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Generativity is a Core Value of the ESJ: A Decade of Growth

Erik Erikson (1902-1994) was one of the great psychologists of the 20th century[1]. He explored the nature of personal human identity. Originally named Erik Homberger after his adoptive father, Dr. Theodore Homberger, he re-imagined his identity and re-named himself Erik Erikson (literally Erik son of Erik). Ironically, he rejected his adoptive father's wish to become a physician, never obtained a college degree, pursued independent studies under Anna Freud, and then taught at Harvard Medical School after emigrating from Germany to the United States. Erickson visualized human psychosocial development as eight successive life-cycle challenges. Each challenge was framed as a struggle between two outcomes, one desirable and one undesirable. The first two early development challenges were 'trust' versus 'mistrust' followed by 'autonomy' versus 'shame.' Importantly, he held that we face the challenge of **generativity** versus **stagnation in middle life**. This challenge concerns the desire to give back to society and leave a mark on the world. It is about the transition from acquiring and accumulating to providing and mentoring.

Founded in 2010, the European Scientific Journal is just reaching young adulthood. Nonetheless, **generativity** is one of our core values. As a Journal, we reject stagnation and continue to evolve to meet the needs of our contributors, our reviewers, and the academic community. We seek to innovate to meet the challenges of open-access academic publishing. For us,

[1] Hopkins, J. R. (1995). Erik Homburger Erikson (1902–1994). *American Psychologist*, 50(9), 796-797. doi:http://dx.doi.org/10.1037/0003-066X.50.9.796

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generativity has a special meaning. We acknowledge an obligation to give back to the academic community, which has supported us over the past decade and made our initial growth possible. As part of our commitment to generativity, we are re-doubling our efforts in several key areas. First, we are committed to keeping our article processing fees as low as possible to make the ESJ affordable to scholars from all countries. Second, we remain committed to fair and agile peer review and are making further changes to shorten the time between submission and publication of worthy contributions. Third, we are looking actively at ways to eliminate the article processing charges for scholars coming from low GDP countries through a system of subsidies. Fourth, we are examining ways to create and strengthen partnerships with various academic institutions that will mutually benefit those institutions and the ESJ. Finally, through our commitment to publishing excellence, we reaffirm our membership in an open-access academic publishing community that actively contributes to the vitality of scholarship worldwide.

Sincerely,

Daniel B. Hier, MD

European Scientific Journal (ESJ) Natural/Life/Medical Sciences

Editor in Chief

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Navigating Research Trends in Support and Stigma: A Bibliometric Analysis and Future Research Agenda

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Abstract

Aim and Scope: Stigma has changed and evolved over time with the progress of knowledge and humanity. The negative outcomes of stigma, such as social isolation, exclusion, poor treatment adherence, and limited access to healthcare services, have garnered interest among research communities. The complex nature of stigma as a socially constructed phenomenon and its continuous evolution raises the need to track changes and fit future interventions. **Methods:** We synthesize extant research on stigma and support through a bibliometric analysis of 257 articles investigating the stigma phenomenon. The study contributes to a comprehensive understanding and helps the translation of research findings into action to drive social change and evidence-based policies. **Findings:** Our analysis revealed a growing interest in the domain in recent years. The results show six main directions of research: (1) stigma as a barrier, (2) cultural contexts of stigma, (3) perceived stigma and coping strategies, (4) stories of experiences of stigma, (5) action to mitigate stigma, and (6) community stigma. **Conclusions:** This study has theoretical and practical implications, in highlighting the multidimensionality

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of stigma and the need for multi-level policies to raise awareness among communities.

Keywords: Support, stigma, health, review, future agenda

Introduction

The confirmation of a health diagnosis often leads to uncertainties, fear, and loss, causing self-regarding attitudes that can impact interpersonal relationships and healthcare treatment outcomes. People suffering from different health conditions may experience difficulties getting understood by others, followed by a lack of information and resources to deal with their diagnosis (Munro et al. 2022). This can be the beginning of a vulnerable position in society. Stigmatization, as a social determinant of health, derives from institutional and community norms that identify certain characteristics or conditions as undesirable. Moreover, technological advancement and social media usage can exert an effect on how stigma is experienced, and this can be both positive and negative.

This work contributes to the social marketing domain, which embodies the application of marketing to social causes. It focuses on two of the many changes aimed by social marketing; the changes in places where people live, work, and interact to "facilitate the adoption of desirable behaviors, inhibit undesirable behaviors and enhance well-being"; and changes in the political allocation of resources to "ensure quality of access and opportunity in society" (Donovan & Henley 2010, p. 17). The domain is complex and adopts perspectives and principles from several disciplines including psychology, sociology, communication sciences, politics, health sciences, etc. (Brennan & Brady 2011). Given these assumptions, social marketing is best considered within a broad context of social change.

A good amount of research on stigma interests the social sciences, as it affects human behavior and relationships. Therefore, stigma is investigated in communication and media studies, social work, education, healthcare, etc. The most important work on stigma remains the work by Erving Goffman. Goffman's theory explains stigma as the negative social reaction towards an individual's attribute, which can lead to societal rejection and can spoil normal identity (Goffman 1963).

Existing research has emphasized that an array of definitions exist for stigma, adding complexity and difficulty to its' understanding (Link & Phelan 2001). Definitions start from considering stigma as an "attribute that makes a person different from others in a social category" (Goffman 1997 p. 133), to more complex definitions considering it a combination of interrelated components of: 1- distinguishing and labeling differences, 2- associating human differences with negative attributes, 3- separating "us" from "them"

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and 4-status loss and discrimination (Link & Phelan 2001). Several studies confirm the linkage between social support and stigma experienced by individuals (Chen et al. 2021). Social support is considered an important resource for individual empowerment and extant research suggests that support from others may be an important driver of the destigmatisation process, and alleviate help-seeking behaviors (Makris et al., 2021).

Another important consideration of stigma is that being a present phenomenon in every society, culturally constructed and evolving through time with the change and accumulation of knowledge, it must be continuously researched to keep track of changes and fit future interventions to these evolutionary perspectives (Earnshaw et al. 2022).

Most of the extant reviews have a concentric focus on stigma experiences and outcomes. While there is broad research in the domain (Scambler 2009), most reviews take a narrative approach that is heavily influenced by the authors' perceptions and personal preferences. Unfortunately, there is scarce scientific research aligned toward a comprehensive analysis of the academic domain. Additionally, there is a lack of alignment between researchers and policymakers, due to the complexity of translating research findings into evidence-based policies (Smith 2014; Wehrens et al. 2011). A synthesis of extant literature is necessary to consolidate and guide the way forward while encouraging better communication between researchers and policymakers and guiding future interventions (King et al. 2014).

The broad interest of research also takes rise from the complexity of the phenomenon and its intersectionality with other constructs in social sciences. Stigma experiences are commonly characterized at the personal level even though their causes and consequences extend beyond the person. At the individual level, stigma is researched in terms of self-stigma or internalized stigma, used interchangeably, focused on individuals' experiences of negative beliefs about themselves. In the interpersonal level, stigma is researched in terms of public stigma, expressed as verbal harassment, and/or physical assault of the individual (Link & Phelan 2001). The community level delves into the investigation of communities to understand their beliefs and community stigma expressions as society rejection and social exclusion. Overlapping stigmas have also attracted increased interest in understanding how the co-existence of health-related undesired attributes may overlap with existing stigmatized identities (Cluver & Orkin 2009). From a social marketing perspective, researchers consider the sociocultural context and the role that different stakeholders in the market have in the destigmatization process, as well as try to provide strategies to reduce stigma by means of social marketing (Yeh et al. 2017; Kirkwood & Stamm 2006).

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Given the interdisciplinarity of social marketing research and the layered nature of the stigma concept, together with extant research calls for an investigation of stigma that logically synthesizes the concept and tracks changes over time, this article aims to investigate trends and patterns of literature and advance a future research agenda (Rao et al. 2019).

In the next section, we present and define the stigma concept and its interrelations with other concepts such as culture, society, etc. In the third section, we present the methods used to collect and analyze the literature on support and stigma. The state and the evolution of literature is then described, including an analysis of publications over years, publication outlets, influential works, authors, and thematic research patterns as relevant sub-fields in the domain. Following we consider and address a research agenda from the identification of unanswered questions and knowledge gaps, to inform future research efforts and guide the development of policies. The paper concludes with a discussion of implications from a theoretical, managerial, and policymakers' perspective.

Methods

Review questions

This article draws on a literature review approach which is often used to make sense of large and complex bodies of knowledge (Gaur & Kumar 2018), and therefore it becomes useful in the investigation of stigma in healthcare as a complex phenomenon. We performed a bibliometric-based analysis, which applies quantitative measures and indicators for science and technology based on bibliographic information (Van Leeuwen 2004).

We aim to answer the following research questions:

RQ1. How is support and stigma research evolving over time?

RQ2. What are the most frequently addressed research directions?

RQ3. What are the gaps in the body of knowledge to shape future research efforts and inform policies in the domain?

Study selection process

We apply the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) to perform the literature review process. Scopus was selected as the largest abstract and citation database, covering a broad range of publications from international publishers (Elsevier 2020). The following search string was used:

((“stigma*”) AND (“communit*”) AND (“social support*” OR “informational support*” OR “instrumental support*” OR “emotional support*”)).

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The initial database screening resulted in a total of 1731 records. To select among the results, we considered a set of eligibility criteria. The search was limited to articles appearing in an academic source, concerning Social Sciences as a subject area, and published in English language. No time restriction was included in the eligibility criteria as we aim to investigate the evolution of the domain from inception. This process provided a set of 430 eligible records that were further screened to ensure the relevance of the studies. We considered reading titles, abstracts, and keywords to assess the relevance of the studies. When relevance was difficult to assess, full-text reading enabled a decision on the inclusion or exclusion of articles. This process resulted in 173 false positives. Therefore, a total of 257 documents were included in this review and used for the data analysis. The flow chart of the study selection process is presented in Figure 1.

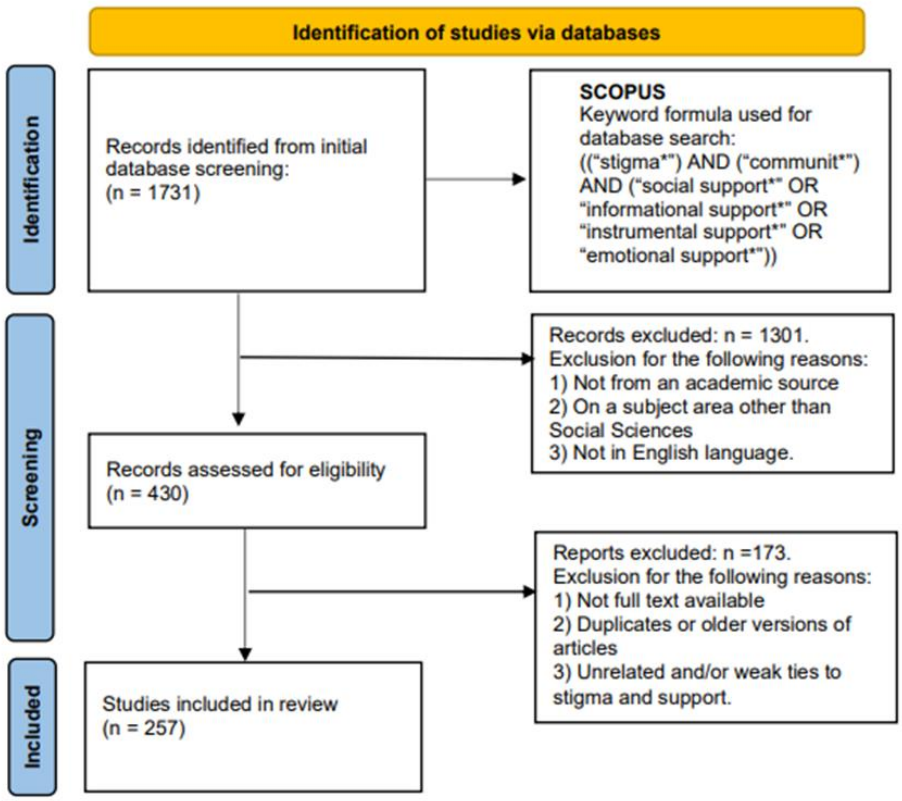

Figure 1. Flow chart of study selection

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Results

Descriptive Analysis

We investigated the sample of 257 articles to understand the evolution of research in the domain and developed a chart of the publication trend over the years. As we can notice, approximately 60% of the articles in our sample have been published from the year 2015 till 2023.

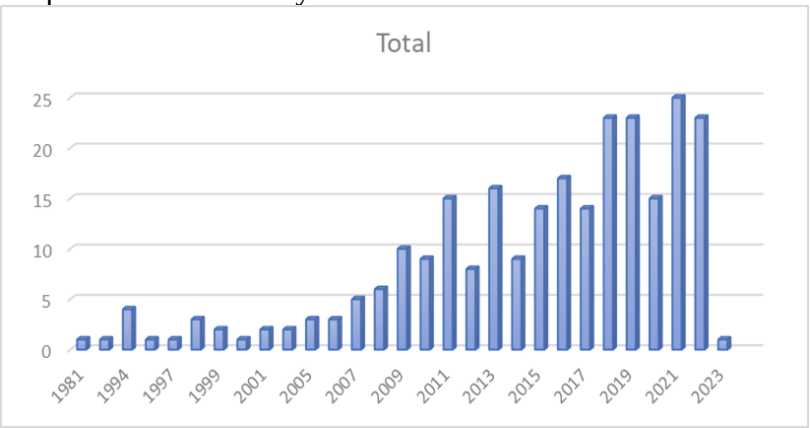

Figure 2. Publication over years

Table 1 presents the top contributing journals in our sample. We considered only journals with at least three publications. As it is evident from the table, the *AIDS Care – Psychological and Socio-Medical aspects of AIDS/HIV* is the top contributing journal with a total of 54 articles published in the domain, followed by *Social Science and Medicine* with 18 articles, *AIDS Education and Prevention* and *Community Mental Health Journal*, each with 12 articles, *Health and Social Care in the Community* with 8 articles, *Culture, Health and Sexuality* with 7 articles, and *Sahara J: Journal of Social Aspects of HIV/AIDS* with 6 articles. All the other journals in the sample account for 4 or fewer publications. It is important to notice that these 7 journals together account for more than 45% of the entire sample, as well as provide an understanding of the studies of stigma related to diseases such as AIDS/HIV and mental health as well as a range of sexually transmitted diseases. While we do not exclude the fact that a broader set of health conditions appears in the sample of stigma research, the prominence of the above-mentioned health conditions suggests an increased relevance of these conditions in unfolding the stigma phenomenon.

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Table 1. Top contributing journals with at least two publications

Journal title	Articles
AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV	54
Social Science and Medicine	18
AIDS Education and Prevention	12
Community Mental Health Journal	12
Health and Social Care in the Community	8
Culture, Health and Sexuality	7
Sahara J	6
Others	
Dementia Health Promotion International Journal of Health Communication Social Psychiatry and Psychiatric Epidemiology American Journal of Community Psychology American Journal of Men's Health	4
Health Communication Journal of Community and Applied Social Psychology Qualitative Report	3

Network Analysis

To gain insights into the relationships between the documents in our sample, we developed a visualization of the bibliographic coupling of documents (see Figure 3) using VOSviewer, a tool for visualizing bibliometric networks. The software is widely used in exploring relationships among articles, citations, or respective keywords used in these articles. Through a number of functionalities, it helps understand networks connected by co-authorship, co-occurrence, bibliographic coupling, or co-citation. For this specific analysis, we used a bibliographic coupling map. Bibliographic coupling finds frequent use as a measure of similarity among documents and it considers the number of times a document is cited by two target documents (Kessler 1963). This distance-based approach to visualize bibliometric networks aids in assigning the nodes in the network to a cluster (van Eck & Waltman 2014). From a total of 257 items, we kept only the largest set of interconnected items in the visualization, which resulted in 232 documents. We considered an attraction parameter of 2, a repulsion parameter of 1, and a resolution of 0.6. The 232 documents were assigned to six clusters.

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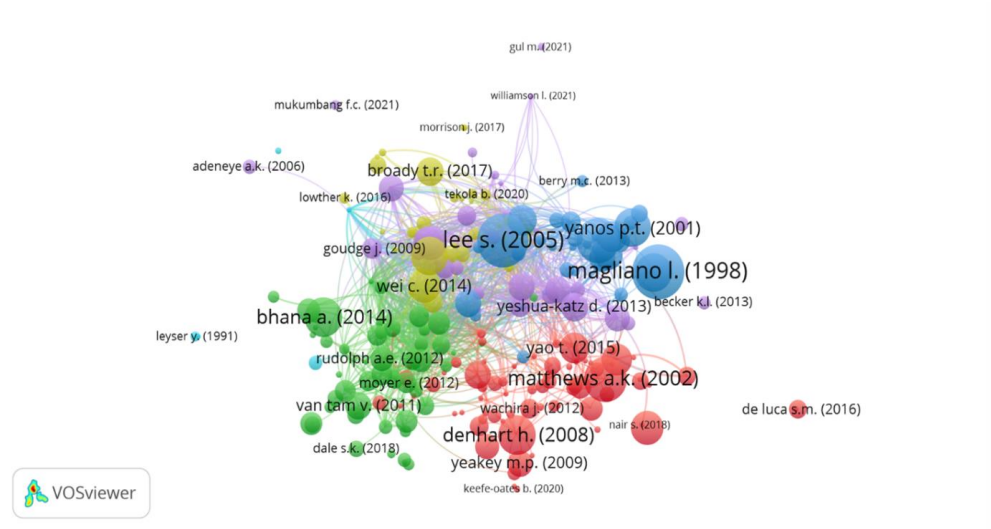

Figure 3. Network visualization of bibliographic coupling of documents

Stigma as a barrier (Red cluster)

This is the biggest cluster in terms of number of items included, with 72 items. Going through the contents of the items included in this cluster, we can evidence that it includes articles that investigate stigma as a barrier to healthcare-seeking behaviors, barriers to treatment adherence in investigations of factors of adherence, illness disclosure, and care access.

The article by Ahmed et al. (2018) finds that disease-related stigma is a barrier to the status disclosure of people living with HIV. In the same line are also the findings of Arend (2005) that investigates overlapping stigmas, and finds an important barrier in status disclosure and the perception of available support networks. Again, the study of Barry et al. (2018) focuses on overlapping stigmas to find that they are not only a barrier to treatment, but also a barrier to HIV prevention and the development of supportive social networks.

Fear of stigma is also a barrier to higher education for students with learning disabilities as suggested in the study by Denhart (2008). The study of Busza et al. (2018) suggests that fear of stigma affects also the delivery of community-based support; De Luca et al. (2016) find stigma as a barrier to mental health care service utilization which is further reinforced by the study of Alhomaizi et al. (2018).

Cultural contexts of stigma (Green cluster)

This cluster consists of a total of 53 items. It investigates specific minorities (i.e., sexual minorities, ethnic minorities, etc.), and different cultures (African culture, Indian culture, etc.). Several articles of this cluster investigate overlapping stigmas in different geographical areas (i.e., HIV-

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related stigma and homosexuality stigma), making a point to stigma as a socially constructed concept.

The article by Chan and Mak (2019) finds that due to the cultural context and common beliefs, sexual minorities living with HIV in China face stigmatizing attitudes also within the gay community, contributing to peer isolation. Körner (2007) in his study explains the effect of cultural background in disease disclosure as related to the perceived stigma in that cultural context.

Next, Lin et al. (2010) suggest that the perception of stigma is culturally constructed and deeply varies in different contexts. The cultural factors are present also in the study of Tomori et al. (2014) where the authors unveil the importance of socio-economic and sociocultural factors in the retention of HIV care and treatment services in Tanzania. To continue, other studies included in this cluster focus on cultural adaptations of existing measures of stigma. This is the case in the study of Pantelic et al. (2018) which develops a cross-cultural adaptation of the existing HIV stigma scale, or the study of Pardo et al. (2017) that adapts an existing evidence-informed intervention to be used in the Thai context in addressing the needs of the HIV positive youth, and the study of Vlassoff, Weiss and Rao (2013) that describes a question module to assess community stigma specific for the rural India.

Perceived stigma and coping strategies (Blue cluster)

This cluster consists of a total of 33 items. It includes articles that investigate how stigma is experienced by people living with specific health conditions and their need for help and support.

The study of Breet, Kagee and Seedat (2014) suggests the designing and implementation of interventions that increase the perceived social support and decrease the perceived HIV-related stigma, as an effective strategy for coping with the disease. Heslin et al. (2012) in their study describe the responses to stigma among sober living home residents and highlight their role in challenging the personal tragedy approach and empowering individuals to develop valued identities in their communities.

Craig, Austi,n and Alessi (2013) offer useful recommendations for better meeting the needs of sexual minority youth related to mental health and stress management through positive affirmative practices and cognitive behavioral therapy. Social support and community connectedness are found as effective strategies for stigma management also in the study of Pflum et al. (2015), as well as tailored social media use is found to exert a protective role against stigma and to enhance mental health outcomes in the study of Chong et al. (2015).

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Stories of experiences of stigma (Yellow cluster)

This cluster consists of a total of 33 items. It includes articles that investigate how stigma is experienced by people living with specific health conditions and expressions of need for help and support.

The study of Broady, Stoyles, and Morse (2017) finds four domains of stigmatizing experiences such as 1) lack of knowledge, 2) judgment, 3) rejection,and 4) lack of support, as well as reports the existence of stigma in four contexts as school, public, family and friends. The experiences of stigma are investigated also in the studies of Cardon and Marshall (2021) exploring the experiences of parents raising a child with autism spectrum disorder, and Coleman, Peterson and Walker (2022) who try to understand the experiences of stigma in relation to social support among people living with epilepsy.

Next, Khvorostyanov and Yeshua-Katz (2020) unveil the types and expressions of surrogacy stigma in Russia and find that women experience stigma due to the fact that surrogacy is in contradiction to the basic traditional concepts of family, motherhood and gender roles. On the other hand, Stutterheim et al. (2022) investigate trends in HIV stigma and find a decrease in stigma among friends, family, acquaintances, workplace and in the financial services sector, while media remains the main space with a high prevalence of expressing stigmatizing messages.

Action to mitigate stigma (Purple cluster)

This cluster consists of a total of 33 items. It includes articles that investigate and report on delivering interventions to facilitate the psychological and social effects of stigma, such as health promotion, new care delivery models, cyberspaces and new perspectives of empowerment, etc.

The study of Becker (2013) explains the extent to which digital communication technology can fulfill the need for a safe and secure place where stigmatized individuals can share experiences and aid in validation and encouragement of the stigmatized. Clarke et al. (2020) investigate ways of reshaping dementia care and suggest relational care through cooperative endeavour (cooperative communication, cooperative action and cooperative care that promote inclusion).

The study of Gul and Aqeel (2021), investigating stigma and shame in substance use disorder, suggests the combination of acceptance and commitment therapy with the standard treatment as an effective strategy for improving the quality of life of this group of patients. On the other hand, Mukumbang (2021) suggests that differentiated service delivery models and patient-centred treatment are associated with higher engagement and improved support, and can be successfully used to reduce the perceived stigma. Two other studies take a different perspective and investigate online negative enabling support groups to uncover their role in undermining

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recovery and nurturing negative behaviors (Chang & Bazarova 2016), as well as address the negative enabling support group as a challenge and threat for increased stigma (Haas et al. 2011).

Community stigma (Light blue cluster)

This is the last cluster emerging from the analysis. Being relatively close to other clusters, we find intertwined results and similar topics. The cluster consists of a total of 5 items that investigate insufficient community support, community-consumerism, religious communities and online health communities' role on stigma and quality outcomes of the stigmatized (i.e., in terms of quality of life, quality of care, support, etc.).

Alsabah and Vittrup (2017) investigate the negative effects of insufficient support systems on and reveal greater stress and social isolation of mothers of children with disabilities. Next, the study of Bilgrei (2019) explores the social organization of risk within online drug-related communities in order to understand how forums influence the notion of risk among participants and their role in being informed, responsible and empowered.

On the other hand, Leyser and Dekel (1991) in their investigation of religious Israel families with disabled children suggest relief services, parent training programs and stronger support networks may decrease the perceived stress. Lastly in this cluster, the study of Vigilant, Heitkamp and Heitkamp (2022) investigated online sexual health communities to understand the structures of help-seeking requests and found that online community plays an important role in alleviating stigma related to sexually transmitted infections.

It is important to highlight that some of the clusters are intertwined and we cannot gain a pure division between them, as is the case with the purple cluster (action to mitigate stigma) and the blue cluster (perceived stigma and coping strategies). In both clusters, we may find studies investigating coping and empowerment strategies, even though we may find a distinction in the level of action, where most articles on the action to mitigate stigma are focused on the community level. The same is present in the green cluster (cultural contexts of stigma) and red cluster (stigma as a barrier), and so on. As previously anticipated in literature, this can be partly explained by the fact that stigma is a multidimensional concept and the "stigma complex" is an interrelation of units that constitute a system, shaped by culture and society structure (Pescosolido & Martin 2015). Therefore, the social relationships from which this phenomenon arises are the result of a set of values, beliefs, and formal institutions that interact together to set the frame for acceptance. Moreover, as shown in Figure 4 where the articles were distributed across years per each of the six clusters, and the size of the bubble represents the number of articles, it is clear that the domain is consolidated considering that

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in most of our clusters articles are published regularly almost every year (i.e., cluster 1, cluster 2, etc.), while the last cluster can be suggested as emerging due to its publication trend.

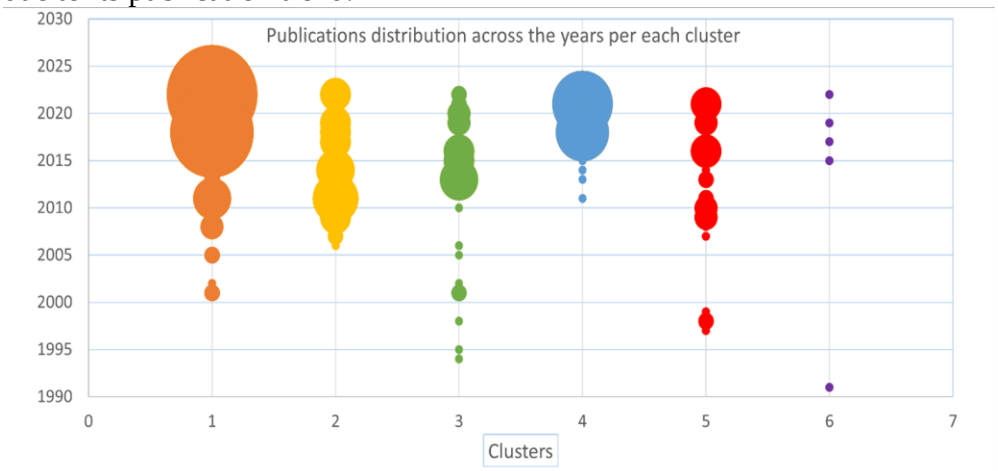

Figure 4. Distribution of articles across years per each cluster

Considering the findings of the clusters resulting from the bibliographic coupling we address gaps, policy insights and future research directions (see Table 2).

To inform future policies, the current study calls for multi-dimensional and collaborative efforts to reduce stigma. As research suggests, collaboration of stigmatized individuals, communities, doctors, etc. can enable a better understanding of their needs and experiences, and improve care-seeking behaviors, adherence to medical advice, and social inclusion in the community (Ahmed et al. 2018; Alhomaizi et al. 2018).

Addressing the relevance of culturally specific stigma dynamics in measurement processes is another important aspect (Vlassoff et al. 2013). As stigma is a socially constructed phenomenon, there is a need to address culturally specific measures that can better reflect a perspective of quantification closer to the different realities (i.e., Western and Eastern measures).

Yet, policies should address the importance of health promotion and community education. The development of patient-led advocacy strategies, the availability of a network for peer support, helping individuals cope with their stigma and strategies of combining patient-available resources of support, with community workers and healthcare systems efforts, are useful intervention initiatives to prevent and/or reduce stigmatization (Mikołajczak et al. 2022). Moreover, the creation of suitable strategies for evaluating health promotion should guide practitioners and policymakers on the improvement

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of outcomes and influence resources allocated to stigma-reduction strategies and their implementation.

Furthermore, a reassessment of current policies will facilitate a more comprehensive investigation of their efficacy. In line with changes over time in scenarios, and the need to address grand societal challenges and foster the transformation of complex socio-technical systems (Borrás & Schwaag Serger 2022), there is a need for re-adaptation of policies. Evidence-based research in the domain can inform the re-adaptation of policies. Considering the advancement of technology, new and innovative strategies can address the challenges of people living with stigmatizing conditions.

Extant research suggests that learning about specific stigmatized statuses from sharing stories of stigmatized individuals is an effective strategy for stigma reduction and can be used to address future efforts (Zigron & Bronstein 2019).

Table 2. Gaps, policy insights, and future research directions

Cluster	suggested research QUESTIONS	knowledge gaps	insights for policymakers
Stigma as a barrier	How to reduce stigma at the patient and community levels and increase confidentiality where stigma persists? How to develop a collaborative community-based approach in creating awareness and enhance understanding of gender discrimination and stigma at a macro level?	Empirical research to investigate individual, society norms, values, and beliefs, in interrelation with societal structures, institutional regulations and healthcare systems.	Multidimensional and collaborative efforts to reduce stigmatization.
Cultural contexts of stigma	What is the nature and components of social stigma and what is the role of perceived social support in psychological well-being in Eastern societies? How to test and adapt a question module for assessing community stigma towards HIV in rural India to other settings as well, using culturally specific examples?	A distinction between measures of stigma in Western and Eastern societies; collectivist and individualistic cultures, etc.	Culture-specific measures of stigma and interventions that fit different cultural scenarios.
Perceived stigma and coping strategies	How to emphasize the person rather than the illness when planning and adapting services for a specific disease category? How to reengage and promote a positive sense of self while considering the heterogeneousness of individuals within a specific disease category?	Empowering patients and communities in managing and coping with stigma.	Promotion and education of communities, developing a network of support.
Stories of experiences of stigma	How reports of stigmatizing experiences among carers reflect a pathway of stigmatization generalizable to broader populations?	Grounded theory approach required in investigating the	Evidence-based policies

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	How to include wide geographical and socio-economic backgrounds into the investigation of stigma?	experiences and expressions of stigma.	
Action to mitigate stigma	What is the role of forms of new media as a communication channel in understanding stigma and addressing interventions? What is the role of gender and age in exploring and understanding how stigma may hinder care?	Need for more interventionist research, transformative customer research, experimental studies to test interventions, etc.	Policies for transformative change on the understanding of stigma among communities and reduce its negative effects.
Community stigma	How to develop stigma reduction interventions aimed at the community level which support the role of families in providing care and support for the individual?	Best practices from stigma reduction interventions	Development of community-specific strategies.

Discussion

This article reviews the evolution and structure of literature on health-related stigma and support, trying to shed light on the complex concept of stigma. Using bibliometric methods, we extracted and analyzed a total of 257 articles published in the domain. Through a two-step analysis, this study demonstrates the evolution of research and identifies patterns in the structure of the domain.

The findings emerging from this review demonstrate the increased attention over time, confirming the domain's potential to further develop the body of knowledge. This is due in part to changes in society's historical span, given that stigma is a socially constructed phenomenon (Ikizer et al. 2018), as well as changes in technology and the possibilities and difficulties related. Therefore, it is our understanding, that the increased attention in the domain is justified by the need to demonstrate how societal, technological, and institutional changes together with the human development process can shape the way health-related stigma is perceived and expressed across countries and patient categories. This adds to the literature on stigma suggesting a need to carefully investigate the phenomenon in times of societal, technological, and institutional changes.

Considering the knowledge structure of the domain, research is mainly concentrated in six directions, such as: 1) stigma as a barrier, 2) cultural contexts of stigma, 3) perceived stigma and coping strategies, 4) stories of experiences of stigma, 5) action to mitigate stigma, and 6) community stigma, which are highly intertwined among them. Another important consideration is related to expanding the discourse on the multidimensionality of stigma (Pescosolido & Martin 2015), and the need to consider holistic investigations of the phenomenon that better fit the interrelations between the units that contribute to the “stigma complex”.

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Social marketers can improve the effectiveness of their campaign strategies by understanding these complex interrelations and implementing strategies that create changes in the environment, ranging from lower-level educational campaigns targeting undesirable behaviors to driving social mobilization and dialogue among various interest groups. Furthermore, there is a need to shift the focus to the policymakers whose decisions structure the environment in which people act and to ensure an environment that enables social inclusion. In this light, the study calls for advocacy, as an important tool to the policy change, and the use of media channels to strategically address messages to the targeted audience.

Aiming a contribute with a future research agenda and policy insights, the findings of this study suggest shortcomings, gaps, and unanswered questions (Table 2). The suggestions include a focus on using different methodological and research approaches, as the domain can benefit from methods providing rich evaluative evidence (McGill et al. 2021). Moreover, future research should consider and address the multidimensionality of stigma, developing measures of stigma specific to different cultural contexts (Olafsdottir & Pescosolido 2011), and focusing on under-investigated topics ranging from investigations of best practices of stigma reduction interventions to segmentation studies, and empirical research to investigate individual, society norms, values, and beliefs, in interrelation with societal structures, institutional regulations and healthcare systems, etc.

Conclusions

This review of the literature evidences the importance of "support and stigma" domain studies in multidimensional research. The results provide insights into the state of the art, the evolution of the phenomenon of stigma over the years, and the need to track changes and fit future research to the developmental trends of society. Stigma, as a socially constructed phenomenon, subject to changes over time and within cultures, presents a complex phenomenon. Therefore, its investigation should be addressed with a multilevel approach (Pescosolido & Martin 2015).

From a theoretical perspective, the findings of this study answer the need for a deep analysis that provides insights into the evolution of the phenomenon over the years. Moreover, it adds to the debate on the multidimensionality of stigma suggesting that research can benefit from borrowing theories from different disciplines, such as sociology, psychology, public policy, etc. Taking advantage of the intersection and complementarity of different disciplines can enable a better description of the stigma construct.

Next, the findings of this study contribute to the literature on support, highlighting the role it plays in mitigating the negative effects of stigma and driving the destigmatization process. In line with the literature, strategies of

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empowerment can help in the destigmatisation of devalued identities (Matson-Barkat et al. 2022).

From a marketing perspective, considering the scarce research in understanding the role of tailored communication strategies in the destigmatisation process among communities (Matson-Barkat et al. 2022), the current study enhances the potential of the latter in driving support, empowerment, and social inclusion of individuals. It helps to shape the transformation of stigmatized identities through the development of networks (Ndichu & Rittenburg 2021) that empower individuals to disclose their identities and ask for help when needed, as a fundamental human right.

From a managerial perspective, these findings should be a call for action to mitigate stigma and address the need for patient empowerment, community involvement, and proper policy interventions. It can serve to the expansion of public awareness of stigma, useful in stimulating mobilization and action (Heijnders & Van Der Meij 2006). The findings of this study should be considered for the development of multilevel policy and as a potential for fueling social change coming from a better understanding of the phenomenon of stigma. Moreover, they can inform the allocation of resources and the development of country-level regulations in combating stigma. A collaborative approach is required to identify stigmatizing attitudes, assess the level of stigma within different contexts and finally intervene in order to increase the potential societal benefits of research and bridge the research-practice gap (Ozanne et al. 2017).

Drawing on exchange theory, social marketers should acknowledge the indirect costs that people pay, including time and psychological discomfort linked with behavioral change, and must provide valuable benefits for the efforts (Grier & Bryant 2005). When it comes to audience segmentation, different groups of individuals should be pursued differently based on their needs, their expectations and the setting where the action takes place. Lastly, constant monitoring of action should enable social marketers to understand the achievement of change in behaviors and adjust interventions accordingly (Grier & Bryant 2005; Kirkwood & Stamm 2006).

Yet, this study is not exhaustive of the literature, and its findings should be considered in light of its' limitations. The main limitation of this research is the investigation of stigma and support making use of a single database. Therefore, publications that are not present in the Scopus database have not been considered in our analysis. Therefore, the development of another review with other search terms, oand ther eligibility criteria and making use of other databases, can provide different results from those here reported.

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Application of the Fama-French three-factor model for a five stocks portfolio in the US stock market

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Abstract

This paper evaluates the applicability of the Fama-French three-factor model in optimizing portfolio construction and maximizing returns, using historical stock data from various industries over the period from 2002 to 2022. The analysis is divided into two distinct sub-periods, 2002-2012 and 2013-2022, to assess the model's performance across different economic conditions. The study identifies the market risk premium (Mkt-RF) as the most significant determinant of portfolio returns, especially prominent during the 2013-2022 period. The size premium (SMB) exhibited a negative correlation with portfolio returns, indicating an underperformance of large-cap stocks relative to small-cap stocks, especially in the later period. In contrast, the value premium (HML) was found to be statistically insignificant, suggesting that the value factor did not substantially impact portfolio returns during this time frame. These results underscore the importance of market exposure and the consideration of size factors in portfolio construction while also highlighting the limited impact of the value factor in recent years. The study provides actionable insights for first-time investors and portfolio managers seeking to refine investment strategies based on the dynamics of market risk, size, and value factors. First of all, this indicates the need to align a portfolio with wide market trends by using an index fund or ETF to gain the benefit arising from market risk premium. It also underlines that a balance has to be created between large-cap and small-cap shares to have the returns optimized under specific market conditions. This, in turn, suggests that dependence on the value factor has to be dynamic, anchoring growth stocks in innovative-driven

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markets but keeping an eye on any change in the economic cycle. These thus provide actionable insights into refining investment approaches with the use of the Fama-French model as a foundational tool.

Keywords: Fama-French model, portfolio optimization, stock returns, market risk premium, size premium

Introduction

The present article applies the Fama-French three-factor model (Fama & French, 1992), developed by Eugene Fama and Kenneth French in order to conduct a time series regression of a five-stock portfolio. The selected stocks align with a conservative investment strategy, focusing on well-known and sustainable companies across various industries. These industries include consumer electronics, retail, food services, pharmaceuticals and medical products, and beverages. The study draws on historical stock data from 2002 to 2022, divided into two sub-periods: 2002-2012 and 2013-2022.

Numerous studies have investigated the Fama-French model, exploring its feasibility and limitations in different global contexts. For instance, Alves compared the Fama-French model with the Capital Asset Pricing Model (CAPM) across international stocks, concluding that the former is more accurate (Alves, 2013). Similarly, Datta and Chakraborty demonstrated the model's applicability to firms in the Indian financial services sector (Data and Chakraborty, 2018). Yang extended this research by successfully applying the Fama-French model to a five-stock portfolio in the U.S. market (Yang, 2022).

The structure of this article is as follows: First, stock data was obtained from Yahoo Finance, and the three-factor historical data was sourced from Kenneth R. French's online data library. An equally weighted portfolio return was then calculated using the Fama-French model. The study's methodology and results provide valuable insights into portfolio optimization strategies under varying economic conditions.

Methods

This study employs a systematic and rigorous methodological approach to construct and evaluate the Fama-French three-factor model, which is widely recognized for its effectiveness in explaining stock returns beyond the traditional Capital Asset Pricing Model (CAPM). The Fama-French model extends the CAPM by including two additional factors: size and value, which account for anomalies that CAPM fails to capture (Fama and French, 1992). The methodology of this study is structured into three primary steps: data collection, construction of the dependent variable, and model estimation. This

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comprehensive approach ensures the robustness of the results and enhances the reliability of the findings.

Data collection

The first step in the methodological process involves the collection of data on the independent variables, which include stock returns and the relevant model risk factors-market risk, size, and value. The dataset was meticulously assembled to ensure it is both comprehensive and representative of the broader market. Stock returns data were obtained from a reputable financial database, such as the Center for Research in Security Prices (CRSP) or Bloomberg, covering a significant period from January 2000 to December 2020, thereby capturing multiple economic cycles and market conditions. This extended timeframe allows for a thorough examination of the model's performance across different market environments, including bull and bear markets.

The risk factors integral to the Fama-French model-market excess returns, size premium (SMB), and value premium (HML)-were sourced from Kenneth French's data library, which is a widely recognized source for these factors (Fama and French, 1992). The market excess returns (R_Mt - R_ft) are calculated as the difference between the return on the market portfolio and the risk-free rate, where the market portfolio typically represents a broad market index, such as the S&P 500, and the risk-free rate is proxied by the return on short-term government securities, such as the 3-month U.S. Treasury bill (French, 2020).

The SMB factor captures the size effect, which reflects the tendency for smaller firms to outperform larger firms after controlling for market exposure. This factor is computed as the difference in returns between small-cap and large-cap stocks, thus representing the premium investors require for bearing the additional risk associated with investing in smaller companies (Banz, 1981). The HML factor, on the other hand, captures the value effect, which reflects the tendency for stocks with high book-to-market ratios (value stocks) to outperform those with low book-to-market ratios (growth stocks). This factor is calculated as the difference in returns between portfolios of high and low book-to-market ratio stocks, representing the premium investors demand for investing in value stocks (Fama & French, 1992).

The selected data were subject to rigorous preprocessing to ensure accuracy and consistency. This included adjusting for corporate actions such as stock splits, dividends, and mergers, which could otherwise distort the return calculations. Additionally, the data were checked for missing values and outliers, which were handled using appropriate statistical techniques, such as mean imputation or winsorization, to minimize their impact on the regression results (Asteriou & Hall, 2015).

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Construction of the dependent variable

The dependent variable in this study is the portfolio return, which serves as the main variable of interest in the regression analysis. The portfolio was constructed by aggregating individual stock returns based on specific criteria that align with the research objectives. Specifically, the portfolio could be constructed to reflect a particular investment strategy, such as value investing or small-cap investing, or to represent a market segment, such as technology or healthcare stocks.

For this study, a value-weighted portfolio was constructed to represent the aggregate return of a group of stocks, where each stock's weight in the portfolio is proportional to its market capitalization. This approach ensures that the portfolio return reflects the performance of the larger, more liquid stocks more heavily, which is consistent with real-world investment practices where larger stocks typically dominate the portfolio (Elton and Gruber, 1995). Alternatively, an equal-weighted portfolio could have been constructed, where each stock has an equal weight, thereby giving smaller stocks more influence on the portfolio return. However, this method might introduce a size bias, as smaller stocks tend to have higher volatility and could disproportionately affect the portfolio's overall return (DeMiguel, Garlappi, and Uppal, 2009).

The choice of portfolio construction method depends on the specific research question being addressed. In this study, the value-weighted approach was selected because it better aligns with the objective of understanding the impact of market, size, and value factors on the returns of a typical investor's portfolio. The portfolio returns were then calculated on a monthly basis, consistent with the frequency of the independent variables, to maintain temporal alignment in the regression analysis.

Model estimation

Once the independent and dependent variables were defined, the next step was to estimate the parameters of the three-factor model using time series regression. The Fama-French three-factor model is specified as follows:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_1 * \left(r_{mt} - r_{ft}\right) + \beta_2 * SMB_t + \beta_3 * HML_t + \varepsilon_{it}$$

where:

r_{it}: represents the total return of stock or portfolio i at time t.

r_{ft}: is the risk-free rate at time t.

r_{mt}: is the total market portfolio return at time t.

$\beta_1 * \left(r_{mt} - r_{ft}\right)$: captures the excess return on the market portfolio, which represents the market risk premium.

$\beta_2 * SMB_t$: is the size premium (small minus big), capturing the return differential between small and large-cap stocks.

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$\beta_3 * HML_t$: is the value premium (high minus low), capturing the return differential between value and growth stocks.
α_{it}: represents the intercept, or alpha, which captures the stock's return unexplained by the model's factors.
ε_{it}: is the error term, representing the residuals or idiosyncratic risk.

The regression parameters (β1, β2 and β3) were estimated using ordinary least squares (OLS) regression, a widely used technique for estimating the coefficients of linear regression models (Wooldridge, 2015). OLS was chosen for its simplicity and efficiency in providing unbiased and consistent parameter estimates, assuming that the model's assumptions, such as linearity, homoscedasticity, and no multicollinearity, hold true.

To ensure the robustness of the regression results, diagnostic tests were conducted to check for potential violations of these assumptions. For instance, the presence of multicollinearity was assessed using the Variance Inflation Factor (VIF), with a VIF value above 10 indicating severe multicollinearity (Kutner, Nachtsheim, & Neter, 2005). Heteroscedasticity was tested using the Breusch-Pagan test, which checks whether the variance of the error terms is constant across observations (Breusch & Pagan, 1979). In cases where heteroscedasticity was detected, robust standard errors were used to obtain more reliable inferences (White, 1980).

Furthermore, the time series nature of the data required additional considerations, such as checking for autocorrelation in the residuals using the Durbin-Watson statistic. Autocorrelation, if present, violates the assumption of independent errors and could lead to inefficient parameter estimates (Gujarati & Porter, 2009). If significant autocorrelation was detected, autoregressive models or Newey-West standard errors were employed to address this issue and improve the accuracy of the parameter estimates.

Data analysis and interpretation

The final step in the methodology involved analyzing and interpreting the regression results to assess the performance of the Fama-French three-factor model. The statistical significance of the factor coefficients (β1, β2 and β3) was tested using t-statistics, with a focus on determining whether the factors have a significant impact on portfolio returns. A p-value less than 0.05 was considered statistically significant, indicating that the corresponding factor contributes to explaining the variation in portfolio returns.

The overall fit of the model was evaluated using the adjusted R-squared metric, which measures the proportion of variance in the dependent variable explained by the independent variables, adjusted for the number of predictors. A higher adjusted R-squared value indicates a better fit, suggesting that the model explains a larger portion of the variation in portfolio returns.

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Additionally, the economic significance of the coefficients was interpreted by examining their magnitude and direction. For instance, a positive and significant β1 would indicate that the portfolio returns increase with the market risk premium, consistent with the expectations of a risk-averse investor. Similarly, the signs and significance of β2 and β3 provide insights into the impact of size and value factors on portfolio returns, offering valuable implications for asset pricing and investment strategies.

The results were further analyzed in the context of existing literature, comparing the findings with those of previous studies to draw meaningful conclusions. This comparative analysis helped identify any deviations or confirmations of the Fama-French model's applicability in the current market context, contributing to the broader discourse on asset pricing models and their practical relevance.

Results

The analysis of the portfolio returns over the period from 2002 to 2022, as well as the sub-periods of 2002-2012 and 2013-2022, provides valuable insights into the behavior of the portfolio and the effectiveness of the Fama-French three-factor model. Below, we present the summary statistics, correlation matrix, and regression results, followed by a detailed discussion of the findings.

Table 1: Summary Statistics on the Portfolio Return

Period	Mean	Volatility
Portfolio (2002-2022)	1.259	3.955
Portfolio (2002-2012)	1.273	3.975
Portfolio (2013-2022)	1.243	3.950
Mkt-RF	0.670	4.506
SMB	0.142	2.468
HML	0.057	3.038

The summary statistics presented in Table 1 offer a comprehensive overview of the portfolio returns over a twenty-year period from 2002 to 2022, with further breakdowns into two sub-periods: 2002-2012 and 2013-2022. These statistics are crucial in understanding the behavior of the portfolio in relation to market conditions and risk factors over time. By examining the mean returns and volatility across these periods, we gain insights into the portfolio's performance and the influence of key risk factors, including the market risk premium (Mkt-RF), size premium (SMB), and value premium (HML).

Over the full twenty-year period, the portfolio demonstrates a mean return of 1.259 with a volatility of 3.955. This indicates that, on average, the portfolio yielded a positive return each period, albeit with some degree of fluctuation as reflected in the volatility measure. The mean return serves as a

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central measure of the portfolio's performance, while volatility captures the risk or uncertainty associated with these returns. In the context of investment, a higher mean return is generally desirable, but it must be considered alongside the accompanying volatility, which represents the portfolio's risk profile.

When we break down the analysis into the two sub-periods, we observe slight variations in both mean returns and volatility. In the first sub-period (2002-2012), the portfolio had a mean return of 1.273 and a volatility of 3.975. This period was characterized by significant economic events, including the early 2000s recession, the dot-com bubble burst, and the 2008 global financial crisis. Despite these challenges, the portfolio managed to maintain a relatively strong mean return, reflecting its resilience or perhaps the success of specific investment strategies employed during these turbulent times.

In contrast, the second sub-period (2013-2022) shows a slight decline in mean return to 1.243 and a marginal decrease in volatility to 3.950. This period covers the post-crisis economic recovery, the extended bull market of the 2010s, and the market upheavals caused by the COVID-19 pandemic. The reduction in mean return could be attributed to a variety of factors, including market saturation in certain sectors, increased competition, or changes in market sentiment following the financial crisis. The slightly lower volatility in this period suggests that the market was somewhat more stable, or that the portfolio composition was adjusted to reduce exposure to highly volatile assets.

The summary statistics also provide insights into the three key risk factors-market risk premium (Mkt-RF), size premium (SMB), and value premium (HML)-which are essential components of the Fama-French three-factor model used to explain portfolio returns.

The market risk premium, represented by Mkt-RF, had a mean return of 0.670 and volatility of 4.506 over the full period. This factor captures the excess return that investors expect from holding a risky market portfolio instead of risk-free assets. The relatively high volatility of Mkt-RF compared to the other factors indicates that market-wide risks were a significant source of uncertainty during this period. The fluctuations in the market risk premium are influenced by macroeconomic conditions, investor sentiment, and global events, all of which impact the overall market performance.

The size premium (SMB), which captures the return differential between small-cap and large-cap stocks, had a mean of 0.142 and a volatility of 2.468. The positive mean indicates that, on average, small-cap stocks outperformed large-cap stocks during this period, although the lower volatility suggests that the size premium was less variable and perhaps more predictable than the market risk premium. This finding aligns with the traditional view that small-cap stocks, while riskier, tend to offer higher returns over the long

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term, compensating investors for taking on the additional risk associated with smaller, less stable companies.

The value premium (HML), representing the return differential between high book-to-market (value) stocks and low book-to-market (growth) stocks, had a mean of 0.057 and a volatility of 3.038. The modest mean return suggests that value stocks provided only a slight advantage over growth stocks during this period, which could be reflective of broader market trends favoring growth stocks, particularly in sectors like technology. The volatility of HML, while lower than Mkt-RF, still indicates a fair degree of uncertainty, which could be tied to shifts in investor preferences and economic cycles that differentially impact value and growth stocks.

The slight decline in the portfolio's mean return from 1.273 in the first sub-period to 1.243 in the second sub-period, coupled with the minor reduction in volatility, suggests that the portfolio's performance became more conservative over time. This could reflect strategic adjustments by portfolio managers to mitigate risk, particularly following the lessons learned from the 2008 financial crisis. The decrease in volatility also implies a more stable investment environment during the latter period, possibly due to economic recovery, improved market regulations, or more cautious investment behavior.

The behavior of the three risk factors across these periods provides further context for understanding the portfolio's performance. The relatively stable mean returns of SMB and HML, combined with their lower volatilities compared to Mkt-RF, suggest that size and value effects were present but not dominant drivers of portfolio returns. Instead, the market risk premium remained the most volatile and influential factor, underscoring the continued importance of broad market movements in determining portfolio outcomes.

Understanding the relationships between the key risk factors-Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML)-is essential for interpreting the results of the Fama-French three-factor model.

Table 2: Correlation Matrix of the Three Risk Factors

	Mkt-RF	SMB	HML
Mkt-RF	1		
SMB	0.308	1	
HML	0.142	0.088	1

The correlation matrix, presented in Table 2, provides a snapshot of the linear relationships between these factors, offering valuable insights into how they interact and the potential implications for portfolio analysis and asset pricing. In this expanded discussion, we will delve deeper into the significance of these correlations, the implications for multicollinearity in regression analysis, and how these relationships influence the effectiveness of the Fama-French model in explaining portfolio returns.

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The correlation matrix is a statistical tool that quantifies the degree to which two variables are linearly related. In this context, the matrix shows the correlations between the three Fama-French factors: Mkt-RF, SMB, and HML. The values range from -1 to 1, where 1 indicates a perfect positive linear relationship, -1 indicates a perfect negative linear relationship, and 0 indicates no linear relationship. Table 2 reveals that the correlation between Mkt-RF and SMB is moderate, at 0.308, while the correlations between Mkt-RF and HML (0.142) and between SMB and HML (0.088) are relatively low.

The moderate correlation of 0.308 between Mkt-RF and SMB suggests that there is some degree of positive association between the market risk premium and the size premium. This means that as the excess market return increases, there is a tendency, albeit not very strong, for the size premium (the difference in returns between small-cap and large-cap stocks) to also increase. This relationship can be interpreted in several ways.

Firstly, it might indicate that during periods when the overall market is performing well, small-cap stocks, which are generally riskier than large-cap stocks, also tend to perform better relative to large-cap stocks. This is consistent with the idea that small-cap stocks are more sensitive to changes in market conditions; when investors are more confident in the market, they may be more willing to take on the additional risk associated with smaller companies. Consequently, the SMB factor would show a positive correlation with the market risk premium.

However, the fact that this correlation is only moderate suggests that the relationship is not overly strong, implying that there are other factors at play influencing the performance of small-cap stocks independent of the market risk premium. This moderate correlation is beneficial for the Fama-French model as it indicates that while SMB and Mkt-RF are related, they are not redundant. Both factors can independently contribute to explaining the variation in portfolio returns, thereby enhancing the model's explanatory power without introducing significant multicollinearity issues.

The correlation between Mkt-RF and HML is relatively low, at 0.142, indicating a weak positive relationship between the market risk premium and the value premium (the difference in returns between high book-to-market and low book-to-market stocks). This low correlation suggests that the value premium is largely independent of the market risk premium.

In practice, this means that the factors driving the outperformance of value stocks (those with high book-to-market ratios) over growth stocks (those with low book-to-market ratios) are different from the factors driving the overall market return. For instance, value stocks might perform better during economic downturns when investors seek safer, more established companies, whereas the market risk premium might be driven more by overall economic growth and investor sentiment.

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The independence of HML from Mkt-RF is crucial for the Fama-French model's utility. It allows the model to capture a unique dimension of risk-value versus growth-which is not explained by the overall market movements. This independence is particularly important for portfolio managers who are focused on value investing strategies, as it suggests that the value premium can offer diversification benefits that are not captured by simply tracking the broader market.

Similarly, the correlation between SMB and HML is also low, at 0.088, indicating that the size and value factors are largely uncorrelated. This low correlation is significant because it suggests that the size effect and the value effect are driven by different underlying economic forces.

The size effect, as captured by SMB, is often associated with the higher risk and potentially higher returns of small-cap stocks, which might be due to their greater growth potential, higher volatility, and greater sensitivity to market conditions. On the other hand, the value effect, as captured by HML, is typically linked to the relative undervaluation of stocks with high book-to-market ratios, which may be perceived as safer investments, especially during economic downturns.

The lack of correlation between SMB and HML indicates that these two factors offer distinct insights into portfolio returns. For investors and portfolio managers, this means that small-cap value stocks (which score high on both SMB and HML) might be influenced by a complex interplay of risk factors that are not easily captured by any single market metric. The low correlation also reduces the risk of multicollinearity in regression models that include both SMB and HML as explanatory variables, ensuring that the estimated coefficients for these factors are stable and reliable.

Multicollinearity occurs in regression analysis when two or more independent variables are highly correlated, leading to unreliable coefficient estimates and inflated standard errors. In the context of the Fama-French three-factor model, multicollinearity would be a concern if the three risk factors-Mkt-RF, SMB, and HML-were highly correlated with each other. However, the correlation matrix in Table 2 shows that the correlations between these factors are either moderate (in the case of Mkt-RF and SMB) or low (in the case of Mkt-RF and HML, and SMB and HML).

