Research Journal of Agricultural Science, 57 (2), 2024 ISSN: 2668-926X
http://doi.org/10.59463/RJAS.2025.2.06

# THE FERTILITY OF SOILS FROM BUZIAS -STIUCA AREA AND THEIR QUALITY STATE

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***Abstract.*** *The purpose of this research is to develop a knowledge base regarding the characteristics of the natural framework and its regional particularities, in order to scientifically and technically substantiate the elements that define the structure of the soil cover. This work is addressed both to specialists and to agricultural landowners, as well as to representatives of local administrations, aiming to identify the most appropriate solutions for the sustainable management of natural resources.The study focuses on an area of 86,180 hectares, of which 70,705 ha (82.04%) are agricultural lands (including 51,139 ha or 59.34% arable land), and 10,034 ha (11.65%) are forested lands, located in the Buziaș–Ştiuca area. This region is characterized by diverse geological and physico-geographical conditions, which have led to the formation of a soil cover composed of: Alluvial soils, Chernozems, Phaeozems, Eutric Cambisols, Preluvosols, Luvisols, Vertisols, Pelosols, Stagnosols, Gleysols, Solonetz soils, and Anthrosols. These soil types differ significantly in their properties and in the specific measures required to maintain their fertility, depending on the ecopedological profile characteristics of each territorial unit (TEO/UT).The paper provides fundamental knowledge and methodological elements for the evaluation and characterization of soil and land resources, in the hope that the presented information will attract the attention of decision-makers. The ultimate goal is that, in the near future, agricultural research and practice—together with environmental protection—will intensify efforts to develop interdisciplinary studies on the quality of life.Moreover, the work offers basic information and methodological guidelines regarding the inventory, classification, and evaluation of soil and land resources for their sustainable use. Thus, it fits into the broader field of complex studies on natural resources and their valorization while ensuring environmental protection—especially in a period when the need to educate society about the importance of soil as the foundation of human communities and as a vital component and support of terrestrial ecosystems is increasingly felt.*

***Keywords****: soil, fertility, area, quality, quantification*

## INTRODUCTION

Consequently, ecopedological knowledge emerges as an increasingly pressing necessity, demanded by a modern and "rational" agriculture that transforms both soils (through fertilization using well-defined methods) and plants (by developing new varieties and hybrids).

Soil, as a fundamental component of terrestrial ecology, possesses a range of properties that have been defined and studied over time. These properties have served—and continue to serve—not only to establish genetic and parametric classification entities, but also to guide agricultural practices. Together with physico-geographical factors and climatic regimes, they shape terrestrial ecosystems. Within these systems, soils are unique environments, as they are the only ones that inherently contain both inherited, non-renewable orogenic energy and renewable solar energy—providing all organic components and supporting all forms of soil life.

Representing a clearly defined condition with significant spatial variability but relative temporal stability, pedological factors—through their major components—play an essential role in characterizing specific land areas. There are complex and diverse reciprocal relationships between soil properties and both cultivated and spontaneous plant species.

Numerous national-level studies and research have highlighted the interdependent relationships between agricultural plant cultivation technologies, the state of the environment, economic development levels, and quality of life (Borcean et al., 1996, 1997; David et al., 2018; Dumitru et al., 2000; Ianoş et al., 1997; Munteanu, 2000; Rogobete, 1979; Rogobete et al., 1997, 2021; Teaci, 1980; Țărău et al., 2018, 2019; Uruioc, 2002).

In light of these considerations, the present paper includes a series of data processed/adapted from the study *"Lands and Places between the Danube–Gugu Peak–Crișul Negru"* by D. Țărău et al. (2019). This study is based on pedological information archived at OSPA Timișoara and Arad, primarily in traditional format, as well as on the SPED1 information system and the BDUST-B system (ICPA Bucharest). The work also incorporates findings from long-term research conducted by the authors (within OSPA and USAMVB Timișoara), including various aspects related to pedoclimatic characteristics, as elements defining soil quality, aimed at providing land users with professional support for the development of sustainable land management programs.

## MATERIAL AND METHODS

The study focuses on an area of 86,180 hectares, of which 70,705 hectares (82.04%) are agricultural lands (51,139 hectares, representing 59.34%, are arable lands), and 10,034 hectares (11.65%) are forested lands located in the Buziaș–Săcălaz area (Tab. 1), characterized by varied geological and physico-geographical conditions.

