Journal of Business Economics and Agribusiness, Volume 3, Number 2, 2026, *Page*: *1-12*

Narrative Review of Sustainable Vegetable Production Using Efficiency and Environmental Sustainability Approaches

Hansley Richie, Haneen Basori, Niken Estri Rahmawati, Betania Klarita Barimbing, Nurhayati*

Universitas Prasetiya Mulya

*Correspondence: Nurhayati
Email: nurhayati@prasetiyamulya.ac.id

Received: 28-12-2025
Accepted: 28-01-2026
Published: 28-02-2026

Abstract: This study aims to analyze the implementation of Sustainability Principle 2 in vegetable production systems by synthesizing recent scientific literature. The review focus on resource-efficient and beneficial agricultural practices that support sustainable vegetable cultivation. A literature narrative review method was used to analyze studies published between 2016 and 2026 on vegetable production practices aligned with Sustainability Principle 2. The analysis synthesizes findings across key themes, including soil health and fertility, water and nitrogen use efficiency, chemical inputs, energy use, and sustainable cultivation practices such as crop rotation, agroforestry, and the adoption of green technologies. The findings imply that traditional vegetable production methods frequently rely heavily on the use of energy, water, fertilizer, and pesticides. Environmental problems like greenhouse gas emissions, nutrient losses, soil degradation, and water pollution can result from this reliance. Nonetheless, a number of different strategies show encouraging promises for enhancing sustainability. For instance, it has been demonstrated that organic farming practices enhance soil quality and boost soil carbon sequestration. Furthermore, hydroponic systems enable more accurate control over the use of nutrients and water. Additionally, decrease reliance on synthetic agrochemicals while preserving production efficiency can be achieved by applying ecological technologies and improving input management techniques.

Keywords: Sustainable Vegetable Farming, Organic Vegetable Farming, Environmental Impact of Vegetable Farming, Sustainable Horticulture Practices, Water and Nitrogen Efficiency, Environmental Impact Assessment

Introduction

Fundamentally, the environment serves as the primary support system for human life, as the relationship between humans and the environment is inseparable, with humans relying on natural resources to meet their various needs (Aufa, 2021). One of the most direct forms of this interaction is agricultural production, particularly vegetable farming, which depends heavily on environmental resources. Vegetable farming is an important sector for food security because it produces nutrient-rich commodities needed by society (Sree et al, 2025). Vegetable are also a major source of essential vitamins, minerals, and dietary fiber that support human health and nutrition (FAO, 2022). As global populations grow and dietary preferences shift toward healthier consumption patterns, the demand for vegetables has significantly increased. A study conducted by Hu et al. (2025) reports that the intensification of greenhouse-based vegetable farming has become increasingly important to meet this rising global demand. However, many of these intensified cultivation systems depend on the excessive use of water, fertilizers, and chemical inputs, which can severely damage ecosystems. Research by Valenzuela (2024) and Kashyap et al. (2023) highlights that overuse of nitrogen fertilizers in vegetable systems contributes to nutrient leaching, soil degradation, greenhouse gas emissions, and acidification of water bodies. This condition is contrary to the principles of sustainable agriculture, which emphasize environmentally friendly production and the efficient use of natural resources (Baldwin, 2015).

Several previous review studies have examined various aspects of sustainable vegetable production, particularly from the perspectives of organic practices, ecological intensification, and input substitution. For example, Shahrajabian et al. (2021) explored the role of biostimulants in reducing chemical dependency in vegetable crops, while Mazibuko et al. (2023) reviewed broader agroecological frameworks for sustainable horticulture. However, these studies have not systematically synthesized how diverse production practices can collectively support Sustainability Principle 2. In the context of sustainable food systems, this principle refers to agricultural production systems that actively benefit the environment through practices that reduce greenhouse gas emissions, conserve biodiversity, and minimize inefficiencies in resource use. In line with this, agricultural sustainability is understood as the application of sustainability principles within food production systems through a holistic approach to producing food, fiber, and other agricultural products while maintaining ecosystem balance, supporting social well-being, and ensuring long-term economic viability (Efendi et al, 2025). Previous reviews have also given limited attention to findings from tropical and subtropical regions such as Indonesia, where vegetable production systems operate under unique climatic, socio-economic, and infrastructural conditions. By explicitly focusing on resource efficiency and environmental performance, this review aims to clarify how Sustainability Principle 2 has or has not been implemented in practice and to identify opportunities for improvement based on empirical evidence.

