

EĞİTİM yayınevi

Editör: **Prof. Dr. Korkmaz Bellitürk**

Toprak Bilimi ve Bitki Besleme

Alanında Uluslararası Araştırmalar - I

International Research in the Field of Soil Science and Plant Nutrition

Editör: **Prof. Dr. Korkmaz Bellitürk**

Toprak Bilimi ve Bitki Besleme

Alanında Uluslararası Araştırmalar -I

International Research in the Field of Soil Science and Plant Nutrition

EĞİTİM yayınevi

Toprak Bilimi ve Bitki Besleme Alanında Uluslararası Araştırmalar –I
(International Research in the Field of Soil Science and Plant Nutrition)

Editör: Prof. Dr. Korkmaz Bellitürk

Yayınevi Grubu Genel Başkanı: Yusuf Ziya Aydoğan (yza@egitimyayinevi.com)
Genel Yayın Yönetmeni: Yusuf Yavuz (yusufyavuz@egitimyayinevi.com)
Sayfa Tasarımı: Kübra Konca Nam
Kapak Tasarımı: Eğitim Yayınevi Grafik Birimi

T.C. Kültür ve Turizm Bakanlığı
Yayıncı Sertifika No: 76780

ISBN: 978-625-385-202-3
1. Baskı, Mayıs 2025

Baskı Cilt: Sayfa Basım Sanayi
Tevfik İleri Mah. Emek Cad. Polat Sok. No: 2 Pursaklar / Ankara
Matbaa Sertifika No: 77079

Kütüphane Kimlik Kartı

Toprak Bilimi ve Bitki Besleme Alanında Uluslararası Araştırmalar –I
(International Research in the Field of Soil Science and Plant Nutrition)
Editör: Prof. Dr. Korkmaz Bellitürk
IV+255 s., 160x240 mm
Kaynakça var, dizin yok.
ISBN: 978-625-385-202-3

Copyright © Bu kitabın Türkiye'deki her türlü yayın hakkı Eğitim Yayınevi'ne aittir. Bütün hakları saklıdır. Kitabın tamamı veya bir kısmı 5846 sayılı yasanın hükümlerine göre kitabı yayımlayan firmanın ve yazarlarının önceden izni olmadan elektronik/mekanik yolla, fotokopi yoluyla ya da herhangi bir kayıt sistemi ile çoğaltılamaz, yayımlanamaz.

EĞİTİM
yayınevi

Yayınevi Türkiye Ofis: İstanbul: Eğitim Yayınevi Tic. Ltd. Şti., Atakent mah. Yasemen sok. No: 4/B, Ümraniye, İstanbul, Türkiye

Konya: Eğitim Yayınevi Tic. Ltd. Şti., Fevzi Çakmak Mah. 10721 Sok. B Blok, No: 16/B, Safakent, Karatay, Konya, Türkiye
+90 332 351 92 85, +90 533 151 50 42
bilgi@egitimyayinevi.com

Yayınevi Amerika Ofis: New York: Egitim Publishing Group, Inc.
P.O. Box 768/Armonk, New York, 10504-0768, United States of America
americaoffice@egitimyayinevi.com

Lojistik ve Sevkiyat Merkezi: Kitapmatik Lojistik ve Sevkiyat Merkezi, Fevzi Çakmak Mah. 10721 Sok. B Blok, No: 16/B, Safakent, Karatay, Konya, Türkiye
sevkiyat@egitimyayinevi.com

Kitabevi Şubesi: Eğitim Kitabevi, Şükran mah. Rampalı 121, Meram, Konya, Türkiye
+90 332 499 90 00
bilgi@egitimkitabevi.com

İnternet Satış: www.kitapmatik.com.tr
bilgi@kitapmatik.com.tr

EĞİTİM YAYINEVİ GRUBU

İÇİNDEKİLER

AGRICULTURAL SOURCE GREENHOUSE GASES 1
Fatma Nur Kılıç, Osman Sönmez

AKARSU YATAKLARINDA YER ALAN ALÜVYAL TOPRAKLAR VE TARIMSAL FAALİYETLER 15
Bahadır Atmaca

CLIMATE CHANGE ADAPTATION: URBAN AGRICULTURE 47
Erdal Sakin, Mehmet Fatih Dilekoğlu, İbrahim Halil Yanardağ, Zemzem Fırat, Hakan Yıldırım

GRANÜL KALSİYUM OKSİT UYGULAMASININ BATI KARADENİZ BÖLGESİ ASİT TOPRAKLARININ BAZI MAKRO BESİN ELEMENTİ İÇERİKLERİ ÜZERİNE ETKİSİ 59
Aydın Adiloğlu, Doruk Akar

KEŞAN İLÇESİ CEVİZ (*JUGLANS REGIA* L.) BAHÇELERİNİN BESLENME DURUMUNUN YAPRAK ANALİZLERİ İLE BELİRLENMESİ 77
Fatih Büyükfiliz, Korkmaz Bellitürk

SAZOVA PARKI (ESKİŞEHİR) TOPRAKLARINDA ELEMENT KONSANTRASYONLARININ FARKLI ENTERPOLASYON TEKNİKLERİ İLE HARİTALANDIRILMASI 91
Gafur Gözükara

TOPRAK DOKUSU VE BESİN DAĞILIMININ İLİŞKİSİ: TOPRAK HARİTASININ MODELLENMESİNDE KULLANILAN YÖNTEM 103
Leyla Atasay, Murat Bakan

TRAKYA BÖLGESİNDE TARIMSAL GÜBRE KULLANIMININ ANALİZİ 125
Umut Yıldırım, Mecit Ömer Azabağaoğlu