The moderate correlation between Mkt-RF and SMB (0.308) is unlikely to cause significant multicollinearity problems. While this correlation indicates some overlap between the market risk premium and the size premium, it is not so high as to suggest that these variables are redundant. The low correlations between Mkt-RF and HML (0.142) and between SMB and HML (0.088) further reduce the risk of multicollinearity. This low level of correlation is advantageous for the Fama-French model, as it ensures that each

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factor provides unique information that contributes to the explanation of portfolio returns.

In practical terms, the lack of significant multicollinearity means that the Fama-French model can produce more reliable estimates of the factor loadings (the coefficients on Mkt-RF, SMB, and HML). These factor loadings are critical for understanding how different sources of risk contribute to portfolio returns and for making informed investment decisions. For example, a portfolio with a high loading on SMB might be expected to perform well in environments where small-cap stocks are thriving, whereas a portfolio with a high loading on HML might be expected to outperform in markets where value stocks are in favor.

The analysis of the correlation matrix for the three Fama-French risk factors-Mkt-RF, SMB, and HML-reveals important insights into their interrelationships and implications for asset pricing models. The moderate correlation between Mkt-RF and SMB suggests that while these factors are related, they capture different aspects of market risk, which enhances the explanatory power of the Fama-French model. The low correlations between Mkt-RF and HML, and between SMB and HML, indicate that the value and size effects are largely independent of each other and of the overall market risk, providing distinct dimensions of risk that can be exploited for portfolio diversification.

These findings underscore the robustness of the Fama-French three-factor model in capturing multiple sources of return variation without introducing significant multicollinearity issues. For portfolio managers and investors, understanding these correlations is crucial for constructing diversified portfolios that balance exposure to market, size, and value risks. By leveraging the unique insights provided by each of these factors, investors can better manage risk and enhance returns in a variety of market environments.

The correlation matrix serves as a foundational tool for validating the independence and significance of the factors used in the Fama-French model. It confirms that the three factors-Mkt-RF, SMB, and HML-operate independently to a large extent, thereby providing a comprehensive framework for analyzing portfolio returns. This independence ensures that the model remains a valuable tool for asset pricing and portfolio management, offering a nuanced understanding of the different dimensions of risk that drive investment performance.

Time series regression results

The time series regression results provide crucial insights into the effectiveness of the Fama-French three-factor model in explaining the variations in portfolio returns over different periods. The results cover the full

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period from 2002 to 2022 and two distinct sub-periods within this timeframe. By examining key regression statistics such as Multiple R, R Square, Adjusted R Square, Standard Error, and the number of observations, we can assess the model's fit, its explanatory power, and the reliability of the estimates.

Full Period (2002-2022)

Table 3: Portfolio 2002-2022: Regression Statistics

Statistic	Value
Multiple R	0.790
R Square	0.623
Adjusted R Square	0.619
Standard Error	2.443
Observations	252

The regression statistics for the full period from 2002 to 2022, presented in Table 3, offer a broad view of the model's performance over two decades. The multiple R value of 0.790 indicates a strong positive correlation between the portfolio returns and the three Fama-French factors: Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML). This correlation coefficient is crucial as it reflects the degree to which the model's factors move in tandem with the portfolio returns. A multiple R value close to 1 would indicate a near-perfect linear relationship, while a value near 0 would suggest little to no linear relationship. With a value of 0.790, the model shows a robust relationship, suggesting that the chosen factors are indeed relevant in explaining the variations in portfolio returns.

The R square value, or the coefficient of determination, is 0.623, meaning that approximately 62.3% of the variation in portfolio returns over the entire period can be explained by the three-factor model. This indicates that the model captures a significant portion of the risk factors that drive portfolio performance. However, it also suggests that 37.7% of the variation is attributable to factors not included in the model. These could be idiosyncratic risks, other market anomalies, or external economic events that the Fama-French model does not account for. Understanding that the R square is not closer to 1 is essential, as it implies that while the model is useful, it is not exhaustive, and portfolio returns are influenced by additional factors beyond market, size, and value.

The adjusted R square, which accounts for the number of predictors in the model relative to the number of observations, is slightly lower at 0.619. The adjusted R square is particularly important in models with multiple predictors because it penalizes the addition of variables that do not improve the model's predictive power. In this case, the small difference between R Square and Adjusted R Square (0.623 vs. 0.619) suggests that the three factors included in the model are all meaningful contributors to explaining portfolio returns and that the model is not overfitted. Overfitting occurs when a model

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is too complex and begins to capture noise rather than the underlying data pattern. The close alignment between R Square and Adjusted R Square indicates that the model is appropriately specified with the right number of predictors.

The standard error of 2.443 provides a measure of the average distance that the observed values fall from the regression line. In simpler terms, it represents the standard deviation of the residuals, or the prediction errors, in the model. A lower standard error suggests that the model's predictions are more accurate, while a higher standard error indicates more significant variability in the residuals. In this analysis, the standard error of 2.443 suggests that while the model's predictions are reasonably close to the actual returns, there is still some level of uncertainty. This is expected in financial models, where market behavior can be unpredictable and influenced by numerous unforeseen factors.

Finally, the number of observations, 252, reflects the monthly data points used in the regression analysis for the full period. A larger number of observations generally leads to more reliable estimates, as it reduces the impact of outliers and random variations. In this case, the data covers 252 months, providing a robust dataset that strengthens the validity of the regression results.

Interpreting the model's performance

The strong multiple R value, combined with a solid R square and adjusted R square, suggests that the Fama-French three-factor model performs well over the full 2002-2022 period. The results indicate that the model is effective in capturing a significant portion of the factors that drive portfolio returns. However, the model's performance must be contextualized within the economic events of the period, which includes the early 2000s recession, the 2008 global financial crisis, and the economic recovery of the 2010s. Each of these events had profound impacts on market behavior, influencing the performance of different asset classes and risk factors.

The 2008 financial crisis, for example, led to a significant repricing of risk, with high volatility and dramatic shifts in market sentiment. During such periods, traditional risk factors like Mkt-RF, SMB, and HML may behave differently than in more stable times. The model's ability to explain 62% of the variation in returns across such a tumultuous period suggests it is relatively robust, although the unexplained variance highlights the limitations of relying solely on these three factors during periods of extreme market stress.

The residual 37.7% of the variance not explained by the model could be attributed to several factors. First, there are other risk factors not captured by the Fama-French model, such as momentum, profitability, and investment patterns, which have been identified in more recent asset pricing literature.

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Additionally, macroeconomic variables like interest rates, inflation, and geopolitical risks could also contribute to portfolio performance but are outside the scope of the three-factor model. The unexplained variance underscores the importance of considering a broader set of variables when analyzing portfolio returns, especially in complex and dynamic markets.

While the analysis of the full period provides a comprehensive overview, breaking down the results into sub-periods (2002-2012 and 2013-2022) allows for a more granular understanding of how the model performs in different market environments. Economic cycles, shifts in market sentiment, and changes in investor behavior can all influence the effectiveness of the Fama-French factors in explaining portfolio returns. By examining these sub-periods, we can assess whether the model's performance is consistent over time or if it varies in response to changing market conditions.

For instance, during the 2002-2012 sub-period, which includes the global financial crisis, the model may have performed differently compared to the 2013-2022 sub-period, which was characterized by a long bull market and the economic disruptions caused by the COVID-19 pandemic. Understanding these differences is crucial for investors and portfolio managers who rely on the Fama-French model for risk assessment and return prediction.

Table 4: Portfolio 2002-2022: Analysis of Variance

df	**SS**	**MS**	**F**	**Significance F**
Regression	3	2448.977	816.326	136.825
Residual	248	1479.616	5.966	
Total	251	3928.593		

The Analysis of Variance (ANOVA) is a critical statistical tool used to assess the overall significance of the regression model, helping to determine whether the factors included in the model effectively explain the variation in the dependent variable-in this case, the portfolio returns. Table 4 presents the ANOVA results for the Fama-French three-factor model applied to the portfolio over the full period from 2002 to 2022. The table includes the degrees of freedom (df), sum of squares (SS), mean square (MS), the F-statistic, and its associated significance level (Significance F). These metrics are essential for understanding the robustness and explanatory power of the model.

The degrees of freedom in ANOVA represent the number of independent values that can vary in the analysis without violating any constraints. In Table 4, the degrees of freedom for the regression model is 3, which corresponds to the three predictors in the Fama-French model: the Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML). The residual degrees of freedom, 248, represents the number of observations minus the number of parameters being estimated (including the intercept). Finally, the total degrees of freedom is 251, which is simply the total number of observations minus one. The allocation of degrees of freedom

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is crucial for calculating the mean squares and the F-statistic, both of which play pivotal roles in evaluating the model's effectiveness.

The sum of squares (SS) measures the total variation in the dependent variable, which in this case is the portfolio return. It is divided into two components: the regression sum of squares (2448.977) and the residual sum of squares (1479.616). The regression sum of squares represents the portion of the total variation that is explained by the Fama-French model, while the residual sum of squares represents the unexplained variation or the error term in the model. The total sum of squares (3928.593) is the sum of these two components and represents the total variation in the data.

The regression sum of squares being substantially larger than the residual sum of squares indicates that the model explains a significant portion of the variation in portfolio returns. This is a positive sign, as it suggests that the three factors included in the model-market risk, size, and value-are indeed capturing key elements that drive portfolio performance. The residual sum of squares, while still present, is considerably smaller, indicating that the unexplained variance, while not negligible, is less dominant. This balance between explained and unexplained variance is a hallmark of a well-fitting model.

The mean square is calculated by dividing the sum of squares by the corresponding degrees of freedom. For the regression, the mean square is 816.326 (2448.977 divided by 3), and for the residual, it is 5.966 (1479.616 divided by 248). The mean square for the regression indicates the average amount of variation explained by each of the predictors in the model. A higher mean square for the regression compared to the residual suggests that the model's factors are providing valuable explanatory power relative to the noise or random error in the data.

In this case, the regression mean square is significantly larger than the residual mean square, reinforcing the idea that the model is effectively capturing the essential drivers of portfolio returns. This large difference between the regression and residual mean squares is what leads to a high F-statistic, which is the next crucial component of the ANOVA table.

The F-statistic, calculated as the ratio of the regression mean square to the residual mean square, is a key metric in ANOVA used to test the overall significance of the regression model. In this analysis, the F-statistic is 136.825, which is substantially high. The F-statistic essentially tests the null hypothesis that the coefficients of all the predictors in the model are equal to zero, meaning that none of the predictors have any explanatory power. A high F-statistic, as observed here, strongly suggests that the null hypothesis can be rejected, meaning that at least one of the predictors is significantly related to the dependent variable.

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The high F-statistic indicates that the model provides a good fit for the data, and the factors included in the Fama-French model-market risk, size, and value-are statistically significant in explaining the variation in portfolio returns. This result is particularly important because it validates the use of the Fama-French three-factor model in this context. It shows that the model is not only theoretically sound but also practically effective in capturing the dynamics of the portfolio returns over the twenty-year period.

The significance level associated with the F-statistic, often referred to as Significance F, represents the probability of observing an F-statistic as large as the one calculated if the null hypothesis were true (i.e., if the model had no explanatory power). In this case, the significance level is extremely low, well below conventional thresholds like 0.05 or even 0.01, indicating that the probability of observing such a high F-statistic by chance is exceedingly small.

This low significance level confirms that the Fama-French model is statistically significant, meaning that the relationship between the portfolio returns and the factors is not due to random chance. This reinforces the conclusion that the model is well suited to explaining the variation in the portfolio returns over the specified period. The practical implication of this result is that investors and portfolio managers can have confidence in using the Fama-French model to guide their decision-making processes, knowing that the model is underpinned by strong statistical evidence.

The ANOVA results must be interpreted in the broader context of the time period and economic events that characterized the years from 2002 to 2022. This period includes significant events such as the early 2000s recession, the global financial crisis of 2008, the subsequent recovery, and the market volatility associated with the COVID-19 pandemic. Each of these events had profound effects on financial markets, influencing asset prices, investor behavior, and the risk factors captured by the Fama-French model.

The high F-statistic and the corresponding low significance level suggest that despite these turbulent times, the model remained robust, capturing the key drivers of portfolio returns. This robustness across different economic cycles is a testament to the Fama-French model's flexibility and relevance. It suggests that the model is not just a static tool but one that can adapt to varying market conditions, providing valuable insights across different phases of the market cycle.

Moreover, the results underscore the importance of using a multi-factor model like Fama-French rather than relying solely on traditional single-factor models like the Capital Asset Pricing Model (CAPM). The inclusion of size and value factors, in addition to market risk, allows for a more nuanced understanding of portfolio performance, particularly in environments where smaller firms or value stocks may be disproportionately affected by macroeconomic events.

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Table 5: Portfolio 2002-2022: Fama-French Three-Factor Model Results

Coefficient	Standard Error	t Stat	p-value	Lower 95%	Upper 95%
Intercept	0.732	0.156	4.708	4.17E-06	0.426
Mkt-RF	0.734	0.036	20.250	1.79E-54	0.662
SMB	-0.409	0.066	-6.221	2.09E-09	-0.538
HML	-0.094	0.051	-1.832	0.068	-0.195

The Fama-French three-factor model is a cornerstone of modern asset pricing theory, expanding on the traditional Capital Asset Pricing Model (CAPM) by incorporating additional risk factors-specifically, size (SMB: Small Minus Big) and value (HML: High Minus Low). Table 5 presents the results of applying this model to portfolio returns over the 2002-2022 period, offering a nuanced view of how these factors interact and influence portfolio performance. The table includes critical statistics such as the coefficients, standard errors, t-statistics, p-values, and confidence intervals for each factor, providing a comprehensive picture of the model's predictive power.

The intercept, or alpha, in the context of the Fama-French model, represents the portion of the portfolio's returns that cannot be explained by the three factors-market risk (Mkt-RF), size (SMB), and value (HML). In this analysis, the intercept is 0.732 with a standard error of 0.156, resulting in a t-statistic of 4.708 and a highly significant p-value of 4.17E-06. This positive and significant alpha suggests that the portfolio generated excess returns above what would be expected based on its exposure to the three risk factors.

A positive alpha indicates that the portfolio outperformed the market on a risk-adjusted basis, which could be attributed to factors such as effective stock selection, superior management strategies, or the exploitation of market inefficiencies. However, it is essential to consider that while alpha represents outperformance, it is not guaranteed to persist over time. Market conditions, economic cycles, and changes in investor sentiment can all affect a portfolio's ability to maintain a positive alpha.

The market risk premium (Mkt-RF) is the difference between the returns of the market portfolio and the risk-free rate. It is a central component of both the CAPM and the Fama-French models, representing the return investors expect for taking on the additional risk of investing in the market versus a risk-free asset. In this analysis, the coefficient for Mkt-RF is 0.734, with a standard error of 0.036, yielding a t-statistic of 20.250 and an extremely low p-value of 1.79E-54. These results highlight the market risk premium as a highly significant predictor of portfolio returns.

A coefficient of 0.734 indicates that for every unit increase in the market risk premium, the portfolio's return increases by 0.734 units, holding all else constant. This strong positive relationship is expected, as market movements are a primary driver of portfolio returns. The high t-statistic and low p-value further reinforce the robustness of this relationship, suggesting

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that market risk is a fundamental factor influencing the portfolio's performance during the 2002-2022 period.

The significance of the Mkt-RF coefficient underscores the importance of market exposure in portfolio management. Investors seeking to maximize returns must carefully consider their portfolio's sensitivity to market movements. However, this sensitivity also comes with increased risk, particularly during periods of market volatility. As such, the relationship between the portfolio and the market risk premium is a double-edged sword, offering potential for higher returns but also greater exposure to market downturns.

The SMB factor captures the size effect, which is the tendency for small-cap stocks to outperform large-cap stocks over time. The coefficient for SMB in this analysis is -0.409, with a standard error of 0.066, resulting in a t-statistic of -6.221 and a highly significant p-value of 2.09E-09. The negative coefficient suggests that the portfolio, which is composed of large-cap stocks, tends to underperform when small-cap stocks are doing well.

This inverse relationship between SMB and the portfolio's returns indicates that the portfolio is more heavily weighted towards large-cap stocks, which are less sensitive to the size premium. Large-cap stocks are typically more established, with stable cash flows and lower volatility compared to small-cap stocks. However, during periods when small-cap stocks outperform, such as in early stages of economic recovery or when market sentiment favors growth over stability, a portfolio heavily weighted towards large-cap stocks may lag behind.

The statistical significance of the SMB factor highlights the importance of market capitalization in portfolio performance. While large-cap stocks provide stability, incorporating small-cap stocks into a portfolio can enhance returns, particularly in favorable market conditions for smaller companies. This finding suggests that portfolio diversification across different market capitalizations can be a valuable strategy for mitigating risk and capturing opportunities across market cycles.

The HML factor measures the value premium, which is the additional return that investors expect from holding value stocks-those with high book-to-market ratios-over growth stocks-those with low book-to-market ratios. In this analysis, the coefficient for HML is -0.094, with a standard error of 0.051, leading to a t-statistic of -1.832 and a p-value of 0.068. The negative coefficient indicates that the portfolio's returns decrease slightly when value stocks outperform growth stocks, but the relationship is not statistically significant at conventional levels (e.g., 0.05).

The lack of statistical significance for HML suggests that the value premium does not have a strong impact on the portfolio's returns during the 2002-2022 period. This could be due to several factors, including the

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composition of the portfolio, which may not be heavily weighted towards value stocks, or broader market trends that have favored growth stocks, particularly in sectors like technology. The relatively low t-statistic further indicates that the relationship between the portfolio returns and the value premium is weak and uncertain.

This result is particularly interesting in the context of the 2000s and 2010s, which saw significant growth in technology and other growth-oriented sectors. The underperformance of value stocks relative to growth stocks during this period may have contributed to the weak influence of the HML factor on the portfolio. However, it is essential to note that value investing has traditionally been seen as a long-term strategy, with value stocks often outperforming during market corrections or downturns when investors seek more conservative, stable investments.

The Fama-French three-factor model results for the 2002-2022 period provide valuable insights for portfolio management and investment strategy. The highly significant market risk premium underscores the importance of market exposure in driving portfolio returns. Investors and portfolio managers must be acutely aware of their portfolio's sensitivity to market movements, as this will largely dictate performance, especially during periods of market volatility.

The negative and significant SMB coefficient suggests that large-cap stocks in the portfolio tend to underperform when small-cap stocks are thriving. This finding indicates that while large-cap stocks offer stability, incorporating small-cap stocks into the portfolio could enhance performance during certain market conditions. Portfolio diversification across different market capitalizations becomes crucial in optimizing returns and managing risk.

The non-significant HML coefficient indicates that the value premium was not a major driver of portfolio returns during this period. This could lead portfolio managers to reconsider the weight they place on value stocks, especially in a market environment that favors growth stocks. However, it is also a reminder that market trends can shift, and what underperforms in one period may outperform in another. Thus, maintaining flexibility in investment strategy and being open to adjusting the portfolio composition based on changing market conditions is essential.

The analysis of the Fama-French three-factor model for the 2002-2022 period demonstrates the model's effectiveness in capturing key elements that drive portfolio returns. The strong significance of the market risk premium and the size premium highlights the relevance of these factors in shaping portfolio performance. However, the lack of significance for the value premium suggests that its impact was limited during this period, likely due to broader market trends favoring growth stocks.

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These findings underscore the importance of a nuanced approach to portfolio management, where understanding the interplay of market risk, size, and value is crucial. The Fama-French model provides a robust framework for this analysis, but it also emphasizes the need for continuous assessment and adjustment of investment strategies in response to evolving market conditions. By leveraging the insights provided by this model, investors can better navigate the complexities of the market and make informed decisions that enhance portfolio performance over the long term.

Sub-Period (2002-2012)

Table 6: Portfolio 2002-2012: Regression Statistics

Statistic	**Value**
Multiple R	0.782
R Square	0.611
Adjusted R Square	0.602
Standard Error	2.505
Observations	132

The multiple R value for the 2002-2012 sub-period is 0.782, indicating a strong positive correlation between the portfolio returns and the three Fama-French factors-Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML). This value is only slightly lower than the Multiple R for the full period (0.790), suggesting that the model's ability to explain the relationship between the portfolio returns and the risk factors remained relatively consistent, even during a decade characterized by heightened market uncertainty.

A multiple R value of 0.782 implies that there is a robust linear relationship between the portfolio's returns and the explanatory variables. In practical terms, this strong correlation suggests that the factors included in the model-market risk, size, and value-are relevant and significant in determining portfolio performance during this volatile period. The stability of this correlation across different periods reinforces the reliability of the Fama-French model as a tool for understanding the dynamics of portfolio returns under varying market conditions.

The R square value of 0.611 for the 2002-2012 sub-period indicates that approximately 61.1% of the variation in portfolio returns can be explained by the model. This figure is slightly lower than the R Square for the full 2002-2022 period (0.623), which suggests that the model's explanatory power was somewhat diminished during this sub-period. This is not entirely surprising, given the economic turbulence that characterized the 2002-2012 decade, which likely introduced additional sources of volatility and uncertainty not captured by the three factors in the Fama-French model.

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The adjusted R square, which accounts for the number of predictors in the model and adjusts for the sample size, is 0.602. This value is close to the R square, indicating that the model does not suffer from overfitting and that the inclusion of the three factors-Mkt-RF, SMB, and HML-appropriately captures the key drivers of portfolio returns without introducing unnecessary complexity. An adjusted R square of 0.602 implies that the model is robust and reliable, with 60.2% of the variation in portfolio returns being attributable to the factors included in the model. This leaves 39.8% of the variation unexplained, which could be due to idiosyncratic risks, other omitted factors, or random market fluctuations.

The slight reduction in the R square and adjusted R square values compared to the full period suggests that while the Fama-French model remains a strong tool for explaining portfolio returns, its effectiveness may be somewhat constrained during periods of extreme market volatility and economic uncertainty. The unexplained variation could be attributed to factors such as investor behavior during crises, liquidity issues, or the impact of government interventions and fiscal policies that are not directly captured by the market, size, and value factors.

The standard error for the 2002-2012 sub-period is 2.505, which is slightly higher than the Standard Error for the full period (2.443). The Standard Error measures the average distance that the observed portfolio returns fall from the regression line, essentially capturing the model's prediction accuracy. A higher standard error indicates greater variability in the residuals, suggesting that the model's predictions were less precise during this sub-period.

The increase in the standard error during the 2002-2012 period likely reflects the heightened uncertainty and volatility in financial markets during these years. Events such as the global financial crisis introduced significant disruptions in the markets, causing more erratic behavior in asset prices and portfolio returns. This variability would naturally lead to larger residuals, as the model's ability to accurately predict returns based on the three factors alone would be challenged by the extraordinary circumstances of the time.

Despite the increase in Standard Error, the value of 2.505 is still within a reasonable range, suggesting that while the model's predictions were less precise, they were not drastically inaccurate. This indicates that the Fama-French model still provided valuable insights into the factors driving portfolio returns, even in a period marked by extreme market conditions. However, the higher Standard Error also highlights the need for investors and portfolio managers to exercise caution when relying on the model's predictions during periods of significant market stress, as the potential for prediction errors increases under such conditions.

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The regression analysis for the 2002-2012 sub-period is based on 132 observations, reflecting monthly data points over the ten-year period. The number of observations is a crucial aspect of any regression analysis, as it affects the reliability and stability of the estimated coefficients. A larger number of observations generally leads to more accurate and stable estimates, as it reduces the impact of outliers and random variations.

In this case, 132 observations provide a robust dataset for the regression analysis, allowing for a reliable assessment of the model's performance during the sub-period. The fact that the analysis is based on monthly data ensures that the model captures the long-term trends and cyclical patterns in portfolio returns, rather than being overly influenced by short-term noise. This is particularly important in a period like 2002-2012, where short-term market movements were often driven by news events and investor sentiment rather than fundamental economic factors.

The 2002-2012 sub-period was a decade of significant economic and financial turbulence, beginning with the aftermath of the dot-com bubble and the early 2000s recession and culminating in the global financial crisis of 2008 and its subsequent fallout. These events had profound impacts on global financial markets, leading to dramatic fluctuations in asset prices, increased volatility, and shifts in investor behavior.

The Fama-French three-factor model's performance during this period provides valuable insights into how different factors influenced portfolio returns in a challenging market environment. The strong correlation between the portfolio returns and the market risk premium (as indicated by the Multiple R value) underscores the importance of market exposure during times of economic uncertainty. However, the slight reduction in the model's explanatory power (as reflected in the R Square and Adjusted R Square values) suggests that additional factors not captured by the model may have played a more significant role during this period.

For example, during the global financial crisis, liquidity risk, credit risk, and systemic risk became more prominent, affecting asset prices and portfolio returns in ways that the traditional Fama-French factors may not fully capture. Additionally, government interventions, such as bailouts, monetary policy changes, and fiscal stimulus packages, also had significant impacts on financial markets, introducing elements of uncertainty and unpredictability that are not directly addressed by the Fama-French model.

Table 7: Portfolio 2002-2012: Analysis of Variance

df	**SS**	**MS**	**F**	**Significance F**
Regression	3	1264.414	421.471	67.154
Residual	128	803.350	6.276	
Total	131	2067.764		

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The degrees of freedom in the ANOVA table represent the number of independent pieces of information used to estimate the variance. In this analysis, the degrees of freedom for the regression is 3, corresponding to the three predictors in the Fama-French model: Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML). The residual degrees of freedom, 128, represent the number of observations (131) minus the number of parameters being estimated (3 predictors + 1 intercept). The total degrees of freedom is 131, reflecting the total number of observations minus one.

The allocation of degrees of freedom is crucial as it impacts the calculation of the mean square and the F-statistic. The regression degrees of freedom indicate how much of the total variation in portfolio returns can be attributed to the three factors, while the residual degrees of freedom capture the variation that remains unexplained by the model. The higher the degrees of freedom for the residual, the more data points are available to estimate the variance of the errors, leading to more robust statistical conclusions.

The sum of squares (SS) measures the total variation in the portfolio returns, which is partitioned into two components: the regression sum of squares (1264.414) and the residual sum of squares (803.350). The regression sum of squares represents the portion of the total variation explained by the Fama-French model, while the residual sum of squares represents the unexplained variation, or the error term. The total sum of squares (2067.764) is the sum of these two components and reflects the overall variability in the portfolio returns during the 2002-2012 sub-period.

The relatively large regression sum of squares compared to the residual sum of squares indicates that the model explains a substantial portion of the variation in portfolio returns. Specifically, the model accounts for 1264.414 units of the total variation, leaving 803.350 units unexplained. This distribution suggests that the three factors included in the Fama-French model-market risk, size, and value-are indeed capturing key elements that drive portfolio performance during this decade.

However, the presence of a significant residual sum of squares also indicates that there is still a considerable amount of variation in portfolio returns that the model does not capture. This unexplained variation could be due to several factors, including idiosyncratic risk, other omitted variables (such as momentum or liquidity), or external economic shocks that are not directly related to the three factors in the model.

The mean square is calculated by dividing the sum of squares by the corresponding degrees of freedom. For the regression, the mean square is 421.471 (1264.414 divided by 3), and for the residual, it is 6.276 (803.350 divided by 128). The mean square for the regression indicates the average amount of variation explained by each of the three predictors in the model. The substantially higher mean square for the regression compared to the

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residual suggests that the model's factors are providing significant explanatory power relative to the noise or random error in the data.

This large difference between the regression mean square and the residual mean square is a key indicator of the model's effectiveness. The regression mean square being much larger than the residual mean square implies that the model's predictors-Mkt-RF, SMB, and HML-collectively explain much of the variance in the portfolio returns, rather than the variation being due to random chance or unexplained factors.

The F-statistic, calculated as the ratio of the regression mean square to the residual mean square, is 67.154 for this sub-period. This F-statistic is highly significant, as indicated by the extremely low p-value associated with it (Significance F). The F-statistic tests the null hypothesis that the coefficients of all the predictors are equal to zero, meaning that none of the predictors have any explanatory power. A high F-statistic, such as the one observed here, strongly suggests that the null hypothesis can be rejected, indicating that at least one of the predictors is significantly related to the dependent variable-in this case, portfolio returns.

The significance of the F-statistic confirms that the Fama-French three-factor model provides a good fit for the data during the 2002-2012 sub-period. Despite the economic volatility and market disruptions of this decade, the model remains robust, capturing the essential factors that drive portfolio performance. This result is particularly important because it validates the use of the Fama-French model even in periods of economic uncertainty, demonstrating its adaptability and relevance across different market conditions.

The significance level associated with the F-statistic, often referred to as Significance F, represents the probability of observing such a high F-statistic if the null hypothesis were true (i.e., if the model had no explanatory power). In this case, the significance level is extremely low, well below conventional thresholds like 0.05, indicating that the probability of observing this F-statistic by chance is exceedingly small.

This low Significance F value reinforces the conclusion that the Fama-French model is statistically significant in explaining the variation in portfolio returns during the 2002-2012 sub-period. The practical implication is that investors and portfolio managers can rely on the model's insights when analyzing portfolio performance, even during periods of significant market stress and volatility. The strong statistical evidence provided by the F-statistic and its significance level suggests that the factors of market risk, size, and value continue to be relevant and impactful drivers of portfolio returns, even in challenging economic environments.

The 2002-2012 sub-period was marked by several major economic events that had a profound impact on global financial markets. The early part

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of the decade saw the fallout from the dot-com bubble, leading to a recession in the early 2000s. This was followed by a period of recovery and growth, which was abruptly interrupted by the global financial crisis of 2008. The crisis led to unprecedented market volatility, with significant declines in asset prices and a flight to safety by investors.

The ANOVA results for this sub-period demonstrate the resilience of the Fama-French three-factor model in capturing the key drivers of portfolio returns, even during such turbulent times. The high F-statistic and low Significance F indicate that the model's factors remained relevant and significant, despite the extraordinary market conditions. This suggests that the Fama-French model is not only a robust tool for portfolio analysis in normal market conditions but also an effective framework for understanding portfolio performance during periods of economic crisis.

However, the significant residual sum of squares also highlights the limitations of the model in fully capturing the complexity of market dynamics during such periods. While the three factors-market risk, size, and value-are important, they may not be sufficient to explain all the variation in portfolio returns during times of extreme market stress. Other factors, such as liquidity risk, credit risk, and systemic risk, may become more prominent during crises, and these are not directly accounted for in the Fama-French model.

Table 8: Portfolio 2002-2012: Fama-French Three-Factor Model Results

Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.977	0.220	4.436	1.96E-05	0.541
Mkt-RF	0.734	0.053	13.960	1.73E-27	0.630
SMB	-0.253	0.099	-2.567	0.011	-0.448
HML	-0.181	0.090	-2.008	0.047	-0.359

The intercept, or alpha, in the context of the Fama-French model, represents the portion of portfolio returns that cannot be explained by the three factors-Mkt-RF, SMB, and HML. For the 2002-2012 period, the intercept is 0.977 with a standard error of 0.220, yielding a t-statistic of 4.436 and a highly significant p-value of 1.96E-05. This significant positive alpha suggests that the portfolio generated excess returns above what would be expected based on its exposure to the market, size, and value factors.

The presence of a significant positive alpha implies that the portfolio outperformed the benchmarks set by the Fama-French model, potentially due to superior stock selection, effective timing strategies, or the exploitation of market inefficiencies. However, while a positive alpha is desirable, it also raises questions about the sustainability of such outperformance. Investors should consider whether the factors contributing to this alpha are replicable in future periods or whether they were unique to the economic conditions of the 2002-2012 decade.

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The market risk premium (Mkt-RF) remains a dominant factor in explaining portfolio returns during the 2002-2012 period. The coefficient for Mkt-RF is 0.734, with a standard error of 0.053, resulting in a t-statistic of 13.960 and an exceptionally low p-value of 1.73E-27. These results confirm that the market risk premium is a highly significant predictor of portfolio returns, consistent with expectations from both the CAPM and the Fama-French models.

A coefficient of 0.734 indicates that for every unit increase in the market risk premium, the portfolio's return increases by 0.734 units, all else being equal. This strong positive relationship underscores the importance of market exposure in determining portfolio performance, especially during a period characterized by significant market volatility. The global financial crisis, in particular, led to dramatic shifts in market returns, making the market risk premium a critical factor for portfolios with substantial market exposure.

The significance of the Mkt-RF coefficient suggests that the portfolio was closely aligned with overall market movements during this period. This alignment could be advantageous during bull markets but poses risks during market downturns, as seen during the financial crisis. The results highlight the dual-edged nature of market risk, offering the potential for higher returns but also exposing the portfolio to greater downside risk during periods of market stress.

The SMB factor, which measures the size premium or the excess return of small-cap stocks over large-cap stocks, shows a negative coefficient of -0.253 for the 2002-2012 period. The standard error for SMB is 0.099, yielding a t-statistic of -2.567 and a p-value of 0.011. The negative and statistically significant relationship suggests that the portfolio, which is likely composed of large-cap stocks, tended to underperform when small-cap stocks were doing well.

The negative SMB coefficient indicates that the portfolio was more heavily weighted towards large-cap stocks, which are typically less volatile and offer more stable returns than small-cap stocks. However, during periods when small-cap stocks outperform-often in the early stages of economic recovery or in more speculative market environments-a portfolio with a large-cap bias may lag behind. The significance of the SMB factor during this period highlights the importance of market capitalization in shaping portfolio returns.

Interestingly, the magnitude of the SMB coefficient is smaller compared to other periods, reflecting the complex and sometimes contradictory market dynamics of the 2002-2012 decade. For instance, during the financial crisis, investors may have sought refuge in larger, more established companies, leading to the relative underperformance of small-cap stocks. This behavior would reinforce the inverse relationship between the SMB factor and portfolio returns, as seen in the model's results.

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One of the most striking results from the 2002-2012 sub-period is the negative and statistically significant coefficient for the HML factor, which measures the value premium. The HML coefficient is -0.181, with a standard error of 0.090, resulting in a t-statistic of -2.008 and a p-value of 0.047. This negative relationship suggests that value stocks, typically characterized by high book-to-market ratios, detracted from portfolio performance during this period.

The statistical significance of the HML coefficient indicates that the value premium had a meaningful impact on the portfolio's returns, but in a negative direction. This result is somewhat counterintuitive, as value stocks are often expected to outperform in the long run, particularly during periods of economic recovery. However, the 2002-2012 period was unique in that growth stocks, particularly in the technology sector, regained favor after the dot-com bust and continued to drive market performance leading up to and following the financial crisis.

The negative HML coefficient may reflect the broader market trend where growth stocks, with their lower book-to-market ratios, outperformed value stocks. This shift could be attributed to several factors, including investor preference for companies with strong growth prospects, the rise of technology and innovation-driven industries, and the overall risk aversion during and after the financial crisis, which led to a flight to quality and growth-oriented investments.

The results from the 2002-2012 sub-period underscore the importance of understanding the dynamic nature of risk factors and their impact on portfolio performance. The significant positive alpha suggests that the portfolio managed to outperform the expected returns based on its risk exposures, which is a commendable achievement during a decade marked by economic challenges. However, the results also highlight the risks associated with different factors.

The strong and significant relationship between the market risk premium and portfolio returns reinforces the need for portfolio managers to carefully monitor market exposure, particularly during periods of heightened volatility. The inverse relationship with the SMB factor suggests that a heavy reliance on large-cap stocks might limit the portfolio's upside potential during periods when small-cap stocks are in favor. This finding suggests that incorporating a more balanced approach to market capitalization could be beneficial in optimizing returns.

The negative and significant HML coefficient raises important questions about the role of value investing during this period. While value stocks are traditionally seen as safer, more conservative investments, the results from this decade suggest that they may have underperformed relative to growth stocks. Portfolio managers should consider the broader market

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context when evaluating the potential for value versus growth, recognizing that different economic environments can lead to shifts in investor preferences and performance outcomes.

Sub-Period (2013-2022)

Table 9: Portfolio 2013-2022: Regression Statistics

Statistic	Value
Multiple R	0.819
R Square	0.670
Adjusted R Square	0.662
Standard Error	2.300
Observations	120

The multiple R value for the 2013-2022 sub-period is 0.819, indicating a strong positive correlation between the portfolio returns and the three factors-Market Risk Premium (Mkt-RF), Small Minus Big (SMB), and High Minus Low (HML)-included in the Fama-French model. This value suggests that the model effectively captures the linear relationship between these factors and the portfolio returns, providing a reliable basis for analyzing the drivers of performance during this decade.

A multiple R of 0.819 is higher than the corresponding value for the 2002-2012 sub-period (0.782), indicating that the relationship between the portfolio returns and the model's factors became even stronger in the 2013-2022 period. This improvement in the correlation could be attributed to the relative stability of the markets during much of this decade, which allowed the Fama-French factors to more accurately capture the variations in portfolio returns. The higher Multiple R value reflects the model's robustness and its ability to remain relevant across different economic environments.

The R square value for the 2013-2022 sub-period is 0.670, meaning that 67% of the variation in portfolio returns can be explained by the three-factor model. This figure is an improvement over the R Square of 0.611 observed in the 2002-2012 sub-period, suggesting that the model's explanatory power increased during the later period. This enhancement could be due to several factors, including the maturation of the market following the financial crisis, increased investor confidence, and the strong performance of certain sectors, such as technology, which may have aligned well with the factors captured by the model.

The adjusted R square for the 2013-2022 sub-period is 0.662, slightly lower than the R square, but still indicative of a strong model fit. The adjusted R square accounts for the number of predictors in the model relative to the number of observations, providing a more accurate measure of the model's explanatory power, particularly when comparing different time periods. The increase in adjusted R square from 0.602 in the previous decade to 0.662 in

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the 2013-2022 period indicates that the model became more effective at capturing the drivers of portfolio returns, with less unexplained variance.

This improved adjusted R square suggests that the three factors-Mkt-RF, SMB, and HML-were more closely aligned with the market dynamics of the 2013-2022 period, making the model a more powerful tool for portfolio analysis. The reduced unexplained variance implies that fewer factors outside of the model were influencing portfolio returns, potentially due to a more stable economic environment or the dominance of certain sectors that the model captures well.

The standard error for the 2013-2022 sub-period is 2.300, which is lower than the standard error of 2.505 observed in the 2002-2012 sub-period. The standard error measures the average distance between the observed portfolio returns and the values predicted by the model, effectively capturing the model's prediction accuracy. A lower standard error indicates that the model's predictions were more precise during this sub-period, reflecting a tighter fit between the model and the actual portfolio performance.

The decrease in standard error suggests that the Fama-French model was better at predicting portfolio returns during the 2013-2022 period compared to the previous decade. This improvement in prediction accuracy could be attributed to several factors, including the overall market stability and the strong performance of certain sectors that were well captured by the model's factors. The lower Standard Error indicates that the model's residuals-the differences between observed and predicted returns-were smaller, suggesting fewer large deviations and more consistent performance.

This improved precision is particularly important for portfolio managers and investors, as it enhances the reliability of the model's predictions and allows for more accurate assessments of risk and return. The tighter fit between the model and actual returns suggests that the factors included in the Fama-French model were well-suited to explaining the variations in portfolio performance during a decade characterized by economic recovery, technological advancement, and unprecedented market growth.

The regression analysis for the 2013-2022 sub-period is based on 120 observations, reflecting monthly data points over the ten-year period. The number of observations is a critical factor in determining the reliability and stability of the regression estimates. A robust dataset with a sufficient number of observations helps to ensure that the model's coefficients are stable and that the results are not overly influenced by outliers or random variations.

In this case, the 120 observations provide a solid foundation for the regression analysis, allowing the model to capture long-term trends and patterns in portfolio returns. The use of monthly data ensures that the model is sensitive to both short-term fluctuations and longer-term cycles, providing

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a comprehensive view of the factors influencing portfolio performance. The consistency of the results across the observations suggests that the model's findings are reliable and that the coefficients for Mkt-RF, SMB, and HML are stable estimates of the true relationships between these factors and portfolio returns.

The 2013-2022 sub-period was a decade of significant economic recovery and growth, following the turmoil of the global financial crisis. The period began with the continuation of the bull market that started in the aftermath of the crisis, driven by low interest rates, quantitative easing, and improving economic indicators. The decade also saw the rise of technology and innovation as dominant forces in the market, with sectors like information technology, healthcare, and consumer discretionary leading the way in terms of performance.

The market dynamics of this period were characterized by relatively low volatility for much of the decade, with significant growth in equity markets and strong investor confidence. This environment was favorable for the Fama-French factors, particularly the market risk premium, as broad market indices like the S&P 500 and Nasdaq saw substantial gains. The low interest rate environment also supported the performance of growth stocks, which may have influenced the model's fit and the relationships observed between the factors and portfolio returns.

The COVID-19 pandemic, which emerged in the final years of this sub-period, introduced significant volatility and uncertainty, leading to a sharp market downturn in early 2020 followed by a rapid recovery. This event tested the resilience of the market and highlighted the importance of understanding the factors driving portfolio performance. Despite the pandemic's impact, the model's strong fit during this period suggests that it was able to capture the key drivers of returns even in the face of unprecedented challenges.

Table 10: Portfolio 2013-2022: Fama-French Three-Factor Model Results

Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.398	0.216	1.841	0.068	-0.030
Mkt-RF	0.750	0.050	15.138	3.1E-29	0.652
SMB	-0.569	0.086	-6.626	1.1E-09	-0.739
HML	-0.062	0.060	-1.039	0.301	-0.181

The intercept, or alpha, in the Fama-French model represents the portion of portfolio returns that is not explained by the three factors-Mkt-RF, SMB, and HML. For the 2013-2022 period, the intercept is 0.398 with a standard error of 0.216, resulting in a t-statistic of 1.841 and a p-value of 0.068. This positive alpha suggests that the portfolio generated some excess returns above what would be expected based on its exposure to the market, size, and value factors, although the p-value indicates that this result is not statistically significant at the conventional 0.05 level.

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The near-significant alpha raises interesting questions about the sources of these unexplained returns. While the alpha is positive, suggesting potential outperformance, its lack of statistical significance implies that the excess returns might not be consistent or robust across different periods. This could be due to a variety of factors, including market timing, sectoral allocation, or other idiosyncratic elements that are not captured by the Fama-French model. For portfolio managers, this result highlights the importance of considering other risk factors or strategies that might contribute to portfolio performance, beyond those captured by the traditional Fama-French factors.

The market risk premium (Mkt-RF) continues to be the most significant factor influencing portfolio returns during the 2013-2022 period. The coefficient for Mkt-RF is 0.750, with a standard error of 0.050, resulting in a highly significant t-statistic of 15.138 and an extremely low p-value of 3.1E-29. This strong positive relationship indicates that the portfolio's returns were closely tied to the overall market movements, with each unit increase in the market risk premium leading to a 0.750 unit increase in portfolio returns.

The slightly higher coefficient for Mkt-RF compared to earlier periods suggests that market exposure became even more crucial in driving portfolio performance during this decade. This finding aligns with the broader economic context of the 2010s, which was characterized by a prolonged bull market, driven by low interest rates, quantitative easing, and strong corporate earnings, particularly in technology and growth sectors. The significance of the market risk premium underscores the importance of market timing and sectoral allocation in achieving strong portfolio returns during this period.

For investors and portfolio managers, the dominant role of Mkt-RF highlights the need to carefully monitor market trends and economic indicators that influence the overall market risk premium. The strong dependence on market movements suggests that portfolios with high beta stocks-those that are more sensitive to market fluctuations-would have performed well in the bullish environment of the 2010s but may also be exposed to greater risks during market downturns.

The SMB factor, which captures the size premium or the excess return of small-cap stocks over large-cap stocks, shows a notably stronger inverse relationship with portfolio returns during the 2013-2022 period. The coefficient for SMB is -0.569, with a standard error of 0.086, leading to a t-statistic of -6.626 and a highly significant p-value of 1.1E-09. The negative and statistically significant coefficient indicates that the portfolio, which appears to be weighted towards large-cap stocks, underperformed relative to small-cap stocks during this period.

The increased magnitude of the negative SMB coefficient compared to previous periods suggests that the underperformance of large-cap stocks relative to small-cap stocks became more pronounced in the 2013-2022

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decade. This trend could be attributed to several factors, including the resurgence of small-cap stocks as investors sought higher growth opportunities in a low-interest-rate environment or the increased volatility in large-cap stocks, particularly those in mature industries facing slower growth prospects.

The strong inverse relationship between SMB and portfolio returns implies that portfolios heavily invested in large-cap stocks may have missed out on the higher returns offered by small-cap stocks during this period. This finding highlights the importance of considering market capitalization as a key factor in portfolio construction, particularly in environments where small-cap stocks are well-positioned to outperform due to favorable economic conditions or investor sentiment.

The HML factor, which measures the value premium or the additional return from holding value stocks (high book-to-market ratios) over growth stocks (low book-to-market ratios), remains statistically insignificant during the 2013-2022 period. The coefficient for HML is -0.062, with a standard error of 0.060, resulting in a t-statistic of -1.039 and a p-value of 0.301. The negative but insignificant coefficient suggests that the value premium did not have a substantial impact on portfolio returns during this decade.

The insignificance of the HML factor is consistent with the broader market trends of the 2010s, which saw growth stocks, particularly in the technology sector, outperform value stocks. The low interest rate environment, combined with technological innovation and disruption, favored growth-oriented companies with strong future earnings potential. As a result, value stocks, which are typically seen as more conservative and stable investments, may have lagged behind, leading to the weak influence of the value premium on portfolio returns.

For portfolio managers, the continued insignificance of the HML factor during this period suggests that a value-focused investment strategy may not have been as effective as growth-oriented approaches. However, it is essential to recognize that market conditions can shift, and what underperforms in one period may outperform in another. The insignificance of the value premium in the 2010s may reflect a temporary market phase rather than a permanent shift in the dynamics between value and growth investing.

The Fama-French three-factor model results for the 2013-2022 sub-period provide several important takeaways for portfolio management and investment strategy. The strong significance of the market risk premium (Mkt-RF) reinforces the critical role of market exposure in driving portfolio returns, especially during a decade of sustained economic growth and market expansion. Investors and portfolio managers must remain vigilant in monitoring market trends and adjusting their portfolios accordingly to optimize returns and manage risk.

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The strengthened inverse relationship with the SMB factor suggests that large-cap stocks may have underperformed relative to small-cap stocks during this period, emphasizing the importance of diversification across different market capitalizations. Incorporating a mix of small-cap stocks into a portfolio could have provided a performance boost during the 2013-2022 period, particularly as investors sought growth opportunities in a low-interest-rate environment.

The continued insignificance of the HML factor indicates that value investing may not have been as effective during this period, as growth stocks dominated the market. However, this finding also serves as a reminder that market dynamics are constantly evolving, and what underperforms in one period may become more relevant in the next. Portfolio managers should maintain flexibility in their investment strategies, being prepared to shift focus between value and growth as market conditions change.

Discussion

This analysis signifies the results of three non-overlapping periods: 2002 to 2022, 2002 to 2012, and 2013 to 2022, in explaining variations in the return on the sample stocks over shifting market conditions through the Fama-French three-factor model-market risk premium, size premium, and value premium.

Full Period (2002-2022)

The multiple R of 0.80 for the full period is a reasonably good correlation of portfolio returns with the three factors. The R square of 0.64 implies that the model explains 64% of the variance in returns.

The findings support the robustness of the Fama-French model in explaining returns that arise in different market environments-from economic crises through growth phases. It thereby supports the grounding provided by Fama and French's original 1993 research, which demonstrated the model's strength in capturing return variation across multiple market cycles and environments.

It is also in line with strong explanatory power over the full period, something which is supported by various studies (Harvey, Liu and Zhu, 2016). Evidence was seen that the market risk premium remains a dominant role both in the crisis and recovery stages. It is on the premise that Harvey's findings support the view that beta-or the sensitivity of market movements-remain a dominant force in explaining returns at times of large economic transition.

Sub-Period (2002-2012)

With the multiple R of 0.782 and R square of 0.611 for the 2002-2012 period, the model seems to have a fairly reasonable fit. In comparison with the

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result from the period 2013-2022, the lower R square might imply other influences on returns in such a high-volatility, crisis-prone decade.

The economic instability, such as that seen during the 2008 financial crisis, serves to weaken the explanatory power of the three-factor model as returns start to depend on additional factors, such as momentum or volatility (Hong, Jeremy, and Yu, 2009).

With an adjusted R square value of 0.602 in this period, which was below that in the period of 2013-2022, additional factors other than the three-factor model have a significant influence, such as macroeconomic shocks and volatility. So, similar to Daniel and Titman's work, beyond market beta, size, and value, other major influential factors become stronger in economically turbulent periods.

Sub-Period (2013-2022)

The period of 2013-2022 had the highest multiple R of 0.819 and R square of 0.670, hence having the strongest explanatory power of the model. It could be contributed to economic recovery and lower market volatility, generally favoring the Fama-French factors, with an emphasis on the market risk premium.

The standard error of 2.300 was smaller compared to 2.505 in 2002-2012. Therefore, the model performed with higher accuracy within a low-volatility environment (Asness et al. 2015), where they indicated its greater efficacy in tranquil, expansionary environments.

Also, the market conditions of this period favored growth over value (Bali et al., 2016), which indicates the value premium has become muted in recent times as growth stocks outperformed amidst technology-driven markets.

Limitations of the Study

The Fama-French three-factor model omits other relevant factors that comprise the extended five-factor model as suggested by Fama and French, 2015-opCit. These could, therefore, provide more explanatory powers, especially for highly volatile years between 2002-2012, at which additional factors besides Mkt-RF, SMB, and HML may come into play.

The general structure of the model does not take into account sector-specific dynamics or how recent years have been so auspiciously disposed to high growth in technology industries. A study pointed out (Daniel and Titman, 1997) that sector exposure to return is a critical factor; thus, for example, the lack of sectoral adjustments in this study may have partly influenced the poor fitness of the model during times of exceptionally strong sectoral growth, such as during 2013-2022.

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Each period also bears the signature of different macroeconomic factors, ranging from crises to recoveries. In fact, literature such as Harvey et al. 2016 has shown that such exogenous shocks to the economies can drain model fit because a linear model, such as Fama-French, cannot effectively capture sudden breaks in the market, like the 2008 financial crisis or the COVID-19 pandemic, which greatly affected the 2002-2012 and 2013-2022 periods under consideration, respectively.

This reliance on historical data immediately opens up the possibility of survivorship bias, wherein companies that did not survive would not be included, and that could affect the results. Moreover, according to Fama and French (1993), historically based, static portfolios are not representative of actual rebalancing for the investor and hence may not serve as a good indicator of the model's performance in reality.

Conclusions

The primary aim of this study was to assess the effectiveness of the Fama-French three-factor model in explaining the variability of returns for a portfolio of five U.S. stocks. To evaluate the model's performance under varying market conditions, the analysis covered the period from 2002 to 2022, with a focused comparison of two sub-periods: 2002-2012 and 2013-2022. This approach allowed a comparative assessment of the model's explanatory power across distinct economic environments, particularly examining the model's relevance in the more recent period.

The regression analysis demonstrated that the market risk premium (Mkt-RF) was consistently the most influential factor in explaining portfolio returns throughout the study period. This finding underscores the pivotal role of market risk in driving stock performance, particularly during favorable market conditions such as the prolonged bull market of the 2010s. The significance of the market risk premium indicates that portfolio returns were closely aligned with overall market trends, emphasizing the dominant influence of broad market movements on performance.

The size premium (SMB) exhibited a negative relationship with portfolio returns, reflecting the portfolio's focus on large-cap stocks. This negative correlation was especially pronounced during the 2013-2022 period, a time when small-cap stocks outperformed large-cap stocks. The negative SMB coefficient indicates that the portfolio, with its emphasis on large-cap stocks, underperformed relative to small-cap stocks during times when smaller companies gained market favor. This finding underscores the importance of considering market capitalization in portfolio construction and suggests that a diversified mix of both large-cap and small-cap stocks could enhance returns.

In contrast, the value premium (HML) was found to be largely insignificant across the analyzed periods, suggesting that the distinction

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between value and growth stocks had a minimal impact on the portfolio's performance during the study timeframe. The insignificance of the HML factor reflects broader market trends of the 2010s, during which growth stocks particularly in the technology sector-often outperformed value stocks. This reduced the relevance of the value premium as a driver of returns in the observed context.

Overall, this study confirms that while the Fama-French three-factor model provides a valuable framework for understanding the drivers of portfolio returns, its effectiveness can vary based on the prevailing economic environment and market conditions. The model's reliance on the market risk premium underscores the critical importance of market exposure in determining portfolio performance. Meanwhile, the context-dependent impact of the size and value factors suggests that these elements should be carefully considered when applying the model. Investors and portfolio managers are advised to recognize the limitations of the Fama-French model and to complement it with additional factors or adjustments, such as integrating macroeconomic analysis, sector-specific insights, and behavioral considerations, all tailored to current market dynamics to achieve optimal investment outcomes.

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Impact of Official Development Assistance on Economic Growth in the East African Community

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Abstract

This research focuses on the effect of Official Development Assistance (ODA) on the economic development of the East African Community, with Trade openness as a moderating variable. This study adopts a Vector Error Correction Model (VECM) for 1974-2022 to investigate the cointegration between ODA balance, trade openness, and economic growth in five East African countries. The findings reveal a complex dynamic relationship: whereas ODA has a positive individual impact on economic growth, as well as the interaction of ODA and Trade openness also has a positive and significant effect. This indicates that the characteristics of trade policy condition the ability of ODA to promote economic growth. This means that characteristics of the trade policy condition the ability of ODA to promote economic growth. Based on the findings, the study adds to the ever-ongoing aid inefficiency discourse by underlining the necessity of an 'enabling environment' in the form of trade openness, significantly boosting the growth impact of ODA. These outcomes have significant implications for policymakers in countries of the third world where compliance with ODA missions could be made efficient by implementing the missions of trade openness. According to the study, there is a call for the strategies of foreign

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aid and trade liberalization toward the development of economic growth in developing countries.

Keywords: Official Development Assistance; Vector Error Correction Model; Trade openness; economic growth; developing countries

Introduction

International investment has been equally considered a major determinant of economic development, especially for developing nations. In the broader sense, foreign investment includes the Official Development Assistance (ODA) in many developing countries. East African Community (EAC) comprises Burundi, Kenya, Rwanda, Uganda, South Sudan, and Tanzania, signed in 2000 and aimed at socio-economic development. Surprisingly, while these countries are highly endowed with foreign aid with which they fund their development programs, they continue to be among the poorest in the world (Liew et al., 2012).

Empirical analysis and study on the link between ODA and economic growth has been severely conducted and still is. According to the evidence, it has been found that foreign aid has a long-term impact on the gross domestic product (GDP), including some of the previous detailed studies (Martinez-Zarzoso, 2015). For example, Refaei and Sameti (2015) identified that the ODA had a statistically significant and relatively large impact on Iran's economic growth in the long-run communication. Suphian and Kim (2017) also established a substantial and positive relationship between ODA and economic growth in the selected East African countries in the long run.

Nevertheless, the impact on growth in recipient countries has been an object of intense discussion (Booth, 2012). ODA can be contingent on sound macroeconomic settings and fiscal, monetary, and trade policies (Ceesay, 2020). This conditionality is documented in works such as Chen and Singh (2016), which state that, for example, while aid volatility generally positively influences economic growth in Asian and Pacific Island countries, public investment volatility moderates this impact.

Surprisingly, other empirical works have established a non-linear relationship between ODA and economic growth. Yiew and Lau (2018) conducted a study across 95 countries. They observed a U-shaped relationship of ODA, which hurts economic growth but has a positive impact in the later period. However, they urged caution in reliance on ODA as negative impacts could be observed within receiving economies.