Therefore, this study aims to analyze the implementation of Sustainability Principle 2 within vegetable production systems. It examines resource-efficient practices such as water and fertilizer conservation, crop rotation, agroforestry, and green technology adoption, and assesses their impact on soil health, water quality, biodiversity, and climate resilience. By identifying existing gaps and emerging opportunities, this review seeks to deepen the understanding of how vegetable production can be transformed to deliver environmental benefits while sustaining food quality and productivity.

Research Method

This study uses a narrative literature review method. Narrative reviews are commonly used to provide a comprehensive understanding of a research topic by summarizing and critically interpreting findings from multiple studies (Snyder, 2019). Literature searches were conducted using several major scientific databases, namely Google Scholar, ScienceDirect, and MDPI. The search used keywords related to sustainable vegetable production, including "sustainable vegetable farming," "organic vegetable farming," "environmental impact of vegetable farming," "sustainable horticultural practices," "water and nitrogen efficiency in vegetable production," and "environmental impact assessment in vegetable farming." The search was limited to publications from 2016 to 2026 to obtain the latest literature from the last decade. Inclusion criteria included scientific articles that focused on vegetable production in Indonesia and discussed aspects of agricultural sustainability, environmental impact, or environmentally friendly cultivation practices. Exclusion criteria included review articles, popular or non-scientific publications, studies that focused on commodities other than vegetables, and literature that was not relevant to the sustainability principles under review. All literature findings were summarized in a single table to facilitate analysis. A descriptive synthesis was then conducted by analyzing and interpreting findings related to sustainability principles. The results were then interpreted within the framework of Sustainability Principle 2 (agricultural production).

Result and Discussion

Overview of Principle 2

Principle 2 of food industry sustainability emphasizes agricultural production that has a positive impact on the environment, which can be achieved through the efficient use of natural resources, protecting the climate by reducing greenhouse gas emissions, protecting soil and water by reducing the use of chemicals, and maintaining healthy biodiversity (Baldwin, 2015). In vegetable production, environmental efficiency is an important aspect to consider. This is due to cultivation systems that tend to be intensive, especially the use of fertilizers and irrigation water, which can increase nitrous oxide (N2O) emissions, nitrogen loss through leaching, and soil quality degradation due to improper management. Previous studies have shown that greenhouse vegetable systems generally use excessive nitrogen fertilizers and irrigation inputs, leading to low nitrogen efficiency and substantial N2O emissions, nitrogen leaching, and soil degradation (Zhao et al, 2019). However, if fertilizer doses are reduced to optimal levels, this can reduce N2O emissions without negatively impacting crop yields. (Qasim et al, 2021).

Other studies have also shown that reducing nitrogen doses and efficient water use can lower N2O and CO2 emissions, while also reducing ammonia evaporation (Zhou et al, 2023). This research confirms that sustainable agriculture requires a coordinated input management strategy to maintain agricultural productivity while minimizing negative environmental impacts. These studies clarify that environmental efficiency efforts cannot be separated from input management, the application of integrated soil health practices, and appropriate emission mitigation strategies. With this approach, sustainable vegetable production systems can continue to produce good agronomic performance while maintaining ecosystem balance and sustainability.

Overview of Studies

This review found articles showing that sustainable vegetable production increasingly depends on the efficient use of natural resources, environmentally friendly technologies, and cultivation practices that support ecosystem health. Most studies emphasize the importance of production systems that balance productivity, economic viability, and environmental protection, especially in horticulture. The approaches analyzed include hydroponic systems, organic farming, production input optimization, and the application of modern technology in vegetable cultivation (Maisarah et al, 2023) (Khasyap et al, 2023) (Sardiana & Kusmiyarti, 2021) (Mariyono, 2020). These approaches show great potential in supporting more efficient and sustainable food production. A summary of the articles to be reviewed is presented in Table 1 below.

