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Luvisols and related clay-illuvial soils (*gleby płowe*) – soils of the year 2023. Current view of their origin, classification and services in Poland

Cezary Kabała*

Wrocław University of Environmental and Life Sciences, Institute of Soil Science, Plant Nutrition and Environmental Protection, ul. Grunwaldzka 53, 50–375 Wrocław, Poland

* Prof. Dr. Cezary Kabała, email: cezary.kabala@upwr.edu.pl, ORCID ID: https://orcid.org/0000-0001-9796-3716

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Abstract

The Soil Science Society of Poland has elected *gleby płowe* (clay-illuvial soils) to be the Soils of the Year 2023. *Gleby płowe* are the most important soils in Poland, both in terms of occupied area, at least 45% of the total soil cover of Poland, and the importance for national agriculture. *Gleby płowe* are considered medium to highly productive soils, suitable for wheat, rapeseed and corn cultivation, so the vast majority of these soils are occupied by arable land use, while only their little fragments remained in forests, forming mesotrophic and eutrophic habitats. The joining feature of all *gleby płowe* is the presence of an argic illuvial diagnostic horizon, developed in the course of mechanical translocation of the clay fraction. However, this group is probably among the most diversified soils in Poland, as a consequence of the huge diversity of its parent materials and environmental conditions of their origin, as the well as the subsequent transformation induced by the long-term agricultural land use. This diversity is reflected in the highest number of soil subtypes (13) distinguished in a single soil type in the Polish Soil Classification, and their partial correlation with at least five reference soil groups (Luvisols, Retisols, Stagnosols, Planosols and Alisols) of an international WRB classification. This paper contains a brief review of (a) the development of the concept of clay-illuvial soils in the world and in Poland, (b) the current definition and classification of *gleby płowe* in Poland in relation to international classification, and (c) the state of the art in the knowledge of clay-illuvial soils in Poland, considering the unsolved issues of their origin, transformation and distribution in Poland.

1. Introduction

Although Chernozems are known to have the highest productivity and importance for global food security (Pozniak, 2019), the largest practical impact on the volume of agricultural production in Poland have *gleby płowe* – the most widely distributed soils in the country (Marcinek and Komisarek, 2004; Strzemski et al., 1972; Szafranek, 2000). The name *gleby płowe*, introduced by Uggla (1962), refers to specific pale brown colour that prevails in their subsoil. The closest English translation refers to the "fallow" colour, which was historically used to describe the coats of some animals, such as fallow deer, as well as to describe withered foliage or sandy soil in fallow fields (Webster, 1999). The term "fallow soils" would be ambiguous, so *gleby płowe* are formally translated as clay-illuvial soils (Świtoniak et al., 2016) referring to their origin, or as Luvisols/Alfisols, which are their closest theoretical equivalents in international soil classifications (IUSS Working Group WRB, 2022; Kabała et al., 2019a; Soil Survey Staff, 2022).

Despite the knowledge on the morphology, properties and productivity of *gleby płowe* has grown substantially since their separation from Podzols, several questions related to their origin, classification, and services remain under discussion (Gus-Stolarczyk et al., 2023; Szymański et al., 2011, 2017; Woronko et al., 2022). The discrepancies between researchers and definitions result from extremely complicated origin and lithology of parent materials in glaciated areas (Komisarek, 2017; Musztyfaga and Kabała, 2016), long-term land use and secondary agricultural transformations (Marcinek and Komisarek, 2014; Viet, 2023), sometimes considered as soil degradation (Kozłowski et al., 2018; Świtoniak et al., 2016). The fact that the vast majority of *gleby płowe* exist now under cultivation and only a minority in the forest, their natural habitat (Duchaufour, 1951), does not support finding answers to many questions.

Gleby płowe are considered to have a single equivalent in the international soil classification (Luvisols), but the issue is more complicated. Even in Poland, the number of soil types with substantial diagnostic horizon argic/argik varies between

1 and 3 (Systematyka gleb Polski, 2011, 2019; Klasyfikacja gleb leśnych Polski, 2000); whereas, at least five soil refernce groups may be correlated with Polish *gleby płowe* in the WRB classification: Luvisols, Retisols, Planosols, Stagnosols, and Alisols (IUSS Working Group WRB, 2022). The correlating of *gleby płowe* with their equivalents in international soil classification is affected by different attempts at identifying their origin and different priorities placed on particular soil horizons and properties (such as lithological discontinuity, stagnic properties, tonguing or trophic status). It does not mean that Polish classifications must strictly follow the international soil classification, but Polish soil scientists could at least tend to recognise the spatial differentiation of *gleby płowe* into subunits easily correlated with international classification to allow proper reflection of Polish soils on European and global soil maps (Białousz, 2022).

The Soil Science Society of Poland has elected *gleby płowe* the soils of the year 2023 to increase national awareness of their ecological and economic services, as well as to focus the society on unsolved questions about their origin, transformation and variability in Poland. The aim of manuscript is to briefly present the evolution of concept, definition and classification of *gleby płowe* (clay-illuvial soils) in Poland in a broader international context and review the state-of-the-art of research of these soils in Poland.

2. Evolution of the concept of clay-illuvial soils

The concept of illuvial differentiation of soil profiles emerged probably in Denmark as early as the middle 19th century (Simonson, 1968). Although soils were intensely studied in the late 19th century in Scandinavia and Germany (Aaltonen, 1935), the first internationally accepted name for illuvial soils – Podzols (or Podsols) - was derived from the Russian pedological tradition. Dokuchaev (1879) reported that silty / loamy textured soils with bleached, ash-like topsoil layers are widespread in the northern European part of Russia. Dokuchaev correlated the development of the bleached eluvial horizon with the impact of forest and wetland vegetation in a humid or moist or humid climate. According to Dokuchaev and his successors, Sibircev and Glinka, podzolization is a complex process of decomposition and translocation of many soil components, including humus, iron and manganese oxides, fine earth particles (clay) and other (Glinka, 1915). Ramann (1911, 1918) accepted the broad Russian definition of podzolization and as the first west-European scientist applied the word Podsol, but did not exclude that the illuviation of mineral particles in fine-textured soils may proceed in a different way than podzolization in sandy soils, poor in colloids. Glinka (Dobrovolskiy, 1976) accepted the possibility of Chernozem degradation by leaching of “clay suspensions” under “the protective impact of humus colloids”. A compelling documentation of the diffusion, translocation, and accumulation of colloidal particles in a form of compact and less permeable subsoil horizons in humid regions of the USA provided Merrill in the first decade of the twentieth century (Bockheim and Hartemink, 2013).

