology sub-direction; Environmental engineering (mining and mineral processing)	2020-2021	**Z.Lomsadze**	**G.Magalashvili –** Responsible Performer **J.Kakulia** **A.Dvaladze**
1.15	**"Formation of the organizational-economic mechanism of land management (conceptual-methodological approach)".** Fields of sciences and scientific directions: Agrarian sciences, agriculture, soil science, economics	2020-2021	**N.Chitanava**	**I.Akhalbedashvili** **D.Gamezardashvili** **R.Pirtskhalava** -
1.16	**"Drinking water resources of Georgia and problems of rationalization of their internal consumption".** Fields of sciences and scientific directions: Hydrology, water resources	2021	**K.Makharadze**	**R.Pirtskhalava**
1.17	**"Comparative evaluation of traditional and modern technical**	2021	**T.Patarkalashvili**	**T.Patarkalashvili**

	systems of timber extraction in mountainous conditions". Fields of sciences and scientific directions: Forestry			
1.18	**"Climate change, energy challenges in Georgia and ways to solve them".** Fields of sciences and scientific directions: Energy	2021	**N.Mirianashvili**	**K.Vezirishvili-Nozadze** **D.Gamezardashvili** **A.Dvaladze**
1.19	**"Trends and perspectives of development of labor resources of Kvemo Kartli region".** Fields of sciences and scientific directions: Sociology, Demography	2021	**A.Sakhvadze**	**A.Sakhvadze**
1.20.	**"Integral resources of Georgia and optimization of their management (conceptual approach)".** Fields of sciences and scientific directions: Economics, Econometrics, Industrial Relations, Business and Management, Engineering and Technology	2021	**G.Talakvadze**	**G.Talakvadze**
2.	**Study of problems of rational use of natural resources of Georgia**	2022-2026	**Z.Lomsadze**	All scientific staff

	and sustainable development of productive forces of regions (countries). Fields of sciences and scientific directions: Study of problems of rational use of natural resources of Georgia and sustainable development of productive forces of regions (countries). Scientific directions: earth and related environmental sciences (geology; environmental sciences; water resources) (1.5.); Environmental engineering (mining and mineral processing) (2.7.); agriculture, forestry and fishing (4.1.); Economy and business (5.2.); Sociology (demography) (5.4.); Social and economic geography (environmental sciences) (5.7.); Natural sciences (7.1.) ; engineering and technologies (7.2.); Agricultural Sciences (7.4); Social Sciences (7.6).			
2.1	**Conceptual-methodological approaches to the formation of a complex (integral) management system of agricultural land resources** Fields of sciences and scientific directions:	2022-2023	**N.Chitanava**	**I.Akhalbedashvili** **V.Zeikidze** **R.Pirtskhalava**

	Georgian sciences (natural, agrarian, social sciences), economics and business (business and management), other agrarian sciences.			
2.2.	**Georgia's fresh water resources and water consumption problems according to regions** Fields of sciences and scientific directions: Earth and related environmental sciences (water resources, hydrology)	2022-2023	**V.Geladze**	**K.Makharadze** **R.Pirtskhalava** **Kh.Lezhava**
2.3.	**Problems and challenges of sustainable development of forests in Georgia** Fields of sciences and scientific directions: Agrarian Sciences (4), Agriculture, Forestry, Fisheries (4.1)	2022-2023	**T.Patarkalashvili**	**T.Patarkalashvili**
2.4.	**Study of the so-called "tails", ash of the Tkibuli - Shaori deposit's "waste rocks" - argillites, clays, enriching rocks in order to determine possibilities for production of building materials and fertilizers.** Fields of sciences and scientific directions: Natural sciences (1); Earth and related environmental sciences	2022-2023	**G.Magalashvili**	**N.Poporadze** **G.Lobzhanidze**

	(1.5., Geology); Environmental engineering (2.7., mining and mineral processing)			
2.5.	**Europe's "Green Agreement" and its influence on the energy sector of Georgia** Fields of sciences and scientific directions: Engineering and technologies (2.); Energy	2022-2023	**N.Mirianashvili**	**K.Vezirishvili-Nozadze –** Responsible Performer **D.Gamezardashvili** **M.Jibashvili**
2.6.	**Main directions of effective use of tourist-recreational resources: assessment and forecasts** Fields of sciences and scientific directions: Social Sciences (5), Economics and Business (5.2, Business and Management (5.2.3); Georgian Studies (7), Social Sciences (7.6)	2021-2024	**N.Grdzelishvili**	**L.Kvaratskhelia**
2.7.	**Causes of demographic problems in the highland regions of Georgia and ways to solve them** Fields of sciences and scientific directions: Social Sciences (5), Demography (5.4), Georgian Studies (7), Social Sciences (7.6)	2021-2024	**N.Grdzelishvili**	**N.Grdzelishvili**

2.8.	**Georgia's development priorities and integral resources: potential, analysis, vanagement** Fields of sciences and scientific directions: Social Sciences (Economics and Business: Economics, Econometrics; Industrial Relations; Business and Management)	2022-2023	**G.Talakvadze**	**I.Archvadze**
2.9.	**Development of an electronic information platform of natural resources of Georgia (concept)** Fields of sciences and scientific directions: Natural Sciences (1), Computer and Information Sciences (1.2), Engineering and Technology (2), Information Engineering (2.2).	2020-2023	**Z.Lomsadze**	**O.Paresishvili** – Responsible Performer **V.Mirzaeva** **K.Solomonishvili** **G.Gaikharashvili**
2.10.	**Name of the project:** "Study of argillites and clays of the "waste" rocks of the Tkibul-Shaori coal deposit, "tails", sludge, ash of the enrichment plant, construction and refractory bricks, "Metlakh" type tiles, cement, clay, aluminum, its alloys and " in order to determine the possibility of "humates". **Field of science** - natural science **Scientific direction** - earth and related environmental sciences, geology, minerals.	2022 – 2024	**G.Magalashvili**	**J.Kakulia** - Responsible Performer

2.11.	**Name of the project:** "Europe's "Green Agreement" and its impact on Georgia on the energy sector". **Field of science -** Study of the potential of natural and human (labour) resources of Georgia and sectoral and regional problems of its rational use.	2022-2023	**N.Mirianashvili**	**K.Vezirishvili-Nozadze -** Responsible Performer D.Gamezardashvili - Responsible Performer M.Jibashvili - Performer

Abstract

The project examines the utilization of Georgia's primary natural resources categories as it stands today, the reasons behind the issues with nature management, the shortcomings of the organizational and management structure, and the reasons behind the low level of labor organization and production.

Established are the primary ways of rational and efficient utilization of the nation's resource potential under current circumstances, A novel categorization of integral resources is introduced as a methodological basis for evaluating resource potential, establishing utilization priorities, and ranking the natural resources, alternate techniques for evaluating mineral resources are discussed, It is established that local natural resources play a crucial role in driving economic growth in regions, and that national resource policies and resource potential management need to be consolidated, The conceptual visions for establishing an integrated system to manage the nation's resource potential are put forth, The recommendation to set up an e-information platform of Georgia's natural resources is given, The necessity and exceptional significance of close collaboration between the scientific circles and the government in guaranteeing the nation's economic growth are establishe, The most significant concrete suggestions for fostering and speeding up this process are provided.

The most crucial element of the nation's sustainable socioeconomic development at this point in the history of the society is the management optimization and rational use of natural resources and productive forces.

The socioeconomic development of society in the context of globalization should take into account common strategic goals and objectives, the wise and efficient use of natural resources, the preservation of the environment's ecological balance, the needs of future generations, and the industrial and natural features of individual nations. This strategy implies a close connection and interdependence between the nature conservation and the use of natural resources.

Thus, in order to prevent the irrational and, in certain cases, predatory exploitation of natural resources and, most importantly, to preserve biodiversity and the possibility of continuously improving living conditions for the populace, every state should develop and implement a planned

(targeted), transparent policy in the natural resource use and nature conservation. **Natural resources are essential for improving the competitiveness of the national economy and raising the nation's export potential. Increasing the significance of natural resources as a budget-forming and capital-intensive asset of national wealth is also crucial.**

Any nation's ability to sustain its socioeconomic growth and raise its citizens' standard of living are primarily dependent on its ability to extract and use natural resources in an efficient manner, as well as to take advantage of opportunities for resource export and import substitution.

Factors, such as the Covid-19 pandemic, the Russian-Ukrainian War, and the emergence of new hotspots of tension, have all aggravated further the complicated and contradictory processes of globalization that are occurring in today's world, and the motivation underlying these factors aggressively striving for the redistribution of the world natural resources has been revealed.

In light of these circumstances, the state's socioeconomic policy, which relies primarily on the idea of making full and effective use of its own resource potential, must be developed for the sake of national security. As the measures to address this challenging endeavor are developed, the present approaches (paradigms) of the nation's use of natural resources must be critically evaluated and modified as needed.

Georgia is recognized for having a wide variety of natural resources. The majority of their exploration, potential assessment, and use occurred during the Soviet era. Within the Socialist economic system, each Soviet Republic's resources were assessed in relation to the Soviet Union's overall resource potential, thereby serving the strategic interests of one of this world's superpowers. Consequently, according to the Soviet practice, resources that were judged to have an average or lower volume received less attention. Obviously, the use of natural resources of Georgia in the Soviet period could not be prioritized based only on the interests and peculiarities of our Republic. It should be noted that data on mineral reserves of the Soviet era were not always objective or comprehensive, as the exact volume of reserves would frequently not be determined for a variety of subjective and objective reasons. The aforementioned demonstrates the relevance of a thorough analysis and evaluation of natural resource potential given our nation's current state of development.

A system analysis of the results (features, trends) of the national economy's transformation processes has demonstrated that the process of natural resources utilization has remained outside the purview of the effective state regulation.

As confirmed by the analysis of contemporary global processes, the rational utilization of the nation's own resource potential is an inevitable prerequisite for both a notable improvement in living standards and sustainable and safe economic development in the country. The country's economy must grow quickly in order to tackle these challenging tasks, and the best way to do this is by gradually and deliberately integrating the nation's resource potential into the economic cycle. To achieve this, it is first necessary to inventory the primary categories of natural resources using contemporary scientific methods and technologies (experience of developed nations), analyze their actual state using methodical techniques, and estimate their potential and prospects for gradual use. It will only be feasible to end the detrimental practice that emerged in Georgia when "measures" of using natural resources were implemented without a proper legislative framework, an appropriate economic mechanism, or an effective organizational and management structure necessary for their high-efficient management and control.

Unfortunately, comprehensive (objective) information regarding the nation's exploitation of its natural resources is still lacking. No more land balances are drafted in the country and the scientific and design agencies that once supported nature management (land management, geological survey,

assessment of the reserves, involvement in integration processes, training of qualified personnel in the industry, etc.) are no longer in operation. Their responsibilities are often split across several departments, making it impossible for them to complete the complex tasks imposed by time challenges.

Under the current circumstances, it is best to look at the nation's resource potential using an integrated approach, where decisions about the intended use of specific natural resource types are made while taking other significant tangible and intangible resources and capabilities of the nation into consideration.

Integral resources are a systematic combination of different categories of resources (material, informational, geostrategic, historical and cultural, scientific and technological, energy, etc.), characterized by different characteristics of the level of resource interdependence and respond to their qualitative and quantitative changes. In this context, land and other natural resources are seen as a single integrated system, the view given in the present paper. Furthermore, the system of interdependence of other major factors of production (labor, capital, entrepreneurial ability, integrated knowledge, and public regulation of the economy) takes land into account as a natural resource, the primary factor of production, and the object of agriculture. This approach has revealed a number of features, new trends and certain regularities that need to be taken into account in state policy. The analysis has demonstrated that historically, land owners, society, and the state have not all taken adequate responsibility for the sensible and effective use of land, particularly agricultural land. Issues like land accounting, registration, and management are still unresolved; there is no land cadastre or Land Code in the country; there is no economic assessment of land; and it is getting harder to regulate land consolidation procedures.

Along with the analysis and assessment of the use of land and other natural resources, the article gives relevant conclusions, proposals, recommendations for their effective management and rational use. **Along with the analysis and assessment of the use of land and other natural resources, the article gives relevant conclusions, proposals, recommendations for their effective management and rational use. It is substantiated that land and other natural resources are the most important strategic resource, and the level of political, socio-economic and environmental development of the country depends on their rational utilization. The rational and effective use of land and other natural resources is therefore the most important of the recent challenges, as it will enable the building of an environment that is beneficial to the overall growth of the national economy.**

In order to provide a solid base for developing the potential of natural resources as a priority area for speeding up the development of the national economy, state policy should be based on the appropriate legislation, organizational and management system, and economic mechanism.

This will contribute to: creating a solid food supply base for the population; developing basic industries based on mineral resources; efficiently using recreational resources (developing tourism and resort economies); improving population living environment, and exploiting the territory's geoeconomic factors in line with state interests, among other things – the factors that will significantly accelerate the formation of the branch structure of the national market economy, increase its efficiency and develop productive forces. In light of the prospects for wise use of the nation's natural resource potential, the article examines the unique importance of the state-and-science partnership as the most critical component of the nation's development.

It is crucial to adequately highlight the regional aspect in the context of varied resource utilization potential. The idea of an electronic natural resource information platform is covered in this regard in the article. This will assist in ranking the information that is currently available on the natural resources of a given region (region, municipality) in a way that consistently takes into account the unique characteristics of the area, the demographic

(labor resources), the land, soil, forest, water and recreational resources, the exploitation of minerals, and other issuest hat will eventually form the basis to design the programs for the socioeconomic development of the area.

In order to form the state's resource policy through an integrated approach, it is necessary to identify the resource potential of the country, as well as to determine and accurately register its volume, quantitative and qualitative indices; to evaluate the degree of resource interdependence, establish utilization priorities, and develop logical plans for their realization using cutting-edge, resource-saving technologies.

In response to this standpoint, the "breakthrough strategy - mobilization (innovation) model" is proposed to use. This model is predicated on the idea of choosing strategic goals for the nation's development and the methods by which they should be accomplished.

Currently, the establishment of an efficient economic system based on market principles is the strategic aim of the nation's development. Utilizing the nation's resource potential in a logical and efficient manner is how this goal will be accomplished. Setting up a state program for Georgia's socioeconomic development and modernization up to 2030 is essential to achieving this strategic goal.

The above actions, when consistently carried out, will contribute to building a strong basis for the nation's sustainable development.

Engineering Institute of Membrane Technologies of Georgian Technical University

Scientific projects of 2018 - 2023

Annex 3

№	The name of the completed project, indicating the field of science and scientific direction	Date	Project head/ heads

project 1	**Monitoring of modern aspects of educational, scientific and innovative activities of membrane sciences and industry in sectoral areas of the economy;** **Technical sciences – nano and membrane technologies;** **Summary of the I project** **The purpose of the proposed project is to identify and systematize the latest information data of educational, scientific and innovative membrane technologies in the sectoral areas of the country's economy based on local, international publications, scientific and technological and Internet databases.**	**2021-2026**	**G. Bibileishvili**
project 2	**Experimental research of processing of new nanocomposite materials, processing and creation of micro-, ultra- and nanofiltration membranes;**	**2021-2026**	**N. Gogesashvili**

	Chemistry and Science of Materials - Processing of Nanocomposite Materials; **Summary of the II project** **The aim of the project is experimental research of new nanocomposite materials, processing of micro-, ultra-, nanofiltration membranes;**		
project 3	**Theoretical and experimental study of baromembrane processes for solutions of variable composition and viscosity;** **1. Engineering sciences - nano and membrane technologies;** **2. Chemical sciences - colloidal chemistry, analytical chemistry;** **3. Mechanics - fluid mechanics;** **Summary of the I I I project**	**2021-2026**	**M. Kezherashvili**

	The objective of the proposed project is to develop membrane separation processes refining in terms of industry requirements and to theoretically and experimentally investigate baromembrane processes.		
project 4	**Test-design-engineering works of membrane devices,** **for automation, nanotechnologies and equipment processing;** **1. Engineering sciences - nano and membrane technologies;** **2. mechanics-fluid mechanics;** **Summary of the IV project** **The aim of the project is to create and develop new membrane devices, automation means, nanotechnologies and devices based on theoretical, experimental and test and design studies of baromembrane processes. To solve this task it is necessary to carry out research,**	**2021-2026**	**L. Kuparadze**

	theoretical and experimental works on creation and development of new tangential filtering industrial and household automated membrane devices with plane-parallel, tubular and coiled elements.		
project 5	**Physical-chemical and microbiological studies of solutions, liquid and solid phases of polymer compositions;** **Chemistry and science of materials - working out the problems of chemical protection of man and the biosphere;** **Summary of the V project** **The purpose of the proposed project is physicochemical and microbiological studies of solutions, polymer compositions, drinking and waste water, wine, fruit juices. Experimental studies on ionometer, optical microscope, nanosizer to determine the size and molecular weight of nanoparticles, turbidity and viscosity meter, scanning probe and**	**2021-2026**	**M. Mamulashvili** **T. Butkhuzi** **L. Ebanoidze**

	tunneling microscope, bioreactor, membrane lab devices.		
project 6	**Study of theoretical and experimental issues of ion selection of liquids.** **1. Engineering sciences - nano and membrane technologies;** **2. mechanics-fluid mechanics;** **Summary of the I project** **The aim of the proposed project is to investigate theoretical and experimental issues of ionic selection of liquids. To solve this problem, the following were carried out: theoretical and experimental studies of the chemical and structural composition of brackish water (ocean, sea, some lakes) to develop membrane separation methods for their desalination (drinking water). Development of membrane technology and experimental equipment for desalination of Caspian Sea water. Investigation of**	**2018 - 2019**	**G. Bibileishvili,** **L. Kuparadze** **M. Kezherashvili** **N. Gogesashvili** **M. Mamulashvili**

	baromembrane processes for desalination of Black Sea water, development of membrane technology and corresponding experimental equipment. Theoretical and experimental study of fresh water demineralization processes as molecular and ionic systems at different levels (transitional between drinking and distilled water), their complex ecological classification and introduction of appropriate membrane technology and equipment for processing at the appropriate level. Study of membrane separation process for obtaining process (distilled) water from drinking water and introduction of appropriate compact membrane equipment. study of chemical composition and morphological-structural organization (molecular, supramolecular and micro levels) of polymer systems;		

project 7	**Theoretical and experimental aspects of structural and topographic research of polymeric nanomaterials.** **Engineering sciences - nano and membrane technologies;** **Summary of the II project** **The aim of the proposed project is theoretical and experimental aspects of structural and topographical studies of polymer nanomaterials. In order to solve this problem, the following were carried out: investigation of elements possessing the ability to self-organization necessary for nanostructural formation of new materials based on the principle of purposeful design; Kinetic analysis of the dynamics of phase inversion processes: in order to determine the size of microgel particles (associates), concentration distribution mechanisms; determination of the topological and surface structure of membranes**	**2019**	**G. Bibileishvili,** **L. Kuparadze** **M. Kezherashvili** **N. Gogesashvili** **M. Mamulashvili**

	based on different materials at the atomic level; In the process of phase inversion by a subnanometer approach in phase inversion by a sub-nanometer approach (10-2 nm), micellar globule aggregation (200A^{o}), and the study of supramolecular cellular formations resulting from the interaction of functional group atoms;		
project 8	Research of theoretical and experimental issues of the process of phase inversion of composite membranes based on polymer nanomaterials, development and creation of appropriate membrane devices. 1. Engineering sciences - nano and membrane technologies; 2. mechanics-fluid mechanics; Summary of the I I I project	2019-2020	G. Bibileishvili, L. Kuparadze M. Kezherashvi N. Gogesashvili M. Mamulashvili

	The aim of the proposed project is to investigate theoretical and experimental issues of the phase inversion process of composite membranes based on polymer nanomaterials, design and development of appropriate membrane devices. In order to solve this problem we have carried out: determination of specific energies of formation of spherulites, single crystals and forces of different nature acting between atoms in the process of creation of different types of membranes and study of their influence on morphological properties of membranes; Determination of topological and surface structure of membranes at the atomic level in the mode of constant exposure. Study of microphotographs of lateral slices. Determination of the size of voids (400-800A^{o}) and sponge-like formations between spherical micellar structures. Investigation of the effect of concentrations on the physical and mechanical properties of nanocomposite materials. Theoretical and experimental study		

	of fresh waters as molecular and ionic systems of different levels of demineralization (transitional between drinking and distilled water), their complex ecological classification and creation of technologies and equipment based on appropriate composite membranes for treatment at the appropriate level; Study of membrane separation process for obtaining process water (distilled water) from dairy industry wastewater;		

The institute Of Constructions, Special Systems and Engineering Maintenance

of The Georgian Technical university

Projects financed from the state budget, implemented according to the plan for 2018-2023

appendix 3

№	Title of the project with indication of scientific branch and direction	year	project leader	project executors
1	"Development of a methodology for engineering situational assessment and for site engineering development of chosen operational direction in conditions of total defense"	2021-2024	E. Medzmariashvili. academician	T. Shubladze-project manager, G. Danelia, G. Surmava, I. Buishvili, G. Gratiashvili, M. Sanikidze

Project meaning: In the selected operational area, the operational situation is assessed with the help of operational variabl es. The current operational environment is then compared with the desired one (according to the support of joint functions by means of operational variables). Shortcomings are then identified and remedial measures are planned.