TRICHODERMA SP.'DEN HAZIRLANAN NANOFORMÜLASYONLAR 143
Çiğdem Küçük

TUZ STRESİ ALTINDA FARKLI MISIR VE SORGUM BİTKİLERİNDE BÜYÜME PARAMERELERİNİN İNCELENMESİ 157
Bülent Yağmur Hatice Köse

YAĞ BİTKİLERİNİN TOPRAK İSTEKLERİ VE GÜBRELENMESİ 183
Burhan Arslan, Emrullah Culpan

MARMARA BÖLGESİ TOPRAKLARININ TOPRAK SICAKLIK REJİMLERİ..... 193
Özgül Atakorkut Altun , Duygu Boyraz Erdem

AGRICULTURAL SOURCE GREENHOUSE GASES*

Fatma Nur Kılıç**, Osman Sönmez***

Introduction

Due to its extensive adverse effects, climate change has become one of the most urgent global challenges. The alterations pertain to enduring trends in meteorological data, including temperature and precipitation, where departures from mean values act as critical markers of climate change (Malhi et al., 2021). Greenhouse gases (GHGs), such as methane (CH_4), carbon dioxide (CO_2), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), and water vapor, are atmospheric gases that are essential for regulating Earth's temperature. These gases absorb a part of the long-wave radiation from the sun and reflect another part back to the Earth's surface, contributing to the temperature increase (Manabe, 2019). The heat retention by greenhouse gases in the atmosphere, which elevates the Earth's surface temperature, is called the greenhouse effect (Edemen et al., 2023). The greenhouse effect is crucial for sustaining a livable temperature on Earth; nevertheless, an elevation in greenhouse gas concentrations might disturb this equilibrium, resulting in global warming (Kulchitskiy et al., 2023). Greenhouse gases originate from both natural and anthropogenic sources. Natural sources encompass forest fires, oceans, earthquakes, volcanic eruptions, and permafrost. In contrast, anthropogenic factors stemming from human activities encompass the combustion of fossil fuels, transportation, industrial processes, and agricultural practices (Navrotsky, 2017; Bastviken et al., 2011; Guo et al., 2015; Gołasa et al., 2021). The escalation of human activity, alongside population growth, has expedited climate change (Purcell et al., 2023), accounting for roughly 47-66% of the rise in global greenhouse gas concentrations (Yue & Gao, 2018). While the energy sector is the leading contributor to GHG emissions, the agricultural industry follows closely, accounting for 18.4% of total emissions (Ritchie & Roser, 2023). Various strategies have been implemented within the energy sector to mitigate GHG emissions, including raising awareness about alternative energy sources. In contrast, the increasing rate of emissions from the agricultural sector has often been overlooked. This oversight has led to a growing focus on academic research on GHG emissions in agriculture, underscoring this sector's vital role in global

** Research Assistant., Erciyes University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Kayseri, fatmanur@erciyes.edu.tr, ORCID: orcid.org/ 0000-0003-3498-2455
*** Professor, Erciyes University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Kayseri, ORCID: orcid.org/ 0000-0002-9134-6466

emission reduction efforts (Şahin & Avcıoğlu, 2016). Key gases such as CO_2, CH_4, and N_2O are predominantly emitted through agricultural activities, with human actions such as livestock production, deforestation, and land use change being significant contributors (Razzaghi, 2021). These emissions, driven by anthropogenic activities, highlight the importance of understanding and managing the agricultural sector's role in increasing GHG emissions (Shakoor et al., 2021; Chataut et al., 2023).

This study's objective is to systematically review the literature on agricultural source GHGs and thoroughly examine the contributions of various agricultural practices to these emissions.

The contribution of agricultural sources to greenhouse gas emissions

Agricultural activities have long been recognized as significant contributors to atmospheric emissions of CH_4 and N_2O, which are primary GHGs, along with CO_2 as a secondary GHG, all of which impact climate change (Deng et al., 2023; Tang et al., 2024). These activities, accounting for approximately 11% of anthropogenic GHG emissions, influence global climate change considerably. The contribution of agricultural activities to emissions is directly related to factors such as soil management, livestock production, agricultural practices, and the indiscriminate use of fertilizers (Shukla et al., 2019; Yue et al., 2019). The sources of greenhouse gases within the agricultural sector are depicted in Figure 1. Understanding the stages of emission generation from these sources is crucial for developing greenhouse gas mitigation strategies in agricultural practices and promoting sustainable farming methods.