Further arguments for the separateness of the “traditional” podzolization from clay illuviation, and the morphological and physicochemical separateness of sandy Podzols from fine-textured illuvial soils were provided in the 1930s by Sellke in Germany (Borowiec, 1965), Cernescu (1937) in Romania and by Wolfanger, Robinson and Joffe in the USA (Bockheim and Hartemink, 2013). The most comprehensive model of eluvial and illuvial horizons was proposed in France in the late 1930s by Aubert and Demolon (Gerasimov, 1960; Strzemski, 1971), whose new terms – lessivagé and *sols lessivés* – have been spread by Duchaufour (1951), extended by the new concept of clay cutans/coatings formation in the illuvial horizon (Duchaufour, 1956). Evidence of clay cutans as diagnostic features and a reliable explanation of their origin led to a worldwide discussion on the need to distinguish a new unit of clay-illuvial soils in national classifications. As a consequence, the *Parabraunerden* (Mückenhausen, 1962) have been introduced in Germany and the unique illuvial horizon argillic has been introduced to the American classification (Soil Survey Staff, 1960) as a crucial diagnostic horizon for Alfisols and Ultisols orders. The major feature of a new diagnostic horizon, apart from the larger content of clay fraction compared to an overlying eluvial horizon, was the presence of (macro- or microscopically) recognisable clay cutans on the aggregate walls and in biochannels or clay bridges between sand grains. As Soil Taxonomy (1975) became the first informal international classification, the separateness of podzolization and lessivagé gained worldwide acceptance among soil scientists.

The new point of view has also been discussed in the Soviet Union. Fridland (1958) generally accepted the idea of separate the processes of podzolization and illimerization processes, as he called lessivagé. Gerasimov (1960) suggested the term *pseudopodzol* as the Russian synonym of the *soils lessivés*. On the contrary, Parfenova and Jarilova (1960), argued that under the cold and humid climate conditions of the Soviet Union, the phenomena typical for podzolization and lessivagé may cooccur in the same soils, thus they may be recognised as forms of the same, widely defined eluvial/illuvial process. Thus, they supported the preservation of the traditional understanding of podzolization and soil naming system (including the distinction of “soddy-podzolic soils”). This point of view persisted in the Soviet Union over the next decades.

3. Evolution of the concept of illuvial soils in Poland

Among the local Polish soil names, collected and characterised for the first time by Łuszczewski and Cichocki in years 1859–1861 (Strzemski, 1971), *bielica* appeared commonly as a name for soils with a clearly lighter or bleached topsoil colour. Names such as *bielica ilasta* (clay-textured bielica), *bielica gliniasta* (loam-textured bielica), *bielica ciężka* (heavy bielica), *szara bielica* (grey bielica), *jasnożółta bielica* (light-yellow bielica) and *szczerk bieliczkowy* (loamy sand-textured podzolized soil) suggested a wide textural extend of *bielica* soils, not restricted to sandy soils only. Grabski (1904, cit after Strzemski 1971) described the properties of *bielica lipnowska* (toponymic name for *bielica* soils common in Lipno village and its sorrunding) in the following words: "whitish when moist, white when dry; coherent in the topsoil and having the loam in the subsoil, but sometimes also steel-grey sand; does not contain lime, suffers similarly from droughts and rains; poor and cold soil". Miklaszewski (1930) explained the origin of the word *bielica* in the following words: "fine siliceous powder turns white on the surface of ploughed soil after drying in the sun or after heavy rain. This fine sand may be so whitish that the surface of the soil looks from the distance like it was sprinkled with lime". Irrespective of such a characteristic of the topsoil, Miklaszewski (1930) considered the reddish glacial till to be the most typical parent material for *bielica* in Poland. In his opinion, "all soils developed from fine-textured materials may turn into *bielica*, because the podzolization process is the most prominent under current climate conditions in Poland". The term *bielica* was obviously considered a Polish equivalent for the Russian word Podzol and the concept of bielicowanie was very close to the Russian podzolization as presented by Glinka and Williams (Miklaszewski, 1922).

The understanding of Podzols and podzolization process in Poland directly after World War II did not change (Strzemski, 1952). The new French and American concepts remained unknown mainly due to war collapse of research and educational institutions and the postwar political situation, which limited international contacts and access to Western papers and books. Polish soil science has been reconstructed under the large influence of Soviet pedology (Musierowicz, 1953). Thus, the first soil classifications (Przyrodniczo-genetyczna klasyfikacja gleb Polski, 1956; Genetyczna klasyfikacja gleb Polski, 1959) and the first soil maps (Tomaszewski, 1950; Musierowicz, 1961) edited in post-war time in Poland merged all eluvial-illuvial soils under the term *gleby bielicowe* or *bielice* (podzolic soils or Podzols). The papers of Tomaszewski (1952, 1957) give insight into the theoretical discussion concerning the podzolization and, in particular, the origin of textural differentiation of loamy and silty-loamy soils. Tomaszewski, the student of Glinka, fully accepted the Russian concept of podzolization as multi-aspect decomposition, leaching and resynthesis of minerals that may result in a differentiation of soil profile into bleached eluvial and dark-brown illuvial horizons, both in sandy and fine-textured soils. Tomaszewski strongly supported the opinion on the influence of seasonal reducing conditions and anaerobiosis (related to the excess of moisture in the soil profile) on a decomposition of minerals and translocation of colloids in fine-textured soils, in particular in soil developed from loess (Tomaszewski and Borkowski, 1959).

After the Congress of International Soil Science Society (ISSS) in Paris in 1956, and, in particular, after the conference of soil science societies from East European countries in Warsaw in 1957, where the idea of lessiváge and *sols lessivés* has emerged (Ehwald, 1959; Reuter, 1959), the discussion started also among Polish soil scientists (Kuźnicki, 1959), based on ongoing theoretical and cartographic works (Konecka-Betley, 1960, 1961; Kowalkowski, 1966; Musierowicz et al., 1963; Prusinkiewicz and Kowalkowski, 1964). Despite the fact that the term *sols lessivés* quickly became popular (Borowiec, 1965) and despite the unique Polish name for a new type of soils – *gleby płowe* – has been proposed (Uggla, 1962), the terminological tradition was so strong, that the Russian term applied by Gerasimov (1960) – *gleby pseudobielicowe*(pseudopodzolic soils) – has been selected the first formal name for clay-illuvial soils in a new country-wide cartographic project of detailed soil-agricultural maps (Bartoszewski et al., 1965). The term *gleby pseudobielicowe* was supported in particular by those soil scientists, who, like Tomaszewski, believed in a close relationship between podzolization and seasonal anaerobiosis, reflected in the common presence of pseudogley characteristics in texturally differentiated soils (Strzemski et al., 1973). Although the term *gleby pseudobielicowe* has soon been replaced in official soil classifications with *gleby płowe (lessivés)* (Klasyfikacja gleb leśnych, 1966; Systematyka gleb Polski, 1974), it persisted until now on soil-agricultural maps, including their electronic versions (Kabała et al., 2022; Świtoniak et al., 2019) and in the map-based nonpedological reports (Duma et al., 2019).

The validity of separating a new soil type was confirmed during the ISSS Congress in Bucharest in 1964, during which almost all European countries (except the Soviet Union) presented the proposals of new soil classifications or new national soil maps, which considered *sols lessivés* (Dudal, 1964).

