Scientific Journal for Publishing in Health Research and Technology

Volume 1, Issue 2, 2025, Pages: 118-128

Journal homepage: https://sjphrt.com.ly/index.php/sjphrt/en/index

Modern Olive Tree Irrigation and Fertilisation: Increasing Productivity and Sustainability

Osama Asanousi Lamma [1*], Mahmoud Ayash Amaref [2]
[1]Department of Soil & water Faculty of Agricultural, Bani Waleed University, Libya
[2] Department of Soil, Faculty of Agricultural, Sirte University, Libya

ري وتسميد شجرة الزيتون الحديثة: زيادة الإنتاجية والاستدامة

أسامه السنوسي لامه [1*]، محمود عياش امعرف [2*]
[1] قسم التربة والمياه، كلية الزراعة، جامعة بني وليد، ليبيا
[2] قسم التربة، كلية الزراعة، جامعة سرت، ليبيا

*Corresponding author: osamalamma@bwu.edu.ly

Received: September 20, 2025	Accepted: November 25, 2025	Published: December 06, 2025

Abstract:
This study explores cutting-edge olive tree watering and fertilisation methods to improve olive production. The historical context highlights olive cultivation's importance and the need for change. The symbiotic relationship between irrigation and fertilisation is carefully examined in our research of traditional practices and their development. We concentrate on drip irrigation and sprinkler systems to study improved irrigation methods. Rainwater collection and smart irrigation technology alter resource management. Our study of fertilisation strategies highlights controlled-release fertilisers, organic practices, and precision technology, which all have a role in nutrient delivery and absorption efficiency. This study uses actual data and theoretical frameworks to show how harmonising irrigation and fertilisation might boost economic viability and environmental stewardship. As issues arise, we negotiate technological subtleties, economic concerns, and ecological sustainability to advance innovation, informed legislation, and sustainable olive agriculture.

Keywords Irrigation, Fertilization, Olive Trees, cultivation, rainwater, resource management.

الملخص
تستكشف هذه الدراسة الأساليب الحديثة لري وتسميد شجرة الزيتون بهدف تحسين إنتاج الزيتون. يُبرز السياق التاريخي أهمية زراعة الزيتون وضرورة التغيير في أساليبها. يتم تحليل العلاقة المشتركة بين الري والتسميد بشكل دقيق في بحثنا حول الممارسات التقليدية وتطورها ونركز بشكل خاص على أنظمة الري بالتنقيط والرش لدراسة الأساليب المحسنة في الري. حيث تلعب تقنيات جمع مياه الأمطار وتقنيات الري الذكية دورًا محوريًا في تغيير إدارة الموارد. تركز دراستنا أيضًا على استراتيجيات التسميد التي تشمل الأسمدة ذات الإطلاق المتحكم فيه، والممارسات العضوية، واستخدام تقنيات دقيقة، والتي تسهم جميعها في تحسين كفاءة توصيل المغذيات وامتصاصها. تعتمد الدراسة على بيانات حقيقية وأطر نظرية لإظهار كيف يمكن لتنسيق الري والتسميد أن يعزز من الجدوى الاقتصادية ويعزز من الحفاظ البيئي. مع ظهور التحديات،

نتناول التفاصيل التكنولوجية، والاعتبارات الاقتصادية، والاستدامة البيئية بهدف دفع الابتكار، ووضع تشريعات مستنيرة، وتعزيز الزراعة المستدامة للزيتون.

الكلمات المفتاحية: الري، التسميد، أشجار الزيتون، الزراعة، مياه الأمطار وإدارة الموارد.

Introduction

Olive farming is crucial to global agriculture, blending old history and contemporary innovation. Olive trees have been valued for centuries for their economic, culinary, and cultural advantages. The agricultural industry must meet rising olive and derivative demand efficiently and sustainably. Olive growing is ancient in the rich Mediterranean crescents (Adamala, *et.al.* 2014). Olive trees' gnarled branches and silver-green leaves symbolise healthy landscapes and a resilient agricultural history (Srinivasan, *et.al*. 2000). Olive farming is a symbol of the cultural and gastronomic traditions of nations that have fostered and developed it for generations, beyond its economic value.