To develop the methodology, one operational variable (Physical Environment) was selected and evaluated on the support of one joint function (Movement and Maneuvering).

Muskhelishvili Institute of Computational Mathematics of Georgian Technical University

Scientific works, implemented in 2018-2023 (by years)

Projects, implemented in 2018-2023 (financed by the state budget)

№	name of the completed project, indicating the field of science and scientific direction	years	project manager	project participants
1	Mathematical and computer models – theory and practice. Construction and realization of computational algorithms / exact and natural sciences / mathematics, Informatics **(project is completed)**	2018 - 2022	Jemal Sanikidze, Vakhtang Kvaratskhelia	scientific staff and programmers of the institute
2	Construction, analysis and realization of mathematical and computer models **(first year of the project is in progress)**	2023 - 2027	Hamlet Meladze, Vakhtang Kvaratskhelia	scientific staff and programmers of the institute

Project 1 annotation.

In the completed project, research was carried out in the following directions:

- construction and use of computational algorithms for the approximate solution of some problems of mathematical physics and mechanics;

- Mathematical modeling of operational, non-linear and ill-posed problems and processing of analytical and numerical solution methods of corresponding problems.

- Rearrangements of series and maximal inequalities in functional analysis, statistical analysis of big data, and discrete optimization problems. Stochastic equations.

- Construction, analysis, realization and verification of the corresponding software of parallel algorithms for processing data of large volumes and complex structures.

Project 2 annotation.

The current project aims at mathematical and computer research of theoretical and applied tasks, development and implementation of appropriate computing methods and modern information technologies. The project presents both traditional directions for the institute, as well as modern, new tasks.

In the project, significant attention is paid to the motivating and recruiting the younger generation to science .

Archil Eliashvili Institute of Control Systems of the Georgian Technical University

Scientific works performed in 2018-2023

№	Project name, scientific field and scientific direction	Years	Principal Investigator	Researcers
1.	Research on modeling, identification and optimization tasks of complex systems Engineering and technology Electrical engineering, electronic engineering, information engineering. Automation and control systems	2018 - 2020	V. Gabisonia	B. Shanshiashvili N. Dadiani V. Khutsishvili N. Kilasonia K. Kutkhashvili D. Sikharulidze D. Tsintsadze K. Omiadze
2	Identification and modeling of non-linear control systems, research of mathematical modeling and	2021 – 2023	B. Shanshiashvili	N. Dadiani V. Khutsishvili

	optimization tasks of complex physical and economic systems; 2. Engineering and technology 2.2 Electrical engineering, electronic engineering, information engineering. Automation and control systems			N. Kilasonia K. Kutkhashvili D. Sikharulidze D. Tsintsadze K. Omiadze
3	Development of a combinatorial online dictionary of the Georgian language; Informatics; Computational Linguistics	2018-2020	G. Chikoidze	L. Lortkipanidze N. Amirezashvili A. Tushishvili M. Tushishvili L. Samsonadze A. Chutkerashvili N. Javashvili L. Makrakhidze
4	Georgian language interface of dialogue systems Informatics; Computational Linguistics	2021-2023	L. Lortkipanidze	G. Chikoidze A. Chutkerashvili M. Tushishvili N. Amirezashvili

				L. Samsonadze **N. Javashvili** **L. Makrakhidze** **M. Kloyan**
5.	**Development of a Medical Decision Support System to Solve the Problem of Diagnosing and Treating Rare Diseases.** **Artificial Intelligence. Intelligent Information System Models.**	**2021-2023**	**M. Mikeladze**	**N. Ananiashvili** **V. Radzievski** **N. Jaliabova** **D. Radzievski** **I. Okonyan**
6.	**Development of a Medical Intelligent Decision Support System Based on Data Mining Technologies;** **Artificial intelligence, intelligent information system models.** **Data Mining.**	**2018-2020**	**M. Mikeladze**	**G. Besiashvili** **N. Ananiashvili** **V. Radzievski** **N. Jaliabova** **D. Radzievski**
7.	**Investigation of some actual problems of Georgian energy.**	**2018-2020**	**T. Magrakvelisze**	**G. Gigineishvili**

	Energetics. Optimization of the structure of the electric power system and power plants.			A. Mikashavidze Kh. Lomidze M. Janikashvili I. Archvadze T. Koberidze
8.	Investigation of some problems of electric energy and power plants. Energetics. Optimization of the structure of the electric power system and power plants.	2021-2023	T. Magrakvelisze	G. Gigineishvili A. Mikashavidze Kh. Lomidze M. Janikashvili I. Archvadze T. Koberidze
9	Processing of information transformation devices and systems using modern technologies; Development of electromagnetic converters for control systems.	2018-2020	O. Labadze	N. Kavlashvili Z. Buachidze L. Gvaramadze P. Stavranidi T. Saanishvili M. Tsertsvadze D.

				Purtskhvanidze **K. Kvirikashvili** **V. Bakhtadze** **G. Kiknadze** **T. Khutsishvili**
10	**Processing of information transformation devices and systems using modern technologies;** **Engineering and technology;** **Electrical engineering, electronic engineering, information engineering;** **Robotics and automatic control;** **Automation and control systems;**	**2021-2023**	**D. Purtskhvanidze**	**N. Kavlashvili** **Z. Buachidze** **L. Gvaramadze** **P. Stavranidi** **T. Saanishvili** **M. Tsertsvadze** **K. Kvirikashvili** **V. Bakhtadze** **G. Kiknadze** **T. Khutsishvili** **N. Mirianashvili** **N. Gdzelishvili** **V. Khatashvili** **O. Kartvelishvili**

Archil Eliashvili Institute of Control Systems of the Georgian Technical University

"Scientific Research Facilitation" Program (Program Code 32 05 04)

„Control theory, identification, optimization and construction of technical systems and devices, modeling of intelligent proc esses“

Short summary of scientific works carried out in the frames of the program

in 2021-2022

I

Identification and modeling of nonlinear control systems, research on mathematical modeling and optimization of complex physi cal and economic systems

(Mindia Salukvadze department of system identification and optimal control)

Scientific field: Engineering and technology;

Scientific sub-field: Electrical engineering, electronic engineering, information engineering;

Automation and control systems

The project is conducting research in two directions:

Direction I - identification and modeling of nonlinear control systems.

Direction II - mathematical modeling of complex systems and multi-objective optimization.

2021

Direction I. A review and analysis of modern methods of structure identification of nonlinear systems was carried out. The discussion of mathematical models of closed-loop nonlinear systems was carried out and the task of structure identification of such systems was set. A method and algorithm for structure identification of closed-loop nonlinear systems based on observations of input and output signals of the system was developed. The developed structure identification method and algorithm were investigated regarding adequacy and accuracy.

Direction II. The problem of scheduling theory was investigated when a single-stage multiprocessor system can perform the tasks. An optimization algorithm of polynomial complexity was constructed using integer and dynamic programming methods.

A model was considered, in which the problem of selecting the best innovative project from a given set of projects is formulated as a binary five-criteria optimization task. The problem was reduced to a binary linear programming problem with restrictions.

A strategy game depicting an antagonistic conflict "Shooter Battle" is offered. A preliminary package of game competition models has been created.

In 2021, the following was published in Georgia: textbook - 1, course of lectures - 1, scientific article - 9; abroad: article 3; participation in the forum held in Georgia - 3, abroad - 1.

2022

Direction I. A review and analysis of modern methods of parameter identification of nonlinear systems was carried out. A discussion of mathematical models of closed-loop nonlinear systems was carried out. The task of parameter identification of closed-loop nonlinear systems when representing them with feedback block-oriented models was posed. The methods of parameter identification of closed-loop nonlinear systems in the frequency domain were developed in their representation by Hammerstein and Wiener models with unit feedback under conditions of input harmonic signal of the system. The developed identification methods were tested for accuracy.

Direction II. A model was considered, in which it is necessary to draw up an optimal plan for a company owning several raw materials processing enterprises to efficiently use raw materials, production resources, and capacities.

A mathematical model of the one-criteria problem of the theory of discrete optimization schedules was built under conditions of uncertainty, in which tasks are performed by a continuous one-step system. A program in C++ language is created based on the constructed algorithm.

The capabilities of the software package Matlab in vector optimization and particular interactive vector optimization were discussed.

A study of multicriteria tasks was carried out by discretization of multicriteria optimization tasks in functional-analytical spaces.

Experiments were carried out and the final version of the game model was selected for the computer game "Shooter Battle".

In 2022, the following was published in Georgia: scientific article - 7; participation in the forum held in Georgia - 2.

II

Processing of information transformation devices and systems using modern technologies; (Department of Information Transformation issues)

Scientific field: Engineering and technology;

Scientific sub-field: Electrical engineering, electronic engineering, information engineering;

Robotics and automatic control; Automation and control systems;

In 2021, 2 tasks were carried out in the departments: automation of a small-sized drip irrigation system in conditions of limited irrigation water resources and a multifunctional mobile robot and its control system.

Within the framework of the first task, one of the principles of building a capacitive transducer for water reserve resource estimation was investigated and an analytical expression was obtained that connects the physical parameters of the transducer and output capacity. The latter allows us to choose the appropriate physical parameters of the transducer when designing the system. The construction of the structure of the automated drip irrigation system based on the combined principle is discussed.

According to the second task, the structural elements of the multifunctional robot control system were selected; A patent search was conducted on a designable multifunctional robot.

In 2022, the department was working on 3 tasks. Within the framework of task 1, the following was carried out: work on taking into account the temperature and humidity of the environment, environmental conditions (sunny, rainy, windy weather) in the system model; creation and testing of soil moisture determination transducer; Creation of a wind speed transducer.

In the direction of task 2, an algorithm for recording information about the path traveled in the robot's memory during movem ent was developed. Planning of the control system of the robot working with the obtained algorithm. The type of robot moving platform is selected.

Within the scope of task 3, the working experimental unit of the heat pump was processed, which consists of the, thermoreduct ion valve. In the institute, studies were conducted on the experimental device of the heat pump and the economic efficiency of th e said device was determined.

Employees of the department published 15 scientific articles, including 1 abroad. They participated in 2 conferences. A works hop was held. An annual scientific report was prepared.

III

Georgian language interface of dialogue systems

(Departments of Language Modelling)

Scientific field: Informatics;

Scientific sub-field: Computational Linguistics;

The Georgian language interface of dialog systems is a software system that carries out information search, reception and pro cessing.

2021

In the project, we used a new approach, according to which the semantic model of the GeWordNet database was processed to crea te an SQL corresponding to the user's Georgian query.

In accordance with the set plan, the experience of creating automatic text processing systems has been investigated and a con clusion has been reached that we should use an expert system based on the combined methods of object -oriented frames and production to form the linguistic knowledge base of the Georgian language.

We have developed an interactive dialogue system based on the templates of different proposal models, in which the algorithm for transforming a natural language query/request into an SQL query for intelligent search in the semantic database is realized.

2022

The structure of the dialogue system and the principles of its construction, as well as the criteria for evaluating the effectiveness of the system, were developed. The software was created, which was based on the semantic database model, the natural language dialog interface model, and the algorithms for determining the keywords of the query, according to which the software implementation of the dialog system with the Georgian language interface was implemented.

1 project funded by the Shota Rustaveli National Science Foundation is in progress. 12 scientific articles were published by employees. 4 reports were made at the international scientific conference. An annual scientific report was prepared.

IV

Development of a Medical Decision Support System to Solve the Problem of Diagnosing and Treating Rare Diseases

(Chavchanidze Department of Artificial Intelligence Problems)

Scientific: Informatics.

Scientific sub-field: artificial intelligence, models of intelligent information systems.

Within the framework of the project, the following tasks were performed in 2021:

- **Searching for medical clinical data about researched diseases and composing a formalized description of said diseases;**
- **Modeling of the primary diagnosis process in order to establish a preliminary diagnosis based on the patient's complaints and anamnesis;**

When developing an intelligent system, a cause-and-effect semantic network was used to represent knowledge, and a cause-and-effect analysis based on a semantic network was used to model the diagnostic process. On the basis of the developed methods, the software realization of primary diagnostic subsystem of the intelligent system was implemented in C++ language.

Within the framework of the project, the following tasks were performed in 2022:

- **Modeling the process of planning instrumental-laboratory studies based on anamnesis and preliminary diagnosis;**
- **Modeling of the differential diagnosis process based on the patient's anamnesis and instrumental-laboratory studies in order to determine the final diagnosis;**

When developing an intelligent system, a cause-and-effect semantic network was used to represent knowledge, a cause-and-effect analysis based on a semantic network was used to model the diagnostic process, and a multi-criteria decision-making method based on the theory of fuzzy sets was used to solve the research planning task. On the basis of the developed methods, the software realization of planning subsystem for instrumental-laboratory studies and differential diagnostic subsystem of the intelligent

V

Investigation of some problems of electric energy and power plants

V. Gomelauri Department of optimization of the power system structure and energy installations

Scientific field: Energetics. Optimization of the structure of the electric power system and power plants.

Task 1. The role of renewable energy resources in the electric energy of Georgia, taking into account the sharp instability o f prices for organic heating and environmental problems

Task 2. Experimental investigation of the effect of wall roughness on the power required for liquid mixing in a mixing device

2021

The first task. Statistical data and development trends of electric energy of the world countries were analyzed. The current level of Georgia's energy development was evaluated against the background of the world's electric energy development.

Estimated the expected demand for electricity in the coming decades and the ways to meet this demand. In particular, it was s hown that in the next two decades, due to the sharp increase in the demand for electricity, an annual increase in the capacity of the electric power system by no less than 5% will be necessary.

The second task. The latest literary data dedicated to the problem were analyzed. The aim and objectives of the research were established. The principal scheme of the experimental unit was worked out.

Separate nodes of the experimental unit were made. In particular, the body of the device, mixing device, surfaces with differ ent types of texture.

2022

The first task. The risks caused by the import of organic heating in the conditions of sharp instability of prices for organi c heating in the world were assessed and, based on this, local traditional and so-called the need for widespread use of non-traditional energy resources and energy-saving technologies in industry and utilities.

The mathematical model of the structure of power plants was specified, on the basis of which the optimization tasks were solv ed for the inertial, stagnant and innovative scenarios of the development of electricity, taking into account modern technological achievements.

The second task. An experimental setup with proper power supply and measurement systems and high precision measuring instruments was assembled. An algorithm and a corresponding program were created to process the experimental data. Test experiments were carried out for a smooth surface.

Experiments were carried out with different values of the height of the two-dimensional mesh elements and the BJ between the elements. Experiments were also conducted for different types of wall texture (longitudinal grooves, transverse grooves, combined texture and others).

In 2021 and 2022, 2 proceedings of the institute, N25 and N26, dedicated to the 100th anniversary of the establishment of the Technical University of Georgia, were published. The works relate to three main directions of the institute: control theory, control systems and devices, including control processes in energy systems, and informatics.

In the proceedings, the results of scientific research conducted by the employees of the institute (and other authors) are printed. In 2022, articles with the participation of students were published for the first time. Also 2 manual collections were published. Employees published 65 scientific works (including 4 abroad). They also participated in 15 scientific forums (including 3 abroad).

In 2021, 8 sessions of the Scientific Council were held and in 2022 – 10.