Regional influence might play an essential role in determining the impact of ODA on growth. According to Dedehouanou and Kane (2021), a sample of West African countries shows that ODA has a positive and significant impact on growth in the industrial and services sector. They also

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describe the broad contagion impacts of aid granted to spatially adjacent countries in the regional bloc.

However, some research has revealed that ODA has a negative or insignificant impact on economic growth, although most of the previous research work suggested a positive impact. In their study, Abdou-Razak et al. (2019) concluded that ODA has a negative though insignificant effect on Togo's economy. Another study by Veledinah (2014) revealed little and insignificant short-run effects of ODA on Kenya's economic growth, though insignificant differences were revealed in the long run. Liew et al. (2012) used panel analytics to analyze the ODA-growth link for the East African countries for the 1985-2010 period and identified negative linkage across most models. These mixed findings mean that the relationship between ODA and growth is complex and requires extensive research, especially in East Africa. Evidence shows that the East African economies have yet to attain their full economic growth performance despite policy measures to liberalize the economies to attract foreign capital. The gauged regional GDP average growth rate was 5.8 percent between 1974 and 2022; however, this was marked by a high standard deviation of 16 percent, which underlined volatility in the growth rates (Geda & Yimer, 2023). Far more worrisome, however, is the evidence that the GDP growth rates have been falling from more than 7% in the 1970s to 4-5% in the recent period (Höppner, 2020). This underperformance has implications for foreign aid's capacity to promote economic growth in the region.

Earlier works have isolated some features of foreign investment and have yet to look at how they jointly influence growth. For example, Mutwiri (2012) independently analyzed the effects of foreign debt, Foreign Direct Investment (FDI), foreign aid, and remittances on the economic development of EAC member countries. This approach creates a conceptual gap in assessing the total impact of foreign investment, inclusive of ODA, on economic growth in East Africa. This research was intended to fill these gaps by examining the relationship between Official Development Aid and Economic Growth in East African countries. The research hypothesis assumes that Official Development Aid does not significantly impact Economic Growth in East African countries. This research aims to understand the role of ODA among the other types of FDI in the region's development.

The outcome of this study will be necessary to policymakers, scholars, and the East African Community. For policymakers, particularly governments and agencies involved in attracting private capital, this study will provide objective evidence of the impact of ODA on Economic Growth. It will help design policies that would improve and make good use of the aid supplied by other countries. This paper will interest scholars because it addresses a topic with mixed empirical results, especially concerning the relationship between ODA and growth in the East African region. Lastly, for the EAC, this study

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will provide information on the utilization of ODA-induced economic growth and shape future strategies for the mobilization and efficient use of foreign aid.

This study aims to contribute to the ongoing debate on the effectiveness of foreign aid in promoting economic development in emerging economies by examining the relationship between ODA and economic growth in East Africa using robust empirical techniques. It will provide valuable insights into whether ODA can catalyze sustainable economic growth in the East African Community or if alternative strategies for development financing should be considered.

2. Materials and Methods

2.1 Research Design

This study adopted a quantitative research design. Quantitative research collects and analyzes numerical data. It is conducted in a more structured environment that often allows the researcher to control study variables, environment, and research questions. Quantitative research may be used to determine the relationship between variables and outcomes. It involves developing a hypothesis, which is a description of the anticipated result, relationship, or expected outcome from the question being researched (Rutberg & Bouikidis, 2018).

Specifically, the study adopted a descriptive research design to describe the linkage between foreign investments, trade openness, and economic growth within the East African context. A descriptive research design designates the circumstances at a particular time. It is designed to gather data about present existing situations. It, therefore, provides a systematic description that is factual and accurate concerning the nature and status of the subject under study (Cooper & Schindler, 2016). Usually, a descriptive research design model assesses the rate of occurrence or the association between variables. The model is suitable as it helps to define and contrast variables in a specific study. It, therefore, involves the utilization and investigation of numerical data using specific statistical techniques to answer questions like who, how much, what, where, when, how many, and how. The next feature of the above definition is that in quantitative research design, numerical data are collected and analyzed using statistical methods (Apuke, 2017). A correlational research design was used to identify the cointegrating and causal nexus of variables in the study.

2.2 Target Population

According to Taherdoost (2016), population refers to the entire group of people, events, or things of interest that a researcher wishes to assess. Cooper and Schindler (2016) also defined population as the total collection of

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elements about which we wish to make some inferences. The above definitions suggest that a population comprises the entire collection of elements about which some inferences can be made (Gliner et al., 2016). The target population of this study was the East African Community Member Countries. This was comprised of 6 member countries, namely: Kenya, Uganda, Tanzania, Rwanda, Burundi, and South Sudan.

Table 1: Target Population

Countries in EAC	Country's Name
1. Country 1	Burundi
2. Country 2	Kenya
3. Country 3	Rwanda
4. Country 4	South Sudan
5. Country 5	Tanzania
6. Country 6	Uganda

2.3 Sampling Technique

The study used a purposive sampling method since there are few countries involved in the study. Purposive sampling is used when the population of interest is difficult to access or the researcher experiences difficulty accessing data (Kalman, 2019). According to (Scheaffer, 2013), purposive sampling is preferred where the population is small and manageable. The sample of Kenya, Uganda, Rwanda, Burundi, and Tanzania was informed by the fact that these countries form the East African community, and their data is complete. The study duration was 1974 – 2022. For this study, Kenya, Uganda, and Tanzania were members of the EAC, with the other three countries joining later. Purposive sampling was also adopted since South Sudan had a lot of missing economic data, and a decision was made to exclude it from the study.

Table 2: Target Sample

Countries in EAC	Nation Name	Duration of study	Total observations
Country 1	Burundi	1974-2022	49
Country 2	Kenya	1974-2022	49
Country 3	Rwanda	1974-2022	49
Country 4	Tanzania	1994-2022	29
Country 5	Uganda	1990-2022	33
Total			209

2.4 Data Sources

The study relied on secondary sources for the duration of 1974 – 2022. The frequency of the data is annual for the study duration, implying that the study duration is 49 years. Data on the foreign investment and macroeconomic control variables will be sourced from contrasting sources, including the World Bank database, National Statistical Bureaus, Central Banks, and the Stock exchange of the respective country.

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2.5 Empirical Model

The study employed an econometric investigation approach to quantify the effect of foreign investments and trade openness on economic growth in Kenya, Uganda, Rwanda, Burundi, and Tanzania.

2.5.1 Regression Model Specification

The Vector Autoregressive (VAR) analysis system is the methodology used in this investigation. Changes in the variables under consideration correlate with changes in delays in the multivariate framework provided by the VAR model (Adeniran et al., 2016). Because they describe the joint generation mechanism of the relevant variables, they are employed for economic analysis even though they are natural instruments for predicting (Lütkepohl & Schlaak, 2018). The stationary test, sometimes referred to as the Unit root test, is the initial phase of VAR modeling. If, after performing a unit root test, it is discovered that a series of data is stationary at some levels, it can be estimated directly by modeling an unrestricted VAR; if not, the first difference is used to make the data stationary before modeling an unrestricted VAR, which is known as a VAR in first difference. The models are approximated equations in both instances using the least squares methods. The regression model is expressed as follows

The guiding panel model for this study was

$$Y_{It} = \alpha_{it} + \sum_{i=1}^{K} \delta'_{it} Y_{i,t-j} + \sum_{i-0}^{q} \beta'_{it} X_{i,t-j} + \varepsilon_{it} \quad (1)$$

Where ε_{it} is the error term for country i in year t

Y_{it} = Economic growth for i^{th} country in $t^{th/}$ year, X_{it} = vector representing independent variables for nation i in year t, β'= Vector of Coefficients of the independent variables, i= 1, 2… 6 (countries in East Africa region), t = 1, 2 ……21 (time indicator).

Thus,

$$\Delta Yit = \alpha_{it} + \delta'_{it} Y_{i,t-j} + \beta_1 ODA_{i,t-j} + \varepsilon_{it} \quad (2)$$

Where: Yi,t = Economic growth (Dependent variable)

α_{it}= Intercept term; $\delta'_{it} coefficients\ of\ the\ lagged\ dependent\ variable$

β_i= coefficients of the independent variables; $ODA_{i,t-j}$=official development aid, and $\varepsilon i,t$= error term.

Official Development Aid (ODA) is defined as the financial flows, technical assistance, and commodities provided by donor countries or international organizations to developing countries (Erdem, 2021). It is primarily aimed at promoting economic development and welfare. For this

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study, ODA is measured as a percentage of Gross Domestic Product (GDP) for each country. Data on ODA were sourced from the World Bank database, National Statistical Bureaus, and Central Banks of the respective countries within the study period (1974–2022). This approach ensures consistency and comparability of ODA data across the studied countries and years.

2.6 Pre - Estimation Tests

2.6.1 Normality test

A normal distribution is a function that describes the probability of events within a specific space where all events' probabilities are summed to at least one (Ghasemi & Zahediasl, 2012). If a random variable Z has a Normal (0, 1) distribution, we say it has a standard normal distribution (Guzman et al., 2024). The most common normality test procedures available in statistical software are the Shapiro-Wilk (SW) test, Kolmogorov Smirnov (KS) test, Anderson-Darling (AD) test, and Lilliefors (LF) test. Some tests can only be applied under a specific condition or assumption. Moreover, contrasting normality tests often produce contrasting outcomes, i.e., some tests reject while others fail to reject the null hypothesis of normality. The contradicting outcome should be more accurate and more apparent to practitioners. Therefore, the choice of normality test should indisputably be given tremendous attention (Razali & Wah, 2011). This study used the Shapiro-Wilk (SW) test to test normality since it is more reliable.

2.6.2 Unit Root Test

The concepts of integration and stationarity were the building blocks of this research. This concept was used since empirical literature has suggested that most economic time series data and panel data are integrated of order one $I(1)$, more significant than order zero I (0). This study will adopt a new unit root test that considers the test of stationarity among variables in a group panel setting rather than individual variables (Baltagi & Kao, 2001). Therefore, this study used ADF - Fisher Chi-square since they are the most recent advanced unit root tests and are considered the most robust. The presence of a unit root was tested by conducting tests proposed by Dickey and Fuller (1979). These tests will allow us to determine whether the panel VAR investigation may be used for all models.

2.6.3 Multicollinearity

Multicollinearity problem mainly arises when two independent variables are linearly dependent (if p-values are more significant than 0.05). Its presence inflates the variance of parameter estimates, providing the wrong magnitude of coefficient estimates and signs, hence, poor and incorrect conclusions. This study used variance inflation factor (VIF) or collinearity

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matrices to check for its presence. This is a post-estimation diagnostic test. A rule of thumb of VIF 10 was applied in testing for the multicollinearity problem whereby a VIF of less than ten will imply the absence of multicollinearity among the independent variables (Balogun, 2021)

2.6.4 Lag length selection method

Specifying the appropriate lag order to capture response time and feedback is a delicate econometric issue in time series models. Some early work by Schmidt and Sickles (1975) partly addressed this problem in the context of Autoregressive distributed lag models and suggested various solutions. In dynamic panel models, the problem is known to be even more complex in part because of a fixed effect, which means that the dimension of the parameter space expands with the sample size (Han et al., 2017).

Many lag length selection criteria have been adopted in economic studies to determine the Autoregressive (AR) lag length of time series and panel variables. An AR process of lag length p refers to a time series in which its current value is dependent on its first p lagged values and is normally denoted by AR (p). The AR lag length p is always unknown. It therefore has to be estimated via various lag length selection criteria such as Akaike's information criterion (AIC) (Akaike, 1973), Schwarz information criterion (SIC) (Schwarz, 1978) Hannan-Quinn criterion (HQC) (Hannan & Quinn, 1979), final prediction error (FPE) (Akaike, 1969), and Bayesian information criterion (BIC) (Akaike, 1979). All these criteria were used to compare and solve the lag length problem.

2.6.5 Granger Causality Test

This test was applied to examine the relationship between foreign investments, trade openness, and economic growth. Lopez and Weber (2017) describe it as a construct residual (errors) based on the static regression model. The Granger causality test assumes there can be causality for some individual income but not necessarily for all.

2.6.6 Cointegration Test

Engle and Granger (1987) assert that if each element of a vector of time or panel series first achieves stationarity after differencing. Still, a linear combination is already stationary; the time series are said to be cointegrated with cointegrating vector α. This study sought to test for cointegration in the process of coming up with the model to eliminate the spurious regression problem.

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2.7 Post-estimation Model Tests

2.7.1 Heteroscedasticity Test

Heteroscedasticity is an econometric problem where the error terms have no constant variance (variance is not the same). This is a post-estimation diagnostic test. Non-existence means that confidence levels and test statistics are biased (Greene, 2003); a severe problem in econometrics tends to affect the Ordinary Least Square (OLS) estimators. Upon estimating the empirical model, the Breusch-Pagan-Godfrey test was used to examine heteroscedasticity.

2.7.2 Autocorrelation Test

The autocorrelation problem arises from the serial correlation of the error terms among the variables. Autocorrelation exaggerates the significance of the predictor when, in fact, they are not. This is a post-estimation diagnostic test. This study applied two tests to test serial correlation within the residual from the regression models: the alternative Durbin Watson test and the Breusch-Godfrey LM (Chatterjee & Simonoff, 2013).

3. Results and Discussion

3.1 Descriptive Statistics

3.1.1 Summary Statistics

The study examined the relationship between Official Development Assistance (ODA) and Economic Growth in the East African Community. The analysis encompassed several statistical tests to understand this relationship comprehensively. As presented in Table 3, descriptive statistics offer an initial insight into the nature of the variables.

Table 3: Descriptive Statistics for Study Variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Coefficient of Variation
Economic Growth (%)	5.75	6.75	46.06	-161.60	16.37	284.71
Official Development Aid (% of GDP)	20.39	17.14	138.39	2.75	15.87	77.87

Economic Growth showed considerable volatility, with a mean of 5.75% and a standard deviation of 16.37%. This high variability is further emphasized by the substantial range between the minimum (-161.60%) and maximum (46.06%) values and a notably high coefficient of variation (284.71%). These figures suggest significant fluctuations in economic performance across the studied period and countries.

Official Development Assistance, measured as a percentage of GDP demonstrated less extreme but still considerable variation. With a mean of 20.39% and a median of 17.14%, ODA represents a substantial portion of these economies. The maximum value of 138.39% indicates periods or

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countries where aid inflows significantly exceeded the size of the domestic economy. The coefficient of variation for ODA (77.87%) suggests less volatility compared to economic growth but still indicates considerable inconsistency in aid flows. The normality of data distribution was assessed using the Shapiro-Wilk test.

3.1.2 Normality Test

A normal distribution is not skewed and is defined to have a coefficient of kurtosis. The study used the Shapiro-Wilk (SW) test to test normality since it is more reliable (Lasanthika et al., 2023)

Table 4: Shapiro-Wilk W Test for Normality

Variable	W	V	Z	Probability>z
Economic growth	0.64723	54.687	9.228	0.00000
Official development assistance	0.80516	30.204	7.859	0.00000

According to Table 4, Economic Growth and ODA showed significant departure from normality ($p < 0.00001$ for both variables). This non-normality is essential when interpreting further analyses and selecting appropriate statistical techniques.

3.1.3 Unit Root Test

Stationarity in a time series analysis is an essential assumption. The unit root test determines whether a series is stationary or exhibits a unit root. Applying statistical techniques and assumptions becomes challenging when a series has a unit root, leading to spurious regression results and invalid inferences (Enders & Lee, 2004). This study used ADF - Fisher Chi-square since they are the most recent advanced unit root tests and are considered to be the most robust. The presence of a unit root was tested by conducting tests proposed by Dickey and Fuller in 1979 (Glynn et al., 2007). This test determined whether the investigation required a robust modeling process.

Table 5: ADF - Fisher Chi-square Unit Root Test

Variable	**Statistic**	**Prob.****
Economic Growth	46.9225	0.0000
Official Development Aid	24.8046	0.0057

Economic Growth and ODA were stationary at level ($p < 0.01$ for both), which is favorable for subsequent analyses as it reduces the risk of spurious relationships, as shown in Table 5.

3.1.4 Correlation Analysis

Correlation analysis measures the association between two numeric variables. Table 6 presents the correlation analysis between lagged values of economic growth and official development aid (ODA), as it is essential to

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focus on the relationships over time rather than contemporaneous values, given the nature of the study.

Table 6: Correlation Matrix

Variable	Economic growth	Official Development Aid
Economic growth	1.000000	
Official Development Aid	-0.257021 (0.0023)	1.000000

The correlation coefficient of -0.257 (p = 0.0023) indicates that higher lagged levels of ODA are associated with lower economic growth rates, or vice versa. By considering the lagged values, the analysis aligns with the study's focus on understanding delayed or cumulative impacts of ODA on economic growth. This approach avoids the potential misinterpretation of contemporaneous correlations, as the research seeks to identify how past values of ODA influence current economic outcomes.

3.1.5 Multicollinearity Test

Multicollinearity is a problem in time series analysis that occurs when the independent variables are highly correlated (Brooks et al., 2016). Table 7 presents the collinearity results that were conducted to ascertain the level of association between the independent variable foreign official development assistance

Table 7: Multicollinearity Test

Variable	VIF
Official development assistance	1.091033

The VIF for ODA (1.091) is well below the threshold of 10, indicating no significant multicollinearity issues in the model.

3.1.6 Granger Causality Test

A variable x is said to granger cause a variable y, if past values of x are used to predict future values of y more than y's own past values (Granger, 1969). The study employed the pairwise Granger causality test to determine the direction of causality, as shown in Table 8.

Table 8: Pairwise Granger Causality Test

Null Hypothesis	F-Statistic	Probability
ODA flow does not granger cause economic growth	5.01817	0.0075
Economic growth does not guarantee cause ODA flow	0.25921	0.7719

The results indicate that ODA Granger causes economic growth (F = 5.018, p = 0.0075), but economic growth does not Granger cause ODA (F = 0.259, p = 0.7719). This unidirectional causality suggests that changes in ODA levels precede and potentially influence changes in economic growth but not vice versa.

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3.1.7 Cointegration Test

This test was conducted using the Johansen Fisher Panel Cointegration Test. According to Emmanuel (2015), Engle and Granger assert that if each element of a vector of time or panel series first achieves stationary after differencing, but a linear combination is already stationary, the time series are said to be cointegrated with a cointegrating vector α. This study sought to test for the existence of cointegration in the process of developing the model to eliminate the problem of spurious regression.

Table 9: Johansen Fisher Panel Cointegration Test

Variables	Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Probability value	Fisher Stat.* (from max-eigen test)	Probability value
Economic growth	None	40.41	0.0000	30.94	0.0000
Official Development Assistance	At most 3	5.599	0.4696	4.608	0.5950

Table 9 presents the results of the Johansen Fisher Panel cointegration test for the two study variables, economic growth, and official development assistance flow. Two tests were conducted to test the number of linearly relevant equations. These were Fisher Stat.* (from trace test) and Fisher Stat.* (from max-eigen test). The presence of a cointegrating relationship means that there is a long-run relationship between the variables when economic growth is the dependent variable. The study will, therefore, use the panel VECM model, which captures the short-run and long-run dynamic equilibrium relationships and provides insights into the adjustment process following deviation from the equilibrium (Hassan et al., 2024)

3.1.8 Heteroskedasticity Test

Heteroscedasticity is an econometric problem in which the error terms have no constant variance (variance is not the same). This is a post-estimation diagnostic test. According to Yitayew (2017), Heteroscedasticity is a serious problem in econometrics that tends to affect the estimators. The Breusch-Pagan-Godfrey test was used to examine Heteroscedasticity.

Table 10: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.595386	Prob. F(5,125)	0.7035
Obs*R-squared	3.047251	Prob. Chi-Square(5)	0.6927
Scaled explained SS	5.677038	Prob. Chi-Square(5)	0.3389

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Table 10 presents the Breusch-Pagan-Godfrey heteroskedasticity test results for the two study variables used in the study using Breusch-Pagan-Godfrey heteroskedasticity test. The table presents three test statistics: F-statistic 0.595386 with Prob. 0.7035, Obs*R-squared 3.047251 with Prob. 0.6927 and Scaled explained SS 5.677038 with Prob. 0.3389. These results show no heteroskedasticity problem in the data, and the variance and mean of the errors are stable, as are those of the study variables.

3.1.9 Autocorrelation Test

The autocorrelation problem arises from the serial correlation of the error terms among the variables. Autocorrelation exaggerates the significance of the predictor when, in fact, they are not. This is a post-estimation diagnostic test. In this study, Breusch-Godfrey LM (Chatterjee & Simonoff, 2013) was applied to test the presence of serial correlation, as shown in Table 11.

Table 11: Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.544048	Prob. F(2,123)	0.5818
Obs*R-squared	1.148704	Prob. Chi-Square(2)	0.5631

Breusch-Godfrey Serial Correlation, LM Test table, presents three test statistics: F-statistic 0.544048 p-value 0.5818 and Obs*R-squared 1.148704 P-value 0.5631. These results show that there is no serial correlation problem in the data, and thus, the study variables' errors are also stable.

3.2 Bivariate Analysis

3.2.1 Regression Model for Official Development Aid

Table 12: Official Development Aid Regression

Variable	Coefficient	Standard error	T- statistic	p-value
Official Development Aid	0.331732	(0.10283)	[3.22597]	0.0000
C	13.63930	1.750488	7.791715	0.0000
Error Correction term	-0.459556	(2.39608)	[-2.15812]	0.0000
Fit statistics: R-squared	0.538393			
Adj. R-squared	0.502884			
F-statistic	15.16246			
Log-likelihood	-706.8946			
Akaike AIC	8.519462			
Schwarz SC	8.760224			

To analyze the effect of official development aid on the dependent variable (economic growth), a Panel-VECM regression was employed in Table 12. The following regression model was employed:

$$\Delta Y_{it} = 13.63930 + 1Y_{i,t-1} + 0.331732ODA_{i,t-1} - 0.459556\,\theta ECT_{t-1}$$

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Where Y is $ODA_{i,t-1}$ lagged official development aid, and ECT is error correction speed of adjustment. The regression results in Table 12 show that the relationship between the official development aid variable and economic growth is positive and significant, with a t-value of 3.22597 and a p-value of 0.0000. C represents the intercept term in the regression, with a coefficient of -9.738961. The error correction term coefficient is -0.459556 with a p-value of 0.0000. This means it takes approximately 0.459556 units per period to revert to equilibrium, following a deviation in the dependent variable. R-squared is 0.538393; the variables in the model cause 53% of changes in the dependent variable. The F-statistic = 15.16246, with a p-value of 0.0000, indicating that the overall model is statistically significant. Again, the results from this regression model differ from those on the correlation matrix, which found a significant negative relationship. The violation of the normality assumption could explain this, or the relationship between the two variables may be non-linear, affecting the results of the correlation matrix. The study established a positive relationship between official development aid and economic growth. The findings support Chang and Mendy (2012), who sought to find the empirical relationship between economic growth and openness in Africa. Refaei and Sameti (2015) show that in the long run, the effect of ODA on economic growth was positive and statistically significant. Suphian and Kim (2017) find that ODA has a considerable positive impact in the short and long run. Abdou-Razak et al. (2019) reveal that official development aid has had a negative effect on the economy in Togo.

3.2.2 Moderated Model for Official Development Aid

Table 13: Moderated Model Official Development Aid Regression

Variable	Coefficient	Std. error	t- statistic	p-value
Official Development Aid	0.748348	(0.21904)	[3.41654]	0.0000
Trade openness	0.028953	(0.00648)	[4.46486]	0.0000
Official Development Aid * Trade openness	0.266479	(0.03524)	[7.56284]	0.0000
Error Correction term	-0.317815	(0.51556)	[-0.61644]	0.2178
Fit statistics: R-squared 0.678807				
Adj. R-squared 0.507503				
F-statistic 3.962605				
Log-likelihood -567.5955				
Akaike AIC 8.871878				
Schwarz SC 9.906333				

Using Panel VECM, the following model was generated; $\Delta Yit = 1Y_{i,t-1} - 0.748348ODA_{i,t-1} + 0.028953OE_{i,t-1} - 0.266479OE_{i,t-1} * ODA_{t-1} - 0.317815\,\theta ECT_{t-1}$

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Where Y is $ODA_{i,t-1}$, $OE_{i,t-1}$lagged and $OE_{i,t-1} * ODA_{t-1}$ interaction official development aid and ECT is error correction speed of adjustment as shown in Table 13. The coefficient for ODA is 0.748348; the t-statistic is 3.41654, and the p-value of 0.000. This suggests that the relationship between ODA and the dependent variable is statistically significant, and a unit increase in ODA leads to an increase in economic growth by 0.748348 units. The coefficient for trade openness is 0.028953 with a p-value of 0.000, signifying a statistically significant relationship with the dependent variable. Holding other factors constant, a one-unit increase in ODA leads to an increase of 0.028953 units in the dependent variable. The moderated term has a coefficient of 0.266479, and the t-statistic is 0.04240 with a p-value of 0.0000; this signifies that the combined effect of ODA and trade openness on the dependent variable is positive.

In summary, the regression results indicate a positive relation between ODA and Economic growth. The joint effect of ODA and Trade Openness on economic growth is positive. The R-squared of the moderated model is 0.678807; approximately 67.9% of changes in the dependent variables are explained by the independent variables. The study established a positive significant relationship between official development aid and economic growth.

The findings support Chang and Mendy (2012), who sought to find the empirical relationship between economic growth and openness in Africa. Refaei and Sameti (2015) show that in the long run, the effect of ODA on economic growth was positive and statistically significant. Suphian and Kim (2017) find that ODA has a significant positive effect in the short and long run. Abdou-Razak et al. (2019) reveal that official development aid has hurt the economy in Togo.

3.2.3 Test of Hypothesis

The study used the t-test to test the hypothesis and draw inferences from the regression models. T-test is a widely used method in testing for statistical inferences by assessing the statistical significance of the estimated coefficients of the regression model (Bilon, 2023). At a 95% confidence interval, the null hypothesis is rejected in favor of the alternate hypothesis when the absolute value of t-statistics is greater than the critical value. When the absolute value of t-statistics is less than the critical value, we fail to reject the null hypothesis, concluding that the coefficient is not statistically significant.

H_0: Official Development Aid Has No Significant Effect on Economic Growth among East African Community Countries

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As presented in Table 12, the bivariate regression model between ODA and economic growth, official development aid has a significant relationship with economic growth (t-statistic 3.33597; p-value 0.0000). From the results, we reject the null hypothesis and conclude that official development aid has a significant relationship with economic growth. The study established a positive relationship between official development aid and economic growth. The findings support Chang and Mendy (2012), who sought to find the empirical relationship between economic growth and openness in Africa. Refaei and Sameti (2015) show that in the long run, the effect of ODA on economic growth was positive and statistically significant. Suphian and Kim (2017) find that ODA has a significant positive impact in the short and long run. Abdou-Razak et al. (2019) reveal that official development aid has had a negative effect on the economy in Togo.

Conclusion

This study examined the relationship between Official Development Assistance (ODA) and economic growth in the East African Community, focusing on the moderating role of trade openness. The findings reveal a complex dynamic relationship between ODA and regional economic growth. Our analysis indicates that when considered in isolation, ODA has a positive and statistically significant effect on economic growth in East African countries. This positive individual impact suggests that ODA contributes to economic growth by potentially addressing funding gaps, enhancing investment in critical infrastructure, or fostering human capital development. However, the magnitude of the positive effect might vary due to factors like the efficiency of aid utilization, the institutional capacity of recipient countries, and the alignment of aid with development priorities. While these factors can enhance ODA's contribution, inconsistencies in implementation or external economic shocks might still moderate the overall growth effect.

However, the study uncovered a crucial insight: it tested the relationship between ODA and the extent of trade openness. It determined that this relationship played a positive and significant role in economic growth. This implies that improving trade openness can significantly improve the growth effect of ODA in East Africa. The positive joint effect can be explained by the ability of aid openness to enhance the productivity with which aid is used when trade openness exerts pressure on donors to utilize aid-financed programs and investments effectively.

These observations have implications in showing a need for either primary or additional policies to be implemented to achieve the optimum results from ODA. Even though it has been claimed that aid may not cause growth on its own, there is evidence that growth will start when aid comes together with trade liberalization policies. Therefore, it will be necessary for

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policymakers in East African countries to find ways to complement the impact of ODA with trade openness instruments.

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The Pivotal Role of Management Control in Times of Crisis: Enhancing Organizational Resilience and Strategic Adaptation

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Abstract

This article examines the transformation of management control, which has traditionally been regarded as a support function, into a central strategic lever in times of crisis. The study is focused on three core areas: the impact of management control mechanisms on organisational performance; their role in facilitating adaptation in a crisis context; and the influence of adopting new control tools on the company's strategic direction. The research utilises a quantitative approach and is based on a sample of 97 companies across various sectors and sizes, ensuring diverse representation via non-stratified random sampling. Statistical techniques employed include Wilcoxon Signed-Rank Tests, quantile regression, and Spearman's correlation coefficients to validate the hypotheses. The findings demonstrate that management control is a key factor in enhancing performance, organisational resilience, and the implementation of a proactive strategy. Specifically, advanced technologies such as artificial intelligence (AI) and enterprise resource planning (ERP) systems were shown to enable companies to anticipate risks, seize opportunities, and strengthen their competitive advantage during crises. However, several limitations remain. These include the relatively small sample size, which restricts generalizability, the specific

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nature of the crises under study (COVID-19 crisis) and the potential for respondent bias, as most participants were senior executives or management controllers. These factors highlight the need for further research, particularly the exploration of additional crisis contexts and the use of mixed methodologies for a more comprehensive analysis.

Keywords: Management Control, Control Mechanisms, Management Crises, Strategy, Performance

Introduction

In the current context, characterised by geopolitical, economic and health disruptions, companies are facing unprecedented challenges. As a result, the prevailing uncertainty is forcing organisations to review their entire strategy in order to adapt quickly to market realities and overcome these unprecedented challenges in times of crisis.

This organisational adaptation is accompanied by an in-depth overhaul of the entire company structure. As a result, certain functions that are usually relegated to the status of support functions are being promoted to the status of "core business" or "driving function". This is also the case for management control: traditionally used as a simple mean of measuring financial performance, it has now been given a new strategic role, facilitating the alignment of the company's objectives with fluctuations in the external environment.

This change in the role of management control reflects the need for companies to demonstrate agility and responsiveness in the face of crises, implying the use of innovative control systems. It would not only promote strategic revitalisation but would also enable business leaders to acquire a sharper, sharper strategic attitude. The latter is essential for navigating through the complexity of a crisis and guaranteeing the long-term survival of the organisation (Förster & al., 2022).

Furthermore, academic studies have underscored the pivotal role of management control systems in bolstering competitive advantage in the face of strategic uncertainty (Obrenovic & al., 2020). Additionally, they have demonstrated their capacity to facilitate the implementation of deliberate strategies through their diagnostic control elements (AlTaweel & Al-Hawary, 2021).

The aim of our article is to address the following issue: namely the transition of management control from a support function to a driving role in times of crisis, by validating three hypotheses on the ability of management control to monitor organisational performance on the one hand, to ensure organisational adaptation on the other, and finally to define the strategic direction of the company in times of crisis.

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Literature Review

Management control, control mechanisms and performance

Management control is a vast and multifaceted discipline that has attracted considerable interest from companies over the course of the past century. Management control first emerged in the early 1920s and has since evolved into a strategic tool, no longer limited to the simple function of controlling budgets and costs.

In the literature, there are numerous definitions of management control. For the purposes of this study, we will refer to the initial definition provided by Anthony (1965) which states that management control is "a process by which managers ensure that resources are used effectively and efficiently to achieve set objectives". Subsequently, approximately twenty years later, Anthony (1988) expanded upon this definition, positing that management control is "the process by which managers influence other members of the organization to implement the organization's strategies."

Control mechanisms encompass all the methods, tools and processes that companies implement to facilitate the achievement of their strategic objectives and enhance overall performance. These include budgeting, financial reporting and cost accounting, as well as more innovative tools that are oriented towards strategy and planning, such as the Balanced Scorecard (Kaplan & Norton, 1996) and digitisation (Quattrone, 2016).

Several empirical studies report that the effective implementation of management control mechanisms can significantly influence an organisation's performance (Elhamma, 2013, 2014, 2015). Indeed, Bedford & al. (2016) have shown that consistency between management control mechanisms and the company's strategic objectives promotes more optimal use of resources, resulting in better results both financially and operationally. Similarly, Baird & al. (2019) have proposed that management control mechanisms based on non-financial indicators are crucial for establishing an informational context that encourages more considered decision-making by managers and enables the company to adapt more rapidly.

Accordingly, the agency theory, as postulated by Jensen and Meckling in 1976 is one of the main theories explaining this relationship, highlighting the role of management control mechanisms in reducing the asymmetry of information between principals and agents (Jensen & Meckling, 1976; Elhamma & Slama, 2012), through the utilisation of performance monitoring and evaluation tools. In essence, management control systems play a vital role in providing transparent and relevant information to all stakeholders with the objective of reducing the risk of opportunistic behaviour and maintaining or enhancing company performance (Otley, 1999 ; Chenhall, 2003).

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In conclusion, the aforementioned studies irrefutably illustrate that control mechanisms play a fundamental role in improving organisational performance. They facilitate the alignment of the company's strategic objectives with its operational activities, enhance the organisation's flexibility in order to better withstand market volatility, and improve decision-making processes.
Hence our first hypothesis:

H1: Management control mechanisms have a positive influence on organisational performance.

Management control systems: catalysts for adaptability in times of crisis

The functions of management control systems extend beyond the promotion of organisational performance through the integration of strategic objectives with day-to-day actions. Indeed, these mechanisms are of paramount importance in the management of sudden, unpredictable and unprecedented events such as crises. Crises are characterised by periods of turbulence and uncertainty, necessitating the swift adaptation of companies in order to survive and maintain performance (Teece & al., 2016).

The capacity for adaptability is contingent upon the presence of specific essential factors, including a malleable internal structure, expeditious decision-making processes, and rapid resource management (Teece & al., 1997). From this standpoint, management control systems are regarded as facilitators of flexibility, providing immediate data, facilitating agile strategic adjustments, and promoting business continuity during periods of crisis.

The findings of recent research conducted by Geurts & al. (2022) indicate that organisations with flexible management control systems were particularly effective in mitigating the economic impact of the Coronavirus Disease 2019 (Covid-19) pandemic by adapting their strategies quickly and optimising the use of available resources.

As postulated by Teece & al. (1997) in their dynamic capabilities' theory, organisations that are able to effectively restructure their internal resources in order to respond to the fluctuations of the market are the most likely to flourish in times of crisis. From this perspective, management control systems facilitate the optimisation of resources and the reconfiguration of organisational objectives. Furthermore, Leoni & al. (2021) have highlighted that the adaptability of certain management control systems enables the conversion of challenges arising from a crisis into opportunities for internal restructuring, the promotion of effective communication between departments and a transition from a reactive to a proactive approach.

In addition, the integration of digital technologies and data analysis into management control systems has enhanced decision-making processes

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(Elhamma & El-Moumane, 2023), enabling organisations to respond more rapidly to sudden changes that may emerge from a crisis, while also facilitating the identification of potential risks and opportunities through proactive resource adjustments (Agostino & Sidorova, 2016). In their study, Prasanth & al. (2023) examine the repercussions of AI and predictive analysis methods on the corporate decision-making process, with a particular focus on the ability of these technologies to predict market developments and anticipate change.

In conclusion, management control systems, in addition to their traditional function, are assuming an increasingly pivotal role in enabling organisations to adapt to crises. The integration of new technologies has increased this adaptability by enabling organisations to adopt a more proactive approach.

In light of the aforementioned evidence, our second hypothesis can be formulated as follows:

H2: Management control systems facilitate organisational adaptation in a crisis context.

Towards a strategic perspective: the impact of new management control tools

In addition to their contribution to improving organisational performance and resilience in times of turbulence, management control systems are of vital importance in implementing a long-term strategic perspective. The latter is further enhanced by the evolution of control tools combined with new technological advances (Szukits & Móricz, 2024).

Indeed, the integration of modern and recent tools has marked a turning point in the evolution of management control mechanisms. One such tool is the Balanced Scorecard (BSC), devised by Kaplan and Norton in 1996, which concurrently incorporates financial and non-financial metrics, thereby providing a comprehensive overview of a company's performance across four dimensions: customer satisfaction, organisational learning, internal processes and the financial dimension. Numerous scholars, including Hansen and Schaltegger (2016) have substantiated the beneficial impact of the BSC in the implementation of corporate strategy, particularly within the services sector.

Similarly, technological developments have contributed to the enhancement of management control mechanisms, representing a further advancement in this process. Technological innovations, including artificial intelligence, enterprise resource planning (ERP) and big data analysis, have played a major role in transforming management control practices (Benga & Elhamma, 2024). Furthermore, the study conducted by Appelbaum & al (2017) highlights that the integration of artificial intelligence into management control systems encourages greater anticipation of the organisation's needs, a considerable improvement in decision-making processes and effective resource management. Rikhardsson and Yigitbasioglu (2018) have shown that

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the integration of such technologies (Big Data) increases companies' ability to predict market trends and enables them to adjust their strategy in real time.

Moreover, according to Tessier & Otley (2012), the optimal integration of new management control systems not only enables rigorous performance monitoring but also promotes a continuous strategic vision which is indispensable for long-term planning. Furthermore, Verhoef et al. (2021) have shown that companies that integrate non-financial performance indicators into their management control systems, in particular by utilising digital technologies, are more inclined to develop innovative strategies, thereby strengthening their competitiveness.

In addition, Fähndrich (2023) confirms that the incorporation of digital technologies and data analysis into MCSs has improved decision-making processes, facilitating the ability of companies to respond with greater expediency to sudden changes associated with crises while anticipating risks and opportunities. Additionally, Stoykova and Shakev (2023) posit that the integration of artificial intelligence as a novel management control mechanism markedly amplifies companies' capacity to predict changes in the external environment.

Concurrently, social networks are emerging as an effective new management control tool. Such platforms enable organisations to gather essential data on their various stakeholders in real time, allowing them to adapt their strategy in line with market developments at minimal cost (A. M. Kaplan & Haenlein, 2010; Alhaddi, 2023). Furthermore, social networks offer a novel perspective on management control, providing companies with interactive monitoring of non-financial indicators and enhancing their ability to react to market fluctuations (Bai & Yan, 2023).

In the light of the findings presented in this research, the adoption of new management control tools effectively reorientates the fundamental mechanisms of management control in a proactive and strategic direction, enabling better anticipation of risks and maximum exploitation of opportunities. Consequently, our third hypothesis can be stated as follows:

H3: The utilisation of new management control tools facilitates the transition of the organisation towards a more strategic outlook.

Empirical study

Research methodology

In management sciences, researchers have the option of choosing between quantitative and qualitative methods (Elhamma, 2024). In this study, we have elected to employ a positivist epistemological framework and a quantitative approach to validate or refute the three aforementioned hypotheses. Our methodology is grounded in inductive reasoning, whereby

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data were gathered via an online questionnaire to address our central research question: the role of management control in times of crisis, in our case we took the example of the Covid-19 crisis.

Establishing the sample and verifying the data

The sampling method employed in this study is non-stratified random, which allows for the attainment of overall representativeness with regard to sector of activity, size, type of respondent and year of existence. The questionnaire was distributed online via various channels, including social networks, personal contacts and professional groups. The initial distribution of questionnaires was conducted over a three-month period between April 2024 and July 2024, with a total of 130 questionnaires sent out. A total of 103 responses were obtained, representing a response rate of 79%. However, after eliminating questionnaires that did not comply with the instructions, 97 responses were retained, representing a response rate of approximately 75%. This ensures the reliability of our analysis. Our statistical analyses were carried out using Python and specialised libraries, including *scipy* for T-tests and correlation, and *statsmodels* for linear regression.

Description of the sample

Our sample is made up of companies that fall into several size categories, cover a wide range of business sectors and vary in length of existence:

Table 1: Distribution by Company Size

Company size	Percentage	Number of Respondents
Large company (+200 employees and/or revenue > 175 million dirhams)	45,4 %	44
Medium-sized company (50 to 200 employees and/or revenue between 10 and 175 million dirhams)	33,0 %	32
Small company (10 to 50 employees and/or revenue between 3 and 10 million dirhams)	16,5 %	16
Micro company (<10 employees and/or revenue <3 million dirhams)	5,1 %	5

Table 2: Distribution by Industry Sector

Industry Sector	Percentage	Number of Respondents
Commerce	6,2 %	6
Industry	17,5 %	17
Technology	44,3 %	43
Services	32 %	31

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Table 3: Distribution by Years of Existence

Years of Existence	Percentage	Number of Respondents
2 to 5 years	30,9 %	30
6 to 10 years	45,4 %	44
Over than 10 years	23,7 %	23

Additionally, the respondents to the questionnaire occupy a range of positions within their respective organizations:

Table 4: Nature of Respondents

Type of respondent	Percentage	Number of Respondents
Executive	33 %	32
Management controller	47,4 %	46
Operational Manager	13,4 %	13
Financial Manager	6,2 %	6

The integration of disparate viewpoints will facilitate the examination of the evolving role of management control across a range of domains, including decision-making, operational adaptation, and crisis management. This analysis will be undertaken with reference to each functional area and the distinct attributes of the companies included in our sample.

Analysis and interpretation

Analysis of the hypotheses

In order to test the initial hypothesis, namely that *Management control mechanisms have a positive influence on organisational performance*, a series of statements pertaining to management control mechanisms were presented to respondents for evaluation on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

The variables studied were: strategic budgeting, strategy-oriented reporting, KPIs, adaptability and continuous improvement.

To validate the hypothesis, we used 3 types of non-parametric analysis since it’s not a normal distribution: Wilcoxon Signed-Rank, quantile regression and Spearman's correlation coefficient:

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Table 5: Statistical Results H1

Dimension	Wilcoxon Statistic	Wilcoxon p-value	Quantile Coefficient	Quantile p-value	Spearman Correlation	Spearman p-value
Strategic Budgeting	3366	1.49e-08	1.00e+00	8.87e-78	7.45e-01	2.12e-18
Strategy-Oriented Reporting	3086.5	4.54e-09	1.00e+00	4.11e-79	8.18e-01	1.56e-24
Strategic KPIs	982.5	1.00e-01	1.10e+00	1.24e-38	8.40e-01	5.10e-27
Adaptability	4186	2.29e-18	9.20e-01	1.29e-71	6.33e-01	3.65e-12
Continuous Improvement	3828	4.34e-18	8.00e-01	2.15e-68	1.75e-02	8.65e-01

Wilcoxon Signed-Rank tests were conducted to ascertain whether the medians of the participants' responses for each dimension significantly exceeded the neutral value of 3. The findings, with highly significant p-values for the dimensions Strategic Budgeting, Strategy-Oriented Reporting, Adaptability and Continuous Improvement, substantiate their statistical significance. These mechanisms assume a pivotal role in supporting companies during periods of uncertainty.

The quantile regression coefficients demonstrate a positive and significant effect for each dimension studied, with Strategy-Oriented Reporting and Strategic KPIs exhibiting the highest coefficients. This indicates that these mechanisms are particularly influential in improving organisational performance during periods of crisis. The findings suggest that companies should prioritise these mechanisms to maximise their effectiveness.

The findings underscore the significance of these mechanisms, as evidenced by the robust relationships depicted by Spearman's correlation coefficients, particularly for Strategy-Oriented Reporting (r=0.82) and Strategic KPIs (r=0.84). These results imply that organisations that fortify these management control mechanisms are more likely to attain substantial improvements in their performance, particularly during periods of crisis.

This validates the initial hypothesis that management control mechanisms have a positive influence on organisational performance during periods of crisis, particularly in the context of practices related to Strategy-Oriented Reporting and Strategic KPIs.

To test the second hypothesis, positing that Management control systems facilitate organisational adaptation in a crisis context, a series of statements about management control systems were again presented for

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assessment on a 5-point Likert scale, similar to that used for the first hypothesis.

The variables explored were reactivity assessment, process improvement, strategic orientation, strategy integration and resilience. Each variable represents an aspect of management control systems in the context of a crisis. To analyse this second hypothesis, we performed Normality tests (to validate the use of parametric tests), one-tailed T-tests, a single-factor ANOVA, a Tukey post-hoc test and a Chi-square test.

Table 6a: Normality Tests H2

Dimensions	Shapiro-Wilk p-value	Kolmogorov-Smirnov Statistic p-value
Reactivity	0.12	0.08
Process improvement	0.15	0.09
Strategic orientation	0.05	0.04
Strategy integration	0.10	0.07
Resilience	0.11	0.09

The majority of the dimensions demonstrate normality ($p > 0.05$), thereby validating the utilisation of parametric tests for hypothesis testing. However, Strategic Orientation exhibits minor deviations from normality ($p < 0.05$). But since tests like ANOVA and t-tests are robust to small violations of normality, especially when sample sizes are sufficiently large ($n>30$) we can neglect this slight deviation

Table 6b: Statistical Results H2

Dimensions of Management Control	Mean	t-test (t-stat)	P-value (t)
Reactivity	4.24	21.96	3.25e-39 (<0,001)
Process improvement	4.58	23.03	6.94e-41 (<0,001)
Strategic orientation	3.95	10.45	1.63e-17 (<0,001)
Strategy integration	4.29	18.76	6.97e-34 (<0,001)
Resilience	4.6	27.55	2.21e-47 (<0,001)

One-tailed t-tests indicate that the means of responses for each statement related to the role of management control are all significantly greater than 3. Furthermore, the P-values are all less than 0.05, suggesting that there

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is a significant consensus among participants that management control played a prominent role in crisis management.

Table 6c: Anova H2

ANOVA (F-stat)	P-value (ANOVA)
14.93	1.65e-11 (<0,001)

The ANOVA result (p-value <0.05) reveals that the various dimensions of management control are not perceived in an equivalent manner by the respondents. This indicates that certain aspects of management control are more crucial than others. Additionally, the ANOVA results were corroborated by a Tukey test, which confirmed the importance of specific dimensions of management control over others in a crisis context. Consequently, process improvement and resilience were identified as facilitating organisational adaptation.

Table 6d : Chi Square H2

Chi square χ^2	P-valeur (Chi square)
15.82	0,031

The extremely low p-value (<0.05) implies an association between the responses. This validates the assertion that management control systems function as an integrated whole, operating coherently in adapting to the crisis context.

The analyses carried out for this second hypothesis (H2) therefore confirm that management control systems play a facilitating role in organisational adaptation in times of crisis:

- An integrated, multi-dimensional role, since the different dimensions studied are seen as interconnected, contributing jointly to crisis management.
- Priority responsiveness and resilience, enable organisations to adapt rapidly and maintain operational continuity. This is due to the critical importance of short-term survival during a crisis.

With regard to the third hypothesis of our study, namely whether the utilisation of new management control tools facilitates the transition of the organisation towards a more strategic outlook, a series of questions was posed regarding the adoption of new management control tools and their impact on different aspects of the company in times of crisis. The responses were recorded on a Likert scale ranging from 1 (indicating a very low impact) to 5 (indicating a very high impact).

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Three analytical techniques were employed to test hypothesis 3: multiple linear regression, principal component analysis (PCA) and a Kruskal-Wallis test. The multiple linear regression allows us to determine not only whether each management control tool (independent variable), individually, has a significant impact on the company's strategic vision (dependent variable), but also the extent of this impact. The main results are presented below:

Table 7a: Linear Regression H3

Tool	Regression coefficient	P-value
Advanced ERP systems	0.82	0.021
AI technologies	0.88	0.015
Balanced Scorecard	0.42	0.045
Planification tools	0.65	0.030
Mobile Applications	0.58	0.037

The results demonstrate that artificial intelligence (AI) technologies and enterprise resource planning (ERP) are the tools with the most substantial impact on strategic vision, with coefficients of 0.88 and 0.82, respectively, and P-values of less than 0.05. This suggests that these technologies have facilitated more effective anticipation of challenges and responsive strategic adaptation in response to changing circumstances. Strategic planning tools and mobile applications also demonstrated a notable impact, although to a lesser extent than artificial intelligence technologies. These findings indicate that companies that invest in advanced technologies can enhance their strategic capability, a crucial element in ensuring resilience and responsiveness in times of crisis.

Principal components analysis (PCA) was used to reduce the dimensionality of the variables and to identify the underlying factors that explain the majority of the variance in the data. This was done with the objective of determining how the various management control tools collectively contribute to the strategic direction, responsiveness and overall performance of the company, particularly in periods of crisis:

Table 7b : CPA H3

Components	Esplained variable %
Composant 1	45
Composant 2	27
Total	**72**

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The first principal component explains 45% of the total variance, while the second component represents 27% of the variance. The combined influence of these two components accounts for 72% of the total variance. The first component is strongly associated with the adoption of advanced management control tools, including enterprise resource planning (ERP) and artificial intelligence. The second component is associated with responsiveness and integration between strategy and operations. This suggests that these tools enable not only strategic improvement but also greater responsiveness to unforeseen events.

The Kruskal-Wallis Test, which is employed when the conditions of normality are not present, enabled us to undertake a comparison of the perceived impact of different management control tools on the strategic vision of companies. The aim was to determine whether certain technologies were perceived as having a greater influence than others. The results of the test revealed significant differences between the different tools, particularly between artificial intelligence technologies and other tools, with an (H) statistic of 15.82 and a p-value of 0.031 (<0.05). These pronounced contrasts between the groups indicate that advanced technologies, such as AI, played a more pivotal role than other tools, such as business intelligence tools or social networks, in assisting companies in adopting a strategic vision during the crisis.

The tests carried out therefore also enable us to confirm hypothesis 3, according to which the adoption of new management control tools during a crisis leads the company towards a more strategic vision, this way, they encourage better responsiveness and greater integration between the operational and strategic dimensions, offering companies greater resilience, enabling them to navigate more serenely in complex and uncertain environments, but also to prosper thanks to a more strategic and adaptive proactive approach.

Interpretation of the results

The results obtained for hypothesis 1 indicate that management control mechanisms positively influence organisational performance, particularly in terms of continuous improvement and strategic reporting. These findings align with those of Bedford & al. (2016) who demonstrated that aligning management control mechanisms with strategic objectives promotes the optimal utilisation of resources and enhanced performance. Additionally, the findings of Baird & al. (2019) are corroborated, as they highlighted that the use of control mechanisms based on non-financial indicators improves decision-making and organisational adaptability.

As evidenced by the results of the second hypothesis, management control systems play an instrumental role in facilitating organisational

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adaptation during periods of crisis. This is consistent with the findings of Teece & al. (2016) who posit that a firm's capacity to adapt swiftly to turbulence hinges on its organisational flexibility and the efficient utilisation of resources. Additionally, the findings are corroborated by those of Geurts & al. (2022), which demonstrated that flexible management control systems enabled companies to respond more effectively to the pandemic by optimising their strategies and resources. These results support the concept that integrated management control systems empower companies to transition from a reactive to a proactive approach, as noted by Leoni & al. (2021)

Regarding Hypothesis 3, the adoption of technologies such as artificial intelligence (AI) and ERP shows a positive impact on companies' strategic vision. These results are in line with the work of Appelbaum & al. (2017), who highlighted the importance of AI in improving decision-making processes and the ability of companies to anticipate organisational needs.

Conclusion

The findings of this study demonstrate that management control, traditionally regarded as a supportive function, has undergone a transformation into a pivotal driving force in periods of crisis. Indeed, management control systems have assumed a central position in strategic responsiveness, performance improvement and the adoption of new tools and technologies, thereby endowing companies with the ability to adapt rapidly and reposition themselves proactively. The deployment of management control tools such as artificial intelligence, strategic reporting and dashboards has made significant contributions, enabling companies to be steered effectively through the numerous uncertainties that can arise in the wake of a crisis.

Simultaneously, management control has also become a strategic lever, evolving from a basic operational support function to an indispensable component of resilience and growth. This transformation has enabled companies to not only confront the immediate challenges posed by the crisis but also to anticipate and construct a long-term strategic vision. This evolution of management control into a key strategic steering function underlines its growing importance not only in times of crisis, but also in preparing companies to navigate an increasingly complex and uncertain future.

However, while this study underscores the significance of management control in crisis situations, it is not without certain constraints that must be considered when interpreting the findings:

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Limitations of the sample

The sample selected consists of 97 Moroccan companies, which represents a relatively small sample size and restricts the generalisation of the results. Moreover, the cultural and economic specificities of Morocco may limit the applicability of the results in other contexts. As noted by Hair & al (2019), a larger and more diversified sample is crucial to increase the external validity of empirical studies.

In addition, the constraints on the representativeness of smaller samples, as highlighted by Creswell and Creswell (2018), underscore the necessity for future research to expand the sample size and include participants from a range of geographic and economic contexts, with the aim of generalising the findings beyond the original research setting.

Crisis variability

This study focused on a specific economic and health crisis, namely Covid-19, which limits the scope of the conclusions to other types of crises. Pearson and Mitroff (1993) have shown that each type of crisis requires different and specific responses.

Potential bias in respondents' perceptions

The respondents were primarily senior executives and management controllers, which could potentially bias their perception of the effectiveness of management control tools. These individuals are directly involved in the implementation of these tools and may therefore have an optimistic view of their effectiveness, as previously noted by Jordan and Messner (2012).

A preliminary approach might be to utilise a combination of qualitative and quantitative methodologies, such as qualitative interviews, with a view to establishing data triangulation, thus reducing method-related biases and enhancing the overall rigour of the findings (Nagels, 2022). Furthermore, this approach would facilitate a more comprehensive understanding of internal processes (Eisenhardt & Graebner, 2007).

Secondly, a study of different types of crises could be conducted by, for example, carrying out three case studies of three different types of crises. This would enable the differences in the effectiveness of management control tools to be understood and their adaptability to different crisis situations to be determined. To enhance the generalizability and validity of future research, incorporating larger and more diverse samples is crucial (Creswell & Creswell, 2018; Hair et al., 2019). The geographical and demographic representation of the study population must be expanded in order to facilitate a more comprehensive capture of the variability in organisational responses to crises.

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Furthermore, the combination of this with qualitative methods, such as interviews or case studies, would serve to complement quantitative findings by offering richer insights into the contextual nuances and internal dynamics of management control systems. Such triangulation would not only provide a more comprehensive understanding of these mechanisms but also reduce the potential for biases introduced by a single methodological approach (Flick, 2018).

Finally, it would be judicious to direct attention to the post-crisis phases, with a view to gaining insight into the durability of the tools adopted. This may be achieved by assessing whether they remain as effective once conditions have stabilised (Amankwah-Amoah, 2020). Moreover, exploring the long-term institutionalisation of these tools could reveal how they contribute to resilience beyond crisis contexts (Weick, 2015).

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Post-Devolution Household Healthcare Expenditures in Rural Kenya

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Abstract

Introduction: Despite improvements in a country's income during the era of decentralization, catastrophic expenditures persist. This study aimed to establish the determinants of household healthcare expenditures in rural Kenya. **Methods:** The study utilized data from the Kenya Household Health Expenditure and Utilization Survey (2018). A multiple regression model was employed to estimate the impact of respective determinants on post-devolution health expenditures in rural Kenya. The Ordinary Least Squares (OLS) estimation technique was adopted. **Results:** The gender of respondents, marital status, medical insurance, and chronic illness were found to be positively related to health expenditures, whereas education levels (primary, secondary, and higher levels) and wealth index (second and third wealth quintiles) were significant predictors but had a negative relationship with health expenditures. **Recommendations:** The study suggests promoting gender equality in healthcare access and implementing incentives and training programs to encourage men to practice preventive care, thereby reducing hospital visits. Additionally, the study recommends the creation and implementation of awareness programs across organizations, schools, and government agencies. Empowerment programs should be established to help the population lower hospital visits, consequently reducing healthcare expenditures. Furthermore, the government should increase the number of public health facilities to enhance access to subsidized services in rural areas.