4. Definition of clay-illuvial soils (*gleby płowe*) in Poland

Gleby płowe are defined in Poland as primarily illuvial soils. It is believed that they develop under climate conditions enough humid, at least seasonally, and not all the precipitation water is evapotranspirated, but partly remains and infiltrates the soil profile, which allows vertical translocation of solutes and particles from topsoil to subsoil horizons. The removal of carbonates and base cations (in particular calcium) is considered necessary to allow the dispersion of clay minerals and then the transport of colloidal suspension in percolating water (Mocek, 2015). Clay particles accumulate in the subsoil layers as coatings (cutans/linings) in pores and biochannels and on the surfaces of structural units (peds/aggregates) of any grade, as well as bridges between sand and silt grains and lamellae (Chodak and Kowaliński, 1972; Gus-Stolarczyk et al., 2023). Most commonly, clay coatings and bridges can be observed in the field using hand lenses or even with the naked eye (Świtoniak et al., 2016). Typical coatings contain oriented silicate clay, easily recognisable on micromorphological slides (Kobierski, 2013; Mroczek, 2018; Zasoński, 1983). In polygenetic soils, the coatings can be stratified and may include an admixture of coarser particles (e.g., silt) and humus (Kabala et al., 2019b). Translocation of iron, aluminium, manganese, and humic colloids may accompany clay transport, but it is not essential and has not a diagnostic importance. However, the accompanying accumulation of iron compounds increases the colour contrast of fine-textured soil mass, thus helping in a visual identification of clay coatings, bridges and lamellae (Świtoniak et al., 2022).

As a consequence of clay translocation, the soil profile differentiates into coarser-textured eluvial horizons (A and E) and underlying, finer-textured illuvial Bt horizon, the latter in a continuous/massive or lamellar form (Glina et al., 2014; Gus-Stolarczyk et al., 2023). Classifying soils as *gleby płowe* requires the presence of a diagnostic horizon argik (Systematyka gleb

Polski, 2019). Its definition is based on argic in the WRB classification (IUSS Working Group WRB, 2022), but is not identical, therefore, the spelling of horizon name in Polish classification is different from the original one. The illuvial horizon Bt may be called argik only in the event that it meets all the criteria listed for this horizon. The requirements are as follows: (a) the texture of loamy sand or finer and the clay content at least 8%, (b) the presence illuviation features in the form of coatings on at least 20% of vertical and horizontal pedfaces or in the form of bridges in between of at least 20% sand grains, and (c) the thickness of at least 10% of overlying horizons and at least 15 cm (in the case of lamellic horizon, the latter refers to the sum of lamellae). If no lithological discontinuity occurs between the E and Bt horizons, the criterium (b) may be replaced by a relative difference in clay content. It should be higher in argik than in overlying horizon by at least: (b') 4% (absolute difference), if the overlying horizon contains <10% of clay, or (b") 40% (relative difference), if the overlying horizon contains ≥10% of clay (Systematyka gleb Polski, 2019).

In fact, the latter alternative criterium allows recognising an argik horizon even in case of indistinct development or, theoretically, even a lack of recognisable illuvial features. This makes "Polish" argik closer to argic horizon in the WRB classification (IUSS Working Group WRB, 2022) than to the argillic endopedon in Soil Taxonomy (Soil Survey Staff, 2022). In the WRB, an argic horizon may develop as a result of various pedogenic processes, including not only illuvial accumulation of clay minerals, but also the predominant pedogenic formation of clay minerals in the subsoil, destruction of clay minerals in the overlying horizons, selective surface erosion of clay minerals, upward movement of coarser particles due to swelling and shrinking, and biological activity (IUSS Working Group WRB, 2022). Although Szymański et al. (2017) denied that ferrolysis is responsible for the vertical differentiation of clay content in acid and moist soils developed from loess in south Poland, the question about the mechanism of clay content differentiation in strongly acid soils in Poland remains unanswered (Gerasimova and Khitrov, 2012). In these soils, having a pH value <4.5 down to a depth of 50-90 cm, clay dispersion and translocation can be blocked by high aluminium activity (Quenard et al., 2011). Also, clay coatings may be indistinct in an illuvial horizon due to their secondary destruction by cryogenic processes (Kabala et al., 2022; Woronko et al., 2022).

The key to Polish soil classification (Kabała et al., 2019a) placed *gleby płowe* after vertisolic and chernozemic orders. Therefore, soils with mollic and umbric horizons are excluded from *gleby płowe*, even if they have an argik horizon. All other soils having argik horizon are gathered in a soil type *gleby płowe*. It means that the Polish soil classification gives a priority to argik horizon above all other diagnostic horizons and properties. Only one soil type with essential diagnostic argik horizon was distinguished (*gleby płowe*), regardless of soil moisture status, trophic status, lithological homogeneity/discontinuity, and albeluvic tonguing, which differentiates the Polish soil classification from international classifications, where two orders (Soil Taxonomy) or even seven reference groups (WRB) are identified with argillic/argic as an essential diagnostic horizon. Due to the prevailing temperate moist climate and the absence of naturally saline soils, the natric horizons and respective soil taxa have not been identified in the Polish soil classification.

5. The age of clay-illuvial soils (*gleby płowe*) in Poland

Gleby płowe are considered to develop preferentially in broadleaf forests, typical of eutrophic loamy and silty soils in temperate climate (Brożek et al., 2007; Lasota et al., 2011). Argik horizon appears commonly in thick loess sections confirming the formation of *gleby płowe* in all climatically favourable periods of the Pleistocene (Jary, 2007; Maruszczak, 1991). Also, the Holocene is considered favourable for their origin, thus illuvial soils are considered typical modern soils on Polish territory (Miklaszewski, 1930). Some authors argued for possible formation of illuvial Bt horizons since the late Pleistocene (Konecka, 2019; Konecka-Betley and Zagórski, 1996), in particular, indicating the cryoturbation features in Bt horizons developed in Pleniglacial loess and Vistulian tills (Kühn, 2003; Kühn et al., 2006; Mroczek, 2018). However, the other findings indicate a slow decalcification rate and the absence of illuvial horizons in buried mid-Holocene soils (Kabala et al., 2019b; Krupski et al., 2021). Of course, it is highly probable that the beginning and rates of the formation of clay-illuvial soils were individually related to local conditions, in particular, to initial content of carbonates in the parent material, the moisture regime and drainage related to landscape morphology, vegetation history and the history of human activity (Mroczek, 2018). Nevertheless, the dating of buried clay-illuvial soils and the observations of soils developed on Neolithic barrows confirmed their origin in various periods of the Holocene (Kabala et al., 2019b; Krupski et al., 2021; Mroczek, 2018). The same findings confirmed that the formation of an illuvial horizon, which meets the criteria for argic/argik, may require a relatively short time, as approximated by Alexandrovskiy (2007).

Arguments referring to the age of clay-illuvial surface soils developed from the tills of the older glaciations have recently been reconsidered towards the recognition of the subfossil pre-Vistulian soils (Kabala et al., 2021; Woronko et al., 2021).

