Sustainable Agriculture through Efficient Leadership: A Comparative Analysis on Italy and Romania

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Abstract

This paper explores how efficacious leadership is vital in furthering enduring agriculture, pivoting upon a comparative assessment between Italy and Romania. The research integrates both quantitative as well as qualitative methodologies. It scrutinises indicators including ammonia emissions, pesticide usage, energy consumption within agriculture, organic farming development, and technological investments. Italy exhibits a deeply secured leadership hierarchy. It is additionally distinguished via strong regional governance coupled with prominent integration of digital as well as agroecological practices, alongside cohesive public policies. Conversely, Romania confronts institutional disaggregation, sluggish technological uptake, and infrastructural constraints yet presents auspicious advancements within organic agriculture and sustainable power. The study accentuates how forward-thinking and flexible governance, by means of leadership, can substantially shape the sustainability path of national farming systems if established upon innovation, collaboration, and considered progression. The findings underscore Italy's capacity for intimate alignment to EU Green Deal goals, whilst Romania requires further structural reformation, stakeholder coordination, and investment toward improving its leadership plus sustainable agriculture framework. Juxtaposing these approaches highlights that policies necessitate contextual awareness and that formal plus informal leadership structures within rural locales require enablement.

Keywords

Sustainable agriculture, efficient leadership, agricultural policies, Italy agriculture, Romania agriculture, comparative analysis.

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Introduction

Sustainable agriculture represent a structure of land management practices focused at meeting the current food and essential resources of the population without disregarding the needs of future generations. It is created around the principle of balance between environmental protection, economic stability, and helping agricultural communities (Sarkar et al.,2022).

The concept of sustainable agricultural production development encompasses four fundamental principles like persistence, resilience, autarchy, benevolence. Regarding the persistence, it is the ability to consistently deliver desired outputs on long periods, ensuring predictability. The resilience is about the ability to adapt, maintaining structural integrity without significant changes. The autarchy is the capacity to generate outputs using inputs and resources sourced within defined system limits. Benevolence refers to the capacity to produce preferred outputs while protecting ecosystem services and avoiding the reduction of environmental assets (Pretty, 2007).

Italy and Romania were selected for this analysis due to their particular agricultural contexts and diversity in land management practices and policy administration. Italy, a founding member of the European Union, has a established tradition in sustainable agriculture, while Romania, a more recent EU member, is in the process of developing its agricultural sector and applying sustainable methods. The fundamental purpose of this paper is to analyze how efficient leadership can sustain sustainable agriculture in each countries, analyzing indicators such as ammonia emissions, food waste and food waste prevention, agri-environmental indicator - consumption of pesticides and investments in sustainable agriculture.

1. Review of scientific literature

Ensuring the transition to sustainable agriculture requires effective leadership that promotes ecological practices, mobilizes farmers and communities, leverages local knowledge, and influences public policy. Leaders play a central role in integrating biological and ecological processes into agricultural production, replacing dependence on non-renewable resources with sustainable, accessible, and innovative solutions that contribute to increased productivity and long-term environmental protection (Pretty, 2007).

Westley et. al. (2018) argue that, instead of using the traditional concept of "leadership," the notion of institutional entrepreneurship is more appropriate – that is, individuals or networks of actors who initiate and support transformations in complex systems, not through command and control, but through strategic influence, resource mobilization, and the building of partnerships.

Effective leadership is contextual and phased. Transformational leaders need to adapt their strategies according to the phases of the adaptive cycle. Each stage requires different skills – from creating tensions within the system, to facilitating innovation, and finally to institutionalizing change (Westley et. al, 2018).

Leadership involves collaboration, communication, and building a shared vision. Sustainable transformations emerge through networks of actors who coordinate their efforts. Essential skills include: vision-building, facilitating social learning, network creation, conflict mediation, and leveraging emergent opportunities (Westley et. al, 2018).