Table 1. Summary of Vegetable Production Sustainability Article

Author (Year)	Product	Method	Finding
Sahara et al. (2025)	Red onion *(Allium cepa L. var. aggregatum*)	Survey & analysis using Matrix of Cross Impact Multiplication Applied to a Classification (MICMAC)	This study reveals that the sustainability of shallot farming is influenced by 16 variables and is mainly determined by farmers' knowledge, culture, and weather, requiring adaptation through smart farming to maintain sustainability.
Khasyap et al. (2023)	>24 vegetable commodities	Survey & Life Cycle Assessment (LCA)	This study shows that the Lembang vegetable system has high emissions mainly due to excessive use of organic fertilizers (especially chicken manure), and that the most effective mitigation is to reduce the dose of organic fertilizers while maintaining or increasing yields.
Maisarah et al. (2023)	Hydroponic vegetables	Rapid Appraisal of Agricultural Knowledge System/Farming (RAP-Farm) & survey	This study found that hydroponic vegetable farming in Pekanbaru is quite sustainable with an index of 64.80) (the institutional dimension is highly sustainable, the social dimension is the lowest, and sustainability improvement is focused on training in hydroponic cultivation knowledge and key strategies in the form of implementation and supervision of hydroponic farming.
Gunadi et al. (2023)	Potato (*Solanum*	Field experiment	This study found that potato productivity in West Java, which is only around 16–17

Author (Year)	Product	Method	Finding
	tuberosum)		tons/ha, is greatly influenced by seed quality, while farmers apply excessive amounts of fertilizer, up to 400 kg N and 581 kg P_2O_5/ha, and spray fungicides up to 20–30 times per season with active ingredient doses per spray exceeding the recommended amount by more than six times and water volumes exceeding 500 L/ha. Therefore, improving seed quality, fertilizer efficiency, and leaf blight control are key to increasing yields while reducing environmental impacts.
Sardiana & Kusmiyarti. (2021)	White mustard greens (*Brassica rapa subsp. pekinensis*)	Field experiment	This study reveals that five years of organic farming improves soil quality to meet sustainability criteria and produces white mustard greens equivalent to conventional systems with lower inputs.
Sardiana (2021)	Carrot (*Daucus carota subsp. sativus*)	Farmer interview & Field experiment	This article finds that organic vegetable farming in Bali significantly increases soil carbon sequestration compared to conventional farming, with higher soil organic carbon and labile carbon fractions, increasing carbon storage by about 1.18 Mg C/ha/year, contributing to climate change mitigation, while also providing greater economic benefits for farmers through lower input costs and higher prices despite slightly lower yields.
Mariyono (2020)	Chili (*Capsicum annuum L.*)	Farmer survey & field experiment.	This journal found that applying ecological technologies in Indonesian agribusiness improves economic performance and environmental sustainability by increasing farmers' productivity and profits, reducing reliance on chemical inputs like pesticides and synthetic fertilizers, and minimizing environmental impacts, with success influenced by farmer capacity, adoption rates, agribusiness management, and supported by collaboration among government, extension agencies, farmer organizations, and the private sector.

Relevance of the article to Principle 2

Based on the summary of articles found in this review, it can be seen that currently, many vegetable farms in Indonesia are implementing various practices that demonstrate sustainable production. These studies show that sustainable vegetable production systems are not only oriented towards productivity, but also towards environmental protection and agricultural ecosystem stability (Kahsyap et al. 2023) (Sardiana & Kusmiyarti, 2021). Research on input use and emission reduction shows that excessive use of nitrogen fertilizers and chemicals can increase N2O emissions while reducing agronomic efficiency (Khasyap et al, 2023) (Gunadi et al, 2023). Adjusting fertilizer doses and applying more efficient fertilization techniques have been proven to reduce emissions without causing a decline in crop yields (Khasyap et al, 2023). These findings clearly support the principle of resource efficiency and climate change mitigation efforts. However, most of these studies still focus on one type of input and have not fully analyzed the comprehensive environmental impact, so that discussions on water quality and biodiversity are still relatively limited.