The research on ecopedological conditions was conducted in accordance with the *"Methodology for the Elaboration of Pedological Studies"* (Volumes I, II, III), developed by ICPA Bucharest in 1987, and supplemented with specific elements from the Romanian Soil Taxonomy System (SRTS-2012), as well as other regulatory documents updated through Order of the M.A.A.P. no. 223/2002 and Order of the M.A.D.R. no. 278/2011. A series of processed/adapted data was used from the work *"From the Danube to Gugu Peak – Crișul Negru"* by D. Țărău et al. (2019), compiled based on pedological data archived at OSPA Timișoara and Arad—mostly in traditional format—as well as from the SPED1 information system and the BDUST-B database (ICPA Bucharest). The research also incorporated results obtained over time by the authors (within OSPA and USAMVB), including aspects related to pedoclimatic characteristics as key elements that define soil and land quality, aiming to provide land users with specialized support for the development of sustainable land management programs.

## RESULTS AND DISCUSSIONS

The subject of this study is represented by the land area totaling 86,180 hectares, of which 70,705 hectares (82.04%) are agricultural lands (51,139 hectares, or 59.34%, being arable), located in the Buziaș–Săcălaz area, which from a geomorphological point of view is largely part of the Banato-Crișana physico-geographical unit, specifically the Buziaș Plain and the Timiș Plain.

Located to the north of the Buziaș Hills and the floodplains of the Pogăniș and Timiș Rivers, these physico-geographical subunits extend across eight administrative-territorial units (ATUs), covering a surface of 86,180 hectares (Tab. 1), of which 70,705 hectares correspond to agricultural land within the studied area.

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**Buziaş Plain**

Located between the Şurgani and Pogăniş rivers, this plain extends to the north of the Buziaş Hills and can be classified as a morphological formation of terraces shaped by numerous erosion valleys, most of which drain into the Şurgani. These valleys are bordered by gently to moderately sloping sides, with gradients generally ranging from 5–8%, and occasionally reaching 8–12%.

**Timiş Plain**

Characterized by broad interfluves with varied slopes, this plain forms an intermediate step between the low Timiş Meadow and the hilly plains within the study area, particularly the Buziaş Hills, where it penetrates in the form of small bays. The transition from the hilly and sub-hilly sectors to the Timiş Plain is achieved through a sequence of terraces of varying widths.

*Table 1*

The Land Use Situation of the Buziaș (Sacoș) Plain and the Timiș Plain

| No. cr | Locality | Arable | Pastures | Hayfields | Vineyards | Orchards | Total agricultural land | Forests | Waters | Other categories | Overall total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Boldur | 5618 | 861 | 187 | 1 | 5 | 6672 | 1336 | 111 | 369 | 8488 |
| 2 | Buziaș | 5383 | 1411 | 308 | 849 | 41 | 7992 | 1705 | 41 | 856 | 10594 |
| 3 | Chevereșu Mare | 4371 | 1040 | 571 | 1 | 5 | 5988 | 1092 | 241 | 796 | 8117 |
| 4 | Darova | 7343 | 1188 | 697 | 0 | 144 | 9372 | 629 | 76 | 382 | 10459 |
| 5 | Racovița | 7235 | 1666 | 225 | 1 | 5 | 9132 | 1870 | 244 | 472 | 11718 |
| 6 | Sacoșu Turcesc | 9202 | 1509 | 238 | 4 | 115 | 11068 | 381 | 452 | 552 | 12453 |
| 7 | Știuca | 4491 | 3502 | 554 | 1 | 218 | 8766 | 1299 | 35 | 257 | 10357 |
| 8 | VVDelamarina- | 7496 | 2045 | 812 | 0 | 1362 | 11715 | 1722 | 58 | 499 | 13994 |
| **Total (ha)** | | **51139** | **13222** | **3592** | **857** | **1895** | **70705** | **10034** | **1258** | **4183** | **86180** |
| **% Total area** | | **59,34** | **15,34** | **4,17** | **0,99** | **2,20** | **82,04** | **11,65** | **1,46** | **4,85** | **100** |
| **% Of the total agricultural area** | | **72,33** | **18,70** | **5,08** | **1,21** | **2,68** | **100** | - | - | - | - |

The hilly area, characterized by broad interfluves with relatively steep slopes, forms an intermediate step between the plain and the Buziaș Hills, with altitudes ranging between 145–160 m, bordered by slopes of various shapes and sizes, frequently affected by erosion processes and landslides. The substrate consists of gravel, sands, clays, with lignite intercalations between 5 and 200 m.

