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REVIEW PAPER

Soil management practices improve physical properties of soil, movement of water within the soil and yield of crops: A review

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Abstract

Soil is a fundamental medium for plant growth, and its health and productivity are largely determined by its texture and structural characteristics. Soil management is part of production technology and plays an important role to ensure yield productivity of all crops. Water holding capacity, pH and nutrient absorption vary with respect to the soil type. Crop requirement also depends upon the specific type of soil. Tillage practice can affect the physical properties of soil as well as its water holding property and movement of water within the soil. Maximum temperature extreme can burn the organic matter of the soil. Deep tillage increased the bulk density and soil strength of the cultivated area. Greater agricultural intensification can heighten erosion and soil deterioration, mostly in high-temperature zones characterized by thin topsoil layers. Reducing the tillage system, compared to traditional tillage methods, improves precipitation, storage efficiency and increases the amount of water available for crop production. Farming practice like bed and flat planting, mulching also affected the yield of various crops. This article covers effect of all agronomic practices on different crops and can be very useful for farmers. In future studies other than tillage operation would be conducted because agronomic practices like sowing date, thinning, weeding, intercropping, green manuring, vermicompost and crop spacing also have potential effect on crop yield. So, the wise and timely use of farming practice according to the crop requirement is a key to obtain the higher yield of the crops.

Keywords: Crop productivity, Conservation agriculture, Soil health, Soil management practices, Tillage systems

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Introduction

Tillage operation enhances soil porosity, root growth, water-holding capacity, plant vegetative and reproductive growth, and ultimately the yield and productivity of crops (Baig et al., 2018; Xing et al., 2025; Yohannes et al., 2025). By breaking soil clods, loosening compacted layers, and incorporating crop residues, tillage temporarily improves soil aeration, facilitates seed–soil contact, and promotes early root establishment. These conditions are often favourable for rapid germination and initial crop vigor (Boudiar et al., 2022; Sigar, 2023). However, continuous and intensive tillage can also deteriorate soil structure over time, accelerate the breakdown of soil aggregates, increase susceptibility to erosion, and reduce soil organic matter. The long-term consequences of such degradation include decreased infiltration, reduced water storage, and compromised soil fertility, which ultimately limit crop productivity (Jat et al., 2019; Jin et al., 2023; Dinsa & Balcha, 2024). To address these challenges, adopting appropriate soil management practices has become increasingly important in modern agriculture (Afolayan, 2021; Srivastava et al., 2024). Soil management refers to a combination of practices designed to maintain or improve soil structure, enhance biological activity, regulate water movement, and preserve the long-term functioning of the soil system (Heller et al., 2024). Practices such as conservation tillage, minimum or zero tillage, residue retention, mulching, cover cropping, organic amendments, and integrated nutrient management help restore soil health by improving its physical, chemical, and biological properties (Abbas & Shafique, 2019; Al-Shammary et al., 2024). These methods not only minimize disturbance to the soil but also reduce surface runoff and protect the soil surface against the impact of raindrops (Farmaha et al., 2022; Sadiq et al., 2025).

Improvement of soil physical properties is central to sustainable crop production. Soil texture, structure, bulk density, porosity, infiltration rate, hydraulic conductivity, and aggregate stability are among the most important attributes influencing the soil's performance (Haruna et al., 2020; Wang et al., 2024). Soil management practices that enhance these properties create a favourable environment for root growth and microbial activity (Topa et al., 2025). For instance, the retention of crop residues and incorporation of organic matter improve aggregate stability, which in turn regulates pore size distribution and enhances the soil's ability to absorb and transmit water (Liang et al., 2025; Mahabadi et al., 2025). Similarly, reduced tillage helps preserve macropores formed by plant roots and soil fauna, enabling deeper infiltration of water and better aeration (Busari et al., 2015; Deleon et al., 2021). These structural improvements contribute directly to improved soil water dynamics. The movement of water within the soil profile is a key determinant of crop performance, especially in rainfed agriculture (Nyakudya & Moreblessing, 2025). Effective water management begins with efficient infiltration, reduced evaporation, and improved storage of water in the root zone (Levidow et al., 2014). Soil management practices influence not only the quantity of water available to plants but also its distribution through capillary rise, percolation, and retention. Enhanced water infiltration reduces the risk of surface runoff and nutrient loss, while improved water-holding capacity allows soils to support crops during dry spells (Adeboye et al., 2017; Manik et al., 2019; Feifel et al., 2024). These benefits are particularly important in regions facing erratic rainfall, rising temperatures, and increasing demand for water-efficient cropping systems (Abdallah et al., 2021; Acevedo et al., 2022).