In the context of efforts to transition towards more sustainable agriculture, the concept of leadership requires a re-evaluation beyond traditional hierarchical models. The information presented highlights two distinct, yet potentially complementary, forms of leadership among farmers. Firstly, it is observed informal leadership, manifested through the role of local farmers as principal agents of change within their communities, disseminating agroforestry knowledge and technologies. This form of influence, based on trust and local expertise, demonstrates an intrinsic capacity to generate change from the grassroots level. Secondly, participatory leadership emerges as essential in the process of technological development. By actively involving farmers in the design and adaptation of new technologies, the passive adoption model is overcome, and their practical knowledge is valued, significantly increasing the chances of sustainable and effective adoption. These examples suggest that strategies for promoting sustainable agriculture should recognize and leverage these existing forms of leadership among farmers, creating the necessary framework to amplify their impact (Meijer et al. 2014).

Darnhofer (2014) suggests that farmers are not merely passive subjects of change but active agents who exercise their capacity to make decisions and act to ensure the viability of their farms in uncertain environments. This ability to act strategically and influence the farm's trajectory can be interpreted as a form of leadership, even if not explicitly labeled as such. Therefore, farm resilience significantly depends on farmers' agency, strategic decision-making, and navigation of complex changes, indicating their active and leading role in managing their farms' future.

As Klerk and Rose (2020) sustain, leadership in the context of Agriculture 4.0 requires a balanced approach that integrates technological innovation with social responsibility and sustainability. Leaders must ensure that emerging technologies are implemented responsibly, considering their potential social, economic, and environmental impacts. They should foster inclusivity by supporting both high-tech and low-tech solutions and promote cross-sector collaboration to address food system challenges. Furthermore, a mission-oriented innovation policy is essential for guiding the transition towards more sustainable agricultural practices. Ultimately, effective leadership in Agriculture 4.0 must be adaptable, forward-thinking, and committed to creating a fair and resilient food system for all.

Supporting sustainable livelihoods in agriculture depends on Educational methodologies, adaptation, and repositioning. Knickel et al. (2018) argue that boosting transformational capacity by supporting co-learning represents one of two main strategies for promoting the fundamental systemic changes in agriculture and rural development. Learning, evolution and rebalancing are essential for maintaining livelihoods in the

agricultural environment, and effective leadership should facilitate these processes as part of the transition to more sustainable agricultural systems. Farmers will decisively have the responsibility for executing the policies and programs necessary for long-lasting development. It is important to incorporate their skills, expertise and ideas into current approaches, as well as grow their ability to become leaders in managing the challenges of sustainable development (Zamani and Karami, 2006).

In Romania, one of the most important institution that is involved in a sustainable agriculture is the Ministry of Agriculture and Rural Development (MADR). Regarding leadership in Romania, MADR implements and coordinates agricultural policies in the field of agriculture development and manages the use of European funds for the modernization of the agricultural sector. It also develops the legislative framework, elaborating and promoting normative acts and represents Romania's interests, participating in European and international negotiations on agricultural policies. Similarly, it implements support measures for agricultural producers and sustainable agricultural practices through digitalization with digital solutions to streamline administrative processes in agriculture. Moreover, this institution supports agricultural research via the transfer of knowledge to farmers. MADR, anyway, is confronted with challenges at the leadership level, like the frequency of management changes and impediments in ensuring long-term strategic continuity (MADR, 2021).

MADR (2021) has many institutions under its authority, each dealing with different dimensions of the agricultural sector. These include: the National Agency for Improvement and Reproduction in Zootechnics (ANARZ), the Agency for the Financing of Rural Investments (AFIR), the National Office for Vine and Wine Products (ONVPV), the National Institute for Research and Development in Biology and Zootechnics (ICDBZ), and the National Sanitary Veterinary and Food Safety Authority (ANSVSA). These institutions collaborate to develop national agricultural policies, manage European funds, and stimulate sustainable agriculture in Romania.