The studied territory is located in the lower basin of the Timiș River, which flows from east to west in its northern part, about 400 m from the locality of Jabăr. Its waters affect, through overflow, only the immediate adjacent lands during certain periods.

Another tributary of the Timiș is the Timișina River and its tributaries: Cernabora, which springs from the hills near Oloșag-Dragomirești, as well as Dicșan Creek and Cherăstău Creek, which collect waters from the Sinersig area. These watercourses share a common characteristic of having low flow rates throughout the year, especially in summer when they almost dry up, while in spring, heavier rainfall and snowmelt often cause repeated flooding that damages nearby households and fields.

Due to its geographical position, the territory falls within a plain climate zone, at the transition boundary between the western subtype with oceanic influence and the Banat subtype with Mediterranean influence. The multiannual average temperature is 10.8°C, with an average annual precipitation of 600.4 mm (Timișoara station), respectively an annual average

http://doi.org/10.59463/RJAS.2025.2.06

temperature of 10.7ºC and multiannual precipitation values ranging between 605.5–725.9 mm (Lugoj station).

The Buziaș resort is situated in a transition region between the hilly area and the piedmont plain, characterized by a temperate continental moderate climate with Mediterranean influences. The average annual temperature is 10.8ºC (ranging between -2ºC and 21.5ºC).

The plain climate with mild winters and pleasant summers makes Buziaș a welcoming place both for those seeking treatment and for those wishing to rest.

As a consequence of relief, climate, and soil conditions, the vegetation around Buziaș city consists mainly of steppe and silvosteppe, with isolated forest areas. The existence of these forests from ancient times is evidenced today by the centuries-old oak in Silagiu, in the Măgironi Valley, with a base diameter of 1.80 m and an estimated age of over 500 years.

A special place in the landscape of Buziaș is occupied by the park, which, thanks to the advantageous location of the resort (east-west, along the Salcia stream valley), enjoys favorable natural conditions that allow the development of a rich flora with ornamental species originating from around the world.

The vegetation of the territory has been strongly influenced by prolonged human activity, archaeologically documented since the pre-Roman period. This activity has led to the fragmentation of natural vegetation and its replacement on large areas with secondary vegetation of cultivated crops and meadows used as hayfields and pastures.

As a fundamental component of terrestrial ecology, the soil cover represents one of the most important environmental elements, being in a close interdependence with the vegetation cover. As an open ecological system, it is tightly connected with the surrounding environmental elements through a continuous flux of matter and energy, with phytocenoses influencing the soil both directly and indirectly.

*Table 2*

The Main Soil Types and Associations in the Buziaș-Știuca Area

| No. crt. | Administrative-Territorial Unit (UAT) | Agricultural (ha) | Soil type, subtype | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AS | CZ | FZ. | EC | EL | LV | PL | VS | PE | SG | GS | SN | AT | Aso |
| 1 | Boldur | 6672 | 833 | 0 | 0 | 3425 | 1181 | 173 | 0 | 747 | 0 | 0 | 170 | 0 | 143 | 0 |
| 2 | Buziaș | 7992 | 645 | 0 | 0 | 0 | 3979 | 772 | 0 | 0 | 0 | 1451 | 30 | 0 | 1115 | 0 |
| 3 | Chevereș | 5988 | 132 | 0 | 0 | 379 | 4106 | 0 | 0 | 146 | 180 | 0 | 828 | 0 | 217 | 0 |
| 4 | Darova | 9372 | 821 | 0 | 0 | 854 | 5148 | 661 | 412 | 233 | 0 | 0 | 224 | 0 | 765 | 254 |
| 5 | Racovița | 9132 | 1589 | 0 | 0 | 3762 | 2886 | 0 | 0 | 292 | 0 | 9 | 594 | 0 | 0 | 0 |
| 6 | Sacoșu T | 11068 | 273 | 1445 | 3023 | 1814 | 3092 | 0 | 0 | 768 | 0 | 0 | 153 | 121 | 0 | 379 |
| 7 | Știuca | 8766 | 0 | 0 | 517 | 71 | 3839 | 2184 | 531 | 0 | 0 | 146 | 510 | 0 | 968 | 0 |
| 8 | V.V. Delamarina | 11715 | 273 | 0 | 0 | 651 | 6675 | 1056 | 0 | 71 | 0 | 121 | 200 | 0 | 1189 | 1497 |
| Total | | 70705 | 4566 | 1445 | 3540 | 10956 | 30906 | 4846 | 943 | 2257 | 180 | 1727 | 2709 | 121 | 4397 | 2130 |
| % Of the total agricultural area | | 100 | 6,46 | 2,05 | 5,01 | 15,43 | 43,72 | 6,85 | 1,33 | 3,19 | 0,25 | 2,44 | 3,83 | 0,17 | 6,23 | 3,01 |

