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Antonio Ganga

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Cassio Hamilton Abreu-Junior

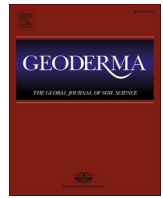
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Authors

Antonio Ganga, Ludmila Ribeiro Roder, Enzo Antônio Paganini, Arun Dilipkumar Jani, Cassio Hamilton Abreu-Junior, Thiago Assis Rodrigues Nogueira, and Gian Franco Capra



Systematic review and meta-analysis

Filming a hidden resource: The soil in the seventh art narrative

Antonio Ganga^a, Ludmila Ribeiro Roder^a, Enzo Antônio Paganini^a, Arun Dilipkumar Jani^{b,*},
Cassio Hamilton Abreu-Junior^c, Thiago Assis Rodrigues Nogueira^d, Gian Franco Capra^a

^a Dipartimento di Architettura, Design e Urbanistica, Università Degli Studi di Sassari, Via Piandanna No 4, 07100 Sassari, Italy

^b Department of Biology and Chemistry, California State University, Monterey Bay, Seaside, CA 93955, USA

^c Center for Nuclear Energy in Agriculture, Universidade de São Paulo, Av. Centenário n° 303, Piracicaba, SP 13416-000, Brazil

^d Department of Agricultural Sciences, School of Agricultural and Veterinarian Sciences, São Paulo State University, Via de Acesso Prof. Paulo Donato Castellane s/n, Jaboticabal, SP 14884-900, Brazil

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ABSTRACT

The general public often perceives soil as a hidden resource. In recent years, the film industry has shown an increasing awareness about the soil environment. Indeed, as public opinion about environmental problems has increased, soil as a natural resource has become more popular in public discourse, and, consequently, the film industry, partly because of its ability to showcase public concerns and mainstream opinion. This review aims to identify depictions of soil in films and the following consequences regarding their impact on society. We investigated movies containing different perspectives and aimed to understand: *i*) the role of the soil environment in their message; *ii*) how soil was approached by filmmakers; *iii*) how and to what extent such an approach changed along the investigated period; and finally; *iv*) how “soil movies” should be used as an innovative educative and didactic tool. Nine hundred and eighty movies where soils represent a direct or indirect source of inspiration or background for the movie’s storytelling were analyzed (from 1903 to 2022). Several approaches to soil resources were observed, which led us to seek quantitative data, too. Results showed that soil has been represented with approaches often far from the simple idea of soil as a static backdrop. Scriptwriters and directors have moved from a stylistic representation of soil to one that includes the soil environment in the main narrative by using innovative metaphoric approaches. With its ability to represent soil as a natural resource, this review demonstrates that “soil movies” can strongly contribute to spreading knowledge about this fragile and non-renewable resource, encouraging its use for educational purposes.

1. Introduction

Soil is a non-renewable resource, at least on a human generational scale (Clunes et al., 2022), sustaining and providing pivotal environmental and ecosystem functions and goods/services for all life forms on Earth (Bouma et al., 2019).

Soil scientists conceptualize it through tangible traits, also called *primary qualities* (i.e., an object’s specific properties independent from the observer; Locke, 2019; Capra et al., 2016). From this viewpoint, soil is a three-dimensional body, the pedon, large enough to include several bio-physical-chemical properties that are, or will be, investigated according to the aims and scope of the study for which soils are under investigation (Singer, 2015). However, the general public recognizes it through *secondary qualities* (i.e., perceived properties such as color, taste, smell, and sound; Locke, 2019; Urbańska et al., 2021, 2022).

Consequently, it is mainly perceived as a bi-dimensional body because its depth is not clearly visible. Indeed, the soil still represents a hidden almost unknown resource (Charzynski et al., 2022).

This lack of confidence in understanding soil as a resource by the general public is alarming because humans strongly depend on soil for a plethora of services and commodities. As stated by actor Edward Norton in the documentary “Nature Is Speaking – Edward Norton is The Soil” (Conservation International, 2014): “I suppose you still want to eat, right?”. As a matter of fact, soil as a resource is under threat (Montanarella et al., 2016). Soil degradation threatens our existence as it is estimated to dramatically increase over time (Borrelli et al., 2017). On a global scale, FAO estimates financial losses of US\$ 400 billion annually due to agriculturally-induced soil degradation (FAO, 2017).

Movies can represent an incredible means for improving human perception on such an important resource. As was first argued by Landa

* Corresponding author.

E-mail address: ajani@csumb.edu (A.D. Jani).

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(2010), soils are a conscious component of many films. In the last few years, with the increasing awareness of global environmental issues, soils stepped forward more often in the minds of movie directors, writers, and, generally speaking, the movie industry as a whole.

In 2022, the global movie industry reached \$76.7bn in terms of market size (home/mobile entertainment included), with an expected \$169bn by 2030 (GlobeNewswire, 2022). The movie market reached 1.3 billion people globally in 2022, with the trend expected to increase in the near future, with a potential market of more than 2.5 billion people by 2050 (Motion Picture Association, 2021). The cinema is not merely a market; it is a field of art with wide visibility and the power to influence public opinion. Perkwitz (2017), suggestively calls it the power of “Hollywood science,” stating that films: *i*) can exert a powerful visual and sensuous introduction to science and technology; *ii*) have the power of temporarily removing viewers from the world as they know it, while; *iii*) showing them a different perspective on human nature, the environment, society as well as behaviors and relationships among them. More frequently, scholars, from different fields of research, investigated how this art can exert its influence on their discipline. From nuclear energy (Araripe Marinho et al., 2021), to urban greening (Hedblom et al., 2020), and climate change (Bulfin, 2017), studies reveal the incredible power of films in influencing society in terms of public opinion, with often unexpected consequences from different socio-economic points of view.

A new approach in the international movie industry has been strongly influenced by the increasing awareness of public opinion on environmental issues (Klinger and Metag, 2021). As public concerns about these themes has increased, political platforms have started to be more involved with new national and international laws for fighting against issues affecting the global environment (Takahashi et al., 2021). Consequently, the movie industry has shown an increasing interest too, thanks to its ability to anticipate public concerns and mainstream opinion (Klinger and Metag, 2021).

It is worth understanding how the movie industry describes, perceives, and treats the soil environment. While Landa (2010) and Feller et al. (2015) previously approached this topic, a global review is still lacking. Our goal in this article was to provide a global perspective on soil perception in the movie industry. We investigated the general context in which the “soil” theme is included, perceived, and represented in the film’s narrative. This review aims to identify depictions of soil in films and the following consequences regarding their impact on society. In particular, the movies we considered were approached from different perspectives, with the aim of understanding the role of the soil environment in their message, how the soil has been approached by filmmakers, and how and to what extent such an approach changed during the investigated period (1903–2022). Considering these aspects, we finally investigated how “soil movies” should be used as an innovative educative and didactic tool; consequently, a step-by-step method is proposed to incorporate “soil movies” in courses with soil science components. Results from this project can be useful in expanding our perspective on the perception of soil in cinema, with new possibilities for using films as an innovative way to communicate about soil with students and the general public.

2. Material and methods

The Internet Movie Database (IMDb) website (<https://www.imdb.com/>), i.e., the largest authorized online source for films and all data related to the movie industry, was used to create the database. We searched (until December 2022) for the keywords “soil” (124) or “ground” (60) or “earth” (804) or “land” (456), identifying 1444 movies in the population. All movies were manually inserted in a database (starting from 2016 to 2022). From these, the following were removed: *i*) duplicates (i.e., same movies found from different keywords), detected by the “conditional formatting” function of Microsoft® Excel® (Microsoft®, 2023); *ii*) movies where the soil environment had no real, direct

or indirect, importance. This was made possible by cross-checking all acquired information available on investigated movies into the dataset; *ii*) movies of local production and distribution interest only, additionally being featured for the absence of any English translation/subtitles (such information is immediately available from IMDb and similar database). Finally, 988 movies were investigated, starting from 1903, i.e., the first year where a “soil movie” was detected in the IMDb database, to 2022 (the last available complete year).