Ultimately, better soil physical conditions and improved water dynamics translate directly into higher crop yields (Edralin et al., 2017; Akram & Iqbal, 2019). Healthy soils support extensive root systems capable of exploring larger volumes of soil for water and nutrients, leading to increased biomass and grain production (Tahat et al., 2020; Kopittke et al., 2024). Sustainable soil management practices also contribute to improved nutrient cycling, higher soil organic carbon, and greater microbial diversity, all of which are linked to higher and more stable yields (Kibblewhite et al., 2007; Handayani & Hale, 2022; Tariq et al., 2024). As global agriculture faces challenges posed by climate change, land degradation, and population growth, soil management becomes an essential strategy for safeguarding productivity and ensuring food security (Iqbal, 2018; Noroz et al., 2021; Alamgeer et al., 2022; Omokhafe et al., 2024). This review synthesizes current knowledge on the influence of various soil management practices on soil physical properties, water movement within the soil, and crop yield. It aims to provide a comprehensive understanding of how different techniques modify soil functions and to highlight the importance of adopting sustainable practices for long-term agricultural resilience.

Impact of tillage practice on barley and canola

Tillage practices play a critical role in influencing crop growth, water utilization, and yield, particularly. Studies have evaluated the effects of conventional tillage (CT), no-tillage (NT), and modified no-tillage (MNT) systems on barley and canola (*Brassica napus*, *Brassica campestris*), highlighting their impacts on dry matter accumulation, grain production, and water use efficiency (WUE) in northern Canadian agroecosystems. In canola, MNT has been reported to increase yield by approximately 12% compared to conventional tillage systems. For barley, NT and MNT systems enhanced WUE substantially. Specifically, barley grain production under NT was 21% higher, and under MNT 18% higher than under CT on sandy loam soils, with a reference WUE of 5.07 kg ha^{-1} mm^{-1}. In other evaluations, WUE was found to be 19% greater under NT and 10% greater under MNT, demonstrating the potential benefits of reduced soil disturbance on water utilization for crop growth. Tillage depth and intensity also significantly affect soil physical properties and subsequent crop performance. Deep tillage (DT), which disrupts soil up to 40–45 cm, has been shown to improve dry matter accumulation and wheat grain yield by enhancing root growth, water, and nutrient uptake, particularly when combined with small, frequent irrigation applications and optimized nitrogen fertilizer rates. In contrast, conventional tillage (CT) typically involves uniform soil disturbance to a depth of 10 cm, which may limit root penetration and reduce water storage capacity. Kiem and Kandeler (1997) reported that deep tillage increased bulk density and soil strength in the first year of experimentation, suggesting an initial trade-off that is offset by enhanced crop productivity when coupled with irrigation. Small-scale, frequent irrigation increased wheat yields by 2.3 mg ha^{-1}, indicating that synergistic combinations of tillage and water management are necessary to maximize crop performance in alluvial sandy soils.

The efficiency of water extraction and utilization is a critical factor for canola production. Stemmer et al. (1998) concluded that reduced tillage systems improve precipitation capture, soil water storage, and overall water availability for crops. In canola, although the crop can access water from soil depths of up to 65 inches, the majority (92–95%) of seasonal water uptake occurs from precipitation and soil water in the upper 47 inches of the profile. This highlights the importance of tillage practices that preserve soil structure and maintain water availability in the rooting zone. Collectively, these findings depict that reduced or modified tillage systems, particularly when integrated with appropriate irrigation and nutrient management, can improve water use efficiency, enhance dry matter accumulation, and increase yields for barley and canola. Such practices are especially relevant for northern Canadian cropping systems, where soil conservation and water management are crucial for sustainable productivity.