6. Classification of clay-illuvial soils (*gleby płowe*) in Poland

Clay-illuvial soils as a separate type of *gleby płowe (lessives)* appeared first in the form of photocopied typescripts in 1966 in the Classification of forest soils (Klasyfikacja gleb leśnych, 1966) and the project of Classification of Polish soils (Projekt Systematyki gleb Polski, 1969). To be identified in the official, printed version of Classification of Polish soils, *gleby płowe (lessives)* waited until the mid-1970s (Systematyka gleb Polski, 1974). Following the ecological concept of Duchaufour (1956), *gleby płowe (lessives)* have been placed together with the type of brown soils in one soil order. Two subtypes, *typical* and *podzolized*, have been recognised based on the morphological features of genetic horizons and the index of relative enrichment of iron and aluminium in a clay fraction. It must be stressed that the identification of the soil type based on a sequence of genetic horizons (A1-A3-Bt-C) and higher clay content in the Bt horizon, while the clay cutans/coatings have been omitted as a possible diagnostic feature. This fact led to discussion of the typological position of texturally differentiated soils with textural differentiation resulting primarily from lithogenesis of the parent material (Strzemski et al., 1973).

The 4th edition of soil classification (Systematyka gleb Polski, 1989) has not changed the name, general definition and placement of *gleby płowe (lessives)*, but added crucial novum in diagnostic criteria. Namely, the classification has introduced the diagnostic horizons adopted from Soil Taxonomy (Soil Survey Staff, 1975), including the argillic one. This means that new diagnostic criteria, in particular clay cutans (called "otoczki ilaste") were introduced and should be applied to resolve the former difficulties with the identification of illuvial horizon. Unfortunately, the criterium has been rarely applied until the end of the twentieth century, as few people only among Polish soil scientists were able to recognise the clay cutans in the field. The situation has rapidly changed at the beginning of 21st century due to increasing international contacts. Whereas, the presence of clay cutans in the micromophological slides has been successfully used as diagnostic criterium for illuvial horizon since mid-1960s (Chodak and Kowaliński, 1972; Kowaliński, 1969, 1970; Kowaliński and Bogda, 1966; Zasoński, 1980, 1983, 1990). The 4th edition of soil classification (Systematyka gleb Polski, 1989) identified seven subtypes of *gleby płowe (lessives)*: *typical, podzolized, brown* (having a B – cambic-like horizon below A), *stagnogleyed, gleyed, having agric horizon* (plough pan), and *having a glossic tonguing*. All soils of the type *gleby płowe (lessives)* have been correlated with Alfisols (Hapludalfs, Ferrudalfs, Albaqualfs, Ochraqualfs, Agrudalfs and Glossudalfs, respectively) of Soil Taxonomy (Soil Survey Staff, 1975).

The 5th edition of soil classification (Systematyka gleb Polski, 2011) has retained the general concept of *gleby płowe*, but has resigned of the word *lessivés* in the name. However, the name and criteria for the diagnostic illuvial horizon have been substantially changed: the criteria derived from Soil Taxonomy have been replaced with those adopted from WRB classification (IUSS Working Group WRB, 2006). Moreover, clay-illuvial soils have been separated from brown soils as independent soil order (*gleby płowoziemne*) with three soil types: *gleby płowe* (common clay-illuval soils), *gleby płowe zaciekowe* (glossic clay-illuval soils) and *gleby płowe podmokłe* (waterlogged clay-illuval soils). The first two types were distinguished to reflect the distribution of soils with an argic horizon among the crucial WRB Reference Soil Groups, namely Luvisols and Albeluvisols. The third soil type was distinguished due to the unique ecological and agricultural position of excessively water-saturated soils. The 5th edition of classification was known for the large number of distinguished subtypes: 12, 9 and 2 in *gleby płowe*, *gleby płowe zaciekowe* and *gleby płowe podmokłe*, respectively.

The present, 6th edition of soil classification (Systematyka gleb Polski, 2019) continues the crucial decision to correlate the requirements for diagnostic horizons with the WRB classification, in this case with its 3rd edition (IUSS Working Group WRB, 2015). However, the classification returned to the tradition of a single soil type of *gleby płowe*. The latter allowed to reduce the number of subtypes from 23 to 13; however, the subtypes can be combined together (like qualifiers in the WRB classification), excluding the *typical* subtype. To avoid overcomplication and misunderstandings, maximum two subtypes may be combined. The following subtypes were distinguished with their most common WRB equivalents (Kabała et al., 2019):

- *typowe* (typical), having the most typical sequence of genetic horizons (A-Et-Bt-C) and not having other diagnostic horizons or properties that place the soil in the other subtypes; correlated with Albic Luvisols (Fig. 1),
- *zerodowane* (eroded), having an argik horizon directly below the Ap horizon (Ap-Bt-C); correlated with Haplic Luvisols (Fig. 2a),
- *dwudzielne* (texturally contrasted), having a sandy topsoil ≥50 (–100) cm thick overlying the argic horizon; correlated with Luvic Planosols, Luvisols, or Retisols, respectively to the presence of lithic discontinuity and other diagnostic properties (Fig. 3a);
- *lamellowe* (lamellic), having the argik horizon consisting of clay lamellae; correlated with Lamellic Luvisols,
- *próchniczne* (humic), having a topsoil humus horizon >30 cm thick (which does not meet criteria for mollik/umbrik/arenimurszik) or topsoil horizon that meets the criteria for mollik/umbrik/arenimurszik, except the thickness, which is in the range of 20–30 cm; correlated with Luvic Phaeozems (Fig. 2b),

Fig. 1. *Gleby płowe typowe* (clay-illuvial soils) developed from loess in south-west Poland: (a) profile Henryków – Albic Luvisol (Siltic, Cutanic) and (b) profile Skarszyn forest – Albic Alisol (Siltic, Cutanic)

Fig. 2. Common subtypes of arable *gleby płowe* (clay-illuvial soils): (a) profile Trzebnica – *gleba płowa zerodowana* – Haplic Luvisol (Siltic, Cutanic) and (b) profile Przeworno – *gleba płowa próchniczna opadowo-glejowa (zaciekowa)* – Luvic Stagnic Phaeozem (Loamic, Albic, Aric)

- *zbrunatniałe* (brown), having a kambik horizon between A and Bt horizons; correlated with Albic Luvisols (Neocambic),
- *rdzawe* (rusty), having a sandy siderik horizon below an A horizon, correlated with Albic Luvisols (Neobrunic) (Fig. 3b),
- *zbielicowane* (podzolic), having an AE or E horizon and Bs or Bhs horizon, correlated with Albic Planosols (Protospodic),
- *wertikowe* (vertic), having a vertic horizon, correlated with Vertic Luvisols,
- *podmokłe* (waterlogged), having gleyic properties starting ≤50 from the surface and groundwater level ≤100 cm, at least seasonally; correlated with Gleyic Luvisols or Eutric Gleysols (Luvic);
- *gruntowo-glejowe* (gleyed), having gleyic properties starting ≤80 cm from the surface; correlated with Gleyic Luvisols;
- *opadowo-glejowe* (stagnogleyed), having stagnic properties starting ≤80 cm from the surface; correlated with Stagnic Luvisols, Luvic Stagnosols, or Luvic Planosols, respectively (Fig. 2b, 3, 4); and
- *zaciekowe* (tonguing), having the albeluvic glossae; may be correlated with Glossic/Retic Stagnosols, and Retisols, respectively (Fig. 2b, 3, 4).