Scientific-Research Institute of Food Industry of Stu

Projects implemented under the 2018-2023 plan financed by the state budget

№	The name of the completed project, indicating the field of science and scientific direction	year	Head of the project	executor
1	Investigation of innovative technologies of Kolkhetian bio wine and bio alcoholic drinks. Investigation of Kolkhetian natural sparkling wine technology.	2018-2023	N.Baghaturia	E.Uturashvili M.Loladze E.Kalatozishvili M.Demeniuki I.Kekelidze

2	**Research of the citrus fruit processing innovative technologies**	**2018-2023**	**N.Baghaturia**	**G.Grigorashvili** **L.qajaia** **A.Khotivari** **M.Loladze** **E.Kalatozishvili** **M.Demeniuki**
3	**There were investigated the influence of bone-free grapes juice fermentation on** **the quality of white and red Kakhetian type wines.**	**2018-2023**	**N.Baghaturia**	**G.Grigorashvili** **L.qajaia** **A.Khotivari** **M.Loladze** **E.Kalatozishvili** **M.Demeniuki**
4	**Investigate the winemaking technology of Kakhetian type young wines**	**2018-2023**	**N.Baghaturia**	**E.Uturashvili** **M.Loladze** **I.Kekelidze**
5	**Research of the new technology of vodka production from Chacha**	**2018-2023**	**N.Baghaturia**	**E.Kalatozishvili** **N.Kherkheulidze**

				M.Loladze G.Grigorashvili
6	Work out the composition of spices for the boiled sausage production on the basis of Georgian spice-aromatic raw material, their production and usage technologies	2018-2023	N.Alkhanashvili	M.Demeniuki
7	Research of innovative technology of red semi-sweet wines enriched with antioxidants.	2018-2023	N.Ebelashvili	E.Uturashvili I.kekelidze
8	Working out the scientific development strategy in food and processing industry	2018-2023	N.Baghaturia	G.Baghaturia M.Loladze

1. Annotation. In recent years on the market appear more and more natural sparkling wines, which are made with the minimal intervention on human in vinification process. There are unfiltered sparkling wines with sediments. Because of naturality spa rkling wines price varies between 35-45 USD. To this group of sparkling wines belong so called Pet-Nat wines.

It is remarkable that the sparkling wines made with old Kolkhetian technology are more high quality than Franch Pet-Nat. Thus, Georgian winemaking should be developed not to the bio wine direction but Kolkhetian sparkling wine producing implementation way,

that will importantly increase the export ability of the country. The analysis of the presented data shows that in Georgian c onditions the alcoholic fermentation process passes very fast and it's difficult to catch the moment when the sugariness lows to 15 %. What's important on 2nd and 3rd day when spirit (alcohol) achieves 12-13%, red wine can not reach its maximal index. It occurs only on 9th – 10th day of alcoholic fermentation, in this connection during the processing of red as well as white grape it is advisable to ferment the wine completely (in qvevri or ground above fermentation vessel), bottle the fermented wine material, grape juice and yeast be adde d and here finish the wine-ageing for 2-9 months.

In the current year were conducted the laboratory research to make Georgian Pit-Nat red and white wines as well. Now the investigation of physico-chemical data of the received samples are in process.

2. Annotation. Every year in Georgia is collected 20-30 thousand tons of tangerine nonstandard fruits, which are used un-efficiently (receiving juice concentrate) or are not used at all and are thrown away. In the Institute there are conducted the research works to find the rational processing technologies for this secondary raw material.

There were conducted the research to make the bread natural additive from tangerine nonstandard fruits. There was established that the tangerine paste can be used in 10-20% of flour amount. It is remarkable that the tangerine paste is enriched with the low ly methoxylized pectin and vitamin – P.

3. Annotation. As a research object there were used Georgian white industrial type grapes – "Rkatsiteli" and "Manavi green" (Kakhetian) and red type grape "Saperavi". There are compared the chemical compositions of Rkatsiteli self-leaked and pressed fractions fermented on seed and seedless must. There was established that wine fermented on seeds are roughened by the containing of leuco-anthocyanin and other monomeric phenols. As the results show content of leuco-anthocyanins are more in the wines fermented on seeds. Herewith, the content of leuco-anthocyanins is so small in Rkatsiteli wines that taking the seeds off the must won't affect the quality of wine. From the data we see that in red wines the number of leuco-anthocyanins are more, so this substance importantly influences on wine quality.

In current year there were made (for the first time in world winemaking history) the Test sample machine taking the seeds off the raw red and white grapes.

4. Annotation. Experiments were conducted in the Test sample workshop of the Institute. Received wine samples were bottled in the December of the current year. In the current year works were continued to establish the seed influence and to receive the young wines from Georgian white type grapes. There were compared to each other Kakhetian green type grape wines that were received from the seedless grapes and grapes with seeds (one year data). Received date proves the fact that during the processing of this type of white grapes with Kakhetian way (grape juice fermentation of must), red type grapes – like Saperavi, presence of seeds in must significantly impacts on the quality of young wine i.e. during fermenting with seeds we receive the rough, bitter wine while the wine fermented on seedless must as well as wines received after fermenting the grape juice taken separately are characterized with softness and velvetiness, without rough taste.

The analysis of the presented date shows that the Kakhetian Green type grapes are wonderful raw material for making the high-quality young wines, during the processing as with Kakhetian way with European as well.

5. Annotation. Last year after investigation conducted by us there was established that ethyl alcohol amount consistent naturally reduces in the distilled fractions. What about admixtures – aldehydes and aethers, curves reflecting their content is not characterized with regularity that shows the chemical changes that occurs during the distillation by the influence of different factors. Movement of volatile admixtures to the distillate depends not only on the fermentation temperature and concentration but also on their solubility in water-alcohol solution. The last depends on the chemical composition of raw alcohol. In this regard the chemical composition of grape juice fermented on must is noticeably different from the one fermented with European way, this factor remarkably influences on the chemical composition and features of wine distillate.

Fusel oil is presented with the isoamyl, isobutyl and octile alcohols. From these the main component is isoamyl alcohol. From data it seems that fusel oil in the starting fractions firstly increases then decreases, reaches its minimal value, again collects in 5^{th} fraction, then naturally reduces and reaches the minimal value in last-distilled fractions. To the same naturality obeys the curve reflecting the isoamyl and other admixtures amount content.

There are presented the changes of chemical composition of distillate in the process of raw alcohol distillation. Analys of the organoleptic data of the received fractions showed that during the distillate distillation process the best quality distillate is received after taking oof the first 35%. The left last-distilled fraction should be distilled second time in order to get the additional amount of commodity (product) fraction.

It is known that last-distilled fractions consist of highly-fermenting alcohols from C_3 to C_{10} and β – phenol-ethyl in a big amount. This last gives to an alcohol the rose's aroma. In this connection secondary distillation of last-fermented fraction and its blending to the main product is necessary.

The existence of the curves expressing the admixture's consistence makes it possible to choose the fractions with the minimal consistence of the fusel oil and in the distillation process of distillate. With regarding the chemical composition and organ oleptic data it is advisable during the distillation to take off the fist-distillated fraction in 3% amount, middle-distillate outcome is 35%. What about the last distilled fraction it can be distillated second time in order to receive the additional amount of commodity output.

Chemical composition of the first distilled, middle distilled and last distilled fractions, analysis of which allows us to make the following conclusions and recommendations:

During the fractioning of the raw alcohol main quantity of high spirits are distributed among middle-distilled and last-distilled fractions;

Aldehydes (and among them acetic acid aldehyde) concentrate in the first-distilled fraction, then their consistence in fractions regularly decreases;

During the transferring of the raw alcohol also with big amount is presented the first-distilled fraction. Then comes middle-distilled fraction and in last-distilled fraction they are not at all.

Most part of toxic substance - methanol presents in the fist-distilled fraction and accordingly its quantitative content in the commodity fraction can be reduced to the norm during the distillation of raw alcohol, regulating the first-distilled fraction amount to be removed. In current year with the conducted works, for the first time there was established that existence of seeds in must negatively effects on the distillate's quality of the received wine. At present takes place the research with using the method of gas-liquid chromatography in order to determine the chemical composition of wine distillates obtained from must fermented with and without seeds.

6. Annotation. In Georgia conditions in order to dry the local raw mono-spices were used the five-conveyer drying device СПК-4 Г, Г-4 КСК, СКО made in Russian Federation, Belgorod.

Innovative technological device for drying and mixing the raw spices is made by amixon – (Germany). This firm produces multifunctional mixers, which in case of necessity provides the drying of spices. Given device provides the high quality of raw spice drying with the minimal duration of mixing.

In order to maintain the organoleptic characteristics maximally the dried mono-spices should be kept on 5-120 temperature and 65-70% relative humidity conditions; the storage where spices and spice compositions should be kept should be ventilated very well. Its advisable to use the hermetic packaging of mono-spices (each separately). The shelf life of dried mono-spices selected for boiled sausages is 1 year.

The technological scheme for the production of spices for boiled sausages consists of the following main processes: the getting of dried mono-spices, the preparation of mono-spices for mixing, mixing of components, packaging and packing.

Each component of mono-spices is got according to the relevant requirement of technical conditions.

Preparation of mono-spices for mixing. Inspection of dried, grinded mono-spices is separately done on the inspection transporter or on inspection tables. At this time, from the main mass of mono-spices are taken the damaged, roughened parts and alien admixtures.

Dried mono-spices are separately grinded on the hammer grinder (grinder КДМК-2, or on crushers ДКУ-УА,Ф-УМ, pepper miller ПП-01, or on other kinds of crushers).

Grinded mass of dried spices is separately sifted on sifter № 0,45 and № 0,95. The mass left on sifter is secondary crushed and sifted on the same sift. Crushing process continuous until the mass left on sifter № 0,95 is 2%, and the mass passed in sifter № 0,45 – not less than 80%.

In order to separate the metal-magnetic admixtures from the grinded mono-spices the sifted mono-spices are separately passed through the magnetic separator.

Before the composition is done the grinded mono-spices prepared with the abovesaid way are separately placed in four-layered craft-bags and keep in storage on 5-120 temperature and 65-70% relative humidity conditions.

Mixing the components to make the spice composition for the boiled sausages. Grinded, sifted mono-spices are weighed on ВЛТК-5 type quadratic electro weigh (with the measuring scale limits 0 – 5kg, grade of accuracy 0,2) according to the composition recipe and mix to each other in cylinder type mixer for 10-15 minutes until getting the uniform mass, after that the composition is weighed, packaged and packed.

While making the composition losses of grinded mono-spices after their weighing, mixing and packaging is 3,5%.

7. Annotation. Control sample was made with the existing (standard) technology: alcoholic fermentation of stalkless Saperavi must on 25-28^{0}C using dry yeast; pressing of fermenting must, when the amount of not-fermented sugar is up to 8-9%, staying of the fermenting grape juice on low temperature, taking the wine material off the sediment when the non-fermented sugar amount is up to 5% and its storage on low temperature using sulfurous dioxide (30mg/l).

Test sample №1 – heating the stalkless must on 65^{0}C, its alcoholic fermentation after chilling the must to 25^{0}C and the following technological processes were conducted similarly to the control sample;

Test sample №2 – taking the half of grape juice from the stalkless must volume, the alcoholic fermentation of the left must and following technological processes were conducted similarly to the control sample;

Test sample №3 - taking the half of grape juice from the stalkless must volume, heating the remained must on 65 ^{0}C, alcoholic fermentation after must is chilled to 25^{0}C and following technological processes were conducted similarly to the control sample;

Test sample №4 - taking 1/3 part of grape juice off the stalkless must volume, heating the remained must on 65 ^{0}C, alcoholic fermentation after must is chilled to 25^{0}C and following technological processes were conducted similarly to the control sample;

In current year (in third year after samples are made) investigated objects were decanted from sediment twice (once in 6 month) and investigation of their chemical characteristics (total amount of phenol substances, titreous acidity, volatile acidity, active acidity, alcohol, coloring intensity tonality).

Research results showed that due to wine stone formation and extraction process, the titratable acidity amount in third year of semi-sweet wine samples noticeably reduced, accordingly changed the active acidity amount. During third year slightly occurs change of volatile acidity and reduction of alcohol indexes; Reduction of alcohol must be explained with its participation in etherification process during storage. Also insignificantly reduces the sum amount of phenol substances, coloring intensity and tonality. Sum amount of phenol substances reduces as a result of rusting, polymerization, forming of protein-tannate and moving process of these components to sediment that runs with comparatively slow intensity on third year samples are made. With high compound of phenol components and better degustation indexes is characterized the test sample №3. During making of this one were used the technological ways: before alcoholic fermentation taking off the half of seedless must and warming up of left must on 65^{0}C. The total amount of total phenols in it is 2 times higher in comparison with control one.

At the end of third year after making phenol substances sum amount is higher than control sample, also in other test samples: in sample №1 – with 35%; sample №2 – with 88 %; in sample №4 - 1,8 times.

The research results of the current year as last years' research results showed that in the semi-sweet wine making technological process before alcoholic fermentation taking off the half of seedless must and warming up of left must on 650C significant ly increases the phenol substances concentration in wine that accordingly increases the prevention effect of cardiovascular, tumor and lot of other diseases.

8. Annotation. The main element of scientific research and development in Georgia are scientific-research institutions, which on 100% are based on governmental estate and belong to the corresponding profile universities as an independent structural unit. O n the same percentage ration its existence depends on governmental budget funds.

Data shows that from the counted countries in terms of funding Georgia is on the lowest level. Here in gross domestic product inner costs on scientific-research and trial-design works are not more than 0,3%.

As government is interested in the development of state-private partnership (SPP) forms and mechanisms, should provide the achievement of the following aims:

1. Growth of intellectual, technological, material and financial potential of education and science, as a term of country's e conomic stable growth;

2. Improvement of managing efficiency factors of science and high professional education, implementation of state funds with more efficiency;

3. Provision of competitiveness of high educational and scientific organization institutions, stimulate the approachment of f undamental and applied sciences;

4. Satisfaction of dynamic changing demand on labor market, strengthen the innovative component of education and science.

Institute Institute of Hydrometeorology Georgian Technikal University

Projects implemented under the 2018-2023 plan financed by the state budget

#	The name of the completed project, indicating the field of science and scientific direction	year	Head of the project	Project performers
1	IHM-19-38-GTU-CD-5702 Avalanche formation risks and possibility of taking anti-avalanche measures in mountain regions of Georgia Earth sciences and environment	2018	M. Salikvadze	T,Tsintsadze, S.Gorgijanidzeↄ, N.Kapanadze
	Annotation in English- To prevent loss of life and material damage, the risk of avalanches in the mountainous regions of Georgia is assessed. Considered the form of the avalanche action and taking into account the features of the object, the place of their holding is considered as well. 338 settlements and 13 passage roads in the mountainous regions of Georgia, which are threatened by avalanches from 1388 avalanche collection, were studied, as well as those anti-avalanche measures that would mitigate the catastrophic consequences of avalanches are given			
2	IHM-19-39- GTU-CD-5702 The forecast methodology of the period of lack of water flow in rivers for serving irrigation systems (for example river Alazani) Earth sciences and environment	2019	Ts.Basilashvili	G.Fifia
	Annotation in English- The paper deals with current problems of aridity and low waters. It describes water-forming factors of the river Alazani, their changes and expected values. It			

	gives refined parameters of water flow of the river Alazani and its tributaries, their long-term dynamics and expected trends. **The prognostic methodology is given, according to which the methods of long-term forecasts of average water discharge of the river Alazani are compiled for the growing season, for individual quarters and months at two hydraulic rams at the village of Birkiani and Shakriani where the sources of the main canals of the upper and lower Alazani irrigation system are located. According to the forecasts, conducting their safe and efficient operations is feasible. Based on the forecasts, plans are made for the rational use of water resources, which will lead to an increase in crop yields.** **The obtained forecasts and characteristics of the river water discharge will also greatly assist water supply specialists, hydropower engineers, other business and design organizations and allow them to properly conduct water management calculations**			
3	**IHM-19-40- GTU-CD-5702** **Study of climate, climatic and agroclimatic resources of certain administrative regions of Georgia. 8. Racha-Lechkhumi, Kvemo Svaneti** **Earth sciences and environment**	**2019**	**E.Elizbasrashvili**	**G.Meladze,** **R.Samukashvili,** **J.Vachnadze,** **M.Meladze,** **L.Kartvelishvili,** **M.Elizbarashvili,** **N.Chelidze,** **M.Fifia,** **N.Shavishvili,** **Ts.Diasamidze**

	Annotation in English- The main factors shaping the climate of Racha-Lechkhumi Kvemo Svaneti were studied: topography, atmospheric radiation factors, circulation processes; regularities of the territorial distribution of the main climatic elements: air temperature and humidity, atmospheric precipitation, snow cover, wind; potential of climatic resources: resort, helio and wind energy resources; considerable attention is paid to agroclimatic resources and forecasts; considered dangerous weather phenomena: strong winds, blizzards, fogs, intense and heavy rainfall, frosts			
4	**IHM-19-41- GTU-CD-5702** **Model calculations of the air flow kinetic energy when stream interacts with the local relief (for certain regions of Georgia)** **Earth sciences and environment**	**2019**	**M.Tatishvili**	**Z.Xhvedelidze**
	Annotation in English- One of the most important problems of modernity, both from a scientific also from an industrial and practical point of view, is the study of the climatic features of local regions on the background of global warming. Based on continuous operational data, it has been established that the climate of some local regions is very different from surrounding area climate. This circumstance is mainly related to the relief shape and dynamic processes caused by it. The determination of relief influence parameters and their analysis is very relevant, important and has great applied value. A hydrodynamic approach was used to explain and justify the microcirculation processes developing in pits in Georgia, in particular, in the Akhaltsikhe concave. The parameters characteristic of the region's relief are estimated and the orographic vertical speed is calculated. Based on the statistical processing of long-term meteorological data, the climatic features of the concaves and the dynamics nature are established. These features were explained by model calculations. Such a study was carried out for the first time throughout the territory of the Akhaltsikhe Municipality			

5	**IHM-19-42- GTU-CD-5702** **Determination of background concentrations of heavy metals in ecosystems and estimation the ecological state in the urbanization centers using numerical modeling and natural observations in the regions of active impacts of East Georgia** **Earth sciences and environment**	**2019**	**L.Intskirveli,** **A.Surmava**	**L.Shavliashvili,** **N.Buachdze,** **G.Gunia,** **G.Kichave,** **G.Kordzaxhia,** **N.Beglarashvili,** **M.Tabatadze,** **N.Dvalishvili,** **S.Mdivani,** **E.Shubladze,** **N.Gigsauri.,** **M.Xhatiashvili,** **A.Giorgishvili.**
	Annotation in English- connection with the resumption of work of active exposure to hail clouds in Eastern Georgia the content of some heavy metals (Cu, Pb, Ag) in the soils and surface waters of this region was studied. It was established that the content of heavy metals in the waters of water bodies is within normal limits. The content of copper and lead in soils is much higher in the 0-10 cm layer than in the 10-20 cm and often exceeds the value of the corresponding clarke. Silver content is low and it ranges between tenth and hundredths (mg/kg). A mathematical model of the evolution of atmospheric processes and the spread of dust is processed in the central part of Eastern Georgia. Four meteorological situations are discussed: background stationary east, west, north and south winds cases. It was found that dust is concentrated in the area of the contamination point itself.			

