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# One Hundred and Five Years of Soil Science in Bulgaria

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## **Abstract**

In this article is presented stage development of Bulgarian Soil Science – from 1911 year until our days. Fonder of soil science of Bulgaria is Nikola Pushkarov. Nearly, with his life is finished the first stage (1947). Pushkarov developed the first scientific program of soils with basic tasks.

Second stage of development (1947-1969) is stage of rapid development of soil science associated with the reorganization of agriculture in Bulgaria.

Third stage (1969-1989) is stage of modernization of equipment, strengthening of international relations and recognition, advanced science servicing of agriculture.

Fourth stage is stage of reforms, changes and integration into European research area.

**Keys words:** Nicola Pushkarov, Bulgarian Soil Science, stage development, science programs, soil diagnostic and classification, soil melioration, research, agroecology and agriculture, reform, changes and integration.

Creative thought of the greatest scientists has persistently strived to reveal the secrets of nature associated with soil and its fertility, to develop useful methods for research, increase, rational use and protection of land wealth. Soil is a unique ecological resource for every living creature as well as air and water.

Concern of soil health is as important as concern of human health. Soil science entered the cycle of scientific disciplines serving practice when in 1883 the famous Russian scientist V.V. Dokuchaev established regularities of soil formation.

## **I. N. Pushkarov - Founder of Soil science. First Stage of Development (1911-1947).**

The basics of soil science in Bulgaria was set in 1911 by the talented Bulgarian scientist, naturalist, founder of soil science and agricultural science, great patriot, public and popular educator Nikola Pushkarov. In his earlier years he was the founder and leader of the company of naturalists and students involved in student fights, teacher and organizer of the teacher movement in different parts of the country, lecturer and professor of cultural and educational organizations, environmentalist and afforestation specialist, head of a revolutionary group, participant in the Ilinden uprising in 1903, Chairman of the Skopje Revolutionary Committee, publisher and editor of newspapers and magazines. Pushkarov belongs to that generation of Bulgarians, who grew up after the liberation of Bulgaria and whose national and civic consciousness was formed under the influence of patriotism, the ideals of freedom, independence, social justice and revival of the fighters for national liberation. Although he was an excellent student of natural science and geology, having an

invitation and opportunity to work in the Ministry of Education and a popular teacher and organizer of young adults in their fight for more education, culture, economic growth and social justice, Pushkarov did not hesitate to lift the rifle with Gotse Delchev and come to the rescue against foreign oppressors in Macedonia (Raikov, 2001). After the revolutionary struggles he dedicated himself to teaching and social work. He extended his journalistic activities, particularly in the magazine "Natural Science and Geography", to which the most important representatives of Bulgarian science at that time contributed. Pushkarov is the first editor of the Magazine of Agricultural Research Institutes in Bulgaria, the first translator of the Origin of Species by Charles Darwin in the country, etc. (Kolarova, Dimcheva, 1959, Raykov, 2001; Teoharov, 1981, 2011). After specializing in Germany, Russia and America, he began an extensive soil survey in the Agricultural Experimental Station - Sofia. In 1911 the highly skilled and knowledgeable professional and young scholar founded the Soil Science and Agro-geological department and introduced the scientific principles of Dokuchaev Genetic Soil Science. As head of the department Pushkarov developed the first scientific program including the following tasks:

1. Systematic study of soils in areas by collection of geological, biological and climatic data and analyzing the collected samples in chemical and physical terms.

2. Tracing the causes of changes in soil properties in a given area and an indication of possibilities of eliminating the hazard.

3. Producing maps for the areas of research.

These common programming tasks are as relevant today as they were at the beginning of the 20-th century. As director of the Central Experimental Station, which he transformed into the Central Research Institute in 1920, Pushkarov founded 8 departments. He significantly broadened the Soil Department, where he trained and prepared the first soil scientists in the country and under his management the first regional soil surveys were carried out. In 1913 he published the Soil and Geological Outline of the Sofia Field and published the first regional soil map in 1:120000 Scale. In 1931, with funds borrowed from a bank mortgage on his home which he paid for a lifetime, he published the first national soil map of Bulgarian and German in 1:500000 Scale. This example of selflessness and devotion to science goes far beyond conventional standards (Raikov, 2001). However, he described and classified soils by genetic diagnostic criterion and established the first National Soil Classification. All these studies place under his direction the earliest scientific service of agriculture, offering concrete methods and choices in the field of assessment, treatment and agricultural technique of soil, its degradation, acidification, salinisation, land reclamation, mineral and organic fertilization, the fight against drought, grain production, forage production, tobacco and others. Despite his major contributions to soil science and agriculture Pushkarov was fired unfairly by the current agriculture minister Prof. Yanaki Mollov. Having retired early, Pushkarov began work on the Second National Soil Map with his own funds only to finish his life in poverty and misery. His scientific works, his scientific, organizational and applied research were appreciated four or five years after his death, when he received international and national acclaim, and his name was chosen for the patron of our Institute. His activity was appreciated and he was rightly called Patriarch of the Bulgarian Soil by future generations (Teoharov, 1981).