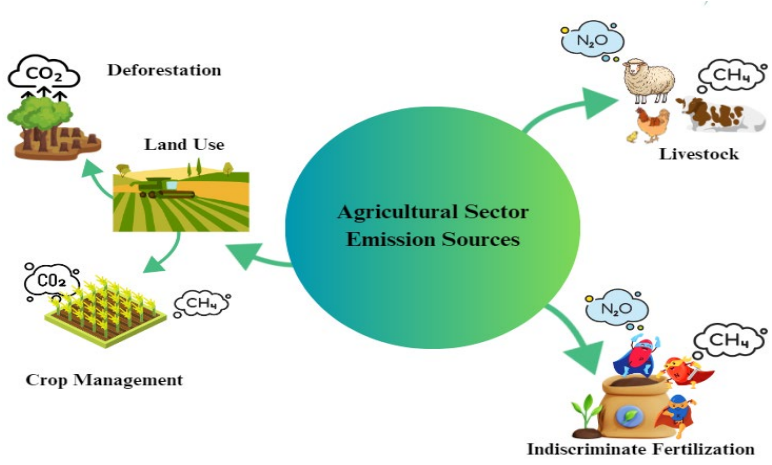


Figure 1. Agricultural sector emission sources

The role of livestock activities in greenhouse gas emissions

Livestock activities and their by-products contribute approximately 18% to agricultural sector GHG emissions. This percentage highlights the significant impact of the livestock sector, particularly in terms of CH_4 and N_2O emissions (Chiarelotto et al., 2021). Methane and N_2O have a higher global warming potential (GWP) in the atmosphere than CO_2 (Edenhofer, 2015). Emissions generally increase due to management practices related to animal housing, manure storage methods, and application techniques (Figure 2) (Hou et al., 2015; He et al., 2023). On farms, especially in ruminant animals (such as cattle, sheep, and goats), high levels of CH_4 emissions are produced because of the activity of methanogenic bacteria in their digestive systems (Allen & Holf, 2019; Debonne, 2019). Additionally, N_2O is released from the oxidation of ammonia (NH_3) from urea in animal excreta and the decomposition of organic matter (Kabelitz et al., 2020; Katongole & Yan, 2022). In a study on methane emission reduction, Ambrose et al. (2023) reported that emission concentrations vary depending on the cleaning and proper use of bedding systems. Anaerobic decomposition processes in oxygen-deficient environments, such as manure pits and storage areas, lead to CH_4 production (Yu et al., 2023). Ershadi et al. (2020) found that anaerobic interactions are more prevalent in liquid manure storage areas, with higher GHG emissions occurring during the initial storage periods. In contrast, emissions increased during the final storage periods in solid manure areas. Furthermore, the temperature of the storage environment plays a significant role in emission levels, with higher temperatures increasing CH_4 emissions from cattle manure (Sommer et al., 2007; Xu et al., 2023). Another study aimed at reducing CH_4 emissions found that lowering the storage temperature decreased CH_4 emissions by 74% (Im et al., 2020). Annually, approximately seven billion tons of animal manure are used globally in agricultural practices to enhance soil fertility (Thangarajan et al., 2013; Shakoor et al., 2021). The contribution of GHG emissions from manure application depends on factors such as animal species, waste type, and feeding conditions (Kılıç & Sönmez, 2024; Zhu et al., 2020). Nitrogen emissions from animal manure sources, especially poultry manure, are significant. In contrast, the composition of the diet and organic matter in cattle, sheep, and goat manure can increase CH_4 and N_2O emissions (Uddin et al., 2020).

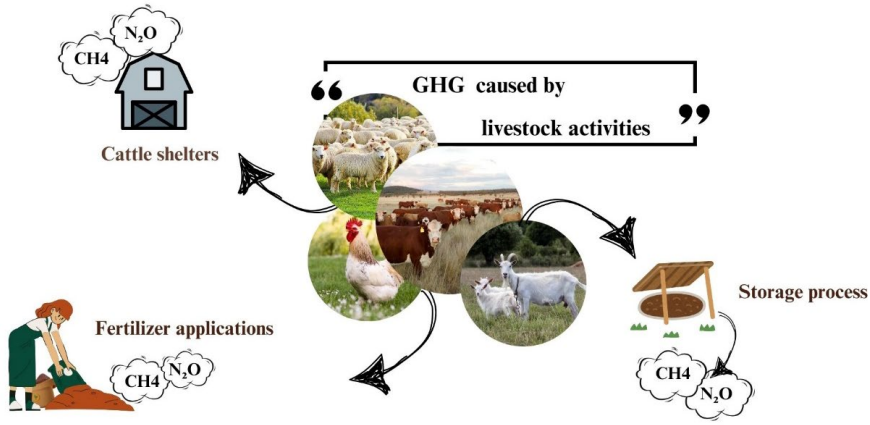


Figure 2. GHG sources of livestock activities

The role of ındiscriminate fertilization practices in greenhouse gas emissions

With the increase in global population, the demand for food has risen, leading to a corresponding increase in the use of synthetic fertilizers in agricultural production (Chataut et al., 2023). Despite the benefits fertilizers offer, improper fertilization practices can lead to nutrient loss, increased soil salinity or acidification, eutrophication, a decline in soil biodiversity, and a rise in soil-derived GHG emissions (Sutton et al., 2013). Synthetic fertilizers primarily provide essential nutrients such as nitrogen (N, phosphorus pentoxide (P_2O_5), and potassium oxide (K_2O) to support the growth and development of crops (Walling & Vaneeckhaute, 2020). Nitrogen-based fertilizers contribute to the nitrogen cycle within the soil microbiota through processes like nitrification and denitrification, making them a primary source of N_2O emissions (Hassan et al., 2022; Schlüter et al., 2024). The N_2O emissions account for about 6% of the greenhouse effect and are also involved in the depletion of the stratospheric ozone layer (Bouwman et al., 1995; Senbayram et al., 2012).

Factors such as soil pH, temperature, moisture content, oxygen availability, and concentrations of carbon (C) and nitrogen sources (e.g., ammonium (NH_4^+), NH_3, and nitrate (NO_3^-)) directly influence N_2O emissions by affecting microbial activity and the rate of N transformation processes in the soil (Schmeer et al., 2014; Oertel et al., 2016; Cui et al., 2022). Higher soil temperatures increase N_2O emissions, with nitrification leading to more NO emissions in alkaline soils, while denitrification

dominates in acidic soils, reducing N_2O emissions (Remde & Conrad, 1991; Oertel et al., 2016). Sudden increases in soil moisture after nitrogen fertilization also enhance N_2O emissions, especially when the water-filled pore space in the soil reaches around 60%, which is considered optimal for such emissions (Gao et al., 2014). Moreover, the size of the soil pores, which affects oxygen levels, is another critical factor: larger pores in coarse-textured soils promote aerobic conditions that favor NO emissions, whereas smaller pores in finer-textured soils encourage anaerobic conditions that increase N_2O emissions (Gu et al., 2013; van der Weerden et al., 2012).