	The spatial distribution of urban dust in the atmosphere is influenced to a certain extent by the change in time of air flows and turbulence. In the air, dust spreads over a large part of the region. Nevertheless, dust concentrations of more than 0.1 of the MPC were obtained only in the vicinity of the cities - Tbilisi and Rustavi. The vertical area of dust distribution is limited by the boundary layer of the atmosphere, above it in the free atmosphere dust content is obtained only in the form of individual spots			
6	**IHM-20-43- GTU-CD-5702** **Study of Georgian Glacier degradation and prediction of their melting due to modern climate change** **Earth sciences and environment**	**2020**	**L.Shengelioa**	**G.Kordzaxhia,** **G.Tvauri,** **M.Dzadzamia,** **V.Tsomaia.**
	Annotation in English- The current climate change has the significant negative impact on Georgia's glaciers and causes their rapid degradation. This is clearly manifested in: **1. Melting statistics of small glaciers (area from 0.1 to 0.5 km^2);** **2. Changes in the characteristics of glacial basins (number and area of glaciers);** **3. Degradation and retreat of large glaciers (area> 2 km^2).** **Accordingly, the melting statistics of small glaciers in eastern and western Georgia (chapter 4), changes in the characteristics of glacial basins (chapter 5) and degradation of large glaciers (chapter 6) due to modern climate change have been studied in detail.** **Based on the project outcomes about all major characteristics of the glaciers of Georgia were identified. The degradation of the glaciers in Georgia due to the influence of the current climate change has been investigated. The melting of large glaciers is discussed thoroughly and the methodology has been developed to predict their complete melting.**			
7	**IHM-20-44- GTU-CD-5702**	**2020**	**M.Tatishvili**	**Z.Xhvedelidze,**

	Development of regional multimodel weather and climate forecasting methods for Georgian conditions **Earth sciences and environment**			**I.Samxharadze,** **D.Demetrashvili,** **I.Mkurnalidze.** **A.Falavandishvili.**

Annotation in English- Solar Flares, Coronal Mass Ejections (CMEs), Solar Energetic Particles (SEPs) are the drivers of the Space Weather effect in Geo-Space. They can produce the following affects: electrostatic spacecraft charging, shifting of the Van Allen radiation belt, space track errors, launch trajectory errors, radar errors, radio propagation anomalies, electrical power blackouts, oil and gas pipeline corrosion, communication landline and equipment damage, electrical shock hazard, electrical fires, heart attacks, and traffic accidents..

The aim was to investigate a possible effect of powerful magnetospheric storms on the evolution character of meteorological processes in the atmosphere to study the correlation between magnetospheric disturbances and meteorological variations. Meteorological effects resulting from fluctuations in the solar wind are presently poorly represented in weather and climate models.

Geomagnetic indices are measure of geomagnetic activity occurring over short periods of time. They have been constructed to study the response of the Earth's ionosphere and magnetosphere to changes in solar activity. To conduct correlation analysis dst, kp kp geo-magnetic index and pre and after storm 3 days meteorological observation data for weather parameters (temperature, precipitation, pressure) and synoptical maps were used. The wave function model for the collision of particles in the atmosphere with a resonant exchange photon is developed. For atmosphere particles -clusters, the equation of the interaction potential for the Van -der -Waals force between the macroparticles is obtained. The atmosphere is thought of as a unity of clusters at different energetic levels that interact through energy absorption and radiation. The Earth's environment is one of the possible

	sources of renewable energy, the use of which is the possibility of switching to new energy carriers			
8	**IHM-21-45- GTU-CD-7134** **Develop climate change adaptation strategies to create integrated water resources management systems for individual river basins (e.g. Iori Rivers).** **Earth sciences and environment**	**2021**	**T.Tsintsadze**	**N.Kapanadze,** **N.Tsintsadze,** **S.Mdivani,** **N.Zotikishvili,** **N.Xhufenia.**
	Annotation in English- The origin of the concept of river basin integrated management and evolution history is discussed. Typical functions of river basins and integrated control mechanisms are studied. On the case of world experience the introducing possibility of the theoretical foundations, goals and objectives of river basin integrated management in practice has been shown. **The relief, climate, soil, infrastructure, local energy resources, groundwater, biodiversity, population and livestock statistics of Iori water-using municipalities - Tianeti, Sagarejo, Dedoplistskaro and Sighnaghi are discussed and analyzed.** **Hydrometeorological survey of the Iori River Basin, divided into three parts according to characteristics and riverbed, has been carried out with the help of both meteorological stations and satellite data. The impact of human activities on the Iori River Basin has been identified. Different types of pressure and their causes are specified.** **Based on international experience, a pilot model for basin management for the Iori River has been proposed.** **The impact of the expected climate change on the economy of the municipalities in the Iori River Basin is studied and appropriate adaptation measures are presented.**			

	Taking into account the effectiveness of works on artificial increase in precipitation in the Iori river basin in the period from 1979 to 1990, it is shown that the prospects for the restoration of these works are one of the main means of adaptation to the expected climate change. **In the Iori River Basin, with the restoration of artificial rainfall enhancement work, along with integrated water resources management, the possibility of replenishing these resources through artificial impact on clouds will be explored, which will be one of the most effective ways to adapt to projected climate change by the end of this century**			
9	**IIHM-22-46- GTU-CD-7171** **Investigation of pollution with PM particles in the cities of Tbilisi, Rustavi and their surrounding areas** **Earth sciences and environment**	**2022**	**A.Surmava, N.Gigauri., N.Beglarishvili**	**.Shavliashvili, N.Buachdze, G.Gunia, G.Kichave, G.Kordzaxhia, N.Beglarashvili, M.Tabatadze, N.Dvalishvili, S.Mdivani, E.Shubladze, N.Gigsauri., M.Xhatiashvili, A.Giorgishvili**
	Annotation in English- The paper studied the distribution of one of the most important pollutants - microparticles (PM2.5 and PM10) in the atmosphere of the Georgian cities of			

	Tbilisi, Rustavi and their environs. The problem is investigated on the basis of experimental measurement data and numerical simulation.The work used the official data of atmospheric air quality monitoring of the National Environmental Agency and the results of studies conducted at the Institutes of Geophysics M. Nodia of TSU named Iv.Javakhishvili and GTU Hydrometeorology.The analysis of atmospheric pollution by microparticles was carried out according to field observations.A brief review of the study of atmospheric air pollution by microaerosols is given, as well as a system of equations describing the distribution of pollutants in the atmosphere on the territory of a region with a complex terrain, method for determining meteorological fields and concentrations in the surface layer of the atmosphere, numerical integration algorithm.It is concluded that the concentrations of PM2.5 particles in the atmosphere of Tbilisi and Rustavi are usually lower than the concentrations of PM10, but the nature of the curve of their change is the same.The trend of hourly change in concentrations of PM particles was studied. The impact of the pandemic on the decrease in the concentration of dust particles in the atmosphere of cities was revealed, and that the main contribution to the pollution of the atmosphere of Tbilisi with PM particles is made by road transport, while the pollution of the atmosphere of Rustavi is made by vehicles and cement production enterprises.Numerical simulation was used to study the local distribution of microparticles in the cities of Tbilisi and Rustavi under the background winds of the northern, southern, eastern and western directions. It was found that the temporal and spatial changes in the concentrations of microaerosols in the atmosphere of the cities of Tbilisi and Rustavi are complex. It depends both on the presence of sources of atmospheric pollution and the intensity of dispersion of the ingredient in space, and on local meteorological processes that are formed under the influence of the terrain			
10	IHM-22-47- GTU-CD-7170 Dynamics of atmospheric microcirculation processes and climatic features in certain regions of Georgia Earth sciences and environment	2022	Z.Xhvedelidze, M.Tatishvili	N.Kapanadze, L.Shengelia, I.Samxharadze, I.Mkurnalidze,

				D.Demetrashvili, **A.Falavandishvili,** **N.Zotikishvili.**
	Annotation in English- There are many micro-regions on Earth in which the study of developed hydrometeorological processes is important and has great practical value. Such regions include various caverns, highways, open quarry work areas, hydropower plant construction area. A special theoretical and model approach to study of local events in such areas in order to set a task is given in the paper. The mathematical basis of this approach is presented; sample examples and calculation procedures are given. The presented materials and obtained results are important for conducting further studies, have practical value and are recommended to be taken into account when carrying out various activities in the local area of similar terrai			
11	**IHM-22-48-GTU-CD-7208** **Snowless winters in the mountainous regions of Georgia, avalanche hazard problems** **and forecasting methods.** **Earth sciences and environment**	**2022**	**M.Salukvadze**	**T.Tsintsadze,** **N.Kapanadze.**
	Annotation in English- One of the most effective measures to combat avalanches is to inform the municipalities and the population in the avalanche zone about the time and place of avalanches. Timely forecasting will mitigate the material damage caused by avalanches and prevent human casualties. **The peculiarities of snow cover are discussed, especially in the snow-free and snow-free mountainous regions of Georgia, as well as the synoptic processes determining this event. The focus is especially on snowy winters, when massive avalanches followed devastation,**			

	huge material losses, and human casualties. The conditions for the breakdown of snow cover stability and its impact on avalanches are discussed. Types of avalanche predictions are presented: mainly deterministic, synoptic, avalanches caused by snow or snow storms, long-lasting avalanches, wet avalanches, new snow avalanches, massive arrivals of avalanches, impact of avalanches on solar activity and avalanche activity. Methods of predicting avalanches for snowy mountainous areas

Institute of Hydrogeology and Engineering Geology

2018 ÷ 2023 implemented projects financed by the state budget

№	The name of the completed and current project, indicating the field of science and scientific direction	Year	Head of the project	Project performers
	"Research of hydrogeological and engineering geological problems of Georgia for the purpose of rational use of resources and environmental protection" Current project	2023-2027	Z. Kakulia	The scientific staff of the Institute
1	I sub-project "Research of mineral waters of the intermountain depression of		B. Mkheidze	L. Glonti A. Songulashvili

	Georgia in order to determine their hydrochemical characteristics and resource potential" Current project			I. Nanadze M. Kopadze L. Khvichia
2	II sub-project "Study of the current state of deposits of thermal waters of Georgia and assessment of chemical composition in order to extract elements" Current project		M. Mardashova	G. Tlashadze L. Khvichia T. Miqava
3	III sub-project "Engineering-geological survey of the Natakhtari-Mleti section of the Georgian military road for the purpose of traffic safety" Current project		Z. Varazashvili	Z. Kakulia G. Gaphrindashvili D. Chutkerashvili I. Ramishvili N. Qebadze O. Oqriashvili
4	IV sub-project "The use of mathematical-cartographic modeling for the		D. Abzianidze	N. Kezevadze V. Abzianidze

	assessment and analysis of the ecological condition of rivers (on the example of Rion River)" Current project			L. Khvichia T. Dzadzamia G. Zadishvili
	"Research of hydrogeological and engineering geological problems of Georgia for the purpose of rational use of resources and environmental protection"	2018-2022	Z. Kakulia	The scientific staff of the Institute
5	I sub-project "Research on the resource potential of mineral waters of the mountainous regions of Georgia"	2018-2022	B. Mkheidze	M. Mardashova L. Glonti A. Songulashvili I. Nanadze M. Kopadze L. Khvichia G. Omsarashvili
6	II sub-project: "Engineering-geological research of liossi rocks in the territory of Georgia for the purpose of rational utilization of territories"	2018-2022	Z. Varazashvili	G. Chokhonelidze Z. Kakulia D. Chutkerashvili N. Qebadze

7	**III sub-project: "Research of the modern engineering-geological conditions of the coastal area of the Adjara Sea in relation to the protection of the geological environment"**	**2018-2022**	**G. Iashvili**	**N. Kezevadze** **O. Okriashvili**
8	**IV sub-project: "Using mathematical ecology methods to solve the problems of river water pollution with toxic metals"**	**2020-2022**	**D. Abzianidze**	**M. Mardashova** **V. Abzianidze** **A. Songulashvili** **T. Lomidze** **L. Khvichia** **T. Dzadzamia** **G. Zadishvili**

TsotneMirtskhulava Water Management Institute of the Georgian Technical University

Projects implemented under the 2018-2023 plan financed by the state budget

№	The name of the completed project, indicating the field of science and scientific direction	Year	Head of project	Project performers
1.	Name of the program: "Modern environmental protection and water management". Researching problems in the context of climate change" 2.1.5 Earth and related environment learning sciences 2.4. Agricultural Sciences 0415 Agricultural Engineering	2015 – 2019	Givi Gavardashvili	The full scientific staff of the institute

Annotation

The following scientific researches were carried out in the institute within the framework of program financing:

- The hydrodynamic model for determining the shearing force of a link tidal flow moving in a wave mode is discussed. It is noted that in many cases the linked tidal flow moves on the free surface of the flow in the form of unstable movement, long continuous waves are formed or the wave takes the form of a monosol. Research conducted in recent years has shown that the speed of a long, continuous wave is three times the average speed of the live section of an even moving stream. It has been determined that in order to reduce the impact force of the flood on the structure, it is necessary to give the pressure side of the flood retaining structure an inclined face (wedge shape) that approaches a springboard type structure. The necessity of hydraulic modeling of the link flood in order to test it in the hydraulic laboratory of the flood, whose special hydraulic installation is located at the Technical University of Georgia, is discussed. in the Tsotne Mirtskhulava Water Management Institute. Once we know the value of the kinematic coefficient of the necessary viscosity of the model flood flow, by observing the appropriate geometric parameters of the test anti-flood springboard type building model, we will have the opportunity to conduct a long-term continuous observation of the large-scale model of the building using the appropriate model (working) fluid - flood.

- **Existing materials were searched around the research issue; Three pilot catchment basins were selected for research: Rion River, Aragvi River and Vere River; An analysis of flood statistics has been carried out and a search for hydrometeorological data has been initiated for the calculation of forecast indicators of floods and landslides. At this stage of the research, the river has been completely studied. Vere basin and the estimated values of the maximum costs are established. Work is currently underway to determine one of the main parameters in the flood reporting methodology - the area of the catchment basin.**

- **Studies of the scale and dynamics of sedimentation and erosion processes were carried out on the reservoirs of Sion and Zhinvali, the data of which were collected during field**

	work. The theoretical results of this direction are presented in the form of forecast graphs and empirical relationships. · **The analysis and evaluation of the rules of technical operation of irrigation systems of Georgia is presented; The modern state of operation of irrigation systems is described in detail, the water resources of Georgia, irrigated areas and their water supply, the main principles of technical operation of irrigation systems, their purpose and costs are discussed; modern state of water use and water consumption; Measures for the maintenance of irrigation systems are discussed, including the rules for the operation of main and other distribution channels and collectors; Issues of amortization of production funds of reclamation exploitation organizations of Georgia are discussed.** · **An assessment of the current state of the drying systems of Georgia is proposed, the purpose of the drying systems of Kolkheti and the requirements for effective functioning, the main measures of the technical operation of the drying systems and their planning methods are described.**

2	**Name of the program: "Security and integrated management of water resources in view of climate change"** **0712.1.1 - environmental engineering;** **0532.1.3 - Geology;** **0532.1.1 - Earth sciences;** **0532.2.1 - Geographical s** **Information systems technologies;** **0532.2.2 - hydrology;** **0532.2.3 - atmospheric sciences;** **0532.2.4 - Hydrogeology**	**2020-2025**	**Givi Gavardashvili**	**The full scientific staff of the institute**

Annotation

The following scientific researchers were carried out in the institute within the framework of program financing:

- **Assessment of the ecological condition of the coastal and mountain reservoir systems of the Black Sea of Georgia caused by climate change and anthropogenic impact;**
- **Management principles of Georgian water resources, natural disasters and development of innovative embankment anti-erosion and waterproofing technologies;**
- **Based on the obtained results, the connections between the dimensions of the irrigation strips and the potential of the irrigation flow are established, taking into account the possibility of full use of water, taking into account the irrigation norm and duration of irrigation;**
- **Models have been selected that take into account the possibility of changing the modes of water movement on the area, supplying the required amount of water to the irrigated fields, and evenly distributing the irrigation water;**
- **The form of free surface forms of irrigation water moving on the area is evaluated in relation to water consumption, time, water content, physical-mechanical characteristics of the soil;**
- **The possibilities of the presence of bound water in the pores of the soil and their influence on the change thresholds of the irrigation characteristics are substantiated;**
- **The possibilities of movement and migration of water on the irrigated area are derived, taking into account the bound water in the soil;**
- **In order to supply water to the irrigated area without loss, a completely new calculation relationship of the irrigation norm in connection with the characteristics of the irrigation water is derived;**

	· Taking into account the anomaly, the ranges and possibilities of changes in the cost of supplied irrigation water are specified, and based on the erosive capabilities of the soil in irrigated farming, the limits of the norm to be supplied to the area of the irrigation cost are specified; · Measures for cleaning drying channels from sedimentation and elimination of deformation of channels were discussed; · The evaluation of natural catastrophic events and the quantification of their parameters was carried out, which is then considered as a determining factor of engineering decisions and plays a special role in the establishment of a decentralized infrastructure of a sustainable environment. It was determined that in order to determine the power of floods and their dynamic impact on structures of various purposes, the determination of the average diameter of sediments transported by the flood is of great importance.

Georgian Technical University,

Biotechnology Center

Projects-2023

“Biodiversity, development of grapevine and fruit storage technologies and use of in vitro biotechnological methods for agricultural crops for their further introduction in Georgia".

1."Preservation- update of potato in vitro plants - (collection) and the study of the adaptability of new varieties in the geographical and climatic conditions of Georgia."

Since 1992, virus-free potatoes in vitro collection have been established and located at the Biotechnology Center. During many years, the collection is constantly updated and reproduced. Because different, high-quality hybrid varieties of potatoes are introduced to

Georgia every year, and keeping them in the collection is a high priority. Not only for the center of biotechnology, but also for the country. Tissue technology is effective for obtaining virus-free products that are characterized by the ability of vegetative propagation.

Tissue technology - the practical importance of microclonal propagation of plants lies in the fact that the mentioned technology ensures the production of planting and seed material that is healthy from viruses with a high multiplication coefficient. Meristem cell culture involves the isolation of the apical meristem, which is located at the tip of vegetative organs and is free from viral infections. The method of tissue cultures is based on in vitro cultivation of organs, tissues, cells and isolated protoplasts. Such technology can facilitate and speed up the traditional process of adopting new varieties and species. It offers fundamentally new ways, namely mutagenesis at the cellular level, cellular selection, and somatic hybridization.

Tissue technology, the process of virus-free clonal propagation consists of three stages: 1. Separation of explants from the original plant tissue. At this stage, it is necessary to obtain virus free cultures, to save the explants in the MS medium, to adapt and grow quickly; 2. Micropropagation ; 3. Rooting.

One of the important stages of obtaining strong in vitro plants is the selection of optimal medium for several varieties, which ensures the maximum parameters of plant in vitro development and their productivity in the future.

In 2023, the influence of a quantitatively different combination of vitamins (B1, B6) on the growth and development of medium-late growing potato varieties "Picasso" and "Amorosa" in the collection was studied under in vitro conditions, based on Murashige-Skuge (MS medium) medium.