In the first period of development of soil science, active research began to develop in the Department of General Agriculture and Soil Science in 1924, led by Academician Ivan Stranski in the Agronomy and Forestry Faculty of St. Kliment Ohridski University. In 1929 he wrote the first textbook of Soil Science (253 pages), which was published with private funds. In 1935 the book was released as the first edition of the University, greatly expanded and improved technically too, and designed to serve not only as a textbook but as a guide for agronomists and foresters in their practical activity. The coursebook of soil science, which was released in 1946, was significantly upgraded and perfected. He also published textbooks titled "Processing of Soil" (1940) and "Fertilizers and Fertilization" (1947), moreover, he published over 800 scientific and popular articles and 8 textbooks and teaching aids. Academician Stransky was the first researcher in the country, who correctly defined the "Black Sofia Soil" as "Vertisols" (Stransky, 1947). He published over 140 articles about nutrition and fertilization of plants. Together with Vl. Valkanov Stransky developed bulky research work to do with fertilizer trials in Bulgaria. Many important developments related to general agriculture and processing of soil, crop rotations, erosion, weeds, bacterial artificial fertilizers and modern agriculture, agrometeorology, the role of legumes, essential-oil crops economy country and soil conservation, agricultural machinery, irrigation agriculture, the impact of drought and water properties, human and industrial soils, drought and disease control, cooperative land use and agricultural policy and more are either his personal or his department's contributions. Academician Stransky remained loyal to his scientific ideas and in the 50's of the previous century he scientifically and openly rejected the modern trends in soil and agronomic science, which as easily clang to it as later disappeared. True science was everything in his life, he was called by the needs of people to help them. It must be noted that Pushkarov and Stransky had a major role in the creation of the first scientists and specialists of soil science and agriculture. This period is associated with the famous Bulgarian educator and soil scientist Bukoreshtliev Boyko, who first investigated saline soils in Bulgaria and wrote a monograph on them (and Dilkov Raykov, 2007).

## **II. Second Stage of Development of Soil Science (1947-1969) - the Stage of Rapid Development of Soil Science Associated with the Reorganization of Agriculture in the Country (Garbucheu, 1972)**

The second stage can be divided into two sub-stages: the first (1947 -1960) was characterized by founding of two Soil Institutes (one at Bulgarian Academy of Science and one at the Ministry of Agriculture), development of soil science mainly in the horizontal direction, training of soil science personnel, completion of the Average-scale Map in scale 1: 200000 and the monograph "The Soils in Bulgaria". The second sub-stage (1960-1969) was characterized by merging of the two soil institutes, intensive construction of modern facilities and equipment, approving methodology in research on Bulgarian soil, expanding international relations, completion of the Average-scale Map in Scale 1:400000 under the leadership of Corresponding Member Koinov C. (1968) and the first National Congress of Soil Science in 1969.

The first sub-stage (1947-1960) began with the founding of the Institute of Soil Research at the Academy of Sciences on 26.04.1947, the initiator and director of it being Academician Ivan Stransky (1947-1959) and, in essence, with the decision of the Ministry of Agriculture to perform the famous Bulgarian-Soviet expedition of that year, led by the Soviet

academicians I.P. Gerasimov and I.N. Antipov-Karataev , in which all Bulgarian soil scientists of that time took part. The beginning was difficult, but scientists were determined to do their best for the sake of soil science. The Institute was accommodated in the rear rooms of the Natural History Museum of Bulgarian Academy of Sciences and occupied not more than 5-6 rooms, mainly offices. Scientists did not have laboratory facilities, consumables and chemicals, but thanks to Prof. E. Levenson, who had personal acquaintances in East Germany and spoke excellent German, the chemical and microbiological laboratory were later properly equipped. In the forthcoming years a soil physics laboratory, drawing halls for soil mapping, a soil museum and a vegetation house were founded and well-equipped. As time passed by seven departments were founded: Genesis and Mapping, Soil Chemistry, Soil Physics, Soil Biology, Soil Erosion, Soil Fertility, Soil Museum. Once the Institute employed 90 people, it was moved to the new building on the Fourth kilometer. In 1949, the Energohidroproekt soil and irrigation lab with all its staff was associated to the Institute of Soil Surveys and Soil Science of the Ministry of Agriculture (Raikov, Dilkov, 2007). With the expansion of the irrigation system in the country during the period 1948-1958 contracts with the Ministry of Agriculture were signed and extensive soil, irrigation and drainage studies in the areas between the Maritsa River, Old River, and Chirpan Average forest area of 2.95 million acres were carried out by Assoc . Dr. V. Koinov; between Belovo and Svilengrad and the rivers of Vacha, Maritza and Chaya to the foothills of the Rhodope Mountains - an area of 3.17 million ha, the studies were performed by two young scientists - L. Raikov and A. Behar. Out of these studies, Dr. Koinov drew a soil map of the Thracian valley in scale of 1:50 000 million for 3 acres. In 1958, the Department of Genesis and Cartography assumed tasks for large-scale mapping of soils of cooperative farms amounting to 5 million acres between the Sazliyka river in Stara Zagora and the Black Sea (Stransky, 1959). The Soil Map became base material and information for all scientific and business organizations. Thanks to joint efforts of soil scientists and forestry engineers, a national program of afforestation of 10 million ha of forest lands was drafted in 1951.