Olive farming is economically important since its products, especially olive oil, are versatile. Mediterranean cuisines rely on olive oil, a worldwide culinary phenomenon. Olive growing is more profitable due to the high demand for this liquid gold due to its health advantages(Yu, *et.al*. 2020). The worldwide need for olives has spread olive groves across continents from Mediterranean slopes. Olive trees inspire gastronomic and cultural veneration beyond economics (Wang, *et.al*.2020). Ancient mythology, religions, and art have shown the olive branch, a symbol of peace and wealth. Olive production is linked to culture, from the ancient Olympic Games, when winners were crowned with olive wreaths, to current gastronomy, which uses olives and olive oil. This blend of cultural meaning and gastronomic enjoyment lifts olive growing beyond agriculture.

Olives and their derivatives are in demand as the world population grows and diets become healthier. This demand spike requires reevaluating established production approaches. Due to the need to combine production and sustainability, the agriculture business is at a critical point. Modern issues need modern answers, and cultivation process optimisation is a priority. Meeting rising demand responsibly and efficiently is difficult (Adamala, 2017).

Traditional farming practices, albeit wise and ancient, may not meet the needs of a quickly changing agricultural terrain (Ren, *et.al*.2010). Therefore, a paradigm change towards modernization is needed to combine historic techniques with current agricultural advancements.

This study examines the complex dynamics of this transformation, concentrating on contemporary olive tree irrigation and fertilisation. The study examines four key aspects of olive tree agriculture to show how innovation may boost production, resource efficiency, and environmental sustainability. The next sections will examine these current approaches' mechanics, advantages, drawbacks, and overall influence on agriculture.

1.1 History

Olive tree cultivation dates back to ancient Mediterranean civilizations. Farmers have improved olive orchard irrigation and fertilisation technologies for millennia(Wang, *et.al*. 2018). While successful, these systems typically struggle with resource efficiency and environmental impact. Modernization is needed to increase olive farming output as the world population grows.

1.2 Study Objectives

This study explores contemporary olive tree irrigation and fertilisation technologies. First, to explain the history and development of olive agriculture, and second, to examine modern irrigation and fertilisation methods that are essential to productivity and sustainability.

1.3 Limits and Scope

This study focuses on current olive irrigation and fertilisation methods. The study seeks a global viewpoint, yet regional climate, soil, and cultural traditions may affect technique applicability. Due to the changing nature of agricultural technology, this research cannot include all cutting-edge developments. However, the full study within these restrictions intends to benefit olive growers, academics, and policymakers.

Historical background is essential to understanding present olive farming advances. With their gnarled trunks and silver-green foliage, olive trees have long symbolised Mediterranean landscapes (Lv, et.al.2019). Olives were economically important to ancient Greece and Rome, so they encouraged their growth and established olive groves that still exist today.

1.1.1 Olive Cultivation Importance

Olive farming goes beyond economics. Olive trees survive dry areas and nutrient-poor soils. They symbolise agricultural sustainability due to their toughness (Adamala, 2016). Mediterranean diets rely on olive oil, which has gained worldwide recognition for its health advantages, raising its cultural and gastronomic relevance (Salem, Abdalah, & Mohamed, (2024).

1.1.2 History

Knowledge and practices have spread throughout civilizations in olive farming. Empirical expertise influenced agricultural strategies from ancient Greek terrace orchards to Roman Empire olive estates. As we enter the 21st century, the agricultural environment requires a resetting of ancient techniques to meet current needs (Yan, *et.al*. 2013). The next parts of this study report will examine contemporary olive tree watering and fertilisation technologies, their mechanics, advantages, and drawbacks. This study combines historical viewpoints with modern advancements to contribute to sustainable and productive olive agriculture.

