Eco-friendly Innovation, Market Access, and Digital Transformation: Exploring Barriers Faced by Central Rif Agri-Food Cooperatives

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***Abstract*— Digital transformation, eco-friendly innovation, and green marketing constitute key drivers of sustainable food systems, fostering economic growth, protecting the environment, and enhancing consumer satisfaction. However, despite their transformative potential, agri-food cooperatives continue to face significant constraints, particularly regarding market access and technological integration. This study seeks to investigate through a structured survey, the challenges faced by agri-food cooperatives in the Central Rif—specifically the province of Al Hoceima in Northern Morocco—with the aim of proposing innovative green solutions and strategic actions designed to strengthen cooperative development. Data were gathered from a representative sample of 50 agri-food cooperatives operating in the Central Rif, selected using a stratified systematic sampling method to ensure diversity in sectoral activity, cooperative size, geographic distribution, and level of market integration. Surveyed cooperatives reported that limited marketing skills, low digital literacy, inadequate infrastructure, insufficient clarity on quality certification procedures, and affordability issues impede their operational growth. In fact, findings show that only 12% of agri-food cooperatives in Central Rif, possess quality certification. Consequently, most cooperatives rely heavily on traditional markets to sell and promote their products, while 38% remain largely unaware or unfamiliar with digital tools, highlighting the persistent digital divide in the rural and marginalized areas of Al Hoceima province. Furthermore, the survey underscores the difficulties cooperatives face in developing new eco-friendly products. The need to innovate product lines, valorize local resources and upcycle waste and by-products emerged as a top priority, indicated by 90% of the cooperatives. Likewise, the study emphasizes how agrotourism, combined with digital transformation, eco-friendly innovation, and sustainable strategies, can promote local products and enhance their visibility. Indeed, targeted training programs in these areas are essential to bridge existing gaps and support agri-food cooperatives in thriving in the market while ensuring environmental sustainability. The establishment of alliances between cooperatives, researchers, digital transformation consultants, artificial intelligence specialists, and policymakers is imperative. Implementing such measures could empower cooperatives to improve their operations, enable them to access new markets, grow the customer portfolio, enhance their economic efficiency, and contribute to the development of sustainable digital innovative food systems.**

***Keywords*— Northern Morocco, survey, eco-friendly innovation, market access, digital transformation, digital divide, sustainable practices, upcycling, agri-food cooperatives.**

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I. INTRODUCTION

Global food systems face enormous challenges, including climate change, malnutrition, biodiversity losses, digital gaps, and food waste. These obstacles compromise the livelihoods of farmers, small producers, agri-food cooperatives, and consumers. Thus, these challenges are driving the global food systems towards more sustainable food production and food innovation [1]–[5]. The Green economic theory emphasizes the connection between people and the environment by suggesting that individuals should prioritize environmental improvement [6], [7]. Indeed, climate change is the biggest failure of the market economy. Carbon emissions pose a significant environmental threat and an economic burden to all countries [8]. Therefore, developed and developing countries must focus on green growth policies by focusing on green projects and low-carbon technologies. In this context, Morocco strives for sustainable food systems, its national strategy Green Generation 2020–2030 marked a turning point by encouraging the emergence of agricultural cooperatives. These cooperatives, as enterprises maintaining stable and unconditional links with rural communities, play a central role in the local economy and in anchoring populations to their territories, making them key actors in territorial development [9], [10]. Through their governance structures, principles, and values, cooperatives act as vectors of social innovation, addressing societal challenges and meeting social needs insufficiently covered by market mechanisms, relying on collective engagement [11].

Thus, cooperatives position themselves as strategic actors in regions characterized by abundant agroecological and cultural assets, including the Central Rif of Morocco. The Central Rif region of Morocco, particularly the province of Al Hoceima, is an area of high agroecological potential, renowned for the richness and diversity of its emblematic agricultural resources. This territory hosts a variety of traditional and heritage crops, including almond trees, carob trees, fig trees, pomegranates, cannabis, high-quality honey, as well as a wide array of medicinal and aromatic plants (MAPs). Deeply rooted in local identity, these resources represent a significant lever for rural community development. The valorization and promotion of these local products play a crucial role in stimulating the local economy, improving the livelihoods of producers and cooperatives, and preserving the region's heritage. Complementing these efforts, sustainable practices including intelligent waste management, digitalization, recycling, upcycling, and renewable energy are supporting circular development. Many countries now consider digital as a key component of their sustainable development objectives. Morocco is among these countries, actively integrating digital initiatives into its development framework. Through the Digital Morocco 2030 strategy, the country focuses on boosting the digital economy by creating a thriving digital ecosystem that will fuel local innovation, generate employment, and increase Morocco's competitiveness in the global market. In this regard, agri-food cooperatives occupy a strategic place. They participate in market share and contribute to rural development [12], [13]. However, these cooperatives present a delay in their digital transformation compared to that of conventional companies [14]. To improve their market access and guarantee sustainability, these organizations must innovate and include digitalization throughout the value chain. Artificial intelligence, big data analytics, mobile technology, and social media platforms are examples of digital innovations [15]. Their benefits are numerous and diverse. For example, digital tools enable agri-food cooperatives to better meet customer expectations by providing customized services and enhancing transparency. Consequently, eco-friendly innovation and green digital technology are intrinsically connected, as green innovation represents a crucial tactic to achieve sustainable development, while green technology refers to the tangible tools and systems that emerge from this innovation, meeting present needs without compromising the ability of future generations to meet their own [16].