At the same time the first scientific papers and dissertations on current issues of soil science and agriculture were developed: Prof. Ts. Staykov - Chemistry of the Processes and Dynamics of Nitrate, Prof. E. Yaranov - Characteristics of Llosa, Associate Vodenicharov - Saline Soils and Desalination, Associate El. Kolarova and E. Bratanova - Primary Soil-Forming Process and Mineralization of Groundwater; Associate L. Raikov - Alluvial-meadow Soils, Assistant Prof. N. Ninov - Podzolized Cinnamon Forest Soils, Junior Research A. Behar and Zdr. Arabadjieva - Hydro-physical Properties and Structure of Soil Crust, G. Voinova - Azotobakter, Assistant Professor Biolchev, Assistant Prof. Al. Djingov and PhD N. Onchev - Erosion and Erosion Resistance, M. Milchev and T. Andonov - Fight against Erosion, and Prof. E. Levenson, Assistant A. Kitipov - Fertilizing and Feeding of Plants (Stransky, 1959).

During this phase independent departments of Soil Science at the Higher Agricultural Institute "G. Dimitrov" in Sofia and "V. Kolarov" in Plovdiv were founded, the Department of Meliorative Soil Science to the Civil Engineering Institute and the Department of Forest Soil at Forrestry Technical Institute were founded as well. At the Forest Institute the Department of Forest Soil was opened. In these departments hundreds of specialists were created under the guidance of Academician Ivan Stransky, Corresponding Member V.

Koinov, Prof. M. Penkov, Prof. I. Atanasov, Prof. G. Gurov, Prof. B. Kolcheva, Prof. T. Totev, Prof. V. Donovan and many other lecturers. Later, soil science was introduced as a discipline in many universities in the country - St. Kliment Ohridski University of Sofia, the Thracian University, The St. Ivan Rilski South-West University, the Constantine of Preslav University of Shumen, NBU and others. Soil science found a place in secondary schools where the rising generation studied soil types and in vocational technical schools where there already was a discipline called Agrochemistry and Soil Science.

In 1948, the Department of Soil Science at the Central Agricultural Research Institute became a second Scientific Research Institute of Soil Studies at the Ministry of Agriculture called N. Pushkarov. Director was Corresponding Member Ts. Staykov and the staff enumerated 100 people. In the Institute at the Ministry of Agriculture leading specialists in various fields of soil science worked such as Prof. E. Tanov, Prof. Chr. Trashliev, Prof. F. Angelov - Genesis and Geography of Soil, Prof. L. Raycheva - Soil Microbiology, Prof. V. Bakalova - Combating Soil Erosion. As a result of the efforts of the Bulgarian soil scientists, the scientific guidance of Prof. E. Tanov and with the active participation of Prof. C. Koinov, work was started on compiling the average-scale map of the country. During 1951-1960, for a short time the Institute grew to 300 people and was housed in the building in Pavlovo, together with the Institute of Hydraulic Engineering and Land Reclamation. These institutes received the important national tasks related to soil and irrigation and agrochemicals scale soil survey, which tasks both institutes performed successfully. In 1954 a second Bulgarian-Soviet expedition led by Academician I.P. Gerasimov again, was organized to study the genesis, classification and agricultural use of chernozem, zhaltzem, gray and maroon forest soils. Apart from soil scientists the expedition involved collaborators from the Institute of Geography at Bulgarian Academy of Science, headed by its Director - Corresponding Member Prof. G. Galabov.

With the help of the two expeditions several problems of soil science and agriculture were solved:

1. Surveys of the soils in Bulgaria were reassessed, using everything valuable, accumulated over the latest period. In 1964 a modern national soil classification was established, which was converted to the new views on soil-formation processes and the names of different soil types (Koinov, 1964).
2. A new national soil map at scale of 1:200000 was comprised and the monograph "The Soils in Bulgaria" was accomplished, making a contemporary interpretation of the main factors of soil formation. Both were honored with Dimitrov premium (Tanev, 1956; Gerasimov et al., 1960).
3. Modern agro-physical, soil-climatic and irrigation methods in agriculture were widely applied.