Research has shown that different N doses can significantly impact GHG emissions in crop production. For example, Du et al. (2019) investigated the effects of various nitrogen doses on tomato cultivation's GHG emissions. They found that increased nitrogen applications and aerated irrigation systems enhanced crop yield and substantially increased GHG emissions, particularly during the spring when soil temperatures rose. Similarly, Nyamadzawo et al. (2014) observed that agricultural activities in wetlands generally lead to increased GHG emissions. However, they also found that organic nitrogen fertilization and combinations of organic fertilizers resulted in lower emissions than inorganic nitrogen fertilizers. Sistani et al. (2011) evaluated the impact of different nitrogen fertilizers on N_2O, CH_4, and CO_2 emissions in a no-till farming system over two seasons of corn production. Their study showed that poultry manure produced the highest N_2O emissions, while polymer-coated urea (ESN) resulted in delayed N_2O emissions compared to other fertilizers. Additionally, fertilizers like SuperU, UAN, and urea produced lower N_2O emissions than ESN, NH_4^+, NO_3^-, and poultry manure, with CH_4 and CO_2 emissions being more influenced by environmental factors like temperature and moisture rather than the N source itself. Walling and Vaneeckhaute (2020) reported that the emission factors (EF) associated with the production of urea and ammonium nitrate vary between 1.3 and 5.5 kg CO_2-eq./kg and 3.5 and 10.3 kg CO_2-eq./kg, respectively. These variations are attributed to differences in raw materials and manufacturing practices across countries. Brentrup et al. (2016) found that European countries generally have lower EFs in nitrogen fertilizer production. In contrast, higher EFs are observed in the United States and China, mainly due to the use of coal instead of natural gas in the steam reforming step during production. Beyond nitrogen fertilizers, the production processes

for phosphorus and potassium fertilizers also significantly contribute to GHG emissions. Each of these processes requires energy-intensive operations, leading to the release of various GHGs into the atmosphere. Studies have shown that the EF for ammonium phosphates and superphosphates ranges from 1.3 to 8.9 kg CO_2-eq./kg and 0.4 to 1.6 kg CO_2-eq./kg, respectively (Walling & Vaneeckhaute, 2020). Regarding potassium fertilizers, Chen et al. (2018) reported that the production of potassium chloride results in emissions of 0.19 kg CO_2-eq./kg K_2O.

The role of land use in greenhouse gas emissions

Changes in land use, especially the conversion of forests, grasslands, and peatlands into agricultural lands, significantly impact GHG emissions. Soil organic carbon (SOC) accumulation largely depends on vegetation cover (Poeplau & Don, 2013). Alterations in land use disrupt natural carbon reservoirs, releasing stored carbon into the atmosphere and changes in the albedo effect, which contribute to the acceleration of climate change (Jones et al., 2015; Oertel et al., 2016). Forested areas with the highest above-ground biomass contain substantial amounts of SOC and reduce terrestrial ecosystem CO2 emissions by approximately 29% (Harris et al., 2021; Friedlingstein et al., 2023). The conversion of forests into agricultural lands or other human uses results in the release of stored carbon into the atmosphere, while changes in the albedo effect increase the absorption of solar radiation, further enhancing emissions (Lawrence et al., 2022). In grassland and pasture areas, overgrazing by livestock and poor pasture management lead to a decrease in SOC and result in increased CO2 emissions from soil and CH4 emissions from animals (Chang et al., 2021). Ma et al. (2018) evaluated the effects of different grazing intensities on CH4 emissions from sheep. They studied no grazing (0 sheep ha-1 year-1), deferred grazing (DG) (1 sheep ha-1 year-1), moderate grazing (MG) (1.43 sheep ha-1 year-1), and heavy grazing (HG) (2.43 sheep ha-1 year-1). Their results showed CH4 emissions of 0.21, 0.32, and 0.37 g CH4-C ha-1 for DG, MG, and HG per 1 g daily live weight gain. They suggested that deferred grazing management is more effective for reducing CH4 emissions and improving productivity. Overall, understanding the impact of land use changes on GHG emissions is crucial for developing strategies to mitigate climate change and promote sustainable land management practices. Broucek (2014) found that ruminant animals grazing on fertilized pastures produced higher CH_4 emissions (223 g/day) compared to those grazing on unfertilized pastures (179 g/day). Additionally, CH_4