In the database, we reported and codified: *a*) the title (T); *b*) the year of production (YP); *c*) the country(s) of production (CP); *d*) the main locations filmed in the movie (ML), through different online databases, such as “Atlas of Wonder” (<https://www.atlasofwonders.com/>), i.e., the most important database for finding movies’ shooting location(s); *e*) the movie type (MT), according to the Academy of Motion Picture Arts and Sciences (AMPAS, 2022), by classifying them as: *i*) feature film (Ff) or “feature-length film” (i.e., a film with a running time long enough to be considered the principal or sole presentation, generally speaking these are of 40 min or longer); *ii*) short film (Sf) or simply “short” (i.e., with a running less than 40 min); *iii*) documentary film (Df) or “documentary” (i.e., usually a nonfictional motion picture documenting some specific aspect of reality for instruction, education, historical, etc. purposes); *f*) the genre(s) (MG), by considering that reported by IMDb database (https://www.imdb.com/feature/genre/?ref=nv_ch_gr), with the relevant exception of “documentary” and “short-film” that belongs to MT voice (*vide infra*); twenty-one different genres were finally considered; *g*) the main kind of soils visible in the movie scenes, by contemporary investigating images and overlaying Soil Maps of the shoot area(s). Indeed, since we already know where the movie was filmed, (see point b, *vide supra*) QGIS (GIS Development Team, 2023) was used to overlay it with related soil maps. In a few cases, soil maps were not available, but information was reported on published soil reports. Soils were then classified at the Order (Soil Survey Staff, 2014) or FAO reference Soil Group (IUSS Working Group WRB, 2022) level (in the text the first mention will make reference to US Soil Taxonomy, the second to FAO WRB; for example, Gelisols/Cryosols (*vide infra*)); *h*) when applicable, the issues, or main type(s) of soil degradation, affecting filmed soils according to FAO’s main soil degradation types (Ballayan, 2000).

Only one movie can obviously belong to multiple categories. For example, in ‘The Wonder,’ profiles of both Histosols (peat soils) and Gelisols/Cryosols (permafrost-affected soils) are clearly visible. In ‘The Road,’ soils are affected by multiple issues, including erosion and chemical and physical deterioration. This means that our analysis was not restricted to one category. Finally, since the paper is intended for a broad audience, most scientific terms that are standard for soil scientists are explained as straightforwardly as possible (*vide infra*).

3. Results and discussion

3.1. Exploring soil perception in the movie history industry

Fig. 1 reports all the 988 investigated “soil movies” vs worldwide movie production according to their exit decade.

The first movie clearly showing a soil as such and strongly involving it in its narrative and ideological message was ‘Alice in Wonderland.’ It was the first cinema transposition of Lewis Carroll’s (1865) ‘Alice’s Adventures in Wonderland.’ The soil, a Mollisol/Kastanozem in Port Meadow, appears in the scene as a pivotal step in the narrative talking about the famous travel of Alice in a fantasy world where she will enter through the soil (Ex. 1; examples (ex.) 1–9 recall discussed movie sequences by using hyperlinked words to publish pictures already). In a short movie (less than 9 min), a hole in the soil became the door for a new magnificent world.

During the first investigated decade (1903–1912), we found only six movies where the soil environment appears as a pivotal step in the movie narrative, equal to 0.005 % of global production (43174). However, the situation completely changed as time went by. Indeed, an

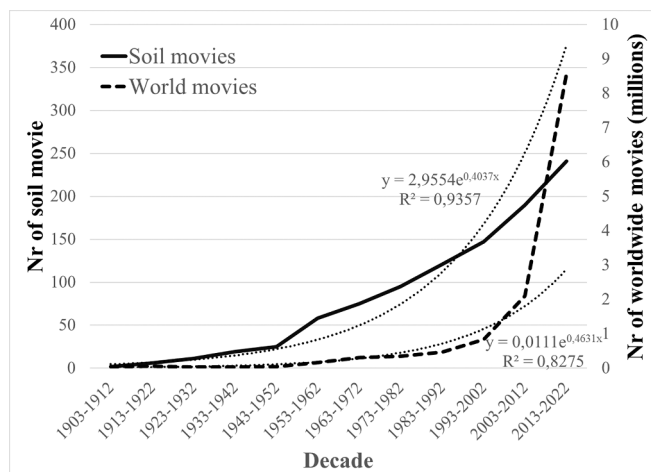


Fig. 1. Comparison between the number (nr) of “soil” movies vs worldwide movies produced per investigated decade.

exponential trend in “soil” movie production has been observed (Fig. 1) with interesting outcomes when compared to global production. A clear behavior in the results we obtained can be underlined. As a matter of fact, there are two evident breakthroughs in movie production with soil as a direct or (mostly) indirect protagonist: *i*) the first is related to the so-called western movie’s “golden age” from 1940 to 1960 (Nowell-Smith, 1996), where the soil movies reached a peak representing 0.12 % of the global movie production (a net increase > 2300 % compared to the first investigated decade); *ii*) the second to the “eco-cinema” (1990–2000) age (Brereton, 2022), i.e., when the movie industry started to talk about environmental issues, such as climate change. During this period, soil movies reached their highest percentage (0.2 %) compared to global movie production.

Fig. 2 reports the distribution map, in percentage, of the 988 investigated movies along the six (Africa, Asia, Europe, North America, Oceania, South America) of the seven (Antarctica was not reported since no movies were investigated in the database) continents.

With 455 (46 %) of 988 movies, North America is a leader in making soil movies. The US alone has produced 41 % (404) of them, being the

leader in this ranking. Europe produced 25 % of investigated movies, with the UK (16 %) as the leading nation followed by France (5 %), Spain (4 %), Italy (2 %), and Germany (2 %). In Asia, 16 % of production occurs and is concentrated in China (8 %) and India (7 %). Oceania (7 %), South America (5 %), and Africa (1 %) globally had minimal production. The results are just partially in contrast with the worldwide general production of movies, with the global ranking showing Asia as the second most important movie production region. However, this can easily be explained by the power of UK productions with the investigated database only involving movies in English for the sake of homogeneity. Since the movie industry is a worldwide global market, the English dialogue in the movie script is a key requisite for every producer hoping to enter the business. Additionally, other aspects must be considered, such as the most powerful centers of all movies produced. As a matter of fact, several studies revealed at least until 2000, the movie industry was concentrated in traditional countries such as US, Canada, and Mexico (Coe, 2001; Scott and Pope, 2007). During the last two decades, new countries substantially increased their production, such as China and India (Zhang and Li, 2018). China’s movie industry has experienced a tremendous growth in recent years, after the 2002 reform promoted by the government that introduced the so-called “shareholding system,” i.e., by encouraging private capital to invest in the industry and forming all kinds of movie technicians to promote China as a film location for all major film studios (Zhang and Li, 2018). China is the second largest movie producer worldwide (after the US) but is first in terms of box office revenue (\$7.3 billion; 2021, i.e., the last complete available data) followed by U.S./Canada (\$4.5) (Statista, 2023). Also, India, with the Bollywood center, started to play a pivotal role in the movie industry now representing the seventh most productive movie industry. These countries increased their production thanks to the fact that production costs for major film studios are lower and specific laws also promote tax reduction. All these aspects represent another weakness in our research; however, with the tool and database now available, artificial intelligence (AI) included, it is extremely hard to make more in-depth comparisons focused on most important production centers. This weakness represents a possible future step for new studies aiming at implementing algorithms and tools like AI and machine learning techniques, to solve such specific issues.

Eighty-seven percent of investigated movies were featured films (*vide supra*), while only 10 and 3 %, respectively, are short films and

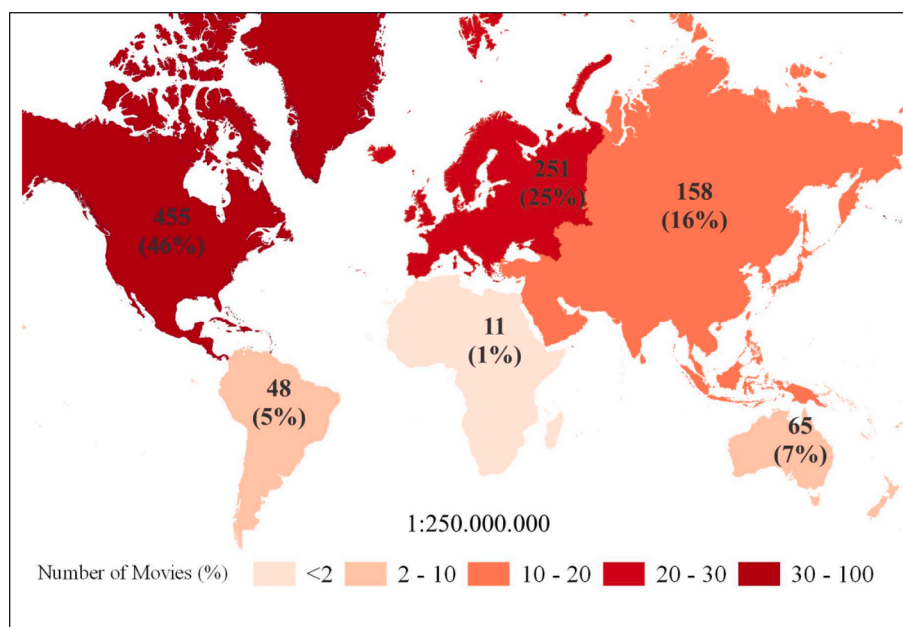


Fig. 2. Distribution map of investigated “soil” movies worldwide.

documentaries. Looking at the genre, other interesting information arises (Fig. 3). Our results can be divided into five main groups according to observed ranges: i) those with values over 10 %, such as the drama (Dr), adventure (Ad), and western (We) movie genre; ii) noir (Nr), action (Ac), crime (Cr), mystery (My) and thriller (Th) are all in the 6–9 % range; iii) around the 4/5% we found the animation (An), fantasy (Fy), sci-fi (Sf), super-hero (Sh), and the horror (Ho) movies; iv) historic (Hi), war (Wa), and biographic (Bi) movies are all grouped around the 2 %; finally, v) we grouped all movies under the 1 % (comedy (Co), family (Fa), romance (Ro), sport (Sp) and music (Mu)). It is immediately clear that the use of the soil environment is strongly influenced by the genre, meaning that its presence is closer to very peculiar kinds of movie narratives. The soil environment fits well with the drama (Dr), adventure (Ad), and western (We) narrative, where it is often used to underline and/or convey specific messages and exacerbate emotional moments along the narrative. Some further paradigmatic examples, over those previously reported, for drama movies can be briefly discussed to explain such a concept easily (*vide supra*).

