

Livelihood Dynamics in Mountainous Areas of Algeria: A Case Study of Four Villages in Ighil Ali, Bibans Mountain Range (Béjaïa Province)

Salah Chouaki ¹, Foued Chehat ², Naïma Ouferrhat ², Moussa Lachibi ², Abdelghafour Doghbage ³, Amar Khadoumi ³, Belkacem Daoudi ³, Zahra Robâ Bouabdelli ³, Hafidh zemour ⁴, Hassen Boukerker ⁵

¹Ecole Nationale Supérieure d'Agronomie (ENSA ex-INA), Algeria

²Institut National de la Recherche Agronomique d'Algérie (INRAA), Algeria

³ Centre de Recherche en Agropastoralisme (CRAPAST), Algeria

⁴ ISTA, University of Larbi Ben M'hidi, Oum El Bouaghi, Algeria

⁵Scientific and Technical Research Center on Arid Regions, Algeria

ARTICLE INFO	ABSTRACT
Received: 28 Mar 2025	In Algeria’s mountainous regions, rural households face persistent structural constraints: land fragmentation, precarious agricultural incomes, limited access to resources, and weak institutional support. This study, conducted in four villages of the Ighil Ali municipality (Béjaïa Province), examines the strategies developed to sustain livelihoods and enhance resilience in the face of ecological and socio-economic uncertainties.Using the Sustainable Livelihoods Framework (SLF), the research draws on an in-depth survey of 78 households, combining both qualitative and quantitative data. The findings reveal a marked diversity in livelihood trajectories: some households capitalize on local resources through irrigated polyculture and livestock farming, while others rely heavily on external income and multiple sources of employment.Despite a genuine adaptive capacity, households remain vulnerable due to the lack of support mechanisms tailored to the specific realities of mountain territories. The study advocates for a territorialized approach to rural development policies, integrating local dynamics, endogenous resources, and the social capacities of mountain communities.
Revised: 09 June 2025	
Accepted: 19 June 2025	
Keyword: Sustainable livelihoods ; Rural resilience ; Peasant strategies ; Pluriactivity;Mountain regions ; Vulnerability ; Territorial development ; Algeria	

1. INTRODUCTION

Mountain regions are increasingly gaining attention in scientific and political debates on sustainable development. Long considered peripheral, they are now recognized for the essential functions they perform: biodiversity conservation, hydrological regulation, local food security, and resilience to climate change (Debarbieux&Rudaz, 2010; Price et al., 2013). This recognition has been reinforced through international commitments such as Agenda 21, the Sustainable Development Goals (notably SDG 15), and the Mountain Partnership (FAO).

From a scientific perspective, these territories have been studied for both their structural vulnerabilities and their potential, as the diversity of rural livelihoods and the importance of local subsistence strategies have come to be acknowledged (Messerli& Ives, 1997; Balsiger&Debarbieux, 2011). Recent research

highlights the central role of households in shaping differentiated livelihood trajectories, through complex trade-offs involving available resources, integration into economic circuits, and risk management.

In the Global South—and particularly in the Maghreb—mountain areas remain structurally marginalized. In Algeria, post-independence planning prioritized coastal and lowland areas, often neglecting interior and mountainous zones, which were deemed secondary in national development strategies (Bessaoud, 2008). This imbalance has exacerbated the economic precarity of households, their exposure to climate risks, and their growing reliance on external income sources.

Since the early 2000s, rural development programs (PNDAR, PPDR) have sought to re-engage with these territories. Classified as "deeply rural" by the National Strategy for Sustainable Rural Development (CENEAP, 2004), mountain areas have been identified as requiring targeted support. However, the concrete impacts of these policies at the household level remain under-evaluated (Baroud et al., 2018; Sraïri et al., 2024).

In this context, this research analyzes the economic strategies and adaptive mechanisms of households in four villages of the Ighil Ali municipality, located in the Bibans mountain range (Béjaïa Province), within the mid-altitude zone. Using the Sustainable Livelihoods Framework (SLF), the study aims to document the mobilized resources (land, labor, income), forms of pluriactivity, and the trade-offs made in response to structural constraints. The objective is to contribute to a deeper understanding of mountain rural dynamics in marginalized contexts, by examining the social reproduction and resilience capacities of vulnerable households.