emissions from manure vary based on its composition, the amount of digestible nutrients it contains, and decomposition rates influenced by climatic conditions (Kılıç & Boğa, 2021). Ribeiro et al. (2020) investigated the net GWP of winter black oat pastures under varying grazing intensities (light, moderate, and heavy) in a subtropical ecosystem. They observed moderate grazing increased SOC accumulation and reduced net GWP, resulting in lower emission levels than heavy grazing. Cover crops typically grown outside regular crop production periods also impact GHG emissions. These fast-growing plants offer significant benefits, such as soil protection, seed health, and soil improvement (Quintarelli et al., 2022). Cover crops are generally classified into legumes, grasses, and broadleaf non-legumes based on their function and characteristics. With strong root systems, legumes fix atmospheric nitrogen through symbiotic bacteria and reduce soil compaction (LaRue & Patterson, 1981; Kakraliya et al., 2018). Grass like barley, wheat, oats, millet, and rye proliferate and have fibrous root systems that prevent soil erosion (Hamidifar et al., 2018). Broadleaf non-legumes are often used as green manure (Ma et al., 2021). Unlike bare soil, cover crops improve soil physical properties such as structure, water holding capacity, and infiltration rates. Additionally, they enhance soil carbon sequestration and nitrogen retention (García-González et al., 2018). Numerous studies have shown that cover crops can enhance carbon sequestration by capturing atmospheric CO_2 and storing it in their biomass (Blanco-Canqui et al., 2020; Ball et al., 2020; Villat et al., 2024). However, the impact of cover crops on GHG emissions varies across different studies. Some research indicates that covering crops improves soil health and increases organic matter content, reducing GHG emissions. Conversely, other studies suggest that the dense root systems and increased biomass of cover crops may promote anaerobic soil conditions, potentially increasing CH_4 and N_2O emissions (Venterea et al., 2011; Razzaghi, 2021). Recent studies on this topic are summarized in Table 1.

Table 1. The impact of different cover crops on greenhouse gas emissions

Cover crop	Types of GHG	Findings	Reference
Zea mays L.-Glycine max L. Avena sativa-Triticum aestivum	CO_2	In a study conducted under no-till management, the effects of cover crops on CO_2 emissions were examined in corn-soybean and corn-soybean-oat-winter wheat rotations. The research found that more extended and more diverse crop rotations, such as the corn-soybean-oat-winter wheat rotation, have a higher potential to reduce CO_2 emissions compared to other practices.	Singh and Kumar (2021)
Secale cereale L.	N_2O, CO_2	In areas where cover crops were planted versus areas where they were not, greenhouse gas (GHG) emissions showed that during the emergence period of rye, N_2O emissions were reduced in the areas with cover crops, while CO_2 emissions were unaffected.	Reicks et al. (2021)
Raphanus sativus-Trifolium incarnatum-Secale cereale	N_2O	A study examining the effects of different cover crop species on N_2O emissions in unmanaged agricultural fields found that mixed cover crops reduced NO_3 leaching. However, the death of cover crops due to winter freeze led to biomass decomposition, directly increasing N_2O emissions. Overall, planting cover crops in mixtures generally resulted in a reduction in N_2O emissions.	Sedghi et al. (2024)
*Zea mays L.-(*Pisum *sativum L., Vicia sativa,)*	CO_2, CH_4	In a study investigating the combined cultivation of legumes and maize, along with reduced tillage and nitrogen fertilization, it was found that High C legumes increased soil CO_2 emissions under tillage. In contrast, reduced tillage in high N legumes decreased these emissions. Additionally, higher CH_4 emissions were observed in no-till.	Fernández-Ortega et al. (2024)
Oryza sativa	N_2O, CH_4,	In a study examining the effects of various cover crops in a mono-rice cropping system on N_2O and CH_4 emissions, the addition of winter cover crops led to increased emissions of N_2O and CH_4 due to increased organic matter accumulation.	Li et al. (2021)

CONCLUSION

This study has extensively examined the contributions of agricultural activities to greenhouse gas emissions and their impacts on the global climate. Our research highlights the significant role of livestock activities and indiscriminate fertilizer use in emitting potent greenhouse gases such as CH_4 and N_2O into the atmosphere. Furthermore, changes in land use, especially the conversion of forests and grasslands into agricultural land, have been identified to decrease soil organic carbon stocks and increase CO_2 emissions. These findings underscore the importance of strategically directing land management and agricultural practices in combating climate change. Our study also addresses the complex effects of covering crops on greenhouse gas emissions. While these crops can enhance carbon sequestration, reducing global warming potential, they can also contribute to GHG emissions by increasing CH_4 and N_2O emissions under anaerobic conditions. This dual impact highlights a significant literature gap in how cover crops can be integrated into ecological management strategies. In conclusion, there is a critical need to reshape agricultural policies and practices based on scientific evidence to address sustainability and climate change issues. This restructuring is crucial for reducing agricultural emissions and effectively combating climate change. Therefore, promoting sustainable agricultural practices, allocating more resources to develop adaptation and mitigation strategies for climate change, and supporting scientific research are paramount. This study is expected to contribute to the literature by comprehensively addressing agricultural greenhouse gas emissions and highlighting current research and resource allocation needs.

Reference

Allen, A. M., & Hof, A. R. (2019). Paying the price for the meat we eat. Environmental science & policy, 97, 90–94.

Ambrose, H. W., Dalby, F. R., Feilberg, A., & Kofoed, M. V. (2023). Additives and methods for the mitigation of methane emissions from stored liquid manure. Biosystems Engineering, 229, 209-245.

Ball, K. R., Baldock, J. A., Penfold, C., Power, S. A., Woodin, S. J., Smith, P., & Pendall, E. (2020). Mixed grass and legume cover crops in vineyard agroecosystems increase soil organic carbon and nitrogen pools: Detecting short-term management effects using infrared spectroscopy. Geoderma, 379, 114619.

Bastviken, D., Tranvik, L. J., Downing, J. A., Crill, P. M., & Enrich-Prast, A. (2011). Freshwater methane emissions offset the continental carbon sink. Science, 331(6013), 50–50.

Blanco-Canqui, H., & Ruis, S. J. (2020). Cover crop impacts on soil physical properties: A review. Soil Science Society of America Journal, 84(5), 1527–1576.

Brentrup, F., Hoxha, A., & Christensen, B. (2016). Carbon footprint analysis of mineral fertilizer production in Europe and other world regions. In Conference Paper, The 10th International Conference on Life Cycle Assessment of Food.Vol:19.