The second sub-stage began with the integration of soil science. In 1960, BAS established the N. Poushkarov Central Research Institute of Soil and Farming Practices with Director Corresponding Member Tzvetan Staykov (1960-1963 years). It was established at Bulgarian Academy of Sciences by combining the Institute for Soil Research at the Academy, the N. Poushkarov Research Institute of Soil Studies at the Ministry of Agriculture and the Department of Soil and Crop Rotation at the Institute of Plant in Bulgarian Academy of Sciences headed by Academician Konstantin Pavlov. In 1962 the joint Institute with Director

Corresponding Member Ts. Staykov transferred to the new Academy of Agricultural Sciences in Bulgaria and after a while (1965) it was already the present N. Poushkarov Institute of Soil Science. During this substage, until 1968 new large-scale studies of farmland in the country were made and the national soil map in 1:400000 scale was completed (Koinov et al., 1968). Detailed studies on food and water regime of soils were carried out. The beginning of extensive soil and geographical network of field experiments was set. Meanwhile the following tasks were defined to be solved by Bulgarian Soil Science:

1. Study of soil resources, genetic processes and improvement of the classification of soils in Bulgaria.
2. Adjusting of soil fertility on the basis of high chemicization in the main soil types in the country.
3. Development and implementation of a system of measures into practice to combat erosion.
4. Amelioration of soil with unfavorable properties or properties.

In the second stage two cycles of systemic agrochemical research on soil were conducted for which a certain role played Prof. K. Enikov being an agrochemist and director of the institute during the period 1951-1960. The first research cycle (1956-1960) on availability in the soil of absorbable forms of nutrients covered 38 million acres and revealed the real possibilities of our land fund (Enikov, 1979). The second cycle (1966-1979) conducted with the aid of modern methods, covered about 45 million acres of agricultural land and confirmed the right way for intensification of agricultural production in terms of mineral fertilization and the need to progressively increase the size of this event (Enikov, 1979 ). Accelerated development in the first decade of this stage was acquired by the research on meso and trace elements, whose role and importance strongly rise in parallel with the increasing scale of fertilization with microelements. On 01/01/1963, at the Academy of Agricultural Science a Central Laboratory for Agrophysical Research was opened which was consistently managed by Prof. R. Andreychin, Prof. Dr. A. Ivanov and Prof. Dr. Ivan Varlev. On 01.01.1976 the lab moved to N. Pushkarov Institute of Soil Science becoming today's Agrophysics department. During this stage, in the early 1966, the magazine Soil Science and Agricultural Chemistry (since 1992, "... and ecology:") was based with senior editors ever since: Prof. K. Enikov, Prof. I. Garbuchevev, Prof. P. Ivanov, Prof. D. Slavov, Prof. M. Penkov, Prof. B. Georgiev, Prof. M. Teoharov.

## **II. Third stage - Modernization of the Equipment, Strengthening of International Relations and Recognition, Advanced Science Servicing of Agriculture (1969-1989)**

In 1963, Professor Ivan Garbuchevev was appointed as director of the Institute. He was a prominent scientist and organizer of soil and agricultural science. He made major structural improvements. He created a new department of Scientific Service Fund Management for Large-scale Soil and Agrochemical Studies with Senior managers M. Jolevski, Ph.D. ASA. Hadzhiyanakiev and Research Georgi Dimitrov. There were also two new departments – one for Soil and Crop rotation with Head E. Dzhumalieva and one for Field Trials, Hospitals and Statistics with Head Prof. E. Ilkov. The Department of Soil Fertility was renamed Department of Agrochemistry. The remaining 6 departments were headed by Prof. V. Koinov (Genesis, Geography and Soil Classification), Prof. C. Galeva (Soil Physics), Prof. L. Raikov (Soil Chemistry), Prof. T. Palaveev (Agrochemistry), Prof. G. Voinova (Soil Biology) and Prof. A. Biolchev (Soil Erosion). In 1969 the first international contract with FAO for 1,2 million

dollars was prepared and signed, led on Bulgarian side by Prof. Ivan Garbucheu and by FAO - Prof. El Gabbana. However, the government was granted BGN 5 million for a new building complex with the growing house fitotron, and School of Postgraduate Studies which was opened in 1972 by the President of the State Council Todor Zhivkov. In the same year the Institute was awarded the Dimitrov Prize. FAO provided funds for new equipment and training of specialists in the world's leading schools. New scientific methods and analyses – radioisotopic and radiometric, X-ray-structural, differentially- thermal and electronic-microscopic – were adopted. The Institute was visited by international government delegations and world-renowned specialists in the field of soil science - Academician Gerasimov, Acad. Turin, Acad. Chernesku, Acad. Filipovski, Prof. Hartke, Prof. Jenny, Prof. Friedland, Prof. Zonn, Prof. Rozanov, Prof. Baumgardner, Prof. Arnold, Prof. Sobolch, Prof. Chirich, Prof. Tavernier, Prof. Dyudal, Prof. Auber, Prof. Elgabali, Prof. Plahi, Prof. Evald, etc. Prof. Ivan Garbucheu had the greatest merit for the Institute to become an international training center for post-graduate students of the countries of Asia, Africa and Latin America; to implement and coordinate a number of important research activities at national level and to participate in the development of international projects and contracts. Moreover, geographical soil and agroenvironmental zoning of the country was made (Ninov et al., 1972, Jolevski et al., 1980). The geographic-soil network of experimental fields and stations in the country (more than 30) was expanded and the laboratory work on agrochemicals service was centralized by closing some of the laboratories in the country. As well as establishing the Data Center and the Central Agrochemical Laboratory, an automated system for making recommendations for fertilization was created (Raikov, 2001). The whole arable area was comprised in a periodic agrochemical control and the large-scale soil mapping at 1:25000 and 1:10000 on agricultural land was completed. An agricultural grouping of soils in Bulgaria was accomplished, which played an effective role in crop-growing (Jolevski et al., 1974). For speeding the development of agricultural production in different areas regional soil maps of several counties were made (Angelov, 1975). The Institute was recognized as a science center with important services to a modern and profitable agricultural production. In the 60,s the different aspects of soil science were accredited, employing well-trained researchers, who left deep traces in its development:

- Genesis, geography and soil classification (Hr. Trashliev, V. Koinov, E. Angelov, N. Ninov, T. Boyadjiev, Sl. Krastanov, E. Fotakieva, T. Andonov, J. Staykov, I. Kabakchiev, P . Treykyashki);
- Soil Physics ( V. Galeva, A. Ralchev, I. Vatrалov, T. Ovcharova);
- Soil Chemistry (L. Raikov, G. Hinov, P. Vodenicharov, A. Behar, K. Paskaleva, St. Ganev, Z.. Varbanova, G. Hubenov, D. Bratanova, S. Mirchev, Y. Kavardzhiev);
- Agrochemistry (T. Palaveev, D. Dinchev, M. Milcheva, E. Neykova, A. Kitipov, N. Mitreva, Y. Bachvarova, D. Stoyanov, N. Patarinski, E. Ikonomova, S. Nesterova, M. Mincheva );
- Soil Biology (G. Voynova, L. Raycheva, B. Todorova, P. Petkov, D. Bakalivanov);
- Soil erosion (A. Biolchev, V. Bakalova, Al. Djingov, N. Onchev, S. Nikolov);
- Soil and crop rotation (D. Dzhumalieva, F. Todorov, K. Stoynev, P. Pavlov);
- Field experiments, stations and statistics (D. Ilkov, V. Barov, S. Lichev, Y. Shanin, T. Gruev, S. Atanasov, P. Petrov, M. Benevski, T. Konov).

In 1973 a new basic scientific direction - Programming of Yields was introduced in the Institute. It was originally created in 1971 in the Faculty of Agronomy of the Academy of Agricultural Science - the Department of Plant Physiology and it gave a complex nature of soil research. The management of agrochemical service of agriculture, which concentrated all the chemical laboratory work and computing equipment, allowed making recommendations by tabulograms for blocks and crops across the country. During the period 1973-1974, being Director of the Institute and Head of the Permanent Working Group on Fertilization to the Commission of Agriculture in the Union for Economic Cooperation, Prof. Cyril Enikov significantly accelerated the work on agrochemicals characterization of the major soil types in Bulgaria, in conjunction with the need for fertilization of soil. In the 70's a Long-term Program to Combat Erosion and a National Program for Improvement of Fertility of 15 million ha of low productive lands were developed and implemented with the participation of the Institute for Forest and The Forestry Engineering Institute. In 1976 the N. Pushkarov Institute was incorporated into the structure of the National Agro-Industrial Union. Decree № 8 of 09.02.1976 extended the objects of activity and until the year 1978 it bore the name Institute of Soil Science and Agrochemistry. After that it was renamed to Institute of Soil and Programming Yields. From 1982 onward the Institute was again in the system of the Academy of Agriculture. With the appointment as Director of Prof. L. Glogov in 1977, the objects of activity of the Institute were greatly expanded to 5 directions and 17 departments:

I. Direction - Balance, Preservation and Reproduction of the Soil with four departments - Genesis and Classification of Soils, Soil Chemistry, Soil Microbiology, Soil Erosion.

II. Direction - Increasing and Regulation of Fertility with four departments - Agrochemistry, Mineral Nutrition, Soil Cultivation and Crop Rotation, Statistics and Mathematical Modeling.

III. Direction - Programming of Yields with four departments - Crops, Productive Processes and Mathematical Modeling, Parametersetting of Soil Conditions and Photosynthetic Activity, New Technological lines in programming yields.

IV. Direction - Agrophysical Research with three departments - Soil Physics, Biophysical and Microclimatic Studies, Instrumentation Design Bureau.

V. Direction - Soil and Agrochemical Service to Agriculture with two departments - Soil Mapping and Soil Analysis Control.