More broadly, green innovation encompasses the development and implementation of new products, processes, or practices that reduce environmental harm while delivering economic benefits [17]. Existing literature has classified green innovation into two major dimensions: process innovation and product innovation. Both are crucial in responding to regulatory and market-based environmental challenges [18].

More recently, scholars have begun to distinguish between the quantity and quality of green innovation [18]. The quantity dimension captures the breadth of innovation, such as the number of green patents [19], whereas the quality dimension reflects the technological novelty and industrial relevance of those innovations, often measured by patent citations, international patent classification diversity, or technology weightings [20]. Building on this distinction, it appears that only a small number of cooperatives are aware of what green innovation entails, let alone how to upgrade their products, processes, or organizational models in alignment with these emerging standards. Many continue to lack the technical knowledge, digital tools, and strategic guidance required to integrate green innovation into their value chains, limiting their capacity to move toward higher-value, sustainable, and competitive product offerings.

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While many studies highlight the benefits of digitalization and green innovation, few demonstrate how agri-food cooperatives can embrace these trends, bridge the digital divide, and adopt sustainable practices at a small scale. Hence, this survey aims to diagnose the barriers related to digitalization, green practices, and market access, identify opportunities for sustainable growth and outline potential pathways for improving performance.

II. METHODOLOGY

A. Study Area

The survey was carried out in Northern Morocco, with a particular focus on the Central Rif, specifically in Al Hoceima province. The study concentrated on both urban and dominant rural areas of this province. It focused on assessing cooperatives operating in three high-potential sectors namely, beekeeping, medicinal and aromatic plants (MAPs), and the valorization of local agricultural resources.

B. Study Design, Sampling Method and Sample Size

This study, taking place during 2025, used a questionnaire based on a cross-sectional design to conduct a quantitative investigation. The data was collected from a representative sample of agri-food cooperatives operating in Al Hoceima province, selected through a stratified systematic sampling method to ensure diversity in terms of sector, size, geographical location, and level of market integration. To ensure statistical representativity, the required sample size was calculated based on Cochran's formula, adjusted for a finite population. The Central Rif region hosts around 100 registered cooperatives across diverse sectors. This study targets 55 cooperatives engaged in beekeeping, MAPs, and agricultural resource valorization, as these align closely with the research objectives. Using a 95% confidence level ($z = 1.96$), an estimated population proportion $p = 0.5$ (maximizing sample size under uncertainty), and a margin of error of 5%, the minimum representative sample size was calculated to be 49 cooperatives. A total of 50 cooperatives were surveyed using this stratified approach, providing broad coverage across all defined strata.

C. Data Collection: Survey Instrument

The questionnaire was developed based on the key themes relevant to the diagnostic objectives of the study, ensuring a structured approach to gathering comprehensive data from agri-food cooperatives. It consists of eight sections designed to provide a comprehensive diagnosis of the functioning of cooperatives. Each section was carefully designed to address specific aspects of cooperative operations, with a focus on identifying challenges, exploring opportunities, and assessing the level of integration of valorization, upcycling practices and digital tools.

The first section focuses on general information about the cooperative, including its name, date of establishment, location, number of members, as well as basic data regarding its governance and operational structure.

The second section addresses production, quality, and productivity. It explores the types of products manufactured, production techniques employed, quality standards applied, and key performance.

The third section examines practices related to processing, valorization, and upcycling, assessing the use of by-products, traditional or semi-industrial processing methods, and the degree of integration of innovative approaches for the valorization of raw materials and waste.

The fourth section is devoted to sustainability, analyzing the cooperatives' efforts in waste management, environmental impact, and social engagement.

The fifth section focuses on market access, analyzing the marketing channels used, partnerships established, challenges faced in product commercialization, and the strategies implemented to enhance visibility.

The sixth section deals with innovation and digitalization, particularly the use of digital tools, technologies for production, management, communication, and marketing.

The seventh section explores dimensions related to human resources and training. It examines team composition, available skills, and training needs.

Finally, the eighth section gathers information on the challenges encountered, opportunities identified, and future vision providing insight into the cooperatives' ambitions and the levers to be activated to strengthen their economic, social, and environmental impact.

The administered questionnaire comprised a total of 41 questions distributed across different formats—closed, semi-open, and open-ended—some allowing multiple responses to capture the diversity of observed

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situations. On the last page of paper questionnaire, there was an explanatory opening paragraph on the purpose of the study, assuring the confidentiality of the information collected.

D. Data Analysis

The objective of this data analysis is to interpret the survey results effectively using graphical and statistical methods. Excel was utilized as the primary tool for data visualization and analysis, leveraging its robust functions to produce informative graphs and charts. Quantitative data were analyzed using descriptive statistics, while thematic analysis was applied to qualitative responses.