The famous Tara cotton plantations, even if replaced on RKO ‘Forty Acres’ backlot studio (Culver City, California), were inspired by the ‘The Twelve Oaks’ (Covington municipality, Newton County, Georgia, US) with its fertile sandy-loam Inceptisols/Umbrisols. This is the main outdoor framework of Scarlett O’Hara and her family’s vicissitudes in ‘Gone with the Wind.’ Here cotton soils, as in the most recent ‘12 Years a Slave’ and ‘Django Unchained,’ filmed in historic antebellum plantations in Louisiana featured by very similar soil conditions (sandy-loam soils with a fertile umbric surface horizon), are used as a powerful metaphor for the hard work made by slaves during the slavery period in the US. The soil is not only showed to increase drama, but it also represents the metaphoric background in slavery dehumanization (Malekpour and Kordlar, 2020); soil as dirt, efficiently works in making the whole narrative more distressing. In ‘Babel’ and ‘No Country for Old Men’ the harsh environment of the desert with its Aridisols/Solonetz, Calcisols, Durisols is the perfect framework of lonely and desperate souls with their melancholy and no hope for the future. Conversely, genres such as comedy (Co), family (Fa), romance (Ro), sport (Sp), and music (Mu) poorly fit the rhetorical message that could mediate throughout the soil environment.

Fig. 4 shows the main soil degradation issues affecting soil movies we investigated. Of the 988 movies inside the database, 33 % are affected by some problem, showing that the soil environment is often used to empathize with very specific moments or themes in the movie narrative.

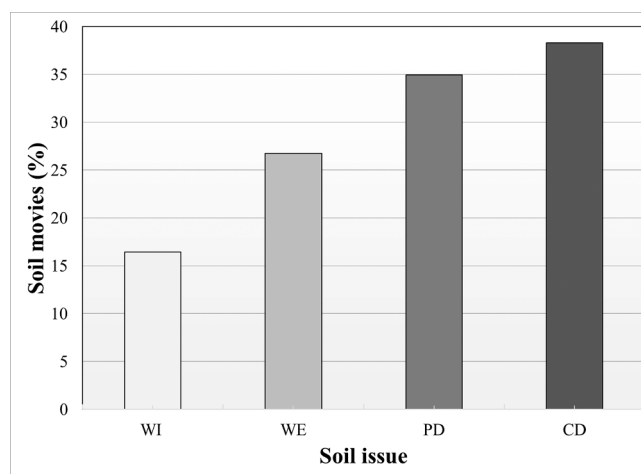


Fig. 4. Soil movies (%) vs soil issues. WI = Wind erosion, WE = Water erosion, PD = Physical deterioration, CD = Chemical deterioration.

Chemical deterioration, with particular emphasis on soil pollution, is the most represented soil issue. In ‘Astro Boy,’ an animated movie based on the Osamu Tezuka’s manga series, an unlivable Earth was entirely covered by waste, an immense discharge where the consumer culture completely polluted the soils bringing to the decision to realize a new floating Metro-city. In ‘Apocalypse Now,’ the epic opening showed a gentle breeze moving palm trees inside the jungle. A peaceful heaven broken by the smoke and noise that suddenly bursts the forest into a fiery apocalypse of napalm; the sound abruptly changes with Jim Morrison’s voice definitively underlining, “this is the end.” War movies, with their propaganda, often approach soil pollution issues. Examples are also represented by ‘Platoon,’ ‘Full Metal Jacket,’ ‘The Thin Red Line,’ or ‘Saving Private Ryan.’ In all these movies, soils are destroyed and heavily polluted until their definitive loss; a visual representation of humankind’s insanity featured by its unsensed arrogance against the natural environment.

Fig. 5a, b shows the main Soil Order (Soil Survey Staff, 2014) and Soil Group (IUSS Working Group WRB, 2022) represented in soil movies. The observed results are surprising if compared with soil distribution worldwide. However, as will be clearer in the following part of the paper (*vide infra*), soils are a significant part of the movie narrative, as such, they are carefully selected, even without specific soil knowledge, to be an essential part of the whole story. As a matter of fact, the more represented soils in the investigated database are Mollisols (21.5 % in soil movies vs 7 % in terms of worldwide soil distribution), Aridisols (19.7 vs 12.0 %), Entisols (19.1 vs 18.0 %), Inceptisols (16.3 vs 15.0 %), and Alfisols/Ultisols (18.2 vs 15.0 %; they are considered together since in ST classification system the main difference is due to a chemical reason (base saturation, BS%) that cannot be easily recognized by the way used for the present review. All the other orders are under 10 %, being less representative in the soil movies we investigated.

The abundance of WRB Soil Groups is similar to what was previously observed, with differences due to the classification methods. Indeed, in this case, Cambisols seem the more representative Soil Group, but in WRB, simplifying, Kastanozems, Chernozems, and Phaeozems have a correspondence with Mollisols in ST classification system, thus showing more or less the same 21 % if considered all together. The same was for Aridisols (Soil Taxonomy) vs Calcisols, Gypsisols, and Arenosols in the WRB soil classification system. Overall, the two systems show a clear dominance of quite fertile (Mollisols in ST, Kastanozems, Chernozems, and Phaeozems) vs sandy, quite unfertile soils (Aridisols; Calcisols, Gypsisols, Arenosols). A dichotomy that can be explained by considering that both fit well as stereotyped and rhetorical constructs; like the fight between good and evil, i.e., a sustainable soil use vs the humane attitude for its destruction.

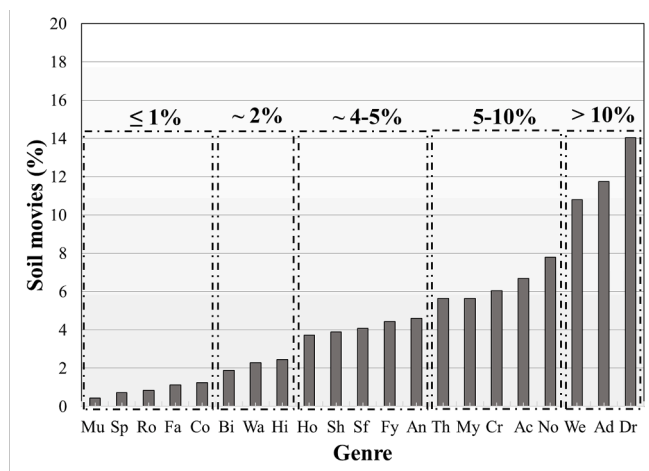


Fig. 3. Soil movies (%) according to genre. Mu = Music, Sp = Sport, Ro = Romance, Fa = Family, Co = Comedy, Bi = Biography, Wa = War, Hi = History, Ho = Horror, Sh = Superhero, Sf = Sci-Fi, Fy = Fantasy, An = Animation, Th = Thriller, My = Mystery, Cr = Crime, Ac = Action, No = Noir, We = Western, Ad = Adventure, Dr = Drama.