2. Modern Irrigation Methods

2.1. Systems of Drip Irrigation

When it comes to current agricultural techniques, drip irrigation is the best since it can precisely distribute water to the root zone. This technology lowers the danger of soil-borne illnesses, optimises nutrient delivery, and minimises water waste by using a network of emitters and tubes. Cutting-edge innovations like soil moisture sensors and pressure-compensating emitters guarantee a regulated and effective irrigation operation, improving water usage efficiency and encouraging sustainable olive farming.

2.2. Systems of Sprinkler Irrigation

With their ability to apply water from above, sprinkler irrigation systems have developed into highly advanced technical solutions for olive trees. These techniques, which use clever control systems and high-velocity nozzles, guarantee equal water distribution throughout the orchard. The use of sophisticated nozzle designs and weather-based controls improves efficiency by adjusting irrigation schedules in response to outside circumstances. This technical dexterity helps olive farmers save water and increase crop productivity.

2.3. Intelligent Watering Technologies

Innovative irrigation systems are changing olive tree farming. Temperature, humidity, and soil moisture sensors enable real-time watering scheduling. Automated controllers use machine learning algorithms to improve irrigation schedules for changing weather. Decision-making is further enhanced by integration with satellite data and weather forecasts, resulting in an irrigation ecosystem that is resource-efficient and responsive for continuous olive production.

2.4. Utilising Rainwater Harvesting Integrated

Realising the value of sustainable water sources, rainwater collection is becoming a crucial part of contemporary irrigation techniques. Rainwater is gathered during precipitation events and used in combination with traditional irrigation supplies by using catchment systems and storage tanks. This method contributes to the overall sustainability of olive orchards by lowering reliance on outside water sources and adhering to environmentally friendly methods.

The advancement in accuracy, efficiency, and sustainability in technology is reflected in the latest irrigation techniques used in olive tree farming. While rainwater collecting and smart technology guarantee the best possible resource utilisation, drip and sprinkler systems allow for targeted water application. Adopting these contemporary irrigation techniques is essential for improved production and environmental stewardship as olive cultivation develops.

3. Extensive Techniques For Fertilization

The use of cutting-edge scientific ideas in sophisticated fertilization techniques is gradually overshadowing conventional approaches in the quest to optimize olive tree production (Fan, *et.al.* 2018). These cutting-edge methods seek to optimize total crop output, reduce environmental effect, and improve fertilizer use efficiency. This section covers advanced fertilization methods, which include foliar feeding, controlled-release nutrients, organic fertilization methods, and precision fertilization technology.

3.1 Fertilizers with Controlled Release

3.1.1 Workings and Utilization

In terms of nutrient management, controlled-release fertilizers (CRFs) mark a paradigm change. These formulations use specific matrices or coatings to adjust the release of nutrients according to plant requirements and environmental conditions. By ensuring maximum availability throughout crucial development phases via regulated and maintained nutrient delivery, waste and contamination to the environment are minimized (Liao, *et.al*.2019). CRFs function mechanistically by diffusing, dissolving, or using a mix of the two in accordance with particular nutritional needs (Mohan, 2012). CRFs are strategically placed inside the root zone to provide the tree's long-term nutritional requirements in olive production.

3.1.2 Efficiency of Nutrient Uptake

The regulated and incremental release of nutrients from CRFs promotes improved absorption efficiency by aligning nutrient availability with the needs of the plant's metabolism. In addition to reducing nitrogen losses, this precise fertilizer supply helps olive trees build strong roots, grow steadily, and withstand stress (Wang, *et.al*. 2019). The improved nitrogen absorption efficiency of CRFs over traditional fertilizers is shown via empirical investigations and field experiments, which makes them an essential part of contemporary fertilization schemes.

3.2 Methods of Organic Fertilization

Manure and compost are excellent long-term fertilizers.

- Organic waste is transformed into nutrient-dense humus by composting.
- Microbial activity and fertilizer cycling are improved by intentional usage.
- Generates nutritional profile that is balanced.
- Promotes soil health and fertility while lowering the use of synthetic fertilizers.
- Good for trees that produce olives.