III. Results and Discussion

A. Overview of the Agri-food Cooperative Sector in Central Rif

The study conducted on a sample of 50 cooperatives located in the Central Rif reveals a distinct sectoral distribution, highlighting the main lines of activity within the region. The beekeeping sector stands out prominently, representing 60% of the cooperatives surveyed (30 structures). This predominance can be attributed to the region's rich floristic diversity, deeply rooted traditional know-how, and the strong demand for honey and other hive products. The sector dedicated to the valorization of local agricultural resources ranks second, accounting for 28% of the cooperatives (14 structures). This reflects a growing interest in the processing of local products such as almonds, figs, olives, and carob—signaling an emerging dynamic in agro-processing, value creation, and territorial anchorage.

In contrast, cooperatives focusing on medicinal and aromatic plants (MAPs) represent only 12% of the total (6 structures), indicating an underexploited potential hindered by technical, logistical, commercial, and environmental constraints (Fig. 1). The Central Rif is characterized by semi-arid conditions with irregular and limited rainfall. Drought reduces productivity, germination, and plant quality, which may discourage cooperatives from investing in MAPs cultivation. This distribution underscores the need to develop differentiated support and capacity-building approaches that consider the specific characteristics and maturity levels of each value chain.

The marked predominance of the beekeeping sector raises several strategic issues for cooperative development in the Central Rif (Fig. 1). While this concentration reflects a strong territorial anchoring, it also reveals a form of sectoral dependency that can render the cooperative ecosystem vulnerable to climatic shocks, bee diseases, and fluctuations in the honey market. This local observation aligns with a broader global context: worldwide, beekeeping is recognized as an effective lever for increasing rural incomes, supporting biodiversity, and enhancing agricultural productivity through pollination services. The Food and Agriculture Organization (FAO) has highlighted that approximately 75% of global food crops rely, to some extent, on pollination, with bees playing a central role. Thus, beekeeping holds dual value: it serves both as a revenue-generating activity and as a pillar for food security and ecosystem stability.

This significance is further supported by empirical evidence from Sub-Saharan Africa, where beekeeping complements smallholder farming systems and promotes sustainable livelihoods. Studies conducted in Ethiopia, Tanzania, and Kenya have shown that beekeeping contributes significantly to household income and creates employment opportunities, particularly for youth [21]. In this context, local cooperatives demonstrate a genuine commitment to transmitting their knowledge and passion for beekeeping to younger generations, aware of the importance of cultivating a skilled successor base to ensure the sector's sustainability. However, this commitment faces technical and organizational challenges, such as managing diseases like Varroa destructor-induced varroosis, securing colonies, and ensuring stable yields. To make beekeeping both attractive and sustainable, it is essential to support cooperatives in acquiring and implementing best apicultural practices, which maintain colony health while optimizing productivity.

The relative marginalization of other sectors, such as MAPs and the insufficient valorization of local products raise questions about the capacity of these territories to diversify their activities and seize new economic opportunities. Diversification is essential not only to strengthen the economic resilience of the cooperative network but also to promote broader inclusion of women and youth in sectors such as MAPs cultivation and agro-processing.

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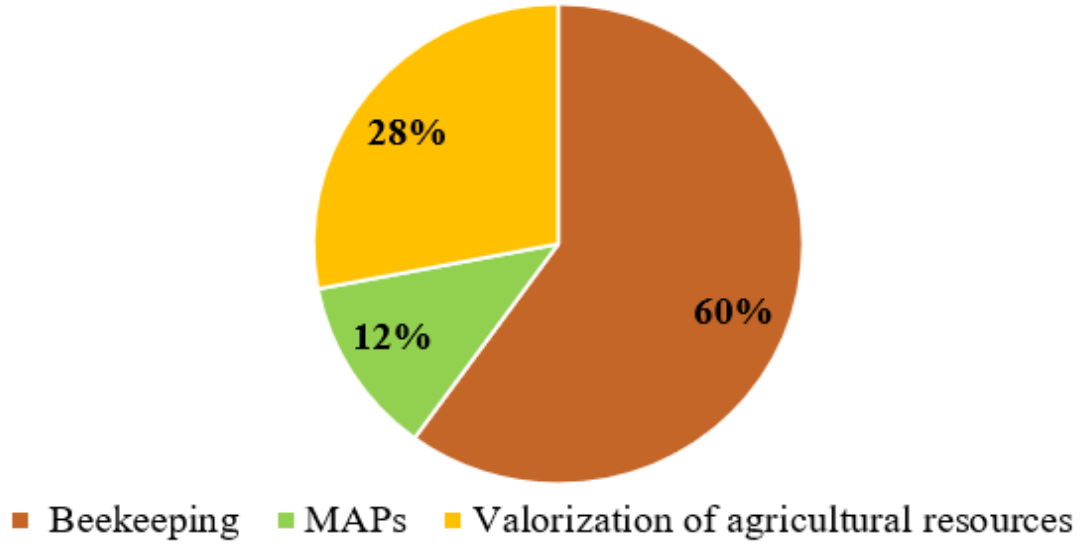

Fig. 1 Distribution of agri-food cooperatives by sector in the Central Rif

B. Limited Use of Marketing and Distribution Channels

The analysis of marketing channels used by cooperatives in the Central Rif reveals contrasting trends. Data collected from the survey indicate that most cooperatives rely primarily on direct sales and traditional markets for product distribution, reflecting a limited diversification of marketing channels. Local markets and direct sales emerge as the most favored outlets, each utilized by 50 cooperatives, underscoring the importance of short supply chains and close proximity to the final consumer. Trade fairs and exhibitions, used by 44 cooperatives, also represent significant means of visibility and promotion, enabling broader audience engagement and the establishment of commercial networks. In contrast, access to large-scale retail and export markets remains limited, with only 5 cooperatives involved in each case, suggesting constraints related to quality standards, logistics, and production capacity. Social media platforms are used by 21 cooperatives, whereas e-commerce remains marginal, with only 3 cooperatives engaged, indicating an underdeveloped potential for digitalization and online marketing (Fig. 2). Overall, these findings demonstrate that cooperatives predominantly prefer traditional and direct marketing channels, while gradually exploring modern and digital commercialization pathways, which remain largely underexploited.