Research on organic farming systems and ecology-based approaches shows improvements in soil quality and increases in soil organic carbon reserves (Sardiana & Kusmiyarti, 2021) (Sardiana, 2021). In addition, the application of ecological technologies has also been shown to reduce dependence on synthetic chemical inputs (Mariyono, 2020). These findings are in line with soil and water protection efforts and contribute to the carbon sequestration process as part of climate protection strategies in accordance with principle 2. However, some of these studies have not measured biodiversity indicators, so the biodiversity aspect of principle 2 is not yet fully supported by comprehensive evidence.

Research on the use of technology-based systems in agriculture, such as hydroponics and smart farming, focuses more on optimizing the use of water and nutrients and applying precision management to promote sustainability (Maisarah et al, 2023) (Sahara et al, 2025). This approach is considered capable of increasing resource utilization efficiency and reducing the risk of environmental pollution. However, the methods used are still based on indices or mapping of influencing factors (Maisarah et al, 2023) (Sahara et al, 2025). Direct measurements of gas emissions and carbon footprints from energy use have not been widely conducted. Therefore, the real contribution of these systems to climate protection efforts has not yet been fully measured. Overall, the literature shows compliance with principle 2, particularly in terms of improving input efficiency and reducing dependence on chemicals. However, most of these studies still discuss only certain aspects of environmental sustainability. The integration of resource efficiency, emission reduction, soil and water protection, and biodiversity conservation into a comprehensive and integrated analytical framework has not been widely implemented.

Environmental Impact of Vegetable Production

Vegetable production has a significant impact, particularly in relation to the use of intensive agricultural inputs such as fertilizers, pesticides, water, and energy. Vegetable production systems are strongly associated with the nitrogen carbon energy nexus, in which inefficient nitrogen management and excessive energy use can substantially increase environmental pressures (He at al., 2024). Based on an analysis by Kahsyap et al. (2023), vegetable production in West Java shows a high environmental burden, mainly due to excessive fertilizer use. This impact includes soil and water pollution due to nutrient runoff and contributions to greenhouse gas emissions. The study also confirms that optimizing fertilizer doses is an important strategy for reducing the environmental footprint without sacrificing productivity. The environmental impact is also evident in intensive potato production systems. Gunadi et al. (2023) reported that the use of large amounts of nitrogen and phosphorus fertilizers, as well as the high frequency of fungicide spraying, increases the risk of soil and water pollution. The intensification of chemical inputs not only affects environmental quality but also increases pressure on agricultural ecosystems. Therefore, more precise fertilization and pest control efficiency are key factors in reducing the environmental impact of vegetable production. In this context, the adoption of enhanced-efficiency fertilizers can further support sustainable vegetable production by improving yields while reducing reactive nitrogen losses and minimizing environmental impacts (Pan et al, 2024).

Conversely, several alternative production systems show potential in reducing environmental impacts. A study by Masyarah et al. (2023) on hydroponic systems shows that more accurate nutrient control allows for reduced nutrient loss to the environment and improves water use efficiency. This system reduces the risk of pollution compared to conventional soil-based cultivation. Organic farming also contributes to improving environmental quality. Sardiana & Kusmiyarti (2021) found that organic farming systems have a lower environmental impact than conventional systems, especially in maintaining soil fertility. Further research by Sardiana (2021) shows that organic vegetable farming increases soil carbon sequestration, which plays a role in climate change mitigation and increases long-term carbon storage capacity. In addition to cultivation practices, the application of environmentally friendly technologies plays a role in reducing the impact of production. Mariyono (2020) shows that the adoption of ecological technologies in agribusiness management can reduce dependence on synthetic pesticides and increase input use efficiency. Meanwhile, Sahara et al. (2025) emphasize that environmental sustainability in vegetable production is greatly influenced by adaptation to environmental conditions and proper cultivation management. Overall, the literature shows that the environmental impact of vegetable production is greatly influenced by the intensity of input use and the production system applied. Conventional systems with high inputs tend to increase the risk of pollution and emissions, while approaches such as hydroponics, organic farming, and environmentally friendly technologies offer opportunities to reduce the environmental footprint. Comprehensive method-based evaluations such as LCA are important for understanding the overall environmental impact and supporting the development of more sustainable vegetable production systems.