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Keywords: Household Healthcare, Expenditures, Rural, Post-Devolution, Kenya

Introduction

Improving population health outcomes and protecting households from illness-related financial catastrophes are primary goals of any healthcare system. In developing countries, significant strides have been made toward achieving Universal Health Coverage (UHC) and the Sustainable Development Goals (SDGs), particularly in increasing access to essential health services and providing financial risk protection (Ndikumana & Pickbourn, 2017). However, achieving these goals remains challenging, as many households continue to face catastrophic out-of-pocket (OOP) expenditures, which account for a large share of total health spending in low- and middle-income countries. For instance, OOP payments often constitute 60-80% of total health expenditure in such nations, leaving many households vulnerable to financial distress when they fall ill (Rodney, 2018; Hsu et al., 2018).

In Kenya, the 2010 Constitution marked a critical turning point for healthcare by introducing devolution, which aimed to decentralize service delivery and enhance equitable access to healthcare at the county level (Republic of Kenya, 2010). Devolution sought to improve governance and resource distribution, especially in underserved regions such as rural areas. Before devolution, healthcare in Kenya was largely centralized, leading to inefficiencies and inequities in service delivery (Tsofa, Molyneux, Gilson & Goodman, 2017). Following the constitutional change, counties assumed responsibility for healthcare provision and received increased budgetary allocations to strengthen health infrastructure and improve service delivery. In the fiscal year 2016/17, county health budgets accounted for up to 25% of their total budget, reflecting a significant shift from previous allocations, where the central government-controlled healthcare spending (Republic of Kenya, 2018).

Despite these efforts, healthcare expenditures remain a major concern for many households, particularly in rural areas. A significant portion of healthcare costs is still borne by households through OOP expenditures, which have the potential to lead to catastrophic health spending (Kimani, Mugo & Kioko, 2016). Catastrophic health expenditure occurs when a household's OOP payments exceed 40% of its capacity to pay, causing significant financial strain that may lead to impoverishment (Kimani et al., 2016). In Kenya, studies have shown that many households, particularly in rural areas, devote a large share of their income to healthcare, often sacrificing other basic needs in the process (Barasa, Maina & Ravishankar, 2017). The 2018 Kenya Household Health Expenditure and Utilization Survey (KHHEUS) highlighted that rural

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households spent an average of Ksh 1,446.94 per person annually on healthcare, with the highest OOP expenditure reaching Ksh 2,356.33 (KHHEUS, 2018).

The financial burden of healthcare has also been exacerbated by the limited reach of health insurance coverage, especially in rural areas. Insurance coverage in Kenya is skewed toward urban populations, with only 12.1% of rural residents having access to health insurance compared to 26.6% in urban areas (KHHEUS, 2018). As a result, rural households are more likely to rely on OOP payments, which can deter them from seeking healthcare altogether or force them to seek alternative, often informal, care options (Chuma & Maina, 2012). Additionally, the 2018 survey revealed that despite the increasing demand for healthcare services, many households still encounter financial barriers due to the high costs associated with chronic illnesses, consultations, and the purchase of medications (Barasa et al., 2017).

Devolution aimed to alleviate these financial burdens by decentralizing healthcare delivery and making it more accessible at the county level; however, disparities in healthcare expenditure persist across counties (Republic of Kenya, 2015). Counties with higher wealth indices, such as Nairobi and Kirinyaga, spend significantly more on healthcare per capita compared to poorer counties such as Turkana and Siaya, reflecting a continued divide in access to healthcare services (KHHEUS, 2018). This geographic variation has prompted concerns about the equity of healthcare spending and whether devolution has truly fulfilled its promise of improving access to healthcare for all Kenyans, particularly in rural areas (McCollum et al., 2019). The quality and availability of healthcare services in rural areas remain a pressing issue. Although public health facilities, which are generally more affordable, play a critical role in providing healthcare to rural populations, they often suffer from inadequate resources, poor infrastructure, and shortages of medical personnel and supplies (Republic of Kenya, 2018). Consequently, rural households often turn to private or religious health facilities, which tend to be more expensive and further contribute to the financial strain of healthcare (VanderWeele, 2017). Even with the introduction of free primary healthcare policies and subsidized services through government interventions, the overall cost of healthcare continues to rise, leaving many households struggling to afford necessary care (Owino, 2018).

The rising cost of healthcare has also been linked to the increasing incidence of chronic diseases such as diabetes and hypertension, which require continuous care and lead to higher healthcare expenditures (Wang, Li & Chen, 2015). Households with individuals suffering from chronic illnesses tend to incur significantly higher OOP expenses, further compounding their financial vulnerability (Barasa et al., 2017). This trend highlights the need for targeted interventions to address the healthcare needs of vulnerable populations,

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especially in rural Kenya, where access to quality healthcare services remains limited despite devolution (Kabia et al., 2018). This study, therefore, seeks to examine the determinants of household healthcare expenditures in rural Kenya, with a focus on post-devolution trends in OOP spending.

Methods

The theoretical framework of this study is based on the Grossman human capital approach to health (Grossman 1972; 2000). As per this model, services of health are sought because they improve the health status of an individual. According to Grossman model one inherits an initial stock of health which decreases with age but can be replenished through investments. In order to restore declining health conditions, it calls the decision to seek medical care as an ingredient to assist in preventing the natural depreciation of the health stock (Nixon & Ulmann, 2006). Other inputs include exercise, education, nutrition, and lifestyle choices. Unlike the normal buying of goods and services, medical care is unique in its own way as what you buy is good health as argued by Grossman. In addition to increasing productivity, better health ensures that there is sufficient time for the production of income as well as commodities (Orayo, 2014). Therefore, health is demanded simply because it enters into individual utility function in terms of consumption commodity at the same time it boosts the stream of health in terms of investment which increases the haven of healthy days that allows both markets as well nonmarket activities (Nixon & Ulmann, 2006, Muthaka, 2014). Therefore, the empirical model of estimation that uses the composition and determinants of health-care expenditure in rural areas was estimated through the specified model.

The study took into account the empirical model used by Qureshi (2008) in modeling and simulating public expenditure. Since this is a household decision-making behavior, our model follows Strauss and Thomas (1995) empirical modeling of household and family decisions. This therefore associates individual household spending with its factors which ease the usage of spending equations. In this study, an econometric maximizing individual model was developed centring on the expenditure of health decisions largely taken from the perspective of health production following the human capital model. Expenditure estimation function through the cross-sectional analysis for rural areas in this study was considered. Following general health expenditure model is expressed as follows;

$$HHEXP = F(X, W) \tag{1}$$

Where: $HHEXP$ household healthcare expenditure, X can be described as a group of variables which are explanatory that affect household expenditure on health while household income is represented as W.

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The expenditure equation comprises a collection of household features that are associated with the extent of spending on health. These are family income, geographical location, family head level of education, number of children in the household as well as other characteristics that may have effects on household health spending decisions. Then, to empirically specify household health expenditure in rural Kenya; a multiple linear functional form is considered in the empirical specification as follows:$HHEXP = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon$ (2)

Where: X_1 =Age; X_2=Gender; X_3=Educational Levels; X_4=Marital Status; X_5=Wealth Quintiles; X_6=Type of health provider; X_7=Medical Insurance; X_8=Chronic illness; and X_9=Distance to health facility. Also, $\beta_1 - \beta_9$ are coefficients to be estimated for the respective variables whereas β_0 and ε is the coefficient for constant and error terms respectively? Equation (2) was estimated using the Ordinary Least Squares (OLS) estimation technique, a standard econometric method for estimating the linear relationships between dependent and independent variables. OLS minimizes the sum of squared residuals (the differences between observed and predicted values) ensuring the best linear unbiased estimates (BLUE) of the coefficients under the Gauss-Markov assumptions.

OOP health spending to be estimated in the first objective can be expounded simply as at the point of receiving health services in the healthcare the payments made by households is what is referred to as OOP. In determining the level of household OOP expenditures, the study considers costs such as registration, consultation, drugs (including over-the-counter drugs and alternative and/or traditional medicine) vaccines, diagnosis, and medical check-up fees. This information is available. Transportation cost and opportunity cost of waiting time are excluded from the OOP payments because the data set does not have these two variables.

Healthcare use variable was measured by the number of medical trips made to a health care provider. The survey asked respondents to state whether any member of the household was sick during the one month preceding the survey and whether medical care was sought. If medical care was sought, the respondents were asked to state how many visits they made to the healthcare provider.

The study used KHHEUS, (2018) which is cross-sectional in nature. It consists of a national and county representative sample survey collected in post devolution era in Kenya. Of importance, the place of residence variable in this study was determined through a multistage sampling design used to choose clusters as representative and households who form the sample. The estimates of key indicators both for rural and urban regions were incorporated in this sample constructed.

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Results

The results show that post-devolution, households in rural areas still experience significant out-of-pocket (OOP) expenditures, with average annual per capita spending on outpatient and inpatient care recorded at Ksh 975.39 and Ksh 692.95, respectively. These expenditures remain substantial, despite efforts to increase healthcare accessibility through devolved county budgets. For instance, counties like Turkana and Siaya, which have seen increased healthcare budget allocations, still report high OOP expenditures due to inefficiencies in healthcare service delivery (KHHEUS, 2018). The finding is as indicated in Figure 1.

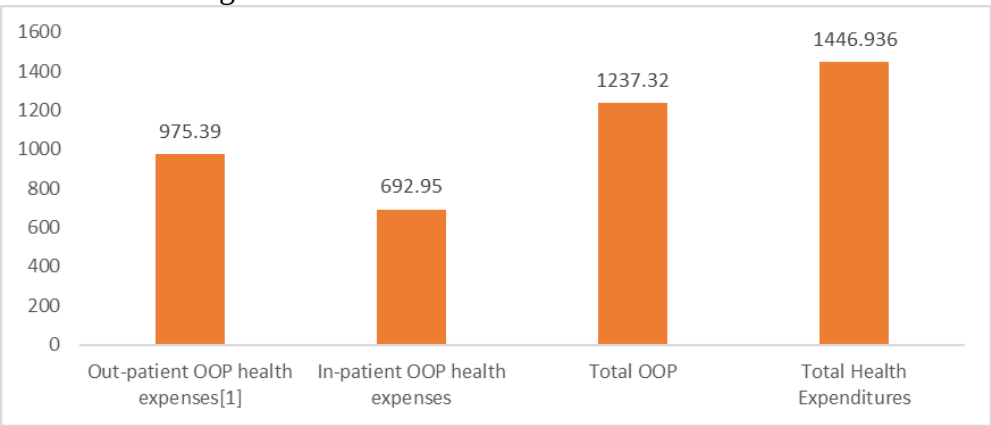

Fig 1: Average Out of Pocket Health Expenditures (*Kshs*) in Rural Kenya

The highest individual spent Kshs 1749.24 and Kshs 1299.93 on outpatient care and inpatient care respectively while the lowest spent around Kshs 10.46 and Kshs 15.19 for outpatient and inpatient respectively. Health expenditures for rural Kenya were used as the dependent variable in this study. Considering the OOP spending, the study revealed that residents in rural areas spent on average Kshs 1237.32 per person in seeking healthcare with the highest OOP expenditure being Kshs 1987.92 and the lowest spending being Kshs 100. It was established that, on average individuals spent about Kshs 1446.94 in seeking healthcare in the rural areas with the highest spending Kshs 2356.33 while the lowest spent Kshs 100.

Table 1: Annual Per Capita Out of Pocket Health Expenditures (*Kshs*) in Rural Kenya

Component of OOP	Observation	Mean	Std. Dev.	Min	Max
Out-patient OOP health expenses[1]	20,205	975.39	216.49	10.46	1749.235
In-patient OOP health expenses	20,205	692.95	134.88	15.19	1299.93
Total OOP	20,205	1237.32	284.59	100	1987.92
Total Health Expenditures	20,205	1446.936	989.0485	100	2356.325

[1] Routine expenses is part of outpatient OOP expenditures

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Model Estimation

To achieve the main objective of this study, the probit model used underwent a thorough assessment of overall fitness via R-squared statistic and F test. The results of the p-value ($p<0.05$) imply that the variables used in the model explained the dependent variable significantly. Table 2 shows regression results.

Table 2: Multiple Regression Model (Dependent Variable: Health Expenditures)

Linear Regression
Number of observations = 10,134
F(14, 10119) = 24.01
Prob > F = 0.0000
R-squared = 0.0432
Root MSE = 0 .65781

***Ln* Health Expenditure**	**Coefficient**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
Age	0.0035	0.0029	1.22	0.222	-0.0021	0.0092
Age Squared	-0.00004	0.00004	-1.14	0.253	-0.0001	0.00003
Gender	0.0601***	0.0150	4.02	0.000	0.0308	0.0894
Marital status	0.0513***	0.0171	2.99	0.003	0.0176	0.0849
Education levels						
Primary	-0.2453***	0.0239	-10.26	0.000	-0.2921	-0.1984
Secondary	-0.2162***	0.0274	-7.89	0.000	-0.2699	-0.1625
Higher	-0.1105***	0.0321	-3.44	0.001	-0.1734	-0.0476
Wealth Index						
Poorer	-0.0606***	0.0182	-3.33	0.001	-0.0963	-0.0250
Middle	-0.0200	0.0193	-1.03	0.301	-0.0578	0.0178
Richer	0.0288	0.0217	1.33	0.183	-0.0136	0.0713
Richest	0.0762**	0.0297	2.57	0.010	0.0180	0.1345
Type of health Provider	-0.0619***	0.0196	-3.17	0.002	-0.1002	-0.0236
Medical Insurance	0.0443**	0.02196	2.02	0.044	0.0013	0.0874
Chronic illness	0.0655***	0.02074	3.16	0.002	0.0248	0.1061
Constant	6.1220	0.0581	105.39	0.000	6.0082	6.2359

**Ln is natural logarithm*
Source: Computation Based on KHHEUS (2018)

From the regression results; the gender of the respondents, marital status, medical insurance and chronic illness were found to be positively associated with health spending. Variables such as education levels (primary, secondary and higher levels), and wealth index (second and third wealth quintiles) were found to be significant predictors but had a negative relationship with health expenditures.

Discussions

The results show that age and age squared were statistically non-significant in determining health expenditures in rural Kenya, with an extra year leading to only a 0.35% increase. This insignificance is consistent with some studies that find age to have a minimal effect on health expenditures,

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particularly in rural settings where access to healthcare may be limited, regardless of age (Garg & Karan, 2009). However, other studies have found a significant positive relationship between age and health expenditures, particularly in urban areas where elderly populations may have better access to healthcare services, leading to increased costs as they age (Schokkaert & Van Ourti, 2012). This suggests that the relationship between age and healthcare expenditure may be context-dependent, with rural settings exhibiting different dynamics compared to urban areas.

Gender was found to be statistically significant, with males incurring 6.01% higher health expenditures compared to females. This finding is in line with studies by Grossman (2000) and Yiengprugsawan et al. (2010), which suggest that males, often household heads, may prioritize their own health or incur higher expenditures for their families. In contrast, Bayar and İlhan (2016) in their study on education expenditures found that gender was not a significant determinant, highlighting the contextual differences in expenditure types. Similarly, Sekhampu (2012) found that gender did not significantly affect food expenditure in South Africa. These differences across expenditure categories suggest that gender may play varying roles depending on the type of expenditure being analyzed, with healthcare being more gender-sensitive due to social and cultural factors influencing health-seeking behavior (Vlassoff, 2007).

Marital status was statistically significant, with married individuals experiencing 5.13% higher health expenditures. This result aligns with findings by Yiengprugsawan et al. (2010), who showed that married individuals tend to have larger households and more healthcare needs. It also resonates with studies in low-income settings where married couples are likely to spend more on healthcare due to family health needs (Agyemang-Duah, Peprah & Osei-Assibey, 2020). However, Sekhampu (2012) found that marital status had a negative influence on household food expenditures, suggesting that the relationship between marital status and expenditure varies across different types of consumption. For healthcare, married individuals may prioritize their families' health needs, leading to higher expenditures (Jowett et al., 2003).

Education was shown to play a significant role in reducing health expenditures. Higher levels of education (primary, secondary, and higher) significantly lowered health expenditures by 24.52%, 21.62%, and 11.05%, respectively. This is consistent with the Grossman (1972) theory of health capital, which posits that education improves individuals' capacity to maintain good health, reducing the need for frequent healthcare visits. Similar results were observed by Bayar and İlhan (2016), who found that higher education levels positively impact income and reduce unnecessary healthcare expenditures through better health management. Contrarily, Yiengprugsawan

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et al. (2010) found that higher education levels in certain contexts could lead to increased healthcare spending, as educated individuals might seek higher-quality and more expensive healthcare services. The findings from this study, however, underscore that in rural settings with limited access to high-quality healthcare, education plays a protective role by reducing unnecessary health costs through preventive care.

The wealth index demonstrated a mixed effect on health expenditures, with individuals in the second wealth quintile spending 6.06% less on healthcare, while those in the fifth quintile spent 7.62% more. These findings are consistent with Kiplagat, Muriithi and Kioko (2013), who found that wealthier individuals are more likely to afford better healthcare services, leading to higher expenditures. On the other hand, poorer households tend to avoid high healthcare costs by either delaying care or seeking alternative treatments, as highlighted by studies in Ghana (Akazili et al., 2017) and Kenya (Barasa et al., 2017). This suggests that wealthier individuals can afford to invest more in healthcare, whereas poorer households are more likely to forgo care due to financial constraints, leading to lower expenditures but potentially worse health outcomes.

The type of health provider also had a significant impact on health expenditures, with those using public health facilities experiencing a significant reduction in their expenditures by 6.19%. This is consistent with Muthaka (2013), who found that public health facilities in Kenya offer subsidized services, resulting in lower out-of-pocket payments for patients. Similar findings were observed in studies from other developing countries, such as India (Sharma et al., 2017), where public health facilities were linked to reduced healthcare costs for low-income households. However, some studies suggest that the quality of care in public facilities may be lower, prompting wealthier individuals to seek private care despite the higher cost (Xu et al., 2007). The results of this study reinforce the idea that public health facilities provide a crucial safety net for reducing health expenditures, particularly for rural populations.

Medical insurance was found to significantly increase health expenditures by 4.43%, a result that can be explained by the concept of moral hazard. As noted by Jowett et al. (2003), individuals with health insurance are more likely to use healthcare services, even for minor ailments, leading to higher overall healthcare costs. This finding is consistent with Barasa et al. (2017), who found that insured households in Kenya were more likely to utilize healthcare services, contributing to increased expenditures. Studies from other contexts, such as Ghana (Akazili et al., 2017), also support the notion that insurance increases healthcare utilization and, subsequently, expenditures. This highlights the dual effect of insurance: while it increases access to healthcare, it can also lead to higher utilization and costs.

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Chronic illness was found to significantly increase health expenditures by 6.55%, a finding consistent with studies across various settings. For example, Wang et al. (2015) demonstrated that households with chronically ill members in China experienced higher healthcare costs due to the continuous need for medical care. Similarly, Barasa et al. (2017) found that chronic illness in Kenyan households significantly increased the risk of catastrophic health expenditures. The results of this study align with these findings, reinforcing the fact that chronic illness is a key driver of healthcare costs, particularly in rural areas where access to long-term care and medication may be limited, necessitating frequent healthcare visits.

Conclusions

The primary objective of healthcare systems is to improve population health outcomes while protecting households from financial distress due to healthcare costs. In Kenya, despite improvements in income and the decentralization of health services following devolution, many households, especially in rural areas, still face catastrophic out-of-pocket expenditures. The findings of this study indicate that education plays a crucial role in reducing healthcare expenditures, likely due to the positive effect of education on health-seeking behavior and preventive care. In contrast, chronic illness and medical insurance are associated with higher healthcare expenditures, suggesting a need for better management of chronic diseases and refinement of insurance models to mitigate moral hazard. Additionally, the utilization of public health facilities appears to reduce OOP expenditures, underscoring the importance of strengthening public healthcare services at the county level.

Based on the findings, promoting gender equality in health-seeking behavior is essential. Men were found to incur higher healthcare expenditures compared to women, likely due to delayed care-seeking behavior. Counties should implement health campaigns and preventive care programs specifically aimed at men, encouraging regular health check-ups and early intervention. This could help reduce the higher costs associated with treating advanced health conditions and promote healthier lifestyles among men.

Reforming medical insurance schemes is necessary to control healthcare costs. Although insurance increases healthcare access, it also raises expenditures due to moral hazard. Counties, in collaboration with national authorities, should design insurance packages that promote preventive care and rational use of services. Co-payment systems for non-essential services could help curb excessive healthcare utilization without limiting access to necessary care. Public education on the appropriate use of medical insurance could also mitigate the rise in healthcare expenditures among insured households.

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Enhancing family health programs would help address the higher healthcare expenditures associated with married individuals. Family health packages that cover essential services, such as maternal and child health, vaccinations, and preventive care, should be promoted. These packages can be made more accessible through county-level public health initiatives, reducing the financial burden on married households and improving overall family health. Counties should also invest in community-based health education programs targeting less-educated populations. These programs should focus on promoting healthy behaviors, such as proper nutrition, hygiene, and disease prevention, thereby reducing the need for frequent healthcare visits and lowering overall expenditures. To ensure equitable access, counties should provide targeted subsidies or vouchers for low-income households to reduce the burden of healthcare costs. Additionally, improving the quality of public health services would encourage wealthier individuals to use public facilities, thereby reducing reliance on more expensive private care.

Strengthening public health facilities is vital to reducing healthcare costs. Public facilities were associated with significantly lower healthcare expenditures, indicating their importance in providing affordable care. Counties must invest in expanding and upgrading these facilities, ensuring they are well-equipped, adequately staffed, and capable of providing high-quality services. This will not only reduce OOP expenses but also enhance the overall healthcare infrastructure in rural areas. Lastly, enhancing chronic disease management programs is necessary to mitigate the financial burden of chronic illnesses, which significantly drive-up healthcare expenditures. Counties should develop comprehensive chronic disease management strategies, including regular monitoring, access to affordable medication, and community support systems.

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Drivers, Barriers, and Impact of Digitalization on Sustainable Rural Development, Focusing on Some Regions of Albania

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Abstract

The rural sector is one of the most important sectors in Albania, referring to the contribution to economic growth, gross domestic product, and level of employment in the country. Increasing the productivity and performance of agricultural farms, efficiency of resource use, cooperation between small farmers, access to financing, implementation of technology, food quality and safety, are considered some of the main challenges for the sustainable development of this sector. An important instrument to face these challenges is the digitization of this sector, through the use of technology and digital platforms, with the aim of increasing the competitiveness and productivity of agricultural farms. The digitalization process holds the potential to bring about a significant change in how agriculture functions, in terms of tools, technologies, platforms and innovative approaches that support precision agriculture and efficient management of resources. In function of the

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purpose of the study, the questionnaire was designed to collect information from the farmers (interviewers). Based on the data of INSTAT & MARD, (2023) for the dominant activities and typology of farms, 938 questionnaires were completed with farmers for the regions selected in the study. The methodology used for this paper is based on the collection, processing, analysis and interpretation of data and indicators, focusing on the drivers, barriers and impact of digitalization on sustainable rural development in Albania. The data were analysed and processed with the SPSS program, in accordance with the purpose and research objectives of the study. Based on the data collected in this study, digital technologies in agriculture are perceived positively by interviewed farmers. The results show that the digitalization process in the rural sector is slow and faces several barriers and challenges, such as the small size of the farms, limited digital skills of farmers, lack of resources to implement digital technologies, and limited digital infrastructure in rural areas.

Keywords: Digitalization, precision agriculture, sustainability, digital technologies, drivers and barriers

Introduction

The rural sector is becoming more and more intensive, related to farmers' knowledge, complex decisions they have to make about their farm activities, the agricultural products they grow, the markets in which they will sell their agricultural products, and other factors affecting their livelihood and the well-being of society as a whole (ITU & FAO, 2020). The development of the rural sector is oriented towards improving infrastructure and increasing investments, farm productivity, environmental protection, effective agricultural land management and food safety standards.

This sector remains the most important sector in the country's economy, contributing 20% to the Gross Domestic Product (GDP) as well as providing the income base for the majority of the population. The agricultural sector employs about 37% of the country's employed population (MARD, 2022). However, agriculture sector development is facing several challenges such as uncertainties about agricultural land ownership, market access for agricultural products, low levels of use of modern technologies, lack of cooperation among farmers, the small size of the farms, price-cost squeezes, rural exodus and youth abandonment, high informality (ITU &FAO, 2020). An important component to face these challenges and problems is the digitization of this sector, through the use of technology and information systems as well as digital platforms, with the aim of increasing the competitiveness and productivity of agricultural farms.

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The studies show that the application of technology and information, affects the exchange of information between actors, in terms of data on the prices of the purchase of inputs and the sale of products, helping to improve the effectiveness of the food value chain and agricultural activities. Access to and use of ICTs has increased considerably in recent decades in rural areas of developing and transition countries (Ma et al., 2023). Agribusiness can potentially add value to agriculture and the entire value chain, but it is difficult to achieve these goals without digitalization of this sector (Kitole et al., 2024). Technological developments lead to the organization of agricultural production, the consumption structure and the agribusiness system. According to Rolandi et al. (2021), technological change is not considered just in terms of "physical" inventions or developments, but as a process interacting with changes in people's behavior and the institutional and economic structures. The transition towards digitalised agriculture and rural areas can have huge socio-economic and environmental impacts (Basso & Antle, 2020; Lajoie-O'Malley et al., 2020).

In developing countries, such as our country, agriculture is one of the main sectors of the economy, so there is a need for a large number of extension agents to advise and interact with farmers on innovative production technologies that can be decisive for their activities. The digitalisation can contribute to improving the quality of work in traditionally rural activities, and can make it more attractive for young people (Brunori et al., 2022). In these countries, there has been a growing awareness of the many challenges facing agricultural extension systems and ICTs can be useful in addressing these problems (Spielman et al., 2021). Digital technologies (eg, artificial intelligence, robotics, innovation, Internet of Things, drones, etc.) are applied along the agricultural value chain to address challenges related to agricultural production systems (Benke et al., 2017; Rose et al., 2020). Building the human capacity, as well as the infrastructure needed to facilitate better connectivity and communication, is critical. Strengthening the skills and capabilities of agricultural producers, especially smallholder producers, to successfully manage their agricultural enterprises requires sustained investment. Digital agricultural technologies are helping to address bottlenecks in productivity, postharvest handling, market access, finance and supply chain management (Sylvester et al., 2021).

In Albania, the farm structures are fully dominated by smallholders with many small farms and few large farms. The development of this sector is accompanied by challenges related to, increasing the productivity of agricultural farms, the size of agricultural farms, efficiency of resource use, cooperation between small farmers, access to financing, modernization of the value chain, food quality and safety, marketing and sale of agricultural products, as well as building administrative capacities to support these

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processes (Tomorri et al., 2024). Sustainable economic growth in Albania is therefore closely related to the performance of the rural sector (Domi and Arapi, 2021). Insufficient extension services as well as poor access to the provision of information, lead to the lack of implementation of new technologies as well as to the decrease in the productivity of their activities. The major barriers to digitization in agriculture, are the small size of the farm, limited financial resources, low level of familiarity with technology and the lack of digital infrastructure in rural areas, but also affordability, for both fixed and mobile broadband access (Mulliri et. al., 2022).

The rural sector in Albania should be transformed into a competitive sector that can guarantee sustainable development, attract investments, and provide employment, especially for youth. Farmers in their decision-making process often face constraints due to a lack of information and knowledge, farm size, access to finance, lack of investment and technology, as well as infrastructure and supporting human capacities (Tomorri et al., 2024).

The purpose of this study is to examine the drivers, barriers and impact of digitalization on sustainable development of the rural sector in Albania.

The main objectives of the paper are: 1) to identify the drivers and barriers that affect the implementation of digitization in the rural sector, 2) to evaluate the impact of digitization on the performance of agricultural farms and 3) to address the issues and challenges for the digitalization of the rural sector in our country.

Literature review

The rural sector plays an important role in the livelihood of the population and economic well-being in rural areas. Digital agriculture represents new knowledge or new combinations of existing knowledge transformed into technologies applied to agricultural farm activities, as a result, it aims to improve the performance of this sector. Digitalisation refers to the adoption of information communication technologies, including the internet, digital technologies and devices, to improve the collection, exchange, aggregation, access, analysis of data and information (Salemink et al., 2017; Wolfert et al., 2017; Shepherd et al., 2020).

Technologies such as smartphones, apps, global positioning systems (GPSs), Internet of things (IoT), sensors, drones, unmanned autonomous vehicles (UAVs) are part of digital agriculture (Rolandi et al., 2021; Salemink et al., 2017).

As a result, investing in the digitalization of agricultural activities should be associated with investments in building the required competences (i.e., skills, knowledge and attitude) for rural workforce. According to Reis et al., (2020), digitalization is the phenomenon of transforming analogue data into digital language which, in turn can improve business relationships

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between customer and companies, bringing added value to the whole economy and society.

Digital technologies can be divided into three groups: basic (phone calls, sms, emails, etc.), medium (online actions such as social media and e-commerce) and advanced (big data analytics, blockchain technologies, Internet of Things (IoT), artificial intelligence (AI), cloud computing, robotics) (Nogales & Casari, 2023; Stoyancheva & Doncheva, 2023). Digital technologies, the use of applications and platforms, increase the exchange of information and cooperation between farmers and other actors who are part of the value chain in the rural sector. Digitalization also offers many other opportunities for agriculture and the food value chain all the way to the consumer to become smarter, more efficient and more connected (ITU & FAO, 2020).

According to Rijswick et al. (2019), "digitalisation is often used to describe the socio-technical processes surrounding the use of digital technologies that impact on the social and institutional context that require and increasingly rely on digital technologies". Digitalisation, as in other sectors, will have an important impact on agriculture. In developing countries, ICT applications are crucial in reducing information costs and sharing information between actors. The spread of the internet and mobile telephony in rural areas has already brought significant changes in the rural sector. Digital platforms increase access to information and capacity-building opportunities, bringing tangible benefits to farmers, in terms of better quality inputs, increased productivity, reduced post-harvest losses, and better market access (Nakasone et al., 2014). Digitalization has also been observed to be a driving force of the evolution of Agricultural Knowledge and Innovation Systems (AKIS).

Digitalization in agriculture is expected to provide technical optimization of agricultural production systems, value chains and food systems (Klerkx et al., 2019). Economic growth is driven by the advancement of ICTs, which are also a key driver for innovation and change (ITU & FAO, 2020). The digitalization technology transformation of entrepreneurship is the main driving force to achieving sustainable development goals (Prasetyo & Setyadharma, 2022; Sridhar et.al., 2023). The sustainable development of rural areas means a dynamic growth of potential in increasing productivity, and competitiveness and improving the standard of living of the population in these areas. The digitalization process holds the potential to bring about a significant change in how agriculture functions, in terms of tools, technologies or practices, and to offer a path for innovation and new ways of organising production and supply chains (Accorsi et.al., 2017).

In particular, the agricultural sector is seeing a set of transformative trends due to digitalisation, such as a greater focus on precision agriculture, the internet of things and the use of big data to drive production and farm

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efficiencies. Digital agriculture will create systems that are highly productive, anticipatory and adaptable to climate changes. This, could lead to greater food security, profitability and sustainability (Trendov et al., 2019). For farmers, digital technologies support better decision-making on farms, helping to boost innovation and improve agricultural productivity, and sustainability (OECD, 2022). Digital technologies could also offer opportunities for new sources of efficiency, supporting research and innovation, the creation of new services for the sector, and improved traceability and more efficient transactions in value chains (Ayre et al., 2019). ICTs can contribute to agro-food sustainability transition by increasing resource productivity, reducing inefficiencies, decreasing management costs, and improving food chain coordination (El Bilali & Allahyari, 2018). The use of digital applications and platforms, increases the exchange of information and cooperation of farmers and other actors who are part of the value chain in the rural sector (Ehlers et al., 2021). In this context, digitalisation and digital technologies allow for precision farming that may attenuate the environmental externalities of agriculture while enhancing efficiency, productivity and profitability for farmers (Martens and Zscheischler, 2022).

Agricultural farms and agribusinesses, through digital platforms, access a wealth of information and services that directly connect the farmer with other actors along the value chain (Khanna, 2021). The Internet of Things (IoT) has drawn attention in recent years for its potential to transform agriculture and food systems (Mahdad et al., 2022). The application of IoT in agriculture aims to empower farmers with decision tools and automation technologies that seamlessly integrate knowledge, products, and services to achieve high productivity, quality, and profit (Abbasi et al., 2022). Inclusion, efficiency and innovation are key mechanisms for digital technology to drive development in rural areas (Miller et al., 2013).

Studies show that the use of digital platforms affects the exchange of information, access to markets, access to financing, and the effectiveness of the operation of the value chain, bringing tangible benefits to farmers and the productivity of agricultural farms. According to Reis et al. (2018), the digital transformation includes three important elements: 1) Technological (use of new digital technologies such as social media, mobile, or embedded devices); 2) Organizational (a change in organizational process); 3) Social (a phenomenon that is influencing all aspects of human life). Digitization can have positive impacts in terms of sustainability and community prosperity in rural areas (Ferrari et al., 2022). Most of the empirical research examines, the impact that ICT has on the sustainable development of the rural sector, the modernization of the value chain, and innovative approaches in rural entrepreneurship (Burkitbayeva and Swinnen, 2018; Nakasone et al., 2014). Through various types of applications and digital platforms, ICT will enable

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the effective sharing and exchange of information and data about inputs, prices and markets between farmers and other actors involved in the value chain (Birner et .al., 2021). In smart farming systems, farmers can monitor and control operations remotely, based on real-time digital information instead of direct observation and manual tasks on-site (Verdouw et al., 2021).

The agricultural sector has shown traditionally poor propensity, especially in the case of small and medium-sized farms, in the implementation of innovation and digital technologies (Giua et al., 2020). Agriculture also faces many challenges, including those posed by the impact of climate change, increased volatility in food prices and dysfunctional supply chains. Linking knowledge to innovation is critical to resolving the agricultural sector's information and knowledge gaps. The impact of digitization concerns the production side of the agri-food sector, where new technologies allow customers to have complete traceability and visibility of the production process and consumer behavior of agricultural products (Passarelli et al., 2023). Digitalization is generally perceived as a positive process, and that also includes some challenges that must be addressed by internal and external actors in the agri-food sector (Kukk et al., 2022).

Digitalization provides farmers with important information for decision-making, which allows them to improve economic performance in farm activities (Šermukšnyte & Melnikiene, 2024; Fielke et al., 2020).

In terms of sustainable development of rural areas, the economic and environmental requirements for digital agricultural technologies should be specified, and the elimination of the existing and expected barriers should be researched (Balayev & Mirzayev, 2022). More specifically, digital technologies implemented can promote cooperation among stakeholders in the agriculture value chain, increase the market access and the bargaining power of small farmers (Rolandi et al., 2021). According to Poppe et al. (2021), the future monitoring system should result in a smart combination of innovations in current statistics, combined with data from satellites and sensors, and a better overall harnessing of data flows within the agricultural sector. The benefits of applying digital technologies along the agriculture value chain are mainly in the economic, environmental and social fields for all the actors involved (Rolandi et al., 2021). Studies show that digital platforms can reduce specific transaction costs and promote the integration of smallholders into value chains. These processes have important implications for developing countries. The digital transformation of agriculture can promote the increase in farmers' income, by improving production efficiency, broadening sales channels, and promoting the upgrading of agricultural structure (Finger, 2023). The rural sector has already undergone many changes that have led to a significant transformation of production processes and activities on agricultural farms (Lieder & Schlaack, 2021; Mathidle et al., 2022). In this

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context, policymakers should design strategies and define actions aimed at developing collaborations between actors involved in the agri-food chain and the use of digital technologies to support rural development (Monda et al., 2023; World Bank, 2016).

In the last ten years, Albania has made progress in terms of developing digital infrastructure. In order to prioritize digitalization, the Albanian government has drawn up several strategic documents. These documents and strategies, it was intended to encourage the use of information technologies and the development of information technology infrastructure as the key to its successful implementation. E-Albania is the online government platform where public services, previously provided at the physical offices, are now provided electronically to the society (citizens, businesses, and NGOs). The platform offers several services to the stakeholders along the agriculture value chain, mostly related to the grant schemes. The e-service "Application for the National Support Scheme for Farmers" involves securing financial support for agriculture and rural development, provided by the Albanian government. In the framework of digitalization, the Agriculture and Rural Development Agency opened the network of "Agro Points" or "Farmer's Windows" (AGROPIKA). This provides farmers with information for applications, access to finance, extension support and other services, (FAO, 2020). Regional Agricultural Extension Agencies (RAAE) also support applicants for grant and subsidy schemes using the e-Albania platform. These agencies play an important role in supporting farmers to upload the required documents to their account in e-Albania, as well as in facilitating the process of knowledge transfer in terms of the use of digital technologies in agricultural farms.

International organizations, research institutions, and universities, have also supported initiatives for the digitalization of agriculture in Albania such as, (The "SARED" program implemented by GIZ, the Japanese International Cooperation Agency (JICA) in collaboration with the Albanian Agribusiness Committee (AAC) have designed the "ABA" online digital platform, as well as several other platforms such as, "Agroalbania.al", "Agrotime.al", "UBgreen", "Agroweb". These digital systems and platforms provide online information about production technologies at the farm level, technical knowledge related to animal breeding and crop production, fostering contacts and cooperation among farmers and other stakeholders along the agriculture value chain (Tomorri et al. 2024).

Data and methodology

In accordance with the purpose of the study, primary data have been collected from the completion of questionnaires with farmers as well as secondary data published by national and international institutions.

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The methodology used for this paper is based on the collection, processing, analysis and interpretation of data and statistical indicators, focusing on the drivers, barriers and impact of digitalization on sustainable rural development in Albania.

Based on the objectives of this study, the methodology is structured to provide a comprehensive analysis, combining quantitative and qualitative research approaches.

The European Commission's Digital Agenda proposes making better use of the potential of ICT to foster innovation, economic growth and progress. Agricultural Knowledge and Information Systems (AKIS), according to EU standards, include; (Agricultural statistics, Farm Accountancy Data Network (FADN), for monitoring the financial processes, and Market Information Systems.

Digital technologies are helping rural entrepreneurs improve market access, improve product quality, and facilitate the production and sale of products.

Table 1. Impact of digital technologies on sustainable development of agricultural farms

Indicator	Economical	Social	Environmental
Increase in income	Increasing income provides the opportunity to invest in equipment and inventory	Farmers' quality of life improves. Better equipment improves working conditions	Investments can be made in storage facilities to reduce agricultural product losses
Increase in quality of production	Improving the quality of the produce allows it to be sold at a higher price	Increasing the supply and variety of local food for consumers.	Reduces the amount of agricultural production that can be thrown away
Increase in farm efficiency	The efficiency of production types is evaluated, and unprofitable production is eliminated	The competitiveness image of small organic farms in society is strengthened	The economic efficiency of environmental solutions can be calculated
Decrease in farmer's labor costs	It provides additional time to develop the agricultural farm	Better balance between professional and family interests. Opportunities to combine farming with other economic activities	Saved time can be invested in processing produce and reducing agricultural production losses
Increase in harvest	Higher harvest leads to increased customer numbers and increased revenues	Increasing the supply and variety of local food for consumers	Sustainable technologies increase harvest without increasing chemical pollution
Decrease in agricultural product losses	Farm income increases because of reduced production losses	Positive image of the farm in the community and among consumers.	Reduces the amount of agricultural production that can be thrown away

Source: Šermukšnyte-Alešiuniene & Melnikienem, 2024; Authors' composition, 2024

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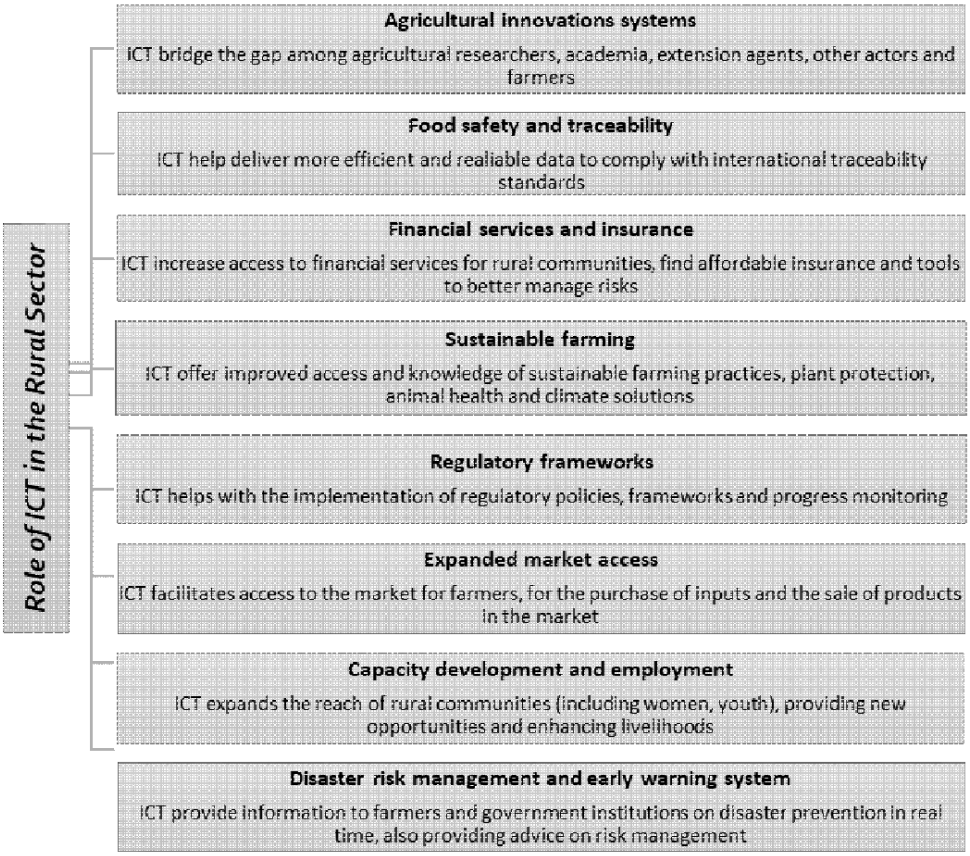
Figure 1. Role of information and communication technology in the rural sector



Source: ITU & FAO, 2020; Authors' composition, 2024

Referring to the above data, it can be observed that the use of ICT platforms and digitalization in the rural sector offers farmers various benefits, such as improving agricultural advisory and services, food safety, product traceability and certification, increasing access to financing, risk management, improving the decision-making process, integrating small farmers into the agricultural value chain, increasing the cooperation of farmers with other stakeholders, improving market access, improving farm management, increasing the exchange of information on prices and markets.

In order to achieve the purpose and objectives of the study, a questionnaire was designed to collect information and data from the interviewed farmers. Based on the data of INSTAT, (2023) for the dominant activities and the typology of farms, the questionnaires were completed face to face with farmers for the five regions selected of the country (Korçë, Kukës, Berat, Fier, Gjirokastër). In total, 938 questionnaires were filled out. After completing the questionnaires, the data were processed and analysed with the

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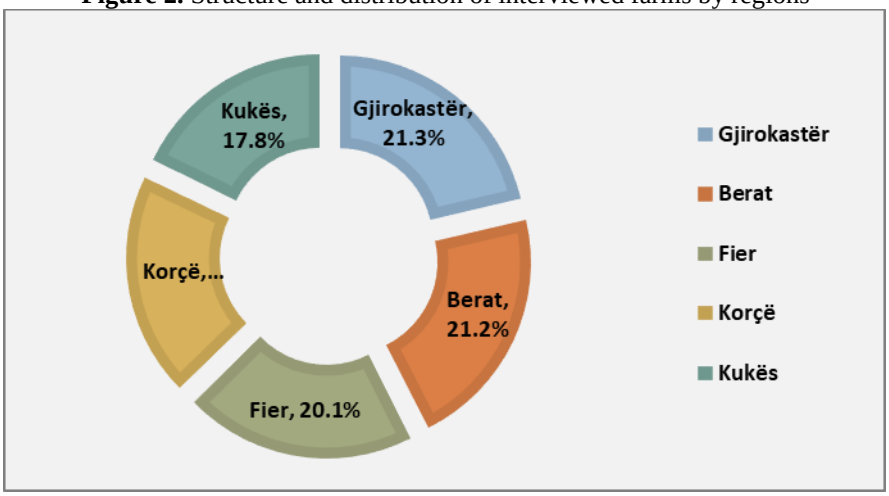
SPSS program. The indicators analysed in the study are evaluated with the Likert scale: [1-5].

Results and discussions

The role of digitalization is multiple: it facilitates the collection and processing of data for inputs and products, improves their traceability, improves access to information and communication between the stakeholders of the value chain, increasing the possibility of providing products and services in compliance with customer requirements; improves competitiveness, reduces costs, increases income; affects the increase of employment opportunities in rural areas, enables farmers to react more quickly to changing weather or market conditions, improving the productivity and sustainability of agricultural farms.

The rural sector is one of the priority sectors of the national economy and the government's objectives, where the main focus is the development and consolidation of this sector in the future. During the last decade, there have been significant positive developments in the rural sector in Albania, in terms of government initiatives and strategies to support farmers' activities through grants and subsidies.

Figure 2. Structure and distribution of interviewed farms by regions



Source: Authors' results, 2024

Referring to the data in the figure above, the completed questionnaires according to the respective regions are: Gjirokaster (200 questionnaires, 21.3%), Berat (199 questionnaires, 21.2%), Fier (189 questionnaires, 20.1%), Korçë (183 questionnaires, 19.5%) and Kukës (167 questionnaires, 17.8%).

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Table 2. Characteristics of respondents by gender, age, education and employment

No	Characteristics	Frequency	Percentage
I	**Gender**		
a	Female	60	6.4%
b	Male	878	93.6%
*	**Total**	**938**	**100%**
II	**Age**		
a	18-30	21	2.2%
b	31-40	79	8.4%
c	41-50	181	19.3%
d	51-60	266	28.4%
e	Over 60	391	41.7%
*	**Total**	**938**	**100%**
III	**Education**		
a	Basic education	350	37%
b	Secondary Education	406	43%
c	Vocational Education	109	12%
d	Higher Education	73	8%
*	**Total**	**938**	**100%**
IV	**Employment**		
a	Employed on the farm	751	80%
b	Not employed on the farm	187	20%
*	**Total**	**938**	**100%**

Source: Authors' results, 2024

The above data show that (93.6%) of interviewed farmers are male and only (6.4%) of them are female. In terms of their age, the majority of interviewees (41.7%) are over 60 years old, (28.4%) are aged 51-60, (19.3%) are aged 41-50, (8.4%) are aged 31-40 years old, and (2.2%) are aged 18-30 years old.

Regarding the level of education, it turns out that (37%) of the farm managers interviewed have basic education, (43%) have secondary education, (12%) have vocational education and (8%) have higher education. As for employment, most of the interviewees (80%) are employed in their farms and (20%) are employed in other sectors.

In accordance with the purpose and objectives of the study, the collected data from the questionnaires are analyzed as follows.

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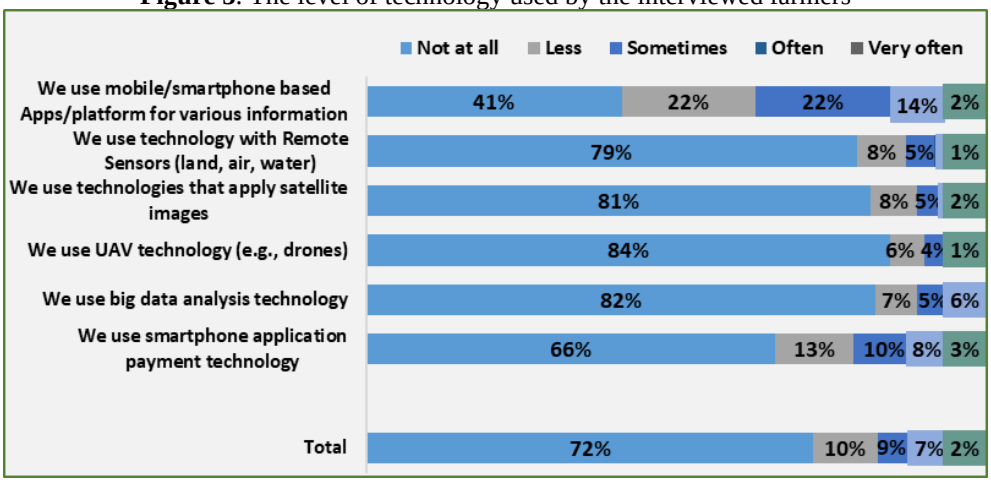
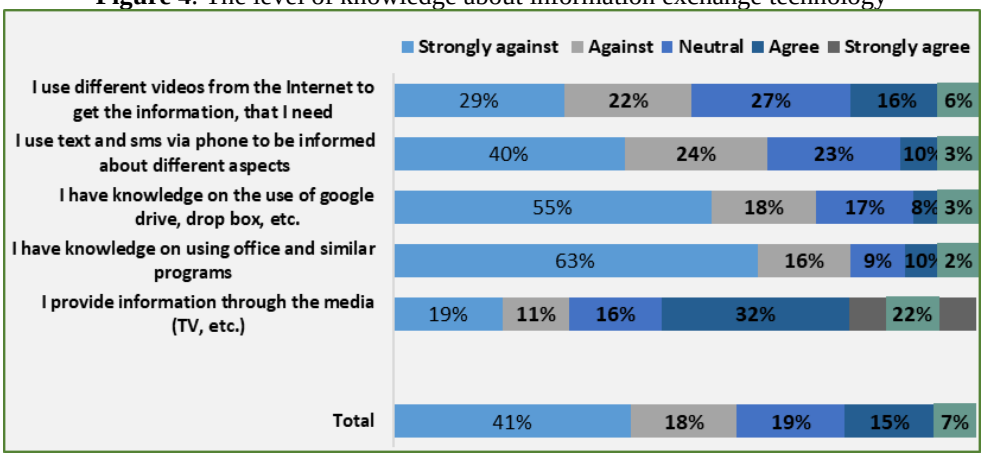
Figure 3. The level of technology used by the interviewed farmers



Source: Authors' results, 2024

Regarding the level of technology used by the interviewed farmers, from the analysis of the survey data, it is noted that in total, (72%) of the interviewed farmers state, that they have not used such technologies, (10%) a little, (9%) sometimes, (7%) often and (2%) very often. This distribution indicates a low level of use of advanced agricultural technologies in the agricultural sector. This shows that a small percentage of farmers are active and involved in the use of advanced agricultural technologies. This information is important to understand at what stages is the use of agricultural technologies in Albania. The low level of use shows that there are challenges and potential for the development and promotion of agricultural technologies in Albanian agricultural farms. Differences in the use of technology between districts help us identify areas where more support and training is needed for farmers in the use of these technologies.

Figure 4. The level of knowledge about information exchange technology



Source: Authors' results, 2024

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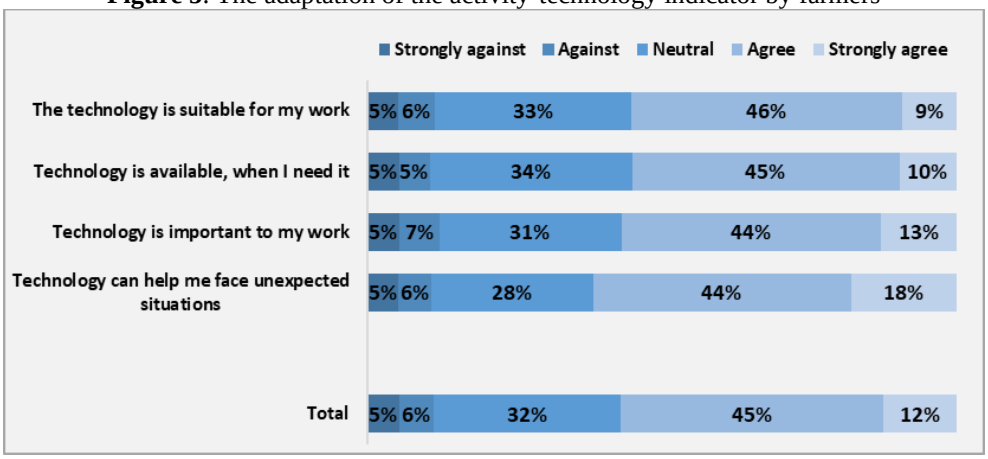
From the analysis of the survey data, it can be seen that in total, the majority of interviewed farmers (41%) are strongly against, (18%) against, (15%) agree and (7%) strongly agree. These data show that farmers' knowledge of information exchange technologies is generally limited. This information is important to understand that most of the interviewed farmers need training and education to increase their level of knowledge regarding the use of information exchange technologies. Such training can help farmers efficiently use modern technologies to obtain and share information that can improve the production and management of their farms.

Figure 5. The adaptation of the activity-technology indicator by farmers



Source: Authors' results, 2024

From the analysis of the survey data for the adaptation of the activity-technology by farmers, it is observed that in total, most of the interviewed farmers (45%) agree and (12%) completely agree. A smaller percentage of farmers, about (6%) expressed against and (5%) completely against. This indicates that a significant proportion of farmers feel adapted and comfortable with the use of technology in their daily work on the farm. This information provides an important perspective on farmers' attitudes and perceptions regarding technology and can help develop strategies and policies for more extensive and efficient use of technology on their farms.

Table 3. The indicators for the use of technology, information exchange technology and adaptation activity-technology, by regions

Region	Use of technology	Knowledge of information exchange technology	Adaptation, activity-technology
Berat	1.49	2.19	3.63
Fier	1.48	2.21	3.09
Gjirokastër	1.49	2.55	3.63
Korçë	2.29	2.65	3.65
Kukës	1.06	2.15	3.73
Average	**1.55**	**2.35**	**3.54**

Source: Authors' results, 2024

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The above indicators are evaluated with the Likert scale: [1-5]. From the analysis of the survey data, related to the use of technology by the interviewed farmers, it is noted that the average of this indicator is (1.55), which reflects a relatively low degree of use of such technologies. This indicator shows that, in general, the interviewed farmers have limited use of advanced agricultural technologies. In the district of Korça, the average is higher, with a value of (2.29). This shows that in this district, farmers have a higher level of adoption of advanced agricultural technologies, using applications, mobile platforms, remote sensors, and other technologies with more regularity. While in the district of Kukës, the average is lower, with a value of (1.06). This indicator shows that in this district, the use of agricultural technologies is very limited. This information is important to understand where there is a need to promote and encourage the use of agricultural technologies in agricultural farms in Albania. Differences in the use of these technologies among districts indicate the potential and challenges in changing and modernizing agricultural practices in the country.

Regarding the level of knowledge about information exchange technology of the interviewed farmers, from the analysis of the data, it is noted that the average of this indicator is (2.35), which reflects a degree close to the average. This shows that, in general, farmers have a limited level of knowledge about information exchange technologies. In the district of Korça, the average is higher, with a value of (2.65). This shows that in this district, farmers have more advanced knowledge about the use of information exchange technologies. Gjirokastra is closely followed with an average of (2.55), the highest indicator after Korça. While in the district of Kukës, the average is lower, with a value of (2.15). This indicator shows that in this district, farmers' knowledge of information exchange technologies is more limited. This information is important to understand how many farmers are equipped with knowledge and skills in using information exchange technologies. Differences between districts help identify areas where training and knowledge improvement are needed in this area to improve interaction and information sharing among farmers.