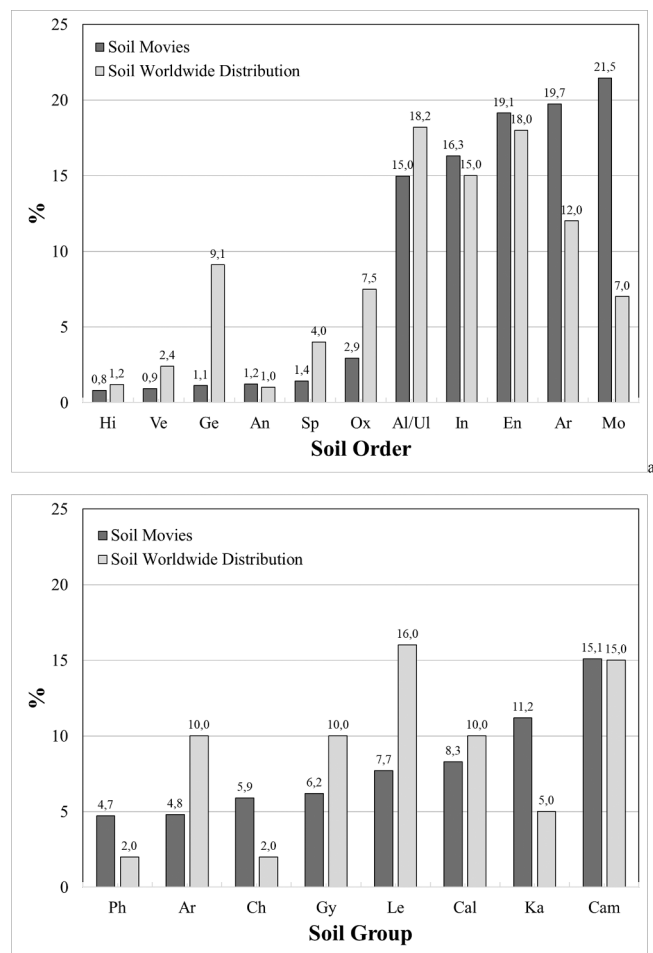


Fig. 5. Soil movies vs worldwide distribution according to Soil Taxonomy Orders (a) and WRB Groups (b). Hi = Histosols, Ve = Vertisols, Ge = Gelisols, An = Andisols, Sp = Spodosols, Ox = Oxisols, Al/UI = Alfisols/Ultisols, In = Inceptisols, En = Entisols, Ar = Aridisols, Mo = Mollisols Ph = Phaeozems, Ar = Arenosols, Ch = Chernozems, Gy = Gypsisols, Le = Leptosols, Cal = Calcisols, Ka = Kastanozems, Cam = Cambisols.

For instance, Aridisols are the typical “soil habitus” used in Western movies with their harsh and sunny environments. The famous Italian movie director Sergio Leone, the inventor of the “spaghetti-western” sub-genre, used to base most of his movies in the more arid areas of Spain (mainly in environments featured by Aridisols and Entisols according to ST; Calcisols, Gypsisols, Arenosols to WRB) to replace the US western frontiers visually. In his disproportionate representation of human vicissitudes, the harsh soil environment was a pivotal protagonist, making the characters’ staging more powerful. Would the famous shootout scenes between gunslingers, with their unforgettable dialogues, perhaps have had the same visual power if they had been set in fertile soils? No, because the soil’s environment plays a fundamental role, even if in an unconscious way, in emphasizing and giving a unique meaning to those specific scenes. Soils and characters come together in a perfect mix of light, sweat, pain, and dust.

On the contrary, if we consider the myriad ways that fertile soils have been represented in movies (*vide infra*), we can further understand that soil cannot be seen as a mere backdrop. The soil environment is not only aesthetically central but can also be directly perceived in the movie’s writer and director’s ideas. Otherwise, we have to expect a distribution of “soil movies” closer to natural soil worldwide distribution. This is not what our results suggest (*vide infra*), i.e., using the soil as a merely static environment. This is not to state that the cinema industry is closer to soil science, knowing its whole features, nor to deny that results show the

central role of the soil environment in movie scripts. Scenes reported on the screen are directly or even indirectly delivered to hit our senses. Even when the soil environment is not clearly visible on stage, yet actors’ words, their interpretation, the way they move on the scene, the camera movements, the lights, etc. “help us make-believe it is, in much the same way that the text of a story does.” (Crippen and Youssef, 2022).

Previously reported results will now be explained to facilitate reader understanding of the importance of soil in the movie narrative through some selected paradigmatic examples.

3.2. Perceiving soils behind the scenes: the multitude of filmmakers’ approaches

Soils can be perceived, treated, and even “used” by movie script-writers and directors from several points of view. In the view of simplifying such a complex aspect, we first divided movies in two main categories, i.e., those focused on soil as the main protagonist (the minority), from those where the soil is a part of the narrative without being the main protagonist. These last ones are obviously the majority of films investigated in the database.

In the first case, the “documentary” is usually the main tool used to describe the soil environment, but it will be surprising discovering that this tool tremendously evolved, especially during the last few years, by using new and innovative communication methods. In most of investigated cases, categorizing a movie as only a “documentary” is quite misleading and not fully consistent to a complex reality where filmmakers have the possibility to use innovative ways of communications never experienced before. This is a pivotal aspect, since, as will be clear in the following discussions, it is not a case that soil becomes increasingly attractive for filmmakers as the evolution of new technologies proceed.

In the second case (indirect protagonist), soils can be narrated and perceived in different ways. To make reading easier, this specific part of the paper has been organized according to the method proposed by Capra et al. (2017) to show the different meanings and ideological messages by which the soil has been represented in our corpus of films. Since the scope of artistic activity with and about soil is so large and diverse, it will be impossible to provide examples of all movies in a single review. However, some examples will be useful to show how soil is lived, treated, and perceived in films. Authors are aware that the choice could be arbitrary, thus resulting in a weakness of the research. However, to decrease arbitrariness in their choice, examples were selected by taking into account all these factors: *i*) differences among selected movies, in terms of location, genre, soil types, soil issues, etc.; *ii*) movies reported in the IMDb database, regardless the used keywords (“soil”, “ground”, “earth”, “land”), in order to avoid ambiguities in terms of their dataset classification; *iii*) authors experience, based on almost 20-years of classroom activities where movies were used with students to easily convey scientific messages (*vide infra*). Selected movies, in the following examples, were among the most appreciated, resulting in an increase of student general interests.

3.2.1. Ladies and gentlemen, the soil

Talking about movies where the soil is the main “actor”, ‘Kiss the Ground’ represents an obvious example of a movie where the soil is the real protagonist (Ex. 2a). As a matter of fact, ‘Dirt! The Movie,’ ‘Symphony of the Soil,’ and ‘Between Earth and Sky: Climate Change on the Last Frontier’ are all distinguished predecessors, but partially lacking in the ability to make soils something available for a larger, multicultural audience. Arguing in favor of viewing the film, Wheeler (2009) said “don’t expect to like it but see it anyway.” Indeed, even if all these movies increase public awareness of soils, they suffer from a “quasi-spiritual romance” narrative that is often superimposed on the whole script (Wheeler, 2009). In a broader sense, they seem to be all affected by a highly rudimentary form of communication, which avoids falling into easy stereotypes, additionally lacking in a narrative “continuum.”

There is also a lack of a broader vision making them a commendable but still not entirely successful tool efficiently talking about soil. As a result, their distribution has been confined to a small audience, partially failing in one of the greatest qualities of the seventh art, which is to convey complex messages to a multicultural audience.

'Kiss the Ground' has several merits. It is more than a documentary; it is a multifaceted project available for a large audience, as never experienced before for such a film. Its impact has been helped by the fact that it is distributed by Netflix, which has more than 223 million subscribers (December 2022; Statista, 2022).

The movie emphasizes, with spectacular scenes and the involvement of famous actors and scientists, the importance of soil resources for all humanity by using a simple but not superficial narrative. Science and communication are harmoniously and efficiently combined, through impressive images, coming from different parts of the world, with the only aim of showing the multitude of vital functions for which soil must be preserved. The first minutes of the movie feature three primary sub-scenes, all connected to each other in narrative terms, but intentionally broken through changes in movie editing, narrator's (Woody Harrelson, *vide infra*) voices, and soundtrack. At the beginning, Harrelson's voice is superimposed on a series of heavenly images of our planet; he states, "Planet earth [...] it's a great place to live." The music changes becoming bothersome, a syncopated succession of images recalls catastrophic events (tornadoes, floods, melting glaciers, fires, mass extinctions, etc.) with everything thought out to brutally interrupt the idyllic vision of the first movie frames; it's the beginning of the second brief, but tremendously efficiently, subscene. Myriads of fragments coming from all over the world are shown as emblematic signs of climate change. Finally, the third part; the music changes again; it clears up; and Harrelson's persuasive voice explains that the "solution [...] is right under our feet [...] we call it soil..." In the remaining minutes, the movie guides the viewers through an intense journey, all over the world, aimed at discovering the soil and its important properties for fighting against climate change. During this "journey of hope" (Capra and Jani, 2020), the soil is the real and only one protagonist. Indeed, soil represents, not only in metaphoric terms, the real hope for the future of humanity. Another important, innovative aspect is that soil scientists, farmers, politicians, and regular people alike are called together to give their opinion as direct witnesses of the possible environmental and socio-economic changes that sustainable soil management can entail. Behind the film there is also a complex and articulated series of action programs such as the promotion of best soil management practices, podcasts and short movie productions all aimed at increasing knowledge on soil resources, a specific training program to involve interested farmers in improving the health of their soil according to regenerative principles (<https://kisstheground.com/>).