The Role of Organic Farming and Environmentally Friendly Practices

Conventional vegetable production has been widely documented to exert substantial environmental pressure due to excessive input use. Kashyap et al. (2023) demonstrated that production systems encompassing more than 24 vegetable commodities in Java generate high emissions and contribute significantly to global warming and eutrophication, primarily as a consequence of the overapplication of organic and synthetic fertilizers. Comparable findings were reported by Gunadi et al. (2023) in potato cultivation, where excessive nitrogen fertilization and intensive pesticide use increased environmental burdens without proportional gains in productivity. These findings underscore that inefficient cultivation practices not only diminish resource-use efficiency but also degrade ecosystem quality and undermine long-term production sustainability. As an alternative, organic farming systems have been associated with improvements in soil quality and enhanced environmental performance. Sardiana and Kusmiyarti (2021) reported that organic white cabbage cultivation improved soil quality while maintaining yields comparable to conventional systems with lower input intensity, while similar enhancements in soil carbon content and carbon sequestration capacity were observed in organic carrot production systems (Sardiana, 2021). Nevertheless, the environmental effectiveness of organic systems is highly contingent upon land suitability.

On sloping terrain, organic practices remain susceptible to nutrient losses through erosion, which may offset their ecological benefits and increase fertilizer demand (Bashagaluke et al, 2018). Under these conditions, the presence of tree cover becomes a critical ecological factor in maintaining soil stability and regulating nutrient dynamics. George dan Santos (2025) emphasize that agroforestry systems reduce soil, water, and nutrient losses while enhancing ecosystem services, whereas croplands characterized by 0% tree cover do not benefit from such ecological synergies and are consequently more vulnerable to resource depletion and ecosystem degradation. Therefore, the implementation of organic vegetable cultivation on sloping land should be integrated with adequate tree cover to mitigate surface runoff and preserve fertile topsoil (Nurmi et al, 2025), and vegetable production on sloping areas without such vegetative protection is environmentally inadvisable.

Beyond conventional and organic systems, hydroponic cultivation is also regarded as a relatively sustainable alternative. Meta-analysis studies indicate that hydroponic systems can achieve higher vegetable productivity while improving resource use efficiency compared to conventional soil-based cultivation (Goh et al, 2023). Maisarah et al. (2023) reported that vegetable hydroponic systems exhibit a moderate level of sustainability, although they remain highly dependent on electrical energy. This finding suggests that production system sustainability is determined not only by cultivation methods, but also by the efficiency of supporting resource use. Economic and management factors likewise play a crucial role in the sustainability of environmentally friendly agriculture. Sahara et al. (2025) showed that the sustainability of shallot farming is strongly influenced by farmers' knowledge, cultural practices, and environmental conditions, indicating that environmentally friendly practices must be supported by adaptive management strategies.

Furthermore, the application of environmentally friendly technologies in chili cultivation has been shown to enhance production efficiency while reducing environmental impacts (Mariyono, 2020). Taken together, the sustainability of vegetable cultivation systems cannot be achieved solely by replacing conventional systems with organic ones) (rather, it requires improvements in input efficiency, land suitability, erosion management, the adoption of environmentally friendly technologies, and effective farm management.