Direct sales and local markets foster strong interpersonal relationships, built on trust, proximity, and business practices deeply rooted in cultural habits. These channels also enable immediate payment and circumvent the costs and technical skills associated with digital tools. Conversely, the limited use of digital platforms is attributed to insufficient training in digital marketing, restricted access to digital infrastructure (such as internet connectivity and equipment), and low awareness of the potential benefits of these technologies for product visibility and competitiveness.

Furthermore, some cooperatives perceive digital platforms as risky or unsuitable for their target clientele, preferring established and well-controlled marketing methods. Another major factor contributing to the slow adoption of digital tools for marketing is the sense of intimidation experienced by certain cooperatives, who view digitalization as a domain reserved for younger generations. It is often considered complex, unclear, and difficult to master, particularly regarding monetization and management mechanisms. This apprehension is also reinforced by concerns about fraud or scams.

Interviews indicate that a significant number of cooperatives remain insufficiently aware of the strategic value of digital technologies and lack clear guidance on how to integrate them into operational practices. This gap is particularly concerning, given that basic digital infrastructure is a key driver of rural digital development, with significant impacts not only on the modernization of agricultural practices but also on the reduction of carbon emissions [22].

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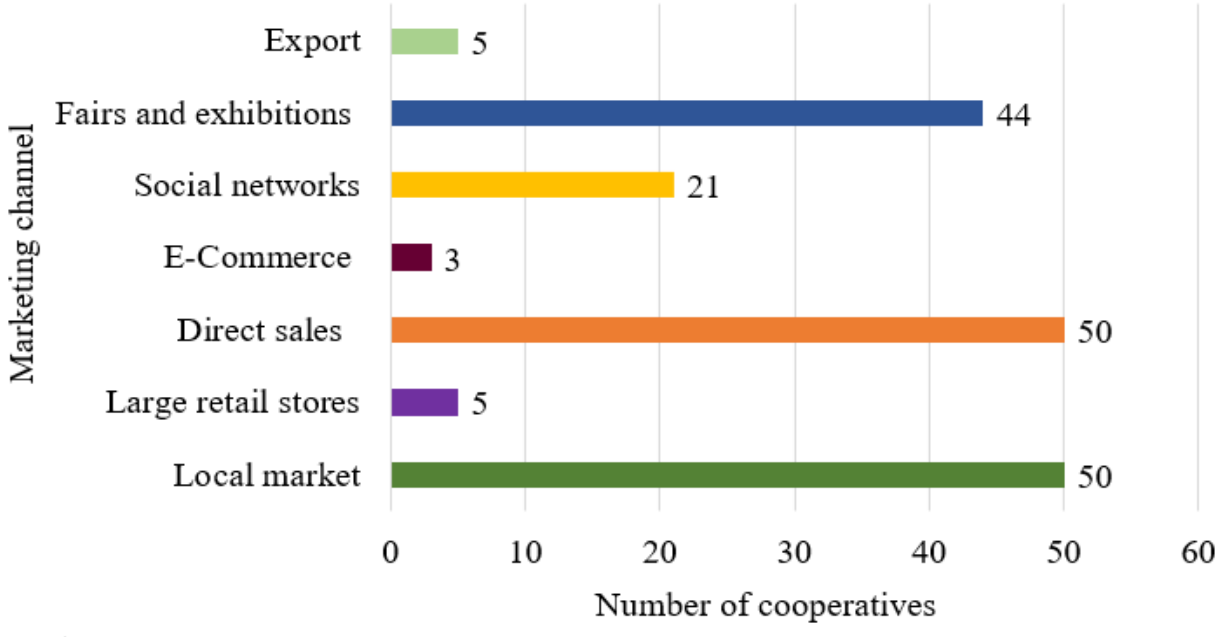

Fig. 2 Cooperative engagement across various marketing channels

C. Assessment of the Digital Divide in Central Rif Cooperatives

Regarding digitalization, the results uncover a significant disparity between awareness and the actual adoption of digital tools among the surveyed cooperatives. Although 50% of cooperatives reported being aware of digital technologies such as social media platforms and e-commerce tools, only 12% actively integrate them into their operations. This low adoption rate highlights a critical gap between knowledge and practice, often attributed to the lack of targeted training and limited digital literacy within these organizations. Furthermore, 38% of cooperatives remain entirely unaware or unfamiliar with digital tools, underscoring the persistent digital divide in rural and marginalized areas of the Al Hoceima province (Fig. 3).