'Kiss the Ground' talk about the soil environment as a living ecosystem "on which the fate of all humanity depends." This message is present in the term, "*the soilution*," coined by the former French Agriculture Minister (2012–2017), Stéphane Le Foll, founder and vice-president of the "4 per 1000" initiative, which aimed to promote and funding programs for improving soil organic carbon restoration and recovery. The movie was far from being a perfect representation of soil, especially when it is viewed from an expert's perspective. Amundson (2022) argued "there are no magical solutions." However, the movie has merit in that it brings soil to Hollywood as never happened before, demonstrating that in just a couple of decades, the narrative on soil in the movie industry has changed even faster than Landa's (2010) previsions: "soil scientists and soil itself will likely be confined to the anonymity of the background of most movies" and, in talking about movies on soil and plant scientists, with specific reference to 'The Agronomist,' Landa (2010) says "undoubtedly this will never be a large pool to draw from" (Landa, 2010). Times are rapidly changing, even for soils and the narrative behind them.

As previously stated, 'Kiss the Ground' is a more recent example of a change that started in the early 2000s. 'The Agronomist' (Ex. 2b), has

been widely discussed by scholars from several disciplines (Stone, 2003; Bhavnani and Foran, 2005; Landa, 2010) and is one of the first films that moves away from the view of soil as a static backdrop serving the purpose of hosting human actions (Feller et al., 2015), and instead focuses on its importance for people and all humanity from several viewpoints. The film was about the life of Jean Léopold Dominique, a Haitian agronomist, journalist, and human rights activist, who was assassinated on 3 April 2000 in front of his famous Radio Haiti-Inter and whose killers remain unknown. The movie director and co-producer, Jonathan Demme, started working on the project in 1993, and made four documentaries on Haiti before its final release in 2004 (Bhavnani and Foran, 2005).

The movie primarily consists of interviews discussing Dominique's life; those of a man fighting for a nation's struggle and social justice, or better, for "bread, peace, land!". The entire film is pervaded by Demme's and Dominique's love for what they call "land" with clear references to agricultural soils. Indeed, the protagonist became an agronomist before the age of 20, following a deep passion for his native land. Several shots show the land, cultivation practices, farmers, etc. with Dominique's words and Demme's struggle mixing to explain the depth of the relationship between land and Haitian's culture is. Dominique it is not simply an agronomist but rather a "soil lover"; to use his words "I am not a journalist, I became a journalist. I am an agronomist." Demme illustrates such a concept when Jean talks about the soil's smell, by evoking his love for the land together with the political sense of his social fights. By interviewing "an agronomist without land," Demme has the merit to underline one of the most pressing political issues in recent human history: there is no justice without land available for all people. Soils are the starting point for a just society, with Demme's movie being the first promoting the powerful message of the soil's social and political meaning. The movie extends beyond the conventional "documentary" boundaries, thanks to Demme's to ability to promote a world where freedom - "film is about the possibility of freedom" and "cinema is a window open to another world" Dominique states - and soils are told together through a plot that makes them inextricably linked to each other. There is no freedom without soils! A revolutionary message, that every soil scientist knows well, but which is far more striking when conveyed cinematically.

3.2.2. Not merely a static backdrop: the soil as a cultural heritage

Some paradigmatic examples of films where the soil metaphoric message influences the narrative are discussed here. As a resource characterizing our cultural heritage (Amato et al., 2017), the soil is also often used by filmmakers to convey specific messages.

'Blade Runner 2049' (see [Supplementary Material 1](#) for further information) is the sequel of Ridley Scott's famous original ('Blade Runner'), based on P. K. Dick's novel 'Do Androids Dream of Electric Sheep?' (Dick, 1968). Filmed in Hungary, Spain, Iceland, Mexico, and Nevada (United States), the soil plays a central role in the film, as extremely common for the dystopian genre.

The movie opens with a dark environment showing a megalopolis' suburban area, effectively reconstructed by filming the Gemasolar Plant in Seville (Spain) and the impressive sea of greenhouses in El Ejido (Almería, Spain). Here, at a protein farm, agent K, after killing an old replicant, finds a box buried in an Andisol/Andosol (Ex. 3) featured by a deep humic A surface horizon and several lithological discontinuities (soil layers (horizons) formed at different times due to, for example, volcanic ash or alluvial/fluvial sediment deposition), as typical for soils of volcanic origin. The scene, even if modified in post-production, was originally filmed in Iceland (Vík í Mýrdal).

The remains of a female replicant were discovered in the box. From the fundamental question, 'Are replicants evolving as a biologically independent species?', the film focused on the K agent's efforts to solve the mistake, which could be the fuse that would lead to a war between humans and replicants. The soil is represented as a synthesis of the life/death dichotomy simultaneously coexisting in one single shot. Indeed,

even if the bones in the box witness the end of a “life,” they temporarily reveal the birth of a new synthetic species (*vide infra*). Ville-neuve underlines this dichotomy using suggestive overhead shots. The scene contemporarily shows the anguished, disturbed, and doubtful face of agent K, a soil profile featured by perfect geometries, and a tree that died due to atmospheric pollution. This last scene is translated on the screen by creative and compelling photography. An intense red in rural areas underlines that the world is affected by devastating sandstorms due to massive soil erosion and sealing processes (the cinematographer Roger Deakins, awarded with the Oscar®, confirmed to be inspired by the Australian 2009 red dust storm; Provost, 2021), a dark gray atmosphere in urban ones as a consequence of massive industrialization. Overall, a suffocating barrier making it impossible to see even the slightest glimmer of light. The soil is barren, devoid of life; the atmosphere is gloomy, and the absolute silence underlines the moment. The protagonist digs into the wet deepest horizons, a virulent rain falls on his body, and his breathing becomes more labored, almost suffocated. In this depth, he finds disturbing questions. The soil hides them but, at the same time, can detect painful secrets, at least for those looking for answers. Hence the deepest fear of the protagonist, as deep as the soil on which he sinks his hands: could he be the child born by the replicant? A wooden toy horse shows him a well-known number. Questions and doubts arise from the soil. While unraveling a complex and intriguing plot, references to the soil will continue to be fundamental for the development of the entire narrative. In a suggestive scene, a new generation of replicants came from a slimy mixture of clay. Jared Leto states: “The first thought, one tends to fear, to preserve clay.” Here again, the brown of a thin and shimmering patina covers a female replicant’s naked body. The soil symbolizes the birth of a new, more evolved version of replicants, a generation with reproductive abilities; in biological terms, a new species. Soil is not a mere static, immovable object. It is not the background to a visionary tale. The soil is a fundamental part of the narration, and in Villeneuve’s hands, it becomes both a symbol of death and the rebirth of a new era. Will humans be part of it?

3.2.3. Metaphoric romance

‘Into the wild’ is based on the anonymous book (Krakauer, 1996) written by the Pulitzer Prize-winning writer Jon Krakauer about the Christopher J. McCandless story (Supplementary Material 1). It was entirely filmed in the US, specifically in Alaska, Arizona, Oregon, and South Dakota, strictly following McCandless’s steps (locations complete list at LatLong (2012)). To understand the relationships between the script and the use of the soil, it must be underlined that Sean Penn (the director) divided the movie into different chapters starting after the beginning, where the main movie’s characters were introduced. It is like McCandless’s “real” life began just after leaving his previous one. Indeed, after he cut his ID card and driving license and burned the social security card, he donated all his money to charity. It is the end of the “Introduction,” the end of previous McCandless’s “material life.” The first Chapter is significantly entitled “My own birth” and started with Penn’s skills in metaphorically using the soil.

McCandless leaves Atlanta during the sunrise, driving his yellow Datsun. Eddie Vedder’s ‘Big hard sun’ rises, following Chris’s travel from the towns to open highways. The urban landscape changes into the desert. McCandless reaches a “Flash Flood Area” (Ex. 4) at Detrital Wash in the “Lake Mead National Park” (southeast Arizona, US) to spend one night in the desert before starting his new adventure. During the night, McCandless’s car is caught in a flash flood, which buries the car. The following scene shows one of the most iconic moments: “what remains of Chris’ traveling money burns in a pile” and “a slight smile gets on his face” (Penn, 2007). Penn films Chris standing and scanning the horizon. Behind him, the car, partially buried at the edge of a soil (Aridisol/Fluvisol profile, i.e., a soil characterized by a limited moisture available for plants growth, typical of deserts areas (Soil Survey Staff, 2014), or a soil featured by stratified fluvial sediments (IUSS Working Group WRB, 2022), respectively) featured by several lithological discontinuities (*vide*

supra) (Ex. 4).