Chang, J., Ciais, P., Gasser, T., Smith, P., Herrero, M., Havlík, P., ... & Zhu, D. (2021). Climate warming from managed grasslands cancels the cooling effect of carbon sinks in sparsely grazed and natural grasslands. Nature Communications, 12(1), 118.

Chataut, G., Bhatta, B., Joshi, D., Subedi, K., & Kafle, K. (2023). Greenhouse gas emissions from agricultural soil: A review. Journal of Agriculture and Food Research, 11, 100533.

Chataut, G., Bhatta, B., Joshi, D., Subedi, K., & Kafle, K. (2023). Greenhouse gas emissions from agricultural soil: A review. Journal of Agriculture and Food Research, 11, 100533.

Chiarelotto, M., Restrepo, J. C. P. S., Lorin, H. E. F., & Damaceno, F. M. (2021). Composting organic waste from the broiler production chain: A perspective for the circular economy. Journal of Cleaner Production, 329, 129717.

Debonne, N. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems: Chapter 1: Framing and Context.

Deng, H., Zhang, D., Yu, H., Man, Y., & Wang, Y. (2023). Assessing life-cycle GHG emissions of recycled paper products under China's imported solid waste ban: A case study. Science of The Total Environment, 891, 164407.

Du, Y. D., Gu, X. B., Wang, J. W., & Niu, W. Q. (2019). Yield and gas exchange of greenhouse tomato at different nitrogen levels under aerated irrigation. Science of the total environment, 668, 1156-1164.

Edemen, M., Engin, V., Boynukara, E., Narin, E., Yalçın, M., Küçükilhan, H., ... & Kavlak, A. (2023). Küresel ısınma, küresel ısınmanın nedenleri ve sonuçları dünya ve türkiye üzerine olası etkileri. International Journal of Social and Humanities Sciences Research (JSHSR), 10(91), 37-48.

Edenhofer, O. (Ed.). (2015). Climate change 2014: climate change mitigation (Vol. 3). Cambridge University Press.1454, 147.

Ershadi, S. Z., Dias, G., Heidari, M. D., & Pelletier, N. (2020). Improving nitrogen use efficiency in crop-livestock systems: A review of mitigation technologies and management strategies, and their potential applicability for egg supply chains. Journal of cleaner production, 265, 121671.

Fernández-Ortega, J., Álvaro-Fuentes, J., & Cantero-Martínez, C. (2024). Double-cropping, tillage, and nitrogen fertilization effects on soil CO2 and CH4 emissions. Agriculture, Ecosystems & Environment, 359, 108758.

Friedlingstein, P., O'sullivan, M., Jones, M. W., Andrew, R. M., Bakker, D. C., Hauck, J., ... & Zheng, B. (2023). Global carbon budget 2023. Earth System Science Data, 15(12), 5301-5369.

García-González, I., Hontoria, C., Gabriel, J. L., Alonso-Ayuso, M., & Quemada, M. (2018). Cover crops to mitigate soil degradation and enhance soil functionality in irrigated land. Geoderma, 322, 81-88.

Gołasa, P., Wysokiński, M., Bieńkowska-Gołasa, W., Gradziuk, P., Golonko, M., Gradziuk, B., ... & Gromada, A. (2021). Sources of greenhouse gas emissions in agriculture, with particular emphasis on emissions from energy used. Energies, 14(13), 3784.

Guo, Z. F., Zhang, M. L., & Sun, Y. T. (2015). Research progress of greenhouse gas release flux and observations in volcanoes. Bulletin of Mineralogy, Petrology and Geochemistry, 34(4), 690-700.

Hamidifar, H., Keshavarzi, A., & Truong, P. (2018). Enhancement of riverbank shear strength parameters using Vetiver grass root system. Arabian Journal of Geosciences, 11, 1-11.

Harris, N. L., Gibbs, D. A., Baccini, A., Birdsey, R. A., De Bruin, S., Farina, M., ... & Tyukavina, A. (2021). Global maps of twenty-first-century forest carbon fluxes. Nature Climate Change, 11(3), 234-240.

Hassan, M. U., Aamer, M., Mahmood, A., Awan, M. I., Barbanti, L., Seleiman, M. F., ... & Huang, G. (2022). Management strategies to mitigate N2O emissions in agriculture. Life, 12(3), 439.

He, Z., Zhang, Y., Liu, X., de Vries, W., Ros, G. H., Oenema, O., ... & Zhang, F. (2023). Mitigation of nitrogen losses and greenhouse gas emissions in a more circular cropping-poultry production system. Resources, Conservation and Recycling, 189, 106739.

Hou, Y., Velthof, G. L., & Oenema, O. (2015). Mitigation of ammonia, nitrous oxide, and methane emissions from manure management chains: a meta-analysis and integrated assessment. Global change biology, 21(3), 1293-1312.

Im, S., Petersen, S. O., Lee, D., & Kim, D. H. (2020). Effects of storage temperature on CH4 emissions from cattle manure and subsequent biogas production potential. Waste management, 101, 35-43.

Jones, A. D., Calvin, K. V., Collins, W. D., & Edmonds, J. (2015). Accounting for radiative forcing from albedo change in future global land-use scenarios. Climatic Change, 131, 691-703.

Kabelitz, T., Ammon, C., Funk, R., Münch, S., Biniasch, O., Nübel, U., ... & Amon, T. (2020). Functional relationship of particulate matter (PM) emissions, animal species, and moisture content during manure application. Environment international, 143, 105577.