Impact of contrasting tillage and crop sequences on soil properties and crop yield

Long-term studies in Western New South Wales, Australia (1985–1993), have evaluated the effects of contrasting tillage and crop rotation practices on soil properties and cotton-based production systems. The systems compared included: (i) maximum tillage with continuous cotton (disc plows, chisel plows), (ii) minimal tillage with continuous cotton, and (iii) a cotton–winter wheat–summer fallow–cotton rotation, in which cotton was sown with minimal tillage and wheat without tillage. Results indicated that minimal tillage systems improved soil chemical and physical properties compared to maximum tillage. By 1993–1994, soils under minimal tillage exhibited lower exchangeable sodium, reduced sodium adsorption ratio (SAR), and decreased dispersion index. In contrast, nitrate nitrogen levels, particulate organic matter, and total organic matter were higher under minimal tillage, while soil pH decreased slightly, reflecting improved nutrient cycling and soil quality under reduced soil disturbance (Hulugalle & Entwistle, 1997).

Similar effects of tillage on soil physical properties and crop performance have been observed in canola (rapeseed) production under rainfed conditions in India. Sharma et al. (1990) reported that tillage influenced soil bulk density, air-filled porosity, weed infestation, and yield response. Grain yield of manually weeded, rain-fed rapeseed was comparable under minimal and conventional tillage but lowest under no-tillage. These findings mention that moderate soil disturbance can optimize crop productivity while maintaining soil structure. Economic analyses further support minimal tillage as a more cost-effective approach, providing favorable cost–benefit ratios compared to conventional or no-tillage systems (Hulugalle et al., 1997). Collectively, these studies demonstrate that reduced or minimal tillage, especially when combined with suitable crop rotations, enhances soil health, improves nutrient availability, and maintains or increases crop yields, offering both agronomic and economic benefits in diverse climatic regions.

Transition from flat to bed tillage systems

The shift from traditional flat field preparation to bed tillage systems represents a major advancement in crop management practices. In bed tillage, raised beds typically 70–80 cm wide are formed, allowing rainfall to infiltrate and promote weed germination before planting. Beds can be reshaped just prior to sowing, and in wheat cultivation, each bed is often planted with two rows spaced approximately 20 cm apart (Sonnleitner et al., 2003). Research consistently demonstrates that bed tillage can maintain or slightly increase crop yields while improving water use efficiency (WUE). By structuring the soil in beds, infiltration and root-zone water availability are enhanced, which can support stable productivity even under variable rainfall conditions. Comparative studies of traditional tillage and no-tillage have provided further insights. Ali et al. (2013) reported that traditional tillage produced taller wheat plants with longer and heavier spikes, higher grain counts per spike, and ultimately greater grain yields than no-tillage systems. However, crop rotation and seasonal conditions modulate these effects. For example, studies comparing continuous wheat and wheat–fallow rotations over multiple years showed that in the first two years, grain yields were similar under conventional and no-till systems. During subsequent drought years, no-tillage yields in wheat–fallow rotations were 62–67% of those under traditional cultivation, although wheat rotation under no-till resulted in yield increases ranging from 18% to 75% compared to conventional management (Gurumurthy et al., 2006). Therefore, bed tillage and no-tillage systems offer flexibility for maintaining or enhancing yields under varying climatic conditions. The adoption of raised beds, in particular, can improve water utilization efficiency and support sustainable wheat production, especially in regions prone to water limitations.

Effect of tillage systems on wheat yield

The influence of tillage practices on wheat productivity has been extensively studied, revealing significant interactions with nitrogen management and soil moisture availability. Experimental results indicate that grain yield is highly dependent on the chosen tillage system and nutrient application. Maximum wheat grain yield (1,727 kg ha^{-1}) was achieved under no-tillage combined with 101 kg N ha^{-1}, highlighting the potential of conservation tillage systems to optimize both water and nutrient use efficiency. However, yield responses are strongly influenced by seasonal water availability. In years when total plant-available water was below 300 mm, grain yields were markedly reduced, and little benefit was observed from either tillage or nitrogen application. These findings suggest that in the northern Great Plains, farmers can maintain good-quality wheat production annually using systems that minimize soil disturbance, particularly no-tillage or minimal-tillage, when paired with appropriate nitrogen fertilization (Prihar, 2000). Comparative studies of conventional and conservation tillage further support these conclusions. Lafond et al. (1996) evaluated six conservation tillage treatments against conventional tillage and found that the average water storage in fallow soils and water utilization efficiency under conservation tillage were approximately 9% and 13% higher, respectively, than under conventional systems. These results demonstrate the dual benefits of reduced-tillage approaches: maintaining soil moisture and enhancing yield stability, particularly in water-limited environments.