In the Ministry of Agriculture, Food Sovereignty and Forestry of Italy (MASAF), leadership plays an essential role in defining strategic direction and representing Italy's agricultural interests both nationally and internationally. The leadership role in MASAF is complex and multifaceted, including the coordination of rural development policies, the representation of Italy's priorities internationally, the promotion of Italian agri-food quality and the implementation of long-term development strategies. The current leadership has refocused the ministry towards the concept of food autonomy, highlighting the valorization of Italian agricultural practices and the competitive orientation of Italian products on international markets (MASAF, 2024). Moreover, CREA (Council for Agricultural Research and the Analysis of Agricultural Economics) is a leader in agricultural research and in developing creative solutions to strengthen the productivity of the agricultural sector in Italy. Institutional leadership here signify coordinating research across various sectors, such as bioeconomy, environmental protection, and sustainable development. Also, CREA shapes policies through its research, which engages a form of leadership in sustainable agriculture and technological improvements (CREA, n.d.).

2. Research methodology

This paper represents a comparative analysis of sustainable agriculture in Romania and Italy with a focus on the importance of leadership in managing sustainable agriculture. The two countries were chosen for the analysis because the article represents the result of research activities carried out within an Erasmus mobility at the Aldo Moro University of Bari. Italy. To achieve the research objectives, a quantitative analysis of statistical data on sustainable agriculture was conducted. A qualitative analysis of policies and initiatives in the two states for sustainable agriculture was also conducted.

3. Results and discussion

Ammonia emissions from agriculture are a major source of air pollution, driven by the use of fertilizers and the management of animal manure. In the period 2018-2022, Italy recorded average annual emissions of approximately 336.6 thousand tonnes, with a maximum in 2020 (356.2 thousand tonnes) and a minimum in 2022 (299.1 thousand tonnes), reflecting a total reduction of 12.9% compared to 2018. Romania had much lower average emissions, of approximately 139.9 thousand tonnes annually, with a slower decrease of only 5.9% over the same period.

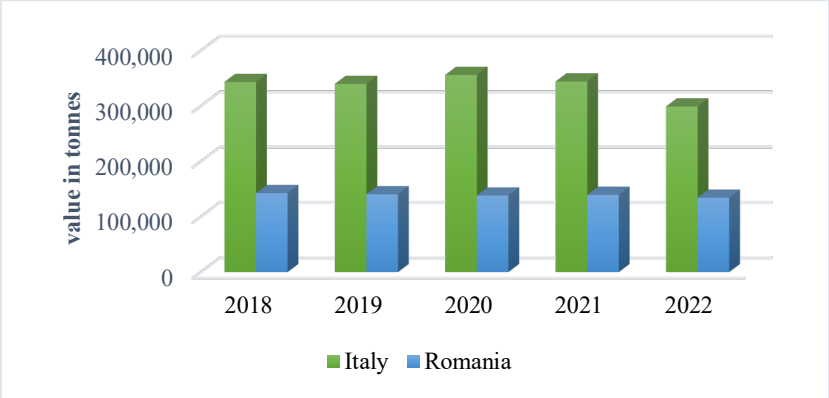

Figure no. 1. Comparative ammonia emissions from agriculture in Italy and Romania

Source: Eurostat, 2024. Ammonia emissions from agriculture

Italy has consistently emitted approximately 2.4 times more ammonia than Romania, a difference explained by the larger size of the agricultural sector and the intensity of production. At the same time, the faster pace of reduction in Italy suggests a more efficient implementation of environmental measures. Romania, although stable, indicates potential for improvement through sustainable agricultural technologies and policies.

Energy usage within the farming and forestry industries signals the resilience of agri-food schemes plus energy conservation across countryside locales. Examination of Italy and Romania throughout 2019–2023 uncovers substantial structural divergences as amongst them, and also some correspondences within the proportion of agrarian energy comparative to the national aggregation.

Regarding direct energy usage in agriculture and forestry, Italy's listed figures exceeded those of Romania by a meaningful amount. During the period of 2020-2022, Italy's agricultural sector utilised from 2.759 thousand to 2,986 thousand tonnes of oil equivalent (toe), with a minor reduction in 2022 from the apex of 2021. By contrast, agricultural consumption in Romania was approximately five times less. The consumption incremented to 555 thousand toes within 2022 from 531 thousand toe during 2020, which mirrors a rise of near 4.5%. The greater economic and technological scale of Italian agriculture plus its superior degree of mechanisation validate this quantitative distinction.