On the parameters of morphogenesis (height, number of nodes, root system), the combination of vitamins B6 3.0 mg/l + B1 1.5 mg/l was the best for these potato varieties. Such a combination of vitamins in the MS medium, in the case of both varieties gave us plants with well-developed strong stem and root system, with 6-7 internodes after 20 days of cultivation.

During the research, the positive influence of different vitamins on plant morphogenesis parameters was study. The best vitamin combination was selected for each potato variety. Thus, when using different concentrations of vitamins in the medium, specific morphological development was showed which is directly related to morpho-botanical features.

This indicates that the realization of the potential of the cultivars is directly related to their genotype and type of medium.

Among virus-free in vitro potato collection, there is a sweet potato variety - "Jewel". This year, for better development of the sweet potato in vitro plant (leaves, stem, roots), we have developed a modified medium based on Murashige-Skuge (MS) medium. To improve

the quality of microclones, it is necessary to optimize the technology at each stage of clonal micro propagation. (Medium, p hytotron condition, types of sterilization).

Modification of medium is mainly assosiated by changing the concentration of sugar and growth hormones (6-benzylaminopurine (BAP) and indoleacetic acid). Namely, 9% sugar/l+ 300µl/6 benzylaminopurine+ 250µl/indoleacetic acid+ 100µl/l zeatin).

This change allowed us to established in vitro plants in 17-19 days instead of 25-30 days, which are characterized by a strong root system, a well-developed stem and large leaves.

At this stage, the BiotechnologyCenter found new varieties of potatoes in Akhaltsikhe village Skvilis: "Sofia", "Arizona", "Queen Anna", B-1, "Donata", "Spectra", "Varuna". In the first stage, the mentioned varieties were washed in warm water, then they were washed with cold water for 15 minutes, after drying, they were treated with 70% ethanol and quickly rinsed with water. The last stag e was to treat them with distilled water. The tubers were dried in laminar-bactericidal boxes, usually at room temperature and stored in the laboratory. After testing for viruses, it will be possible to establish in vitro culture, in case of infection, such a healin g method as thermotherapy + apical meristem method will be used depending on the botanical-morphological features of the varieties.

We have studied the adaptation of potato varieties ("Amorosa", "Jelly") spreading in the village of Akhashen, Tsalki region i n relation to the local climatic conditions. It was found that "Jelly" is better adapted to climatic conditions than "Amorosa", wh ich was reflected in the timely completion of its complete vegetation (which is typical for the variety) and yield.

2."Survey of potato viral infections according to EPPO standards in different regions of Georgia." (Agrarian filed).

The high yield of potatoes is directly related to the quality of seed potatoes, the main determining factor of which is viral infections. Potato viruses are one of the dangerous pathogens that can have a negative impact on yield. Symptoms caused by viruses are varied and depend on the potato variety, virus strain, location above sea level and the presence of the vector (insect). It is very important that the propagating material is virus free and that this status is more or less maintained during the period of their propagation.

According to the standards of the International Plant Protection Organization, potato seed material must be free from the 6 v iruses: A, Y-, X-, S-, M-potato viruses and potato leaf curl virus (PLRV).

The purpose of the study is to study potato virus diseases in Tsalki and Akhalkalaki regions according to potato varieties, i n order to select virus-free seed material and increase yield in Georgia.

According to the protocol of the International Plant Protection Organization, potato varieties "Sante", "Jelly", "Picasso" were tested for 6 types of viral infections: Potato virus A (PVA), Potato virus M (PVM), Potato virus S (PVS), Potato virus X (PVX), Potato virus Y (PVY) and potato leaf roll virus (PLRV) using Double Antibody Sandwich-Enzyme linked Immunosorbent Assay (DAS-ELISA) method. The study was conducted by commercial kits of BIOREBA(Switzerland).Results were measured at 405/450 nm using Stat Fax 2100 Microplate Reader (DOTMED®, USA) spectrophotometer. We also used LAMP- loop mediated isothermal amplification methods for more accuracy, the results were measured on a Bioranger PCR machine.

The potato seed material of Tsalki and Akhaltsikhe regions was studied, the research material was provided by local farmers, with whom the STU Biotechnology Center has constant contact.

Based on the request of the local farmers, the Biotechnology Center reproduces in vitro plants from the potato collection, grows them in the laboratory and transfers them to the farmers for the study of adaptation of the varieties and the production of seed material. The Biotechnology Center monitors both the production of potato seeds in the open filed and their virus infections. The elite seed material obtained in this way is healthy and virus-free, which leads to a significant increase in yield.

Within this research, the potato varieties "Sante", "Jelly", "Picasso" were tested for potato viral infections.

As expected, PVY virus infection is the most prevalent (70% of the examined samples), followed by PVX virus infection (45%), and PVS infection (2%) was observed in only one sample. Other pathogens causing viral diseases were not confirmed.

It was found that the variety "Sante" is most infected with PVY virus (83%), "Jelly" with PVY and PVX virus infection respectively 45% and 27%, and 28% were found to be virus-free. "50% of Picasso is infected with PVY virus, and 50% is completely healthy.

It should be noted that virus Y (PVY) is one of the most severe potato viruses in terms of impact on yield reduction, so seed material should be selected and tested for this virus infection at all stage of propagation.

The research continues, the study of the ability of new varieties to adapt to the geographical and climatic conditions of Georgia will allow us to provide farmers in different regions with complete information and recommendations on the adaptability of the introduced variety to the climatic conditions of their region, which will allow them to choose potato varieties with maximum yield, which will improve their economic status.

The local farmers in Georgia will have the opportunity to save their finances to purchase the seed material of potatoes that will be profitable for them from an economic point of view.

Biotechnology Center was conducted the study to evaluate the effect of thermotherapy with the combination of apical meristem culture on the four potato varieties "Picasso", "Raya", "Santé" and 'Arizona" infected with Potato virus M (PVM) in Georgia. Tree types of temperature: 330C, 360C, 390C with combination of 2, 3 and 4 h exposure were used for thermotherapy on the four potato varieties "Picasso", "Raya", "Santé" and "Arizona" infected with Potato virus M. After 27 days Enzyme-linked immune sorbent assay (DAS-ELISA) were used to evaluate the virus infection rate. The most effective result (100% virus eradication) was obtained by temperature- 360C with 2h exposure during 27 days for potato varieties "Picasso" and "Raya". Results show that on treatment 360C/4h during 27 days was effective for potato varieties "Sante" and "Arizona". Sprouts generated on 390C with 4h exposure started to degrade due to heat. Based on the results virus free potato accessions were added collection of Biotechnology Center.

Establish in vitro potatoes culture using the apical meristem method along with heat treatment allow us to obtain virus-free material. The original material of cultivars propagated in developed countries is kept in sterile culture by clonal propagation and finally, a controlled, virus and bacterial pathogen-free, potato seed is obtained.

3. Biodiversity of Useful or Medicinal, Aromatic, Melliferous, Dye, Spicy and Poisonous Plants, Monitoring, Cultivation Technologies, Improvement and Conservation of Phytogenetic Resources, Ethnobotanical Skills, Prospects of Sustainable Use

The rich and unique phytogenetic fund of Georgia represents a natural-historical treasure and requires permanent conservation-rehabilitation, as it progressively exterminates or changes under the influence of various natural disasters, genetical erosion or anthropological impacts. The problem is important to our country while the number of cultural plants and their wild ancestors originate in Georgia as it is their primary and secondary source hearth of origin. There is spread the unique medical, aromatic, spicy and poisonous plants in Georgia which cannot be found anywhere in the world. Due to their current state, most of these plants are on the verge of extinction. The erosive processes of genetic resources and uncontrolled export / import are going on. Therefore, it is necessary to preserve a biodiversity through ensuring *in-situ and ex-situ/on farm*. For the purposes of further consumption, raising awareness in conservation of genetic and varietal diversity and rational usage of the unique flora of Georgia is gaining the most importance. This can be observed along, with intensification and sustainable use of ethno-botanical traditions and promotion of phyto-production, based on the rights acquired from the Georgia biodiversity convention, through integration of the benefits distribution principles.

Due to this purpose, the following project is being developed at the Biotechnology Center of the Technical University of Georgia: "Biodiversity of Useful or Medicinal, Aromatic, Melliferous, Dye, Spicy and Poisonous Plants, Monitoring, Cultivation Technologies, Improvement and Conservation of Phytogenetic Resources, Ethnobotanical Skills, Prospects of Sustainable Use".

At the Faculty of Agricultural Sciences and Biosystems Engineering of the Technical University of Georgia is leading accredited master's educational program "Medicinal Plant Cultivation Technology".

More than 10 scientific works have been published around the existing project, including: one book -catalogue. A data bank of useful (medicinal, aromatic, spicy, dye, melliferous and poisonous) plants distributed in Georgia with photos taken in their natura l conditions, the condition of genetic resources in a number of regions is investigated, the recommendations for cultivation and sustainabl e use are distributed - meetings and consultations are held for the purpose of sustainable use, including with foreig ners (Koreans). The research results have been demonstrated both at local (Batumi, Telavi, Tbilisi) and international conferences (India, Ukraine, Italy).

Since 2002, the project leadind has been participating in the project of the working group of the European corporation EC/PGR on the genetic resource of medicinal and aromatic plants, the head of the project is the representative of this corporation in Ge orgia;

1 academic doctor and 1 master's degree were prepared by the head of the project. Currently, two PhD students and three maste r's students participate in the implementation of the mentioned topic.

The bioresources of the unique plant - *Prúnus laurocérasus*, widespread in Georgia (13 thousand hectares in the wild), quality indicators and practical prospects for their use were studied. *Prúnus laurocérasus* as an exotic fruit, jam, comfiture, as a natural food coloring - processing technologies. Promoting local biodiversity products is relevant for tourism development prospects.

Issued during the reporting period book - catalogue presents the complex model of protection -conservation-monitoring, cultivation - production and differentiation of qualitative indicators of the biodiversity of useful or medicinal, aromatic, melliferous, dye, spicy and poisonous plants, specifying their further protection -conservation and improvement parameters, and on the other hand, their public - economic importance and the necessity of economic rehabilitation for placement - development in the soil-climatic conditions of Georgia, i.e. creation of industrial plantations and seed bank for the balancing and rational use of biodiversity. Country's unique ethnobotanical skills and their importance are differentiated.

4. Use of biopreparations against low fertile soil and root pathogenic microorganisms for agricultural crops in order to obtain a healthy environment and ecologically clean product.

The goal of the first year's research is to increase the fertility of barren soil and to use a biopreparation produced in Geo rgia to reduce the pathogens of the plant's root system. For this, we must study the microflora of the soil and the microorganis ms present in it, both pathogens and soil fertility determinants.

In the first year of implementation of the topic, we selected a less fertile soil, studied its climatic and soil conditions, because during the determination of microbiological activity and energy of the soil, it is important to study the processes of a mmonification,

nitrification, denitrification, nitrogen fixation in the soil and their comparison with the corresponding forms of bacteria, which will give us a certain idea of the microbiological activity in the soil and biological processes.

Before the start of the production trial, we carried out preparatory work. We got acquainted with the literature on the topic , we discussed various methods for studying the mentioned issue. We prepared the necessary equipment and reagents for the test. We selected the region and the less fertile soil of the village in the private farm of Patara Lilo, which is located in Samgori Valley and belongs to Samgori District. It is located at an altitude of 750 m above sea level. The research soil is black soil, which contains a small amount of humus and carbonates. The soil reaction is neutral, sometimes slightly alkaline. We considered it expedient to use the biopreparation made in Georgia, which we have signed with the company Bioagro Plant Protection Center b y means of a memorandum of understanding. The Samgori Valley is characterized by a moderately humid, subtropical climate, with moderately warm winter s and hot summers. The average annual air temperature is 12.70C. Precipitation - 518 mm per year. There is abundant precipitation in May - 90 mm; Small precipitation in January - 22 mm. Therefore, according to the topic, we start research works in the spring.

5.Characterization of promising varieties of persimmons and pomegranates spread in Georgia according to biochemical parameters and nutritional value, study of their storability and developments of storage method.

The further developments of the agricultural sector is an important factor in the country's sustainable development and econo mic growth.

However, based on the principles of the market economy, it is important not only to increase the quantity of the harvest, but also to improve the quality of the products, to maintain the qualitative indicators as much as possible and reduce losses in the p rocess of commodity processing and during storage. That will allow us to significantly increase the opportunity to export the internat ional market and reduce the imported fruits in the local market.

Based on the current reality and problems, the subject of the research is the study of the biochemical indicators, storage ca pacity of persimmons, pomegranates, promising varieties produced in Georgia and testing of a new combined ecologically clean produc t in order to improve the storage capacity of fruits.

Within the project the following scientific works are planed: for the first time the storage capacity of promising varieties of persimmons and pomegranates spread in Georgia will be studied and a new storage method will be developed: a new combined solutio n (Calcium chloride and Methyl jasmonate) will be tested and the optimal concentration of the solution will be selected. During the rep orting period research included both experimental and biochemical works.

In order to determine the effectiveness of the combined solution (Calcium chloride and Methyl jasmonate) and select optimal doses of the components, the test samples were treated with 2 different concentrations of the combined solution before storage;

1. **1% Calcium chloride and 0.003% Methyl jasmonate**
2. **2% Calcium chloride and 0.005% Methyl jasmonate**
3. **Control- fruits treated only water.**

Samples were storage at 0-1^{0}C temperature and 85-90% humidity conditions. In total research is conducted on 9 variation: 2 varieties of persimmon and 1 varieties of gooseberry. Before storage a number of biochemical parameters were studies in each cultivars, in particular dry matter, titrable acidity, total polyphenols and antioxidant activity were determined.

The results showed that among the persimmon varieties "Rojo Briliante" has a high content of soluble dry matter (22.1%) compared to "Hachia" variety (20.3%) and the second variety has high total polyphenols and antioxidant activity.

It was determined that the soluble dry matter in pomegranate variety "Ganja" was 17.1%, pH-4.2, total polyphenols 186.3 and antioxidant activity 1.45 mmole/g equivalent of ascorbic acid.

In order to determine the optimal concentration of the combined solution and its effectiveness during the storage process, the study of the decrease in mass according to individual options is carried out, as well as the study of the mentioned substances is determined at the end of storage. Based on our research we will get the first information about the effectiveness of the combined solution, studies continues.

6. Study of Storability of Promising Quince Varieties and Development of a New Method of Storage.

Based on the principles of the market economy, it is necessary to increase the quantity of the harvest and improve the quality of the products to maintain the qualitative indicators as much as possible in the process of commodity processing, raw storing, and loss reducing.

Despite the existing technologies, there is still a high rate of losses (25-35%) during the raw fruit storage and deterioration of quality indicator. Therefore, local fruits cannot significantly compete with imported fruits, and existing problems have a significant negative impact on the socio-economic status of fruit-producing farmers. In addition, fruits imported from abroad (Turkey, Armenia) are mainly sold in the domestic market of Georgia, especially in the winter months. This, in itself, has a negative impact on the economy of

Georgia, because a lot of money goes out of the country in order to regulate the domestic market with an assortment of differ ent fruits including quince; especially, in winter and spring seasons.

The research and the results obtained within the framework of the project will significantly contribute to solving the proble ms in the field.

It should be noted that within the frames of fruit storage technology : for the first time, promising quince varieties common in Georgia will be studied according to biochemical indicators, it will be explored their storage capacity and a new storage method will be developed to reduce losses in the storage process.

Due to its taste and medicinal properties, it has always been a high demand for quince in Georgia. Physiological and microbiological diseases of quince have been studied at this stage, and the amount of total sugars in quince and the decrease in mass have be en determined. All batches of quince were stored in refrigerators at a temperature of 0° -1.0°C and 85% atmospheric humidity.

The testing object was the selected quince variety "Champion", which was imported from the village of Dzevera, Gori district, from the plot of a local farmer.

Quince fruits were treated with 0.1% and 0.2% solution of calcium chloride CaCl2. The control option was not processed. Analy ses were performed before and during storage.

Studies have shown that on the 30th day of storage, when treated with a 0.2% Calcium Chloride CaCl2 solution, the weight loss of the testing object was minimal and amounted to 0.8% compared to the control. In fruits treated in this way, physiological and microbiological diseases were not observed at this stage, while in the control option and quince treated with 0.1% solution, such physiological diseases as skin scurf were observed (6%). As for diseases caused by microorganisms, no diseases were observed in the variants treated with 0.2% solution, while gray rot (15%) was observed in control and quince treated with 0.1% solution.

As for total sugar, in the options treated with 0.2% solution, the amount of total sugar at this stage increased by 2.5%, whi ch is typical for this stage of quince storage, while in the control and treated with 0.1% solution, total sugar increased compared to the initial increased by 1.0% and 1.4% respectively.

Based on the research, we can conclude at this stage that the biochemical composition of quince is more stable in the samples treated with 0.2% calcium chloride than in the control variants and in the samples treated with 0.1% calcium chloride. In fact, th e use of 0.1% calcium solution for quince to increase its storage capacity does not give any effect. Research is being continued.

7. "Study of storage capacity of Georgian table grape varieties, investigation and characterization according to some biochemical indicators."

The last few years, various organizations and farms have intensively imported seedings of new, selective table grape varieties into Georgia. However, in the winter months there is a great shortage of locally stored grapes in the markets, which dominated varieties of table grapes stored from neighboring countries (Armenia, Turkey). This has a negative impact on the economic and social situation of our country.

Storage of grapes is a rather complex technology. The decrease in fruit quality and organoleptic properties during storage is caused by their physiological and pathogenic diseases. Therefore, during the storage of grapes, it is necessary to take into account such complex complex following factors: genotype of the variety, agro-technical condition, as well as the physiological condition of the fruit, agro-technical conditions and ecological condition, as well as the physiological condition of the fruit, storage conditions and terms. The problem of reducing losses of grapes during storage is multi-factoral and requires an integrated approach to research. These problems can be solved based on modern research by developing technologies that will minimize losses during storage, ensure maximum preservation of grape quality during storage and significantly increase the duration of storage.

Based on the above, in the current year, the object of our research is the Georgian grape variety. As it is known, some wine varieties, with their commodity and taste qualities, are equal to the table variety grapes. Georgian consumers prefer Georgian varieties (based on market research). Therefore , we selected such Georgian varieties that are only available in the collection plots of viticulture and they are distinguished by the best taste and commodity properties. In recent years, in Georgia, the arrangement of refrigeration chambers has been intensively started, where mainly fruits are stored but grapes rarely, therefore, the selection of the technological mode of storage for such varieties is important so that the product should preserves both is appearance and commodity properties at the and of storage. This will motivate the farmers to grow local table grapes and suppy the local market during the winter months, thus competing with imported varieties and improving their economic status.