From a technical perspective, many cooperatives face limited access to reliable internet, appropriate equipment, and adequate digital infrastructure. On the human side, a lack of digital skills and training prevents cooperatives from effectively using online platforms and fully appreciating their benefits. Socioeconomic and cultural factors further exacerbate the situation, including the perception that digital tools are intended for distant markets and clients removed from their daily realities. This digital divide thus keeps cooperatives confined to traditional marketing channels, depriving them of the opportunities offered by digital transformation, particularly in terms of visibility, market diversification, and competitiveness. These observations underscore the importance of targeted initiatives to reduce digital inequalities through training, technical support, and inclusive digital policies tailored to local realities.

Over the past two decades, advances in digital technologies and the rise of the collaborative economy have facilitated the emergence of numerous successful multi-sided digital platforms, such as Amazon [23]–[26]. These platforms bring together two distinct but interdependent customer groups and create value by acting as intermediaries, facilitating direct interactions between different stakeholders [23].

For agri-food cooperatives in the Central Rif to fully leverage the opportunities offered by digital advances, it is essential to move beyond narrow perceptions and limiting beliefs about digitalization, viewing it as an ally rather than an obstacle. This requires, first and foremost, overcoming structural barriers to technology access, particularly in rural areas, where weak digital infrastructure remains a major impediment to digital tools adoption and generates growing frustration among local actors. In this context, strengthening digital capacity emerges as a sine qua non for any inclusive digital transformation strategy. Digital capacity building refers to economic activities aimed at modernizing digital infrastructures in rural areas, leveraging technologies such as cloud computing, blockchain, and the Internet of Things to support the digital transition of agriculture and rural areas. The ultimate goal is to promote a harmonious convergence between the digital economy and the agricultural economy, paving the way for a rural development model that is innovative, sustainable, and resilient [27]. The diffusion of multi-sided platform models illustrates that cooperatives can

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become active participants in these ecosystems if they receive support in technical, regulatory, and marketing domains [23], [24].

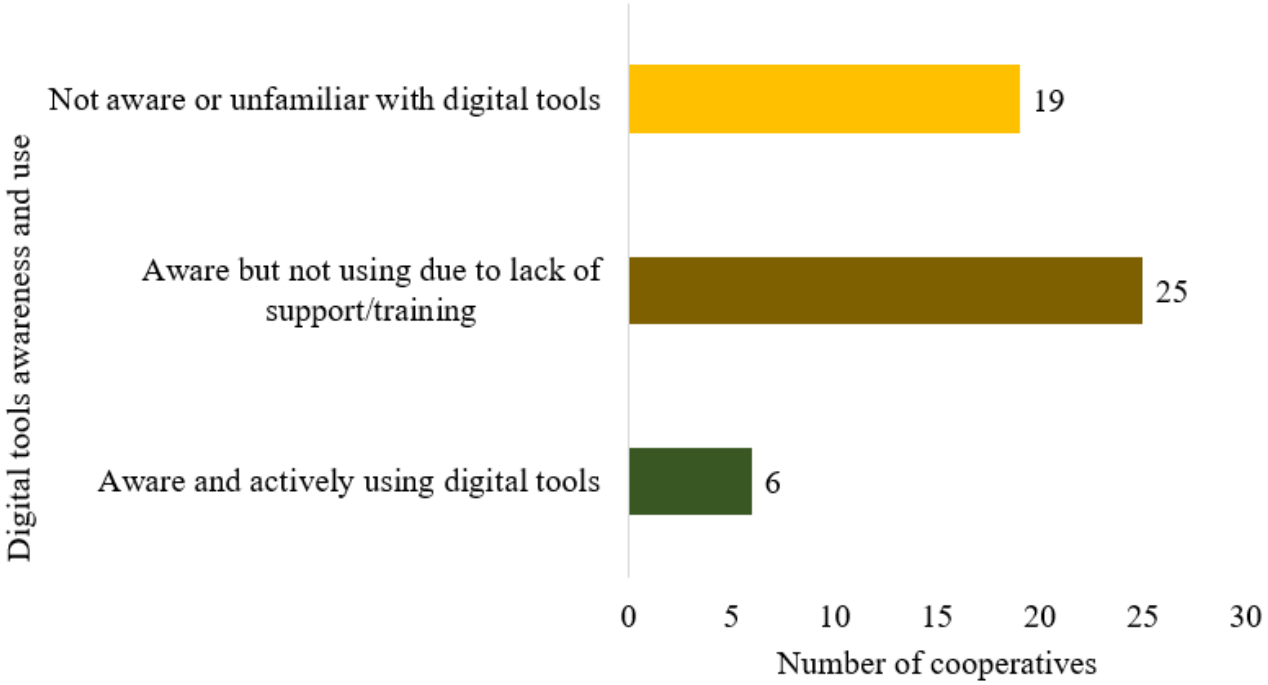

Fig. 3 Awareness and use of digital tools among cooperatives

D. Gaps in Training and Technical Assistance for the Implementation of Sustainable Practices

Among the surveyed cooperatives, 30 out of 50 (60%) reported the absence of targeted training programs enabling them to implement sustainable practices. Regarding sustainability practices within the value chain, only 16% of cooperatives—those with a high level of awareness of upcycling and that have adopted the upcycling of food residues, particularly in the production of scrub products—demonstrate a limited but promising engagement in value addition through the utilization of by-products (Fig. 4).