As the soil regenerates and develops from a natural, extremely violent event, such as a flood, Chris’s past life, the one he hated, is swept away, and a new chapter of his existence can begin. Penn underscores this moment using a long shot showing the buried car close to the alluvial soil, then the camera slowly moves away, shooting Chris’ smiling face. It does not matter having lost a “material asset” that he seemed to care about (in a previous scene, he refuses a new car as a graduation gift from his parents); what matters is starting a new life. Penn’s ability consists in metaphorically comparing the (alluvial) soil vs the most crucial moment in Chris’ new life. From that moment, everything will completely change. As the filmed alluvial soil will continue to evolve, flood after flood, Chris’s life will also follow the same path, being submerged several times to settle then and form an everyday new person. The previous life was buried in the soil, and a new Chris arose.

3.2.4. Blood and dirt

Humans primarily affect soil formation and development through agriculture and urbanization. However, warfare activities are one of humanity’s most dramatic ways of impacting soil properties (Certini et al., 2013). Hupy and Schaetzl (2006), coined the “bomburbation” term for the cratering creation processes in the soil surface and the concomitant soil turbation due to explosions. During the Great War (WWI; 1914-18), the soil environment experienced such a process as never before. Numbers can explain this better than words (Keegan, 1998): i) the trench system consisted of roughly 765 km, along the entire Western European front, from the English Channel to the Swiss Alps; ii) the average front extension, on either side, was 20 km; iii) the amount of land cratered by artillery extended for more than 29,000 km². The “warfare trench” fought in the “no-man’s land” (Ashworth, 1968) - a term indicating the constantly bombed, devastated land between the enemy lines where soldiers had to fight in the trenches - has been visually represented in hundreds of movies.

‘1917’ (Supplementary Material 1) represents just the most recent example of a movie that epitomizes WWI, and the essential character of that archetype is the trench war. Here the soil is constantly represented; the story takes place inside the soil profiles dug to realize the trenches, tunnels, caves and affected by explosions (Ex. 5). The soil presence is made incredibly immersive for viewers thanks to the choice by Mendes (director), Roger Deakins (the cinematographer), and Lee Smith (the editor) to use the “long takes” technique (the camera lingers the scene for a long time without break or editing) to follow the soldiers’ mission as one continuous shot. There are no breaks, and we seamlessly pass from trenches/no-mans land/trenches in a devastated soil environment.

The main scenes were shot in England (Wiltshire, Hankley Common, Low Force, River Tees, Teesdale) by filming both natural and anthropogenic soils (soils whose genesis has been deeply influenced by human activities; Capra et al., 2015). The movie opens in the muddy Mollisols/Phaeozems (soil with a surface fertile dark horizon) and Alfisols/Luvisols (soil with a clay deep soil horizon; Salisbury Plain), featuring the typical British trenches with the excavated earth on the lip of it, the embanked rear lip of the trench, the sides of the trench covered with sandbags, wire mesh, wooden frames. The atmosphere immediately recalls the darkness of the war. Scenes bring the viewer inside the trench. The soil surrounds us, and it is all around us, not just as the material boundary of a trench; it recalls narrow spaces, dirt, a putrid smell, pain, hunger, and severe distress permanently painted on the soldier faces. Inside that soil, they know death is inevitable.

Mendes makes soil darkness even more distressing by deliberately choosing to use only natural light, with all scenes filmed in cloudy conditions only while stopping filming under sunny moments. To emphasize this claustrophobic feeling, The Arri Group (a famous German manufacturer of film equipment) expressly developed a new prototype of a “Mini LF” (a high-technology digital motion camera system), providing it with three different focal lengths. While the 40-mm one was used for filming battles in “no-man land” wider areas, a 35-mm

was selected for trenches, tunnels, and bunkers. A choice that makes the soil clearer and more “alive” during most scenes. The protagonist(s) constantly live in contact with it; the soil is part of them. Explosions create craters, didactically showing what “bomburbation” means (Hupy and Schaetzl, 2006). The soil conditions often slow the protagonist’s frantic run due to permanent rainfall, creating puddles in the craters formed on clayey soils. The soil is so part of the narrative to become, during one of the most dramatic movie scenes, a weapon that will help the protagonist to stay alive.

When he finally reaches his goal, a white hastily dug trench, excavated as improvised defenses, is waiting for him. We are on limestone with man-made soils (Technosols, i.e., a soil containing significant amounts of artefacts) over natural one (Mollisols/Chernozems) hosting the final scenes. From the darkness of the clayey soils featuring the trenches, the craters, and the tunnels of the main narrative, Mendes finally brings his soldier into a more open and shiny space. The bright green of the prairie clearly shows that hostilities have not yet begun. There are no “no-man lands” there. The war’s end is near, and the soldier lies down exhausted on the soil, his shoulders resting on an immaculate tree. The green of the grass envelops the environment, a multitude of colors he never experienced before, at least along his dramatic journey. Where the darkness of the trench clayey soil ends, new hope begins; the soldier looks at his family pictures, closes his eyes, and breathes deeply, lying there on that soft and untouched fertile Mollisol (Pear Tree Hill, Erlestone, Wiltshire) symbolizing the hope for a peaceful future.

3.2.5. A stunning world

“Whitwell in the Shire (an actual English place-name) [...] the reference [...] is to the colour of the soil,” explains Tolkien and Tolkien (1975) in their “Guide to the Names in The Lord of the Rings,” referring to a so-called pedonym (a place-name, toponyms, explicitly referring to a soil feature; Capra et al., 2017) the color of the medium is a deep humic fine loamy (or clayey) calcareous soil over chalk featuring the area: usually Phaeozem/Mollisols (dark fertile soil surface horizon, enriched in soil organic matter).

‘The Lord of the Rings’ movies have been widely investigated by many scholars. However, a soil science perspective has been missing despite the fact that soil has a central role along the entire trilogy; an ecosystem that is pivotal in the whole of Tolkien’s narrative (vide infra). The most obvious connection is immediately evident at the beginning of the movie. “The world is changed. I feel it on the water. I feel it on the earth.” Galadriel, the royal Elf (Cate Blanchett), says in the prologue of ‘The Fellowship of the Ring.’ In Jackson’s movie, her voice is the main narrator explaining the ring’s birth and history until its arrival in Bilbo Baggins’ hands (Ex. 6a). He found it on the mud after Gollum lost his “precious” inside a dark cave when “the ring of power perceived its time now had come [...] but something happen that they did not intend. It was picked up by the most unlikely creature imaginable. A Hobbit.” The Hobbit is the most crucial figure in all Tolkien’s narrative; using his words in the Prologue of the revised 2nd edition, “this book is largely concerned with Hobbits” (Tolkien, 1970). The Hobbit, as a single creature and in terms of civilization, has a strict relationship with the soil. In particular “they lived quietly in Middle-earth [...] love peace and good tilled earth [...] and well-farmed countryside was their favourite haunt” their house (“Smials” from hobbit language) are “holes in the ground [...] in such dwellings they still felt most at home” with “the poorest went on living in burrows of the most primitive kind, mere holes indeed [...] while the well-to-do still constructed more luxurious versions of the simple diggings of old” (Tolkien, 1970).

Jackson’s transposition is very faithful from this point of view. Gandalf vs Frodo’s first meeting and conversation happens in front of a soil profile (Ex. 6b). It seems an involuntary director’s choice. However, according to Tolkien’s perspective and scholars’ investigations, it is the prelude of a world where the soil will be portrayed differently.

In the ‘The Atlas of Middle-Earth,’ the geographer Karen Wynn Fonstad (1981), also former Director of the “Cartographic Services at the

University of Wisconsin–Oshkosh,” follows Tolkien’s works, finally providing a series of suggestive set of Middle-earth’s thematic maps. They range from general geography, passing through the morphology till to geology, with incredibly realistic detail based on scientific concepts applied to an unreal world (Ex. 6c). Although a soil map is missing, the previous ones represent a further aid for a more detailed characterization of the Middle-Earth’s soils.