Impact of tillage systems on rapeseed and mustard

Long-term experiments have evaluated the effects of different tillage systems; conventional tillage (CT), minimum tillage (MT), and no-tillage (NT) combined with varying nitrogen fertilizer rates on rapeseed and mustard. Over a 12-year period, the highest average yield (1,727 kg ha^{-1}) was consistently obtained under no-tillage (NT), highlighting its effectiveness in improving productivity while optimizing nutrient use efficiency. The benefits of NT and conservation tillage extend beyond yield improvement. In South Asia, particularly Pakistan, India, and Nepal, recently promoted permanent bed planting systems where crops are sown on reshaped beds, have been shown to reduce production costs by 25–35%, enhance fertilizer efficiency, lower herbicide requirements, save seeds, improve water use efficiency by an average of 30%, and increase overall yield (Sayre et al., 1997). CIMMYT has developed specialized planters and bed-forming equipment to help farmers maintain permanent beds and retain crop residues, further enhancing the benefits of conservation tillage and reducing the cost of bed plantations by 20–25%. Tolk et al. (1999) reported that wheat grown under such improved tillage and bed systems produced more effective tillers and higher grain yields compared to traditional tillage methods. These studies demonstrate that adopting minimum or no-tillage systems, particularly in combination with permanent beds, offers significant agronomic, economic, and environmental advantages, making them a key component of sustainable crop production strategies.

Impact of tillage systems on water and fertilizer resource conservation

The bed tillage system, also referred to as ridge-and-furrow planting, has emerged as an effective technique for improving water use efficiency (WUE), optimizing fertilizer utilization, and reducing herbicide requirements. This system is widely implemented in Mexico and other regions where efficient resource management is critical. One major advantage of bed planting is realized when beds are maintained over multiple cropping cycles without full reshaping. After wheat harvest, crop residues are either retained or burned, and the furrows are lightly reshaped to preserve bed structure. Subsequent crops such as soybeans, maize, sunflowers, and cotton can then be planted in the same beds, benefiting from accumulated organic matter and improved soil structure. Traditional cultivation using plows and tractors has been identified by FAO as a primary cause of severe soil loss in many developing countries. Mechanized tillage often fosters the misconception that more intensive soil disturbance automatically increases yield. In reality, excessive tillage accelerates erosion and soil degradation, particularly in tropical regions where topsoil is thin. No-tillage systems, in contrast, conserve topsoil, reduce erosion, and can provide higher yields at lower cost by minimizing fuel consumption and wear on machinery. No-till farming is a core component of conservation agriculture (CA), which integrates practices designed to protect and enhance soil, water, and biological resources. By maintaining permanent or semi-permanent organic soil cover and minimizing mechanical disturbance, no-tillage systems allow soil microorganisms and fauna to naturally perform the functions of cultivation. Nutrients are recycled efficiently, and soil structure is preserved, promoting sustainable crop production. Key elements of CA include direct sowing, diverse crop rotations to manage pests and diseases, and integration with residue retention, all of which enhance soil fertility and resource-use efficiency (Lafond et al., 1996).

Impact of tillage systems on the environment

No-tillage (NT) practices have been widely recognized for their positive environmental and economic impacts. NT improves crop yields, reduces production costs, and enhances water use efficiency (WUE) and fertilizer utilization while significantly suppressing weed germination. Farmers adopting no-tillage report using approximately 75% less diesel fuel and 10–30% less water compared to conventional systems. Additionally, no-tillage slows the decomposition of soil organic matter, reduces fuel consumption, and improves nutrient use efficiency, enabling higher yields with lower inputs. In contrast, traditional practices such as burning crop residues release methane, a potent greenhouse gas, contributing to environmental degradation (Qasim et al., 2022). Thus, accelerating the adoption of no-tillage systems is beneficial not only for local and global environments but also economically attractive for farmers (Sharma et al., 1990). Under semi-arid conditions, barley yields over four years were similar between no-tillage and minimum tillage, demonstrating that reduced tillage can maintain productivity while preserving soil health. The benefits of minimizing tillage arise primarily from the conservation of organic matter, improved soil penetration and water retention, and reduced soil compaction and crust formation (Sayre et al., 1997).