This widespread lack of tailored capacity-building programs significantly hampers the cooperatives' ability to integrate ecological innovations into their operations. To support digitalization and the adoption of sustainable value chain methods, it is imperative to address these gaps. Several solutions can be proposed, such as improving internet connectivity in rural and underserved areas. However, infrastructure alone is insufficient without human capacity.

Specifically, customized training programs focused on digital literacy, data management, and environmentally sustainable practices are crucial for ensuring effective adoption. These programs should emphasize digital literacy to enhance the cooperatives' ability to effectively utilize digital tools, data management to ensure reliable collection, processing, and interpretation of information, and environmentally friendly practices to promote responsible and sustainable approaches within their operational activities.

The findings reveal a low level of implementation by cooperatives in adopting green initiatives, such as innovative processing of local products, the use of eco-friendly packaging, upcycling of by-products, and reducing the carbon footprint in value-adding processes. This situation can be attributed to several interrelated factors. On one hand, a lack of concrete knowledge about the steps to undertake, coupled with the absence of targeted technical training, limits cooperatives' ability to identify and exploit innovative opportunities. On the other hand, a narrow perception of the economic and environmental potential of by-products reinforces inertia, as they are still largely considered valueless waste.

Additionally, a deficit in creativity and openness results in weak anticipation of consumer expectations and emerging market trends that favor sustainable and circular products. Consequently, initiatives remain sporadic and fragmented, without a coherent, integrated valorization strategy. These findings underscore the need to support cooperatives through awareness programs, hands-on training, and incentives for upcycling and innovation, in order to foster a broader, proactive vision regarding the opportunities offered by green practices

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and the circular economy. However, this transition remains challenging when cooperatives face material and technological resource constraints.

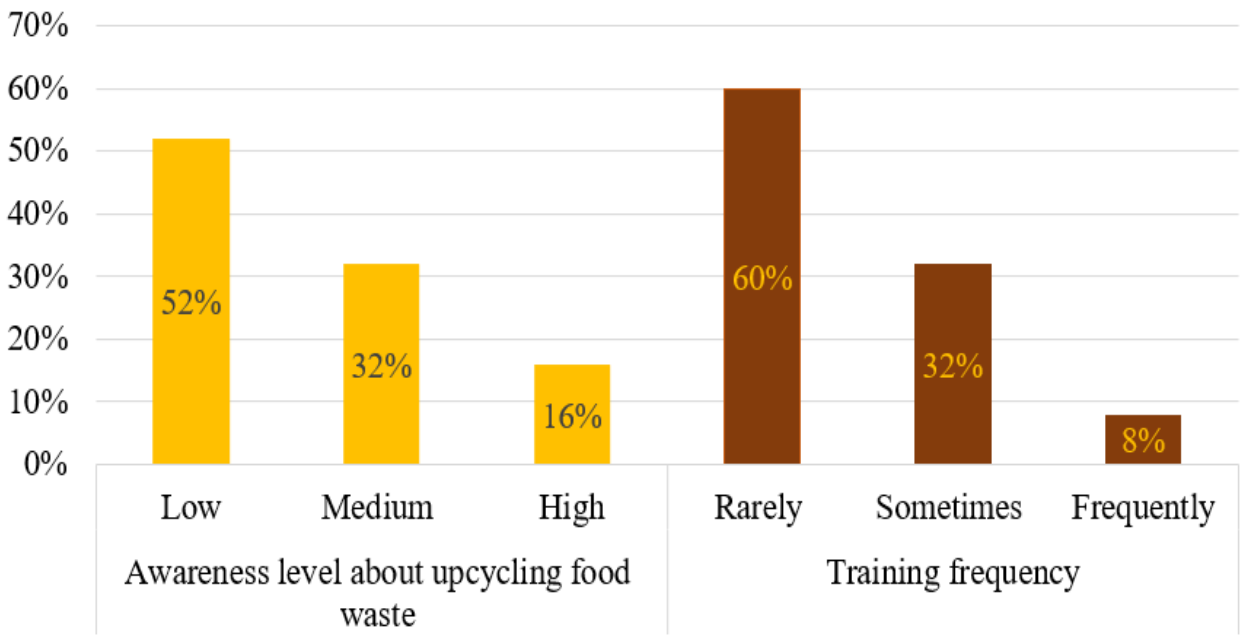

Fig. 4 Impact of training frequency on awareness levels about food waste upcycling

E. Quality Standards and Market Competitiveness among Cooperatives

Quality represents a key differentiating factor for cooperatives, and obtaining certification constitutes formal recognition of the efforts invested throughout the production and valorization processes of local agricultural resources. Fig. 5 presents the quality certification status of agri-food cooperatives in the Central Rif. The results demonstrate a significant gap in this area: 88% of the surveyed cooperatives across the three sectors studied lack quality certification, while only 12% possess it. According to interviews with cooperative managers, the root causes of this certification deficit are not due to ignorance or failure to implement good practices, but rather stem from structural and administrative constraints. These include the absence of infrastructure meeting regulatory standards, limited understanding of administrative procedures, and—for rural cooperatives—the remoteness of application submission centers, the burden of transportation costs, and the sense of intimidation caused by the complexity of certification processes.