Jackson’s transposition looks to be a literal figuration of Tolkien’s words which described the soil of The Shire (the geographic region exclusively settled by the hobbits) as “deep,” “soft,” “fertile,” and “sheltered,” too. Indeed, Gandalf and Frodo’s first meeting (vide supra) is followed by their entry into Hobbiton (the Hobbits’ village). A fertile place, surrounded by green crops - the first scene that takes up the village is that of two young female hobbits who cultivate - where the hobbits live in complete harmony with its fertile land and “an irredentist connection to their soil” (Werber, 2005). “It is best to love first what you are fitted to love [...] you must start somewhere and have some roots, and the soil of the Shire is deep” are the Merrys’ metaphorical words (one of the three member of the of Fellowship of the Ring, together with Frodo and his cousin Pippin) explaining the deep relationships between soils and Hobbits. The Shire, even if mainly agrarian, represents a youthful and vigorous culture in which the Hobbit-soil ties are strong and vital. As argued by Pottsf (2016), the Hobbits are “Spengler’s eternal peasants,” i.e., “the humble people who husband the land.” The German philosopher, in his ‘The Decline of the West’ (Der Untergang des Abendlandes; Spengler, 1918), differentiated between the self-contained “culture-man” of civilizations in their growth phase and the outward-looking, expansionary “civilization-man” of mature and declining civilizations. The Hobbit, according to this view, is a youthful culture that lacks empires or great cities but possesses overall fertility in terms of population growth and an “irredentist connection to their soil.” In contrast, Sauron’s oppressed lands (Mordor) are Spengler’s mature civilizations affected by misguided scholasticism, depopulation, soil sterility, degradation, and pollution (Pottsf, 2016). It is interesting to note that Mordor etymologically came from the Sindarin (one of the languages spoken by the Elves) “Black Land” (we are on Andisols/Andosols, i.e., soils of volcanic origin formed by several black ash layers). Even Gondor’s representation, the greatest realm of Men (west of Middle-earth), i.e., the mortal human race (the second appearing in Middle-Earth after the immortal Elves), once offended by Sauron’s armies’ attack changed from an iridescent land to a hostile, polluted, and unfertile area. Darkness envelops these wastelands; the soils are inhospitable, barren lands.

In such a Manichean representation of an eternal good vs evil’s fight, soils are efficiently used by Jackson. The Hobbiton in The Shire were located in Waikato district (WD; northern of North Island, New Zealand) (Ex. 7a), an agricultural area mainly hosting pasture for wool production and dairy farming (representing New Zealand’s major agricultural export) and horticulture activities. Even if Tolkien described the soils from Shire as fertile lands full of grasses (thus Mollisols/Phaeozems and Chernozems and Alfisols/Luvisols), Jackson transposition showed soils of the district main belong to Andisols/Andosols and Entisols/Planosols; ranked at the higher (“high quality”) in terms of land use capability (Singleton, 2017). Overall, the high-class soils occupy around 16.4 % of the whole territory, meaning that they are concentrated in the WD alone (i.e., 5 % of the “high quality” soils of the entire New Zealand). Considering that only 15 % of New Zealand’s soils are considered highly productive, the WD is the most fertile area of New Zealand (Hill, 2020).

Mordor - “the land [...] where the Shadows lie” (Tolkien, 1970) - was instead located at the Tongariro National Park (c.a. 300 km south of WD), a perfect real-world existing representation of “a barren wasteland, riddled with fire, ash, and dust [...] the very air you breathe is a poisonous fume [...] there is evil” as described by Boromir (a warrior of Gondor, whose joined the Fellowship of the Ring for protecting them during the journey). In the ‘The Atlas of Middle-Earth’ (Fonstad, 1981), Mordor is depicted as a black, volcanic plain chosen by Sauron because

of the three mountains surrounding it thus creating a natural fortress against enemy's attacks (Ex. 7b). The Tongariro National Parks fully replaced all these features, being dominated by three active volcanos: Ruapehu (the largest active New Zealand's volcano, 2,797 m asl), Tongariro, and Ngauruhoe Mountains. This last was used by Jackson, by digitally crafting it, as Mount Doom's transposition, i.e., the place where the ring will be finally destroyed (Ex. 7c). Volcanic activity mainly shaped the landscape, featuring a considerable part of the so-called North Island Volcanic Plateau (New Zealand's North Island, also known as "Central Plateau" or "Waimarino Plateau") a series of lava plateaus interrupted by slopes and crater lakes. Soils, even if mainly belonging to Andosols/Andisols (Entisols/Leptosols along the steep slopes), lacks in fertility, being very thin, acidic, and poor in nutrients. Indeed, due to relief and climatic conditions (mean annual rainfall of c.a. 3000 mm), leaching processes occurs. Additionally, volcanic activities, glaciers, and wind erosion constantly modifies the land surface, renewing the soil profile. All conditions favoring the growth of the typical "tussock" grass, i.e., a group of species mainly belonging to the *Poaceae* family, usually growing as singular plants, as adaptative strategy developed to survive in cold and windy climatic conditions and unfertile substrata.

Thanks to their peculiar environmental features, with soil playing a pivotal role, all the locations represent the transposition on earth of Tolkien's mind. Jackson shaped these environments, making the soils an essential part of the story, not just in metaphorical terms. From the soil and in the soil, the civilization of the Hobbits was born, grew, and developed. Soil is continually present throughout the series, accompanying travelers to their final destiny. In the meantime, soil can either be a friend or the quintessence of evil itself. From a disgusting mixture of soil and stones, the "Uruk-hai" - the orcs hired in Sauron's army to fight against the company and prevent the ring's destruction - comes to life. Walking through stony soils, in the "land of shadows," the ring will be finally destroyed. From the destruction of the evil/ring dualism, a new era can come.

Mordor has fallen, his shadow vanished within an immense chasm opened on the soil (Ex. 7d). The Gondor's lands, which lost their original fertility under Sauron's dominion, can return into their original nature. Their soils are now fertile again, thanks to Hobbits' efforts and sacrifices. The people who take care of their soils - the Hobbit - have been able to defeat evil, thus making the man civilization (Gondor) flourish again. The new era has arisen, and the soils of Gondor are finally returning to their original glory. In the book, the new cycle is symbolically represented through the act of planting a tree in Gondor's "reclaimed" soil, while Jackson shows Aragorn, newly elected King of men, kneeling in front of the little Hobbits to thank them for saving his rein. Is there a more powerful "soil" message?

3.2.6. No more hope: Soil in the dystopian narrative

"The soil [...] we had to get out [...] we had no water [...] it was filth [...] poisoned [...] sour [...] and then the crows came [...] we couldn't grow anything" are the emblematic words used by survivors to describe the barren land in a postapocalyptic world where Furiosa (Charlize Theron), still look for her native "Home. The Green Place." 'Mad Max: Fury Road' belongs to the so-called postapocalyptic genre, where in a futuristic dystopian world, the consequences of climate change and/or nuclear weapons are depicted as a desert, wasteland dominated by unfertile soils.

What is hugely attractive in Miller's vision (the director) is that climate change is never explicitly mentioned; the images of the Namibia Desert (Dorob National Park, central-western Namibia; Dorob is another pedonym that means "dry lands"), linked by a hyperbolic narrative, tight editing, and a deliberately lit, almost blinding photography, explain better than any words, the consequences of the overexploitation of natural resources. In the previously described scene, Miller uses the camera as a frame for a canvas, the Namibian Desert, in which he paints a picture of struggling power using the wide-shot technique (Ex. 8a).

Furiosa kneels and silently screams her pain. A wind looms over her, inexorably eroding barren soils. A sandstorm envelops Furiosa, while the drama is exacerbated by photography highlighting the desert's warm colors. Miller, contrary to the choice of many other directors who have tackled the same issue ('Escape From New York,' 'Children of Men,' 'The Road'), does not choose to combine gloomy and dark colors with the apocalypse. He disputes this stereotype, creating a world in which light perennially hangs over men, devastating their flesh just as it inexorably degrades the soil (Ex. 8b; mainly Aridisols/Arenosols, Gypsisols, Calcisols, Leptosols). Nothing grows on them anymore. Men are destined to die of starvation and fight for what little remains. The desert, with its barren and inhospitable soils, is the metaphor for a world devastated by human greed. As soils are definitely lost, the clean water, coming from the deep ground and under evil's control (Immortan Joe, that in the movie is represented as a God in ordinary people's vision), is used to dominate the world. Plants only grow in a hydroponic farm (Ex. 8c). All hope is now lost, and Miller chooses no "happy ending." In his vision, the end of soil fertility will inevitably mark the collapse of the human race's dominion on Earth.

3.2.7. The disintegration of human society

Animated movies cannot show soils objectively. However, many of them have dealt with the soil theme with fascinating narrative readings. As deeply discussed by Landa (2010), 'The Ant Bully,' the story of Lucas, a kid who shrinks and enters the deep world of an ant colony, represents an example from this point of view. In 'WALL-E,' the 22nd century's Earth has now inhabited a mega wasteland. Humans have destroyed it due to insane consumerism and industrialization, now living in the giant space starliners managed by the megacorp Buy n Large (BnL). Robots remain on Earth to clean up the planet. However, in 2805 the cleanup dramatically failed, with all robots down except for one exemplar of "Waste Allocation Load Lifter: Earth Class (WALL-E)."