Across 2019-2023, Italy's aggregate national energy usage remained consistently superior to that of Romania, concomitantly. Italy's ultimate energy consumption in 2023 attained roughly 36.13 million units (likely MWh), a prominent quantity. In contrast, Romania used 21.99 million units during that annum. The variance in these figures comes to approximately 14 million units, implying Italy's national consumption exceeds Romania's by 64%. The medium-term tendency evinces a modest variation, though with no major structural alterations within either country. Throughout both instances, agriculture's fraction within energy usage has stayed quite constant. Eurostat data (Agri-environmental indicator - energy use, 2024) depict this sector consistently represented 2.6% from total consumption in Italy between 2020 as well as 2022. Within Romania, the sector fluctuated between 2.2% to 2.4%. These proportions hint at a like structural relevance for agriculture within both nations' energy design, though the specific values vary greatly. This might intimate the agricultural energy consumption pattern verges upon convergence. Notwithstanding the convergence, the scale exhibits palpable disparities.

Both Italy and Romania use agricultural energy, showing different quantitative patterns, although proportional to total national consumption. While maintaining a stable proportion overall, Italy is establishing a model of energy conservation in agriculture through a more industrialized agriculture, corroborated with increased consumption. In contrast, Romania shows a measured increase in agricultural consumption, as national consumption stagnates or somewhat decreases. This scenario presents opportunities for Romania to renew itself and move towards more energy-efficient agricultural practices. Pesticide sales indicate, like a measure, the degree agriculture uses chemical input, showing direct effects for the environment, human health and farming systems' sustainability. Data analysis shows key differences between Italy and Romania from 2019-2023 (Eurostat, 2024). These differences are apparent throughout evolutionary trends and throughout total quantities. Pesticide sales within Italy have consistently been high, peaking in 2020 when 56.3+ million kilograms of active substances were sold. In the following years, values gradually decreased to about 39.6 million kilograms in 2023. This marked a reduction overall of 29% from 2020. Organic farming or the use of precision technologies or measures for complying with EU

regulations on the sustainable use of pesticides may be reflected in this decrease toward agricultural practices that are more sustainable.

Comparatively, Romania did record much lower absolute values that ranged from 7.9 to 9.1 million kg on a yearly basis. Besides the gradual decrease between 2019 and 2022 peaking at 7.96 million kg in 2022, 2023 sharply increased it to 9.16 million kg which even exceeded the 2019 level. This reversed trend recently suggests farming strengthens possibly, or strategies reduce chemical input ineffectively. In comparison, Italy sold about 5-6 times more pesticides than Romania in each year of the period analyzed. However, the increase in Romania from 2023, in parallel with the clear decrease in Italy, may indicate a diverging direction in terms of agricultural policies and sustainability of applied practices (Eurostat, 2024. Sales of pesticides by type of pesticide)

In 2023, Italy clearly committed itself to sustainable agriculture and invested greatly in digitization. The Agriculture 4.0 market got to €2.5 billion, that is up 19%, because digital solutions were expanded for traceability and artificial intelligence plus the Internet of Things. However, only 9% of farms adopt green practices like carbon farming, applying them rarely. Romania, in contrast, has focused on the energy transition, plus this focus attracted over €500m investment in wind energy through the Pestera II project. This project does contribute to decarbonizing of the rural economy, even though it is not targeting agriculture so directly. Romania has not made obvious moves toward agricultural digitalization. Romania has not integrated smart technologies on farms either, just unlike Italy. Agricultural technology interests Italy for investment. In Romania, green infrastructure is the focus. For Romanian farms, the integration of digitization becomes important for both sustainable agriculture and complementary approaches.

Between 2019 to 2023, the area that farmers farmed organically in Italy along with Romania followed different trajectories regarding pace plus magnitude, which reflected distinct stages while they transitioned toward sustainable agricultural practices. Italy has borne witness to a steady increase within the area which is farmed organically, going from 1,993,225 hectares back in 2019 up to 2,455,586 hectares in 2023 since it increased by about 23% during five years. This development confirms Italy's leadership within Europe in organic farming, because sound public policies support it, its domestic market is mature, and its infrastructure for certification and distribution is well-developed.