Closely correlated with the variety of geomorphological factors that determine the existence of diverse relief units, geological factors which have resulted in a large diversity of parent materials, climatic and hydrological factors, as well as various anthropogenic interventions (from the pre-Roman period to the present), the current soil cover in the studied area presents a great diversity of soils and soil associations. According to the Romanian Soil Taxonomy System (SRTS-2012), 13 soil types have been identified: Aluviosols, Chernozems, Phaeozems, Eutricambosols, Preluvosols, Luvosols, Planosols, Vertisols, Pelosols, Stagnosols, Gleysols, Solonetzes, and Anthrosols (see Table 2). These reflect, through their geobiochemical and morphological properties, the main defining and determining characteristics for the growth and yield of the main cultivated plants, expressed by fertility scores based on which the lands have been classified into quality classes from I to V for an arable area of 5,383 ha (see Table 3).

*Table 3*

Quality Classes for the 'ARABLE' Land Use Category in the Buziaș Plain and Timiș Plain

| Administrative-Territorial Unit (UAT) | Year of execution | Arable | Class I (81-100 pct.) ha | Class a II-a (61-80 pct.) ha | Class a III-a (41-60 pct.) ha | Class a IV-a (21-40 pct.) ha | Class a V-a (0-20 pct.) ha | Weighted average score |
|---|---|---|---|---|---|---|---|---|
| 1.Boldur | 1987 | 5618 | 185 | 2914 | 1896 | 378 | 245 | 58 |
| 2.Buziaș | 1984 | 5383 | 0 | 1107 | 2714 | 1404 | 158 | 49 |
| 3.Chevereșu Mare | 2003 | 4371 | 0 | 1435 | 2572 | 350 | 14 | 57 |
| 4.Darova | 1989 | 7343 | 0 | 506 | 3859 | 2848 | 130 | 41 |
| 5.Racovița | 1986 | 7235 | 774 | 1302 | 3792 | 1260 | 107 | 55 |
| 6.Sacoșu Turcesc | 2009 | 9202 | 174 | 3748 | 3529 | 1674 | 77 | 57 |
| 7.Știuca | 1989 | 4491 | 0 | 852 | 1105 | 1999 | 535 | 42 |
| 8.VVDelamarina- | 2000 | 7496 | 0 | 335 | 2657 | 4256 | 248 | 38 |
| Total (ha) | - | 51139 | 1133 | 12199 | 22124 | 14169 | 1514 | - |
| Total (%) | - | 100 | 2,22 | 23,85 | 43,26 | 27,71 | 2,96 | - |

In the context of the above, the quality of agricultural land, as a result of the diversity of physico-geographical conditions and their intrinsic properties, as well as anthropogenic interventions over time, varies significantly across space. For this reason, the Romanian methodology for land evaluation—which synthesizes knowledge from various evaluation schools along with local experience (D. Teaci 1980, I.C.P.A. Bucharest 1987)—defines the soil ecologically in relation to cosmico-atmospheric and technical-edaphic factors.

The fundamental principle of the evaluation methodology developed in our country is that for each homogeneous ecological territorial unit (TEO), within an administrative territorial unit (UAT), defined according to the current Methodology for Preparing Pedological Studies, using 23 evaluation indicators commonly found in pedological mapping works produced after 1987 by territorial OSPA under the methodological guidance of ICPA Bucharest, the quality of the land is determined by evaluation scores ranging from 1 to 100.