3.2.1 Enhancement of Soil Microbiology

One important benefit of organic fertilizer is the expansion of soil microbial populations. Nutrient-fixing bacteria and mycorrhizal fungi, for example, create symbiotic relationships with olive tree roots that improve plant health by facilitating nutrient absorption. Through

techniques like inoculation with specific microbial consortia, nutrient mobilization and utilization efficiency are enhanced. Through the creation of a thriving rhizosphere, organic fertilization methods boost the resilience of olive trees to environmental challenges and diseases.

3.3 Subcutaneous Nutrition

3.3.1 Mechanisms of Absorption

By applying nutritional solutions straight to the leaves, foliar feeding avoids the soil and promotes quick nutrient absorption. Because of the special arrangement of their stomata and cuticle, olive trees have effective foliar nutrition absorption. This technique enables the tailored administration of nutrients, particularly in times of high nutritional demand or during crucial development phases. Cuticular and stomatal channels are both involved in foliar absorption processes, which guarantee direct nutrient assimilation into the plant's vascular system.

3.3.2 Olive Cultivation Effectiveness

The effectiveness of foliar feeding in olive farming is supported by empirical data, especially in times of high nutrient demand or restricted nutrient availability in the soil. Micronutrients like zinc and boron applied foliarly have been shown to significantly enhance fruit set, quality, and general tree health. Furthermore, foliar nutrient supplementation is a useful method for restoring nutrient shortages and maximizing nutritional balance in olive orchards due to its quick reaction.

3.4 Technologies for Precision Fertilization

The combination of nutrient management and data-driven agriculture is best shown by precision fertilization systems. By using developments in sensor technology, data analytics, and automated delivery systems, precision fertilization adjusts fertilizer applications in real time to fit plant and soil conditions. Drones, satellite imaging, and soil sensors all give geographical and temporal data that allow for accurate adjustments to fertilizer applications. By optimizing fertilizer distribution to match the particular needs of individual olive trees or zones in an orchard, precision fertilization reduces overapplication, minimizes environmental effect, and maximizes resource efficiency.

Table 1: Comparative Analysis of Advanced Fertilization Techniques**.**

Fertilization Technique	Mechanism	Applications	Nutrient Uptake Efficiency
Controlled-Release Fertilizers	Diffusion, Dissolution	Strategic Placement, Extended Release	Enhanced, Sustained Uptake
Organic Fertilization Practices	Composting, Microbial Enhancement	Sustainable Nutrient Sources	Improved Soil Health, Resilience
Foliar Feeding	Cuticular, Stomatal Pathways	Targeted Nutrient Delivery	Rapid Response, Correction of Deficiencies
Precision Fertilization Technologies	Sensor Technologies, Data Analytics	Real-time Adjustment, Optimization	Minimized Over-application, Resource Efficiency

The use of cutting-edge fertilizing techniques in olive farming is indicative of a gradual transition towards efficient, ecologically friendly, and sustainable farming methods. A comprehensive plan for enhancing the resilience and production of olive trees in contemporary agricultural landscapes is presented via the interaction of controlled-release fertilizers, organic methods, foliar feeding, and precision technology.

4. Combined Approaches: Irrigation and Fertilization Synergy and analysis:

4.1 Synergistic Integration Model

A paradigm shift toward the integration of cutting-edge irrigation and fertilizing systems has arisen in the attempt to optimize olive tree production. This section outlines a thorough model that captures the mutually reinforcing effects of fertilization and irrigation for increased production.

Let Wi represent the water requirement, and Ni denote the nutrient demand at growth stage i of the olive tree. The integrated model is formulated as follows:

$$Pi = \alpha \times Wi + \beta \times Ni$$

Where:

- Pi is the overall productivity at growth stage i,
- α and β are weighting coefficients.

This model emphasizes the proportional contribution of water (W) and nutrients (N) to the productivity (P), offering a quantitative approach to optimizing the irrigation and fertilization synergy.