Thanks to its ability to develop a self-personality, WALL-E remains active by reusing parts from other robots. All changed, thanks to the arrival of a new (female according to the movie's rhetoric) robot named EVE, for "extraterrestrial vegetation evaluator," sent by humans to find signs of life. The two robots begin to interact until WALL-E shows her a seedling fund in a partially still fertile soil surrounded by a waste landscape (Ex. 9). EVE closes it inside her and deactivates; in fact, his mission was to find a form of plant life on Earth. What happens afterwards is a strong ecocriticism dealing to a large extent with environmental concerns, soil pollution included, due to human avidity. In WALL-E, the planet Earth has been completely destroyed and soils polluted and treated as the enormous wasteland of the universe. We clearly observe that Technosols and Anthrosols, i.e., humans-modified and constructed soils, totally replaced natural ones. Wild nature is just a memory shown in an old TV; a dramatic witness showing that human skills in creating new technologies only bring devastations when the profit is over-imposed on natural environmental cycles and wellness.

These types of messages are not rare in animated and long movies, being the aim of several productions during the last few years, such as 'Interstellar' or 'Don't Look Up', to cite some paradigmatic examples. As efficiently argued by Boyle (2022) all these movies "holds a mirror up to ourselves to look at greed and the disintegration of society." In such a terrific vision, the soil has a central role, being depicted as the base for human life on Earth: it's like movie directors, scriptwriters, producers, and all main actors involved in the movie industry are finally screaming on public audience "there is no life without soils." An extremely commonplace message for scientists that finally attracted even the movie industry, thus increasing public interest and political awareness.

4. Movies as a means of soil science education and communication

Soil science education is a step-by-step learning process where classroom and field activities are pivotal. The use of media, such as the

art of movies, could be strategic to enable students further (Vaughan et al., 2003): *i*) to increase knowledge of highly complex concepts in a visual-friendly way that is closer to their daily way to acquire information; *ii*) a positive attitude toward a discipline that is strongly influenced by visual information, thus; *iii*) increasing their level of interest by additional acquiring new knowledge, skills, and attitudes.

All of the previously reported aspects require adding new methods and techniques, such as visual and auditory elements, to those usually applied in classroom activities (textbook and laboratory). Movies can represent pivotal learning materials that could be used to improve the success of education-training processes. As reviewed by Topal et al. (2020), movies are incredible tools that could provide students with immersive experiences, actively contributing to the learning-teaching process. Movies are made for telling a story by using unique technological tools in a way that scholars are not able to provide by using classic tools; additionally, they are highly effective, also thanks to their intrinsic ability to stimulate discussion and, consequently, improve socialization (Roebbers and Schneider, 2005). Several disciplines, such as ecology, have already understood this, with scholars using movies in different curricula taught in a long list of universities worldwide (Breen et al., 2017). Indeed, using movies to learn about soil environmental issues, formation, landscape, etc., can increase motivation for the investigated topic (Weinstein, 2001). Derelioğlu and Şar (2010) demonstrated that movies in classroom activities: *i*) increase student curiosity and attention towards the investigated subject; *ii*) bring students to places and context that are not only tricky, sometimes impossible, to visit but even imagine; *iii*) provide new outstanding opportunities to show examples from different unusual perspectives, thus; *iv*) increase academic success and student's positive attitudes by activating more senses. Additionally, movies improve understanding of abstract and faraway concepts through the implementation of visual and auditory senses (Gregg et al., 1995). They have the power to educate while involving, being thus practical tools in teaching activities. For instance, Elsaesser (2011) evaluates 'Avatar' in teaching activities for environmental purposes, showing its effectiveness as instruction material in making more conscious students about the finite Earth resources issues due to extensive human exploitation.

Starting from all previous examples, the purpose to use movies in everyday classroom activities should be encouraged as an efficient method to derive a better learning outcomes. Indeed, based on worldwide studies and the authors experience, of c.a. 20 years of classroom activities where "soil movies" have been widely used as a didactic tool, a methodology to use film in soil education can be suggested. We argued that soil movies should constitute an important part of "Soil Science", or other similar disciplines. Consequently, a quali-quantitative method, that have been already applied in several "Soil Science" based courses (Soil Conservation and Management, Soil Survey, Soil Mapping, Urban Soils, Soil Urban Planning, Applied Soil Science etc.) for several degrees (Natural Science, Environmental Science, Forest Science, Urban and Landscape Management, etc.) are here proposed.

It is a step-by-step educational method that foresees the following: *i*) viewing films in the classroom or assigning its view as home activity, after each lesson or after a pre-established time (usually one per week). The movie, at least during this step (*vide infra*), must be a teacher's choice. The idea is based on research by Moskovich and Sharf (2011), demonstrating that it is pivotal, providing students with an immediate visual representation of abstract concepts; *ii*) asking students to provide a report (it is suggested that a pre-established number of words or pages not be assigned; this must be a student choice) where they should write about (at least): *a*) movie meaning; *b*) which is the connection between proposed movie and previous soil lessons. This phase encourages students to be familiar with soil scientific terms but using a divulgate writing. Additionally, it develops critical interpretation abilities besides actively involving students in the overall learning processes (Morze, 2008); *iii*) during the next lesson, a debate is open about the assigned movie, by involving every single student asking for their opinion by

using previous reported points (*(a)* movie meaning and *(b)* connection between proposed movie and previous lesson) as specific questions. It is fundamentally important to involve all students, especially during the first lessons, in order to improve their speaking skills, together with a correct use of scientific terms. According to (Murphy et al., 2021) this method will allow students to interpret new acquired knowledge, by both previous lessons and the reviewed movie, by making connections among theoretical concepts and visual information, additionally making comparisons with their prior knowledge. In few words: knowledge becomes experience; *iv*) when the class will be confident enough with the previously reported steps, it is time to ask students for their own personal choice about a movie that could better fit the lesson's argument. The choice must be completely free, avoiding any kind of teacher's influence. In this way, students will actively participate in the learning-educational process, being involved in discussions about content, applied methods, lesson meanings, etc. Positive implications of this method imply an increase in the development of critical and autonomous thinking (Moskovich and Sharf, 2012; Murphy et al., 2021), *v*) for both point (*i*) and (*iv*), when the movie is watched in the classroom, discussion is strongly encouraged not only at the end of the movie but also during watching, since it facilitates student vs teacher interactions, promoting easily understanding scientific concepts and processes. Moskovich and Sharf (2012) and Shehata et al. (2023) demonstrated that before watching the movie, several terms could be vague for most students; however, after all the previous steps have been applied, they become more concrete and much clearer.

We are aware that the proposed method considered imperfect or universal. However, it was based on authors' experiences and sociological studies by outstanding scholars. Using "soil movies" in classroom activities requires a further and greater effort, being a time-consuming activity; this is why some teachers could be reluctant to use them. However, the present research suggests its use could improve students' abilities to make connection between theory vs practice.

5. Conclusions

The present research represents the first paper investigating the role of the soil environment in the movie narrative, by also considering implications for educative purposes. The movie universe is one of the most recognized, popular, and powerful systems to disseminate philosophical and scientific discourses like no other. When watching movies, people usually focus on the main or secondary characters' refiguration, interactions, dialogue, etc. At least unconsciously, the setting is wrongly perceived as a "simple" background. This review shows that movie locations, with specific references to soil landscapes, do not serve as mere backdrops but rather act as characters by shaping the story in a way that becomes incredibly powerful from several points of view. The importance of soil in cinema locations has rapidly increased worldwide in the movie industry, with filmmakers becoming more aware of soil in terms of its issues and importance as a fundamental part of the entire narrative. The movie's soil setting has been intensely used to reflect a character's inner subjective states, becoming: *i*) a way to establish a more complex and even peculiar narrative; *ii*) a tool to correlate the individual's behaviors and vicissitudes with the surrounding (socio-cultural) environment. As a matter of fact, soil setting can also play a pivotal role in a dimension that can now be considered far away from the merely supportive role of a backdrop. The present review shows the powerful ability of the movie industry, especially rapidly in the last decades, to represent the soil resource in multifaceted, incredibly stimulating, and educational ways. We also suggested a method to incorporate "soil movies" in Soil Science and related curricula. As a matter of fact, several disciplines already started using movies as an integral part of their curricula, paraphrasing Linda's words (an adolescent forced to work on a Texas farm) in Malick's 'Days of Heaven,' "I've been thinking what to do with my future. I could be a mud doctor. Checking out the earth. Underneath", we hope that also today and tomorrow's "mud doctors"

think about soil future by increasingly using the power of movies to improve knowledge and awareness about this fragile, underneath resource.

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Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Gian Franco Capra reports financial support was provided by University of Sassari.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.geoderma.2023.116710>.

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