This low level of quality certification has direct consequences on product marketing, cooperative visibility in the market, and overall competitiveness. The absence of official recognition limits access to demanding markets and trade fairs, restricts product valorization, and hinders the strategic development of cooperatives in a competitive environment. The lack of quality certification within agri-food cooperatives in the Central Rif represents another critical challenge for their development and integration into formal, competitive marketing channels. This shortfall is driven by a combination of interrelated factors, including insufficient financial resources to cover audit costs and infrastructure investments, a deficit of technical and organizational skills in quality management, and limited awareness of the importance of standardization and certification processes. These internal constraints are compounded by an institutional environment in which local market incentives remain limited and administrative procedures are perceived as complex by cooperative stakeholders.

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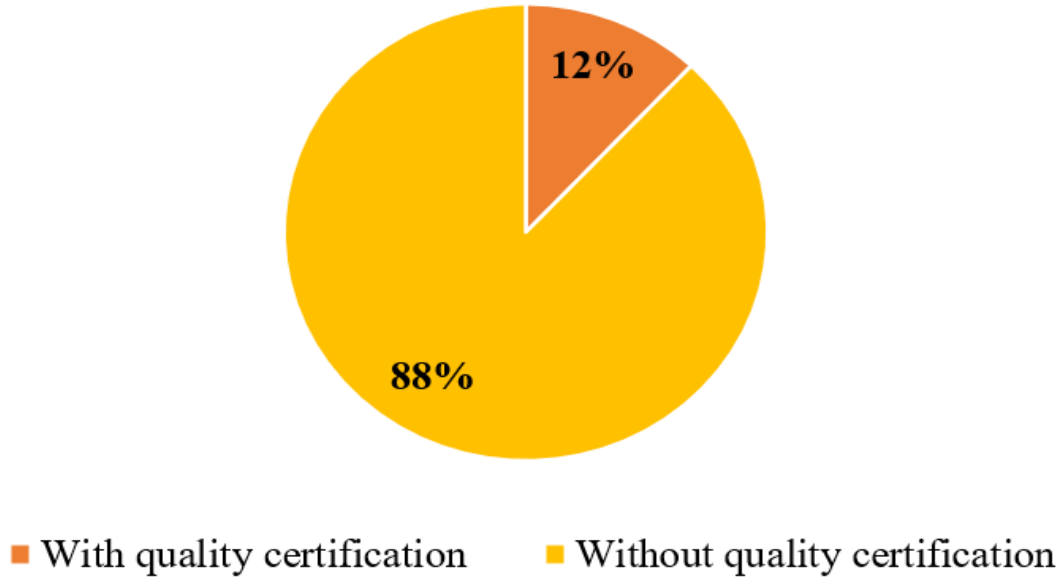

Fig. 5 Distribution of Central Rif cooperatives with or without quality certification

F. Assessment of Operational Assistance Requirements for Central Rif Agri-food Cooperatives

The results concerning the operational support needs of agri-food cooperatives in the Central Rif show clearly defined priorities. The development of new product lines and the valorization of waste and by-products emerge as the most pressing needs, expressed by 90% of the cooperatives. This emphasis on innovation reflects the cooperatives' desire to differentiate themselves in the market, attract customers, and modernize their practices. Through innovation, they can both refine existing practices by adding creative and appealing elements, optimize the use of local resources, and meet consumer expectations for quality and originality.

Support for obtaining quality certifications (84%) and for digital marketing (72%) highlights the importance placed on regulatory compliance, consumer trust, and the modernization of operational practices. The use of digital tools for traceability and quality management (56%) illustrates the willingness of agri-food cooperatives to adopt technological solutions to enhance transparency and competitiveness. Improving existing practices (44%) and the use and maintenance of equipment (62%) remain important needs, though somewhat lower in priority, suggesting that innovation and valorization are favored—partly due to the limited availability of training in these areas (Fig. 6).

Drawing on the survey findings, it becomes evident that immediate interventions are required to help cooperatives overcome these barriers. Cooperatives should be guided in harnessing digital tools to enhance visibility: practical training on creating high-quality photos and videos, sharing content on social media platforms, and deploying digital questionnaires can improve product quality, align offerings with market trends, and strengthen customer engagement. Moreover, the promotion of food tourism catalyzes the development of related infrastructure and services. Strategic investments in culinary schools, food festivals, and guided gastronomic tours not only enrich the visitor experience but also generate educational opportunities and local employment, thereby fostering broader socio-economic development within the community [28]. Food tourism attracts not only culinary enthusiasts but also a wide variety of tourists, highlighting its broad appeal. As a vital part of destination marketing strategies, it significantly boosts local economies by drawing visitors eager to experience local products, regional flavors and culture. In this regard, developing social innovations as local solutions require the cooperatives to behave as social entrepreneurs. The term describes different kinds of community ventures, voluntary, public, or private, that address social issues [29]–[31]. These ventures can arise through the pooling of resources by similar actors or organizations with different but complementary capacities or knowledge [32].

Through a collective social enterprise, it is possible to take advantage of existing resources, create new ones, and generate institutional arrangements that support these changes. Social enterprises obtain their resources through social engagement, in which resources are exchanged through a collaborative process that

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supports the development and growth of individuals and communities [33]. The broader economic impact of food tourism, citing increased demand for accommodations, transportation services, and locally sourced ingredients [34].