In the Great Plains, reduced tillage practices have contributed to increased crop resilience and diversity by enhancing water conservation, which subsequently improves crop yields. Crop residue retention and diversification positively influence soil organic matter and nutrient cycling, particularly for nitrogen (N) and phosphorus (P), which are often limiting nutrients in this region. Management practices significantly affect these nutrient cycles, as phosphorus availability can fluctuate depending on previous crop rotations and fertilizer regimes. Furthermore, preceding crops influence P availability through residue effects and the activity of arbuscular mycorrhizal fungi, which play a critical role in nutrient uptake (Grant et al., 2002; Ahmad & Aslam, 2018). Studies comparing traditional tillage, minimal tillage, and delayed minimal tillage systems report that annual wheat grain yields range from 1,790 to 5,200 kg ha^{-1}, but no significant differences in yield were observed among tillage systems over time. Further experiments confirm that grain yield remains comparable across conventional tillage, minimal tillage (involving herbicides and limited soil disturbance), and delayed minimal tillage, emphasizing that reduced tillage methods can sustain productivity while offering environmental benefits (Vetsch & Randall, 2002).

Impact of fallow and farming on soil health

The impact of fallow periods and different farming practices on soil physical properties and barley root growth was evaluated through a multi-year experiment on two soils with contrasting depths. The shallow soil consisted of a 30 cm-deep Lithic Xeric Torriorthent, while a deeper soil profile was also studied. In the deep soil, three tillage treatments; lower soil tillage (ST), minimum tillage (MT), and no-tillage (NT) were compared, whereas in the shallow soil, only MT and NT were assessed. Key soil physical properties, including Bulk Density (BD), Penetration Resistance (PR), Gravimetric Water Content, Gravel Content, and Root Length Density (RLD), were measured multiple times throughout the year. In the deep soil, bulk density was lower in fallow and post-fallow plots (1.26 mg m^{-3}) compared to continuously cropped plots (1.32 mg m^{-3}). Among the tillage systems, NT exhibited the highest bulk density (mean 1.34 mg m^{-3}), followed by MT (1.27 mg m^{-3}) and ST (1.22 mg m^{-3}). Immediately after tillage, penetration resistance was higher under NT compared to ST and MT in both soil types. Interestingly, despite the higher bulk density and penetration resistance, root length density under NT was often greater than in other tillage systems, suggesting that NT can provide favorable conditions for root growth (Lampurlanes & Cantero-Martinez, 2003).

Effect of tillage on soil and crop yield

Tillage systems and nutrient management have profound impacts on soil chemistry, which in turn influence the long-term sustainability of dryland cropping systems. Several studies have investigated the effects of conventional tillage (CT), minimum tillage (MT), and no-tillage (NT) on soil properties and crop performance under various rotations, including winter wheat (*Triticum aestivum* L.), grain sorghum (*Sorghum bicolor* (L.) Moench), and corn (*Zea mays* L.). A study spanning 27 years (1962–1989) examined the conversion of CT to NT and its impact on soil chemistry. Differences between CT and NT were observed at certain soil depths after 27 years; however, 14 years after conversion (1989–2003), chemical properties under continuous NT were similar to those observed after conversion. Soil chemistry also varied with depth in both 1989 and 2003. Long-term NT consistently produced higher grain yields than CT, with winter wheat yields of 2,718 kg ha^{-1} versus 2,421 kg ha^{-1} and grain sorghum yields of 4,125 kg ha^{-1} versus 3,062 kg ha^{-1}, likely due to improved soil moisture retention from increased residue coverage (Murphy et al., 2006). In permanent NT systems, nutrients are not mixed with the topsoil as they are under template plows or discs, which affects the distribution of soil organic matter (SOM), pH, and available nutrients (P, K, Ca, Mg). After 25 years of continuous NT, NT and chisel disc (CD) treatments showed higher SOM and phosphorus content at the surface than moldboard plow (MD) treatments. Surface pH was higher under NT in the 0–5 cm layer, whereas CD and MD treatments exhibited higher pH at greater depths. Concentrations of P, K, and Ca were consistently higher in the 0–5 cm layer across all tillage systems, particularly under NT and CD, while magnesium distribution remained unaffected (Duiker & Beegle, 2006). Regular lime application is recommended in NT systems to maintain optimal surface pH, though incorporation is not required.