Comparatively, Romania has experienced a faster growth pattern. A smaller base was the starting point though. The organic area grew from 395,228 hectares in 2019 up to 644,520 hectares in 2022. This registered an increase of about 63% in just three years. This expansion is explained by rising interest in sustainable practices and access to European subsidies, though 2023 data is missing. Romania lags behind Italy to a large extent in total organic area nevertheless, but this positive trend does suggest a potential for development. In comparison, Italy has a consolidated organic farming infrastructure so it covers almost four times as much organic cultivated land as Romania, and Romania clearly needs investment in certification plus processing and education.

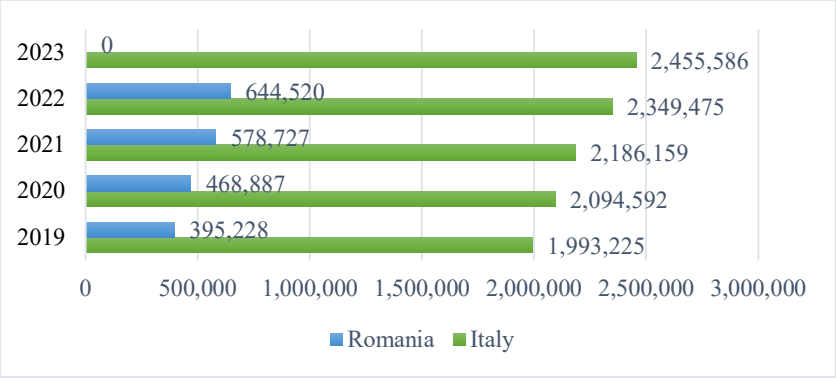

Figure no. 2. Total organic agricultural area

Source: Eurostat, 2024. Agricultural area under organic farming

According to the specialized literature, we identified a series of aspects regarding agriculture in the two states. Sustainable agriculture in Italy and Romania represents a detailed image consisting of disparate prospects and predicaments, as evinced by many investigations. The agricultural sector of Italy displays a distinct economic as well as environmental sustainability trade-off, especially within both livestock and cereal sectors, whilst horticulture reveals a synergy amid these dimensions (Arru et al., 2024). Italian agriculture evolved greatly between 2010 and 2020, whilst farm size, investment in innovation, plus sustainability correlate positively, despite regional disparities persisting (Altamore et al., 2024). A divide

between the north and south additionally confounds the sustainability of agriculture in Italy, with younger farm supervisors displaying a greater inclination to embrace sustainable practices (Gismondi, 2024). Conversely, Romania's agriculture faces predicaments such as fragmented landownership and antiquated infrastructure. This impedes its congruence with Sustainable Development Goals such as climate action and zero hunger (Nistoroiu, Nicolae and Condeianu, 2024). Despite encountering difficulties, Romania reduces unemployment, increases income, yet struggles with industrial innovation plus sustainable consumption (Puiu, 2024). Climate change additionally exerts large impacts upon the Romanian agricultural sector, and this therefore necessitates public-private partnerships for the reduction of methane emissions alongside the promotion of sustainable practices (Stoian et al., 2024). Ecologically sound agriculture represents a main focal point inside the wider European Union framework, in which those countries both participate. Nevertheless large spatial variation in sustainability metrics is displayed by them (Wyrwa, Barska and Jędrzejczak-Gas, 2024). Italy's agricultural sector profits from a more regimented approach to innovation as well as sustainability, however Romania's advancement is impeded by infrastructural plus systemic challenges, also this accentuates the requirement for focused policy interventions plus investments in both nations to achieve sustainable agricultural development (Buzoianu et al., 2024). These discoveries underscore the importance of approaches that are bespoke and contemplate geographical attributes. Furthermore, amalgamating technological innovations and policy increases agricultural sustainability throughout Europe (Zhang, 2024).