This year, We have imported several grape varieties from the Jighaura trail-demonstration base. These are table selection varieties: "Kolkhuri", "Iveria", "Ramishvili", "Vardzia", and "Rqatsiteli". It is true that grape variety "Rqatsiteli" is used as a wine material, but due tuo its taste qualities, it is very population and it is in special demand in the winter months. In addition to Georgian varieties, We are also conduction research on the table grape variety introduced in Georgia –"Napoleon".

At this stage, at the beginning of storage and in the middle of storage, the following were determined according to varieties of grapes: weight loss, microbiological and physiological diseases. Grapes are treated with a solution of 0,1% calcium chloride + 0,2 % jesmonate solution. The control sample is untreated grapes.

By the 45th day after storage, physiological disease is revealed in the varieties "Ramishvili" and "Kolkhuri", however , in r elation to the control variant, the physiological disease is slightly expressed in these varieties.

The decrease in mass for this stage is the most typical for the "Ramishvili" variety, both in control and treated grapes.

At this stage, no microbiological disease was found in any of the samples. There is also no grain loss. Studies are continuin g to the schedule provided by research team.

8. Development of Functional Food Products Using Local Plant Resources

The purpose of research. Based on the research of local plant raw materials, the development of biologically complete new types of functional purpose of food products from natural components and scientifically based technology.To achieve the set purpose, it was necessary to solve the following tasks: Search and analysis of literary material around the project; Determination of the range assortment of plant raw materials; Production of test samples and research of quality; Selection of recipes; New types of products will be manufactured with the selected recipe and technology; Evaluation of the obtained products in terms of nutritional value .

Plant raw materials rich in biologically active substances, widespread in Georgia, but almost unused by the processing indust ry - actinidia and pumpkin.

According to the methodology of scientific research work, the first stage of the research included the collection and process ing of scientific literature on the topic;

Checking for patent purity.

The analysis of literary materials showed us that, for the production of functional food products, it is best to use ecologic ally clean raw materials rich in vitamins, amino acids, food fibers, mineral substances and other biologically active substances of antioxidant action.

At the first stage of the research, the range of products was determined.

The experiments were conducted in the scientific laboratory of the Biotechnological Center of the Technical University of Geo rgia. The properties of raw materials were studied. The quality of the fruits has been determined.

The selected raw materials were subjected to a technological test, in particular, test samples - dried fruits - were made in laboratory conditions and the main indices determining their quality were studied. The produced production met the requirements of documentation applicable to the similar products.

During drying, the amount of water in the fruit decreases and the amount of preservation increases, among them, the dry matte r, acids and etc. The quantity, which in turn ensures long-term storage of dry products.

One of the tasks of the research was the development of technology of new dietary flour products using selected raw materials .

Flours were made from the research of raw materials in the laboratory conditions and their quality was determined. The produced production met the requirements of documentation applicable to the similar products.

It should be noted that fruit and vegetable flours have a balanced chemical composition, high biological value, ease of use, good transportability and a long storage period.

In addition, vegetable flours can be used as natural dyes to give attractive colors to products.

სახელმწიფო ბიუჯეტის მიერ დაფინანსებული 2018 ÷ 2023 წწ გეგმით შესრულებული პროექტები

№	შესრულებული პროექტის დასახელება, მეცნიერების დარგისა და სამეცნიერო მიმართულების მითითებით	წელი	პროექტის ხელმძღვანელი	პროექტის შემსრულებლები
1.	კარტოფილის ტუბერიზაციაin vitro პირობებში და მიკროტუბერების გატანა	2018-2022	მაია კუხალეიშვილი	ივეტა მეგრელიშვილი, ეკატერინე ბულაური, თამარ შამათავა,

	ღია გრუნტში ელიტური თესლის მიღების მიზნით			**თამარ ჭიპაშვილი**
2.	**კაკლის *in vitro*მცენარეების კოლექციის შექმნა და საქართველოს პირობებზე ადაპტირებული ჯიშების შერჩევა**	**2018-2022**	**მაია კუხალეიშვილი**	**ივეტა მეგრელიშვილი, ეკატერინე ბულაური, თამარ შამათავა, თამარ ჭიპაშვილი**
3.	**სასუფრე ყურძნის ჯიშების შენახვისუნარიანობის შესწავლა და შენახვის მეთოდების შემუშავება**	**2018-2022**	**მაია კუხალეიშვილი**	**ივეტა მეგრელიშვილი, ეკატერინე ბულაური, თამარ შამათავა, თამარ ჭიპაშვილი**
4.	**სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი (სასარგებლო) მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა -**	**2018**	**თამარ კაჭარავა**	**თ. ეპიტაშვილი**

	მოყვანის ტექნოლოგიები, ფიტოგენეტიკური რესურსის გაუმჯობესება და კონსერვაცია, ეთნობოტანიკური უნარ-ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარჩვევების ბაზების გამდიდრება. აჭარა			
5.	სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი (სასარგებლო) მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა - მოყვანის ტექნოლოგიები,	2019	თამარ კაჭარავა	თ. ეპიტაშვილი

	ფიტოგენეტიკური რესურსის გაუმჯობესება და კონსერვაცია, ეთნობოტანიკური უნარ-ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარჩვევების ბაზების გამდიდრება. აჭარა			
6.	სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი (სასარგებლო) მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა - მოყვანის ტექნოლოგიები, ფიტოგენეტიკური რესურსის გაუმჯობესება	2021	თამარ კაჭარავა	ზ. გელიაშვილი. თ. ეპიტაშვილი

	და კონსერვაცია, ეთნობოტანიკური უნარ-ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარჩვევების ბაზების გამდიდრება. **ფშავი**			
7.	**„სამკურნალო, არომატული, თაფლოვან, საღებავ, სანელებელ და შხამიან მცენარეთა ბიომრავალფეროვნების მონიტორინგი-კონსერვაცია და კულტივირება- მდგრადი გამოყენების ინოვაციური ტექნოლოგიები საქართველოში“**	**2010 - მიმდინარე**	**თამარ კაჭარავა**	**ზ. გელიაშვილი.** **თ .ეპიტაშვილი**

8.	**ბიოპრეპარატების და ფუნგიციდების გავლენა პომიდვრის ფესვის ლპობის გამომწვევ პათოგენ მიკროორგანიზმებზე და მათი შედარება**	**2018-2022**	**გულიკო დვალი**	**ნ. ლომთაძე, ლ. ზვიადაძე, მ. კობახიძე**
9.	**ზოგიერთი კურკოვანი ხილის შენახვის ახალი მეთოდების შემუშავება და თეორიული დასაბუთება“.**	**2018-2022**	**მერაბ ჟღენტი**	**თ. შამათავა, ი. მეგრელიშვილი, ე. ბულაური**
10.	**ხილის გადამუშავების პროდუქტების კვებითი ღირებულების სრულყოფა ზოგიერთი კენკროვანი კულტურიდან მიღებული ბიოლოგიურად აქტიური ნივთიერებებით**	**2018-2022**	**გულნაზ კაიშაური**	**გ. კაიშაური**

1. **კარტოფილის ტუბერიზაცია in vitro პირობებში და მიკროტუბერების გატანა ღია გრუნტში ელიტური თესლის მიღების მიზნით.**

სინჯარებში მიკროტუბერების მიღება და მათი პირდაპირი გატანა ღია გრუნტში , საშუალებას იძლევა კარტოფილის ე კლასის ელიტური თესლი მივიღოთ უფრო შემოკლებულ ვადებში და ეკონომიურადაც უფრო მომგებიანია.

პროექტის ფარგლებში, ბიოტექნოლოგიის ცენტრის თანამშრომლების მიერ, მოდიფიცირებულ საკვებ არეზე, ფიტოტრონში (ტემპერატურა 26-27 ^{0}C, ტენიანობა 75 %, განათება 5500 ლუქსი ფოტოპერიოდი 16 დღე სინათლე 8 ღამე სიბნელე) მიღებულ იქნა in vitro სინჯარაში კარტოფილის მიკრო ტუბერები. მიღებული მიკროტუბერები(„სანტე“) გატანილი იქნა ბიოტექნოლოგიის ცენტრის დაქვემდებარებულ მიწის ნაკვეთში. 80 დღის შემდეგ მიღებული იქნა კარტოფილის სუპერ-სუპერ ელიტური თესლი.

1. Tuberization of in vitro potato and their transfer in open field for further production of elit e seed

The production of in vitro microtubers and their direct transfer in open filed allow to produce E class elite seed in short t ime and is economically profitable.

Whitin the project in vitro potato microtubers were produced on the modify MS medium in phytotron (temperature 26-27 ^{0}C, humidity 75%, 5500Lux, 16h photoperiod) by scientists of Biotechnology center . Obtained microtubers of potato variety “Sante” wer e transferred in an open filed, Super-super elite seed were produced after 80 days.

2.“ კაკლის *in vitro* მცენარეების კოლექციის შექმნა და საქართველოს პირობებზე ადაპტირებული ჯიშების შერჩევა“.

დღეს, ყველაზე პერსპექტიული მიმართულება კაკლის პლანტაციების გასაშენებლად ითვლება ბიოტექნოლოგიური მეთოდების გამოყენება, კერძოდ in vitro კლონირების ტექნოლოგიის განვითარება და დანერგვა საქართველოში. ბიოტექნოლოგიის ცენტრის ლაბორატორიაში, მიღებული სტერილური ქსოვილის საფუძველზე გამრავლების პირველმა მცდელობებმა საბოლო ჯამში დადებითი შედეგები გამოიღო. პროექტის მიმდინარეობის პერიოდში ჩვენი მეცნიერების მიერ მიღებული იქნა in vitro კაკლის ბიოტექნოლოგიური მეთოდების გამოყენებით , დაფესვიანებული, ძლიერი მცენარეები.

გამოცდილი და დადგენილი იქნა საკვები არეების სხვადასხვა ვარიანტები, in vitro კაკლის სინჯარის მცენარეების მისაღებად. საკვები არეების ცვლილება უკავშირდება მცენარის ზრდის რეგულატორების, როგორც რაოდენობრივ, ისე სახეობრივ ცვლილებას საკვებ არეში.

საკვებ არეში გამოვიყენეთ 1.0 გ/ლ-ზე 6-ბენზილამინოპურინი(BAP) და 1 მგ/ლ-ზე კონცენტრაციის ინდოლ-3-ბუთირის (IBA) მჟავა, წარმოდგენილი კონცენტრაციებით. შედეგად მიღებული იქნა კაკლის in vitro სინჯარის ძლიერი მცენარეები(კარგად განვითარებული ფესვთა სისტემა, სწორმდგომი ღერო და მწვანე, სქელი ფოთლები).

დაფესვიანებული კაკლის სინჯარის მცენარეები გადატანილი იქნა, მიწიან პოლიეთილენის ჭურჭელში (13.0X10.5X4.0სმ),რომელიც ასევე შეიცავდა 2/3 წილ ტორფს, 1/3 წილ ვერმიკულიტს. ნიადაგის pH იყო 5.8. ასეთ პირობებში მცენარეების 35%-მა გააგრძელა განვითარება, თუ შევადარებთ სხვადასხვა ქვეყნების მკვლევარების სტატისტიკურ მონაცემებს, საიდანაც ვიგებთ, რომ კაკლის in vitro სინჯარის მცენარეებიდან, მხოლოდ 20-25%, მიღებული შედეგები სავსებით დამაკმაყოფილებელია.

2. “Establish of walnuts in vitro collection and selection of adapted varieties to the Georgian condition”.

Usage of biotechnology methods for production walnuts orchards is very actual todays, especially development and implementati on of in vitro technology in Georgia. The initial stage of in vitro propagation was usefully conducted in the laboratory of Biotech nology center. Within this project the rooted, healthy in vitro walnuts plants were produced using biotechnology method. The different MS me dium were used for in vitro walnuts propagation. The modification of MS medium was associated with several concent ration of different growth regulators.

The well development (well rooted, strong and green stem with leafs) in vitro walnuts plants were produced on the MS medium w ith 1g/l BAP and 1mg/l IBA.

The rooted in vitro walnuts plants were removed in polyethylene vessel (13.0X10.5X4.0 cm), with soil, 2/3 peat, 1/3 vermiculi te, pH-5.8. Under such conditions, 35% of the plants continued to develop, if we compare the statistical data of researchers from different countries 20-25% plant development were found.

3. “სასუფრე ყურძნის ჯიშების შენახვისუნარიანობის შესწავლა და შენახვის მეთოდების შემუშავება“.

ყოველწლიურად სხვადასხვა ორგანიზაციების თუ მეურნეობების მიერ საქართველოში ბოლო წლებია ინტენსიურად შემოდის ახალი, სელექციური სასუფრე ყურძნის ჯიშის ნერგები, თუმცა ზამთრის თვეებში ადგილობრივად შენახული ყურძნის დიდი დეფიციტია ბაზრებში, სადაც დომინირებს მეზობელი ქვეყნებიდან (სომხეთი, თურქეთი) შენახული სუფრის ყურძნის სხვადასხვა ჯიშები. ეს კი უარყოფით გავლენას ახდენს ჩვენი ქვეყნის ეკონომიურ -სოციალურ მდგომარეობაზე.

წლების მანძილზე ჩვენს მიერ შესწავლილი იყო უცხოეთიდან საქართველოში ინტროდუცირებული ყურძნის რამდენიმე ჯიში: „სენთენიალ-სილდრესი“, „რედგლობი“, დონ მარიანო“ და „იტალია“.

ყურძნის ჯიშები მუშავდებოდა კალციუმის ქლორიდის 2%-იანი და ევკალიპტის ექსტრაქტის 1%-იანი კომბინირებული ხსნარით. ყურძნის დამუშვებული და საკონტროლო ვარიანტები ინახებოდა ბიოტექნოლოგიის ცენტრის KAX-ას ტიპის მაცივრებში. (0-10^0 C ტემპ, 80-90% ფარდ.ტენიანობა).

საუკეთესო შედეგი (შენახვა -60 დღე) დაფიქსირდა ჯიშ „იტალიის“ შენახვის დროს, რომელსაც შენახვის ბოლოს შენარჩუნებული ჰქონდა როგორც გარეგნული შესახედაობა, ასევე ქიმიური შედგენილობა.

3.“Study of storability of table grape varieties and development of storage methods".

Every year, various organizations and farms have intensively imported planting materials of new, selective table grape variet ies into Georgia for the last few years, however, in the winter months there is a lack of locally stored grapes in the markets, imported varieties of table grapes stored from neighboring countries (Armenia, Turkey) are dominated, This has a negative impact on the economic and social situation of our country.

Over the years, we have studied several varieties of grapes introduced to Georgia from abroad: “Centennial seedless", "Red Gl obe", "Don Mariano" and "Italia".

Grape varieties were treated with a combined solution of 2% calcium chloride and 1% eucalyptus extract. Treated and control v arieties of grapes were stored in the KAX-type refrigerators of the Biotechnology Center. (0-100 C temp, 80-90% relative humidity).

The best result (storage – 60 days) was recorded during the storage of the "Italy" variety, which was able to preserved both its appearance and chemical composition at the end of storage.

4. „სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი ანუ სასარგებლო მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა - მოყვანის ტექნოლოგიები, ფიტოგენეტიკური რესურსის გაუმჯობესება და კონსერვაცია, ეთნობოტანიკური უნარ - ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარ - ჩვევების ბაზების გამდიდრება საქართველოს სხვადასხვა რეგიონში“.

საქართველოს ერთ-ერთი მნიშვნელოვანი და ეკონომიკურად მომგებიანი მიმართულებაა ტურისტული ინდუსტრიის განვითარება, მითუმეტეს აჭარის რეგიონში. ჩვენს მიერ ველური შესწავლილი იქნა კენკროვანი კულტურების - მოცვი (Vaccinium), მაყვალი (Rubus fruticosus), მოცხარის გვარის ველური (Ribes) სახეობები, კულტურული ფორმები, ჯიშები. მათი სამკურნალო/სამედიცინო და საკვები ღირებულება უაღრესად მნიშვნელოვანია, ფართო გამოყენება აქვს კოსმეტიკური და პარფიუმერული მიზნებისთვისაც.

მეცნიერულად დასაბუთებულ იქნა კენკროვანი კულტურების, მათ შორის კავკასიური მოცვის, მაყვლის, მოცხარის ადგილობრივი სახეობების, მათ შორის მთისა და კლდის მოცხარის ფოთლებში, ნაყოფებსა და მათგან წარმოებულ პროდუქტებში სასარგებლო, ბიოლოგიურად აქტიურ ნივთიერებათა თვისობრივი და რაოდენობრივი შემცველობა. დადგინდა ნახშირწყლების, ორგანული მჟავების, თვისობრივი და რაოდენობრივი მოცულობა როგორც ნაყოფებში, ასევე წარმოებულ პროდუქტებში.

საკვლევის სახეობების წლიური განვითარების დინამიკაზე დაკვირვებით, ვეგეტაციურ - გენერაციული განვითარება მაღალმთის პირობებში ნორმალურად მიმდინარეობს და აგვისტოს პირველ ნახევარში, ორივე სახეობის მოცხარი ნაყოფების სიმწიფის ფაზაშია. აგვისტოს მესამე დეკადაში ნაყოფმსხმოიარობა დასასრულს უახლოვდება. ახასიათებთ საშუალო და ალაგ-ალაგ, უხვი ნაყოფმსხმოიარობა.

აღსანიშნავია, რომ მოცხარის სახეობების გავრცელება აღნიშნულ ხეობაში ხასიათდება როგორც დამოუკიდებელ ჯგუფებად, ისე სხვადასხვა მცენარეულ დაჯგუფებაში თანაარსებობით, ეს არის მთის ზედა სარტყლისა და სუბალპური სარტყლის საზღვარი, სადაც ძირითადად დაბალი ხე - მცენარეებისა და ბუჩქნარების დაჯგუფებებია. ეს დაჯგუფებები არ არის ერთიანი, ისინი ცალ - ცალკეა წარმოდგენილი და გამოყოფილია მდელოებით.

4. Biodiversity of medicinal, aromatic, melliferous, dye, spicy and poisonous or useful plants, monitoring, growing technologies, improvement and conservation of phytogenetic resources, ethnobotanical skills, perspectives of use. Enriching databases of us eful plants` and ethnobotanical skills in different regions of Georgia, taking into account different ecosystem parameters in the different regions of Georgia.

One of the important and economically profitable directions of Georgia is the tourism industry development, especially in Aja ra region. We have studied the wild berry crops cranberry Vaccinium, blackberry Rubus fruticosus, wild species of currant genus (Ribes), cultural forms, varieties. Their medicinal and nutritional value is extremely important, with extensive use for cosmetic and perfumery purposes as well.

The qualitative and quantitative content of useful, biologically active substances in the leaves, fruits and products of berr y crops, including Caucasian blueberries, blackberries, local currant species, including mountain and rock currants, was scientific ally substantiated by us. The qualitative and quantitative amount of carbohydrates, organic acids in both fruits and manufactured products was determined.