State and government authorities placed the Institute to much higher requirements, utilizing the scientific capacity and the broad interdisciplinary themes. A team of scientists developed a scientific program, models and agroecological engineering projects for programmed yields of main agricultural crops - wheat, corn, barley, potatoes and others. The program was consulted and assisted by Academician Shatilov. To solve the forage and food problems some alternative crops and varieties were introduced whose technological characteristics were checked in the experimental facilities of the Institute. For general support of applied research at this stage some high-level scientists from the Institute of Wheat and Sunflower in General Toshevo joined N. Pushkarov Institute. There were working groups that directly supported the farms on-site. International agreements on issues of programming yields were signed with the USSR, USA, Holland and other countries. In the mid 80's an international treaty with the United Nations Environment Program (UNEP) was signed to develop a project for conservation and development of mountain ecosystems, managed by Prof. Sl. Krastanov and Prof. A. Behar. In 1981, 1982 and 1983, FAO conducted three consecutive meetings of

international and Bulgarian soil science community at the Institute and developed the basic principles and rules for drawing the world reference base for soil resources. The numerous and detailed studies allowed the soil classification scheme in Bulgaria to be improved (Jolevski et al. 1983). An agro-ecological regional map was composed and the country was allocated to 40 agricultural and 10 forest areas (Jolevski et al., 1980). During this stage there was active cooperation with scientists from the Institute of Economics and Organization of Agriculture in conjunction with the assessment and cadastre of land. The joint team from both institutes developed a new methodology for categorization of agricultural land (Petrov et al., 1988).

#### **IV. Stage - Stage of Reforms, Changes and Integration into the European Research Area (from 1989 until today).**

This stage is characterized by withdrawal of important scientific and practical parts of the Institute and limiting its activities, also reduction of the personnel several times. Nevertheless, there has been successful integration with the European Research Area. For two decades the number of personnel of the Institute has dropped from 1041 to 170, and the academic team has been reduced from 214 to 82 scientists. Some subjects have dropped out due to lack of equipment or young scientists. Scientists' pay is low and young people do not consider that science is their vocation. Over the past 15 years the personnel of the Institute has been working under difficult conditions in winter months. Reagents, chemicals and consumables are purchased with funds generated by our own revenues or finance from European projects. Over the past two years funds from European projects have been used to cover part of the maintenance of the Institute. Experimental studies in some of the research facilities have reached critical levels or are no longer performed. However, many topics are reevaluated on a qualitatively new level, according to European standards. Despite the difficulties of the time, the 100-year tradition of soil science and the vital necessity of its scientific products for practice and European structural units have now established new cardinal tasks resulting from the processes of harmonization and globalization of science and problems in the country. Therefore, at this stage the management of the Institute and other entities outside has been trying to preserve the traditional academic subjects, which continue to be sought at the national and international level.

In 1986 Prof. Dr. Valio Valev was appointed as Director of the Institute and he, with a little break (1992-1995), was in charge of its personnel until 2000 (Vichev, 2007). This period was characterized by a gradual reassessment of priorities, objectives and tasks of soil science, according to the changes after 1986 and especially after 1989. A new methodology for categorization and cadastre of agricultural land which was developed in the institute was used for the compilation of cadastral and farm maps. Scientific and applied activities of the Institute were associated with large-scale mapping of soils in 1:10000 and 1:50000 scale. A new classification and diagnostics of soil in Bulgaria in connection with the land partition was created including scientists from the Institute of Forest and Forestry University (Penkov et al., 1992). After 10 years of work an Atlas of Soils in Bulgaria was composed (Koinov et al., 1998). There has been active work on an assessment of environmental potential of soil and crop suitability. The scientific agro-environmental field has been validated and this led to the necessity the Institute to be renamed by a decision of the Presidium of the Academy of Agriculture from 19/07/1990 as Institute of Soil Science and Agro-environment, without its

traditional academic subjects being compromised. A FAO project was won and it was managed by Prof. Dr V. Valev and Prof. Dr. T. Boyadjiev. Prof Valev began training soil scientists from the Mediterranean and the Middle East as the lectures were read in French for students from Algeria, Lebanon, Morocco and Tunisia and in English for students from Egypt, Jordan, Libya, Iraq, Cyprus and Syria.

From 1992 to 1995 Director of the Institute was Prof. Dr. Dimitar Stoychev. Under his leadership a PHARE project for 1,2 million ECU was won, which led to the creation of a modern physico-chemical and agrochemical laboratory for soil, vegetation and water, which was later transferred to the National Service of Agricultural Protection and then it was three more times subsequently wrongly based. Attribution of a "political profile" of soil and agricultural land by nonprofessionals and pseudo-environmentalists at the beginning of the period of democracy strengthened the environmental direction at the Institute. National and international level contracts and projects of pollution of soil and water with heavy metals, radio-nuclides, petroleum products and waste products were signed. A joint US-Bulgarian project for establishing the level of pollution of the Yantra river, run by Dr. E. Stoychev supplied funds for the purchase of new equipment. The Institute led a successful fight to deny the current misconception of soil pollution by fertilizers and pollution of rice fields in Thrace with heavy metals. American scientists were invited, who shared the views of the Bulgarian soil scientists of the absence of local pollution in the rice fields and total soil pollution in the country. Scientists from Bulgarian Academy of Sciences and the Institute developed a project to create a national park "Central Balkan", funded by the National Park Service of the U.S.A. Bulgarian soil scientists participated in comprising the Soil Map of Europe.