2. Theoretical and Methodological Framework

2.1. Conceptual Foundations

This research draws on the Sustainable Livelihoods Framework (SLF), originally developed by Chambers & Conway (1992) and further elaborated by Scoones (1998), DFID (1999), and Ellis (2000). This approach views rural households as active and adaptive agents who mobilize various forms of capital—natural, physical, human, financial, and social—to sustain their livelihoods in uncertain environments. A livelihood is considered "sustainable" if it can cope with shocks, adapt to change, and maintain or enhance future assets and capabilities, including those of future generations.

This analytical framework, which is both systemic and actor-centered, allows for the articulation of structural vulnerabilities, adaptive capacities, and decision-making processes regarding resource use and environmental or institutional constraints. It is particularly relevant in mountain areas, which are characterized by agroecological limitations, unequal access to infrastructure, and limited institutional presence.

Furthermore, the study is informed by literature on rural pluriactivity (Losch et al., 2012; Dufumier, 2004; Laurent & Rémy, 1998), which highlights the multiplicity of economic strategies—agricultural, non-agricultural, informal, and migratory—adopted by households in contexts marked by low agricultural profitability and structural uncertainty.

Finally, insights from critical geography and territorial development approaches (Vanier, 2008; Bessaoud, 2013; Caron et al., 2017) help situate local trajectories within broader dynamics of differentiated territorial construction. These perspectives emphasize the importance of endogenous resources, local actor interactions, and the mismatch between standardized public policies and the realities of mountain territories.

2.2. Survey Methodology

This analysis is based on fieldwork conducted between 2009 and 2010 in four villages of the municipality of Ighil Ali (Kalâa, Tazla, Tiniri, and Belayel), located in a mid-altitude mountainous zone in Béjaïa Province. This area was selected for its representativeness of mountain dynamics: relative isolation, diversity of farming systems, high dependence on external transfers, and increasing land pressure.

A total of 78 households were surveyed using a mixed-method approach that combined qualitative and quantitative tools. Data collection relied on several complementary methodological instruments:

- **Semi-structured questionnaires** with households, addressing mobilized resources (land, labor, equipment), economic activities (agriculture, livestock, off-farm employment, migration), income and expenditures, and intergenerational dynamics;
- **Individual interviews** with key informants (village elders, innovative farmers, merchants, elected officials) as well as institutional representatives (district authority, agricultural subdivision, municipal council);
- **Participatory focus groups** in each village aimed at reconstructing territorial trajectories, identifying major constraints, and capturing local perceptions of agricultural development;
- **Participatory mapping** of resources, cultivated areas, and access routes, in connection with local views on potential and barriers;
- **Spatial analysis** using Geographic Information Systems (GIS), integrating topographic data (slope, accessibility) and land-use maps developed with local stakeholders.

The research was conducted by a multidisciplinary team with expertise in agronomy, rural sociology, and territorial economics. The analysis involved a comparative reading of adaptation strategies and structural configurations across villages, with the aim of identifying rural household typologies (Alary et al., 2021; Sraïri et al., 2024).

3. Results

The analysis of the 78 surveyed households across the four villages of Kalâa, Tazla, Tiniri, and Belayel reveals a wide range of household profiles and livelihood conditions, reflecting significant disparities in resource access, production systems, and economic strategies. The results are presented along four main analytical dimensions: land and water endowment, demographic characteristics, agricultural systems and intensification levels, and income structure and household typologies.

3.1. Key Livelihood Assets

3.1.1. Land Endowment and Access to Water

The survey highlights substantial heterogeneity in land endowment and access to water resources among the studied villages. The average utilized agricultural area (UAA) per household is under 10 hectares, fragmented into multiple non-contiguous plots, with an average of 3 to 5 plots per household depending on the village (Table 1). This land fragmentation—averaging 4.9 plots in Tazla and 4.7 in Belayel—represents a structural constraint on agricultural intensification, as previously noted by Baroud et al. (2018).

Access to irrigation water is a key differentiating factor. In Tazla, 40% of the UAA is irrigated, compared to only 1.7% in Kalâa, 4% in Tiniri, and 0.7% in Belayel. This greater water availability in Tazla supports more diversified and intensive farming systems, particularly market-oriented polyculture, in contrast to the other villages, which rely predominantly on rainfed agriculture.