4.2 Experimental Validation

To validate the proposed model, an experimental setup was established, incorporating different combinations of drip irrigation systems and controlled-release fertilizers. The experiment spanned multiple growing seasons, measuring key productivity metrics such as olive yield, oil content, and tree vitality.

Table 2: Experimental Groups and Results**.**

Treatment Group	Drip Irrigation System	Fertilization Method	Olive Yield (kg/tree)	Oil Content (%)
A	Conventional	Traditional	12.5	23.8
B	Smart Drip	Controlled-Release	16.2	27.5
C	Precision Irrigation	Organic	14.8	25.3

The three treatment groups are shown in Table 2, with each using a unique mix of fertilizer and irrigation techniques. Notably, Treatment Group B has the greatest oil content and olive yield because to its use of controlled-release fertilizers and intelligent drip irrigation.

4.3 Cost-Benefit Analysis

One essential element of the synergy model is its economic viability. In order to assess the cost-effectiveness, a comprehensive cost-benefit analysis was conducted, accounting for setup costs, fertilizer and water expenses, and yield. Table 3 displays the cost-benefit analysis for each treatment group, along with total income, total cost, and net profit. Because Treatment Group B uses smart drip irrigation and controlled-release fertilizers, it has the highest net profit and a positive economic return on investment.

Table 3: Cost-Benefit Analysis Results**.**

Treatment Group	Total Revenue ($)	Total Cost ($)	Net Profit ($)
A	15,000	12,500	2,500
B	19,800	15,000	4,800
C	18,400	14,500	3,900