From the questionnaire data, regarding the adaptation activity-technology indicator, it is noted that the average of this indicator is (3.54), which reflects a degree above average. This shows that, in general, the interviewed farmers feel adapted to the technology and evaluate it positively for their work. However, the lowest value of this indicator is in Fier (3.09), while other regions have almost the same level as the total. This information is important to understand what farmers think about the role of technology on their farms and what can be done to improve their use and adaptation to technology.

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Some of the main findings from the data analysis of the study are:

Limited technology usage: This highlights the importance for public institutions and agencies to encourage and support farmers in accessing and utilizing technologies, thereby enhancing productivity and sustainability in farming activities.

Regional differences in technology use: Discrepancies in the adoption of technologies among districts highlight the importance of tailoring the development and implementation of agricultural policies.

Adaptability to technology: The analyzed data indicates a positive inclination among most farmers toward technology. However, it is crucial to provide support to facilitate their adaptation to technology effectively.

Conclusion

This paper examined the drivers, barriers, and impact of digitalization on sustainable development of the rural sector in Albania. The findings of the study have provided data related to the drivers, barriers and benefits of the adoption of digital technologies in agricultural farms for the regions selected in the study.

Based on the data collected in this study, digital technologies in agriculture are perceived positively by interviewed farmers. Digitization can help farmers optimize production processes and have better access to market sales, increase productivit,y and improve resources and efficiency on their farms.

Regarding the indicator of the use of technology by the interviewed farmers, it shows a relatively low level of technology use in their farms. Concerning the level of knowledge about the information exchange technology, this indicator results in an average degree of use by the interviewed farmers. The data of the questionnaires for the indicator, adaptation activity-technology, show an above-average assessment of the need by farmers for the use of technology in their activities.

The results show that the digitalization process in the rural sector is slow and faces several barriers and challenges, such as the small size of the farms, limited digital skills of farmers, lack of resources to implement digital technologies, and limited digital infrastructure in rural areas.

The digitization of economic activities, especially of small farms, increases the potential to strengthen and diversify agriculture as part of a sustainable development model that will improve livelihoods and create more jobs in rural areas.

Digitalization has the potential to drive economic growth in Albania's rural areas by facilitating market access, improving supply chains, and supporting value-added activities. Digital technologies empower rural

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communities to diversify income sources through new ventures such as agritourism, agribusiness and digital marketing.

Digital platforms facilitate interaction and collaboration among farmers and other stakeholders along the agricultural value chain. Digitization and innovative technologies promote sustainable rural development by providing farmers with advanced equipment and technology and better resource management in agriculture.

The digitization of agriculture must be comprehensive, providing and empowering especially small farmers with the necessary digital competencies. Digital technologies applied in the rural sector, are an important instrument for the empowerment and engagement of youth and women in this sector.

Increasing investment and support from government and public institutions for digital infrastructure, to bridge the digital divide between rural and urban areas.

To address the challenges faced by digitalization in agriculture in Albania, it would be reasonable to undertake training related to innovation and digital technologies along the agricultural value chain. One of the main barriers to the application of digital technology is the lack of knowledge and skills. It is essential to pay special attention when designing strategies for the adoption of digital technologies by small farmers. This involves employing innovative approaches while also acknowledging and respecting the experience and traditional practices in agriculture. A well-functioning rural advisory service can play a crucial role in supporting these endeavors. Extension services should be renewed and improved, including practical training for farmers on the use of digital platforms and technologies.

Stakeholders, such as government, universities and non-governmental organizations (NGOs), can play an important role by providing training for farmers to use digital technologies in their activities.

In the function of the digitization of agriculture, to provide professional competencies in the application of digital technologies, it is necessary to update the curricula and develop programs and courses of study in vocational schools and universities.

Cooperation between government institutions, businesses, international organizations, researchers, and academic institutions is very important for addressing challenges, designing strategies, sharing knowledge and experiences, and promoting best practices for digitization in the rural sector.

Exchange and sharing of experience and best practices among farmers through regional online forums regarding the use of digital technologies. Digitization pilot projects are an important instrument for introducing successful experiences of digitization of agricultural farms, and support for such projects can be an incentive for further digitization of the rural sector.

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The design and implementation of national strategies for digital agriculture should be oriented towards achieving digital transformation and realizing the Sustainable Development Goals (SDGs) of the rural sector in Albania.

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Unveiling the Drivers of Entrepreneurial Internationalization: The Role of Human Capital, Digitalization, and Psychological Traits in Moroccan Early-stage Entrepreneurs

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Abstract

This study examines the factors influencing the internationalization of early-stage Moroccan entrepreneurs, focusing on human capital, digitalization, and psychological traits. Drawing on Human Capital Theory, Dynamic Capability Theory, and Psychological Theories of Entrepreneurship, the research aims to explore how education, digitalization, fear of failure, self-efficacy, and opportunity perception impact export intensity. Using data from 524 early-stage entrepreneurs surveyed by the Global Entrepreneurship Monitor (GEM), the study employs multiple regression analysis to evaluate the relationships between these factors and export activity. The findings reveal that opportunity perception significantly and positively influences export intensity, highlighting the critical role of entrepreneurial alertness in fostering internationalization. Conversely, education demonstrates a significant negative effect, suggesting that higher education levels may increase risk aversion, potentially deterring engagement in global markets. Surprisingly, digitalization, fear of failure, and self-efficacy do not show significant direct effects on export intensity, with the non-significant effect of digitalization reflecting context-specific challenges, such as limited strategic use,

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infrastructure gaps, and insufficient digital literacy. The study highlights the need for fostering opportunity recognition and aligning education with practical skills. It calls for investments in digital infrastructure, training, and entrepreneurial ecosystems to empower entrepreneurs in emerging economies.

Keywords: Internationalization, Education, Digitalization, Fear of failure, Self-efficacy, opportunity perception

Introduction

In Morocco, the internationalization of entrepreneurial firms has gained increasing attention as the country navigates a rapidly globalizing economy. Moroccan entrepreneurs often face unique challenges, including regulatory constraints, limited infrastructure, and financial difficulties, which can shape their approach to foreign markets. Despite these obstacles, the drive toward internationalization is motivated by the need to access broader growth opportunities, enhance competitiveness, and overcome the limitations of the domestic market. Unlike traditional firms that expand internationally only after establishing a robust domestic presence, "born global" firms or international new ventures are those that actively pursue global markets from inception (Escandon-Barbosa et al., 2019; Oviatt & McDougall, 1994). Internationalization offers substantial benefits, including diversified revenue streams (Margolis & Calderon, 2021), access to advanced technologies (Ahi et al., 2022), and enhanced competitiveness (Sun et al., 2019), which in turn can stimulate economic growth through increased employment and foreign exchange flows (Demir et al., 2020; Hessels & van Stel, 2011; Leković & Berber, 2019).

Various factors, both internal and external to entrepreneurial ventures, shape the landscape of internationalization. Digitalization, for instance, has lowered barriers to entry in foreign markets, making it easier for entrepreneurs to reach international customers and suppliers (Brieger et al., 2022). This is particularly evident after the COVID-19 pandemic, where the shift to digital platforms has accelerated global outreach capabilities for small businesses. Additionally, psychological factors such as fear of failure and opportunity perception significantly influence entrepreneurs' decisions to internationalize. Fear of failure, while often viewed as a barrier, can drive entrepreneurs to diversify their market presence internationally as a risk mitigation strategy (Hunter et al., 2021). Opportunity perception, closely tied to self-efficacy, impacts an entrepreneur's confidence in seizing international market opportunities (Mira-Solves et al., 2021).

Guided by Human Capital Theory, Dynamic Capability Theory, and Psychological Theories of Entrepreneurship, this study aims to investigate the impact of education, digitalization, fear of failure, self-efficacy, and

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opportunity perception on the internationalization efforts of early-stage Moroccan entrepreneurs. Human Capital Theory provides insight into the role of education and skills, highlighting how accumulated knowledge and expertise can shape internationalization readiness (Becker, 1964a; Mohammad Shafiee et al., 2024). Dynamic Capability Theory underscores the importance of digitalization in enabling firms to adapt and reconfigure resources for global engagement, especially amid rapidly changing conditions such as those brought about by the pandemic (Massa et al., 2023; Teece et al., 1997). Meanwhile, Psychological Theories of Entrepreneurship offer a framework to understand how individual traits, such as fear of failure and opportunity perception, influence an entrepreneur's decision to venture beyond local markets (N. F. Krueger & Carsrud, 1993; Lattacher & Wdowiak, 2020).

Based on data from 524 early-stage entrepreneurs surveyed by the Global Entrepreneurship Monitor (GEM), this study employs regression analysis to evaluate the influence of these factors on export intensity, a key indicator of internationalization. The results reveal a positive impact of digitalization, fear of failure, and opportunity perception on export intensity, while education demonstrates a negative association. This research marks a pioneering effort to quantify the effects of psychological, technological, and educational factors on the international expansion of early-stage entrepreneurs, contributing to a nuanced understanding of internationalization drivers in emerging markets.

Theoretical background and hypotheses development

Education and Internationalization

Education is widely recognized as a fundamental component of human capital that shapes entrepreneurs' abilities to identify, assess, and pursue opportunities in both domestic and international markets. The role of education in internationalization is complex and can have both positive (Lamotte & Colovic, 2015) and negative (Mattos & Salciuviene, 2019) influences on an entrepreneur's decision to expand abroad.

On the one hand, education enhances cognitive skills, knowledge, and problem-solving abilities, which are essential for navigating the complexities of international markets (Becker, 1964b; Davidsson & Honig, 2003; Silitonga et al., 2024). Higher levels of education often equip entrepreneurs with advanced skills in strategic planning, financial management, and understanding regulatory environments, which are crucial for successful internationalization (Boldureanu et al., 2020; Wright et al., 2007). Research by Zahra. (2005) suggests that educated entrepreneurs are more likely to seek and capitalize on opportunities in foreign markets due to their familiarity with international business practices and ability to leverage global networks.

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However, some studies indicate that higher education can also introduce a more risk-averse approach, potentially hindering internationalization efforts. Educated entrepreneurs may be more aware of the challenges and risks associated with foreign markets, making them cautious about expansion, particularly in unfamiliar or volatile regions (Baggen et al., 2016). Autio et al. (2000) found that entrepreneurs with extensive formal education sometimes over-analyze potential risks and may exhibit less entrepreneurial spontaneity, which can limit their engagement with international markets. This suggests that while education can provide valuable skills, it may dampen an entrepreneur's inclination to take the risks inherent in internationalization.

In emerging economies like Morocco, education may play an even more pivotal role due to limited resources and institutional support for entrepreneurial activities. Educated entrepreneurs in these contexts often compensate for the lack of formal infrastructure by leveraging their acquired skills to overcome challenges in accessing international markets (Naudé, 2008). For example, Arenius & Minniti (2005) found that higher levels of education were associated with a greater likelihood of perceiving international opportunities, particularly in environments where formal support structures were lacking.

Additionally, the relationship between education and internationalization may vary based on the type and focus of educational background. Coviello & Jones (2004) argue that entrepreneurs with international business or technical backgrounds are likelier to pursue global markets than those with general or unrelated educational experiences. Similarly, Musteen et al. (2010 and Szymanski et al. (2021) found that international education or exposure during studies can encourage an entrepreneurial mindset geared toward global expansion.

Human Capital Theory suggests that education enhances an entrepreneur's skills, knowledge, and decision-making abilities, essential for navigating the complexities of international markets (Becker, 1964b; Boldureanu et al., 2020; Davidsson & Honig, 2003). However, prior studies indicate that higher levels of education may lead to increased risk awareness, potentially discouraging high-risk ventures like international expansion (Autio et al., 2000; Bates, 1995; Nawrocki & Jonek-Kowalska, 2022).

In summary, while education generally enhances an entrepreneur's ability to engage with international markets by building critical skills and knowledge, it may also introduce a cautious approach to risk, particularly in uncertain foreign environments. This dual effect of education on internationalization highlights the need to consider both educational attainment's benefits and potential limitations in fostering an entrepreneurial orientation toward global expansion. Thus, we hypothesize:

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H1: Education hurts the internationalization of early-stage Moroccan entrepreneurs.

Digitalization and International Market Access

Digitalization has transformed the way businesses operate, especially for SMEs and entrepreneurial ventures that traditionally face resource constraints in accessing international markets. Through digital tools and platforms, firms can engage in global trade with lower costs and fewer barriers, allowing them to reach international customers, suppliers, and partners more effectively (Coviello & Jones, 2004; Meyer et al., 2023; Nambisan, 2017). Adopting digital technologies has been particularly significant in emerging economies, where entrepreneurs may lack access to traditional support structures and resources necessary for internationalization (Dabbous et al., 2023; Egala et al., 2024).

Digitalization enables entrepreneurs to expand their market reach by providing customers with virtual access and facilitating communication and transactions across borders (Ahi et al., 2022; Dabbous et al., 2023). Platforms like e-commerce websites, social media, and digital payment solutions have made it easier for firms to market and sell products internationally, even with limited physical presence (Autio & Zander, 2016; Tolstoy et al., 2021). For instance, Kraus et al. (2021) found that firms utilizing digital platforms experienced a faster and more seamless transition to international markets, as digital tools lowered logistical and operational costs associated with global expansion.

Furthermore, digitalization enhances an entrepreneur's ability to collect and analyze market data, critical for informed decision-making in foreign markets. Kraus et al. (2021) argue that digital tools enable real-time data collection and analysis, allowing firms to monitor trends, track competitors, and respond to changes in consumer preferences across different countries. This agility in adapting to foreign markets is particularly valuable for small firms, as it enables them to compete effectively against larger, established players (Nambisan et al., 2019). Ritter & Pedersen, (2020) highlight that digitalization fosters a learning orientation, empowering entrepreneurs to iteratively test and refine their approaches to internationalization based on digital insights.

The COVID-19 pandemic accelerated the adoption of digital technologies, as restrictions on physical interactions pushed firms to rely on digital channels to maintain operations. Many entrepreneurs turned to digital tools to survive the crisis and explore new international opportunities, with digital platforms allowing them to adapt and expand their reach quickly (Priyono et al., 2020; Seetharaman, 2020). In a study by Chaturvedi & Karri (2022), digitalization was identified as a critical factor in enabling firms to

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pivot during the pandemic, with many entrepreneurs reporting increased international sales facilitated through online channels.

Digitalization also supports the development of entrepreneurial networks, which are essential for international market entry and success. Brieger et al., (2022) argue that digital platforms allow entrepreneurs to build relationships with foreign distributors, investors, and customers, providing social capital that is essential for internationalization. Digital networks facilitate knowledge exchange and provide entrepreneurs with insights into foreign markets, helping them overcome informational and cultural barriers (Etemad, 2015; Massa et al., 2023).

Digitalization in emerging economies like Morocco is particularly impactful, as it compensates for the often limited physical infrastructure and institutional support for international business (Abdelkhalek et al., 2021). Digital platforms allow Moroccan entrepreneurs to overcome local infrastructure challenges and reach global audiences, thus leveling the playing field with firms from more developed countries (Abdelkhalek et al., 2021; Brahim, 2024). According to Brieger et al. (2022), digitalization has proven to be a key enabler for internationalization among Moroccan SMEs, allowing them to leverage technology to overcome traditional barriers and access new markets.

In summary, Dynamic Capability Theory emphasizes the importance of adaptability and resource reconfiguration in pursuing new opportunities (Teece et al., 1997). Digitalization is crucial in enhancing international market access for entrepreneurial firms by reducing operational costs, enabling real-time market analysis, and supporting network-building activities. For Moroccan entrepreneurs, digitalization facilitates entry into international markets and empowers them to compete more effectively on a global scale. This study investigates the extent to which digitalization influences the export intensity of early-stage Moroccan entrepreneurs, especially as they adopt digital tools as part of a strategic response to the challenges and opportunities presented by the globalized digital economy. Therefore, we hypothesize:

H2: Digitalization positively affects the internationalization of early-stage Moroccan entrepreneurs.

Fear of Failure and its Influence on Internationalization

Fear of failure is a psychological factor that can significantly shape an entrepreneur's decision-making process, particularly when it comes to engaging in high-risk activities such as internationalization. Defined as the apprehension about the potential negative consequences of business failure, fear of failure has hindered and motivated entrepreneurial behavior (Cacciotti et al., 2016; Morgan & Sisak, 2016). In the context of internationalization, fear

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of failure can act as a double-edged sword: it may discourage some entrepreneurs from pursuing foreign markets due to perceived risks, while for others, it may stimulate proactive strategies to diversify and reduce risk exposure.

Fear of failure often manifests as a deterrent to internationalization because entering foreign markets involves substantial uncertainty, including unfamiliar regulatory environments, cultural differences, and fluctuating exchange rates (Hessels et al., 2011). Entrepreneurs with a high fear of failure may perceive these uncertainties as significant obstacles, leading to a more cautious approach or even complete avoidance of international expansion (Gao et al., 2024; J. R. Mitchell & Shepherd, 2010). For example, Kollmann et al. (2017) found that entrepreneurs who exhibit high fear of failure tend to avoid internationalization, preferring instead to concentrate on safer, more predictable domestic markets. This fear-driven conservatism can restrict growth potential, particularly in cases where the domestic market is saturated or highly competitive.

Conversely, fear of failure can also act as a motivating factor for internationalization. Entrepreneurs with a heightened fear of failure may seek to diversify their market presence internationally as a risk mitigation strategy. By expanding into foreign markets, these entrepreneurs can reduce their reliance on a single market, thereby spreading risk across multiple revenue streams (Knight & Liesch, 2016). In a study by Arenius & Minniti. (2005), it was observed that fear of failure motivated some entrepreneurs to engage in international activities as a way to counteract the potential negative impact of domestic market volatility. By leveraging international markets, these entrepreneurs were able to create additional sources of revenue, thereby enhancing the resilience of their businesses.

Research also suggests that the effect of fear of failure on internationalization is moderated by individual and contextual factors, such as self-efficacy and access to resources (Cacciotti et al., 2020; Morgan & Sisak, 2016). Entrepreneurs with high self-efficacy or a strong belief in their ability to succeed may perceive fear of failure as a manageable challenge rather than a prohibitive barrier (Hunter et al., 2021). This confidence can enable them to take calculated risks in international markets, viewing failure not as a catastrophic outcome but as a learning opportunity. Found that entrepreneurs with high self-efficacy were more likely to pursue international opportunities, even if they initially experienced fear of failure, as they viewed the potential rewards as outweighing the risks.

In emerging markets like Morocco, fear of failure may be particularly salient due to the lack of institutional support and the higher volatility of the business environment. Entrepreneurs in these settings often face additional barriers, such as limited access to financing, weak legal frameworks, and

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cultural attitudes that stigmatize failure (Mandili & Elabjani, 2023; Naudé et al., 2008). According to Markowska et al., (2019), entrepreneurs in emerging markets tend to have a heightened fear of failure, which can discourage them from taking on the added uncertainty of internationalization. However, those who are able to overcome this fear often adopt proactive strategies to mitigate risk, such as gradually entering foreign markets or establishing partnerships to share the burden of international expansion (Brinkmann et al., 2014; Kollmann et al., 2017; Reuber & Fischer, 1997).

Psychological theories indicate that fear of failure can influence entrepreneurial decision-making, acting either as a barrier or as a motivator (Cacciotti et al., 2016; Morgan & Sisak, 2016). For some entrepreneurs, fear of failure may discourage risk-taking in foreign markets (Kollmann et al., 2017), while for others, it may encourage diversification into international markets as a strategy to mitigate domestic risk (Knight & Liesch, 2016). In the Moroccan context, where domestic market conditions can be volatile, fear of failure may motivate internationalization.

In summary, fear of failure is a complex factor with dual effects on internationalization. While it can discourage some entrepreneurs from venturing into foreign markets due to perceived risks, it can also motivate others to diversify and reduce dependency on a single market. This study explores how fear of failure influences the internationalization behavior of Moroccan entrepreneurs, with a particular focus on whether it acts as a deterrent or a driver of export intensity. Understanding this dynamic can provide valuable insights into the psychological barriers and motivators shaping international expansion in emerging markets. Thus, we hypothesize:

H3: Fear of failure positively affects the internationalization of early-stage Moroccan entrepreneurs.

Self-Efficacy and Entrepreneurial Internationalization

Self-efficacy, or an individual's belief in their ability to execute tasks and achieve specific goals, is a key psychological factor influencing entrepreneurial behavior (Bandura, 1997; Tantawy et al., 2021). In the context of entrepreneurship, self-efficacy reflects an entrepreneur's confidence in their skills to identify, pursue, and manage new business opportunities, including those in foreign markets (N. Krueger & Dickson, 2007). Entrepreneurs with high self-efficacy tend to be more persistent, resilient, and willing to take risks, making them more likely to engage in internationalization activities.

Research has shown that self-efficacy is a strong predictor of entrepreneurial intentions and behaviors, particularly in high-stakes and uncertain environments such as international markets (Barbosa et al., 2007; Chen et al., 1998; Newman et al., 2019). Entrepreneurs with high self-efficacy

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are more likely to perceive internationalization as an achievable and rewarding goal, rather than as an overwhelming challenge (Wilson et al., 2007; Wu et al., 2022). For instance, (Zahra, 2005b) found that entrepreneurs with higher self-efficacy were more inclined to pursue international markets, as they felt confident in their ability to navigate unfamiliar environments and overcome obstacles associated with foreign expansion.

Self-efficacy also influences how entrepreneurs perceive and manage risks, which is crucial for internationalization. Those with high self-efficacy are more likely to see potential setbacks as surmountable challenges rather than deterrents, enabling them to adopt a proactive approach to international market entry (R. K. Mitchell et al., 2002). De Clercq et al. (2012) suggest that self-efficacious entrepreneurs are more willing to venture into foreign markets because they believe in their capacity to adapt and succeed, even in uncertain and volatile contexts. This confidence allows them to take calculated risks and pursue growth opportunities beyond their domestic borders.

In emerging markets, such as Morocco, self-efficacy may be even more critical for entrepreneurs who face a range of institutional and infrastructural barriers. Entrepreneurs in these environments often rely on their self-belief and resilience to counteract limited support and navigate complex market dynamics (Bruton et al., 2008; Naguib, 2024). Baum & Locke (2004) found that self-efficacy was particularly important for entrepreneurs in resource-constrained settings, as it helped them to remain motivated and persist in pursuing ambitious goals, including international expansion. For Moroccan entrepreneurs, self-efficacy could play a pivotal role in enabling them to view foreign markets as viable options for growth, despite the challenges they may face at home.

Self-efficacy also affects the ability of entrepreneurs to build and leverage networks, which are essential for successful internationalization. Entrepreneurs with high self-efficacy tend to be more proactive in developing relationships with foreign partners, suppliers, and distributors, thus expanding their social capital and enhancing their internationalization prospects (Naz et al., 2020; Newman et al., 2019). According to Coviello & Munro (1995), entrepreneurs with strong self-belief are more likely to seek and utilize international connections, which facilitate entry into foreign markets and help them overcome informational and cultural barriers.

Psychological theories suggest that self-efficacy empowers entrepreneurs to take on challenging tasks and believe in their ability to succeed, making them more likely to engage in internationalization (Bandura, 1997; Wilson et al., 2007). Entrepreneurs with high self-efficacy are likely to approach foreign markets confidently, perceiving fewer barriers and higher rewards (Chen et al., 1998).

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In summary, self-efficacy is a critical psychological trait that enhances an entrepreneur's likelihood of pursuing internationalization. Entrepreneurs with high self-efficacy are more confident in their ability to succeed in foreign markets, more willing to take risks, and more proactive in building networks that support international expansion. This study will investigate the influence of self-efficacy on the internationalization of early-stage Moroccan entrepreneurs, examining whether a strong sense of self-efficacy drives increased export intensity and engagement in foreign markets. Therefore, we hypothesize:

H4: Self-efficacy positively affects the internationalization of early-stage Moroccan entrepreneurs.

Opportunity Perception and Entrepreneurial Internationalization

Opportunity perception, the ability of an entrepreneur to identify and evaluate potential market opportunities, is a crucial factor influencing the decision to internationalize. Entrepreneurs with a high perception of opportunity are more likely to identify foreign markets as viable spaces for expansion and growth, which drives proactive efforts to internationalize their businesses (Chabaud & Messeghem, 2010; Eckhardt & Shane, 2003; Shane & Venkataraman, 2000). Opportunity perception is closely tied to an entrepreneur's alertness to changes in the external environment and their ability to interpret these changes as avenues for profit (Kirzner, 1997; Roundy et al., 2018). In internationalization, opportunity perception enables entrepreneurs to recognize unfilled needs in foreign markets, anticipate consumer demands, and identify advantageous entry points.

Entrepreneurs who perceive high levels of opportunity tend to adopt a growth-oriented mindset, which often includes expanding beyond their domestic borders. (McDougall et al. (2003) found that opportunity perception was a key factor driving internationalization among small firms, as entrepreneurs more attuned to market opportunities were quicker to capitalize on cross-border business prospects. In addition, Chandra et al. (2009) emphasize that entrepreneurs with strong opportunity perception are more likely to view internationalization as a means of gaining a competitive advantage and achieving long-term growth. These entrepreneurs are not only skilled at spotting opportunities but are also motivated to act on them, resulting in a proactive approach to international expansion.

Opportunity perception is often associated with entrepreneurial self-efficacy or the confidence an entrepreneur has in their ability to succeed in new ventures (Krueger Jr. & Dickson, 1994; Newman et al., 2019). Entrepreneurs with high self-efficacy are more likely to view foreign markets as accessible and manageable, perceiving fewer obstacles to entry (Zahra,

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2005b). This positive outlook enhances their ability to recognize opportunities abroad and to act decisively, even in unfamiliar environments. R. K. Mitchell et al. (2002) and Wu et al. (2022) found that entrepreneurs with higher self-efficacy are more likely to pursue international opportunities, as they tend to perceive potential challenges in foreign markets as surmountable rather than prohibitive.

Moreover, opportunity perception is influenced by prior knowledge and experience, which can shape how entrepreneurs assess and respond to international market opportunities. Oviatt & McDougall. (2005) argues that entrepreneurs with prior exposure to international markets are better positioned to identify and exploit opportunities abroad, as they possess insights into market trends, consumer preferences, and competitive dynamics. This exposure enhances their perception of opportunity and enables them to evaluate internationalization more confidently. Similarly, Mainela et al. (2018) found that entrepreneurs with experience in international settings had higher opportunity perception, making them more inclined to engage in international business activities.

For entrepreneurs in emerging markets like Morocco, opportunity perception is particularly significant. Limited domestic opportunities often push entrepreneurs to seek growth prospects abroad, where they may perceive fewer constraints on innovation and profitability (Bruton et al., 2013). Jafari Sadeghi et al. (2019) highlight that entrepreneurs in emerging economies, who often face institutional voids at home, are highly motivated to identify and act upon international opportunities as a way to bypass domestic limitations. This outward-looking approach can be an effective strategy for Moroccan entrepreneurs seeking to overcome local market constraints by capitalizing on favorable conditions in foreign markets.

Opportunity perception is critical to entrepreneurial behavior, reflecting an entrepreneur's ability to identify and pursue new market possibilities (Shane & Venkataraman, 2000). Entrepreneurs with a high perception of opportunity are more likely to recognize foreign markets as viable options for growth and competitive advantage (Anwar et al., 2022; Chandra et al., 2009; McDougall et al., 2003). In emerging markets like Morocco, limited domestic opportunities may enhance entrepreneurs' motivation to identify international opportunities as avenues for expansion.

In summary, opportunity perception is pivotal in entrepreneurial internationalization by driving a proactive orientation toward foreign markets. Entrepreneurs who can effectively perceive opportunities are more likely to pursue international expansion as a growth strategy, particularly in restrictive domestic market conditions. This study examines the influence of opportunity perception on the internationalization of Moroccan entrepreneurs, focusing on

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its impact on export intensity and the decision to enter foreign markets. Therefore, we hypothesize:

H5: Opportunity perception has a positive effect on the internationalization of early-stage Moroccan entrepreneurs.

Methodology

This section describes the data collection process, sample characteristics, measurement of key variables, and the analytical approach used to investigate the factors influencing the internationalization of early-stage Moroccan entrepreneurs.

Data Collection and Sample

The data for this study were obtained from the Global Entrepreneurship Monitor (GEM), an international research project that collects comprehensive data on entrepreneurship from multiple countries annually. GEM's Adult Population Survey (APS) is one of the most extensive data sources on individual-level entrepreneurial activity, capturing various factors such as demographic characteristics, perceptions, and entrepreneurial intentions. This study utilizes GEM data for Morocco, focusing on early-stage entrepreneurs during the period 2021 and 2023.

The sample includes 524 early-stage entrepreneurs from Morocco. Early-stage entrepreneurs are defined as individuals who are in the process of setting up a business or have recently started one. This sample is particularly relevant for examining internationalization drivers because it focuses on new ventures in the initial stages of growth and decision-making regarding international expansion. The data include a range of demographic, psychological, and business-related variables that align with the theoretical framework of this study.

Measurement of Variables

This study examines several key variables, operationalized based on previous research and the GEM data structure:

Dependent Variable

The dependent variable is Based on the studies of Chowdhury & Audretsch (2021) and Yang et al. (2020); we used TEA export intensity (turnover %), which measures the proportion of revenue generated from foreign markets, as the primary indicator of internationalization. GEM's categorization of export intensity allows us to assess the degree of international engagement among early-stage Moroccan entrepreneurs.

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Responses are recorded on a scale indicating whether the firm derives a small, moderate, or large portion of turnover from international sales.

Independent Variables

Education is measured using the GEM harmonized educational attainment categories, which reflect the highest level of formal education completed by the respondent. This variable is categorized to distinguish between different levels of education, ranging from no formal education to postgraduate degrees. By coding education as an ordinal variable, the analysis can capture the incremental effects of higher education on entrepreneurial internationalization. The inclusion of education as a variable draws from Human Capital Theory, which posits that individuals with higher educational attainment are more likely to acquire the skills and competencies necessary for navigating complex international markets. This operationalization allows the study to assess whether increased education correlates with greater export intensity or, conversely, whether higher education may contribute to risk aversion, limiting international engagement.

Digitalization measures the extent to which entrepreneurs incorporate digital tools and technologies into their business operations, focusing on activities that facilitate market expansion and product sales. This variable is derived from a GEM survey question: *"Are you using digital technologies (e.g., online platforms or e-commerce) to sell your products or services?"* The responses are coded as a binary variable, with 1 indicating the use of digital tools and 0 indicating no digital adoption. This operationalization aligns with the Dynamic Capability Theory, which emphasizes the role of technology in enhancing firms' adaptability and international competitiveness. By analyzing digital adoption, the study explores whether leveraging digital platforms lowers market entry barriers and boosts export intensity or whether contextual factors (e.g., limited digital infrastructure) moderate this relationship.

Fear of failure reflects a psychological constraint that may inhibit entrepreneurial action by amplifying perceived risks associated with business ventures. This variable is measured through a Likert-scale question in the GEM survey: *"To what extent does the fear of failure prevent you from starting a business?"* Responses range from low values (indicating minimal fear of failure) to higher values, signifying greater apprehension. This construct stems from the Psychological Theories of Entrepreneurship, suggesting that fear of failure can deter entrepreneurs from exploring international opportunities. Operationalizing fear of failure allows the study to investigate its role as a potential barrier to export activities, shedding light on how psychological traits intersect with strategic business decisions.

Opportunity perception gauges the entrepreneur's ability to identify favorable market conditions and assess potential growth opportunities. This

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variable is measured using the GEM question: *"Do you see good business opportunities in the next six months?"* and is coded as a binary variable (1 = perceives opportunities, 0 = does not perceive opportunities). Opportunity perception reflects the entrepreneur's alertness and proactive stance, which are critical elements in entrepreneurial internationalization. This operationalization aligns with the theory of entrepreneurial alertness, emphasizing that individuals who recognize market opportunities are more likely to engage in export-oriented activities. By including this variable, the study evaluates how opportunity perception drives international expansion and influences export intensity.

Self-efficacy is operationalized through the GEM question: *"Do you have the knowledge, skills, and experience necessary to start a new business?"* Responses are recorded on a Likert scale, where higher values indicate greater self-confidence in entrepreneurial abilities**.** This variable reflects the entrepreneur's belief in their capacity to overcome challenges and successfully manage new ventures. Drawing from Psychological Theories of Entrepreneurship, self-efficacy is considered a critical predictor of entrepreneurial success and risk-taking behavior. By analyzing self-efficacy, the study investigates whether entrepreneurs with higher confidence levels are more inclined to pursue international opportunities and engage in export activities.

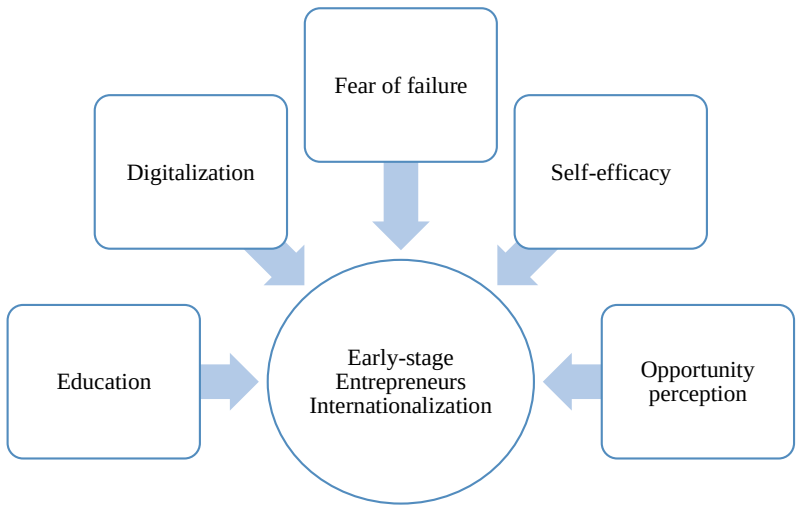

Figure 1: Theoretical framework

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Results

Table 1: Descriptive Statistics and Correlations

Variable	Mean	SD	1	2	3	4	5	6
1. TEA Export Intensity	6.85	0.942	1					
2. Education	4.09	1.712	-0.112*	1				
3. Digitalization	0.66	0.475	-0.070	0.237**	1			
4. Fear of Failure	2.43	1.394	-0.025	0.116**	-0.008	1		
5. Opportunity Perception	0.69	0.463	0.124**	0.020	-0.046	0.009	1	
6. Self-Efficacy	0.90	0.307	0.044	-0.010	0.068	0.015	0.081	1

Significance Levels:
p < 0.05 (*)*:* Significant at the 5% level.
***p < 0.01* (****): Significant at the 1% level.
N = 524 for all variables.

Table 1 provides the descriptive statistics and correlations for the dependent variable (TEA Export Intensity) and the independent variables, including Education, Digitalization, Fear of Failure, Opportunity Perception, and Self-Efficacy. The descriptive statistics include variable, each variable's mean and standard deviation, providing an overview of the central tendency and variability within the sample. TEA Export Intensity, the dependent variable, has a mean of 6.85 (SD = 0.942), indicating that the majority of respondents report low export activity. The independent variables exhibit diverse means and distributions, reflecting variations in education levels, digital tool adoption, psychological factors, and entrepreneurial perceptions among respondents.

The correlation matrix highlights the relationships between the study variables. Significant correlations are noted at the 0.05 and 0.01 levels. Education is negatively correlated with TEA Export Intensity ($r = -0.112$, $p < 0.05$), suggesting that higher education levels are associated with lower export intensity. In addition, Opportunity Perception positively correlates with TEA Export Intensity ($r = 0.124$, $p < 0.01$), indicating that entrepreneurs who perceive good opportunities are more likely to engage in export activities.

Other variables, such as Digitalization, Fear of Failure, and Self-Efficacy, show weak or non-significant correlations with export intensity. These results provide initial insights into the drivers of internationalization among entrepreneurs and set the stage for further analysis using regression techniques.

This table offers a foundational understanding of the dataset, illustrating key trends and relationships among the variables, and provides a basis for testing the proposed hypotheses.

Multiple regression analysis

Our analytical approach involves multiple regression analysis to assess the relationships between the independent variables and export intensity.

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Multiple regression is chosen for its ability to evaluate the impact of each independent variable on the dependent variable.

Table 2: Regression Analysis Results

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p-value
Constant	6.888	0.179	-	38.377	0.000
Education	-0.056	0.025	-0.102	-2.280	0.023*
Digitalization	-0.084	0.089	-0.043	-0.950	0.342
Fear of Failure	-0.010	0.029	-0.015	-0.338	0.735
Opportunity Perception	0.247	0.088	0.121	2.791	0.005**
Self-Efficacy	0.110	0.134	0.036	0.826	0.409

Notes:
Dependent Variable: TEA Export Intensity (measured on a scale from 1 to 7, where 1 = "Export over 90%" and 7 = "No export").
Significance Levels:
***p* < *0.05*( )*:** Statistically significant at the 5% level.
***p* < *0.01* ( ) :** Statistically significant at the 1% level.

Model Summary

Statistic	Value
R	0.177
R^2	0.031
Adjusted R^2	0.022
Std. Error of the Estimate	0.931

ANOVA Results

Source	Sum of Squares	df	Mean Square	F	p-value
Regression	14.578	5	2.916	3.362	0.005**
Residual	449.208	518	0.867		
Total	463.786	523			

The regression results are summarized in Table 2, which includes unstandardized coefficients (B), standardized coefficients (Beta), t-values, and significance levels for each predictor. The model explains a small but significant portion of the variance in export intensity ($R^2 = 0.031$, Adjusted $R^2 = 0.022$), with an overall model significance of $F(5, 518) = 3.362$, $p = 0.005$.

Through the analysis of the table of regression, we observed that Education has a significant negative effect on TEA Export Intensity **(**B = -0.056, p = 0.023). Each one-unit increase in education level reduces the export intensity by 0.056 units, supporting the hypothesis that higher education may make entrepreneurs more risk-averse in engaging with international markets.

This finding may appear counterintuitive but aligns with prior research suggesting that higher education levels can make entrepreneurs more cautious

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or risk-averse in their decision-making (Bates, 1995). Educated entrepreneurs may be more aware of the challenges and risks associated with international markets, such as fluctuating exchange rates, trade regulations, or cultural barriers, leading to a preference for focusing on domestic markets.

Digitalization, it shows a non-significant negative effect on export intensity (B = -0.084, p = 0.342), indicating that adopting digital tools does not directly influence entrepreneurs' level of export turnover. This non-significant effect could reflect context-specific barriers, such as limited infrastructure, digital literacy, or entrepreneurs' lack of strategic use of digital tools to expand into international markets.

Fear of failure has also shown no significant impact on TEA Export Intensity **(**B = -0.010, p = 0.735), suggesting that this psychological factor does not shape export behaviors. This suggests that fear of failure does not directly influence the level of export activity among entrepreneurs. While fear of failure might impact the decision to start a business, it has less relevance once the business is operational and pursuing international markets.

Opportunity perception has a significant positive effect on TEA Export Intensity (B = 0.247, p = 0.005). Entrepreneurs who perceive good opportunities experience a 0.247-unit increase in export intensity, emphasizing the importance of opportunity recognition in driving internationalization. In other words, entrepreneurs who perceive opportunities for growth are more likely to pursue international markets because they view export activities as a means to capitalize on unexploited demand or enhance their competitive advantage. This finding aligns with previous studies highlighting the importance of entrepreneurial alertness and opportunity recognition in driving internationalization (Shane & Venkataraman, 2000).

Finally, Self-efficacy shows a non-significant positive effect (B = 0.110, p = 0.409), indicating that while confident entrepreneurs might engage in export activities, this factor alone does not significantly influence export intensity. This means that although confidence in entrepreneurial skills is an essential trait for business success, it does not directly translate into higher export activity. Entrepreneurs with high self-efficacy might still face external barriers, such as limited market access or insufficient financial resources, that prevent them from expanding internationally.

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Table 3: Hypothesis Testing Summary

Hypothesis	Relationship	Coefficient (B)	p-value	Supported
H1: Education has a negative effect on internationalization.	Negative	-0.056	0.023	Yes
H2: Digitalization has a positive effect on internationalization.	Positive	-0.084	0.342	No
H3: Fear of failure has a positive effect on internationalization.	Positive	-0.010	0.735	No
H4: Self-efficacy has a positive effect on internationalization.	Positive	0.110	0.409	No
H5: Opportunity perception has a positive effect on internationalization.	Positive	0.247	0.005	Yes

The overall regression model demonstrates statistical significance ($p = 0.005$) but explains a modest amount of variance in TEA Export Intensity ($R^2 = 0.031$, Adjusted $R^2 = 0.022$). These results suggest that while the predictors contribute to explaining export intensity, other factors not included in the model may also play a significant role.

Discussion

The findings of this study offer valuable insights into the drivers and barriers of internationalization among Moroccan entrepreneurs, particularly in the context of human capital, digital capabilities, and psychological traits. This research highlights the nuanced and multifaceted nature of entrepreneurial internationalization in an emerging economy by testing five hypotheses derived from the theoretical framework.

The significant negative relationship between education and export intensity (H1 supported) underscores the complexity of human capital's impact on internationalization. While education is often linked to enhanced skills and competencies, the results suggest that it may also increase entrepreneurs' awareness of risks and challenges, potentially deterring international engagement. This finding aligns with prior studies suggesting that higher education can lead to greater risk aversion (Bates, 1995). However, it also reveals a need for more targeted training programs that complement formal education by emphasizing practical international business skills, such as market entry strategies and cross-border operations as noted by (Nawrocki & Jonek-Kowalska, 2022).

Contrary to expectations, we found that digitalization does not significantly influence export intensity (H2 not supported). While digital tools are widely recognized as enablers of internationalization, their limited impact in this context may stem from challenges such as insufficient digital literacy, inadequate infrastructure, or a lack of strategic use. Entrepreneurs may adopt

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digital tools for local operations rather than leveraging them to penetrate international markets. This result emphasizes the importance of enhancing digital infrastructure and providing training to help entrepreneurs maximize the potential of digital technologies for global engagement as suggested by (Massa et al., 2023).

The non-significant relationship between digitalization and export intensity in this study contrasts with prevailing literature that often positions digital tools as key enablers of internationalization (A. Gawel et al,. 2022). This finding suggests that contextual barriers specific to Morocco may moderate the effectiveness of digital adoption in driving export activities. One potential explanation lies in the limited strategic use of digital technologies (MY. Haddoud,. 2023). While many entrepreneurs may adopt digital tools for basic operational purposes (e.g., social media engagement or local transactions), these tools may not be fully leveraged to facilitate international market entry, supply chain integration, or global customer acquisition.

Moreover, infrastructure challenges such as inconsistent internet access, limited digital literacy, and underdeveloped e-commerce ecosystems could constrain the capacity of entrepreneurs to effectively use digital platforms for international expansion. Entrepreneurs in emerging economies often face logistical and regulatory hurdles that diminish the advantages offered by digitalization, thereby limiting its direct contribution to export performance (C.kreiterling, 2023). Additionally, the findings may reflect industry-specific variations in the impact of digital tools. For example, while service-based firms may benefit more directly from digital platforms, traditional sectors such as agriculture or manufacturing may rely more heavily on physical distribution channels and face structural barriers that digitalization alone cannot overcome. To address these barriers, policymakers should consider investing in digital capacity-building programs, e-commerce infrastructure, and export facilitation initiatives. Such efforts could help bridge the gap between digital adoption and effective internationalization, ensuring that Moroccan entrepreneurs can harness the full potential of digitalization to access global markets.

The psychological traits examined in this study reveal varied effects. Fear of Failure, The non-significant relationship with export intensity (H3 not supported) suggests that fear of failure does not directly influence internationalization decisions. While fear of failure may act as a barrier in the initial stages of entrepreneurship, its impact on operational decisions like exporting appears to be minimal in this context (Kollmann et al., 2017). Similarly, self-efficacy does not directly affect export intensity (H4 not supported).

This finding implies that while confidence in entrepreneurial skills is essential, it may not translate directly into higher levels of export activity

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without additional enabling conditions, such as financial resources or market access.

Opportunity perception emerges as a significant positive predictor of export intensity (H5 supported). Entrepreneurs who perceive international opportunities are more likely to engage in export activities, supporting the notion that entrepreneurial alertness and opportunity recognition are critical for internationalization. This result reinforces the importance of fostering an ecosystem that enhances entrepreneurs' ability to identify and capitalize on foreign market opportunities through trade fairs, networking events, and access to market intelligence.

This study contributes to the theoretical understanding of entrepreneurial internationalization by integrating human capital, digital capabilities, and psychological traits within a unified framework. It highlights the dual role of education, where higher education can enhance entrepreneurial capabilities while increasing risk aversion. It challenges assumptions about the universal benefits of digitalization, emphasizing the need for strategic implementation. It underscores also the centrality of opportunity perception as a driver of internationalization, aligning with Psychological Theories of Entrepreneurship.

Conclusions

This study provides valuable insights into the factors influencing the internationalization of early-stage Moroccan entrepreneurs, offering critical implications for policymakers, educators, and practitioners. The findings highlight the pivotal role of opportunity perception while revealing the nuanced impacts of education, digitalization, and psychological traits on export intensity. To foster entrepreneurial internationalization, policymakers should focus on building human capital through targeted training programs that bridge the gap between theoretical education and practical skills. This can be achieved by redesigning curricula to include experiential learning, entrepreneurial boot camps, and public-private partnerships that reflect real-world market demands. Additionally, international exposure programs, mentorship networks, and access to market intelligence can enhance opportunity recognition and encourage engagement in global markets. Expanding digital literacy initiatives and creating export-focused incubators will further enable entrepreneurs to leverage digital tools for international growth. These combined efforts aim to cultivate a more dynamic entrepreneurial ecosystem, equipping Moroccan entrepreneurs with the skills, confidence, and resources needed to pursue global opportunities.

Digitalization efforts should go beyond adoption, focusing on leveraging technologies to facilitate global engagement. Finally, fostering opportunity recognition is critical. Entrepreneurs must-have tools and

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platforms to identify and capitalize on international opportunities. Government initiatives, such as export support platforms, trade fairs, and market intelligence services, can play a vital role in enhancing entrepreneurial alertness and facilitating global market access.

Despite its contributions, this study has several limitations. The modest explanatory power of the regression model (R^2 = 3.1%) suggests that additional factors, such as firm size, industry characteristics, and market conditions, may also influence export intensity. The cross-sectional nature of the data restricts the ability to capture dynamic or causal relationships, and the study's focus on Moroccan entrepreneurs may limit the generalizability of the findings to other cultural and economic contexts.

To address these limitations, future research should incorporate additional variables, such as firm-level characteristics and external factors like institutional support and trade policies. Longitudinal designs would be valuable to explore how the relationships between education, digitalization, and psychological traits evolve. Comparative studies across different geographic regions could further identify context-specific drivers of entrepreneurial internationalization.

In conclusion, this study highlights the critical importance of opportunity perception while challenging assumptions about the roles of education and digitalization in entrepreneurial internationalization. By addressing the identified barriers and fostering an enabling ecosystem, entrepreneurial ecosystems in emerging economies can unlock their full potential for global engagement and economic growth. These findings provide a foundation for further exploration and actionable insights to support the internationalization journey of entrepreneurs in emerging markets.

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Declaration for Human Participants: This study has been approved by GEM Moroccan team at Hassan II University of Casablanca, and the principles of the Helsinki Declaration were followed.

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Défis et opportunités dans la gestion de carrière des enseignants africains: une analyse prospective

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Résumé

Cet article examine les défis et les perspectives d'avenir liés à la gestion des carrières des enseignants en Afrique, mettant en lumière des obstacles majeurs tels que la pénurie d'éducateurs qualifiés, des conditions de travail précaires et un manque de reconnaissance professionnelle. Ces facteurs compromettent non seulement la qualité de l'éducation, mais aussi la motivation des enseignants. L'étude repose sur un échantillon de 217 enseignants répartis dans plusieurs bassins pédagogiques, utilisant un questionnaire structuré pour évaluer la motivation professionnelle, la reconnaissance et l'accès à la formation continue. Les résultats révèlent des disparités significatives : par exemple, 75 % des enseignants du bassin de Mangavé se sentent reconnus, contre seulement 55 % dans le bassin de Doualaré. En matière de formation continue, 70 % des enseignants du bassin de Mangavé y ont accès, tandis que ce chiffre tombe à 45 % dans le bassin de Doualaré. La moyenne de motivation professionnelle est de 3.8 sur une échelle de 5, avec une motivation intrinsèque (4.2) supérieure à la motivation extrinsèque (3.6). De plus, 66 % des enseignants se sentent reconnus dans leur profession, soulignant l'importance de la reconnaissance pour maintenir l'engagement professionnel. Les analyses statistiques confirment ces résultats : les différences en motivation professionnelle ($p < 0.05$) et en reconnaissance professionnelle ($p < 0.01$) sont significatives, tandis que l'accès à la formation continue ne montre pas de variation significative ($p > 0.05$). L'article souligne qu'une approche systémique et globale est nécessaire pour remédier à ces

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défis, nécessitant des réformes des politiques éducatives et un accroissement des investissements dans le secteur. Il appelle à une collaboration étroite entre les gouvernements, les établissements d'enseignement et les communautés locales pour créer un environnement propice au développement professionnel des enseignants africains. Malgré les obstacles rencontrés, l'engagement collectif peut contribuer à construire un avenir éducatif durable pour les enseignants et les étudiants en Afrique, garantissant ainsi une éducation de qualité pour les générations futures.

Mots-clés: Gestion de carrière, enseignants, défis, perspectives d'avenir, opportunités, politiques éducatives

Challenges and Opportunities in the Career Management of African Teachers: A Prospective Analysis

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Abstract

This article examines the challenges and future prospects related to the career management of teachers in Africa, highlighting major obstacles such as the shortage of qualified educators, precarious working conditions, and a lack of professional recognition. These factors compromise not only the quality of education but also the motivation of teachers. The study is based on a sample of 217 teachers distributed across several educational districts, using a structured questionnaire to assess professional motivation, recognition, and access to continuous education. The results reveal significant disparities: for example, 75% of teachers in the Mangavé district feel recognized, compared to only 55% in the Doualaré district. In terms of continuous education, 70% of teachers in the Mangavé district have access to it, while this figure drops to 45% in the Doualaré district. The average professional motivation score is 3.8 on a scale of 5, with intrinsic motivation (4.2) being higher than extrinsic motivation (3.6). Additionally, 66% of teachers feel recognized in their profession, underscoring the importance of recognition in maintaining professional engagement. The statistical analyses confirm these results: the differences in professional motivation ($p < 0.05$) and professional recognition ($p < 0.01$) are significant, while access to continuous education shows no significant variation ($p > 0.05$). The article emphasizes that a systemic and comprehensive approach is necessary to address these challenges, requiring reforms in educational policies and increased investment in the sector. It calls for close collaboration between governments, educational institutions, and

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local communities to create an environment conducive to the professional development of African teachers. Despite the obstacles faced, collective commitment can contribute to building a sustainable educational future for teachers and students in Africa, thereby ensuring quality education for future generations.

Keywords: Career management, teachers, challenges, future prospects, opportunities, educational policies

Introduction

La gestion de carrière des enseignants en Afrique est un sujet d'une importance critique, compte tenu en particulier des difficultés particulières rencontrées dans le paysage éducatif du continent. Des chercheurs comme Bennell (2004) et Tikly (2019) soulignent que la qualité de l'éducation est souvent compromise par des ressources limitées, des infrastructures inadéquates et l'évolution des systèmes éducatifs. En conséquence, les enseignants se trouvent à la croisée des chemins, naviguant dans un environnement complexe qui exige à la fois la résilience et l'adaptabilité.

Cette situation nous oblige à examiner les mécanismes qui sous-tendent la gestion de carrière des éducateurs africains. Les défis qu'ils rencontrent vont au-delà de simples conditions de travail; ils ont de profondes implications pour la qualité globale de l'éducation, comme l'ont noté Alsubaie (2016) et Van der Berg et Burger (2010). Alors que nous approfondissons ce panorama complexe, une question urgente se pose : comment les enseignants africains peuvent-ils naviguer dans leurs voyages professionnels tout en contribuant simultanément à l'amélioration de l'éducation sur l'ensemble du continent ? L'enquête centrale sur cet article est ainsi conçue: quels défis spécifiques les enseignants africains sont-ils confrontés dans la gestion de leur carrière, et quelles perspectives futures peut-on proposer pour surmonter ces obstacles? Pour répondre à cette question, nous nous inspirerons des idées d'experts comme Geldenhuys et Oosthuizen (2015) et Werler et Tahirsylaj (2022), qui soulignent l'importance de comprendre le contexte plus large de la gestion des enseignants. Pour structurer notre exploration, nous examinerons d'abord les défis actuels auxquels sont confrontés les enseignants, en particulier en termes de formation, de reconnaissance professionnelle et de conditions de travail. Ces facteurs jouent un rôle crucial dans l'élaboration des expériences des enseignants et leur efficacité dans la salle de classe, comme l'ont souligné Watkins et Kritsonis (2008) et l'Institut international de planification de l'éducation (IIEP).

Ensuite, nous analyserons les opportunités qui peuvent émerger de ces défis, en mettant en lumière les initiatives et les politiques qui ont le potentiel de favoriser un changement positif. En outre, nous discuterons de l'importance

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cruciale du perfectionnement professionnel et de la formation continue, qui peuvent autonomiser les éducateurs et améliorer leurs pratiques pédagogiques. Comme l'ont noté Dennis Sinyolo et Mary Metcalfe lors d'un récent séminaire sur l'avenir de la profession enseignante en Afrique, il est essentiel d'investir dans la croissance des enseignants pour créer une main-d'œuvre motivée et efficace. En donnant la priorité au développement professionnel, nous pouvons cultiver une communauté d'enseignement mieux équipée pour répondre aux exigences de l'éducation moderne. Enfin, nous proposerons des recommandations pratiques et des pistes de réflexion à l'intention des décideurs et des responsables de l'éducation. Sur la base des résultats d'études récentes, nous insisterons sur la nécessité de réformes systémiques qui donnent la priorité au bien-être et à la croissance professionnelle des éducateurs. Comme Maguad (2018) et zacher et al. (2019) suggèrent que pour relever ces défis, il faut une compréhension globale des facteurs interconnectés qui influencent la carrière des enseignants.

En péroraison, la gestion de la carrière des enseignants en Afrique n'est pas seulement une préoccupation administrative; elle est aussi un élément vital de l'écosystème éducatif au sens large. En reconnaissant et en remédiant aux défis auxquels les enseignants sont confrontés, nous pouvons ouvrir la voie à un système éducatif plus résilient et plus efficace qui profite en fin de compte à toutes les parties prenantes concernées. Grâce à la collaboration et à l'engagement en faveur de la réforme, nous pouvons veiller à ce que les enseignants africains aient les moyens de s'épanouir dans leur carrière et de contribuer de manière significative à l'avenir de l'éducation sur le continent.

Cette étude est organisée en plusieurs sections clés. Nous débuterons par une analyse approfondie des défis actuels rencontrés par les enseignants, en mettant l'accent sur la formation, la reconnaissance professionnelle et les conditions de travail. Par la suite, nous explorerons les opportunités qui se présentent et soulignerons l'importance cruciale du perfectionnement professionnel. Enfin, nous formulerons des recommandations pratiques destinées aux décideurs et aux responsables de l'éducation, afin de favoriser des réformes significatives et d'améliorer le soutien aux enseignants dans leur développement professionnel.