At the beginning of 2001 Prof. Dr. Toshko Raichev was appointed as Director of the Institute and from March the same year until the end of 2003 Director was Prof. Dr. Martin Banov. From 2004 to 2008, the Institute was headed by Prof. Dr. Nicola Vichev. This eight-year period is characterized by constant reforms imposed by the changes. We must appreciate the work of the three directors who were able to preserve the validated for years on basic scientific themes of the Institute. During this phase international cooperation with many countries from Europe and the Balkans has continued to expand. The Institute participated in an international project on environmental assessment of soils. The accredited Test Laboratory in Radioecology and Radioisotope Studies, which by order of the Ministry of Agriculture was declared National Reference Laboratory in 2007, has been sufficiently improved. A comprehensive assessment of environmental agro-production potential of the agro-tech-parks in the country has been created and the structure of agricultural production has been optimized. (Bachvarova et al., 2005). Bulgarian soil scientists participated in the development of the Soil Atlas of Europe.

From 2008 to 2011 the Institute was headed by Prof. M. Teoharov. For the successful implementation of its activities three scientific programs were defined - Balance, Reproduction and Conservation of Soil Resources; Maintenance and Increase of Soil Fertility and Agricultural Research Services; Integration and Innovative Directions in Research on Soil and Land. Related approaches and methods have also been defined for the sustainable development of soil science in the Institute. The three programs include implementation of 11 scientific research projects of the regular curriculum, 4 international projects and an international contract (with a total value of 400 thousand euro), covering the main priorities

of the Institute and the European Research Area. Based on surveys of multi-yearly research of many soil scientists Reference Database of Soils in Bulgaria has been developed and published, which set a new benchmark in the use of soil information for the national and international tasks. This database is used for assessment and strategic development of geo-information services to European soil data at the moment (Teoharov, 2009; Kercheva 2009-2012). Strategically important works have been out of print recently - "The Soils and Land in Bulgaria - National Secular Wealth" (Teoharov, 2011), "Risk of Soil Erosion in Bulgaria and Recommendations for Soil-protection Agricultural Land Use" (Rousseva et al., 2010). Vulnerable nitrate areas in the country have been defined; rules of good agricultural practices have been developed (Stoycheva et al., 2008). A complex system of scientific service to farmers across the country was built and it was developed in the Information, Consultancy and Innovation Center with Central Research Laboratory, Bureau of Recommendations, Advice, Opinions, Expertise and Design, a mobile group for field surveys and sampling, an expert group to read the analyses and give recommendations and opinions, input and output register for sampling and analyses and mapping laboratory. Only in 2010 the Central Research Laboratory received 2506 soil samples and 1566 water samples and 23,443 definitions were made. 206 farmers were serviced and 159 technological solutions, recommendations and opinions were given. In practice, this is a national service system for agriculture and environmental protection.

Applied science and implementation activities are based on the work in established scientific fundamental directions - Soil and Genetics, Environmental Soil, Agrophysics, Agro-environment, Agrobiology, Agrotechnics and Radioecology. Essential scientific trends are at the basis of the technologies and innovative solutions, namely:

- Reference data base for soils in Bulgaria;
- Complete diagnostic and agro-production assessment of soil and climatic and agroecological potential of soil resources for the effective cultivation of crops;
- Models for establishing, maintaining and improving soil fertility;
- Erosion control and soil-protection technology in agricultural land use;
- Technological solutions for the remediation of contaminated land and amelioration of acidic, saline, disturbed and eroded soils;
- Methods and regulations for utilization of waste products from households, industry and agriculture;
- Methodological developments for the production of biogas from waste products;
- Biotechnological methods and solutions to increase yield and quality of plant production;
- Advanced systems and technologies for organic and sustainable agriculture;
- Checking and development of energy technologies and alternative crops;
- Radioecological and radiometric monitoring of soil, water and agricultural produce;
- Norms, regulations and directives for the harmonization of Bulgarian legislation with the EU in the field of agriculture and ecology;
- Training of farmers and specialists in the field of soil science, agriculture and agro-environment.

From 2011 to present moment Directors are Prof. Ds N.Dinev. Prof. Dr T. Mitova and Prof. Dr S. Rousseva. This is a period of reforms and confirmation of new Science directions. In 2012 the Institute is united with the Institute of Mechanization and Hidromelioration and

the Institute of Plant Protection. It was renamed as Institute of Soil Science, Technology and Plant Protection.