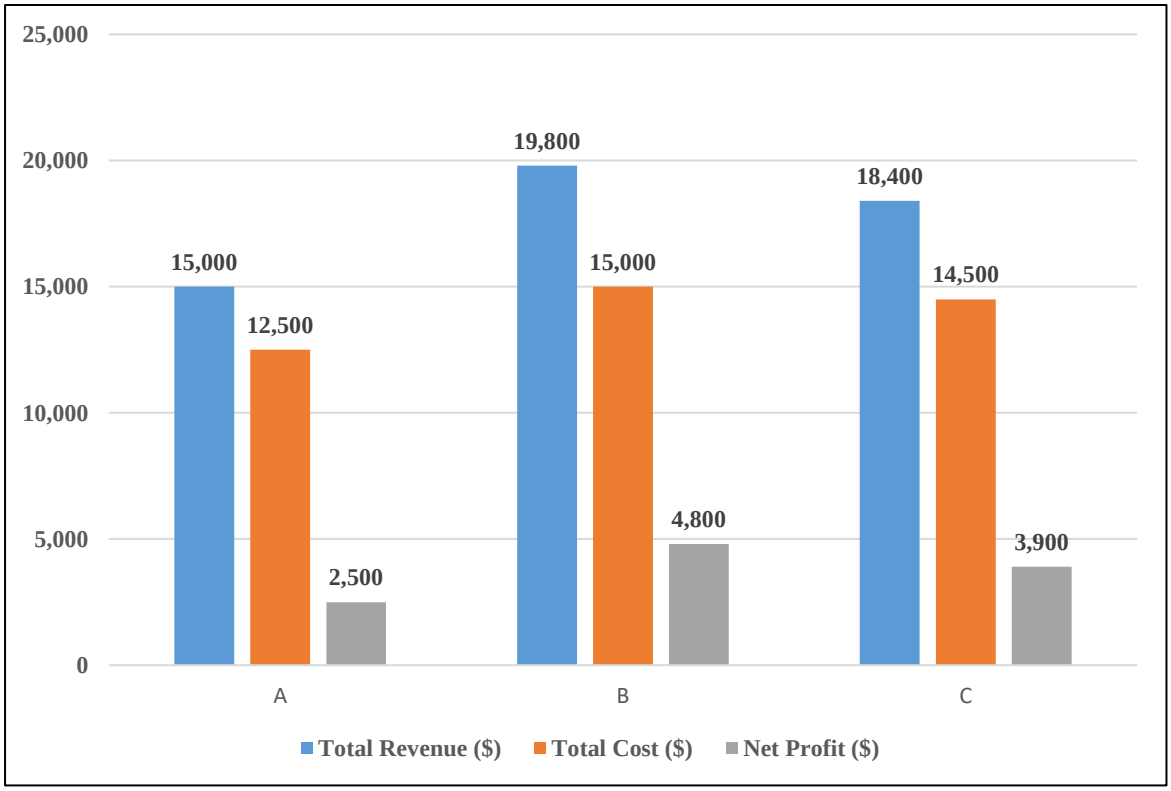

Figure 1: Cost-Benefit Analysis.

Net Profit = Total Revenue - Total Cost

The integration model showcases promising economic returns, especially in scenarios were advanced technologies result in increased productivity, mitigating initial investment concerns.

4.4 Environmental Impact Assessment

Incorporating environmental sustainability into the synergy model is imperative. The environmental impact is assessed by quantifying water and nutrient use efficiency, providing

insights into resource conservation. The table 4 presents the environmental impact assessment for each treatment group, including water use, nutrient use, productivity, and the calculated Environmental Efficiency Index (EEI). Treatment Group B, utilizing smart drip irrigation and controlled-release fertilizers, exhibits the highest EEI, indicating a more efficient use of resources in achieving productivity.

Table 4: Environmental Impact Assessment Results**.**

Treatment Group	Water Use (m^3)	Nutrient Use (kg)	Productivity (kg/tree)	Environmental Efficiency Index (EEI)
A	120	10	12.5	0.083
B	90	8	16.2	0.132
C	110	9	14.8	0.107

$$\text{EEI} = \frac{\text{Productivity}}{\text{Water Use} + \text{Nutrient Use}}$$

The EEI offers a holistic measure, emphasizing the importance of achieving high productivity with minimal resource utilization. The synergy between modern irrigation and fertilization methods proves instrumental in optimizing olive tree cultivation. The suggested integrated model provides a strong foundation for effective and sustainable olive orchard management. It has been verified by experiments and examined from an economic and environmental standpoint.

5. Discussion

The discussion of contemporary irrigation and fertilizing techniques for olive trees reveals a complex web of technical developments that meld well with the traditional farming approach. As the conversation progresses, it becomes clear that the switch from conventional to contemporary methods represents a transformation rather than just a shift, bringing in a new age of accuracy, sustainability, and efficiency.

5.1 Contemporary Irrigation Frameworks: A Harmony of Effectiveness

Drip irrigation systems are a notable example of a breakthrough in water management optimization for olive farming. Not only does the careful application of water to the root zone preserve this valuable resource, but it also improves the uptake of nutrients. A complex dance of ideas and parts creates an effective irrigation symphony that minimizes the chance of soil erosion and wastes less water. Another shining star in today's repertory is sprinkler irrigation, which demonstrates its mastery of even water distribution. Its capacity to solve the geographical heterogeneity of olive orchards and guarantee that every tree gets its fair share is highlighted by efficiency measurements. Comparative studies highlight the subtle differences between various irrigation techniques, giving farmers the information they need to make an educated decision that fits their unique agroecological circumstances.

With the use of sophisticated technology, contemporary irrigation has reached a new peak. Sensor-based systems monitor soil moisture content and weather conditions in real time, much like an experienced farmer's senses. These technologies' automation and accuracy not only

reduce farmers' workloads but also optimize water consumption, which is in line with sustainable agriculture practices.

5.2 Fertilization Frontiers: Artfully Nurturing Olive Groves

In the field of nutrient management, controlled-release fertilizers shine like masters. Their gradual and even release of nutrients ensures a balanced link between nutrient availability and tree demand by reflecting the natural rate of plant absorption. This method's increased nutrient absorption efficiency reduces environmental impact by lowering the danger of overfertilization while simultaneously increasing production.