Kakraliya, S.K., Singh, U., Bohra, A., Choudhary, K.K., Kumar, S., Meena, R.S., & Jat, M.L. (2018). Nitrogen and legumes: a meta-analysis. Legumes for soil health and sustainable management, 277-314.

Katongole, C. B., & Yan, T. (2022). The Effects of Dietary Crude Protein Level on Ammonia Emissions from Slurry from Lactating Holstein-Friesian Cows as Measured in Open-Circuit Respiration Chambers. Animals, 12(10), 1243.

Katongole, C. B., & Yan, T. (2022). The Effects of Dietary Crude Protein Level on Ammonia Emissions from Slurry from Lactating Holstein-Friesian Cows as Measured in Open-Circuit Respiration Chambers. Animals, 12(10), 1243.

Kılıç, F. N., & Sönmez, O. (2024). Pollutant Effects and Management of Animal Manure. Turkish Journal of Agriculture-Food Science and Technology, 12(8), 1467-1475.

Kılıç, H. N., & Boga, M. (2021). Reducing Methane Emissions through Livestock Feeding Strategies. Turkish Journal of Agriculture-Food Science and Technology, 9(9), 1700-1713.

Kulchitskiy, A. R. (2023). Once again, about “global warming” and “greenhouse gases”. Natural Resources Conservation and Research, 6(2), 2607.

LaRue, T. A., & Patterson, T. G. (1981). How much nitrogen do legumes fix?. Advances in agronomy, 34, 15-38.

Lawrence, D., Coe, M., Walker, W., Verchot, L., & Vandecar, K. (2022). The unseen effects of deforestation: biophysical effects on climate. Frontiers in Forests and Global Change, 5, 756115.

Li, J., Wang, S., Shi, Y., Zhang, L. ve Wu, Z. (2021). Nadas mevsimi örtü bitkileri, tek pirinç ekim sisteminde çeltik topraklarından N2O veya CH4 emisyonunu artırır mı? Tarım Bilimi , 11 (2), 199.

Ma, D., Yin, L., Ju, W., Li, X., Liu, X., Deng, X., & Wang, S. (2021). Meta-analysis of green manure effects on soil properties and crop yield in northern China: field Crops Research, 266, 108146.

Ma, L., Zhong, M., Zhu, Y., Yang, H., Johnson, DA ve Rong, Y. (2018). Ilıman karasal bozkırda koyun otlatma sistemlerinin yıllık metan bütçeleri otlatma yoğunlukları tarafından düzenlendi: İki yıllık bir vaka çalışması. Atmosferik ortam , 174 , 66-75.

Malhi, G. S., Kaur, M., & Kaushik, P. (2021). Impact of climate change on agriculture and its mitigation strategies: A review. Sustainability, 13(3), 1318.

Manabe, S. (2019). Role of greenhouse gas in climate change. Tellus A: Dynamic Meteorology and Oceanography, 71(1), 1620078.

Navrotsky, V. V. (2017). The world ocean is the maın drıver of clımate change. In Oceanıc Process and Clımate Change (pp. 60-60).

Nyamadzawo, G., Wuta, M., Nyamangara, J., Smith, J. L., & Rees, R. M. (2014). Nitrous oxide and methane emissions from cultivated seasonal wetland (dambo) soils with inorganic, organic, and integrated nutrient management. Nutrient Cycling in Agroecosystems, 100, 161-175.

Oertel, C., Matschullat, J., Zurba, K., Zimmermann, F., & Erasmi, S. (2016). Greenhouse gas emissions from soils—A review. Geochemistry, 76(3), 327-352.

Poeplau, C., & Don, A. (2013). Sensitivity of soil organic carbon stocks and fractions to different land-use changes across Europe. Geoderma, 192, 189-201.

Purcell, W., Neubauer, T., & Mallinger, K. (2023). Digital Twins in agriculture: Challenges and opportunities for environmental sustainability. Current Opinion in Environmental Sustainability, 61, 101252.

Quintarelli, V., Radicetti, E., Allevato, E., Stazi, S. R., Haider, G., Abideen, Z., ... & Mancinelli, R. (2022). Cover crops for sustainable cropping systems: a review. Agriculture, 12(12), 2076.

Razzaghi, S. (2021). Cover Crops Effects on Greenhouse Gas Emissions: Cover Crops and Sustainable Agriculture. Editors Rafiq Islam and Bradford Sherman. Taylor and Francis. CRC Press, Boca Raton, Florida, USA. pp 280–298.

Reicks, G. W., Clay, D. E., Clay, S. A., Joshi, D. R., Moriles-Miller, J., Westhoff, S., ... & Bruggeman, S. A. (2021). Winter cereal rye cover crop decreased nitrous oxide emissions during early spring. Agronomy Journal, 113(5), 3900-3909.

Ribeiro, R. H., Ibarr, M. A., Besen, M. R., Bayer, C., & Piva, J. T. (2020). Managing grazing intensity to reduce the global warming potential in integrated crop–livestock systems under no-till agriculture. European Journal of Soil Science, 71(6), 1120-1131.

Ritchie, H., & Roser, M. (2023). Sector by sector: where do global greenhouse gas emissions come from? Our World in data.

Şahin, G., & Avcıoğlu, A. O. (2016). Tarımsal üretimde sera gazları ve karbon ayak izi. Tarım Makinaları Bilimi Dergisi, 12(3), 157-162.

Schlüter, S., Lucas, M., Grosz, B., Ippisch, O., Zawallich, J., He, H., ... & Well, R. (2024). The anaerobic soil volume as a controlling factor of denitrification: a review. Biology and Fertility of Soils, 1-23.