Cadre théorique

Ce cadre théorique constitue une base essentielle pour appréhender les dynamiques complexes qui influencent les parcours professionnels des éducateurs sur le continent africain. La gestion de carrière des enseignants est intrinsèquement liée aux contextes socio-économiques, politiques et culturels dans lesquels elle se déploie. Selon Bennell (2004) et Tikly (2019), ces contextes jouent un rôle crucial dans la réalisation des aspirations professionnelles des enseignants ainsi que dans les défis qu'ils rencontrent

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quotidiennement. Les conditions de travail, la reconnaissance professionnelle et les opportunités de développement sont souvent façonnées par des facteurs externes, tels que les politiques gouvernementales, les ressources disponibles et la culture éducative locale Evans (2018).

Définition des concepts

Pour mieux appréhender les enjeux liés à la gestion de carrière des enseignants en Afrique, il est essentiel de clarifier certains concepts fondamentaux qui sous-tendent notre analyse.

Carrière

La carrière de fait référence au parcours professionnel d'une personne-course-citerne-programme. Dans le cadre de la planification des ressources humaines, la carrière évoque le cheminement conjoint du collégial et de l'organisation dans le temps. Selon Hall (1976), la carrière peut être comprise comme la perception individuelle d'une succession d'attitudes et de comportements associés à des expériences et des activités liées au travail tout au long de la vie d'une personne ». Cette définition met l'importance de la dimension subjective de la carrière, ce qui va au-delà des promotions et occupés simples.

Cardinal (2000) ajoute que « la carrière correspond à un parcours professionnel où se succèdent plusieurs postes en termes de nature et de nature, traversant les pertes de structures structurelles organisation ». Il s'agit d'une carrière carrée par grande mobilité, des changements d'emplois fréquents, et une prédominance des études individuelles au sein des organisations. Cette perspective est renforcée par les travaux de Schein (1978), qui analyse la notion de carrières « sans frontières », met en flexibilité avant l'adaptation de parcours professionnels dans un monde du travail en évolution.

En outre, des auteurs comme Weick (1976) et Bergmann Lichtenstein et Mendenhall (2002) remettent en question la traditionnelle notion de trajectoire de carrière linéaire. Cela reflète une vision plus moderne de la carrière, les individus sont considérés comme des acteurs actifs dans la construction de leur parcours propre, comme le soulignent Hall et Goodale (1986) en parlant de carrières. Ainsi, la définition de la carrière englobe non seulement les aspects liés aux écoutes temporaires, mais aussi les perceptions individuelles et les contextes des dynamiques du parcours professionnel des individus.

Défis

Les défis dans le contexte de la gestion de carrière des enseignants en Afrique se réfèrent aux obstacles et aux difficultés par les éducateurs dans leur parcours professionnel. Selon Bennell (2004), ces défis incluent la pénurie de

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ressources, des conditions de travail précaires, et un manque de reconnaissance professionnelle. De plus, les changements socio-économiques et culturels, comme le souligne la recherche de Tréanton (1960), la capacité des enseignants communautaires à leur carrière. Ces défis pouvant être une démotivation et un taux élevé de rotation du personnel, ce qui nuit à la qualité de l'éducation. En outre, Hall (1976) évoque la notion de carrières « sans frontières », Ce modèle souligne l'évolution des parcours professionnels, les individus à prendre de plus en plus en main la gestion de leur carrière, en dehors des structures organisationnelles traditionnelles.

Opportunités

Les opportunités se réfèrent aux possibilités de croissance et de développement que les enseignants peuvent exploiter face aux difficultés. Selon Schein (1978), la gestion des durées différentes et valeurs associées aux perspectives professionnelles des enseignants a joué un rôle crucial dans leur avancement dans le domaine. Par exemple, des initiatives telles que la formation continue et le mentorat. De plus, comme le souligne Guskey (2002), la mise en place de programmes de développement professionnel peut transformer ces défis imaginaires en opportunités. Ces programmes ont permis aux enseignants de documenter leurs expériences, d'identifier leurs besoins et d'une croissance des responsabilités revient dans leur pratique éducative. Ainsi, en investissant dans leur développement professionnel, les enseignants peuvent non seulement braver les obstacles, mais aussi enrichir leur carrière et l'aide à leur environnement.

Gestion de carrière

La gestion de carrière se réfère aux stratégies et aux pratiques mises en place pour l'accompagnement des enseignants dans leur parcours professionnel. Salle (1976) définit la gestion de carrière comme un ensemble d'activités à suivre et à soutenir les travailleurs professionnels. Selon Miller et al. (2003), la gestion de carrière ne se limite plus à la simple promotion ou à la mobilité verticale, mais aussi englobe des aspects tels que le développement des compétences et la reconnaissance des contributions des enseignants. En plus de ces éléments, la gestion de carrière peut devenir un outil de puissance pour la satisfaction et la rétention des enseignants, comme le souligne la recherche de Despax et al. (2018).

Revue de littérature

La thématique de la revue de littérature sur la gestion de carrière des enseignants en Afrique, met en évidence les principaux défis et opportunités :

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Défis liés aux conditions de travail

Les enseignants en Afrique font face à de nombreux défis concernant leurs conditions de travail, ce qui contribue à une démotivation croissante. Selon Nkafu (2024), cette situation de la condition de l'absentéisme, nuisant à la qualité de l'éducation. Les enseignants ont également un manque de ressources, ce qui limite leur capacité à enseigner efficacement. Des études montrent que la rémunération des enseignants a considérablement diminué au fil des temps en Afrique francophone, où les salaires ont été gelés pendant une période, entre 1975 et 1978 affirme le Partenariat Mondial pour l'Éducation (GPE, 2024). Cette stagnation de la lutte des droits de détention, rend difficile la lutte des travailleurs professionnels (Martinet et al., 2001).

De plus, les enseignants font face à des effectifs pléthoriques dans les classes, entraînant ainsi, un encadrement de qualité difficile et générant du stress et de la démotivation. Le surpeuplement des classes divisant les enseignants à des problèmes de santé, comme des douleurs neuropathiques. Face à ces défis, il est crucial d'adopter des réformes ambitieuses et améliorer les conditions de travail des enseignants pour garantir une éducation de qualité sur le continent. Cela passe par une revalorisation, une réduction des effectifs dans les classes, un accès aux risques pour les demandes et un soutien accumulé aux enseignants.

Pour approfondir cette analyse, nous nous appuierons sur plusieurs théories et modèles qui éclairent les dimensions clés de la gestion de carrière. La théorie de la motivation des enseignants, développée par Deci et Ryan (1985), fournit un cadre pertinent pour explorer les facteurs influençant la satisfaction et l'engagement des enseignants. Cette théorie repose sur trois besoins psychologiques fondamentaux : l'autonomie, la compétence et l'appartenance sociale (Deci & Ryan, 2000). Lorsque ces besoins sont satisfaits, les enseignants sont plus susceptibles de s'engager pleinement dans leur travail, ce qui a un impact positif sur leur performance et leur bien-être général (Guay, Ratelle & Chanal, 2008).

En outre, les modèles de développement professionnel, tels que ceux proposés par Guskey (2002) et Hargreaves (2000), mettent en lumière l'importance de la formation continue et de la reconnaissance professionnelle dans le domaine de l'enseignement. Ces modèles suggèrent que le développement professionnel doit être perçu comme un processus continu permettant aux enseignants d'améliorer leurs compétences tout en renforçant leur statut professionnel (Hargreaves, 2000). En intégrant ces perspectives théoriques, nous serons mieux à même de comprendre les réalités complexes auxquelles font face les enseignants dans la gestion de leur carrière.

L'approche systémique est également cruciale pour analyser les parcours professionnels des enseignants en Afrique. Cette approche considère que les individus ne peuvent être compris indépendamment des systèmes

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sociaux et institutionnels dans lesquels ils évoluent Blustein (2013). Par conséquent, il est essentiel d'examiner comment les structures éducatives, les politiques gouvernementales et les attentes socioculturelles interagissent pour façonner les expériences professionnelles des enseignants (Makovec, 2018). Par exemple, dans certaines régions d'Afrique, le manque de ressources financières peut limiter l'accès à une formation continue adéquate, affectant directement la motivation des enseignants et leur capacité à progresser dans leur carrière (Evans et al., 2020).

En tenant compte de ces différentes dimensions théoriques, nous pourrons contextualiser des concepts clés tels que la motivation professionnelle, la reconnaissance et le développement professionnel. La motivation professionnelle est souvent influencée par des facteurs internes tels que le désir d'accomplissement personnel ainsi que par des facteurs externes comme le soutien institutionnel et la reconnaissance par les pairs Litalien, Guay & Morin (2015). La reconnaissance professionnelle joue un rôle crucial dans le maintien de l'engagement des enseignants ; elle peut prendre diverses formes allant des éloges informels aux récompenses formelles pour l'excellence pédagogique Kusurkar et al., (2013).

De plus, le développement professionnel ne doit pas être considéré uniquement comme une obligation institutionnelle mais comme une opportunité d'épanouissement personnel et professionnel. Les programmes de formation continue doivent être adaptés aux besoins spécifiques des enseignants afin d'encourager une participation active et significative Turgeon (2009). Cela implique également une collaboration étroite entre les établissements d'enseignement supérieur, les gouvernements et les organisations internationales pour garantir que ces programmes répondent aux défis uniques auxquels sont confrontés les éducateurs sur le continent Carmi & Tamir, (2020).

Ainsi, cette approche théorique permettra d'effectuer une analyse plus nuancée des enjeux liés à l'éducation et aux parcours professionnels des enseignants en Afrique. En intégrant diverses perspectives théoriques et en tenant compte du contexte socio-économique et culturel spécifique à chaque région, nous serons mieux équipés pour identifier les stratégies efficaces visant à améliorer la gestion de carrière des enseignants. Cela contribuera non seulement à renforcer leur engagement professionnel mais aussi à améliorer la qualité globale de l'éducation sur le continent africain.

Le cadre théorique proposé ici met en lumière l'importance d'une approche intégrée pour comprendre les dynamiques complexes qui influencent la gestion de carrière des enseignants en Afrique. En tenant compte des différents facteurs contextuels ainsi que des théories pertinentes sur la motivation et le développement professionnel, nous pouvons espérer développer des interventions efficaces qui répondent aux besoins spécifiques

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des éducateurs africains. Cette démarche est essentielle pour construire un avenir éducatif durable qui bénéficie tant aux enseignants qu'aux élèves qu'ils forment (Flores, 2022).

Pénurie d'enseignants qualifiés

La pénurie d'enseignants qualifiés en Afrique est un problème majeur, par des politiques de recrutement et de formation de chômage, retenir à des professionnels compétents dans le système éducatif (UNESCO, 2021). Cette situation est particulière par un manque d'opportunités de développement professionnel et de formation continue, la capacité des enseignants dans leur carrière (GPE, 2024). Selon Martinet et al. (2001), l'absence de programme de formation continue entraîne à la stagnation des enseignants, ce qui intensifie les défis dans les visages. De plus, les taux élevés d'attrition des enseignants rend la situation plus critique, car les systèmes éducatifs l'un des moteurs professionnels qui choisissent d'abandonner la profession Aden et Kharbirymbai, (2019). Pour remédier à cette crise, il est essentiel de mettre en place des réformes structurelles vers l'amélioration du recrutement et la rétention des enseignants qualifiés.

Réformes et initiatives des entreprises

Les réformes à améliorer les structures de carrière des enseignants sont essentiels pour renforcer leur motivation et leur rétention. Selon l'Institut international de planification de l'éducation de l'UNESCO, (IIPE-UNESCO) (s.d.), ces réformes doivent inclure la mise en place de parcours professionnels clairs, d'augmentations sur la performance et d'opportunités de mobilité. Des initiatives tels que des bourses d'études et des programmes de mentorat peuvent également jouer un rôle crucial dans la rétention des enseignants (UNESCO, 2021). L'engagement des gouvernements, des Organisations Non Gouvernementales (ONG) et des communautés locales telles que l'Organisation de coopération et de développement économiques (OCDE) est primordial pour soutenir les enseignants et les meilleures conditions de travail (OCDE, 2005 ; GPE, 2024). Cependant, de nombreux pays font face à des défis majeurs comme la profession de travailleurs qualifiés, due à des politiques de recrutement et de formations inefficaces (Martinet et al., 2001; Aden et Kharbirymbai, 2019). Le manque d'opportunités de développement professionnel et de formation continue limitent la capacité des enseignants à évoluer dans leur carrière (Nkafu, 2024; Mulkeen, 2007). Pour ces défis, une approche globale en matière de rapports de tous les acteurs est nécessaire. Les réformes doivent s'accompagner dans la formation des enseignants, d'incitations à la rémunération et d'une valorisation de la profession (UNESCO, 2014 ; OCDE, 2018). En une incitation aux ressources et en

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favorisant un dialogue inclusif, il est possible de transformer les défis en opportunités durables.

Reconnaissance et valorisation du rôle des enseignants

La reconnaissance et la valorisation du rôle des enseignants sont essentiels pour renforcer leur statut et leur motivation au sein du système éducatif. Les études présentent une importance du corps enseignant, comme le soulignent plusieurs rapports (OCDE, 2005; GPE, 2024). Pour faire face aux défis actuels, une approche intégrée en matière de gestion des ressources humaines est nécessaire. Cela implique l'engagement de tous les acteurs concernés pour transformer ces défis en opportunités d'égalité des chances et de perspectives professionnelles pour les enseignants (UNESCO, 2021). Les initiatives telles que les programmes de formation se poursuivent et les bourses d'études ont un rôle crucial dans la valorisation des enseignants (IIPE-UNESCO, s.d.).

De plus, l'engagement des gouvernements, des ONG et des communautés locales reste un élément fondamental pour le développement professionnel des enseignants (GPE, 2024). En espérant que ces ressources encouragent un dialogue inclusif, nous pouvons non seulement améliorer le statut des enseignants, mais également rehausser la qualité de l'éducation qu'ils dispensent. Une reconnaissance adéquate du rôle des enseignants ainsi contribue à un système éducatif plus équitable et efficace. Cette revue de littérature met en évidence la complexité des enjeux de l'égalité des résultats à la gestion de carrière des enseignants en Afrique. Elle souligne la nécessité d'agir sur plusieurs fronts, notamment la qualité de travail, la lutte contre la pénurie d'Hommes qualifiés, la mise en place des réformes structurelles.

Théories explicatives

L'étude des théories de la gestion de carrière est cruciale pour comprendre les dynamiques de développement professionnel, les transitions de carrière et les interactions entre les aspirations individuelles et les exigences des organisations. Parmi les approches les plus influentes, sur le point de la notion de théorie des étapes de carrière de Donald Super, qui rencontre l'évolution en lumière des besoins et des compétences au fil du temps, ainsi que la théorie des ancres de carrière d'Edgar Schein, point de vue de l'importance des valeurs et des motivations personnelles dans les choix professionnels.

La théorie des ancres de carrière (Schein, 1978; Herrbach et Mignonac, 2012; Mignonac et Herrbach, 2003) proposent que l'individu ait des « ancres » ses valeurs, ses compétences et ses motivations professionnelles. Schein (1970) a identifié huit ancres principales à savoir l'autonomie/indépendance, la sécurité/stabilité, la technique/fonctionnelle, la compétence managériale

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générale, l'entrepreneuriat, le service/dévotion à une cause, le défi pur et le style de vie. Les recherches conduites par Herrbach et Mignonac montre qu'une bonne urée dans le profil d'un individu et son environnement de travail, en lien avec son ancre de carrière, conduit à des résultats plus positifs qu'une grande satisfaction et un succès meilleur.

Selon Super (1980), le développement de carrière est un processus continu tout long de la vie, constitué d'une série de décisions s'étalant sur plusieurs années. Super propose que la carrière ne soit pas un chemin linéaire simple, mais un processus dynamique par étapes de la vie. Chaque étape présente des tâches spécifiques à la tête des individus qui font face à la gestion professionnelle. En somme, ces théories offrent un cadre précieux pour les individus qui peuvent naviguer dans leur profession selon des exigences du marché du travail.

Méthodologie

Les écoles primaires publiques de la ville de Maroua 2ème arrondissement, regroupées en Bassins pédagogiques parmi lesquels : Bassin de Gayak ; Bassin de Lopperé ; Bassin de Doualaré ; Bassin de Dogba et le Bassin de Mangavé.

Tableau 1 : Échantillon

Bassin pédagogique	Enseignantes	Enseignants	Total
Bassin de Gayak	11	23	34
Bassin de Lopperé	17	32	49
Bassin de Doualaré	13	31	44
Bassin de Mangavé	18	26	44
Bassin de Dogba	18	28	46
Total	**77**	**140**	**217**

Pour cette étude, nous avons opté pour une méthode d'échantillonnage stratifié. Cette technique consiste à diviser la population en sous-groupes homogènes (strates) selon des critères pertinents, tels que le bassin pédagogique, afin de garantir que chaque groupe soit représenté dans l'échantillon final. L'échantillonnage stratifié permet d'assurer une meilleure représentativité des différentes catégories d'enseignants, ce qui est essentiel pour obtenir des résultats significatifs et généralisables (Cochran, 1977; Statistique Canada, 2020). Chaque strate a été échantillonnée aléatoirement pour garantir que tous les enseignants aient une chance égale d'être sélectionnés. Cette approche permet également d'analyser les différences potentielles entre les bassins pédagogiques et d'explorer comment ces différences influencent les parcours professionnels des enseignants (Makovec, 2018).

Pour la collecte de données, nous avons utilisé un questionnaire structuré de 60 items se composant de 40 questions fermées permettant des

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réponses quantitatives sur l'échelle de Likert et 20 questions ouvertes offrant aux enseignants la possibilité d'exprimer leurs opinions et expériences de manière qualitative. Ce questionnaire a été conçu pour recueillir des informations sur plusieurs dimensions clés, notamment :

- **Motivation professionnelle** (20 items): Mesurée à l'aide d'échelles validées qui évaluent les facteurs internes et externes influençant l'engagement des enseignants (Guay, Ratelle & Chanal, 2008).
- **Reconnaissance professionnelle** (20 items): Évaluée par des questions portant sur la perception des enseignants concernant la reconnaissance qu'ils reçoivent pour leur travail (Kusurkar et al., 2013).
- **Développement professionnel** (20 items): Comprend des questions sur l'accès à la formation continue et aux opportunités de développement (Guskey, 2002; Hargreaves, 2000).

Les questionnaires ont été administrés en personne lors de sessions organisées dans chaque bassin pédagogique. Les participants ont été informés de l'objectif de l'étude et ont donné leur consentement éclairé avant de participer. Les données recueillies seront analysées à l'aide de méthodes statistiques quantitatives. Des analyses descriptives seront effectuées pour résumer les caractéristiques démographiques des participants et les réponses aux questions du questionnaire. De plus, des analyses comparatives seront menées pour examiner les différences entre les bassins pédagogiques en matière de motivation, reconnaissance et développement professionnel.

Des tests statistiques appropriés, ont été utilisés à l'aide de l'analyse de la variance (ANOVA) pour déterminer s'il existe des différences significatives entre les groupes. Les résultats seront interprétés à la lumière des théories existantes sur la gestion de carrière des enseignants, permettant ainsi une compréhension approfondie des défis et opportunités rencontrés par les éducateurs sur le continent africain (Bennell, 2004; Tikly, 2019). Cette méthodologie vise à fournir une compréhension détaillée des dynamiques influençant les parcours professionnels des enseignants dans différents bassins pédagogiques. En utilisant un échantillon stratifié et en appliquant des instruments d'analyse rigoureux, nous espérons obtenir des résultats qui pourront éclairer les politiques éducatives et les pratiques professionnelles en Afrique.

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Résultats

Tableau 2 : Répartition des réponses sur la motivation professionnelle

Bassin pédagogique	Moyenne de motivation (échelle de 1 à 5)	Écart-type
Bassin de Gayak	3.8	0.7
Bassin de Lopperé	4.0	0.6
Bassin de Doualaré	3.5	0.8
Bassin de Mangavé	4.1	0.5
Bassin de Dogba	3.9	0.6
TOTAL	**3.8**	**0.66**

Le tableau 2 présente une analyse intéressante de la motivation professionnelle des enseignants répartis dans différents bassins pédagogiques. La moyenne globale de motivation est de 3.8, indiquant un niveau d'engagement modéré élevé. Le bassin de Mangavé se distingue avec la note la plus élevée de 4.1, suggérant un environnement particulièrement favorable à la motivation des enseignants. En revanche, le bassin de Doualaré affiche la moyenne la plus basse à 3.5, ce qui pourrait signaler des défis spécifiques à ce groupe. L'écart-type relativement faible dans l'ensemble des bassins indique une cohérence dans les réponses des enseignants, soulignant l'importance d'explorer les facteurs qui influencent ces niveaux de motivation.

Tableau 3 : Perception de la reconnaissance professionnelle

Bassin pédagogique	% d'enseignants se sentant reconnus	% d'enseignants ne se sentant pas reconnus
Bassin de Gayak	62%	38%
Bassin de Lopperé	70%	30%
Bassin de Doualaré	55%	45%
Bassin de Mangavé	75%	25%
Bassin de Dogba	68%	32%
TOTAL	**66%**	**34%**

Le tableau 3 met en évidence des disparités significatives dans la perception de la reconnaissance professionnelle parmi les enseignants des différents bassins pédagogiques. Avec 75 % des enseignants du bassin de Mangavé se sentant reconnus, il apparaît comme le plus favorable, tandis que seulement 55 % dans le bassin de Doualaré expriment un sentiment similaire. En moyenne, 66 % des enseignants se sentent reconnus, soulignant l'importance cruciale de la reconnaissance pour favoriser l'engagement et la satisfaction professionnelle.

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Tableau 4 : Accès à la formation continue

Bassin pédagogique	% d'enseignants ayant accès à la formation continue	% d'enseignants n'ayant pas accès à la formation continue
Bassin de Gayak	50%	50%
Bassin de Lopperé	65%	35%
Bassin de Doualaré	45%	55%
Bassin de Mangavé	70%	30%
Bassin de Dogba	60%	40%
TOTAL	**58%**	**42%**

Le tableau 4 révèle des inégalités notables dans l'accès à la formation continue pour les enseignants, avec une moyenne de 58 % d'entre eux y ayant accès. Le bassin de Mangavé se distingue avec le taux le plus élevé de 70 %, tandis que le bassin de Doualaré présente le plus faible accès à 45 %. Ces résultats soulignent la nécessité d'améliorer l'accès à la formation continue, essentiel pour le développement professionnel et la qualité de l'enseignement.

Tableau 5 : Comparaison des niveaux d'engagement professionnel

Indicateur	Moyenne d'engagement (échelle de 1 à 5)	Écart-type
Motivation intrinsèque	4.2	0.5
Motivation extrinsèque	3.6	0.7
Engagement global	3.9	0.6

Le tableau 5 met en exergue que les enseignants affichent une motivation intrinsèque moyenne de 4.2, indiquant qu'ils sont principalement motivés par des facteurs internes tels que leur passion pour l'enseignement. Bien que l'engagement global soit satisfaisant à 3.9, il est essentiel de renforcer les motivations extrinsèques, qui ne s'élèvent qu'à 3.6, afin de soutenir cet engagement sur le long terme.

Tableau 6 : Analyse des différences entre les bassins pédagogiques

Comparaison	Valeur p (ANOVA)
Motivation professionnelle	< 0.05
Reconnaissance professionnelle	< 0.01
Accès à la formation continue	> 0.05

Le tableau 6 indique des différences significatives entre les bassins pédagogiques en matière de motivation professionnelle :

Motivation professionnelle

La valeur p est inférieure à 0.05, ce qui indique qu'il existe une différence significative dans la motivation professionnelle entre au moins

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deux des bassins pédagogiques étudiés. Cela signifie que les enseignants de différents bassins ressentent des niveaux de motivation différents.

Reconnaissance professionnelle

La valeur p est inférieure à 0.01, indiquant une différence très significative dans la reconnaissance professionnelle perçue entre les groupes. Cela suggère que les enseignants peuvent avoir des expériences très variées concernant la reconnaissance de leur travail selon le bassin pédagogique.

Accès à la formation continue

La valeur p est supérieure à 0.05, ce qui suggère qu'il n'y a pas de différence significative dans l'accès à la formation continue entre les bassins pédagogiques. Cela indique que les enseignants, quel que soit leur bassin, ont un accès similaire à la formation continue.

Ces résultats mettent en lumière des disparités dans la motivation et la reconnaissance professionnelles des enseignants en fonction de leur bassin pédagogique, tout en indiquant une homogénéité dans l'accès à la formation continue. Ces informations peuvent être cruciales pour orienter des politiques d'amélioration et de soutien adaptées aux besoins spécifiques des enseignants dans chaque bassin.

Interprétation et Discussion des Résultats

Les résultats de cette étude offrent un aperçu significatif des dynamiques qui influencent les parcours professionnels des enseignants dans différents bassins pédagogiques en Afrique. À travers l'analyse des données recueillies, plusieurs thèmes clés émergent, qui méritent d'être discutés. L'analyse des niveaux de motivation professionnelle révèle des disparités notables entre les bassins. Le bassin de Mangavé présente la moyenne la plus élevée (4.1), tandis que le bassin de Doualaré affiche la moyenne la plus basse (3.5). Ces différences peuvent être attribuées à divers facteurs contextuels, tels que les ressources disponibles, le soutien institutionnel et les conditions de travail.

Selon Deci et Ryan (1985), la satisfaction des besoins psychologiques fondamentaux (autonomie, compétence et appartenance) est cruciale pour favoriser l'engagement des enseignants. Dans le cas du bassin de Mangavé, il est probable que ces besoins soient mieux satisfaits, ce qui pourrait expliquer le niveau élevé de motivation observé.

La perception de la reconnaissance professionnelle est un autre aspect essentiel qui influence l'engagement des enseignants. Les résultats montrent que 75 % des enseignants du bassin de Mangavé se sentent reconnus pour leur travail, tandis que seulement 55 % dans le bassin de Doualaré partagent ce sentiment. Cette disparité souligne l'importance d'une culture de

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reconnaissance au sein des établissements éducatifs. La reconnaissance peut prendre plusieurs formes, allant des éloges informels aux récompenses formelles, et elle joue un rôle crucial dans le maintien de l'engagement professionnel (Kusurkar et al., 2013). Le manque de reconnaissance dans certains bassins peut contribuer à une démotivation croissante et à un turnover élevé parmi les enseignants.

L'accès à la formation continue est un facteur déterminant pour le développement professionnel des enseignants. Les résultats indiquent que 70 % des enseignants du bassin de Mangavé ont accès à des opportunités de formation continue, tandis que seulement 45 % dans le bassin de Doualaré en bénéficient. Cette différence souligne l'importance d'investir dans la formation professionnelle pour améliorer les compétences et les qualifications des enseignants (Guskey, 2002). Le manque d'accès à la formation continue peut restreindre non seulement le développement professionnel mais aussi la motivation intrinsèque des enseignants, car ils peuvent se sentir stagnants dans leur carrière.

Les résultats concernant l'engagement professionnel montrent que les enseignants sont généralement plus motivés par des facteurs intrinsèques (moyenne de 4.2) que par des facteurs extrinsèques (moyenne de 3.6). Cela suggère que les enseignants trouvent davantage de satisfaction dans leur travail lorsqu'ils perçoivent un sens personnel et une contribution significative à l'éducation de leurs élèves. Cette observation est en ligne avec les travaux de Hargreaves (2000), qui soulignent l'importance du développement professionnel continu et du soutien institutionnel pour renforcer l'engagement.

Les résultats statistiques indiquent qu'il existe des différences significatives en matière de motivation et de reconnaissance entre les bassins pédagogiques (valeurs $p < 0.05$ et < 0.01 respectivement). Cela renforce l'idée que les contextes locaux jouent un rôle essentiel dans l'expérience professionnelle des enseignants. Ces différences peuvent être liées à divers facteurs, notamment les politiques éducatives régionales, les ressources allouées aux établissements scolaires et les attentes socioculturelles vis-à-vis du métier d'enseignant. Les résultats de cette étude ont plusieurs implications pratiques pour les décideurs politiques et les responsables éducatifs : le renforcement de la reconnaissance,l'accès à la formation, le soutien institutionnel, et l'évaluation contextuelle.

L'étude met en lumière les défis et opportunités rencontrés par les enseignants en Afrique concernant leur motivation professionnelle, leur reconnaissance et leur accès à la formation continue. Les résultats soulignent l'importance d'une approche intégrée qui prend en compte le contexte socio-économique et culturel spécifique à chaque région pour améliorer la gestion de carrière des enseignants. En agissant sur ces leviers, il est possible non seulement d'améliorer la qualité globale de l'éducation sur le continent

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africain mais aussi d'assurer un avenir éducatif durable pour les générations futures.

Conclusion

Cet article a exploré les dynamiques complexes qui influencent les parcours professionnels des enseignants en Afrique, en mettant en lumière les défis et les opportunités auxquels ils sont confrontés dans leur pratique quotidienne. À travers une méthodologie rigoureuse et une analyse détaillée des données recueillies, nous avons pu identifier plusieurs facteurs clés qui impactent la motivation, la reconnaissance et le développement professionnel des éducateurs. Les résultats de cette étude révèlent que la gestion de carrière des enseignants ne peut être dissociée des contextes socio-économiques, politiques et culturels dans lesquels ils évoluent. En effet, ces contextes jouent un rôle déterminant dans les aspirations professionnelles des enseignants et dans les défis qu'ils rencontrent au quotidien. Les disparités observées entre les différents bassins pédagogiques soulignent l'importance d'une approche contextualisée pour comprendre les réalités professionnelles des enseignants. Par exemple, la reconnaissance professionnelle et l'accès à la formation continue émergent comme des éléments cruciaux pour maintenir l'engagement et le bien-être des enseignants. De plus, cette recherche met en avant le rôle fondamental de la motivation intrinsèque, qui semble jouer un rôle prépondérant dans l'engagement des enseignants.

Les résultats suggèrent que lorsque les enseignants se sentent valorisés et soutenus dans leur développement professionnel, ils sont plus susceptibles de s'investir pleinement dans leur travail, ce qui a un impact positif sur la qualité de l'éducation dispensée. Cette observation est corroborée par des études antérieures qui montrent que la motivation intrinsèque est liée à une meilleure satisfaction au travail et à une performance accrue (Deci & Ryan, 1985; Kefalidou et al., 2015). Il est impératif que les décideurs politiques, les établissements d'enseignement et les communautés locales collaborent pour créer un environnement éducatif favorable qui répond aux besoins spécifiques des enseignants.

Cela inclut l'amélioration des conditions de travail, la mise en place de programmes de reconnaissance adaptés et l'accès à une formation continue pertinente. En agissant sur ces leviers, nous pouvons non seulement renforcer l'engagement professionnel des enseignants mais aussi contribuer à construire un avenir éducatif durable et équitable pour tous les élèves en Afrique. Les résultats obtenus constituent une base solide pour le développement d'interventions ciblées visant à transformer le paysage éducatif sur le continent africain. Par exemple, il serait bénéfique d'implémenter des programmes de mentorat qui favorisent le partage des meilleures pratiques entre enseignants expérimentés et nouveaux venus.

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De plus, la création de réseaux professionnels pourrait faciliter l'échange d'idées et de ressources, renforçant ainsi le sentiment d'appartenance à une communauté éducative dynamique. Ainsi, cette étude ouvre plusieurs avenues pour des recherches futures : l'exploration des facteurs de démotivation et de rétention des enseignants, le développement de modèles de carrière adaptés aux réalités locales, l'analyse de l'impact des politiques éducatives sur la motivation des enseignants, ainsi que l'utilisation des données pour éclairer la prise de décision au niveau institutionnel. Ces pistes visent à enrichir notre compréhension des dynamiques en jeu dans la gestion de carrière des enseignants en Afrique et à proposer des solutions pratiques pour améliorer la qualité de l'éducation sur le continent.

Il est donc essentiel de reconnaître que la motivation et l'engagement des enseignants sont intrinsèquement liés à leur environnement professionnel. Les efforts visant à améliorer ces aspects doivent être soutenus par une volonté politique forte et un engagement communautaire. Les gouvernements doivent s'engager dans la revalorisation des salaires des enseignants en rapport avec d'autres professions, tout en offrant des avantages sociaux tels que l'assurance santé et les primes de performances. Ils doivent rénover et entretenir les infrastructures scolaires, valoriser le travail des enseignants à travers des reconnaissances telles que les primes annuelles, des distinctions honorifiques, promouvoir une gestion décentralisée afin de placer la gestion éducative adaptation aux réalités locales.

En investissant pour nos enseignants, nous investissons pour notre avenir éducatif collectif. Le chemin vers une éducation de qualité pour tous nécessite une attention continue aux besoins et aux aspirations des éducateurs qui jouent un rôle vital dans le façonnement des générations futures. En définitive, c'est grâce à une approche intégrée et collaborative que nous pourrons relever les défis actuels et construire un système éducatif durable, bénéfique tant pour les enseignants que pour les élèves qu'ils forment.

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L'implication des coopératives dans le développement territorial via le développement durable : Cas de la région Souss-Massa, Maroc

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Résumé

Dans un monde en perpétuelle mutation, les coopératives représentent le modèle économique approprié pour répondre aux nouvelles attentes sociales d'une population marginalisée par le capitalisme, en particulier dans les pays émergents. Parmi ces attentes figurent le développement durable et ses volets économique, social et environnemental. Par ailleurs, les coopératives doivent faire face à deux enjeux: concilier la croissance économique et la préservation de l'environnement d'une part, et d'autre part concilier compétitivité et équité sociale. C'est dans cette optique que s'inscrit l'objectif de notre article, il s'agit d'étudier le rôle des coopératives dans le développement durable des territoires en répondant à la problématique suivante : De quelle manière les coopératives marocaines contribuent-elles concrètement au développement durable des territoires? Pour ce faire, nous avons adopté une méthode qualitative exploratoire basée sur des entretiens semi-directifs conduits auprès des responsables des coopératives dans la région Souss-Massa. Pour analyser les discours des interviewés, nous avons opté pour le logiciel d'analyse qualitative Nvivo 10. Les résultats d'analyse présentés confirment que l'intégration des objectifs de développement durable adoptés par les Nations Unies, est un déterminant fondamental dans l'implication des coopératives dans le développement durable des territoires. En outre, il a été ressorti des entretiens semi-directifs menés, une confirmation que l'implication des

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coopératives dans le développement durable contribue significativement au développement territorial.

Mots-clés: Développement territorial, Coopératives, Développement durable

The involvement of cooperatives in territorial development via sustainable development: Case of the Souss-Massa region, Morocco

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Abstract

In a constantly changing world, cooperatives represent the appropriate economic model to meet the new social expectations of a population marginalized by capitalism, particularly in emerging countries. Among these expectations are sustainable development and its economic, social and environmental aspects. Furthermore, cooperatives must face two challenges: reconciling economic growth and environmental preservation on the one hand, and on the other hand reconciling competitiveness and social equity. It is in this perspective that the objective of our article falls, it is to study the role of cooperatives in the sustainable development of territories by responding to the following problem: How do Moroccan cooperatives concretely contribute to the sustainable development of territories? To do this, we adopted an exploratory qualitative method based on semi-structured interviews conducted with cooperative managers in the Souss- Massa region. To analyze the speeches of the interviewees, we opted for the qualitative analysis software Nvivo 10. The analysis results presented confirm that the integration of the sustainable development objectives adopted by the United Nations is a fundamental determinant in the involvement of cooperatives in the sustainable development of territories. In addition, the semi-structured interviews carried out confirmed that the involvement of cooperatives in sustainable development contributes significantly to territorial development.

Keywords: Territorial development, Cooperatives, Sustainable development

Introduction

En réponse à la théorie néolibérale qui met l'économie mondiale au centre d'un système qui entraîne une concurrence accrue et un besoin de

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compétitivité accru entre les territoires, des alternatives émergent et suggèrent de mettre l'accent sur les intérêts collectifs, de privilégier l'humain et l'emploi plutôt que le capital, d'adopter une économie de proximité, basée sur la valorisation des initiatives citoyennes, ainsi que sur la coopération et le dialogue entre les acteurs économiques locaux afin d'améliorer la gouvernance locale (Allard, F. 2013). Il est essentiel que tous les acteurs collaborent afin de favoriser le développement durable des territoires (Carbonnel, A., & Philippe-Dussine, M. P. 2013).

Au lieu de mettre l'accent sur une rentabilité immédiate et maximale du capital investi, les coopératives ont toujours essayé de satisfaire les besoins de leurs membres et de planifier leur activité dans le temps grâce aux réserves. Elles ne peuvent en effet ni être cessées, ni être opérées, et leurs réserves sont inpartageables (Cariou, Y., et al. 2006). Leur initiative est parfaitement en accord avec une vision de développement durable et responsable des territoires.

Le Maroc, tout comme de nombreux pays en développement, est confronté aux répercussions de la mondialisation. Il était conscient des problèmes sociaux et des changements qui impactaient divers secteurs d'activités, ce qui les rendait vulnérables. Les autorités marocaines sont conscientes de ces enjeux et ont mis en place des actions pour renforcer et améliorer les secteurs qui ont été touchés par la concurrence, tout en mobilisant l'action sociale pour combattre la précarité et la pauvreté. Le réseau de l'économie sociale, qui a été établi grâce à l'Initiative Nationale du Développement Humain, a été initié par Sa Majesté le Roi Mohammed VI le 18 Mai 2005. La coopérative joue un rôle essentiel dans le développement durable des territoires. Son but est de fournir un soutien à ses membres et d'améliorer leur situation sociale et économique tout en préservant l'environnement. Cet article vise à évaluer la contribution des coopératives au développement durable des territoires.

L'implication des coopératives dans le développement durable des territoires est un sujet d'actualité important. Les coopératives peuvent jouer un rôle crucial dans la réalisation des objectifs de développement durable, tels que la lutte contre la pauvreté, la protection de l'environnement et la promotion de l'inclusion sociale. Dans ce contexte, il convient d'examiner le rôle des coopératives dans le développement territorial via le développement durable. Dès lors, notre étude aura pour objectif de répondre à la question suivante : De quelle manière les coopératives marocaines contribuent-elles concrètement au développement durable des territoires ?

Pour répondre à cette problématique de recherche, nous avons opté pour une démarche méthodologique de type qualitative. Celle-ci s'est appuyée sur une une revue de littérature approfondie ainsi que sur la réalisation

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d'entretiens semi-directifs conduits auprès des responsables de 3 coopératives dans la région Souss-Massa.

Notre revue de littérature a mis en évidence les déterminants majeurs de l'implication des coopératives dans le développement territorial durable. Par ailleurs, la réalisation d'entretiens semi-directifs a permis d'appréhender en détail la manière dont ces organisations contribuent au développement territorial via le levier du développement durable.

Revue de littérature

Cette première partie se concentrera sur la définition des concepts théoriques essentiels liés au développement territorial, à la coopérative, et au développement durable.

Développement territorial

Le développement territorial est un champ de recherche pluridisciplinaire qui s'intéresse aux dynamiques économiques, sociales et environnementales qui contribuent au développement des territoires. Il s'agit d'un concept en constante évolution, qui s'adapte aux nouveaux enjeux et défis auxquels sont confrontés les territoires. Il est indéniable que ce concept demeure complexe à comprendre par des définitions, nous cherchons à analyser la littérature. Donc, commençons à subdiviser « le développement territorial » par « le développement » et « le territoire ». Le concept de « développement » a connu son essor depuis les années 1970. Le développement est souvent considéré comme un processus de transformation et d'évolution à long terme. Par ailleurs, le « territoire » peut être approprié à un concours d'acteurs ancrés dans un espace géographique délimité, qui vise à identifier puis essaie de résoudre un problème jugé partagé par ces acteurs (Landel, P. A, & Senil, N.2009).

Cependant, il y a eu des études qui ont analysé le concept de développement territorial d'une vision de « compétitivité », et d'autres de « durabilité ». D'après Baudelle, G., et al. (2011), le développement territorial est une démarche ambitieuse qui vise à renforcer la compétitivité des territoires en impliquant les acteurs dans le cadre d'actions concertées, souvent transversales et avec une grande portée spatiale. Or, pour Peemans, J. P. (2008), ce concept est considéré comme étant un processus de construction et de gestion durable d'un territoire implique que la population établisse, grâce à un accord sociopolitique et à la création d'un cadre institutionnel adapté au contexte, sa relation avec la nature et son mode de vie, renforce les liens sociaux, améliore son bien-être et établit une identité culturelle qui repose sur la construction de ce territoire. Ce dernier est considéré selon (Sack, 1986, cité par Torre, A. 2015) principalement comme étant une référence, plutôt que des frontières marquées, à des relations structurées, à des groupes ou à des

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populations spécifiques qui se reconnaissent dans des projets communs. Le développement territorial peut alors se définir par l'articulation entre des projets, des actions collectives, et des coordinations entre des acteurs (Maillefert, M., & Robert, I. 2020).

En résumé, le développement territorial est une initiative volontaire d'acteurs liés à un espace géographique défini pour l'aborder. Il s'agit d'une initiative locale par rapport à une perspective globale. En effet, le territoire est le lieu idéal pour les stratégies de développement durable. C'est également à ce stade qu'il est nécessaire de concevoir et mettre en œuvre des solutions fondées sur l'équité et la démocratie.

Développement durable

Le développement durable est un concept aux multiples facettes qui a fait l'objet de nombreuses recherches et publications au cours des dernières décennies. Ce concept est apparu dans les années 1980, en réponse aux préoccupations croissantes concernant l'impact des activités humaines sur l'environnement et les générations futures. Selon Bocquet, A et al. (2010), la définition la plus communément admise est celle du rapport Brundtland (1987), qui le définit comme un « *développement qui répond aux besoins du présent sans compromettre la capacité des générations futures à répondre aux leurs* » (Gendron, C., & Revéret, J. P. 2000). Il y en a deux concepts qui font partie intégrante de cette notion : le concept des besoins, en particulier des besoins essentiels des plus démunis, qui méritent la plus grande attention, et le concept des limitations que nos techniques et notre organisation sociale imposent à la capacité de l'environnement à satisfaire les besoins actuels et futurs. En outre, Deisting, F., & Paumard, P. (2012) affirment que la définition qualitative du rapport Brundtland repose sur quatre piliers, à savoir : la prudence environnementale, l'équité sociale, l'efficacité économique, et la gouvernance.

Par ailleurs, selon Godard, O. (2003), le développement durable repose sur trois piliers interdépendants défendus lors du deuxième sommet de la Terre à Rio de Janeiro en 1992 : le pilier environnemental qui vise à préserver les ressources naturelles et les écosystèmes pour les générations futures, le pilier économique qui vise à garantir un développement économique équitable et prospère pour tous, et le pilier social qui vise à promouvoir la justice sociale et l'inclusion de tous. Purvis, B et al., (2019) stipule que les trois piliers interdépendants sur lesquels le concept de durabilité est basé (environnemental, social et économique) sont interconnectés. L'objectif est de concilier ces trois éléments afin d'assurer que nos actions actuelles ne mettent pas en péril la capacité des générations futures à satisfaire leurs besoins. Selon Jovovic, R et al. (2017), l'interaction entre les trois piliers nécessite la mise en place de mesures pour équilibrer l'importance et les effets de ces trois piliers

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afin de garantir la durabilité. Des piliers supplémentaires peuvent être inclus, tels que des facteurs institutionnels, culturels et techniques (Purvis, B et al., 2019). Néanmoins, le développement durable est confronté à de nombreux défis, la raison pour laquelle les Nations Unies ont procédé en 2015 à l'adoption du programme de développement durable à l'horizon 2030, qui comprend 17 objectifs de développement durable (ODD) et 169 objectifs spécifiques.

A l'image de ce qui précède, le concept du développement durable est complexe et comprend différentes théories et approches qui cherchent à trouver un juste équilibre entre le développement économique, la préservation de l'environnement et le bien-être social, afin de satisfaire les besoins des générations actuelles sans compromettre ceux des générations à venir.

Coopératives

Les coopératives, grâce à leurs valeurs de démocratie, d'entraide, de responsabilité, d'égalité, d'équité et de solidarité, jouent un rôle de plus en plus crucial dans le développement économique et social du pays. D'autant plus qu'au Maroc, les coopératives ont un rôle principal dans l'économie sociale et solidaire, et constitue l'un de ses piliers (Rhazzane, S., et al. 2023). Les coopératives constituent un mode d'organisation unique, qui trouve ses origines dans la révolution industrielle, la paupérisation et la quête d'un équilibre des richesses au sein d'une société socialement perturbatrice, dans le sillage du mouvement associationiste du XIXe siècle (Ferraton, 2007; repris par Saïsset, L. 2016).

Selon Tchami, G. (2004), la coopérative est une association autonome de personnes qui se rassemblent volontairement afin de répondre à leurs aspirations et besoins économiques, sociaux et culturels communs grâce à une entreprise dont la propriété est partagée et où le pouvoir est exercé de manière démocratique. Ce dernier concept a été introduit sur la définition de l'Alliance Coopérative Internationale (ACI) qui a définit la coopérative comme étant : « *une association autonome de personnes unies volontairement pour répondre à leurs besoins et aspirations économiques, sociaux et culturels communs par le biais d'une entreprise détenue conjointement et contrôlée démocratiquement.* ». Ce contrôle démocratique par les membres, en plus du lien avec le territoire et la démarche collective, désigne l'un des principes sur lesquels les coopératives opèrent. Ainsi, les caractéristiques d'une bonne gouvernance que sont la transparence, la responsabilité, l'obligation, la participation, la réactivité aux besoins des gens et le respect de l'état de droit, sont aussi des traits de l'identité coopérative. Les pratiques de bonne gouvernance demeurent cruciales pour la réussite de ces organisations (Rhazzane, S., & Lahfidi, A. 2021).

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Pour synthétiser, les coopératives jouent un rôle crucial dans le développement endogène en mobilisant les ressources locales pour un projet qui répond aux besoins du territoire. En plus de la dimension environnementale, la satisfaction des besoins économiques et sociaux fait des coopératives de véritables partenaires pour un développement durable des territoires.

L'implication des coopératives marocaines dans le développement durable des territoires

Aperçu sur le secteur coopératif marocain

Les coopératives sont des entreprises dont les membres sont aussi les détenteurs. Dans le contexte marocain, le secteur coopératif a connu une croissance significative au cours des dernières décennies, ce qui a conduit à la mise en place d'un nouveau modèle socio-économique qui combine à la fois l'efficacité économique et l'aspect social pour combattre la pauvreté, le chômage et l'exclusion sociale.

Le secteur coopératif marocain a récemment prouvé sa capacité à jouer un rôle essentiel en tant que membre clé de l'économie sociale et solidaire au Maroc et en tant qu'acteur majeur de l'économie nationale. Sa contribution est essentielle au progrès social et économique du pays, notamment dans les secteurs de l'agriculture, de l'artisanat et de l'habitat. En 2020, selon les statistiques de l'office du développement de la Coopération, le Maroc comptait 40 531 coopératives réparties comme suit : 66,4% dans l'agriculture, 14,2% dans l'artisanat, 9,2% dans l'habitat, 10,2% dans les autres secteurs.

En 2005, l'initiative nationale du développement humain (INDH) et l'appui de l'Office de Développement de la Coopération (ODCO) ont renforcé le secteur coopératif au Maroc. Le programme « MOURAFAKA » et le programme national de constitution de coopératives agricoles « nouvelle génération » (PNCCA -NG-) ont été mis en place pour soutenir la mise en œuvre de la nouvelle stratégie agricole « Génération Green 2020-2030 ». Effectivement, l'État marocain soutient le développement du secteur coopératif en mettant en œuvre divers programmes et stratégies visant à le stimuler, tels que la stratégie nationale de développement durable (SNDD). Ainsi, ces programmes ont joué un rôle dans la concrétisation des objectifs de développement durable, dans la promotion de l'inclusion sociale et territoriale et dans le développement de l'économie sociale et solidaire.

Pourtant, malgré les différents défis auquel le secteur coopératif marocain est confronté, il reste un secteur dynamique et en pleine expansion. Il a un fort potentiel de développement. Il joue un rôle important dans la création d'emplois et de richesse, la réduction de la pauvreté et le développement durable du Maroc.

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La stratégie nationale de développement durable : Une solution pour renforcer la gouvernance du développement durable des territoires

Selon l'impulsion éclairée de Sa Majesté Le Roi Mohammed VI, le Royaume du Maroc s'est engagé à faire du développement durable un véritable projet de société et un nouveau modèle de développement pour faire face aux défis du XXIème siècle. Cet engagement s'est déjà manifesté en 1992, lorsque Sa Majesté, alors encore prince héritier, présentait lors du Sommet de Rio sa « Vision des fondamentaux pour la construction d'un nouveau modèle de société ».

La Stratégie Nationale du Développement Durable 2016-2030 (SNDD) a été élaborée dans cette perspective. Son objectif est de guider les politiques publiques, de coordonner les actions des divers acteurs et de mobiliser les ressources requises pour atteindre les objectifs de développement durable. Selon le diagnostic, la majorité des politiques intègrent des aspects de durabilité, mais leur mise en œuvre demeure limitée. Les atouts du Maroc pour garantir cette mise en œuvre sont indéniables, comme en témoignent notamment sa politique énergétique, son expertise en gestion de l'eau et sa politique sociale soutenue par l'Initiative Nationale de Développement Humain. Cependant, il est nécessaire de généraliser l'approche durable en agissant simultanément sur plusieurs chantiers.

La vision suggérée est le fruit d'un diagnostic approfondi et repose sur l'intégration des quatre piliers essentiels du développement durable, à savoir l'économie, le social, l'environnement et la culture.

- **Le pilier économique :**

Une réelle économie de l'environnement est possible à travers la mise en œuvre d'une économie circulaire, ou encore de l'industrialisation verte. De plus, la mise en place d'une économie circulaire ou de l'industrialisation verte peut contribuer à une véritable économie de l'environnement.

- **Le pilier social :**

Afin d'éviter une aggravation des inégalités, il est important que chacun puisse bénéficier d'une éducation gratuite de qualité. Il est donc essentiel de mettre en pratique la lutte contre la pauvreté et le principe de solidarité (notamment territoriale). Il est envisageable d'adopter une redistribution plus juste, en tenant compte de la notion de Paiement pour les Services Eco systémiques.

- **Le pilier environnemental :**

Cette stratégie vise à renforcer la prise en compte des atteintes environnementales dans les politiques publiques pour découpler croissance économique de la pression sur les ressources, mais également à créer des emplois verts durables dans les métiers liés à l'environnement.

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- **Le pilier culturel :**

Il est possible de définir une stratégie en se basant sur les particularités du Maroc. Cette stratégie a veillé à opérationnaliser ce pilier par l'intégration de l'artisanat comme composante de l'économie verte et la promotion et la valorisation de la culture.

La Stratégie Nationale du Développement Durable (SNDD 2016 – 2030) est un chantier en cours et sa mise en œuvre nécessite la mobilisation de tous les acteurs du développement durable au Maroc.

Méthodes

Nature de l'étude et outil de collecte de données

Dans notre phase empirique, afin d'analyser l'environnement interne des coopératives et de bien comprendre le lien de causalité entre les coopératives et le développement territorial durable, nous utilisons une approche qualitative exploratoire basée sur des études de cas auprès de trois coopératives. Cette étude a été axée sur des entretiens semi-directifs conduits auprès des responsables au sein des coopératives en se basant sur un guide d'entretien préparé au préalable sur la base d'une revue de la littérature sur le sujet de recherche. Cette méthode a été choisie en raison de la nature des données que nous avons souhaité collecter.

En effet, toute recherche dans le domaine de la gestion requiert l'utilisation d'une méthodologie qui permet de la mener de manière méthodique et structurée, car la méthodologie définit la façon dont nous allons analyser, découvrir et décrypter un phénomène (Rispal, M. 2002). Selon Thiétart, R.A. (2014), l'étude de cas peut être définie comme une étude empirique qui nous permet d'analyser un phénomène actuel dans un contexte réel en étudiant les phénomènes dans le temps.

Dans cette optique, nous avons opté pour l'étude de cas afin d'offrir une analyse approfondie des phénomènes dans leur contexte, et d'assurer une validité interne élevée, c'est-à-dire que les phénomènes sont des représentations valables de la réalité étudiée. Miles et Huberman (2003) expliquent que c'est une méthode qui repose sur des données qualitatives présentées en mots plutôt qu'en chiffres.

Échantillon de l'étude

Afin d'atteindre cet objectif, nous avons sélectionné trois coopératives qui œuvrent dans le domaine de l'arganier. Ce dernier est considéré comme la deuxième essence forestière du pays (Charrouf, Z., 2007). Dans la région Souss-Massa, ces trois coopératives sont réputées pour leur histoire de création et leur succès récent. Leur nombre de membres varie de 7 à plus de 100. Cette région est en train de développer son nouveau plan de développement régional et souhaite élaborer sa stratégie en se basant sur cinq

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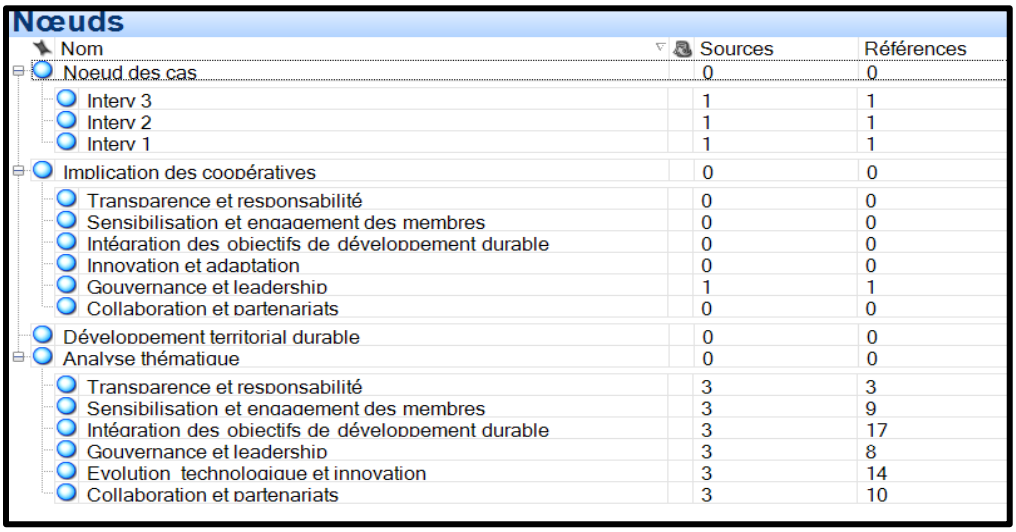
piliers : le social, l'économique, l'écologique, le culturel et l'agriculture. Afin de préserver l'anonymat, comme les coopératives l'ont demandé, nous ne révèlerons pas leur identité. En outre, afin d'étudier les résultats, il n'est pas nécessaire de connaître l'identité des coopératives en question.

Résultats

Notre recherche s'inscrit dans une approche méthodologique basée sur l'analyse des discours collectés auprès des décideurs interviewés. Afin d'accomplir cela, nous avons utilisé le logiciel d'analyse qualitative Nvivo 10, qui repose sur un processus de "décontextualisation-recontextualisation" du corpus (Tesch, 1990 ; Descheneaux, 2007).

Pour présenter ces résultats, nous avons fait appel aux sorties du logiciel Nvivo 10.

Figure 1 : Les nœuds Nvivo



Nœuds

Nom	Sources	Références
Noeud des cas	0	0
Interv 3	1	1
Interv 2	1	1
Interv 1	1	1
Implication des coopératives	0	0
Transparence et responsabilité	0	0
Sensibilisation et engagement des membres	0	0
Intégration des objectifs de développement durable	0	0
Innovation et adaptation	0	0
Gouvernance et leadership	1	1
Collaboration et partenariats	0	0
Développement territorial durable	0	0
Analyse thématique	0	0
Transparence et responsabilité	3	3
Sensibilisation et engagement des membres	3	9
Intégration des objectifs de développement durable	3	17
Gouvernance et leadership	3	8
Evolution technologique et innovation	3	14
Collaboration et partenariats	3	10

Source : élaboré sur la base de notre analyse

Nuage des mots

L'étude des résumés met en évidence surtout quels sont les mots les plus courants et les plus répétés. Cela témoigne de l'importance des mots-clés dans chaque texte. Dans notre analyse, le terme « développement » est le plus utilisés (Figure 2).