Sustainable agriculture has become a central pillar of the European Union's Common Agricultural Policy (CAP), emphasizing the transition towards agro-ecological practices, reducing environmental impacts and ensuring sustainable food security. In this context, Romania and Italy, two Member States with different agricultural structures, have adopted varied measures to implement European objectives, reflecting distinct levels of leadership and strategic coherence in governance (European Environment Agency, 2024).

In Romania, sustainable agriculture is in a phase of institutional consolidation. The measures supported by the National Strategic Plan 2023-2027 aim in particular at digitalizing farms, supporting organic farming and encouraging young farmers. However, the leadership on sustainability is often fragmented between different institutions (Ministry of Agriculture, Rural Investment Financing Agency - AFIR, local authorities), which creates difficulties in the coherent implementation of strategies. Agrienvironmental policies, such as compensatory payments for environmentally friendly practices or the protection of high biodiversity areas, are present, but do not yet reach a critical mass in terms of impact. Moreover, the lack of strategic leadership is reflected in the slow uptake of innovative tools such as precision farming or short supply chains, especially in remote rural areas.

In contrast, Italy stands out with a more integrated and advanced approach to sustainable agriculture. Leadership is more consolidated, especially at regional level, where government structures (such as the Emilia-Romagna or Tuscany Regions) have implemented coherent and well-funded agroecological policies. Italy has a strong tradition in organic farming, being one of the EU leaders in certified areas and number of producers. Public-private initiatives are also well developed and cooperation between research, administration and farmers is closer than in Romania. Platforms such as the Rete Rurale Nazionale or agricultural innovation networks provide systematic support for the adoption of green technologies and circular models in agriculture. Leadership in Italy is thus characterized by proactivity, social dialogue and effective decentralization.

In line with the European strategies "From Farm to Fork" and the "European Green Pact", Italy has demonstrated a superior capacity to translate the objectives into concrete policies, through regional agrobiodiversity programs, the promotion of local food and the reduction of pesticide use. Romania, although theoretically committed in the same directions, faces problems of administrative capacity and limited access of small farmers to information and training, which diminishes the potential for leadership in agro-ecological transformation.

Conclusions

The study highlights the critical importance of effective leadership in the transition towards sustainable agriculture, especially in the context of the current challenges of climate change, food security and sustainable resource use. The comparative analysis between Italy and Romania reveals two different models for the development and implementation of sustainable agriculture strategies, at distinct stages of institutional and technological maturity.

Italy is characterized by a well-established institutional framework, where leadership - at both national and regional level - is coherent, visionary and anchored in the European sustainable development objectives.

Agrarian policies are underpinned by consistent investment in research, digitalization and the promotion of organic farming. Regional programmes, public-private partnerships and innovation networks contribute to effective governance and mobilize farmers to adopt sustainable practices.

Instead, Romania faces a number of structural constraints, such as institutional fragmentation, frequent changes in political leadership, lack of strategic continuity and difficulties in accessing and implementing new agricultural technologies. However, progress in expanding the area under organic farming and in attracting investment in renewable energy points to significant potential for development. To realize this potential, it is imperative to strengthen administrative capacity, stimulate participatory rural leadership and promote education for sustainability.

However, the study also has a number of limitations, including the predominant use of aggregated data and public policy analyses without integrating the perspectives of direct stakeholders such as farmers or local leaders, or a more granular regional detail, especially for Romania. The lack of recent or complete data for all indicators also limits the complexity of the analysis. Future research could explore these dimensions, through qualitative studies, interviews and focus groups with farmers and decision-makers, as well as regional case studies, to better understand how leadership is manifested at the local level. Extending the comparative analysis to other EU Member States could also provide a broader perspective on the factors that determine the success of the transition to sustainable agriculture.

In conclusion, effective leadership - understood not only as institutional authority, but also as the ability to mobilize resources, knowledge and communities - is a key determinant of the success of sustainable agriculture. For Romania, the lessons learned from the Italian model can be valuable benchmarks in the formulation of coherent public policies adapted to the national context. At the same time, both countries need to continue efforts to align with European strategies such as 'From Farm to Consumer' and the 'European Ecological Pact', taking into account territorial specificities and the need for a just transition for all actors involved.

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