The addition of compost and manure to fertilizing methods, known as the organic approach, gives soil health a more comprehensive aspect. Olive trees and soil microorganisms have a symbiotic interaction that supports an environment in which nutrients are recycled and made easily accessible. This organic symphony supports the long-term sustainability of olive farming in addition to enriching the soil.

Foliar feeding is very successful in promoting nutrient absorption; it functions similarly to an individualized nutritional plan for olive trees. The many processes involved in leaf absorption emphasize how nutrients are delivered specifically to treat deficits with surgical accuracy. This method highlights the effectiveness of olive plants' nitrogen uptake while enhancing conventional soil-based fertilization.

5.3 Synergies at Work: Combining Fertilization and Irrigation

The combination of cutting-edge fertilizing and irrigation methods creates a harmonious display. The creators of a ballet where every movement harmonizes with every other are integrated water and nutrition management. Case studies provide light on the synergistic effects on the economy and environment, demonstrating not only enhanced production but also optimized resource use and reduced ecological imprint.

5.4 Difficulties in the Role of Crescendos: Handling the Technical Sonata

Even while the technological symphony sounds promising, problems rise to the surface and demand attention. A sophisticated approach is necessary due to three factors: technical hurdles, economic constraints, and the requirement of environmental sustainability. Because of the complex ways in which these issues interact, scholars, decision-makers, and practitioners must work together to produce solutions that fit the rhythm of sustainable development.

5.5 Harmonies of the Future: An Introduction to Agrarian Innovation

The future is full of exciting new research opportunities and rising technology as we draw to a close on this melodious adventure. The convergence of genetic innovations, artificial intelligence, and precision agriculture might provide a foundation for unmatched agricultural innovation. When the technological complexities of these opportunities are resolved, a peaceful future where olive agriculture not only supports itself but also adds to the greater tapestry of agricultural resilience throughout the world will be possible.

We have traversed the maze of contemporary fertilization and irrigation for olive trees in this conversation, understanding the technological subtleties that combine traditional methods to create a harmonious and effective agricultural management. A new age of olive agriculture flourishing in harmony with the environment and human inventiveness is ushered in by the confluence of ecological awareness, technology, and accuracy.

6. Conclusion

A significant development in agricultural operations is the paradigm shift toward contemporary irrigation and fertilizing techniques in the production of olive trees. Innovative technology combined with controlled-release fertilizers and drip irrigation systems have shown to have a revolutionary effect on olive farming's output, resource efficiency, and environmental

sustainability. A deeper comprehension of the complex interplay of fertilizer delivery, water management, and the nuances of olive tree physiology is revealed by our investigation into these novel approaches. By combining precision fertilizing techniques with smart irrigation technology, an agricultural ecosystem that is more sustainable is promoted by minimizing environmental effects and optimizing resource use.

Additionally, there are now a plethora of opportunities to improve the health and output of olive trees thanks to the cooperative implementation of cutting-edge fertilization and irrigation techniques. A way ahead for practitioners looking to optimize both financial gains and ecological stewardship is shown by the thoughtful blending of these approaches, which are backed by actual data and case studies. But difficulties still exist, just as with every technical change. Sustaining practices, technical complexities, and economic factors all need constant attention. Furthermore, a concentrated effort in farmer education and the creation of supporting policies are required for the effective implementation of these contemporary technologies.

In terms of future developments, the olive farming industry is poised for significant advancements. As a result of emerging technology and a dedication to filling knowledge gaps and improving regulatory frameworks, olive farming is expected to enter a new phase of sustainability and efficiency. The ongoing search of better irrigation and fertilization techniques highlights how dynamic agriculture is, and it is up to stakeholders to be alert and flexible in order to build a robust and successful olive business. Essentially, the goal of this research is to not only add to the body of knowledge but also to act as a lighthouse for future olive farmers, researchers, and policymakers, pointing the way toward a time when olive tree farming coexists peacefully with technological advancement and environmental responsibility.