As mentioned above, the list of subtypes reflects the most common varieties of clay-illuvial soils in Poland, in relation to specific parent materials (*dwudzielne, lamellowe*), accompanying pedogenic processes (*zbrunatniałe, rdzawe, zbielicowane, wertikowe, zaciekowe*), excess of moisture (*podmokłe, gruntowo-glejowe* and *opadowo-glejowe*), and significant human impact – erosion (*zerodowane*) and deep plowing with addition of organic matter (*próchniczne*).

The correlation of *gleby płowe* with WRB classification and Soil Taxonomy is in most cases relatively easy; however, it is true for completely named soil, but not for the majority of single subtypes. As mentioned above and illustrated in figures 1–4, the subtypes can be combined. Thus, the presence or absence of additional subtypes may be essential for correlation. For example, *gleba płowa zaciekowa* can be correlated with Albic Retisol (Fig. 3b), but *gleba płowa opadowo-glejowa zaciekowa* can refer to Luvic Glossic Stagnosol (Fig. 4).

In addition, the list of subtypes (traditionally) does not reflect the trophic status of *gleby płowe*. It is believed, that arable *gleby płowe* have high base saturation due to liming (Strzemski et al., 1973), while forest *gleby płowe* are considered to create relatively eutrophic forest habitats (compared to these on sandy soils), even if acidified (Lasota et al., 2011; Lasota and Błońska, 2014). As a consequence, the correlation of some *gleby płowe* with Alisols (IUSS Working Group WRB, 2022) is impossi-

Fig. 3. *Gleby płowe* (clay-illuvial soils) with lithic discontinuity: (a) profile Prusice – *gleba płowa dwudzielna opadowo-glejowa (zaciekowa)* – Eutric Luvic Planosol (Anoarenic, Endoloamic, Aric, Ochric, Raptic) and (b) profile Grabowno – *gleba płowa rdzawa zaciekowa (słabo opadowo-glejowa)* – Eutric Retisol (Epiarenic, Katoloamic, Ochric, Raptic, Neobrunic)

Fig. 4. Spectacular polygonal structures developed in a thick argic horizon of a soil developed from loess: profile Lubań – *gleba płowa opadowo-glejowa zaciekowa* – Luvic Glossic Albic Stagnosol (Siltic)

ble based only on the soil name (type and subtype) and must be done based on an intentional field pH testing or using analytical data (Table 1). However, placing a soil in Alisols is possible, if albeluvic tonguing is excluded (Fig. 1b), which typically has not been mentioned in field reports. The author's own experience and the analysis of available reports and published papers suggest strong leaching and acidification in up to 10% of forest *gleby płowe*.

Forest soils classification (Klasyfikacja gleb leśnych Polski, 2000; hereafter KGLP), applied for the evaluation and mapping of forest habitats in Poland, recognises *gleby płowe* based on the presence of morphologically and texturally recognisable argic horizon, thus the soils identified on forest maps and in forest databases can be easily correlated with other classifications, even if KGLP recognises only a few soil subtypes. The major difficulties in correlation are in three cases: (a) soils with strongly marked stagnic properties, which are in Stagnosols and thus may have or miss an argic horizon, (b) clay lamellae do not form the argic horizon in KGLP; thus sandy soils with clay lamellae are placed in arenosols (Dystric Arenosols) or rusty soils (Brunic Arenosols), and (c) eroded or post arable soils with A-Bt-C morphology are most commonly identified as brown earths (Cambisols) in KGLP, as an eluvial horizon is missing.

Table 1
Brief overview of colour and physicochemical properties of selected clay-illuvial soils (presented in Figures 1–4)

Profile	Horizon	Depth cm	Munsell colour (moist)	2.0–0.05 mm	0.05–0.002 mm	<0.002 mm	Texture class	SOC	$CaCO_3$	pHw	BC	Al_{ex}	BS %
					%			%			cmol(+) kg^{-1}		
Henryków	Ah	0–5	10YR 2/1	20	71	9	pyg/SiL	9.26	0	4.0	5.1	3.5	59
	AE	5–15	10YR 5/2	21	69	10	pyg/SiL	3.22	0	4.2	3.0	3.1	49
	Et	15–48	2.5YR 7/3	21	65	14	pyi/SiL	0.56	0	4.4	1.9	2.1	48
	E/B	48–55	2.5YR 7/3 +10YR4/6	23	59	18	pyi/SiL	0.19	0	5.4	11.2	0.9	93
	Btg1	55–75	10YR 4/6	19	58	23	pyi/SiL	0.28	0	5.6	12.7	0.4	97
	Btg2	75–125	10YR 5/6	27	57	24	pyi/SiL	0.16	0	5.7	12.8	0.3	98
	BCk	125–140	10YR 6/7	17	67	16	pyi/SiL	0.14	2	8.0	49.8	0	100
	Ckc	140–160+	10YR 6/6	19	68	13	pyi/SiL	0.12	16	8.3	81.9	0	100
Skarszyn forest	Ah	0–4	10YR 4/3	12	85	3	pyz/Si	4.24	0	3.8	1.0	17.6	5
	Et1	4–20	2.5Y 7/3	16	76	8	pyg/SiL	0.87	0	3.9	0.9	14.8	6
	Et2	20–50	2.5Y 7/3	15	76	9	pyg/SiL	0.52	0	4.0	0.9	13.1	7
	E/B	50–75	10YR 5/6 + 2.5Y 7/4	13	70	17	pyi/SiL	0.25	0	4.2	3.7	14.2	21
	Btg1	75–110	10YR 5/6	12	64	24	pyi/SiL	0.13	0	4.5	5.8	11.6	33
	Btg2	110–140	10YR 6/6	15	63	22	pyi/SiL	0.11	0	5.0	7.5	5.4	58
	BCg	140–165	10YR 7/6	13	71	16	pyi/SiL	0.09	0	5.4	7.6	2.0	80
	Ck	165–190+	2.5Y 8/3	15	72	13	pyi/SiL	0.16	5	8.3	30.5	0	100