At the final stage of its development the Institute has held its equivalent position in the ERA. Research projects within 5-th , 6-th and 7-th Framework Programs of the European Commission, the scientific and technological development Inko- Copernicus programs, COST programs, E-content + , Program for Southeast Europe have been completed. Bilateral cooperation with Belgium, Germany, Greece, China, Russia, USA, France, Netherlands, Poland, Hungary, Slovenia, Slovakia, Cyprus and more has been extended. We are respected partners in the European Soil organizations and networks such as the European Soil Bureau, European Association of Soil Scientists, the Centre for Drought Management in Southeastern Europe, International Centre for Theoretical Physics and others. Some of our young scientists currently specialize in these reputable centers. World renowned scientists have been visiting the Institute and working with our team – for example Prof. Targulyan, Prof. Montanarella, Prof. Blum, Prof. Bech, Prof. Mermut, Prof. Uenema, Prof. Teridze, Prof. Urushadze, Prof. Bielek, Prof. Kapizhotis, Prof. Mikkeli, Prof. Shein, Prof. Paschalidis, Prof. Ttsadilas, Prof. Varalay, Prof. Vaca, Prof. Zdruli, Prof. Haynos, Prof. Jozefachiuk, Prof. Sokolovska, Prof. Nemetch, Prof. Kozak, Prof. Dimitru, Prof. Gabrielle, Prof. Horn, Prof. Haigh, Prof. Lal, Prof. Mesič and many others. Important issues of bilateral cooperation have been discussed with the Director of the Dokuchaevski Institute Prof. N. Khitrov. Scientists from the Institute participated in the teams developing the European Strategy for Soil Protection, the national position of Bulgaria on the Adoption of European Directive for Soil Research Projects in support of the European strategy on soil protection, the CAP of the EC to reduce greenhouse gas emissions of agricultural lands, the INSPIRE directive management, standardization and coordination of spatial database, protection of waters against pollution caused by nitrates from agricultural sources and biogas from waste products from livestock.

Our scientists are in aid of legislation and government. Working groups from the Institute participated in the development of Land Act, Law on Soil Protection, the National Action Program for Sustainable Land Management and Combating Desertification in Bulgaria (2007-2013), National Agro-ecological Program of Bulgaria (2007-2013) within the Program for Rural Development, Environment Operational Program (2007-2013), in the drafting of regulations, standards and others at Parliament, ministries (Ministry of Agriculture and Food, Ministry of Environment and Water, Ministry of Regional Development), intergovernmental and parliamentary committees.

For its contribution to the development of Bulgarian science and active international activity, the Institute was awarded a Golden Book and Golden Seal in 2009 by the Council of the European scientific and cultural community and in 2011 biggest state reward – Honorary Sign of President the Republic Bulgaria.

Today the Bulgarian Soil Science has one hundred and five years. The Institute, named after its founder Nichola Pushkarov, a pioneer and generator of new ideas, and many smaller structural units in institutes and universities of the country are key holders and custodians of soil science and distribute knowledge acquired in the institute. The Bulgarian Soil Science company, led alternately by Academician Ivan Stransky, Prof. Ts. Staykov, Prof. I. Garbuchevev, Prof. L. Raykov, Prof. M. Jolevski, Prof. T. Boyadjiev, Prof. I. Kolchakov,

Prof. R. Dilkova and Prof. M. Teoharov has had an important role to its international prestige and social significance.

It has been a century in which Bulgarian soil science has emerged as an important branch of biological science and has become a science of undoubtedly great public importance. In its 100-years' history, soil science has always been in service of people closely related to problems of soil fertility, of land and its efficient use and conservation. Soil science is a capital that must not be lost. In all stages of its development in its foundation soil science has always been a recent addition to basic scientific direction, which shows its inseparable connection with practice. When new needs of society emerge, then new research directions are created. Soil science as a leader and at the heart of agrarian science is destined to go 10-15 years ahead, to give strategic outlines, according to the needs of people, the agro-economic and social development of the country.

With its interdisciplinary nature of research and many wide and varied research subjects, soil science disposes of current research and innovations, which have always been sought by a wide range of users. Therefore, management of soil and land resources must become a consistent and sustainable government policy, and N. Poushkarov Institute of Soil Science must be maintained as a national scientific and methodical base and focal point for scientific services to agriculture, ecology and environmental protection. Soil science, despite the difficulties of the time, has scientists of high human potential, scientific capacity, necessary knowledge and competence of quality and up-to-date solving of tasks, performed at national and international level.

The history of the Institute of Soil Science is in fact history of Bulgarian soil science itself, for Pushkarov Institute is bearer, guardian and propagator of this science and it is in turn an inspirator of its scientists.

May the science of soil and land live through the future centuries! Let us worship the first who put its foundations and all the others who upgraded it with more consistency, new ideas and courageous work! Let us pay tribute to all those who in various stages of its development remained true to themselves, boldly defending their scientific ideas! Let us thank the galaxy of scientists who gave their modest personal contribution to the preservation of our national and secular wealth - soil and land!

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