Conclusion

This narrative review shows that the implementation of Sustainability Principle 2 in vegetable production in Indonesia is increasingly evident through practices such as organic farming, hydroponic systems, input optimization, and environmentally friendly technologies. Conventional production systems that rely heavily on synthetic fertilizers, pesticides, and intensive resource use are associated with significant environmental impacts, including greenhouse gas emissions, nutrient pollution, and soil degradation. In contrast, sustainable approaches demonstrate potential to improve resource efficiency, enhance soil health, reduce chemical dependency, and lower environmental footprints while maintaining productivity. These findings indicate that achieving environmentally responsible vegetable production requires integrated strategies that combine efficient input management, technological innovation, farmer capacity building, and supportive policies. Strengthening sustainability assessment frameworks and expanding the adoption of eco-friendly practices are essential to support food security while minimizing environmental impacts. Further long-term and standardized research is needed to strengthen the evidence base and guide sustainable agricultural policy development. Future research should focus on conducting long-term field studies that compare conventional and sustainable vegetable production systems using standardized sustainability indicators, including environmental, economic, and social dimensions. In addition, practical efforts should emphasize farmer training programs, wider access to sustainable farming technologies, and stronger collaboration between researchers, policymakers, and agricultural practitioners to accelerate the adoption of environmentally responsible vegetable production practices.

References

Aufa, A. A. (2021). Prinsip sustainable development dalam penegakan hukum lingkungan. Staatsrecht: Jurnal Hukum Kenegaraan dan Politik Islam, 1(2).

Bashagaluke, J. B., Logah, V., Opoku, A., Sarkodie-Addo, J., & Quansah, C. (2018). Soil nutrient loss through erosion: Impact of different cropping systems and soil amendments in Ghana. PLoS One, 13(12), e0208250. https://doi.org/10.1371/journal.pone.0208250

Baldwin, C. J. (2015). The 10 principles of food industry sustainability

Efendi, E., Pratomo, B., Harahap, L. H., & Dewi, S. M. (2025). Keberlanjutan pertanian: Tantangan dan solusi. PT Media Penerbit Indonesia.

FAO. (2022). The State of Food and Agriculture 2022: Leveraging agricultural automation for transforming agrifood systems. Food and Agriculture Organization of the United Nations.

George, M. A., & Santos, M. J. (2025). Effects of tree cover and crop diversity on biodiversity and food security in tropical agricultural landscapes. Landscape Ecology, 40, Article 156. https://doi.org/10.1007/s10980-025-02167-0

Goh, Y. S., Hum, Y. C., Lee, Y. L., Lai, K. W., Yap, W. S., & Tee, Y. K. (2023). A meta-analysis: Food production and vegetable crop yields of hydroponics. Scientia Horticulturae, 321, 112339. https://doi.org/10.1016/j.scienta.2023.112339

Gunadi, N., & Pronk, A. (2023). Identifying key factors to improve productivity and reduce environmental impact of potato farms in West Java, Indonesia. In E3S Web of Conferences, Volume 373. EDP Sciences. https://doi.org/10.1051/e3sconf/202337304019

He, Y., Su, R., Wang, Y., Li, S., Huang, Q., Chen, X., ... & Yao, Z. (2024). Environmental impacts and nitrogen-carbon-energy nexus of vegetable production in subtropical plateau lake basins. Frontiers in Plant Science, 15, 1472978. https://doi.org/10.3389/fpls.2024.1472978

Hu, J., Wan, L., Wang, Y., Dai, K., Butterbach-Bahl, K., & Lin, S. (2025). The Decrease of Soil Microbial Community Diversity and Network Complexity Results in the Increase of Soil-Borne Diseases With Monocultural Years in Greenhouse Tomato Production Systems. Environmental Microbiology Reports, 17(4), e70165.