Studies in semi-arid tropical regions (Villapur) demonstrated that deep plowing, combined with organic amendments and nitrogen fertilizers, improved soil water conservation and increased sorghum yields. Medium and deep tillage increased yields by 23–57% compared to shallow cultivation, while water use efficiency also improved from 4.90 to 7.30 kg ha^{-1} mm^{-1} (Patil & Sheelavantar, 2006). Deep plowing combined with 25 kg N ha^{-1} or integrated nutrient management (organic + inorganic N) further enhanced sorghum yields, especially under drought conditions. Minimal or reduced tillage systems produced similar yields to conventional tillage for soybean, wheat, rapeseed, and maize, except for potato and corn, where differences were more pronounced (Rusu, 2014). Comparisons of NT, rotational tillage (RT: NT for summer crops, conventional tillage for winter crops), and CT revealed that summer crops initially grew faster under NT, yielding higher than CT, while winter crops showed reduced yield under NT but better performance under RT compared to CT. This suggests that combining summer NT with winter CT may optimize overall production (Tsuji et al., 2006).

Experiments comparing deep chisel plow (25–30 cm), shallow cultivator (10–15 cm), and minimum tillage (5–7 cm) techniques with occasional direct drilling or strip tillage showed that reduced tillage combined with proper crop rotation could enhance dryland farming sustainability. Significant reductions in weed species such as oilseed rape (*Brassica napus*) and wild mustard (*Sinapis arvensis*) were observed under plowless systems (Vullioud et al., 2006). Tillage and crop rotation significantly influenced soil organic carbon (SOC), nitrogen (N), phosphorus (P), potassium (K), and micronutrients (Fe, Mn, Cu, Zn) in the topsoil. NT and MT increased SOC in the upper 15 cm by 75%, while N increased by 154% under NT, 108% under MT, and only 30% under CT. NT systems maintained higher surface levels of P, K, and Cu compared to MT and CT, supporting sustained fertility in upper soil layers (Martin-Rueda et al., 2007; Mehmood et al., 2022). Tillage effects generally diminished with depth, and nutrient retention under NT contributed to high yields during the first four years of rotation while preserving soil fertility. Long-term studies also evaluated the residual effects of fallow and tillage on soil hydraulic properties. Penetration resistance, permeability, and porosity were assessed using double-ring infiltrometers and tension measurements. While initial saturated permeability showed no significant differences, steady-state permeability ranged from 36 to 68 mm h^{-1}, and pore density at 5 cm tension was significantly higher under certain treatments (Nyamadzawo et al., 2008).

Conclusion

Tillage and farming practices play an important role in determining soil health, water dynamics, and crop productivity. The choice of tillage system directly affects soil physical properties, including bulk density, penetration resistance, porosity, and overall soil strength. Deep tillage, while useful for loosening compacted layers, can increase soil bulk density and promote erosion, particularly in warm regions with thin topsoil layers. Conversely, reduced or no-tillage systems help maintain soil structure, enhance water infiltration, and improve moisture retention, making more water available for crops throughout the growing season. Farming practices such as bed versus flat planting, mulching, residue retention, and crop rotations further influence soil conditions and crop yield. Mulching and organic residues protect the soil from extreme temperature fluctuations, prevent the loss of organic matter, and promote favorable conditions for root development. Integrated agronomic practices including optimized sowing dates, thinning, weeding, intercropping, green manuring, vermicomposting, and proper crop spacing can synergistically enhance soil fertility, nutrient availability, and crop growth. Overall, the sustainability and productivity of agricultural systems depend on the judicious selection and timely application of tillage and agronomic practices. Tailoring these practices to specific crop requirements and local soil conditions is essential for maximizing yield, preserving soil health, and ensuring long-term agricultural sustainability. Therefore, the wise management of soil and crop practices is a key strategy for achieving higher and more consistent crop yields while minimizing environmental degradation. Periodic nutrient and lime management, combined with water conservation strategies, can ensure long-term soil fertility and resilience under changing climatic conditions. Promoting these practices through farmer training, knowledge transfer, and supportive policies will be essential for sustainable and climate-smart agriculture.

Declarations

i. Ethics approval and consent to participate

Ethical approval and informed consent were not required for this study as it did not involve human participants, human data, or animals.

ii. Consent for publication

Consent for publication is not applicable.

iii. Data availability

All data generated or analyzed during this study are included in this article.

iv. Competing interests

Authors have declared that no competing interests exist.

v. Authors' contributions

A.L. developed the main idea and scope of the review article, collected and analyzed literature related to soil physical properties, tillage practices, and water movement; A.A. prepared the initial manuscript draft.

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viii. SDGs addressed

Zero Hunger (SDG 2); Responsible Consumption and Production (SDG 12); Climate Action (SDG 13)

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