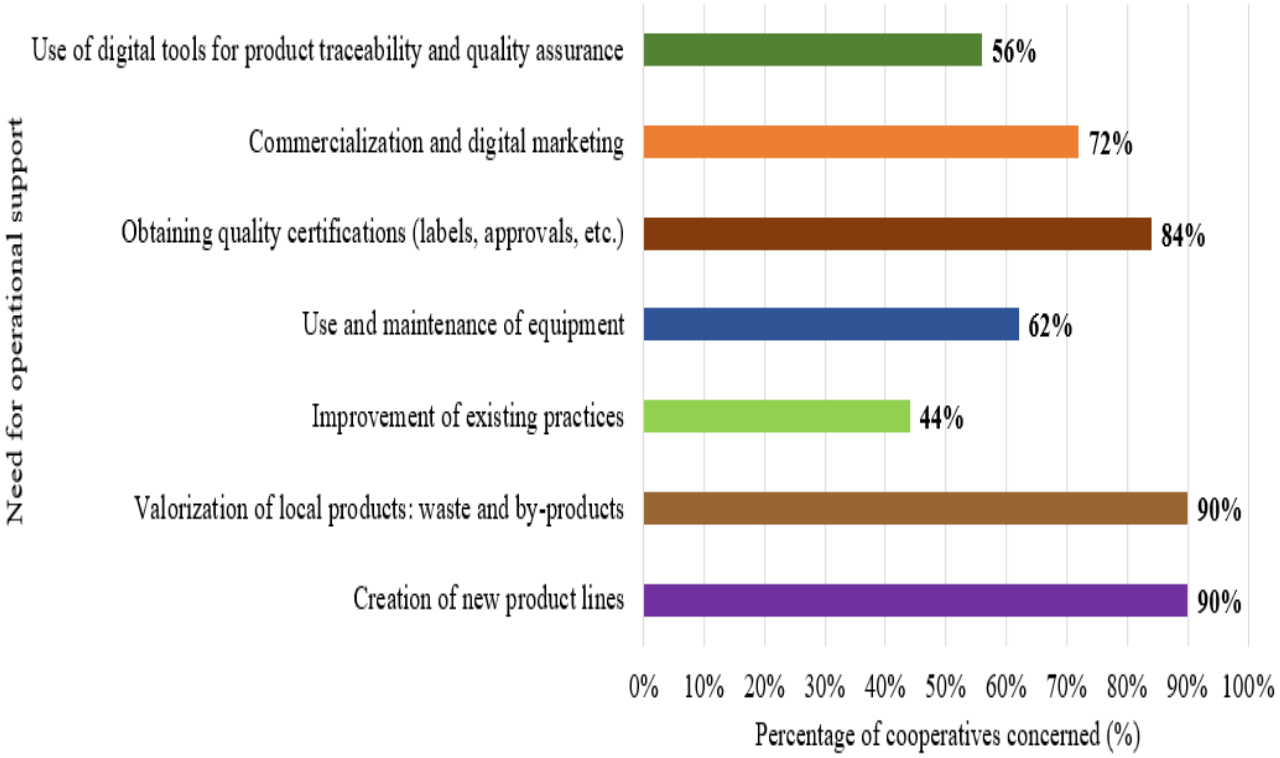

Fig. 6 Operational support needs of agri-food cooperatives in the Central Rif

IV. Conclusions

This survey highlights the multidimensional challenges faced by agri-food cooperatives in the Central Rif in their digital and sustainable transition. The absence of practical and sector-specific programs limits their capacity to build skills in both local product valorization and digital transformation. Moreover, the limited quality certification of most agri-food cooperatives restricts their market access and diminishes the perceived value of their products among consumers. The study also emphasizes the impact of limited adoption of digital tools. This deficiency undermines cooperatives' market visibility, impedes their ability to attract and retain customers, and limits opportunities for continuous product improvement based on collected data (e.g., customer feedback, traceability, preference analyses). The situation is further compounded by low awareness of the value of digital technologies and limiting beliefs regarding their accessibility and profitability, often reinforced by an underdeveloped rural digital environment. The importance of digital literacy in ensuring successful sustainable transition cannot be emphasized enough. Context-specific training, tailored support programs, eco-friendly initiatives such as agrotourism, and practical affordable methods play an indispensable role in bridging the gaps, boosting the awareness concerning digitalization and green practices, enhancing the cooperatives' performance and market integration. Furthermore, targeted training programs encompassing best practices, quality certification processes, sustainable use of local products are essential. Creating streamlined channels to raise awareness about quality certification—explaining how to obtain it in a less complicated way, how to meet the criteria, and how to make the process more accessible—will help address this gap. Equally important is training cooperatives in effectively communicating the quality, eco-friendly attributes of their products and employing storytelling to convey their origin and values, thereby enhancing marketing skills. Demonstrating these connections helps cooperatives overcome the narrow perception of digitalization as a barrier, showing instead that it is a valuable tool for growth and visibility. Developing capacity-building hubs enables cooperatives to innovate, access resources, and expand their market reach. Accordingly, strong collaboration among stakeholders, including public institutions, researchers, consultants,

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and cooperatives in parallel with establishing digital support hubs is fundamental to guarantee access to effective support, knowledge-sharing, and scalable solutions.

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