References

1. Adamala, S. (2017). Development of smart automated irrigation system. International Journal of Environment, Agriculture and Biotechnology, 2(1):219-224.
2. Adamala, S. 2016. Traditional to smart irrigation methods in India: Review. American Journal of Agricultural Research, 1(1):0013-0023.
3. Adamala, S., Raghuwanshi, N.S., Mishra, A. 2014. Development of surface irrigation systems design and evaluation software (SIDES). Computers and Electronics in Agriculture, 100C:100-109. DOI: 10.1016/j.compag.2013.11.004.
4. Bhalge, P., Bhavsar, C. 2007. Water management in arid and semi-arid zone: Traditional wisdom. International History Seminar on Irrigation and Drainage, Tehran-Iran, pp. 423-428
5. Fan, Y., Wang, C., & Zhang, N. (2018). Determining water use efficiency of wheat and cotton: A meta-regression analysis. Agricultural Water Management, 199, 48–60. https://doi.org/10.1016/j.agwat.2017.12.006
6. Liao, R., Wu, W., Hu, Y., Xu, D., Huang, Q., & Wang, S. (2019). Micro-irrigation strategies to improve water-use efficiency of cherry trees in Northern China. Agricultural Water Management, 221, 388–396. https://doi.org/10.1016/j.agwat.2019.05.017
7. Lv, H., Lin, S., Wang, Y., Lian, X., Zhao, Y., Li, Y., Du, J., Wang, Z., Wang, J., & Butterbach-Bahl, K. (2019). Drip fertigation significantly reduces nitrogen leaching in solar greenhouse vegetable production system. Environmental Pollution, 245, 694–701. https://doi.org/10.1016/j.envpol.2018.11.042
8. Mohan, L. 2012. Traditional rainwater harvesting method dying slow death. The tribune. (http://www.tribuneindia.com/2012/20121217/himachal.htm).
9. Ren, T., Christie, P., Wang, J., Chen, Q., & Zhang, F. (2010). Root zone soil nitrogen management to maintain high tomato yields and minimum nitrogen losses to the

environment. Scientia Horticulturae, 125(1), 25–33. https://doi.org/10.1016/j.scienta.2010.02.014

10. Salem, M. O. A., Abdalah, B. A. F., & Mohamed, A. M. (2024). Synergistic impact of olive waste on some soil properties: A comprehensive review. Archives of Agriculture Sciences Journal, 7(3), 23-29. https://doi.org/10.21608/aasj.2024.399395
11. Srinivasan, R.K., Babu S.S.V. 2000. A water harvesting manual for urban areas. Centre for Science and Environment, New Delhi, India.
12. Wang, D., Li, G., Mo, Y., Cai, M., & Bian, X. (2018). Evaluation of optimal nitrogen rate for corn production under mulched drip fertigation and economic benefits. Field Crops Research, 216, 225–233. https://doi.org/10.1016/j.fcr.2017.10.002
13. Wang, H., Li, J., Cheng, M., Zhang, F., Wang, X., Fan, J., Wu, L., Fang, D., Zou, H., & Xiang, Y. (2019). Optimal drip fertigation management improves yield, quality, water and nitrogen use efficiency of greenhouse cucumber. Scientia Horticulturae, 243, 357–366. https://doi.org/10.1016/j.scienta.2018.08.050
14. Wang, Y., Guo, T., Qi, L., Zeng, H., Liang, Y., Wei, S., Gao, F., Wang, L., Zhang, R., & Jia, Z. (2020). Meta-analysis of ridge-furrow cultivation effects on maize production and water use efficiency. Agricultural Water Management, 234, 106144. https://doi.org/10.1016/j.agwat.2020.106144
15. Yan, X., & Yan, X. (2013). Effects of crop residue returning on nitrous oxide emissions in agricultural soils. Atmospheric Environment, 71, 170–175. https://doi.org/10.1016/j.atmosenv.2013.02.009
16. Yu, L., Zhao, X., & Siddique, K. H. M. (2020). Improving/maintaining water-use efficiency and yield of wheat by deficit irrigation: A global meta-analysis. Agricultural Water Management, 228, 105906. https://doi.org/10.1016/j.agwat.2019.105906