Kashyap, D., de Vries, M., Pronk, A., & Adiyoga, W. (2023). Environmental impact assessment of vegetable production in West Java, Indonesia. Science of The Total Environment, 864, 160999. https://doi.org/10.1016/j.scitotenv.2022.160999

Maisarah, N. P., Fariyanti, A., & Rosiana, N. (2023). Sustainability of vegetable hydroponic system in Pekanbaru City. Jurnal Manajemen & Agribisnis, 20(2), 214. https://doi.org/10.17358/jma.20.2.214

Mariyono J (2020), "Peningkatan kinerja ekonomi dan keberlangsungan manajemen agribisnis menggunakan teknologi ekologi di Indonesia". Jurnal Internasional Produktivitas dan Manajemen Kinerja , Vol. 69 No.5 hal. 989–1008, doi: https://doi.org/10.1108/IJPPM-01-2019-0036

Mazibuko, D. M., Gono, H., Maskey, S., Okazawa, H., Fiwa, L., Kikuno, H., & Sato, T. (2023). The sustainable niche for vegetable production within the contentious sustainable agriculture discourse: barriers, opportunities and future approaches. Sustainability, 15(6), 4747.

Nurmi, N., Nurdin, N., Rahman, R., Bahi, I. V., & Dai, D. N. (2025). Kegiatan reboisasi pada lahan miring untuk menurunkan laju erosi dan sedimentasi. Jurnal Pengabdian Masyarakat Teknologi Pertanian, 4(1), 36–41.

Pan, Z., He, P., Fan, D., Jiang, R., Song, D., Song, L., ... & He, W. (2024). Global impact of enhanced-efficiency fertilizers on vegetable productivity and reactive nitrogen losses. Science of The Total Environment, 926, 172016. https://doi.org/10.1016/j.scitotenv.2024.172016

Sahara, D., Yaumidin, U. K., Suhendrata, T., Setiani, C., Beti, J. A., Dewi, T., Fadwiwati, A. Y., Idaryani, Atman, Yardha, E. W., Asnawi, R., & Syam, A. (2025). Sustainability of shallot farming system in lowland Central Java Province, Indonesia: MICMAC analysis approach. Environmental Challenges, 20, 101212. https://doi.org/10.1016/j.envc.2025.101212

Sardiana, I. K. (2021). Organic vegetable farming system enhancing soil carbon sequestration in Bali, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 724, No. 1, p. 012025). IOP Publishing.

Sardiana, I. K., & Kusmiyarti, T. B. (2021). Sustainability performance of organic farming at vegetable fields in Tabanan, Bali, Indonesia. SAINS TANAH – Journal of Soil Science and Agroclimatology, 18(1), 7–14. https://doi.org/10.20961/stjssa.v18i1.45482

Shahrajabian, M. H., Chaski, C., Polyzos, N., Tzortzakis, N., & Petropoulos, S. A. (2021). Sustainable agriculture systems in vegetable production using chitin and chitosan as plant biostimulants. Biomolecules, 11(6), 819.
Sree, K. B., Sathish, R., Arunbabu, T., Rajesh, K., & Kumar, M. S. Exploring sustainable practices in vegetable farming. development, 6, 7.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of business research, 104, 333-339. https://doi.org/10.1016/j.jbusres.2019.07.039

Qasim, W., Xia, L., Lin, S., Wan, L., Zhao, Y., & Butterbach-Bahl, K. (2021). Global greenhouse vegetable production systems are hotspots of soil N_2O emissions and nitrogen leaching: A meta-analysis. Environmental Pollution, 272, 116372. https://doi.org/10.1016/j.envpol.2020.116372

Valenzuela, H. (2024). Optimizing the nitrogen use efficiency in vegetable crops. Nitrogen, 5(1), 106-143.

Zhou, P., Bai, X., Wang, H., Yang, M., Bao, L., Deng, X., Chen, Z., & Zhou, J. (2023). Optimizing nitrogen and water management for sustainable greenhouse vegetable production with less greenhouse gas emissions. Agriculture, Ecosystems & Environment, 352, 108529. https://doi.org/10.1016/j.agee.2023.108529

Zhao, H., Li, X., & Jiang, Y. (2019). Response of nitrogen losses to excessive nitrogen fertilizer application in intensive greenhouse vegetable production. Sustainability, 11(6), 1513. https://doi.org/10.3390/su11061513