Observing dynamics of the annual development of study species, the vegetative-generative development is normal in the high mountain conditions and in the first half of August, the currant fruits of both species are in the ripening phase. In the thi rd decade of August, fruiting comes to the end. They are characterized by medium and patchy, abundant fruiting.

It should be noted that distribution of currant species in the mentioned valley is characterized by both independent groups a nd coexistence in different vegetation groups, it is the border of the upper mountain belt and the subalpine belt, where there a re mainly groups of low trees and shrubs. These groups are not united, they are presented separately and separated by meadows.

5. სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი ანუ სასარგებლო მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა - მოყვანის ტექნოლოგიები, ფიტოგენეტიკური რესურსის გაუმჯობესება და კონსერვაცია, ეთნობოტანიკური უნარ - ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარ - ჩვევების ბაზების გამდიდრება საქართველოს სხვადასხვა რეგიონში“.

საქართველოს სასარგებლო მცენარეთა გენეტიკური რესურსის გამოკვლევისას აღმოჩნდა, რომ ქვეყნის ეს უნიკალური და მრავალფეროვანი სიმდიდრე არასაკმარისად არის კატალოგირებული და გამოყენებული. უფრო მეტიც, რაციონალური გამოყენების ტექნოლოგიები იმ მცენარეთათვისაც კი, რომლებიც ფართო მოხმარების საგანს წარმოადგენენ, დამუშავებული არ არის. მათ რიცხვს ეკუთვნის ისეთი პოპულარული მცენარე, როგორიცაა მოცხარის გვარი (Ribes L.).

შესწავლილი იქნა აჭარის მაღალმთაში ველურად გავრცელებული, ადგილობრივ ეკოსისტემის პარამეტრებთან ადაპტირებული მოცხარის გვარის, Ribes. შეუსწავლელი სახეობების: *Ribes bibersteinii* Berl. ex DC. (კლდის მოცხარი) და *Ribes alpinum* (მთის მოცხარი), მაღალხარისხოვანი ნედლეულისა და პროდუქციის მისაღებად შესწავლილია ტექნოლოგიური რეჟიმები (შრობა - ფოთლები და ყლორტები; გაყინვა - ნაყოფები, მოცხარის ნაყოფების და შაქრის ნარევი, ასევე ყვავილებისა და ნაყოფების თაფლის ნარევი, მისი ნაყოფებისა და წაბლის თაფლის ნარევი) და ქიმიური მაჩვენებლები.

ჩვენს მიერ სწორად არის შეფასებული და განხილული თანამედროვე მნიშვნელოვანი გამოწვევა - კენკროვანი კულტურების, კერძოდ მოცხარის ბიომრავალფეროვნების შესწავლა, წარმოება და გადამუშავება სასურსათო უსაფრთხოებისა და სურსათის უვნებლობის გათვალისწინებით, ასევე ჩვენი საზოგადოების, მოსახლეობის ცალკეული ჯგუფების, მოზარდებისა და სხვა ინდივიდების აუცილებელი მატერიალური პირობა, რომელიც უზრუნველყოფს დემოგრაფიული, ეკონომიკური, პოლიტიკური, კულტურული, ინტელექტუალური და ა. შ. განვითარების ფუნქციებსა და შესაძლებლობებს.

5. Biodiversity of medicinal, aromatic, melliferous, dye, spicy and poisonous or useful plants, monitoring, growing technolog ies, improvement and conservation of phytogenetic resources, ethnobotanical skills, perspectives of use. Enriching databases of us eful plants` and ethnobotanical skills in different regions of Georgia, taking into account different ecosystem parameters in the different regions of Georgia.

During the investigation of genetic resources of useful plants of Georgia, it was found that this unique and diverse wealth o f the country is insufficiently cataloged and used. Moreover, technologies for rational use even for those plants that are the subj ect of wide consumption have not been developed. Their number includes such a popular plant as the currant genus (Ribes L.).

Unstudied species of the currant genus Ribes, wildly distributed in the highlands of Ajara, adapted to the local ecosystem pa rameters, was studied: *Ribes bibersteinii* Berl. ex DC. (rock currant) and *Ribes alpinum* (Mountain currant), technological modes have been studied to obtain high-quality raw material products (drying - leaves and shoots, freezing - fruits, a mixture of currant fruits and sugar, as well as a mixture of flowers and fruit honey, a mixture of its fruits and chestnut honey) and chemical ind icators.

We have correctly assessed and discussed an important modern challenge - study, production and processing of the biodiversity of berry crops, in particular currants, taking into account food safety as well as the necessary material condition of our socie ty, individual population groups, adolescents and other individuals, which provides demographic, economic , political, cultural, intellectua l, etc. development functions and capabilities.

6. სამკურნალო, არომატული, თაფლოვან, მღებავი, სანელებელი და შხამიანი ანუ სასარგებლო მცენარეების ბიომრავალფეროვნება, მონიტორინგი, მოვლა - მოყვანის ტექნოლოგიები, ფიტოგენეტიკური რესურსის გაუმჯობესება და კონსერვაცია, ეთნობოტანიკური უნარ-ჩვევები, გამოყენების პერსპექტივები. საქართველოს რეგიონებში განსხვავებული ეკოსისტემის პარამეტრების გათვალისწინებით სასარგებლო მცენარეთა მონაცემთა და ეთნობოტანიკური უნარ - ჩვევების ბაზების გამდიდრება საქართველოს სხვადასხვა რეგიონში“.

ეწყობა ექსპედიციები ეკოსისტემის პარამეტრების გათვალისწინებით საქართველოს სხვადასხვა მხარის სამკურნალო მცენარეების რესურსის შესასწავლად. მათ შორის თიანეთში, ბორჯომისა და დარიალის ხეობაში. ამიტომაც წარმოდგენილი ნაშრომი ეფუძნება არა მხოლოდ არსებულ ლიტერატურულ მონაცემებს, არამედ ჩვენ მიერ ჩატარებულ საველე - კვლევით სამუშაოებს. აღწერილია ჩვენს მიერ გამოკვლეულ ტერიტორია, მისი რელიეფი, ფლორა, ფიზიკურ - გეოგრაფიული მახასიათებლები, საინტერესო მცენარეთა მოკლე მიმოხილვა, რის საფუძველზეც:

- **შევსებულია ჩვენს ხელთ არსებული საქართველოში გავრცელებული სასარგებლო მცენარეთა მონაცემთა ბანკი;**
- **დიფერენცირებულია ენდემური, იშვიათი, გადაშენების პირას მყოფი მცენარეები;**
- **ბუნებრივ პირობებში გადაღებული მცენარეთა ფოტოები;**
- **ადგილობრივ მოსახლეობასთან ურთიერთობით შევსებულია სასარგებლო მცენარეთა ეთნობოტანიკური გამოყენების მონაცემთა ბანკი.**

6. Biodiversity of medicinal, aromatic, melliferous, dye, spicy and poisonous or useful plants, monitoring, growing technolog ies, improvement and conservation of phytogenetic resources, ethnobotanical skills, perspectives of use. Enriching databases of us eful plants` and ethnobotanical skills in different regions of Georgia, taking into account different ecosystem parameters in the different regions of Georgia.

Expeditions are organized to study resources of medicinal plants in the different parts of Georgia, taking into account the p arameters of the ecosystem, among them in Tianeti area, Borjomi and Dariali valley. That is why the presented work is based not onl y on existing literary data, but also on the field-research works we have conducted. The territory investigated by us is described, its relief, flora, physical-geographic characteristics, a brief overview of interesting plants, on the basis of which:

- **The data bank of useful plants common in Georgia at our disposal has been filled;**
- **Endemic, rare, endangered plants are differentiated;**
- **Photos of plants taken in their natural conditions;**
- **The database of ethnobotanical use of useful plants has been filled in with the local population.**

7. „სამკურნალო, არომატული, თაფლოვან, საღებავ, სანელებელ და შხამიან ანუ სასარგებლო მცენარეთა ბიომრავალფეროვნების მონიტორინგი - კონსერვაცია და კულტივირება- მდგრადი გამოყენების ინოვაციური ტექნოლოგიები საქართველოში“

გენეტიკური და სახეობრივი მრავალფეროვნების შესანარჩუნებლად უდიდეს აუცილებლობას იძენს მომავალი მოხმარებისათვის საქართველოს უნიკალური ფლორის სახეობების დაცვისა და რაციონალურად გამოყენების მნიშვნელობაზე ინფორმირების ამაღლება, ეთნობოტანიკური ტრადიციებისა და ფიტოპროდუქციის პოპულარიზების მექანიზმების ინტენსიფიკაცია და მდგრადი გამოყენება, მიღებული სარგებლის განაწილების პრინციპების ინტეგრირებით ბიომრავალფეროვნების იმ კონვენციით მინიჭებული უფლებებით, რომლის წევრიც არის საქართველო.

შესწავლილ იქნა ბაყაყურას (*Silybum marianum*) ბოტანიკური აგებულება; ბაყაყურას (*Silybum marianum*) ბიოლოგიური თავისებურებანი ფენოლოგიური ფაზების, ფიზიოლოგიური ეტაპებისა და ეკოსისტემის პარამეტრებისაგან დამოკიდებულებით; ერთწლოვანი, ბალახოვანი მცენარის ბაყაყურას (*Silybum marianum*) სამრეწველო პლანტაციების

შექმნა ხელს შეუწყობს ქვეყნის უნიკალური ფიტოგენოფონდის შენარჩუნებას, სამკურნალო მცენარის პროდუქტულობის გაზრდას. კულტივირებული ჯიშების მასა აღემატება ველური ფორმების მასას, შესაბამისად იზრდება თესლის მოსავალიც, რაც ინტენსიური ტექნოლოგიების გამოყენებისა და მცენარეთა გარკვეულ ფართზე კონცენტრირების შედეგია.

- **კვლევაში ჩართულია საქართველოს ტექნიკური უნივერსიტეტის ფაკულტეტების (ქიმიური ტექნოლოგიისა და მეტალურგიის, აგრარურული მეცნიერებებისა და ბისისტემების ინჟინერინგის, მთის მდგრადი განვითარების სტუდენტები;**
- **აკრედიტებულია საგანმანათლებლო - სამაგისტრო პროგრამა „სამკურნალო მცენარეთა მოყვანის ტექნოლოგია“, სადაც გამოყენრბულია სტუ-ს ბიოტექნოლოგიის ცენტრის მატერიალურ - ტექნიკური და ინტელექტუალური პოტენციალი.**
- **კვლევების შედეგების საფუძველზე გამოქვეყნებულია სამეცნიერო სტატიები მაღალრეიტინგულ ადგილობრივ და საერთაშორისო გამოცემებში, კონფერენციებში;**
- **გამოცემულია სახელმძღვანელოები, მონოგრაფიები, კატალოგები;**
- **დამუშავებულია რეკომენდაციები სასარგებლო მცენარეთა მოვლა - მოყვანის შესახებ და სხვ.**

7. Monitoring - conservation and cultivation - innovative technologies of sustainable use of biodiversity of medicinal, aromatic, melliferous, dye, spicy and poisonous plants in Georgia.

In order to preserve genetic and species diversity, it is essential to raise awareness about the importance of protecting and rationally using Georgia's unique flora species for future consumption, intensification and sustainable use of ethnobotanical trad itions and phytoproduct promotion mechanisms, integrating the principles of benefit distribution with the rights granted by the Conventi on on Biodiversity, of which member Georgia is.

It has been studied botanical structure of *Silybum marianum*; Biological features of *Silybum marianum* depending on phenological phases, physiological stages and ecosystem parameters; Creation of industrial plantations of annual herbaceous plant - *Silybum marianum*, will help preserve country's unique phytogenefund, increase productivity of the medicinal plant. The mass of the cultivated

varieties exceeds the mass of the wild forms, therefore seed yield also increases, which is the result of use of intensive te chnologies and the concentration of plants on a certain area.

- **Students of the Georgian Technical University (faculty of Chemical technology and metallurgy, faculty of Agricultural sciences and biosystems engineering, faculty of Mountain sustainable development) are involved in the research.**
- **Master's degree educational program "Technology of medicinal herb growing" is accredited, where the material-technical and intellectual potential of the GTU Biotechnology Center is used.**
- **Based on research results, scientific articles have been published in the highly rated local and international publications, conferences;**
- **Textbooks, monographs, catalogs are published;**
- **Recommendations on the growing - cultivation of useful plants have been elaborated and etc.**

8.“ ბიოპრეპარატების და ფუნგიციდბის გავლენა პომიდვრის ფესვის ლპობის გამომწვევ პათოგენ მიკროორგანიზმებზე და მათი შედარება“.

მცენარეთა დაცვის მიზნით ნიადაგში ფუნგიციდების გამოყენებამ გამოიწვია ნიადაგის ეკოლოგიური მდგომარეობის გაუარესება, ამიტომ ნიადაგისა და მცენარის დაავადებების გამომწვევ პათოგენებზე ბიოპრეპარატების გავლენის შესწავლა ერთ-ერთ აქტუალურ საკითხს წარმოადგენს გარემოს გაჯანსაღებისათვის და ეკოლოგიურად სუფთა პროდუქტის მისაღებად.

შესწავლილი იქნა პომიდვრის რიზოსფეროდან გამოყოფილი და იდენტიფიცირებული ფესვის ლპობის გამომწვევ სოკო Fusarium-ი, ასევე ნიადაგში არსებულ პათოგენებზე და პომიდვრის რიზოსფეროში არსებულ სასარგებლო მიკროოგანიზმებზე ბიოპრეპარატ „ბიოკატენას“ გავლენა, რომელსაც ვადარებდით სისტემური ფუნგიციდი „რიდომილ გოლდის“ მოქმედებით გამოწვეულ ეფექტის. განსაზღვრული იქნა ბიოპრეპარატის შეტანის დრო, მთელი სავეგეტაციო პერიოდის განმავლობაში, რადგან ბიოპრეპარატის შემადგენლობაში შემავალი მიკროორგანიზმების ცოცხალი უჯრედები ნიადაგში და მცენარეში მოხვედრისას აქტიურდებიან, ნიადაგში უჯრედი იზრდება და გარშემო გამოყოფს სხვადასხვა

ნივთიერებებს, ერთნი თრგუნავენ პათოგენი მიკრობების გავითარებას (ზრდას), მეორენი ასტიმულირებენ მცენარის ზრდა-განვითარებას, მესამენი კი ამაღლებენ მცენარის იმუნიტეტს.

აღმოჩნდა, რომ ბიოპრეპარატმა ბიოკატენამ პომიდვრის ფესვისპირა ნიადაგში და რიზოსფეროში შეაფერხა ფუზარიუმის განვითარება. მცენარე გახდა ჯანსაღი და მიკროფლორა პათოგენებისაგან თავისუფალი. მართალია, პომიდორი ფუზარიუმით და პათოგენებით ძირითადად აქტიურად ყვავილობისა და დაკოკრების ფაზაში ავადდება, მაგრამ იმისათვის, რომ არ მოხდეს ამ პერიოდში მცენარის დაავადება საჭიროა ბიოკატენა შეტანილ იქნას მცენარის დარგვისას და არა დაავადების აღმოჩენის და განვითარების დროს. ამასთანავე ბიოკატენას გამოყენება უზრუნველყოფს გარემოს დაცვას დაბინძურებისაგან და ბიოლოგიურად უსაფრთხო პროდუქტის წარმოებას.

8. The effect of biopreparates and fungicides on pathogenic microorganisms causing tomato root rot and their comparison".

The use of fungicides in the soil for the purpose of plant protection has led to the degradetion of the soil's ecological con dition, therefore the study of the effect of biopreparates on soil and plant disease-causing pathogens is one of the actual issues for improving the environment and obtaining an ecologically clean product.

The fungus Fusarium which can cause the root rot was isolated and identified from the tomato rhizosphere, as well as the eff ect of biopreparation "Biocatena" on pathogens in the soil and useful microorganisms in the tomato rhizosphere, which we compared w ith the effect caused by the action of the systemic fungicide "Ridomil Gold". The time of biopreparate application during the ent ire vegetation period was determined.

Because the living cells of the microorganisms included in the biopreparate are activated when they get into the soil and the plant, those cells grows in the soil and releases various substances around it, some inhibits the development (growth) of pathogen ic microbes, others stimulate the growth and development of the plant, and the third increase the immunity of the plant.

It was found that the biopreparate Biocatena inhibited the development of Fusarium in the root zone and rhizosphere of tomato es. The plant became healthy and the microflora was free from pathogens.

Tomatoes are actively affected by fusarium and pathogens mainly during the flowering and ripening phase, but in order to preve nt plant disease during this period, biocatena should be applied during planting period, not during the discovery and developmen t of the disease. At the same time, the use of biochain ensures the protection of the environment from pollution and the production of a biologically safe product.

9.“ზოგიერთი კურკოვანი ხილის შენახვის ახალი მეთოდების შემუშავება და თეორიული დასაბუთება“.

ქვეყნის შიდა ბაზარზე იმპორტული ხილის და მისი გადამუშავების პროდუქტების ხვედრითი წილი საკმაოდ მაღალია და ზამთრის პერიოდში 70-80%-ს აღწევს. მაშინ, როცა ადგილობრივი წარმოების ხილით შესაძლებელია არა მარტო ადგილობრივი ბაზრის დაკმაყოფილება, არამედ მისი ექსპორტი, რაც ბუნებრივია, ეკონომიკური თვალსაზრისითაც გამართლებულია. ამასთან ნედლად შენახვის პროცესში დანაკარგები 25-39% აღწევს.

შემუშავებული იქნა საქართველოში ახალი ინტროდუცირებული ხილის: ატმის, ნექტარინის, ბლის და მსხლის ჯიშების ბიოქიმიურ-ფიზიოლოგიური გამოკვლევა და მათი შენახვისუნარიანობა. შესწავლილი იქნა .კალციუმის ქლორიდის და ევკალიპტის ექსტრაქტის კომბინირებული პრეპარატის ოპტიმალური კონცენტრაცია და ექსპოზიცია ხილის შენახვის დროს. შესწავლილი იქნა ხილის შემდეგი ჯიშების (ბლის 3 ჯიში: კორდია, რეჯინა, სვით ჰარდი. ატმის 2 ჯიში: ფეიმტაიმი, ო- ჰენრი. ნექტარინის 2ჯიში: მორსიანი, მაქსი-7, მსხლის „კონფერენსიე“ და „სამარიობო“) შენახვის ვადები და ქიმიური შემადგენლობა შენახვის დროს და ბოლოს. ხილი ინახებოდა КАХ -ას ტიპის მაცივრებში 0-10^0 C და 80-90% ფარდობითი ტენიანობის პირობში.