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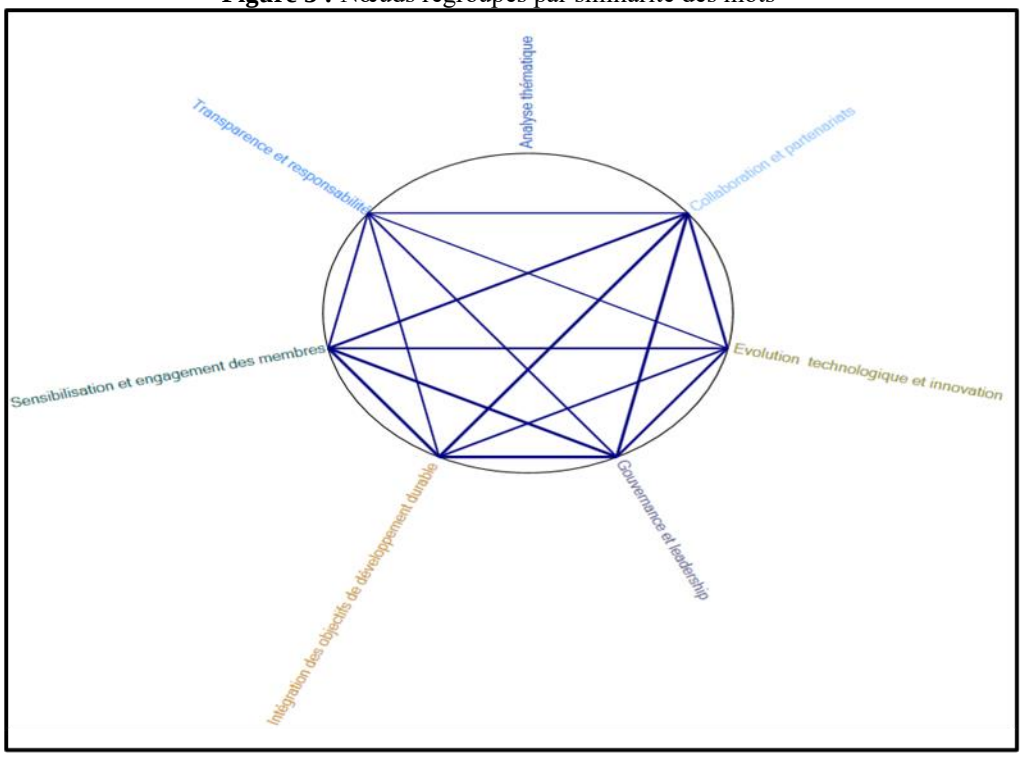
Figure 2 : Nuages de fréquence des mots

Source : élaboré sur la base de notre analyse

Les mots qui sont les plus proches du terme « développement » (Figure 2) sont ceux qui sont dans les résumés des références à côté de ce terme, tels que : territorial, économique, local, durable . Ensuite, les termes écrits en grands caractères sont plus souvent répétés que les autres.

Nœuds regroupés par similarité des mots

Figure 3 : Nœuds regroupés par similarité des mots



Source : élaboré sur la base de notre analyse

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L'implication des coopératives dans le développement durable des territoires peut être influencée par divers déterminants tels que l'intégration des objectifs de développement, la transparence et la responsabilité, la gouvernance et le leadership, la collaboration et les partenariats, la sensibilisation et l'engagement des membres, ainsi que l'évolution technologique et innovation. Nous pouvons résumer que ces variables représentent le moteur essentiel au développement durable des territoires.

Croisement matriciel des nœuds avec les sources

L'analyse des données selon les requêtes de croisement matriciel sur le logiciel Nvivo nous permet de classifier les résultats selon six variables bien distinctes.

Le tableau suivant synthétise le résultat de l'analyse globale des données. Les chiffres figurant dans la colonne des interviewés sont issus de la somme des références d'encodage liées à chaque critère de sélection.

En additionnant les références d'encodage figurant dans chaque colonne, nous obtenons des totaux généraux qui vont nous permettre de calculer les moyennes à attribuer à chaque critère d'implication. Le classement des critères est alors obtenu en fonction de la moyenne attribuée.

Tableau 1 : Résultat de requête de croisement matriciel

	Interv 1	**Interv 2**	**Interv 3**	**Total**	**Moyenne**	**Classement**
A.Transparence et responsabilité	1	1	1	3	1	6 éme
B.Sensibilisation et engagement des membres	4	2	3	9	3	4 éme
C.Intégration des objectifs de développement durable	7	5	5	17	5,66	1er
D.Gouvernance et leadership	5	2	1	8	2,66	5 éme
E. Évolution technologique et innovation	5	4	5	14	4,66	2 éme
F.Collaboration et partenariats	3	4	3	10	3,33	3 éme

Source : Élaboré par nos soins

D'après ce tableau, nous pouvons déduire la hiérarchisation des critères subjectifs de l'implication des coopératives. Par conséquent, d'après ce que nous a renseigné la pratique, l'intégration des objectifs de développement durable se trouve en première position. Alors que la transparence et responsabilité ne sont pas significatifs.

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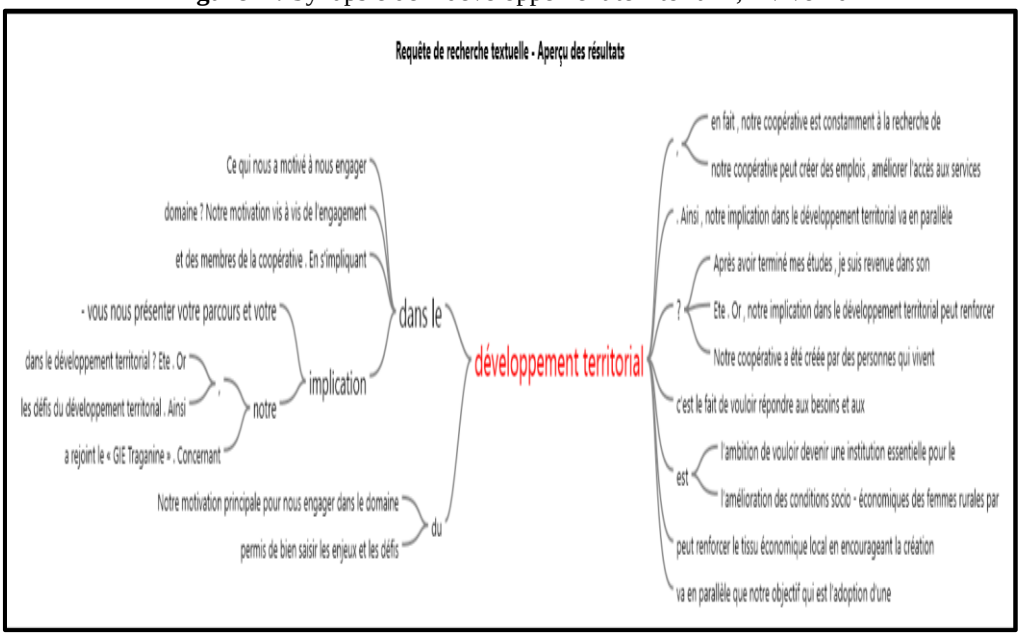
Les Associations et liens entre les mots exprimés par les interviewés

Figure 4 : Synapsie de « développement territorial », Nvivo 10



Source : élaboré sur la base de notre analyse

L'analyse de cette synapsie révèle les liens entre les termes utilisés par les interviewés, soulignant ainsi comment les déterminants de l'implication des coopératives dans le développement durable contribue-elle au développement territorial. Nous avons obtenu des résultats qui confirment les propos des auteurs (Brodhag, C. 2000 ; Theys, J. 2002 ; Berard, L & al., 2004 ; Tekelioglu,Y & al., 2009) qui ont mis en évidence l'importance de l'approche territoriale du développement durable et son impact économique, social et environnemental.

Discussion

Synthèse de l'analyse des résultats de l'étude qualitative

Les résultats d'analyse présentés précédemment démontrent un ordre de priorité. L'ensemble de nos interviewés confirment que l'intégration des objectifs de développement est un déterminant fondamental dans l'implication des coopératives dans le développement durable des territoires. Il est primordial que les coopératives jouent un rôle essentiel dans la mise en œuvre des Objectifs de Développement Durable (ODD), comme l'affirme (Fontaine, G. 2018), notamment en favorisant la lutte contre la pauvreté, la création d'emplois, la sécurité alimentaire et la préservation de l'environnement. Les coopératives pourront attirer des investissements et des partenariats en

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alignant leurs stratégies avec les objectifs de développement durable (ODD), ce qui renforcera leur influence sur le développement territorial.

L'évolution technologique et l'innovation, qui apparait après l'intégration des objectifs de développement, ont le potentiel de jouer un rôle crucial dans la promotion du développement durable et du développement territorial. Les territoires et les communautés ont la possibilité de construire un avenir plus durable et plus prospère en investissant dans les technologies vertes et en utilisant de manière créative les technologies numériques, dans l'objectif de faire face aux défis du développement durable, tels que la lutte contre le changement climatique, la pauvreté, le chômage et les disparités.
Tandis que nos interviewés confirment que la collaboration avec les coopératives et les partenariats avec les acteurs locaux sont essentielle pour renforcer leurs capacités, partager les bonnes pratiques et mutualiser les ressources, ce déterminant n'arrive qu'en troisième position.

Selon les résultats de l'analyse, la sensibilisation et l'engagement des membres peuvent également influencer l'implication des coopératives dans le développement territorial durable, mais cela n'arrive qu'en quatrième place dans le classement. Cela s'explique par le fait que sensibiliser les membres des coopératives à leurs droits et à leurs responsabilités, et de les impliquer activement dans la gouvernance et la gestion de leur organisation nécessite du temps.

Également, les coopératives sont un modèle de développement économique et social durable qui repose sur des principes de gouvernance solides et transparents, et de leadership. Ce dernier est un des facteurs clés selon les propos de (Chouinard, O., et al, 2010). En encourageant une participation équitable, une gestion responsable des ressources et la création de valeur commune, les coopératives jouent un rôle dans l'amélioration de la qualité de vie des membres et la promotion d'un développement territorial durable qui bénéficie à tous. D'après notre analyse, le déterminant de transparence et responsabilité n'est pas significatif, tandis que les coopératives doivent être transparentes dans leurs activités et rendre compte à leurs membres et aux autres parties prenantes.

En définitive, l'implication des coopératives dans le développement durable des territoires repose sur une combinaison de facteurs clés, comme cité ci-dessus. En prenant en compte ces déterminants, les coopératives peuvent jouer un rôle crucial dans la construction d'un avenir plus durable et plus prospère pour les communautés.

Conclusion

Les coopératives représentent une alternative économique qui cherche à générer de la valeur économique, sociale et environnementale, tout en encourageant l'inclusion et la participation de tous les acteurs. Le

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développement territorial durable, de son côté, a pour objectif d'améliorer de manière durable les conditions de vie et les opportunités d'une région ou d'un territoire. Ainsi, les coopératives sont étroitement liées au développement territorial durable.

Grâce à notre analyse conceptuelle et théorique de la question étudiée, nous avons pu développer un cadre théorique qui regroupe les concepts essentiels de notre problématique. De la même manière, lors de l'analyse qualitative effectuée auprès des 3 coopératives, nous avons utilisé l'outil du guide d'entretien, dont les questions principales ont été tirées de notre cadre conceptuel. Décidément, le guide a mis l'accent sur trois piliers fondamentaux du développement durable des territoires, à savoir : le volet économique, le volet social et le volet environnemental.

Nous pouvons conclure que les résultats de notre étude montrent d'un côté le degré d'implication des coopératives dans des initiatives de développement durable. D'un autre côté, cette implication a joué un rôle important dans l'impact des coopératives sur le développement territorial durable. En outre, il a été ressorti des trois entretiens semi- directifs menés, une confirmation que l'implication des coopératives dans le développement durable contribue significativement au développement territorial.

Ce travail de recherche n'est pas exempt de limites. La principale limite concerne la taille de l'échantillon, en fait, le nombre limité d'entretiens semi-directifs peut restreindre la généralisation des résultats et la compréhension de la variété des expériences et des perspectives. Il aurait été intéressant de mener une étude quantitative avec un échantillon plus important de coopératives pour confirmer et étendre les résultats de l'étude qualitative. Ainsi, la nature qualitative de la recherche peut limiter la capacité à établir des causalités et à généraliser les résultats à d'autres contextes. Il aurait été intéressant d'adopter une approche mixte, c'est-à-dire combiner des méthodes de recherche qualitatives et quantitatives pour obtenir une compréhension plus complète du phénomène à l'étude.

Conflit d'intérêts : Les auteurs n'ont signalé aucun conflit d'intérêts.

Disponibilité des données : Toutes les données sont incluses dans le contenu de l'article.

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Études humaines: Les approbations appropriées ont été obtenues auprès du comité d'examen institutionnel compétent et les directives éthiques ont été suivies.

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Contribution des pratiques agroécologiques au développement des exploitations familiales dans la Commune de Notto Diobass au Sénégal

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Résumé

L'agriculture sénégalaise influencée par les pratiques conventionnelles est dominée par des exploitations de types familiales à 95% (DAPS, 2009). Ses pratiques ont eu des impacts négatifs sur l'environnement, l'appauvrissement des sols, la raréfaction des ressources naturelles, la déforestation et l'effondrement de la biodiversité. Pour jouer pleinement son rôle, elle doit nécessairement opérer à des ruptures transformationnelles vers une transition agroécologique avec des systèmes de cultures plus durables et diversifiés. C'est pourquoi cette étude faite dans le cadre de la mise en œuvre du projet de promotion et de développement de l'agroécologie (PDAE) s'intéresse aux contributions des pratiques agroécologiques au développement des exploitations familiales. L'objectif visé à travers cette étude est d'étudier la contribution des pratiques agroécologiques au développement des exploitations familiales. Pour se faire deux groupes ont été ciblés : les exploitations familiales (EFs) accompagnées par le projet PDAE (47) et celles non accompagnées (47). Au total 94 EFs ont été enquêtées dans 08 villages de la commune pour avoir des données quantitatives. Les données qualitatives sont obtenues à travers des entretiens semi-structurés auprès de quelques

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structures d'accompagnement et de spécialistes qui interviennent dans la zone. L'étude a montré globalement que les accompagnements proposés sont adaptés aux types d'EFs de la zone et la mise en application des pratiques agroécologiques permettait effectivement aux EAF d'améliorer le niveau de fertilité des sols et de l'accès aux intrants, de développer les compétences technico-pratiques des producteurs, d'augmenter les rendements agricoles, de faciliter l'accès aux marchés porteurs et de renforcer l'autonomie financière des ménages.

Mots-clés: Agroécologie ; exploitation familiale ; agriculture conventionnelle ; Pratiques et transition agroécologique

Contribution of agroecological practices to the development of family farms in the Commune of Notto Diobass, Senegal

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Abstract

Senegalese agriculture influenced by conventional practices is dominated by 95% family farms (DAPS, 2009). Its practices have had negative impacts on the environment, soil depletion, scarcity of natural resources, deforestation, and the collapse of biodiversity. To fully play its role, it must necessarily operate transformational ruptures towards an agroecological transition with more sustainable and diversified crop systems. This is why this study carried out as part of the implementation of the PDAE project focuses on the contributions of agroecological practices to the development of family farms. The objective of this study is to study the contribution of agroecological practices to the development of family farms. To do this, two groups were targeted: family farms (EFs) supported by the PDAE project (47) and those not supported (47). A total of 94 EFs were surveyed in 08 villages of the commune to obtain quantitative data. Qualitative data are obtained through semi-structured interviews with some support structures and specialists who operate in the area. The study showed overall that the support offered is adapted to the types of EFs in the area and the implementation of agroecological practices effectively allowed the EAF to improve the level of soil fertility and access to inputs, develop the technical

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and practical skills of producers, increase agricultural yields, facilitate access to promising markets and strengthen the financial autonomy of households.

Keywords: Agroecology; family farming; conventional agriculture; agroecological practices and transition

Introduction

L'agriculture sénégalaise est en dominance conventionnelle avec l'utilisation des engrais de synthèse pour augmenter les rendements et les produits phytosanitaires (pesticides) pour le traitement des maladies et la lutte contre les ravageurs des cultures. Cette méthode de production, qui, pendant longtemps faisait le bonheur des acteurs du monde agricole, notamment les EFs à travers ses résultats sur les principales cultures vivrières (mil, mais, riz…), et de rentes (arachides, légumes, coton…), a perdu peu à peu son efficacité et a eu comme conséquences directes l'effondrement continu des performances des unités de production familiales (baisse des rendements agronomiques, faible productivité agricole, insuffisance des revenus des ménages agricoles, etc..), depuis maintenant plus de trois décennies. Aujourd'hui, le véritable mal identifié des EFs sénégalaises demeure la perte prononcée de la fertilité de ses terres. Des études réalisées par le CILSS en Novembre 2010, indiquent que sur les 3 805 000 ha de terres arables dont dispose le pays, 2 400 000 ha sont fortement dégradées (soit 63%). Et selon (FAO 2015), cette dégradation est due principalement aux effets conjugués de facteurs dont principalement :

- L'utilisation continue et abusive des intrants de synthèses qui a entrainé un appauvrissement progressif des sols en matière organique (minéralisation puis exportation par les facteurs érosifs, volatilisation, dénitrification, élimination de la faune souterraine etc..),
- Certaines pratiques culturales endogènes (monoculture, culture sur brulis, déboisements massifs à la recherche de nouvelles terres de cultures et de bois à usages domestiques).
- La baisse et l'instabilité des pluviosités annuelles (depuis trois décennies) consécutive au recul des boisements naturels et des effets des changements climatiques (20 000 ha de forêts perdues par an.

Par conséquent, les effets de ces mauvaises pratiques agricoles endogènes et des changements climatiques sont devenus une source d'inquiétude majeure pour l'agriculture sénégalaise en général et pour les EFS en particulier. Fort de ce constat, et depuis le début des années 80, les politiques nationales, la société civile et les acteurs se sont orientés vers un système intégré de production agricole qui tienne compte à la fois de la productivité, de la qualité des productions, de la préservation de

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l'environnement et des facteurs de production. Cette mode de production qui a fait ses débuts au Sénégal au sein des exploitations familiales est généralement désignée par les expressions "agriculture saine et durable" (ASD), "agriculture écologique", ou encore "agroécologie". Cette étude va tenter de répondre à la question suivante : ***« Les pratiques agroécologiques contribuent-t-elles au développement des exploitations familiales dans le système agricole sénégalais ? »***. Ainsi, pour cette étude nous nous pencherons d'abord dans la première partie sur le cadre théorique, ensuite sur le cadre analytique et en fin sur le bilan argumentaire dans la troisième partie.

Objectifs de la recherche

Objectif général :

L'objectif général de notre recherche est d'étudier la contribution de la pratique de l'agroécologie au développement des exploitations familiales dans la Commune de Notto Diobass.

Objectifs spécifiques :

Il s'agira de :

OS1 : Caractériser les exploitations familiales de la commune de Notto Diobass avant l'intervention du PDAE ;

OS2 : Etudier les accompagnements promus par le PDAE et faire l'état des lieux des exploitations familiales de la commune de Notto Diobass à la fin du projet ;

OS3 : Analyser les effets de ces accompagnements au développement des exploitations familiales dans la commune de Notto Diobass.

Methodologie

La démarche méthodologique adoptée dans le cadre de cette étude consiste, en premier lieu, de faire la revue documentaire sur le sujet de l'étude ; en second lieu, de procéder à l'échantillonnage des acteurs ; en troisième lieu, d'élaborer des outils de collecte adaptés ; en quatrième lieu, d'organiser et de faire la collecte des données de terrain ; et en cinquième lieu, de faire l'analyse et interprétation des données collectées.

Présentation du cadre de l'étude :

Notre cadre d'étude porte sur l'agriculture et plus spécifiquement sur l'évolution des exploitations familiales dans la commune de Notto Diobass. Dans cette zone, l'agriculture conventionnelle avec utilisation d'engrais a pris le dessus sur le système traditionnel qui s'appuyait sur des techniques qui permettaient une bonne productivité en assurant le maintien de la fertilité des sols sans même parfois recourir à de longues jachères (Ndiaye, 1997). Cela a eu comme effets la dégradation des sols, la destruction de façon accélérée de

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l'environnement et des ressources naturelles et la baisse des rendements au niveau des exploitations familiales. Plusieurs alternatives sont proposées aux agriculteurs pour renforcer la performance des exploitations familiales ; parmi lesquelles le développement des pratiques de l'agroécologie dans les exploitations familiales promues par la synergie des acteurs de l'ONG BD à travers le PDAE.

Présentation de la commune de Notto Diobass :

Situation géographique :

La commune de Notto (ou Notto Diobass) est située au centre de la région de Thiès, dans le département du même nom. Elle fait partie de l'arrondissement de Notto et couvre une superficie de 252,10 km². Elle est approximativement à et 12 km de Thiès, chef lieux de région, et à environ 80 km de Dakar, en passant par Thiès. Elle est limitée à l'est par la commune de Thiénéba ; au sud-ouest par la commune de Diass ; au nord par la commune de Fandène et au sud par la commune de Tassette.

Données socioéconomiques :

- **Population :** La population de la commune de Notto est estimée à 45 515 habitants (22 740 hommes ; 22 776 femmes) inégalement répartie dans 67 terroirs villageois avec une densité moyenne de 177 habitants/km². La diversité ethnique et culturelle de la localité est riche et variée : Sérères, Ouolofs, Toucouleurs, Bambaras, Peuhls …etc. On note une large prédominance de l'ethnie Sérère (58,80 %), suivi du wolofs (30, 94%), toucouleur (6%), bambara (2%), (ANSD-2016).
- **Agriculture :**L'agriculture est une des principales activités économiques de la commune de Notto. Elle a une vocation vivrière et maraichère. Elle adopte en grande partie les pratiques de l'agriculture conventionnelle. Ses systèmes de production sont fortement influencés par les caractéristiques du milieu naturel. Celui-ci est de plus en plus marqué par une crise écologique qui se répercute inévitablement sur la performance des activités productives. A l'image de la région de Thiès, la production agricole de Notto est dominée par les exploitations de type familial. Les principales spéculations sont le mil, l'arachide, le niébé, et la pastèque en plateau ; le manioc et l'arboriculture sont associés au maraichage dans les bas-fonds. Dans la zone, le mil occupe la première place parmi les spéculations vivrières produites, suivi de l'arachide et du niébé. Malgré une nette amélioration de la production durant ces deux dernières années, elle reste encore faible et n'arrivent toujours pas à assurer la sécurité alimentaire de la population. Le maraichage quant à lui, bien que limité par un accès à l'eau productive faible, constitue une source de revenus assez intéressant pour les

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exploitations familiales qui le pratiquent. Le développement du secteur agricole de la commune est tributaire de l'évolution des systèmes de production qui fait face aux contraintes écologiques engendrées par les changements climatiques et la dégradation des ressources naturelles. A cela s'ajoute la dégradation des techniques de production. En effet, depuis les indépendances, les techniques de production ont peu évolué et reposent sur l'utilisation d'instruments traditionnels (hilaires, coupe-coupe…) ; l'utilisation des intrants chimiques à la place de l'assolement et de la jachère qui sont devenus de plus en plus difficile face à la pression foncière.

Présentation de la synergie des acteurs autour de l'ONG BD :

BD est une ONG belge d'appui au développement qui intervient dans 14 pays d'Afrique et d'Amérique du sud. Elle travaille en partenariat avec les associations et ONG locales.

Présente au Sénégal depuis plus de 30 ans, elle a mené de nombreux projets avec la synergie des acteurs locaux constituée de sept associations et ONGs locales que sont : **ADT-GERT, APAF, 3AP, SYMBIOSE, GRAIF, JED, FONGS, YEESAL AGRI HUB**.

Lors de son précédent programme quinquennal 2016-2021, la synergie BD avait comme objectif spécifique « Les exploitations familiales des régions de Thiès, Fatick, Diourbel, Kaffrine et Kaolack contribuent avec les autorités locales à la mise en place d'un système alimentaire durable, résilient et équitable, ainsi qu'à une gestion et une réhabilitation durables de leur environnement où les femmes et les jeunes reçoivent la reconnaissance sociale, politique et économique ».

Données et sources d'échantillonnage

Nous avons fait les enquêtes dans les 07 villages de la commune de Notto où le PDAE a intervenu entre 2017 et 2021. Des enquêtes de référence ont été effectuées dans ces villages cibles avant le démarrage du projet. Elles nous ont permis de recenser 133 EFs. En 2017, le PDAE a choisi de travailler avec 47 EFs parmi les 133 que totalise la zone d'intervention. Les 86 EFs restantes ne bénéficient pas de l'accompagnement. Ainsi, pour une meilleure représentativité, et vue les tailles des deux catégories d'exploitations, nous avons choisi de mener notre étude sur l'ensemble des exploitations familiales accompagnées par le projet entre 2019 et 2021(47) et un nombre égal d'exploitations familiales non accompagnées par le projet (47). Pour choisir les EFs non accompagnées, nous avons procédé par un tirage aléatoire sur la liste de l'ensemble des EFs non accompagnées. Ainsi nous auront un total de 94 EFs à enquêter soit un pourcentage de représentativité de 70, 68% par

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rapport à la population totale. Le tableau numéro 01 ci-dessous récapitule l'ensemble des données liées à l'échantillonnage :

Tableau 01 : Récapitulatif de la cible

Villages	EF recensées	EF Accompagnées	EF Non accompagnées	Échantillon EF accompagnées	Echantillon EF non Accompagnées	Total échantillon
Tawa FALL	16	06	10	06	06	12
Tatène Mbambara	21	08	12	08	08	16
Mbodjène	16	03	13	03	03	06
Ndioukhane	19	06	12	06	06	12
Pout Diack	23	08	15	08	08	16
Mbousnakh	16	07	6	07	07	14
Hanène	22	09	18	09	09	18
TOTAL	133	47	86	47	47	94
Taux (%)	**100**	**35,34%**	**64,67%**	**35,34%**	**35,34%**	**70,68%**

Source : Nos enquêtes novembre 2023

Outils de collecte :

Ils ont été élaborés à travers Sphinx, un logiciel qui nous a permis en même temps de faire le traitement des données collectées. Deux outils ont été produits: le questionnaire et le guide d'entretien.

Le questionnaire :

Deux types de questionnaires ont été élaborés :

Pour les EFs accompagnées, le questionnaire est subdivisé en trois grandes parties. Une première partie d'identification de l'enquêté qui concerne les données personnelles. Une deuxième partie sur l'inventaire des actions menées par le PDAE au niveau des EFs : les types et les modalités de l'accompagnement. Et enfin une troisième partie qui revient sur les caractéristiques actuelles des EFs afin de ressortir les effets de l'accompagnement du PDAE au niveau des EFs : adaptabilité de l'accompagnement, ses effets sur les pratiques culturales, les rendements agricoles et le développement des EFs.

Pour les EFs non accompagnées par le PDAE, le questionnaire se limite à deux (2) grande parties : une première partie sur l'identification de l'enquêté et une deuxième partie sur la caractérisation actuelle des EFs non accompagnées par le PDAE.

Le guide d'entretien :

IL est destiné aux personnels et responsables des ONGs membres de la synergie BD qui sont impliqués dans le projet, aux responsables des services techniques de l'agriculture, de l'environnement de l'arrondissement de Notto

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et quelques spécialistes du domaine intervenant dans la zone, pour un total de 15 cibles. Ce guide d'entretien a permis de recueillir des données qualitatives qui viendront renforcer celles des questionnaires.

Collecte des données de terrain

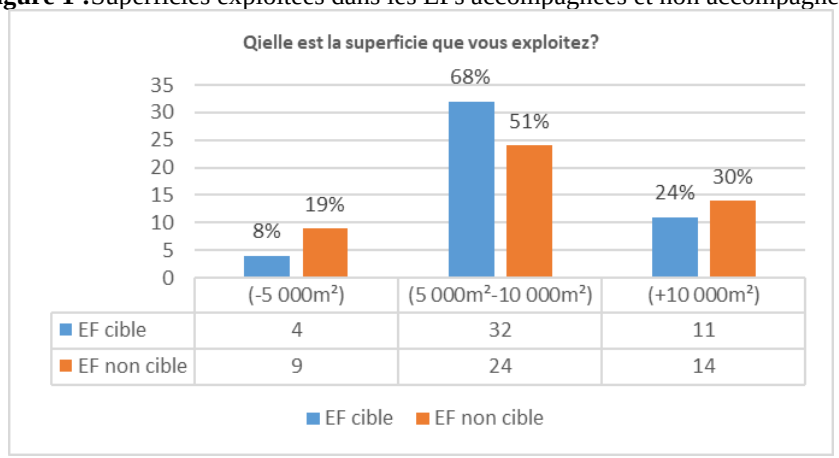
Elle est faite à travers des entretiens directs avec les responsables des EFs ou en focus groupe avec quelques membres clés des EFs ciblées. Après élaboration des questionnaires, nous les avons testés sur 10 cibles (5 EFs accompagnées et 5 autres EFs non accompagnées) pour mesurer la pertinence des questions et le timing nécessaire pour chaque enquête afin d'en apporter les correctifs nécessaires. A l'issu de cela nous avons lancé la collecte de terrain. Pour se faire, nous avons mobilisé un groupe de 5 enquêteurs constitués de relais communautaires des organisations membre de la synergie. Quant à la collecte d'informations auprès des personnes ressources, nous nous sommes déplacés nous-mêmes vers leurs structures respectives pour recueillir leurs avis.

L'ensemble de ces données ont ensuite été traitées, analysées et interprétées par recoupement grâce au logiciel sphinx et au tableur Excel.

Analyse comparative des caractéristiques des exploitations familiales de la commune de Notto à la fin du PDAE :

Superficies exploitées

Figure 1 : Superficies exploitées dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

L'analyse comparative des superficies exploitées entre les EFs accompagnées et celles non accompagnées montre une légère différence (figure 1). En effet, pour 47 EFS accompagnées, 32 ont des superficies comprises entre 5 000m² et 10 000m² soit 68% en valeur relative. Celles non accompagnées enregistrent 24 EFs (51%) pour les mêmes superficies. Pour

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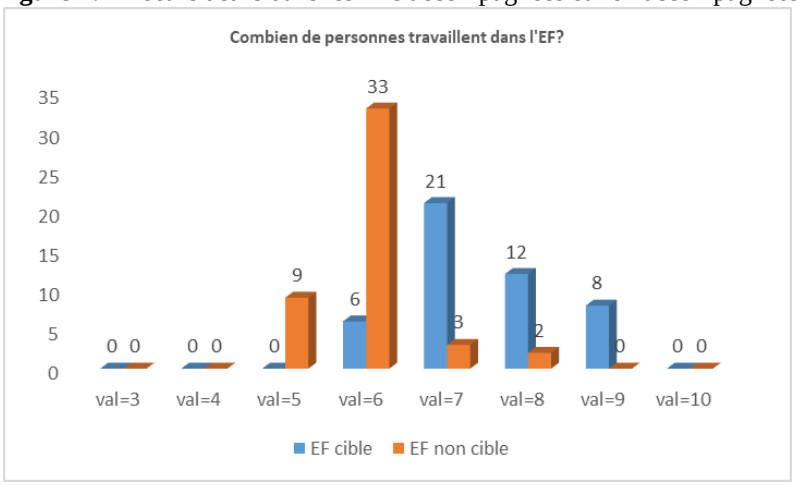
les superficies de plus de 10 000m², les EFs accompagnées sont au nombre 11, soit 24% de l'échantillon et celles non accompagnées 14 (30%). L'interprétation de ces données montre que les superficies exploitées des EFs de la commune de Notto sont en moyenne entre 5 000m² et 10 000m² et que l'accompagnement du PDAE n'a pas eu d'effets sur la taille des EFS.

Effectifs actifs :

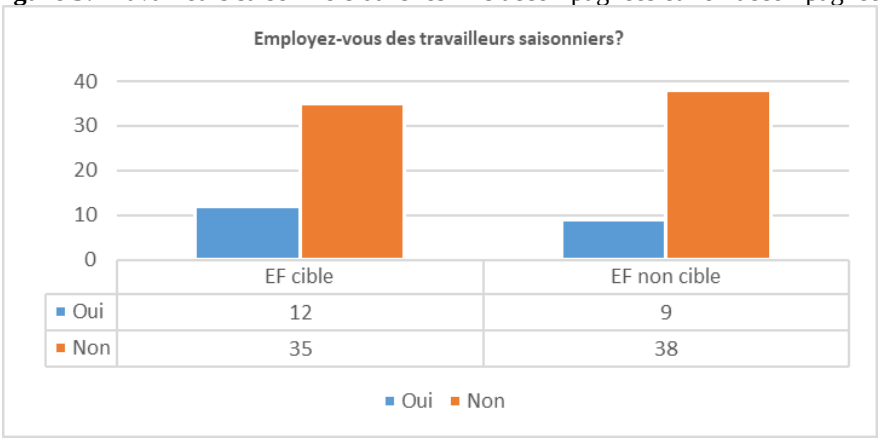
Figure 2: Effectifs actifs dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

Le graphique 2 montre que la majeure partie des EFs non accompagnées ont des effectifs de moins de 7 personnes (42/47), alors que la quasi-totalité des EFs accompagnées ont des effectifs supérieurs ou égaux à 7 personnes (41/47). L'interprétation de ces résultats met en lien l'accompagnement du PDAE à l'augmentation des effectifs des EFs accompagnées pour faire face au volume d'activités et soutenir leur développement.

Figure 3: Travailleurs saisonniers dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

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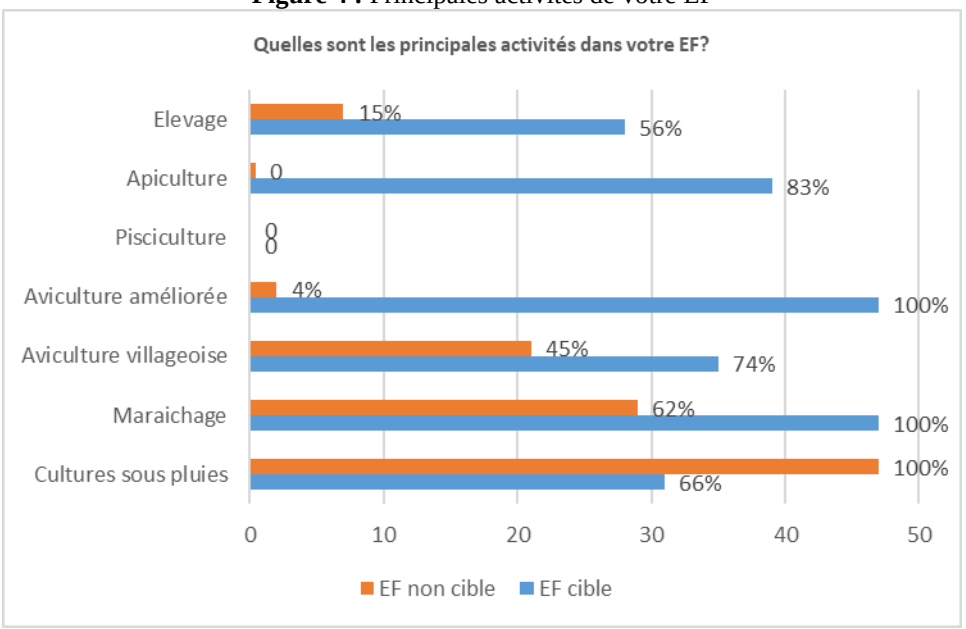
Sur la figure ci-dessus, les données de l'enquête montrent que les EFs de l'échantillon emploient peu de travailleurs saisonniers dans leurs effectifs. La tendance est presque la même au niveau de toutes les EFs enquêtées. Ce qui nous amène à retenir que l'emploi de travailleur saisonnier ne s'est pas bien développé au sein des EFs de la commune de Notto et que l'accompagnement du PDAE n'y a pas apporté de changement.

Activités principales des EFS

Figure 4 : Principales activités de votre EF



Source : Nos enquêtes novembre 2023

Au niveau des activités principales, nous constatons l'élargissement des activités anciennes et le développement de nouvelles au sein des EFs accompagnées. Les EF non accompagnées quant à elles, sont restées sur leurs activités anciennes avec peu d'innovation. Ainsi, nous pouvons lire sur la figure 4 que, mis à part les cultures sous pluies, peu d'EF non accompagnées diversifient leurs activités : 62% font du maraichage, 45% de l'aviculture améliorée, 15% de l'élevage. Pendant que, les EFs accompagnées font toutes le maraichage, et l'aviculture améliorée, 83% d'entre elles font de l'apiculture et 56% de l'élevage. L'analyse comparative de ces informations montre que l'accompagnement du PDAE a participé à la diversification des activités au sein des EFS dans sa zone d'intervention.

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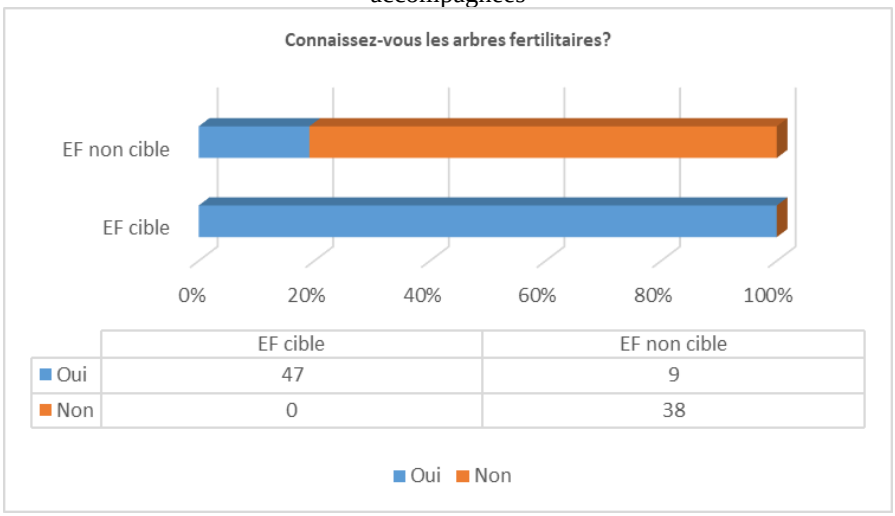
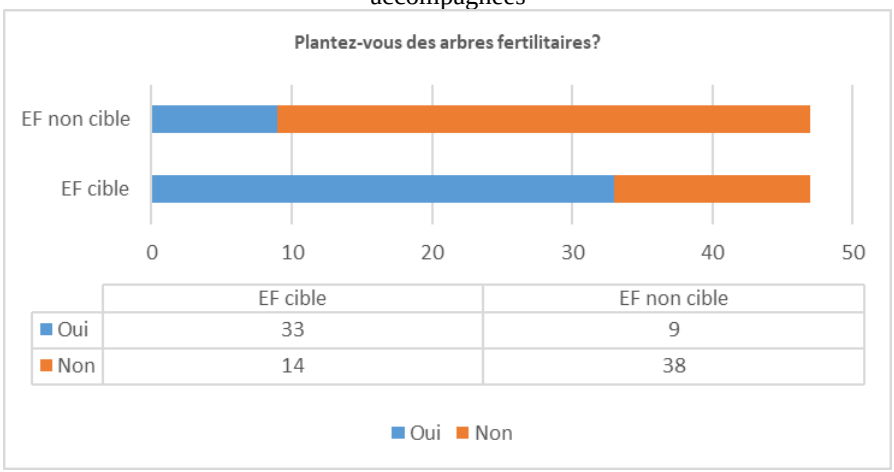
Connaissance et utilisation des arbres fertilitaires :

Figure 5 : Connaissance des arbres fertilitaires dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

Figure 6 : Plantation des arbres fertilitaires dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

Les arbres fertilitaires sont connus par 9 EFs non accompagnées pendant que 38 les ignorent. Par contre la totalité des EFs accompagnées déclarent les connaitre (figure 30). Le nombre d'EFs non accompagnées qui plantent ces arbres est de 9 EFs (soit 19%), alors que du côté des EFs accompagnées 33 les plantent (soit 70%). L'interprétation de ces résultats démontre que les arbres fertilitaires sont plus utilisés par les EFs accompagnées par le PDAE, ceci peut en partie être lié au niveau de fertilité de leurs sols.

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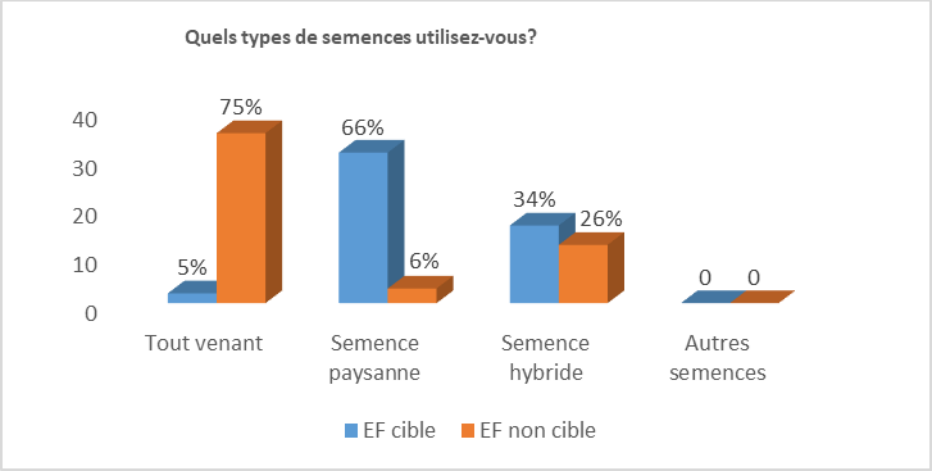
Types de semences utilisées :

Figure 7 : Types de semences utilisées dans les EFs accompagnées et non accompagnées

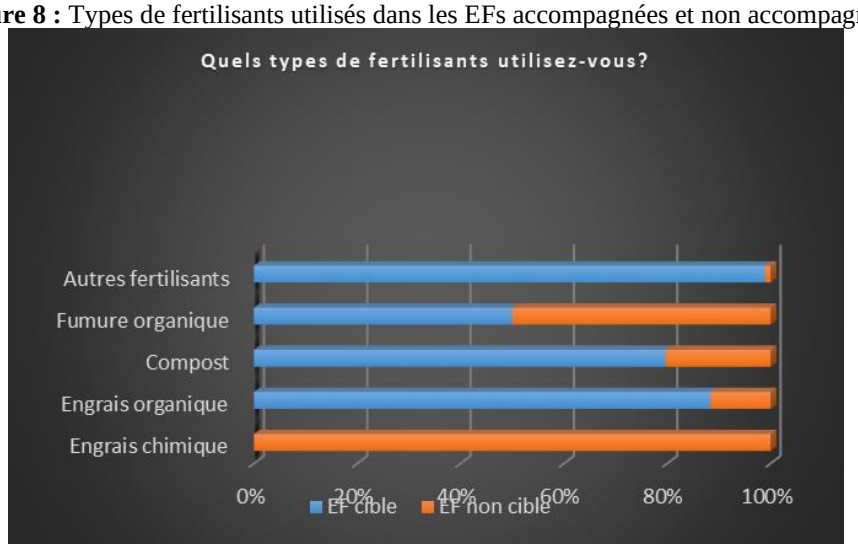


Source : Nos enquêtes novembre 2023

Les types de semences utilisées par les EFs non accompagnées sont dominées à 75% par les « tout venant » alors que pour les EFs accompagnées ce sont les semences paysannes qui dominent à 66%. Les semences hybrides sont utilisées respectivement à 26% et 34%. L'interprétation de ces données permet de mettre en relation l'accompagnement du PDAE à l'utilisation des semences paysannes plus adaptées dans la zone et plus maitrisées par les producteurs. Ce qui aura des effets sur leur niveau d'accès aux semences.

Types de fertilisants utilisés :

Figure 8 : Types de fertilisants utilisés dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023
NB : Autres fertilisants cités : Thé de compost, inoculum, Bocashi.

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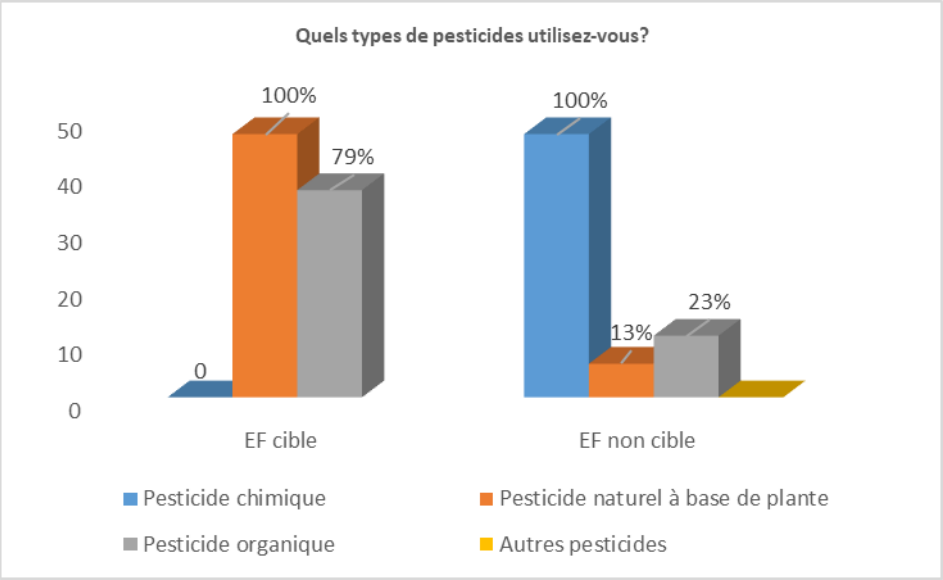
Les types de fertilisants utilisés sont essentiellement d'origines chimiques pour les EFs non accompagnées (100%) et d'origines organiques et naturelles pour EFs accompagnées : 89% d'engrais organique et 78% de compost. L'interprétation des données met en lien d'une part l'utilisation des engrais chimiques avec le bas niveau de fertilités des sols dans les EFs non accompagnées et d'autre part celle des engrais organiques et naturelles au bon niveau de fertilité des sols dans EFs accompagnées. Chemin faisant on en retient que l'accompagnement du PDAE a développé l'utilisation des engrais organiques au sein dans les EFs de la zone d'intervention.

Types de pesticides utilisés :

Figure 9: Types de pesticides utilisés dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

Les informations obtenues à travers la figure 34 montrent que les EFS non accompagnées utilisent à 100% des pesticides chimiques et à 23% les pesticides organiques pour protéger leurs cultures. Les EFs accompagnées quant à elles portent leurs choix à 100% sur les pesticides naturels à base de plante et à 79% sur les pesticides organiques. L'interprétation de ces résultats nous amène à dire que l'avènement du PDAE a permis une large utilisation des pesticides non chimiques par les EFs accompagnées . Ces types de pesticides ont moins d'effets négatifs sur la santé des producteurs et des consommateurs mais aussi sur l'équilibre biologique et sur l'environnement.

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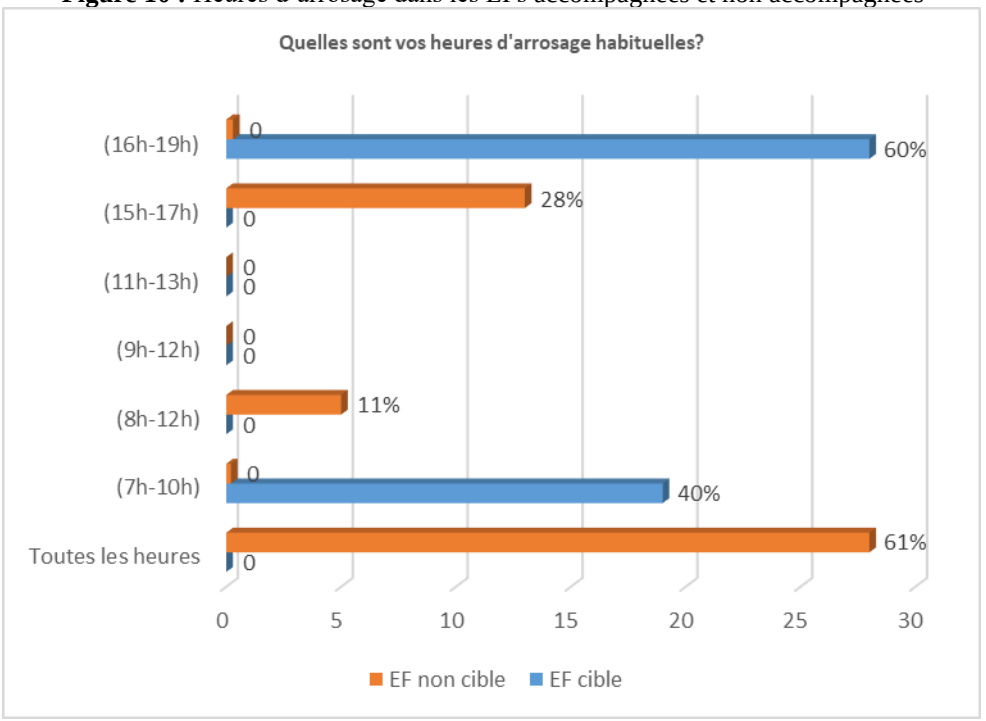
Heures d'arrosage habituelles :

Figure 10 : Heures d'arrosage dans les EFs accompagnées et non accompagnées



Source : Nos enquêtes novembre 2023

Les informations recueillies sur la figure 35 montrent que la majeure partie des EFs non accompagnées n'ont pas de plages horaires préférées pour l'arrosage de leurs cultures (61% arrosent toutes les heures). Les EFS accompagnées quant à elles ont deux plages horaires bien définis pour arroser leurs plants : 40% ont porté leurs choix entre 7h et 10H et le reste 60% entre 16H et 19H. Si on considère les conditions climatiques de la zone et les connaissances scientifiques agronomiques, les deux derniers créneaux horaires constituent les meilleurs moments pour arroser les cultures. Ils vont non seulement contribuer à l'économie de l'eau de production, mais également favoriser l'absorption de l'eau par les plantes et in fine optimiser les rendements des cultures.

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L'analyse comparative des EFS accompagnées par le PDAE et celles non accompagnées met en évidence les caractéristiques ci-dessous :

- Pas de différence entre les superficies des différents types d'EFS : superficies moyennes entre 5 000m² et 10 000m² ;
- Les effectifs sont légèrement supérieurs dans les EFS accompagnées : ≥7 en moyenne ;
- L'emploi saisonnier ne s'est pas développé, aussi bien dans les EFS accompagnées que non ;
- Les EFS accompagnées ont des activités principales plus diversifiées avec l'introduction de nouvelles activités peu connues par les EFS de la zone : l'apiculture et l'aviculture améliorée;
- Pour renforcer la fertilité de leurs espaces de culture, les EFs accompagnées connaissent mieux et plantent plus d'arbres fertilitaires que celles non accompagnées ;
- Les EFs accompagnées utilisent dans leur majorité des semences paysannes plus aptes aux conditions climatiques et dont les producteurs maitrisent le mieux la traçabilité ; alors que les EFs non accompagnées utilisent en général des « semences tout venant » non maitrisées et peu productives ;
- Les fertilisants et pesticides chimiques font l'essentiel des traitements chez les EFs non accompagnées alors que celles accompagnées par le PDAE utilisent plutôt des fertilisants et pesticides organiques et à base de plante ;
- Les EFs non accompagnées n'accordent aucune importance aux choix des heures d'arrosage alors que celles accompagnées préfèrent arroser tôt le matin et tard le soir.

Recommandations

A l'issu de notre étude sur la contribution des pratiques agroécologiques au développement des exploitations familiales dans la commune de Notto, quelques recommandations peuvent être suggérées à l'endroit des différents acteurs du système agricole sénégalais. Il s'agit entre autres :

Pour l'Etat ;

- De recentrer le model d'agriculture sénégalais sur les exploitations familiales car elles peuvent constituer les principales pourvoyeuses de denrées alimentaires pour nourrir durablement les populations ;
- D'autoriser la production et la commercialisation des semences paysannes afin de libérer les exploitations familiales des emprises des firmes semencières occidentales;

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- ❖ De soutenir la transition agroécologique par la recherche développement participative avec l'ensemble des acteurs ;
- ❖ De soutenir les initiatives communautaires et/ou privées en faveur de la promotion de l'agroécologie au sein des exploitations familiales ;
- ❖ De développer des marchés de produits agroécologiques dans toutes les localités pour renforcer la sécurité alimentaire des populations car « Nourrir les gens » ne se limite pas à produire suffisamment mais à s'assurer que la nourriture est disponible et accessible à tous.
- ❖ **Pour les projets et autres acteurs;**
  - D'adapter les mécanismes et les accompagnements à la transition agroécologique en fonction des zones écologiques et des spécificités des exploitations familiales;
  - D'intensifier le plaidoyer auprès des autorités locales et nationales pour des facilitations à l'accès des exploitations familiales aux facteurs de productions (terre, eau et intrants agroécologiques) ;
  - De diffuser les pratiques agroécologiques dans toutes les exploitations familiales au niveau national pour développer leur résilience face aux changements climatiques ;
  - De renforcer les capacités de production des exploitations familiales pour booster les rendements et la production.
  - De renforcer la sensibilisation et la communication sur l'agroécologie à l'endroit des producteurs individuels, des exploitations familiales, des services techniques, des autorités locales et des consommateurs.
- ❖ **Pour les EFs :**
  - De développer des alternatives de substitution aux intrants chimiques ;
  - De produire, de sélectionner et d'utiliser les semences paysannes pour développer leur autonomie par rapport aux producteurs de semences sélectionnées

Conclusion

Influencée depuis très longtemps par le modèle industriel de la « révolution verte » le système agricole sénégalais fait face aujourd'hui à la hantise de la dégradation massive et continue de ses écosystèmes et de l'abandon progressif de sa population active au profit d'autres activités.

L'agriculture sénégalaise étant majoritairement (95%) le fait des exploitations familiales, toute réforme d'envergure les concerne au premier chef. Dans cette logique, notre étude s'est intéressée à la contribution de l'agroécologie au développement technique, économique et social des exploitations familiales dans la commune de Notto Diobass à travers la mise

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en œuvre du projet de promotion et de développement de l'agroécologie (PDAE). Nos recherches ce sont intéressées aux caractéristiques des EFs de la zone d'intervention avant l'intervention du projet, à l'analyse de ses interventions et à leurs effets sur le développement des exploitations familiales. Les résultats de nos enquêtes, confirment quasiment les hypothèses exprimées au début de notre étude.

- Certes les exploitations familiales de la commune de Notto Diobass sont caractérisées par de petites superficies, de faibles revenus et des pratiques culturales basées sur l'agriculture conventionnelle. L'étude sur les caractéristiques montre des évolutions significatives au niveau des EFs accompagnées par le PDAE, notamment en ce qui concerne les pratiques culturales qui s'adaptent de plus en plus au contexte actuel des changements climatiques.
- Cette étude a mis en exergue les effets positifs des pratiques agroécologiques au développement des exploitations familiales dans la commune de Notto Diobass. Les effets positifs recensés sont liés d'abord à l'amélioration du niveau de fertilité des sols et de l'accès aux intrants ; mais aussi de l'amélioration des compétences technico-pratiques**,** de l'augmentation des rendements agricoles et de l'accès aux marchés porteurs ; et ensuite de l'augmentation des revenus et de l'autonomisation financière des ménages agricoles.
- Mais aussi, les résultats de nos enquêtes confirment que les pratiques agroécologiques promues sont adaptées aux types d'exploitations familiales de la commune de Notto Diobass car leur ayant permis d'améliorer leurs conditions de production.