Each of the units identified within the studied area was characterized according to the Methodology for Preparing Pedological Studies (MESP 1987, vol. I, II, III), using the 23 evaluation indicators, namely: climatic indicators (indicator 3C – mean annual temperature – corrected values, indicator 4C – mean annual precipitation – corrected values); indicators of morphological, chemical, physical, hydro-physical characteristics and the volume of the soil cover (indicator 14 – gleying, indicator 15 – stagnogleying, indicator 16 or 17 – salinization or alkalization, indicator 61 – total $CaCO_3$ content in 0-50 cm layer, indicator 63 – soil reaction in Ap or first 20 cm, indicator 144 – humus reserve in 0-50 cm layer, indicator 23A – texture in Ap or first 20 cm, indicator 44 – total porosity in the restrictive horizon, indicator 133 – useful soil volume); indicators of relief characteristics (indicator 33 – slope, indicator 38 – landslides); indicators related to hydrography, hydrology and drainage of the territory (indicator 40 – flood risk, indicator 181 – excess stagnant moisture, indicator 39 – depth of the groundwater table); indicators related to some anthropogenic interventions (indicator 29 – pollution, indicator 271 – land improvement arrangements), as well as interactions between these values characterizing natural properties and those induced by human activity.

Using this methodology, evaluation scores are established for each homogeneous ecological territorial unit (TEO) for the main fruit species (MR, PR, PN, CV, CS, PC), crops

http://doi.org/10.59463/RJAS.2025.2.06

(GR, OR, PB, FS, CT, SF, SO, MF, IU, IF, CN, LU, TR, LG), and land use categories (PS, FN), along with weighted average evaluation scores for each administrative territorial unit (tab. 3).

The qualitative assessment of agricultural lands within the studied area, based on the evaluation scores, indicates an average potential in the current state of soil exploitation and conservation. This potential can be improved considering that some indicators, such as soil reaction, porosity, useful water capacity, etc., are relatively easy to modify positively but only through the application of measures that expand their area of influence, as well as through improvements of other environmental factors.

The means of human intervention (understood as the agricultural producer who can thus become a wise partner of nature) can be very diverse: ranging from simple or routine cultural works to pedo-hydroameliorative measures or the use of superior biological materials—actions which, when applied in combination, can lead to an increase in the productive capacity of the land and to the improvement of its quality.

Thus, regarding the restrictive elements identified within the area of the 43 administrative-territorial units in the studied region, which affect the production potential of the soil cover, case-by-case measures are required, such as correction of acidic reaction through periodic liming, improvement of plant nutrition conditions via ameliorative fertilization (the dose of amendment, type and quantity of fertilizer to be established based on agrochemical mapping, according to land use and cultivated crop), elimination of excess moisture by prevention and control works (land leveling, ditches, trenches, channels, drains, etc.), prevention and control of soil erosion (routine cultural works, strip cropping, earth waves, furrows, contour channels, anti-erosion windbreaks), and so on.

Considering that a large part of the agricultural soils are successively affected during the growing season by both excess and deficit moisture, with negative effects on agricultural yields, the specific technologies will target both increasing aeration porosity and permeability for water through deep loosening works, combined with well-timed and high-quality agrotechnical works, land improvement works aiming at ameliorating saline soils or those with excess moisture, major leveling and shaping, as well as the remediation and maintenance of the existing drainage and desiccation systems.

## CONCLUSIONS

The knowledge of natural conditions, and especially of the ecological potential of the land (defined according to M.E.S.P.–ICPA Bucharest, 1987, based on bonitation scores) for the main land use categories and cultivated species, is of particular importance in carrying out qualitative evaluations and establishing their suitability. Its purpose is to provide agricultural specialists with a comprehensive overview of the phenomena occurring within elementary units of the pedological landscape, from which a general strategy can be developed to determine the best use of the land.

In this context, determining the production capacity of the land as well as establishing the most appropriate technologies for each cultivated species can serve as an effective tool for decision-makers (Government, local public administration) to choose working methods that favor efficient use of land resources within the studied area, in accordance with the specific pedoclimatic conditions. The processing and marketing of agro-food products can thus represent an ecological and efficient solution for the future.

In this regard, ecopedological knowledge, bonitation, and land evaluation impose themselves as an imperative necessity increasingly demanded by a modern, "rational"

http://doi.org/10.59463/RJAS.2025.2.06

agriculture that transforms soils (through fertilization and amelioration by various methods) as well as plants (creating new varieties and hybrids).

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