Schmeer, M., Loges, R., Dittert, K., Senbayram, M., Horn, R., & Taube, F. (2014). Legume-based forage production systems reduce nitrous oxide emissions. Soil and Tillage Research, 143, 17-25.

Sedghi, N., Cavigelli, M., & Weil, R. R. (2024). Cover Crop Species and Timing Affect Direct and Indirect Nitrous Oxide Emissions from No-Till Cropland. Available at SSRN 4536443.

Senbayram, M., Chen, R., Budai, A., Bakken, L., & Dittert, K. (2012). N2O emission and the N2O/(N2O+ N2) product ratio of denitrification as controlled by available carbon substrates and nitrate concentrations. Agriculture, Ecosystems & Environment, 147, 4-12.

Shakoor, A., Shahbaz, M., Farooq, T. H., Sahar, N. E., Shahzad, S. M., Altaf, M. M., & Ashraf, M. (2021). A global meta-analysis of greenhouse gas emissions and crop yield under no-tillage as compared to conventional tillage. Science of the Total Environment, 750, 142299.

Shakoor, A., Shakoor, S., Rehman, A., Ashraf, F., Abdullah, M., Shahzad, SM, ... & Altaf, MA (2021). Hayvan gübresi, ürün türü, iklim bölgesi ve toprak özelliklerinin tarım

topraklarından kaynaklanan sera gazı emisyonları üzerindeki etkisi - Küresel bir meta-analiz. Temiz Üretim Dergisi , 278 , 124019.

Shukla, P. R., Skeg, J., Buendia, E. C., Masson-Delmotte, V., Pörtner, H. O., Roberts, D. C., ... & Malley, J. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

Singh, J., & Kumar, S. (2021). Responses of soil microbial community structure and greenhouse gas fluxes to crop rotations that include winter cover crops. Geoderma, 385, 114843.

Sistani, K. R., Jn-Baptiste, M., Lovanh, N., & Cook, K. L. (2011). Atmospheric emissions of nitrous oxide, methane, and carbon dioxide from different nitrogen fertilizers. Journal of environmental quality, 40(6), 1797-1805.

Sommer, S. G., Petersen, S. O., Sørensen, P., Poulsen, H. D., & Møller, H. B. (2007). Methane and carbon dioxide emissions and nitrogen turnover during liquid manure storage. Nutrient Cycling in Agroecosystems, 78, 27-36.

Sutton, M. A., Bleeker, A., Howard, C. M., Erisman, J. W., Abrol, Y. P., Bekunda, M., ... & Zhang, F. S. (2013). Our nutrient world. The challenge to produce more food & energy with less pollution. Centre for Ecology & Hydrology.

Tang, Y., Qiao, Y., Ma, Y., Huang, W., Komal, K., & Miao, S. (2024). Quantifying greenhouse gas emissions in agricultural systems: a comparative analysis of process models. Ecological Modelling, 490, 110646.

Thangarajan, R., Bolan, N. S., Tian, G., Naidu, R., & Kunhikrishnan, A. (2013). Role of organic amendment application on greenhouse gas emission from soil. Science of the Total Environment, 465, 72-96.

Uddin, M. E., Larson, R. A., & Wattiaux, M. A. (2020). Effects of dairy cow breed and dietary forage on greenhouse gas emissions from manure during storage and after field application. Journal of cleaner production, 270, 122461.

Venterea, R. T., Maharjan, B., & Dolan, M. S. (2011). Fertilizer source and tillage effects on yield-scaled nitrous oxide emissions in a corn cropping system. Journal of Environmental Quality, 40(5), 1521-1531.

Villat, J., & Nicholas, K. A. (2024). Quantifying soil carbon sequestration from regenerative agricultural practices in crops and vineyards. Frontiers in Sustainable Food Systems, 7, 1234108.

Walling, E., & Vaneeckhaute, C. (2020). Greenhouse gas emissions from inorganic and organic fertilizer production and use: A review of emission factors and their variability. Journal of Environmental Management, 276, 111211.

Walling, E., & Vaneeckhaute, C. (2020). Greenhouse gas emissions from inorganic and organic fertilizer production and use: A review of emission factors and their variability. Journal of Environmental Management, 276, 111211.

Walling, E., & Vaneeckhaute, C. (2020). Greenhouse gas emissions from inorganic and organic fertilizer production and use: A review of emission factors and their variability. Journal of Environmental Management, 276, 111211.

Xu, X., Yan, M., Sun, Y., & Li, Y. (2023). Bioaugmentation with cold-tolerant methanogenic culture to boost methane production from anaerobic co-digestion of cattle manure and corn straw at 20°C. Chemical Engineering Journal, 466, 143183.

Yu, D., Li, Z., Fan, S., & Sun, T. (2023). Optimal management of an energy-water-carbon nexus employing carbon capturing and storing technology via a downside risk constraint approach. Journal of Cleaner Production, 418, 138168.

Yue X. & Gao Q. (2018). Contributions of natural systems and human activity to greenhouse gas emissions. Advances in Climate Change Research. 9(4), 243-252.

Yue, Q., Cheng, K., Ogle, S., Hillier, J., Smith, P., Abdalla, M., ... & Pan, G. (2019). Evaluation of four modelling approaches to estimate nitrous oxide emissions in China's cropland. Science of the Total Environment, 652, 1279-1289.

Zhu, Z. P., Dong, H. M., Wei, S., Ma, J. Z., & Xue, P. Y. (2020). Impact of changes in livestock manure management on greenhouse gas emissions in China.