Table 1, continue

Profile	Horizon	Depth cm	Munsell colour (moist)	2.0–0.05 mm	0.05–0.002 mm	<0.002 mm	Texture class	SOC	$CaCO_3$	pHw	BC	Al_{ex}	BS %
				%				%			cmol(+) kg^{-1}		
Trzebnica	Ap	0–25	10YR 4/3	18	70	12	pyg/SiL	0.91	0	6.5	9.0	0	100
	Bt1	25–55	10YR 5/6	15	57	28	gpyi/ SiCL	0.18	0	6.8	11.0	0	100
	Bt2	55–75	10YR 6/6	15	59	26	pyi/SiL	0.11	0	7.0	8.7	0	100
	BC	75–120	2.5Y 6/8	16	67	17	pyi/SiL	0.06	0	7.4	7.3	0	100
	C	120–150	10YR 6/8	18	67	15	pyi/SiL	0.05	0	7.4	7.2	0	100
Przeworno	Ap	0–27	10YR 3/2	47	42	11	gp/SL	1.00	0	7.0	7.8	0	100
	Etg	27–35	2.5Y 6/4	39	40	21	gz/L	0.24	0	7.2	7.6	0	100
	2B/E	35–55	7.5YR 5/7+ 2.5Y 7/1	44	26	30	gi/CL	0.29	0	7.3	10.5	0	100
	2Btg	55–100	7.5YR 5/8+ 2.5Y 7/1	42	22	36	gi/CL	0.11	0	7.6	12.4	0	100
Prusice	Ap	0–27	10YR 4/2	93	5	2	pl/S	0.38	0	5.2	3.8	0.3	92
	Et	27–53	2.5Y 7/2	94	4	2	pl/S	0.11	0	5.9	3.7	0.1	98
	E/2Btg1	53–65	7.5Y 5/6 + 2.5Y 7/2	64	21	15	gl/SL	0.13	0	5.4	6.7	0.9	88
	E/2Btg2	65–75	7.5YR 5/6-8 + 2.5Y 7/1	47	32	21	gz/L	0.17	0	5.1	9.0	2.3	79
	2Btg1	75–95	7.5YR 5/6	35	39	26	gz/L	0.17	0	4.0	11.8	2.8	81
	2Btg2	95–120	7.5YR 5/6	42	35	23	gz/L	0.18	0	5.0	10.4	2.1	83
Grabowno	AE	0–6	2.5Y 4/1	84	14	2	pg/LS	5.17	0	4.8	5.7	0.2	96
	ABv	6–12	7.5YR 4/3	84	12	4	pg/LS	1.41	0	4.2	2.2	1.5	60
	Bv	12–45	2.5Y 5/4	84	13	3	pg/LS	0.49	0	4.7	1.3	1.0	55
	E/2Btg	45–70	7.5YR 5/4 + 2.5Y 7/2	64	21	15	gl/SL	0.13	0	4.5	5.1	3.1	62
	2Btg/E	70–90	7.5YR 5/6 + 2.5Y 7/2	57	22	21	gpi/SCL	0.11	0	4.9	5.8	2.2	73
	2Btg	90–130	7.5YR 5/8	48	25	27	gpi/SCL	0.08	0	5.0	8.0	2.9	73
Lubań	Ah	0–6	7.5YR 3/1	16	75	9	pyg/SiL	14.5	0	3.7	4.0	12.0	25
	Etg	6–15	10YR 6/2	22	66	12	pyg/SiL	0.86	0	4.3	2.0	3.5	36
	E/Btg	15–25	2.5Y 6/4	14	72	14	pyi/SiL	0.23	0	4.1	1.7	3.0	36
	Btg/E1	25–50	7.5YR 6/6	12	69	19	pyi/SiL	0.15	0	4.1	1.6	7.0	19
	Btg/E2	50–65	7.5YR 6/6	14	66	20	pyi/SiL	0.12	0	4.2	2.3	7.1	25
	Btg	65–140	7.5YR 6/8	12	67	21	pyi/SiL	0.10	0	5.1	7.5	1.5	84

Explanation: SOC – soil organic carbon, pHw – pH in distilled water, $CaCO_3$ – calcium carbonates (equivalent), BC – sum of base cations (Ca+Mg+K+Na, in 1M NH_4OAc at pH7), Al_{ex} – exchangeable Al (in 1M KCl extract), BS – base saturation as BC*100/(BC+Al_{ex}); texture class (according to USDA/WRB): CL – clay loam, L – loam, LS – loamy sand, S – sand, SCL – sandy clay loam, Si – silt, SiCL – silty clay loam, SiL – silt loam, SL – sandy loam; texture class (according to Systematyka gleb Polski, 2019): gi – glina ilasta, gl – glina lekka, gp – glina piaszczysta, gpi – glina piaszczysto-ilasta, gpyi – glina pylasto-ilasta, gz – glina zwykła, pl – piasek luźny, ps – piasek słabogliniasty, gpi – glina piaszczysto-ilasta, pyg – pył gliniasty, pyi – pył ilasty, gpi – glina piaszczysto-ilasta

7. Knowledge about the spatial distribution, properties, and services of clay-illuvial soils (*gleby płowe*) in Poland

It is well known, since at least 1930s, that the fine-textured clay-illuvial soils, then called *bielice* and now *gleby płowe* are the most widespread soils in Poland, which is reflected in all soil maps published in Poland since the late 1970s (Białousz, 2022). However, all these maps have been derived based on field work and primary maps completed before the concept of *gleby płowe* was established and before the impact of erosion was sufficiently recognised (Kabała et al., 2022a). This may explain why clay-illuvial soils (*gleby płowe*) are combined together with brown soils (*gleby brunatne*) and brown soils are considered the dominant soils in large arable areas covered with loess and morainic materials (Zawadzki, 1999). The reasons for this state lie deep in the past (Białousz, 2022). Miklaszewski (1930) reported that *podzols* are severely eroded in intensely cultivated areas, which can result in simplification of profile morphology and blurring of the eluvial horizon, but does not change their *podzolic* identity. Whereas, Mieczyński (1938) supported Ramann's concepts and classification, followed by Kwinichidze and Prusinkiewicz (1952), who based on a review of foreign papers, but resigned of the analysis of the local distribution and spatial relationships between *gleby bielicowe* and *gleby brunatne* in Poland. Despite the objections of some pedologists, the common presence of *gleby*