დადგინდა, რომ კალციუმის ქლორიდის 2% და ევკალიპტის ექსტრაქტის 1 % კომბინირებული ხსნარის ეფექტურობა დამახასიათებელია, როგორც ატმის და ნექტარინის, ასევე ბლის და მსხლის ჯიშებისთვის. შემცირებულია, როგორც მასაში კლება, ასევე ფიტოპათოგენური სახის დანაკარგები შენახვის ბოლოს. განსაკუთრებით საუკეთესო შედეგები მიღებული იქნა ნექტარინის ჯიშებში და მსხლის ჯიშებში მათი 42 დღით შენახვის დროს.

9. Development and theoretical justification of new storage methods of some stone fruits".

The specific share of imported fruits and their processing products in the domestic market of the country is quite high and reaches 70-80% during winter. While with locally produced fruit it is possible not only to satisfy the local market, but also to export it, which is naturally also justified from the economic point of view. In addition, losses in the process of raw storage reach 25-39%.

A biochemical-physiological study of newly introduced fruits in Georgia: peach, nectarine, plum and pear varieties and their storability was developed. The optimal concentration and exposure of the combined preparation of calcium chloride and eucalyptus extract during fruit storage were studied.

The storage periods and chemical composition of the following fruit varieties (3 varieties of cherry: "Cordia", "Regina", "Sweet Hardy"; 2 varieties of peaches: "Feimtime", "O-Henry". 2 varieties of nectarines: "Morsian", "Maxi-7", "Conference" and "Samariobo" varieties of pears) were studied during and at the end of storage. Fruits were stored in KAX-type refrigerators at 0-10^0 C and 80-90% humidity.

The positive effect of the combination of 2% calcium chloride and 1% eucalyptus extract was found on the storability for both peach and nectarine as well as plum and pear varieties. Both weight loss and phytopathogenic losses at the end of storage are reduced. Especially the best results were obtained in nectarine varieties and pear varieties when they were stored for 42 days.

10. "ხილის გადამუშავების პროდუქტების კვებითი ღირებულების სრულყოფა ზოგიერთი კენკროვანი კულტურიდან მიღებული ბიოლოგიურად აქტიური ნივთიერებებით".

თანამედროვე პირობებში კაცობრიობის წინაშე მდგარ ერთერთ ყველაზე აქტუალურ პრობლემას დედამიწის მოსახლეობის კვების პროდუქტებით უზრუნველყოფა წარმოადგენს.

შესწავლილია ბიოლოგიურად აქტიური ნივთიერებებით მდიდარი ველურად მზარდი ზოგიერთი კენკროვანი (კუნელი, მოცხარი) მცენარეული ნედლეული და მათი გამოყენებით ზოგიერთი ხილის გადამუშავების პროდუქტების კვებითი ღირებულების სრულყოფა. ასევე შესწავლილია მათი ტექნოლოგიური მაჩვენებლები. მიღებულია მოცემული კენკროვანი კულტურებიდან ბუნებრივი დანამატები.

მზა პროდუქციაში განისაზღვრა ძირითადი სტანდარტული ხარისხობრივი (ორგანოლეპტიკური და ფიზიკურ-ქიმიური) მაჩვენებლები. ორგანოლეპტიკური მაჩვენებლების შესწავლამ გვიჩვენა, რომ დანამატს ჰქონდა ერთგვაროვანი, ფხვიერი კონსისტენცია და შესაბამისი კენკრისათვის დამახასიათებელი გემო და სუნი. დამზადებული პროდუქცია აკმაყოფილებდა ანალოგიური სახის პროდუქციაზე მოქმედი ნორმატიული დოკუმენტის მოთხოვნებს.

დამზადდა სხვადასხვა სახის პროდუქცია (საკვლევი ნიმუშები): დასპირტული ნაყენი და მორსი -კუნელისა და მოცხარის სახეობებისაგან, ხოლო ცუკატი, სასმელი, კომპოტი, ჟელე, მურაბა, კონფიტიური, პექტინის ნამზადი და საკონდიტრო ნაწარმი (პასტილა) _ წითელი და შავი მოცხარისაგან.

10. Improving the nutritional value of fruit processing products with biologically active substances obtained from some berry crops".

One of the most urgent problems in the modern word is providing the population with food products.

Some wild berry (hawthorn, currant) plant raw materials, rich in biologically active substances, and the improvement of the n utritional value of some fruit processing products using them have been studied. Their technological indicators are also studied. N atural supplements are obtained from the given berry crops.

The main standard qualitative (organoleptic and physico-chemical) indicators were determined in the final product. The study of organoleptic indicators showed us that the supplement had a uniform, loose consistency and a characteristic taste and smell f or the corresponding berries. The manufacturedproducts are suitable for the requirements of the normative document applicable to sim ilar products.

Different types of products (research samples) were made: alcoholic tincture and morsi - from hawthorn and currant species, and candied fruit, drink, compote, jelly, jam, confit, pectin products and confectionery (pastilla) - from red and black currant.

Archil Eliashvili Institute of Control Systems of the Georgian Technical University

Scientific works performed in 2018-2023

Projects funded from the state budget (2018-2023)

№	Project name, scientific field and scientific direction	Years	Principal Investigator	Researcers
1.	Research on modeling, identification and optimization tasks of complex systems Engineering and technology Electrical engineering, electronic engineering, information engineering. Automation and control systems	2018 - 2020	V. Gabisonia	B. Shanshiashvili N. Dadiani V. Khutsishvili N. Kilasonia K. Kutkhashvili D. Sikharulidze D. Tsintsadze K. Omiadze
2	Identification and modeling of non-linear control systems, research of mathematical modeling and optimization tasks of complex physical and economic systems; 2. Engineering and technology 2.2 Electrical engineering, electronic engineering, information engineering. Automation and control systems	2021 – 2023	B. Shanshiashvili	N. Dadiani V. Khutsishvili N. Kilasonia K. Kutkhashvili D. Sikharulidze D. Tsintsadze K. Omiadze

3	**Development of a combinatorial online dictionary of the Georgian language;** **Informatics; Computational Linguistics**	**2018-2020**	**G. Chikoidze**	**L. Lortkipanidze** **N. Amirezashvili** **A. Tushishvili** **M. Tushishvili** **L. Samsonadze** **A. Chutkerashvili** **N. Javashvili** **L. Makrakhidze**
4	**Georgian language interface of dialogue systems** **Informatics; Computational Linguistics**	**2021-2023**	**L. Lortkipanidze**	**G. Chikoidze** **A. Chutkerashvili** **M. Tushishvili** **N. Amirezashvili** **L. Samsonadze** **N. Javashvili** **L. Makrakhidze** **M. Kloyan**
5.	**Development of a Medical Decision Support System to Solve the**	**2021-2023**	**M. Mikeladze**	**N. Ananiashvili** **V. Radzievski**

	Problem of Diagnosing and Treating Rare Diseases. **Artificial Intelligence. Intelligent Information System Models.**			**N. Jaliabova** **D. Radzievski** **I. Okonyan**
6.	**Development of a Medical Intelligent Decision Support System Based on Data Mining Technologies;** **Artificial intelligence, intelligent information system models.** **Data Mining.**	**2018-2020**	**M. Mikeladze**	**G. Besiashvili** **N. Ananiashvili** **V. Radzievski** **N. Jaliabova** **D. Radzievski**
7.	**Investigation of some actual problems of Georgian energy.** **Energetics.** **Optimization of the structure of the electric power system and power plants.**	**2018-2020**	**T. Magrakvelisze**	**G. Gigineishvili** **A. Mikashavidze** **Kh. Lomidze** **M. Janikashvili** **I. Archvadze** **T. Koberidze**

8.	**Investigation of some problems of electric energy and power plants.** **Energetics.** **Optimization of the structure of the electric power system and power plants.**	**2021-2023**	**T. Magrakvelisze**	**G. Gigineishvili** **A. Mikashavidze** **Kh. Lomidze** **M. Janikashvili** **I. Archvadze** **T. Koberidze**
9	**Processing of information transformation devices and systems using modern technologies;** **Development of electromagnetic converters for control systems.**	**2018-2020**	**O. Labadze**	**N. Kavlashvili** **Z. Buachidze** **L. Gvaramadze** **P. Stavranidi** **T. Saanishvili** **M. Tsertsvadze** **D. Purtskhvanidze** **K. Kvirikashvili** **V. Bakhtadze** **G. Kiknadze** **T. Khutsishvili**

10	**Processing of information transformation devices and systems using modern technologies;** **Engineering and technology;** **Electrical engineering, electronic engineering, information engineering;** **Robotics and automatic control;** **Automation and control systems;**	**2021-2023**	**D. Purtskhvanidze**	**N. Kavlashvili** **Z. Buachidze** **L. Gvaramadze** **P. Stavranidi** **T. Saanishvili** **M. Tsertsvadze** **K. Kvirikashvili** **V. Bakhtadze** **G. Kiknadze** **T. Khutsishvili** **N. Mirianashvili** **N. Gdzelishvili** **V. Khatashvili** **O. Kartvelishvili**

Short summary of scientific works carried out in the frames of the program

in 2021-2022

I

Identification and modeling of nonlinear control systems, research on mathematical modeling and optimization of complex physi cal and economic systems

(Mindia Salukvadze department of system identification and optimal control)

Scientific field: Engineering and technology;

Scientific sub-field: Electrical engineering, electronic engineering, information engineering;

Automation and control systems

The project is conducting research in two directions:

Direction I - identification and modeling of nonlinear control systems.

Direction II - mathematical modeling of complex systems and multi-objective optimization.

2021

Direction I. A review and analysis of modern methods of structure identification of nonlinear systems was carried out. The discussion of mathematical models of closed-loop nonlinear systems was carried out and the task of structure identification of such systems was set. A method and algorithm for structure identification of closed-loop nonlinear systems based on observations of input and output signals of the system was developed. The developed structure identification method and algorithm were investigated regarding adequacy and accuracy.

Direction II. The problem of scheduling theory was investigated when a single-stage multiprocessor system can perform the tasks. An optimization algorithm of polynomial complexity was constructed using integer and dynamic programming methods.

A model was considered, in which the problem of selecting the best innovative project from a given set of projects is formula ted as a binary five-criteria optimization task. The problem was reduced to a binary linear programming problem with restriction s.

A strategy game depicting an antagonistic conflict "Shooter Battle" is offered. A preliminary package of game competition mod els has been created.

In 2021, the following was published in Georgia: textbook - 1, course of lectures - 1, scientific article - 9; abroad: article 3; participation in the forum held in Georgia - 3, abroad - 1.

2022

Direction I. A review and analysis of modern methods of parameter identification of nonlinear systems was carried out. A discussion of mathematical models of closed-loop nonlinear systems was carried out. The task of parameter identification of closed-loop nonlinear systems when representing them with feedback block-oriented models was posed. The methods of parameter identification of closed-loop nonlinear systems in the frequency domain were developed in their representation by Hammerstein and Wiener model s with unit feedback under conditions of input harmonic signal of the system. The developed identification methods were tested for accura cy.

Direction II. A model was considered, in which it is necessary to draw up an optimal plan for a company owning several raw materials processing enterprises to efficiently use raw materials, production resources, and capacities.

A mathematical model of the one-criteria problem of the theory of discrete optimization schedules was built under conditions of uncertainty, in which tasks are performed by a continuous one-step system. A program in C++ language is created based on the constructed algorithm.

The capabilities of the software package Matlab in vector optimization and particular interactive vector optimization were di scussed.

A study of multicriteria tasks was carried out by discretization of multicriteria optimization tasks in functional-analytical spaces.

Experiments were carried out and the final version of the game model was selected for the computer game " Shooter Battle".

In 2022, the following was published in Georgia: scientific article - 7; participation in the forum held in Georgia - 2.

Processing of information transformation devices and systems using modern technologies; (Department of Information Transformation issues)

Scientific field: Engineering and technology;

Scientific sub-field: Electrical engineering, electronic engineering, information engineering;

Robotics and automatic control; Automation and control systems;

In 2021, 2 tasks were carried out in the departments: automation of a small-sized drip irrigation system in conditions of limited irrigation water resources and a multifunctional mobile robot and its control system.

Within the framework of the first task, one of the principles of building a capacitive transducer for water reserve resource estimation was investigated and an analytical expression was obtained that connects the physical parameters of the transducer and o utput capacity. The latter allows us to choose the appropriate physical parameters of the transducer when designing the system. The construction of the structure of the automated drip irrigation system based on the combined principle is discussed.

According to the second task, the structural elements of the multifunctional robot control system were selected; A patent sea rch was conducted on a designable multifunctional robot.

In 2022, the department was working on 3 tasks. Within the framework of task 1, the following was carried out: work on taking into account the temperature and humidity of the environment, environmental conditions (sunny, rainy, windy weather) in the system model; creation and testing of soil moisture determination transducer; Creation of a wind speed transducer.

In the direction of task 2, an algorithm for recording information about the path traveled in the robot's memory during movem ent was developed. Planning of the control system of the robot working with the obtained algorithm. The type of robot moving platfo rm is selected.

Within the scope of task 3, the working experimental unit of the heat pump was processed, which consists of the, thermoreduct ion valve. In the institute, studies were conducted on the experimental device of the heat pump and the economic efficiency of th e said device was determined.

Employees of the department published 15 scientific articles, including 1 abroad. They participated in 2 conferences. A works hop was held. An annual scientific report was prepared.

III

Georgian language interface of dialogue systems

(Departments of Language Modelling)

Scientific field: Informatics;

Scientific sub-field: Computational Linguistics;

The Georgian language interface of dialog systems is a software system that carries out information search, reception and pro cessing.

2021

In the project, we used a new approach, according to which the semantic model of the GeWordNet database was processed to crea te an SQL corresponding to the user's Georgian query.

In accordance with the set plan, the experience of creating automatic text processing systems has been investigated and a con clusion has been reached that we should use an expert system based on the combined methods of object-oriented frames and production to form the linguistic knowledge base of the Georgian language.

We have developed an interactive dialogue system based on the templates of different proposal models, in which the algorithm for transforming a natural language query/request into an SQL query for intelligent search in the semantic database is realized.

2022

The structure of the dialogue system and the principles of its construction, as well as the criteria for evaluating the effec tiveness of the system, were developed. The software was created, which was based on the semantic database model, the natural language dialog interface model, and the algorithms for determining the keywords of the query, according to which the software implementation of the dialog system with the Georgian language interface was implemented.

1 project funded by the Shota Rustaveli National Science Foundation is in progress. 12 scientific articles were published by employees. 4 reports were made at the international scientific conference. An annual scientific report was prepared.

IV

Development of a Medical Decision Support System to Solve the Problem of Diagnosing and Treating Rare Diseases

(Chavchanidze Department of Artificial Intelligence Problems)

Scientific: Informatics.

Scientific sub-field: artificial intelligence, models of intelligent information systems.

Within the framework of the project, the following tasks were performed in 2021:

- **Searching for medical clinical data about researched diseases and composing a formalized description of said diseases;**
- **Modeling of the primary diagnosis process in order to establish a preliminary diagnosis based on the patient's complaints and anamnesis;**

When developing an intelligent system, a cause-and-effect semantic network was used to represent knowledge, and a cause-and-effect analysis based on a semantic network was used to model the diagnostic process. On the basis of the developed methods, the software realization of primary diagnostic subsystem of the intelligent system was implemented in C++ language.

Within the framework of the project, the following tasks were performed in 2022:

- **Modeling the process of planning instrumental-laboratory studies based on anamnesis and preliminary diagnosis;**
- **Modeling of the differential diagnosis process based on the patient's anamnesis and instrumental-laboratory studies in order to determine the final diagnosis;**

When developing an intelligent system, a cause-and-effect semantic network was used to represent knowledge, a cause-and-effect analysis based on a semantic network was used to model the diagnostic process, and a multi-criteria decision-making method based on the theory of fuzzy sets was used to solve the research planning task. On the basis of the developed methods, the software realization of planning subsystem for instrumental-laboratory studies and differential diagnostic subsystem of the intelligent

V

Investigation of some problems of electric energy and power plants

V. Gomelauri Department of optimization of the power system structure and energy installations

Scientific field: Energetics. Optimization of the structure of the electric power system and power plants.

Task 1. The role of renewable energy resources in the electric energy of Georgia, taking into account the sharp instability of prices for organic heating and environmental problems

Task 2. Experimental investigation of the effect of wall roughness on the power required for liquid mixing in a mixing device

2021

The first task. Statistical data and development trends of electric energy of the world countries were analyzed. The current level of Georgia's energy development was evaluated against the background of the world's electric energy development.

Estimated the expected demand for electricity in the coming decades and the ways to meet this demand. In particular, it was shown that in the next two decades, due to the sharp increase in the demand for electricity, an annual increase in the capacity of the electric power system by no less than 5% will be necessary.

The second task. The latest literary data dedicated to the problem were analyzed. The aim and objectives of the research were established. The principal scheme of the experimental unit was worked out.

Separate nodes of the experimental unit were made. In particular, the body of the device, mixing device, surfaces with different types of texture.

2022

The first task. The risks caused by the import of organic heating in the conditions of sharp instability of prices for organic heating in the world were assessed and, based on this, local traditional and so-called the need for widespread use of non-traditional energy resources and energy-saving technologies in industry and utilities.

The mathematical model of the structure of power plants was specified, on the basis of which the optimization tasks were solved for the inertial, stagnant and innovative scenarios of the development of electricity, taking into account modern technological achievements.

The second task. An experimental setup with proper power supply and measurement systems and high precision measuring instruments was assembled. An algorithm and a corresponding program were created to process the experimental data. Test experiments were carried out for a smooth surface.

Experiments were carried out with different values of the height of the two-dimensional mesh elements and the BJ between the elements. Experiments were also conducted for different types of wall texture (longitudinal grooves, transverse grooves, combined texture and others).

In 2021 and 2022, 2 proceedings of the institute, N25 and N26, dedicated to the 100th anniversary of the establishment of the Technical University of Georgia, were published. The works relate to three main directions of the institute: control theory, contr ol systems and devices, including control processes in energy systems, and informatics.

In the proceedings, the results of scientific research conducted by the employees of the institute (and other authors) are pr inted. In 2022, articles with the participation of students were published for the first time. Also 2 manual collections were publi shed. Employees published 65 scientific works (including 4 abroad). They also participated in 15 scientific forums (including 3 abroad).

In 2021, 8 sessions of the Scientific Council were held and in 2022 – 10.

Grants in 2021 and 2022

1.

The Compiler of the Georgian-English Grammatical Dictionary,

Shota Rustaveli National Science Foundation of Georgia, FR-21-3509, 17.03.2022-16.03 2025

2.

Experimental investigation of the effect of artificial roughness on heat transfer to falling water film on the outer surface of the vertical tube

Shota Rustaveli National Science Foundation of Georgia, FR-19-3034, 09.03.2020-09.03.2023