En déduction, nous pouvons retenir que la pratique de l'agroécologie peut contribuer de façon significative au développement des exploitations familiales et du système agricole sénégalais. En effet, les informations et statistiques obtenues, montrent que l'adoption des pratiques agroécologiques est un indicateur important d'effectivité de la transition vers une agriculture durable porteuse d'espoirs et plus résiliente face aux changements climatiques. Pour ce faire, l'Etat ne devrait-il pas commencer par allouer jusqu'à 70% de la subvention à l'agriculture vers l'agroécologie ? Et, ne devrait-il pas aussi lever l'interdiction sur la commercialisation des semences paysannes ?

Conflit d'intérêts : Les auteurs n'ont signalé aucun conflit d'intérêts.

Disponibilité des données : Toutes les données sont incluses dans le contenu de l'article.

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Évaluation des filières énergétiques marocaines : Impacts environnementaux et implications pour une transition vers une économie verte

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Résumé

L'objet de notre article est de déterminer la relation qui existe entre le modèle de développement basé sur l'option de l'économie verte, son défi énergétique ainsi que ses impacts environnementaux attribuables aux diverses filières énergétiques marocaines. En utilisant la méthodologie des scénarios et les données collectées auprès des organismes nationaux et internationaux, nous avons comparé les impacts environnementaux de ces filières sur l'ensemble de l'économie marocaine en les classant les unes par rapport aux autres, en mettant l'accent sur des critères tels que les émissions de CO2 et de CH4, la modification de l'écosystème, le changement de paysage et les risques pour la santé et la sécurité. Ensuite, et sur la base de ce classement, nous avons déterminé les répercussions environnementales de ces filières sur la transition énergétique du modèle de développement basé sur l'option de l'économie verte. Nos résultats montrent qu'en plus de présenter le moins d'impacts environnementaux, les filières hydraulique, solaire et éolienne sont plus durables et produisent un flux d'énergie continue et pratiquement inépuisable. Ils suggèrent qu'un mix énergétique équilibré, intégrant ces trois ressources,

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est essentiel pour maximiser les avantages socio-économiques et environnementaux.

Mots-clés: Économie verte, Impacts environnementaux, Transition énergétique, Énergies renouvelables, Filières énergétiques marocaines

Assessing Morocco's Energy Branches: Environmental Impacts and Green Economy Implications

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Abstract

The purpose of our paper is to determine the relationship between the development model based on the green economy option, its energy challenge, and the environmental impacts attributable to the different Moroccan energy branches. Using the scenario methodology and data collected from national and international organizations, we compared the environmental impacts of these sectors on the Moroccan economy as a whole by ranking them against each other, focusing on criteria such as CO2 and CH4 emissions, ecosystem modification, landscape change, and health and safety risks. Based on this ranking, we then determined the environmental impact of these sectors on the energy transition of the development model based on the green economy option. Our results show that hydro, solar, and wind power not only have the lowest environmental impact but are also more sustainable and produce a continuous and virtually inexhaustible flow of energy. The results suggest that a balanced energy mix integrating these three resources is essential to maximise socio-economic and environmental benefits.

Keywords: Green economy, Environmental impacts, Energy transition, Renewable energy, Moroccan energy branches

Introduction

Le concept d'économie verte est né en réponse aux problèmes mondiaux urgents tels que la détérioration de l'environnement et les inégalités socio-économiques (PNUE 2011). Les modèles économiques classiques qui dépendent largement des combustibles fossiles et des pratiques à forte

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intensité de ressources se sont avérés non viables car ils aggravent les crises environnementales sans parvenir à garantir une croissance juste. En outre les partisans de l'écologisme alertent la communauté internationale et les entreprises sur le fait que les ressources naturelles diminuent plus rapidement que prévu (Yuyang, 2024). De plus, à l'horizon 2030, la consommation d'énergie devrait augmenter de 40 % en Europe et de 50 % aux États-Unis tandis qu'elle devrait doubler en Inde et tripler en Chine (Abu Al-Haija, 2021).

Pour répondre à ces défis particuliers, le Programme des Nations unies pour l'environnement (PNUE) a lancé l'initiative pour une économie verte "Towards a Green Economy" en 2008. Cette démarché est devenue un cadre clé pour trouver un équilibre entre la croissance économique et la préservation de l'environnement tout en favorisant l'inclusion sociale. En outre, en 2015, près de 200 nations et régions se sont engagés à promouvoir un environnement plus durable à énergie écologique et à émissions de carbone réduites conformément aux directives de l'Accord de Paris (Murshed et al., 2022). La priorité accordée à l'économie verte, dans son essence la plus simple, s'explique par sa capacité à résoudre des problèmes interdépendants, notamment l'amélioration du bien-être des individus, l'équité sociale et la croissance économique tout en réduisant les effets néfastes sur l'environnement (PNUE, 2011). D'ailleurs, elle porte promesses en ce qui a trait à réduire les émissions de gaz à effet de serre, la création d'emplois verts et la promotion de la résilience face aux risques climatiques (Mikhno et al., 2021). Par conséquent, la transition vers une économie verte est incontournable.

Au cœur de cette transition, le secteur énergétique joue un rôle essentiel en raison de sa contribution significative aux émissions de carbone à l'échelle mondiale et de son rôle crucial dans l'économie. Actuellement, la transition énergétique d'un mix aux combustibles fossiles à un mix à énergies propres s'avère crucial. Toutefois, elle ne se limite pas à l'arrêt progressive des centrales à combustibles fossiles et au développement des énergies renouvelables ; elle représente un véritable changement de paradigme qui impacte l'écosystème dans son ensemble dans l'espoir de réduire les impacts environnementaux tout en favorisant l'innovation, en renforçant la stabilité énergétique et en créant des possibilités de croissance économique durable. (Liu et al., 2022 ; Hao et al., 2021 ; Mohsin et al., 2022).

Situé en Afrique du Nord, le Maroc fait face à une demande croissante d'énergie (Boulakhbar et al., 2020). Cette augmentation de la demande énergétique a également engendré une dépendance croissante envers les sources d'énergie fossiles importées, notamment les produits pétroliers. Le pays importe environ 90% de ses besoins énergétiques (Farhani et al., 2021) et sa production locale d'énergie primaire ne répond qu'à environ 10 % des besoins du pays (IEA, 2019). Selon Nafil & Bouzi (2020), le pays a mis en

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place une stratégie d'investissement de plus de 20 milliards de dollars pour augmenter sa capacité installée de plus de 6 750 MW au cours de cette décennie.

Situé dans l'une des régions arides du monde, le Maroc est particulièrement vulnérable au changement climatique, avec des précipitations très variables et des sécheresses récurrentes ayant des conséquences environnementales, sociales et économiques (Achbah et al., 2024). Afin de réduire sa dépendance aux énergies fossiles et de tirer parti de ses importantes ressources, le Maroc a commencé à investir dans les énergies renouvelables en 2000 et a accéléré, depuis 2009, le déploiement des énergies renouvelables afin d'atteindre 52% du mix énergétique en 2030 (20% d'énergie solaire, 20% d'énergie éolienne et 12% d'énergie hydraulique). Ces objectifs ont été annoncés lors de la réunion COP21 à Paris.

Compte tenu de cette situation fragile, notre travail vise à examiner le paysage énergétique actuel du Maroc et analyser le potentiel d'intégration des ressources renouvelables dans l'économie. Nous évaluerons les différentes filières énergétiques au Maroc, en nous concentrant sur leur impact environnemental et en les classant de la plus durable à la moins durable. Cela nous permettra également d'explorer le potentiel des énergies renouvelables à jouer un rôle significatif dans la transition vers une économie verte et à évaluer les politiques mises en œuvre par le gouvernement marocain à ce jour et comment elles peuvent être améliorées.

Pour ce faire, dans un premier point, nous présenterons une évaluation approfondie des filières énergétiques marocaines au niveau environnemental et de durabilité, mettant en lumière les possibilités d'une intégration accrue des sources d'énergie renouvelable. Ensuite, nous analyserons les politiques mises en place par le gouvernement marocain et nous explorerons les voies d'amélioration possibles. En mettant l'accent sur ces éléments spécifiques de notre étude, nous tenterons de fournir des éléments favorisant la transition du Maroc vers une économie respectueuse de l'environnement tout en participant au débat plus global sur les changements des plans énergétiques durables.

Méthodes et matériels

Bien que le Maroc est dépendant des énergies fossiles importées, il présente un énorme potentiel en termes des énergies renouvelables (principalement l'énergie solaire et éolienne) qui fait de lui l'un des pays les plus ambitieux en termes de promotion du développement durable (Saidi, 2022).

L'approche méthodologique que nous avons choisie dans le cadre de notre travail pour anticiper la transition du modèle de développement actuel du Maroc vers un modèle de développement basé sur l'option de l'économie verte, à travers les défis énergétiques futurs, est celle des scénarios.

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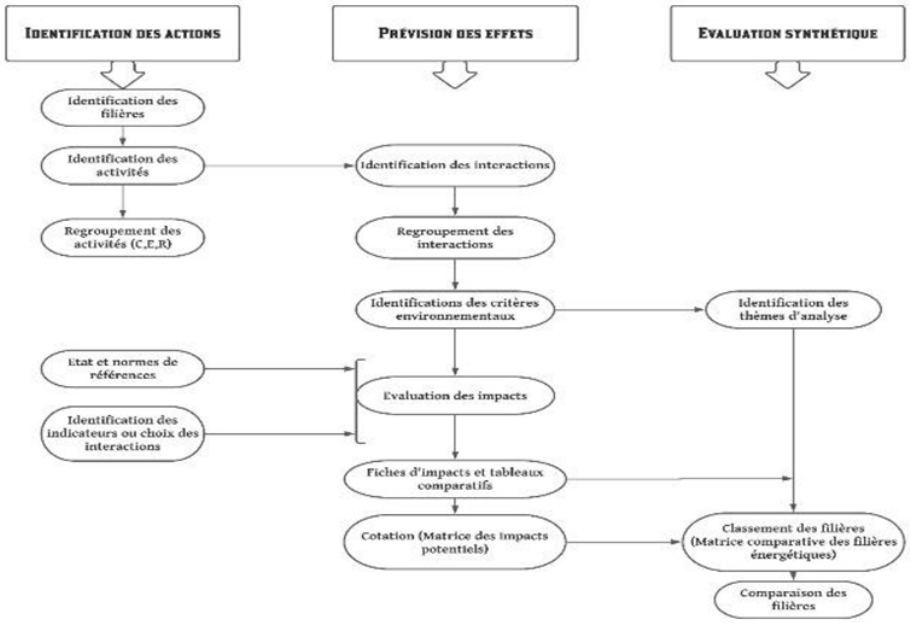
Un scénario est une description riche d'un futur plausible qui permet l'étude par la suite des implications de ce futur plausible. Il ne repose pas sur l'extrapolation, mais sur l'assignation des valeurs extrêmes choisies avec précaution pour leur impact important sur ce que l'on souhaite étudier, il permet, d'une part, d'élargir l'horizon de pensée, et d'autre part de se préparer à agir dans le cas où le scénario deviendrait réalité. Il n'est pas conceptuellement différent d'une prédiction. La seule différence c'est qu'au lieu d'avoir un futur prédit, il y en a plusieurs. Cependant, et contrairement à la prédiction, le concepteur du scénario ne prend pas de position sur ce futur et sa capacité à advenir, il se contente de l'estimer plausible. Un scénario peut également modifier la manière de prendre des décisions par les agents en les éclairant sur l'impact réel à long terme de leurs actions.

L'approche méthodologique adoptée permet de fournir un aperçu global d'évaluation des filières énergétiques les unes par rapport aux autres de même que la détermination des orientations possibles de la gestion de l'énergie dans une perspective de développement durable et donc de l'économie verte (Whitney et al., 1985). Elle permettra également d'évaluer et de comparer les impacts environnementaux des diverses filières en fonction de certain principes qui se dégagent du concept de l'option de l'économie verte (Dalal-Clayton et al., 1991).

La démarche suivie dans le cadre de notre papier se résume en trois phases. Il s'agit de : L'identification des actions faisables et possibles, la prévision des effets de chaque action et l'évaluation synthétique de ces effets.

Figure 1 : Étude d'impacts : les étapes de l'approche d'évaluation environnementale



Source: Raymond et al. (1994).

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L'identification des actions[1] permet de recenser les activités issues de chacune des filières tout au long du processus d'exploitation des ressources impliquées. En procédant ainsi, nous pouvons identifier les interactions entre les filières et évaluer leur impact environnemental.

La synthèse de ces évaluations nous permettra de regrouper les critères environnementaux, sous forme de thèmes, qui vont nous permettre de procéder à une comparaison finale entre les filières énergétiques et d'attribuer à chacune d'elles un rang[2] pour chacun de ces critères.

Avant de présenter ces points, nous tenons à signaler que nos sources de données proviennent dans leurs majorité du :

- Ministère de l'Énergie des Mines et de L'environnement du Maroc;
- L'Agence Internationale de l'Énergie (IEA) ;
- Haut-Commissariat au Plan Marocain (HCP) ;
- Les Données de la Banque Mondiale (World DataBank) ;
- Différents rapports traitant du cas du Maroc.

Identification des filières énergétiques

Les filières énergétiques qui seront considérées sont celles dont les incidences environnementales sont connues ou du moins identifiables et prévisibles. Leurs identifications se feront selon les utilisations possibles d'une même ressource ainsi que des technologies disponibles pour la production d'énergie à partir d'une même ressource. Leur analyse se fera sur la base de leurs caractéristiques techniques. Elles seront regroupées en fonction de leur utilisation de la ressource en respectant les étapes suivantes :

- L'étape de construction. Celle-ci tient compte de toutes les activités nécessaires à la mise en place des installations nécessaires pour l'exploitation d'une filière ;
- L'étape d'exploitation active. Elle prend en compte les activités en lien direct avec la phase de fonctionnement et à l'utilisation de la ressource nécessaire à ce fonctionnement ;
- L'étape du rejet final. Elle est liée aux dispositions qui doivent être prises à la fin du processus, après l'utilisation.

Prévision des effets

Pour identifier les filières énergétiques qui peuvent avoir une interaction avec les éléments environnementaux, nous allons utiliser la matrice de

[1] La détermination de diverses filières énergétiques qui peuvent être considérées comme les choix possibles pour l'établissement d'une politique de gestion des ressources énergétiques.

[2] Le rang obtenu est indiqué à la matrice comparative des diverses filières énergétiques. Les rangs obtenus par les différentes filières pour chacun des critères à l'intérieur d'un thème d'analyse sont ensuite utilisé pour déterminer l'impact relatif de la filière à l'intérieur du thème d'analyse.

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Léopold[3] (Leopold et al. 1971). Celle-ci permettra la comparaison des différentes filières tenant compte des impacts négatifs en fonction des critères retenus[4].

L'évaluation des impacts repose sur un certain arbitraire car elle constitue une transposition subjective d'un effet sur une échelle de valeurs prédéterminée (Simos, 1990 ; Wathern, 1988). Il est donc nécessaire, pour une meilleure compréhension de l'évaluation, de procéder à la définition des normes référentielles et à l'identification du choix d'indicateurs qui pourront quantifier et qualifier les impacts environnementaux avant de procéder à une quelconque cotation sur l'échelle de valeurs.

Tableau 1 : Critères environnementaux et leurs indicateurs d'évaluation

Critères environnementaux	Indicateurs d'évaluation
Qualité de la ressource	Durabilité à long terme du flux d'énergie fourni par une ressource déterminée (épuisable (E), renouvelable (R))
Changement climatique global	Émissions de CO_2 et CH_4
Risque de catastrophe	Probabilités du risque telles que définies par les assureurs
Modification de l'écosystème	Effets produits sur l'environnement par les différentes filières énergétiques
Modification de l'aménagement	Possibilités d'utilisations alternatives du territoire
Modification du paysage	Taille des installations (volume et surface du sol)
Modification du mode de vie	Flexibilité d'implantation des infrastructures (exploitation et extraction de la ressource)
Pollution thermique	Quantités d'eau prélevées pour assurer le fonctionnement des systèmes de refroidissement et les changements de la température locale
Santé et sécurité	Degré de sécurité nécessaire au fonctionnement des installations, fiabilité technique des installations, risques d'accidents liés à chaque filière

Source : Leduc (1992), Boulanger et al. (2015), ADEME (2012), RTE (2020), Banque Mondiale (2013),Raymond et al. (1994) …

L'évaluation des impacts des différents scénarios sur l'environnement doit se faire sur la base d'un référentiel de base. Dans le cadre de notre travail, il s'agit de l'état observé de l'environnement avant l'action entreprise, c'est-à-dire que l'évaluation des différents scénarios doit se faire en fonction de l'importance du changement opéré par chaque activité énergétique. Il est donc

[3] La matrice de Léopold est une méthode d'évaluation qualitative de l'impact environnemental mise au point en 1971. Elle est utilisée pour identifier l'impact potentiel d'un projet sur l'environnement.

[4] Il faut tenir compte des éléments biophysiques et humains dans une perspective d'économie verte et donc de développement durable.

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primordial de choisir des indicateurs qui feront l'objet de l'évaluation, vu la diversité des interactions qui existent entre eux.

Ces critères (tableau 1) ne sont pas tous identiques (même signification ni même importance) au niveau environnemental, de ce fait, leurs conséquences sont également différentes. Ainsi, l'évaluation globale de chacune des filières posera certainement un problème de pondération des critères les uns par rapport aux autres.

Pour notre part, nous avons regroupé les thèmes en quatre catégories et nous avons tenu à ce qu'ils représentent les fondements de l'économie verte et par là du développement durable. Il s'agit :

- Des impacts énergétiques : ils sont liés à la nature de la ressource (critère de durabilité) ;
- Des impacts globaux : ils tiennent compte de l'incidence globale sur la biosphère (changement climatique, couche d'ozone, …) ;
- Des critères affectant le patrimoine mondial (modifications des écosystèmes, l'aménagement, le paysage et le mode de vie de la population) ;
- Des critères ayant un effet précis et qui est limité dans le temps et l'espace (tenir compte des connaissances actuelles sur le sujet).

Cette hiérarchisation des thèmes, et par là des incidences environnementales allant du général vers le particulier, nous permettra de juger les impacts de chacune des filières dès le départ.

Classement et comparaison des filières

Un premier classement est effectué au niveau de chacun des critères environnementaux. À partir des cotes accordées à chacune des filières sur la base des trois stades d'exploitation des ressources, un rang comparatif sera attribué aux différentes filières.

Cette première comparaison permet d'abord d'obtenir un rang qui tient compte de l'ensemble des trois phases d'exploitation de la ressource ainsi que de la différenciation des filières qui, dans la matrice des potentiels, présentaient des cotes de même valeur. Nous nous sommes basés dans une première phase sur les rangs obtenus par filière à partir de la matrice comparative des différentes filières et ensuite sur les côtes obtenues pour différents impacts à partir de le tableau de l'évaluation globale des impacts environnementaux des différentes filières énergétiques et finalement sur les synthèses des différents rapports établis dans ce sens pour le Maroc.

Résultats

Après avoir présenter la méthodologie de notre travail, nous passons à la presentation des résultats de l'analyse comparative des différentes filières

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énergétiques marocaines. Les résultats mettent en évidence le classement des différentes filières et leurs implications pour la transition énergétique du Maroc vers une économie verte.

Pour ce faire, Nous commençons, premièrement, par analyser les impacts globaux, pour ensuite se concentrer sur les impacts particuliers de chaque filière (tableau 2).

Tableau 2 : Viabilité de chaque filière énergétique

Viabilité de la ressource	Ressource	Utilisation ou forme d'exploitation
Ressources non renouvelables (épuisable)	Charbon	Électricité (Centrale thermique)
		Chauffage et métallurgie
	Pétrole	Électricité (Centrale thermique)
		Chauffage et transport
	Gaz naturel	Électricité (Centrale thermique)
		Chauffage et transport
Ressources renouvelables	Biomasse	Électricité (Centrale thermique)
		Chauffage
		Déchets
		Combustible de substitution
	Hydraulique	Centrale avec réservoir
	Solaire	Thermique
		Photovoltaïque
	Éolien	Centralisé
		Décentralisé

Source: Ministère de la transition énergétique et du développement durable du Maroc, (2019)

Les impacts globaux

Changement Climatique

Le système climatique est un système mondial très complexe composé de l'interaction d'un ensemble d'éléments qui lui assure sa stabilité relative dans le temps. Les gaz à effet de serre (GES) comme le dioxyde de carbone (CO_2), le méthane (CH_4), l'ozone (O_3) et l'oxyde nitreux (N_2O) font partie de ces éléments. Ils sont transparents au rayonnement solaire entrant (ondes courtes) mais empêchent le rayonnement infrarouge (ondes longues) de quitter l'atmosphère terrestre (EPA, 2024). Ces gaz emprisonnent le rayonnement du soleil et contribuent ainsi à maintenir la température moyenne de la planète à 15°C; en leur absence cette température moyenne serait plutôt de -18°C (Levi, 1991).

L'évaluation de l'impact pour les filières énergétiques a été effectuée à partir des facteurs d'émissions de CH4 et des facteurs d'émissions de CO2 (*Bilan GES de l'ADEME, méthode dite « saisonnalisée par usage »*).

En 2023, de façon globale, la combustion des ressources énergétiques fossiles a contribué pour environ 90% des émissions de CO_2 dont le charbon est responsable d'environ 42,1% , le pétrole de 33,7% et le gaz naturel pour

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20,4% (Friedlingstein et al., 2024). Les 4% autres restants d'émission de CO_2 sont attribuables à l'utilisation des terres ou de leurs changements d'affectation (UTCATF)[5]. Les émissions en provenance des réservoirs hydrauliques sont relativement faibles en comparaison.

Pour les émissions anthropiques mondiales de méthane (CH_4), en 2022, environ un tiers provient du secteur de l'énergie. Il est responsable de près de 40% des émissions totales de méthane attribuables à l'activité humaine, second à l'agriculture. Le pétrole est responsable d'environ 34% des émissions de CH4 du secteur énergétique, le charbon de 31%, alors que 27% proviennent de fuites du secteur gazier, c'est-à-dire les émissions fugitives (production, transport et distribution). Les 7% qui restent sont attribuables aux bioénergies, principalement de l'utilisation traditionnelle de la biomasse (IEA, 2024).

Le CO_2 est la cause d'environ 65% des émissions totales de GES (IEA, 2024). Le méthane, provenant principalement de l'agriculture et de l'énergie, représente 18% des émissions de GES à cause de son potentiel de réchauffement global élevé, soit 25 à 30 fois de plus que celui du CO_2 durant cent ans, mais qui persiste moins de dix ans dans l'atmosphère (IEA, 2024).

L'impact des filières énergétiques utilisant les énergies fossiles et la biomasse est d'importance majeure à cause de la combustion source des quantités importantes de CO2 et de CH4. Les fuites de l'exploitation pétrolière et celles de l'exploitation gazière sont responsables d'environ 40% des émissions anthropiques des émissions de CH4 dans le monde (IEA, 2024).

La production et l'emploi des combustibles fossiles comptent pour près de 99% de toutes les émissions des émissions de CO2 d'origine anthropique au Maroc (IEA, 2024). Le 1 % restant est attribué à d'autres sources, y compris les processus industriels et les changements d'utilisation des terres (IEA, 2024). L'impact de la filière hydraulique avec réservoir est mineur car ses émissions de CO2, comparativement aux filières à base d'énergie fossile, demeurent très faibles. Pour les autres filières, il n'y a pratiquement pas d'impact significatif en termes d'émission de CO2.

Les filières de production d'électricité, quant à elles, contribuent aux émissions de CO2 de façon variable. Les centrales au charbon occupent la première place suivie de celles à base de pétrole et de gaz naturel.

En comparant les filières les unes par rapport aux autres, nous constatons que, quatre filières n'émettent pas de CO2 et occupent donc le premier rang. Les six derniers rangs sont occupés par les filières du charbon, du bois et du pétrole, étant donné leurs niveaux élevés d'émissions de CO2 et de CH4. Les filières du gaz naturel viennent aux sixième et septièmes rangs vu leurs

[5] Le secteur UTCATF (Utilisation des terres, changement d'affectation des terres et foresterie) permet de rapporter les flux de CO_2 entre différents réservoirs terrestres (biomasse, sols, etc.) et l'atmosphère qui ont lieu sur les surfaces gérées d'un territoire. Il peut ainsi constituer une source nette ou un puits net de CO_2.

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importances d'émissions de méthane et de CO2, qui lui est, nettement inférieures à celles des filières précédentes.

Risque de catastrophe

Les éléments composants ce critère, comme défini par l'IEA (2014) concernent les accidents de l'environnement : accidents nucléaires[6], les ruptures de barrages et les déversements majeurs de pétrole, …. Bien que la structure même des systèmes énergétiques[7] soit à la base de ces risques, la nature de la ressource même et le transport des ressources énergétiques doivent être également évalués.

Les indicateurs retenus sont la fréquence des accidents et l'intensité de leur impact, tels que définis par les compagnies d'assurances œuvrant dans ce domaine (Munich Reinsurance Company, 1990).

Nous remarquons que les centrales conventionnelles (thermique, transport[8] et hydraulique) présentent des niveaux de risques majeurs à cause de la proximité de leurs installations des centres urbains (tableau 3). De ce fait, l'évaluation globale des filières hydrauliques avec réservoir et les centrales thermiques montre un indice d'impact majeur.

Les risques d'explosion, d'incendies ou de fuite pour les filières du gaz naturel, des centrales thermiques au bois et des incinérateurs ont un indice d'impact moyen. L'impact faible de la filière des combustibles de substitution est principalement attribuable aux risques d'incendie.

Tableau 3: Indices d'évaluation pour le risque de catastrophe

	Centrale thermique	Pétrole Transport	Gaz chauffage et transport	Biomasse déchets	Biomasse (combustible de substitution)	Hydraulique réservoir
Risque d'incendie, de fuite et d'explosion	3	3	3	3	3	1
Risques d'erreurs humaines reliées à la complexité technologique	3	1	1	2	1	2
Risque d'endommagement suite aux intempéries	1	3	1	1	1	3*
Risque de sabotage,	2	3	2	1	1	2

[6] Nous avons écarté ce risque de notre étude car le Maroc ne dispose pas de centrales nucléaires.

[7] Elles se présentent généralement sous forme de grosses installations industrielles ou de constructions de grandes dimensions,

[8] Les déversements pétroliers représentent également des risques environnementaux élevés en raison de l'âge des superpétroliers, des multiples traversées et des itinéraires souvent difficiles

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terrorisme et guerre						
Responsabilité civile : dommages corporels, matériels et immatériels	3	3	2	3	1	3
Évaluation globale	**3**	**3**	**2**	**2**	**1**	**3**

*Principalement les crues rapides, les inondations, le gel et les tremblements de terre.
Échelle de 1 à 3 (faible à fort)
Source: (Munich Reinsurance Company, 1990).

Le classement de la filière du pétrole (chauffage et transport) au 15ième rang est dû au risque de catastrophe important lié au déversement du pétrole et son impact sur l'environnement et l'économie de façon générale. Le 13ième rang des grands barrages hydrauliques avec réservoirs, quant à eux, occupent le 14ème rang à cause d'éventuelles conséquences désastreuses sur les populations humaines et le milieu biophysique en cas de rupture de tels ouvrages.

Pour les autres filières, les risques de catastrophes sont peu probables, par conséquent, l'effet global des impacts peut être considéré comme faible comparativement à celui des deux premières, même si certains demeurent tout de même majeurs. C'est le cas, entre autres, des centrales thermiques qui se partagent le 11ème rang. Les filières occupant les rangs 5 à 8 présentent des impacts qualifiés de moyen.

Le premier rang est obtenu par les filières solaires et éoliennes, car elles ne présentent presque pas d'impact significatif pour ce qui est du risque de catastrophe.

Impacts sur le patrimoine mondial

Modification des écosystèmes

Nous nous limiterons pour l'analyse des impacts de ce critère au milieu biophysique[9]. Il est à signaler que, généralement, les filières énergétiques étudiées affectent l'écosystème bien qu'à des niveaux différents.

Au Maroc, l'impact le plus connu concerne les modifications consécutives à la mise en eau des grands réservoirs pour la production de l'électricité (IEA, 2019). Les exploitations minières (surtout pour les mines de charbon) et les constructions de grande taille présentent également un impact majeur .

Les écosystèmes peuvent être également affectés lorsqu'on procède aux exploitations forestières, aux modifications de débit des écosystèmes

[9] Il regroupe toutes les interventions qui peuvent affecter directement la structure et les composantes des écosystèmes de sorte que la diversité, le flux d'énergie ou la circulation de la matière en seront modifiés et éventuellement détruits.

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aquatiques et à la gestion des déchets énergétiques du cycle d'utilisation des ressources (Shah et al., 2022).

Le premier rang revient aux filières ayant des infrastructures relativement petites ou exploitant des ressources hors écosystème naturel (biomasse – déchets). Le dernier rang, quant à lui, revient à la filière hydraulique vue la destruction des écosystèmes terrestres et aquatiques environnants qu'elle entraîne.

Un barrage et un réservoir peuvent également modifier les températures naturelles de l'eau, la chimie de l'eau, les caractéristiques du débit de la rivière et les charges de sédiments. Tous ces changements peuvent affecter l'écologie et les caractéristiques physiques de la rivière (Botelho et al., 2017).

La filière du charbon est avant dernière car ses installations créent des perturbations majeures lors de l'exploitation de la ressource[10] (EIA, 2024), alors que les positions des filières du bois, des combustibles de substitution, du pétrole et du gaz est intermédiaire avec des rangs allant de 10 à 13.

Modification de l'aménagement

Il s'agit, surtout de la structuration du territoire. Pour l'évaluer, nous avons retenu l'harmonie de ces structures avec des utilisations alternatives possibles du territoire et des ressources. Plusieurs éléments[11] sont pris en considération dans l'analyse de cet impact. Il s'agit, surtout, des territoires inondés, l'exploitation minière à ciel ouvert et l'exploitation des schistes bitumineux, et les grandes exploitations forestières.

L'impact des autres filières sur l'écosystème est mineur. C'est le cas par exemple des parcs éoliens et solaires qui permettent des utilisations alternatives possibles du territoire.

Le dernier rang revient à la filière du charbon à cause de l'absence de potentiel d'utilisations à d'autres fins. Le 12ième rang revient aux filières pétrolières pour les mêmes raisons, surtout, dans le cas de l'exploitation des schistes bitumineux où le territoire est dédié, exclusivement, à celle-ci. Bien que le milieu aquatique puisse être utilisé à d'autres fins, la filière hydraulique avec réservoir occupe le 11ième rang, puisque la mise en eau des réservoirs empêche toute utilisation alternative du milieu initial, avant inondation.

Les filières solaires, les filières des grandes exploitations forestières (centrales thermiques – bois) ou agricoles (combustible de substitution) et celles de l'exploitation des gisements souterrains de gaz naturel ont des rangs intermédiaires car elles permettent toutes quelques autres usages. La filière éolienne centralisée occupe le 8ième rang à cause de la diversité des

[10] L'impact sur l'écosystème existe ne serait-ce que par la nécessité d'installer dans un milieu récepteur, les équipements nécessaires à l'exploitation de la ressource.

[11] Il s'agit des activités qui affectent grandement l'occupation du territoire puisque l'utilisation de ces espaces est exclusivement dédiée à ces activités précises.

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utilisations alternatives du territoire. Le classement des autres filières aux 4 premiers rangs est dû au fait qu'elles offrent plus d'opportunités pour d'autres usages.

Modification du paysage

La modification du paysage se distingue de la modification de l'aménagement, d'abord par son contenu esthétique ensuite parce qu'il en est souvent la conséquence de celui-ci[12]. Afin de l'évaluer, nous avons retenu trois indicateurs. Il s'agit de la taille des installations, leur aspect esthétique et le degré de leur intégration dans le milieu récepteur.

La filière hydraulique avec réservoir et du charbon occupent les derniers rangs en raison de l'octroi des cotes d'impact majeur à au moins deux des trois indicateurs (Botelho et al., 2017). Les filières de biomasse, du pétrole, du gaz naturel quant à elles, présentent soit un impact majeur accompagné d'impacts moyens soit plusieurs impacts moyens. Les filières éoliennes centralisées et solaires occupent les rangs 2 à 4 car au moins un des indicateurs de ces filières présente un impact mineur. L'éolien décentralisé se retrouve en tête de liste.

Modification du mode de vie

L'évaluation de l'impact d'une filière énergétique sur le mode de vie et par là sur le bien-être de la société est relativement difficile à déterminer à cause de l'adaptation graduelle de la population aux différents changements occasionnés par le développement des filières énergétiques (Seddighi et al., 2023). Dans le cadre de notre travail, nous nous limiterons à l'évaluation des impacts des filières énergétiques sur les groupes isolés et vivant en dehors des centres urbains.

Le dernier rang accordé à la filière hydraulique avec réservoir est justifié par sa rigidité car la ressource doit être exploitée là où elle se trouve. Les importations de technologie sont importantes et la durée de réalisation des projets est relativement longue de même qu'une faiblesse de la compatibilité de la filière avec le mode de vie de la population (Botelho et al., 2017).

Tout comme pour la filière hydraulique, les filières du charbon, des centrales thermiques au pétrole et au gaz occupent l'avant dernier rang car, pour ces filières, le lieu d'extraction est spécifique à certains endroits[13]. Toutes ces filières présentent plusieurs impacts majeurs.

[12] Le critère est principalement fondé sur la perception visuelle des installations (cheminées, lignes à haute tension, plaques photovoltaïques, …) ou de ses manifestations (panache de fumée…).

[13] A noter également que le traitement des matières première nécessite une main-d'œuvre abondante et de grosses infrastructures, généralement, peu compatibles avec le mode de vie des populations autochtones.

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Les premiers rangs reviennent aux filières du chauffage domestique au bois, éoliennes et solaires qui pourraient être considérés comme ne présentant pas d'impact significatif à cause de la flexibilité d'implantation.

Impacts particuliers

Pollution thermique

Bien que l'impact de la pollution thermiques[14] se pose avec acuité durant la décennie 70, nous constatons aujourd'hui qu'elle est reléguée au second rang. Il est à noter, cependant, que les rejets thermiques affectent tous les milieux : eau, air et sol.

Les indicateurs retenus pour la mesure de la pollution thermique concernent les quantités d'eaux prélevées pour assurer le fonctionnement des systèmes de refroidissement et les changements dans les régimes de température locale.

L'utilisation d'énormes quantités d'eau pour le système de refroidissement des installations fait des centrales thermiques des opérateurs qui exercent un impact majeur sur l'environnement (Pan et al., 2018).

Les grands réservoirs hydrauliques entrainent la diminution des écarts de température du milieu environnant (Botelho et al., 2017). A noter que la filière solaire thermique peut capter de l'énergie solaire incidente et ainsi soustraire une portion importante de la chaleur au milieu ambiant (Physics World, 2022).

Les derniers rangs reviennent aux filières solaires thermiques à cause des quantités de chaleurs dégagées par unité de puissance produite. A noter que les filières chauffage et transport du gaz naturel, chauffage et métallurgie du charbon et combustibles de substitution exercent un impact moyen en raison de la pollution thermique en provenance des procédés industriels, des systèmes de chauffage ou des véhicules, selon les cas (Munawer, 2018). La filière chauffage et transport du pétrole présente un impact majeur en raison du dégagement de chaleur beaucoup plus important, occasionnée par les véhicules et la formation conséquente « d'îlots de chaleur » en milieu urbain (Pour et al., 2023), elle occupe le 14ième rang. Le 9ème rang est occupé par toutes les filières avec centrales thermiques pour la quantité de chaleur dégagée et celles de l'eau nécessaires à leur exploitation. La filière charbon et métallurgie occupe le 8ème rang.

Les 3^{ième} et 4^{ième} rangs reviennent aux filières solaires photovoltaïques et hydrauliques avec réservoir à cause de leurs modifications mineures qu'elles exercent sur le climat local.

[14] Selon Environnement Canada (Anderson, 1999), la pollution thermique, c'est-à-dire l'apport de chaleur au milieu résultant d'une activité humaine, est totalement imputable à l'utilisation de l'énergie.

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Santé et sécurité

Il s'agit des dangers et risques d'accident découlant des activités énergétiques. Nous avons retenu trois indicateurs pour apprécier ce critère. Il s'agit des risques d'accidents et de décès des travailleurs et le public, la maturité technique des installations et le degré de sécurité nécessaire au bon fonctionnement des installations.

L'évaluation globale obtenue pour chacune des filières (tableau 5) montre que les risques d'accidents dans les mines de charbon et lors des forages de puits de pétrole[15] sont très élevés et présentent à un impact majeur.

Tableau 4 : Indices d'évaluation de la santé et sécurité

	Charbon	Pétrole (électricité)	Gaz naturel	Biomasse-déchets	Biomasse-comb. De substitution	Hydraulique (avec réservoir)	Solaire et éolien	Géothermique
Degré de sécurité nécessaire au bon fonctionnement des installations	3	3	2	3	2	2	1	3
Maturité technique des installations	2	2	2	2	2	1	2	2
Risques d'accidents et de décès	3	3	2	2	2	2	3	2
Évaluation finale	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**

Échelle de 1 à 3 (faible à fort)
Source : Münchener Rückversicherungs-Gesellschaft (Munich Reinsurance Company), 1990

La maturité technique des filières éoliennes et solaires reste à démontrer car pour ces filières nous observons un grand nombre d'accidents et de décès dus, probablement, au manque de normes et de procédures de sécurité, et du nombre d'éléments à mettre en place et à entretenir (Huber et al., 2022).

Les filières du charbon et du pétrole occupent le dernier rang à cause de leurs impacts majeurs pour au moins deux des trois indicateurs retenus, suivies des filières du gaz naturel. La filière hydraulique avec réservoir occupe le 6ième rang. Son impact, tout comme pour le gaz naturel et le bois, est moyen.

[15] A signaler que la production pétrolière est très marginale au Maroc.

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Les filières éoliennes et solaires et les autres filières de la biomasse occupent les rangs 4 et 3.

De façon générale, la totalité des filières énergétiques présente des impacts majeurs ou moyens sur la santé et la sécurité.

Des résultats présentés ci-dessus, nous pouvons présenter un récapitulatif dans la matrice des impacts potentiels (tableau 5) et le tableau de l'évaluation globale des impacts environnementaux des différentes filières énergétiques (tableau 6).

En résumé, le critère retenu pour les impacts énergétiques, à savoir la durabilité de la ressource[16], montre que, dans le but de sauvegarder l'environnement et basculer vers un modèle de développement basé sur l'option de l'économie verte, les filières solaires, éoliennes et hydrauliques doivent être privilégiées car le flux qu'elles génèrent est inépuisable.

Les filières de biomasse peuvent être également préférées puisqu'elles regroupent les ressources renouvelables dont le flux énergétique peut être quasi inépuisable à condition que les usages respectent le cycle de renouvellement de la ressource.

[16] Exprimée en fonction du flux d'énergie que procurent les différentes ressources

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Tableau 5: Matrice Comparative des Diverses filières énergétiques *Rang comparatif de 1 à 15* *[1]Ressource épuisable* *[2]Ressource renouvelable*		Impacts énerg.	Impacts Globaux		Impacts sur le patrimoine mondial				Impacts particul.	
		Qualité de la ressource	**Changement climatique global**	**Risque de catastrophe**	**Modification d' écosystème**	**Modification de l' aménagement**	**Modification du paysage**	**Modification du Mode de vie**	**Pollution thermique**	**Santé et sécurité**
Charbon	Électricité (centrale thermique)	E[1]	15	11	13	15	13	13	9	15
	Chauffage et métallurgie	E	14	10	13	15	13	13	8	14
Pétrole	Électricité (centrale thermique)	E	11	11	8	12	11	11	9	10
	Chauffage et transport	E	10	15	12	12	12	8	14	10
Gaz Naturel	Électricité (centrale thermique)	E	6	11	7	4	6	11	9	9
	Chauffage et transport	E	7	9	7	4	5	8	6	9
Biomasse	Électricit (centrale thermi., bois et tourbe)	R[2]	13	8	11	6	9	7	9	7
	Chauffage domestique	R	12	1	12	3	8	1	5	2
	Déchet (Incinérateur)	R	9	7	2	2	10	5	9	4
	Combustibles de substitution	R	8	5	10	6	7	6	6	4
Hydraulique	Centrale avec réservoir	R	5	14	15	11	15	15	4	6
Solaire	Thermique	R	1	1	5	8	2	4	15	4
	Photovoltaïque	R	1	1	4	8	2	4	3	4
Eolien	Centralisé	R	1	1	3	8	4	4	1	3
	Décentralisé	R	1	1	1	1	1	1	1	1

Source: Basé sur l'analyse des auteurs dans les sections précédentes

En se focalisant sur deux critères[17] pour les impacts globaux, les processus de combustion des ressources fossiles et de la biomasse entraînent la libération des GES affectant le climat global. Les filières des ressources renouvelables (hydraulique, solaire, éolien) sont de nature différente et ne

[17] Il s'agit du changement climatique global, qui constitue le problème majeur auquel l'humanité et la planète font face, et le risque de catastrophe.

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contribuent pratiquement pas au changement climatique mais certaines filières présentent des risques de catastrophes importants.

En ce qui concerne les impacts sur le patrimoine mondiale, toutes les filières, excepté la filière éolienne décentralisée, présentent des impacts majeurs, entrainant des conséquences sur les écosystèmes, l'aménagement, le paysage et le mode de vie sont causées par des facteurs tels que la taille des installations, les sites d'implémentation et leur influence sur les sociétés. Cependant, l'impact des ressources renouvelables (à l'exception de l'hydraulique) reste moyen comparé à l'impact majeur des combustibles fossiles qui doivent être érigés là où se trouvent les ressources et nécessitent la mise en place d'installations pour acheminer ces ressources.

Finalement, pour les impacts particuliers, Partant des deux critères choisis[18], les filières du charbon et du pétrole présentent les impacts les plus importants. Les ressources renouvelables présentent globalement des impacts plutôt faibles avec une possibilité de quelques effets majeurs[19]. Si on les compare aux filières des ressources non renouvelables, ces filières ont peu d'impacts. Nous observons également la persistance d'un écart relativement important avec les filières à base de ressources fossiles et de la biomasse.

Tableau 6: Évaluation globale des impacts environnementaux des différentes filières énergétiques

Ressources	Filières énergétiques	Thèmes d'analyse			
		Impacts énergétiques	Impacts Globaux	Impacts sur patrimoine mondial	Impacts particuliers
Charbon	Électricité (Centrale thermique)	Majeur	Majeur	Majeur	Majeur
	Chauffage et métallurgie	Majeur	Majeur	Majeur	Majeur
Pétrole	Électricité (Centrale thermique)	Majeur	Majeur	Majeur	Majeur
	Chauffage et transport	Majeur	Majeur	Majeur	Majeur
Gaz Naturel	Électricité (Centrale thermique)	Majeur	Majeur	Moyen	Moyen
	Chauffage et transport	Majeur	Majeur	Moyen	Moyen
Biomasse	Électricité (Centrale thermique)	Moyen	Majeur	Moyen	Moyen
	Chauffage	Moyen	Majeur	Moyen	Moyen
	Déchets	Mineur	Moyen	Mineur	Moyen
	Combustible de substitution	Moyen	Moyen	Moyen	Moyen
Hydraulique	Centrale avec réservoir	Nul	Moyen	Majeur	Moyen
Solaire	Thermique	Nul	Nul	Moyen	Moyen
	Photovoltaïque	Nul	Nul	Moyen	Mineur

[18] Il s'agit de la santé et sécurité ainsi que de la pollution thermique.
[19] Il s'agit surtout de la pollution thermique de l'énergie solaire thermique

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Éolien	Centralisé	Nul	Nul	Mineur	Mineur
	Décentralisé	Nul	Nul	Mineur	Mineur

Source: Basé sur l'analyse des auteurs dans les sections précédentes.

Discussions

Vu les ambitions du Maroc à transiter vers un modèle de développement basé sur l'option de l'économie verte et tenant compte des ressources actuellement utilisées, la filière hydraulique avec réservoir est la plus avantageuse. La ressource est renouvelable et sa contribution aux impacts globaux est plutôt faible. Ses impacts sur le patrimoine mondial sont cependant très importants bien que, dans un contexte plus particulier, certains de ces impacts pourraient être réévalués à la baisse au point de devenir négligeables. À noter généralement que la plupart des filières ont d'importants effets sur le patrimoine mondial.

À titre de rappel, l'énergie hydraulique s'est développée au Maroc depuis la fin des années vingt du siècle dernier, bien avant l'énergie solaire et éolienne. Elle demeure la première source d'énergie renouvelable avec une capacité installée de 1771 MW. Pour le solaire et l'éolien, la puissance installée à fin 2022 est respectivement de 1430 MW et 830 MW (Ministère de la transition énergétique et du développement durable, 2023). L'importance de l'énergie hydraulique n'est plus à démontrer. Il faut cependant tenir compte de la variabilité de la pluviométrie de même que du problème de la variabilité du solaire et de l'éolien qui ne produisent pas de l'énergie de manière constante et stable. « *L'énergie hydroélectrique permet de réguler cette variabilité innée. Mobiliser les eaux stockées dans les barrages ne prend que cinq minutes pour produire de l'énergie électrique et stabiliser le réseau* » (Houachmi[20]).

Les filières de biomasse, pourraient être considérées comme une alternative, sachant qu'elles ont des impacts relativement importants lorsque les ressources sont exploitées sur une grande échelle. Le potentiel en biomasse, selon les conclusions de l'étude réalisée par le Ministère de la transition énergétique et du développement durable[21], montre que « *le Maroc présente un total en énergie primaire estimé à 11,5 millions MWh/a, répartis sur trois secteurs clés à savoir les déchets verts, l'agriculture, la foresterie et les eaux usées. Concrètement, 6,6 millions de MWh/a du potentiel technique national est issu du secteur agricole, 1,7 M MWh/ proviennent du secteur forestier, 3 M MWh/a du secteur des déchets tandis que 0,2 M MWh/a peuvent être générés à partir du secteur des eaux usées* ». La biomasse offre, en plus de délimiter la déforestation, la particularité de préserver un environnement

[20] Consultant Marocain en énergies renouvelables.

[21] Réalisée en prélude de l'élaboration de la Stratégie Nationale pour la Valorisation Energétique de la Biomasse.

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propre et favoriser la réduction de 6,2 à 8,5 millions de tonnes de CO2 d'émissions de GES.

Tenant compte du potentiel disponible au Maroc[22], les filières hydrauliques, solaires et éoliennes devraient être le pivot des stratégies de gestion de l'énergie du pays. Ces ressources sont durables et leurs impacts sont peu dommageables pour l'environnement, surtout lorsqu'elles sont comparées aux filières à base de ressources fossiles et à celles de la biomasse.

Analyse comparative des ressources énergétiques renouvelables

En examinant le potentiel de substitution entre différentes filières notamment éolienne, solaire et hydraulique. Alors que l'hydraulique permet de réaliser d'importantes économies, le solaire et l'éolien offrent un meilleur progrès et des possibilités de création d'emplois (García et al., 2016). Par conséquent, un mix énergétique équilibré qui intègre ces trois sources d'énergie est une meilleure solution pour maximiser les avantages socio-économiques et écologiques. Une stratégie sera d'opter pour l'énergie solaire dans les régions où elle constitue un potentiel énorme et peut être utilisé de manière exponentielle (notamment Laayoun, Tarfaya, Marrakech …), et opter pour l'énergie éolienne à Tanger et les réserves environnementales de Dakhla,Taroudant… Pour l'hydraulique, Khénifra, Inezgane et Beni Mellal offrent de bonnes conditions.

Cependant, il faut prendre en considération les limites industrielles du Maroc. Le développement des industries locales produisant les technologies nécessaires des énergies renouvelable est insuffisant. D'un point de vue juridique, il est nécessaire de combler les lacunes législatives qui découragent les projets renouvelables à petite échelle (García et al., 2016). Ceci aidera à créer un environnement industriel et réglementaire favorables pour assurer un transition énergétique fluide.

Défis et limites

La transition énergétique et l'efficacité énergétique créent une valeur ajoutée significative surtout pour l'industrie et pour les secteurs à forte intensité de carbone, (la pétrochimie, les engrais, le ciment, le fer…) (Nurdiawati et al., 2021). Néanmoins, les énergies renouvelables soulèvent un

[22] La centrale solaire, connue sous le nom de complexe Noor, a la capacité d'alimenter un million de foyers et de réduire considérablement l'utilisation de combustibles fossiles. En ce qui concerne l'éolien, et avec une capacité installée d'environ 1430 MW en 2022, le Maroc représente le troisième plus grand marché africain pour l'énergie. Dans le cadre de l'ambition du Maroc d'atteindre 52% de ses besoins en électricité à partir de sources d'énergie renouvelables d'ici 2030, les autorités ont accéléré ces dernières années le développement de parcs éoliens à grande échelle à travers le royaume en mettant davantage l'accent sur les investissements privés.

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certaines questions dans de nombreux pays, y compris le Maroc, en raison de l'absence de solutions de stockage permettant de stabiliser leur intermittence intrinsèque (Lin et al., 2022). En fait, l'électricité produite à partir d'une énergie renouvelable est utilisable sur place (Lin et al., 2022).

Certainement, les batteries de stockage associées aux centrale solaire ou aux barrages complémentaires ou encore les batteries de stockage électrochimiques de l'énergie éolienne servent de solutions pour stabiliser les fluctuations de la production des énergies renouvelables (Lin et al., 2022). De cette manière, l'énergie produite en temps réel peut être transformée en une ressource stable capable d'alimenter les réseaux en cas de pics de demande journaliers et hebdomadaires, ou de fournir de l'énergie à la production industrielle, qu'elle soit hors-réseau renouvelable (Akinsooto et al., 2024). Toutefois, les problèmes de coût des solutions existantes ou la faible densité intrinsèque nécessitent un développement technologique important et innovant pour faire de l'énergie renouvelable et du stockage un couple parfait.

Au sujet de la production électrique à partir des énergies renouvelables, le défi principale est qu'il manque une industrie locale spécialisée en développement des équipements nécessaires pour toute phase d'exploitation du processus de production initial au système final (Ghazi et al., 2021). De plus, la qualité de la configuration existante ne répond pas aux contraintes environnementales limitant ainsi la capacité de développer un approvisionnement durable pour produire localement des composants solaires résistants aux des conditions climatiques extrêmes, vécues au Maroc (Ghazi et al., 2021). Il est donc nécessaire de développer une chaîne d'approvisionnement locale complète et durable pour les technologies d'énergies renouvelables, en particulier l'énergie solaire. Néanmoins, la conception d'un tel système est multidimensionelle combinant une approche géographique, technique, industrielle et sociale (Ghazi et al., 2021). En outre, un plan d'arbitrage crédible doit être mis en place pour ne pas privilégier une énergie propre par rapport à une autre, mais plutôt envisager la synergie des trois énergies dans le cadre d'une production et d'une consommation nationales optimales.

D'autres d'obstacles majeurs sont fréquemment évoqués notamment la disponibilité ou la rentabilité des technologies et des pratiques d'économie d'énergie (Hrovatin et al., 2021). C'est une question de motivation où les contraintes financières ou l'insuffisance des capitaux est souvent citée comme obstacle à l'application de l'efficacité énergétiques par les ménages et les entreprises (Hrovatin et al., 2021).

En conséquence, Les conditions préalables pour réussir une transition fluide sont l'établissement d'une véritable feuille de route qui tient compte de tous ces obstacles et qui associe les départements concernés et le

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gouvernement et augmente la flexibilité des banques et des représentants financiers.

Recommendations

Dans le but d'améliorer la politique énergétique à long terme et réussir la transition vers un système économique durable dont le secteur énergétique est le catalyseur, les recommendations suivantes peuvent être proposées:

- La cohérence et l'engagement lors de la mise en place du cadre politique, en s'éloignant des politiques expérimentales. La clarté et le cohérence peuvent attirer davantage d'investissements à long terme;
- Mise en place d'une bonne gouvernance réactive, capable de s'adapter facilement aux changements dans les institutions et de l'énergie, et délibérative. Veiller à ce qu'elle implique des parties prenantes, y compris la communauté, la société civile, le gouvernement et le secteur privé;
- Intégration des réponses politiques à l'aide d'outils de modélisation reflétant la réalité des contraintes politiques et institutionnelles afin de fournir de meilleures solutions. Ceci permettr d'élaborer des stratégies à long terme plus réalisables et des plans d'action à court terme adéquats;
- Conception de politiques participatives ciblant une grande partie de l'économie notamment le système de transport, l'industrie, la sylviculture …;

A cet égard, la participation directe et ascendante des communauté pourrait améliorer la mise en oeuvre de ces politiques, y compris le grand public, favorisant ainsi une appropriation effective. En outre, les mesures ne tenant pas compte de l'accéleration réelle au niveau local et s'appuyant uniquement sur une hiérarchie politique sont vulnérables aux changements dans le soutien du public et moins susceptibles d'encourager l'adhésion.

Conclusions

Le Royaume du Maroc s'est mobilisé pour transitionner vers un nouveau paradigme porteur de promesses environnementales, économiques et sociales. Présentant un énorme potentiel en matière des énergies renouvelables, il est l'un des pays les plus ambitieux en termes de promotion du développement durable.

Afin de répondre à la problématique de notre recherche, particulièrement l'évalutaion des filières énergétiques sur la base de leur impact environnemental et le potentiel du pays, nos résultats montrent que les filières les plus avantageuses sont les filières hydraulique, solaire et éolienne. Les ressources sont durables, produisant un flux d'énergie continu et

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pratiquement inépuisable. Un mix énergétique regroupant les trois filière en synergie semble un bon point de départ.
Pour ceci, des réformes systémiques s'avèrent nécessaires, par exemple:

- La maximisation du bien-être et de la richesse tout en limitant l'empreinte carbone à travers l'utilisation efficace des ressources naturelles;
- La compensation des pertes d'emploi dans les secteurs traditionnels à travers la création de nouveaux emplois tout au long de la chaîne de valeur des énergies renouvelables;
- L'implication des communautés et des entreprises locales dans les projets d'énergie dans le but de favoriser une croissance inclusive;
- La prise en comptes des incidences économiques à long terme, stipulant que les avantages politiques de transition énergétiques peuvent ne pas se réaliser qu'après une longue période.

En guise de conclusion, la transition énergétique marocaine présente des avantages envionnementaux indéniablesmais qui s'accompage de compromis. Citons comme exemple les effets sur la biodiversité et les écosystèmes utilisés dans les grands projets renouvelables. De plus, l'impact à long terme sur la sécurité énergétique doit faire l'objet d'une attention particulière. Egalement, les répercussions socio-économiques de cette transition doivent également être prises en compte.

Au-delà des solutions techniques, comprendre les facteurs comportementaux affectant la transition énergétique est crucial. Qu'est ce qui motive le public, consommateurs et entreprises, à adopter des technologies d'énergie renouvelable? De même, qu'est ce qui incitera les investisseurs à investir dans des projets énergétiques durables au Maroc? Il sera bénéfique d'explorer comment le pays peut attirer des investissements nationaux et internationaux, et comment ces investissements peuvent être alloués pour un impact maximal. La réponse à toutes ces questions fera l'objet de notre prochain travail.

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