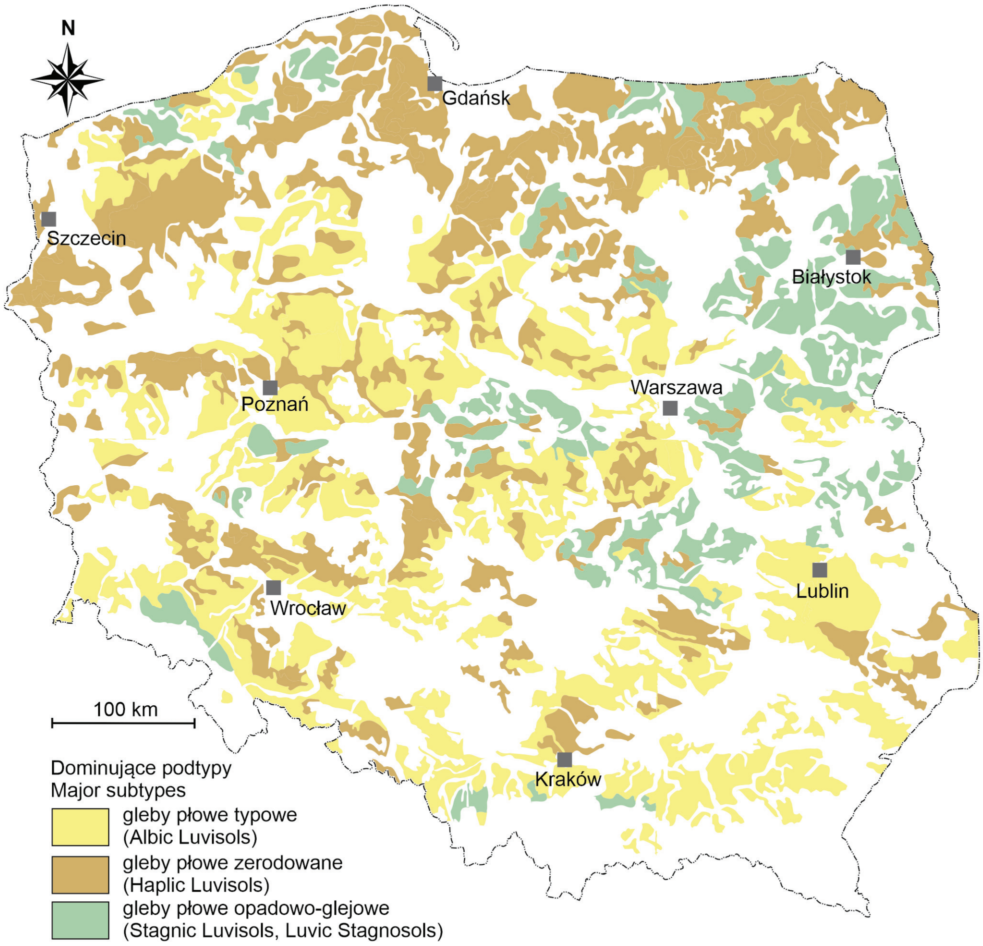

Fig. 5. Distribution of clay-illuvial soils (*gleby płowe*) in Poland (prepared based on the map of Białousz and Różycki, 2015)

brunatne in Poland has been formally accepted in the legends of maps already prepared or planned. Currently it seems obvious (Kobierski, 2013; Świtoniak, 2014), that Miklaszewski was right. The first attempt to identify *gleby płowe zerodowane* (eroded clay-illuvial soils, Haplic Luvisols) instead of *brown soils* was a soil map attached by Białousz and Różycki (2015) to the textbook of Mocek et al. (2015). Therefore, estimations of *gleby płowe* at 45% (Systematyka gleb Polski, 2019) or at 52%, as the sum of *gleby płowe* and *gleby brunatne* (Bednarek and Prusinkiewicz, 1997), as well as the distribution of their major subtypes (Fig. 5), still require verification. Methodological proposals for a new estimate, exploring existing large-scale maps, have been recently published (Kabała et al., 2019, 2022).

Clay-illuvial soils (gleby płowe) are among the most frequently investigated soil units in Poland, in relation to their common occurrence and importance for agriculture and forestry (Table 2). Clay-illuvial soils (*gleby płowe*) were among the first soil types studied using micromorphological and X-ray diffraction metods (Konecka-Betley, 1966; Kowaliński and Bogda, 1966). The general differentiation and spatial variability of texture, physicochemical and water properties, as well as chemical properties, including natural and anthropogenically elevated levels of the major and minor elements, are elaborated very well. Based on these findings, *gleby płowe* are commonly considered medium to high productive soils, both in terms of agriculture and forestry (Strzemski et al., 1973). However, the agricultural evaluation (bonitation) of these soils may vary extremely in relation to parent material, texture and its vertical differentiation, thickness of humus, eluvial and illuvial horizons, water regime and other factors, well reflected in the distinguished subtypes (Systematyka gleb Polski, 2019). The highest evaluation (up to class II of the Polish bonitation system) can reach *gleby płowe próchniczne* (humic clay-illuvial soils), in particular if eluvial horizon is not presereved, which is typical for *gleby płowe zerodowane* (eroded clay-illuvial soils). However, soils of the latter subtype, particularly common on moraine and loess rolled plains and highlands, typically are evaluated in classes IIIa and IIIb, due to the constant threat of erosion. An evaluation of *gleby płowe dwudzielne* (texturally contrasted clay-illuvial soils) depends mainly on the thickness of the topsoil sandy layer. Soils with thinner loamy sands resting on sandy clay loams may still represent productivity of class IIIb, but the rating of soils with thicker loose sandy topsoil may fall down to IVb class. Whereas, sandy *gleby płowe lamellowe* (lamellic clay-illuvial soils) typically have the lowest evaluation, respective to the class V (Systematyka gleb Polski, 2019). Due to their spatial appearance and variability, *gleby płowe* are the soils most commonly in growing and fertilisation experiments in Poland (Długosz, 1994, 1996; Furczak, 2006; Komisarek, 2017; Marcinek et al., 1999).

Table 2
The main research topics focused on the clay-illuvial soils (*gleby płowe*) in Poland

Research issue	Citation
Regional spread and variability	Chojnicki, 1993; Cieśla, 1968; Cieśla et al., 1978; Dąbkowska-Naskręt and Jaworska, 1997a; Kabała et al., 2015; Konecka-Betley and Czępińska-Kamińska, 1979; Kuźnicki et al., 1979; Szałata and Komisarek, 2014; Szafranek et al., 2007; Szymański et al., 2012; Uziak et al., 1987; Zasoński, 1981
Position in the landscape	Bojko and Kabała, 2016; Kozłowski and Komisarek, 2016; Piaścik et al., 1996; Pindral et al., 2020
Origin and transformation	Jaworska et al., 2016; Kabala et al., 2019; Konecka-Betley, 2009; Kowalkowski, 1980; Krupski et al., 2021; Łabaz et al., 2022; Marcinek and Komisarek, 2004; Mroczek, 2018; Świtoniak, 2006, 2021; Waroszewski et al., 2018; Woronko et al., 2022;
Classification and correlation	Charzyński, 2006; Kabała and Musztyfaga, 2015; Kabała et al., 2022a, 2022b; Świtoniak et al., 2019; Zagórski et al., 2015
Erosion/truncation of profiles	Kobierski, 2013; Loba et al., 2023; Radziuk and Świtoniak, 2021; Świtoniak, 2014
Lamellar Bt horizon	Gus-Stolarczyk et al., 2021, 2023
Fragipan formation	Szymański et al., 2011, 2012
Textural variability	Dąbkowska-Naskręt and Jaworska, 1997b, Kabała and Marzec, 2010; Komisarek, 2017; Komisarek and Szałata, 2008; Musztyfaga and Kabała, 2016
Physical properties and water retention	Bryk, 2023; Glina et al., 2013, 2014; Kaczmarek et al., 2006; Kozłowski and Komisarek, 2014; Kozłowski et al., 2011, 2018; Owczarzak and Grzelak, 2007; Paluszek, 2001; Pranagal, 2007; Słowińska-Jurkiewicz et al., 2004; Turski and Witkowska-Walczak, 2004; Usowicz and Rejman, 2000; Witkowska-Walczak et al., 2004; Zaleski, 2012; Zaleski et al., 2003
Cation exchange and pH	Gruba et al., 2013; Gworek et al., 2000; Jaworska and Długosz, 1996; Skłodowski, 1995; Spychalski, 2007
Humus content and humic substances	Drzymała and Mocek, 1993; Janowiak, 1993; Kobierski et al., 2009; Kowaliński et al., 1986; Kuźnicki and Skłodowski, 1979; Licznar and Drozd, 1985; Marcinek and Komisarek, 1991; Sytek, 1974; Turski and Flis-Bujak, 1980; Zwydak et al., 2017; Żukowska et al., 2007
Clay fraction	Bogda et al., 1998; Chodak, 1980, 1994; Drewnik et al., 2014; Długosz, 1994, 2002; Konecka-Betley, 1966; Szymański et al., 2014, 2017; Uziak et al., 1987;
Micromorphology	Chodak and Kowaliński, 1972; Świtoniak et al., 2016; Zasoński, 1974, 1983, 1990
Mineral composition	Jaworska and Dąbkowska-Naskręt, 1999; Szymański et al., 2014; Waroszewski et al., 2019
Biochemical and biological activity	Bielińska and Węgorek, 2005; Furczak, 2006; Piotrowska-Długosz et al., 2013
Macro- and microelements	Chojnicki and Kowalska, 2009; Kaniuczak, 1999; Kaniuczak et al., 2003; Kobierski et al., 2011; Komisarek, 2008; Marcinek and Komisarek, 1996; Pakuła and Kalembasa, 2012; Raczuk, 2001; Wiatrowska and Komisarek, 2015
Fertility and productivity	Kowaliński et al., 1978; Skłodowski and Bielska, 2009
Forest habitats	Brożek et al., 2007; Lasota et al., 2011; Lasota and Błońska, 2014
Contamination with trace elements	Czarnowska, 1989; Długosz, 1996; Drozd and Kowaliński, 1985; Kabała et al., 2014, 2020; Kabala and Singh, 2001; Kwasowski et al., 2010; Medyńska-Juraszek and Kabała, 2012; Roszyk and Szerszeń, 1988; Szerszeń et al., 1991
Contamination with organic substances	Banach-Szott et al., 2012; Dębska et al., 2012; Klimkowicz-Pawlas et al., 2017
Topsoil and subsoil compaction	Marcinek et al., 1995, 1999,
Paleosols/buried soils	Jary, 2007; Maruszczak, 1991; Mroczek, 2018; Rodzik et al., 2014

The papers presenting the results of growing, fertiliser and remediation experiments carried out on the clay-iluvial soils, which presented the properties of topsoil layer affected by experimental factor only, are not included.

Due to the attractiveness mentioned above of *gleby płowe* to agriculture, forests occur on these soils only incidentally, in poorly available sites. More extensive forest fragments on highly productive *gleby płowe* exist in large forest complexes, in sites having historical importance or in the areas currently protected as nature reserves or national parks (Prusinkiewicz and Kowalkowski, 1964). *Gleby płowe* create at least mesotrophic, but most often eutrophic forest habitats, reflected in high values of forest trophic index (SIG), typically reaching 30–38 points on a scale of 4–40 (Lasota and Błonska, 2013). The reaction of forest vegetation differs from field crops, due to the deep rooting system of trees, easily reaching the water and nutrient rich subsoil horizons, thus particular subtypes of forest clay-illuvial soils do not differ substantially in their habitat evaluation, and are considered most appropriate for multispecies broadleaf communities, such as *Tilio-Crapinetum typicum*, *Galio-Carpinetum typicum*, *Galio odorati-Fagetum,* etc. Texturally differentiated soils, with a thick sandy topsoil, can represent the mesotrophic category, thus more commonly classified as "habitat of mixed-species forests", with prevailing *Luzulo pilosae-Fagetum*, *Calamagrostio arundinaceae-Quercetum,* and others (Brożek et al., 2007, Lasota et al., 2011; Systematyka gleb Polski, 2019).

8. Final remarks

Although the origin of clay-illuvial soils seems well known, some aspects are still insufficiently recognised. This is in particular the evolution of subsurface horizons under long-term cultivation, connected with deep plowing, liming, and fertilization. Furthermore, proper reflection of soil cover in Poland on regional/global soil maps is difficult, as the spatial distribution of *gleby płowe* in Poland among the Reference Soil Groups (Luvisols, Retisols, Planosols, Stagnosols, and Alisols) of the WRB classification (IUSS Working Gropus WRB, 2022) is not done or provisional (Fig. 5). The ecosystem services of *gleby płowe* have been studied in many aspects; whereas, their potential to mitigate the climate change through carbon sequestration is still poorly recognised (Galka et al., 2014; Jonczak, 2014; Olejnik and Małek, 2020).

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Gleba płowa – gleba roku 2023. Aktualne poglądy na genezę, klasyfikację i funkcje gleb płowych w Polsce

Słowa kluczowe

Luvisols
Retisols
Planosols
Stagnosols
Geneza gleb
Pokrywa glebowa

Streszczenie

Polskie Towarzystwo Gleboznawcze wybrało gleby płowe jako gleby roku 2023. Gleby płowe są najważniejszą grupą gleb w Polsce zarówno pod względem zajmowanej powierzchni (około 45% pokrywy glebowej Polski), jak i znaczenia dla krajowej produkcji rolniczej. Gleby płowe odznacza się średnią i dobrą wartością rolniczą, właściwą dla uprawy pszenicy, kukurydzy i rzepaku, dlatego zdecydowana większość tych gleb znajduje się w użytkowaniu rolniczym, a tylko niewielkie ich fragmenty występują pod lasami, tworząc dobre i bardzo dobre siedliska lasów i lasów mieszanych. Wspólną cechą gleb płowych jest obecność poziomu iluwialnego (argik), wytworzonego w procesie przemieszczania się frakcji ilastej, ale gleby płowe są prawdopodobnie najbardziej zróżnicowanych typem gleb w Polsce. Wynika to z ogromnego zróżnicowania skał macierzystych, z których wytworzyły się te gleby, warunków środowiskowych, w jakich występują oraz przeobrażeń jakim uległy wskutek długotrwałego użytkowania rolniczego. Zróżnicowanie typu gleb płowych odzwierciedla wyodrębnienie aż 13 ich podtypów w systematyce gleb Polski oraz częściowa alokacja w najmniej pięciu referencyjnych grupach gleb w klasyfikacji międzynarodowej WRB. W niniejszym artykule zaprezentowano krótki przegląd: (a) rozwoju koncepcji gleb iluwialnych na świecie i w Polsce, (b) współczesnej definicji i klasyfikacji gleb płowych w Polsce na tle klasyfikacji międzynarodowej, oraz (c) stanu zbadania gleb płowych w Polsce ze wskazaniem nierozwiązanych zagadnień dotyczących ich genezy, transformacji i rozprzestrzenienia w Polsce.