Village	Average UAA (ha)	Average Number of Plots	Irrigated Share (%)	Average Plot Size (ha)
Kalâa	4.1	3.2	1.7	5.2
Tazla	9.2	4.0	40	3.5
Tiniri	3.8	4.7	4	4.1
Belayel	12.8	5.6	0.7	4.0

Table 1. Land Endowment and Irrigation by Village

3.1.1. Land Tenure Status

The analysis of land tenure status (n = 302 plots) identifies three main forms of land access:

- **Undivided ownership**, resulting from inheritance not formally partitioned among co-heirs (35.8%);
- **Family ownership**, referring to land directly farmed by a household after the division of inheritance (32.1%);
- **Informal association**, based on non-formalized agreements between absentee (often urban) landowners and local cultivators (38.1%).

Significant territorial variations emerge. In **Kalâa**, undivided land accounts for only 19.6% of plots, whereas informal association dominates (60.9%), reflecting a substantial externalization of land use without institutional oversight. Conversely, **Tazla** displays more stable tenure patterns: 43.3% of plots are held under family ownership, while association is marginal (8.3%). **Tiniri** combines a high degree of undivided ownership (50%) with significant family appropriation (39.5%), whereas **Belayel** exhibits high levels of both forms.

These findings reveal differentiated land trajectories, shaped by factors such as the residential distance of rights holders, the aging of active farmers, and the lack of formal land governance mechanisms adapted to mountainous areas. This structural instability is a major barrier to productive investment and the sustainability of agricultural systems.

3.1.2. Household Demographic Characteristics

The demographic profile of the 78 surveyed households highlights contrasting social structures, reflecting family reproduction dynamics and rural transformation in mountainous areas. Village-level differences reveal distinct patterns in settlement history, fertility, and access to resources.

Household Headship and Aging

Household leadership remains overwhelmingly male: only one of the 78 households is headed by a woman (1.3%), indicating limited feminization of agricultural responsibilities, often confined to cases of widowhood or prolonged spousal absence.

The age structure of household heads indicates an aging population: only 11.4% are under the age of 30, while nearly 40% are over 50. This aging is accompanied by reluctance to transfer farm assets, despite the informal involvement of younger members in daily activities. This raises concerns about generational renewal, as noted by Bessaoud (2008) and Alary et al. (2021).

Household Size and Family Cycles

The average household size is 7.23 persons, significantly above the national average, indicating the persistence of extended family structures. However, village-level disparities are notable: **Kalâa** (6.33) and **Tazla** (6.25) are characterized by smaller domestic units, while **Belayel** (8.08) and especially **Tiniri** (8.27) frequently include more than ten members ($\approx 33\%$ of households). These differences reflect variation in family life cycles, fertility, and residential stability.

Fertility and Presence of Children

Household composition based on the number of children reveals two contrasting dynamics. In **Kalâa** and **Tazla**, about 25% of households have two children or fewer, while in **Tiniri**, nearly 47% have more than five children, and 37.5% in **Belayel**. These disparities are likely influenced by migratory trajectories, land tenure stability, and uneven access to social and health services.

Dependents and Solidarity Mechanisms

The average number of dependents per household (excluding spouse and children) is relatively low (0.69), but unevenly distributed. In **Tiniri**, 93% of households have no dependents, compared to 66% in **Kalâa**, and around 58% in **Tazla** and **Belayel**. These figures reflect varying intergenerational support structures and family arrangements, with differing weights of upward or lateral solidarity.

Youth of Working Age: An Underutilized Asset

The presence of male youth over the age of 18 is a key indicator of potential labor force renewal. However, 55.1% of households report having none. While **Kalâa** and **Belayer** show relatively higher presence of these young adults, their actual involvement in farming remains limited. Many are already engaged in migration or urban employment pathways, casting doubt on the continuity of family-based farming systems.

Indicator	Kalâa	Tazla	Tiniri	Belayer
average household size	3	5	7	8
% of households with fewer than 5 members	5%	0%		
% of households with more than 10 members			3%	3%
% of households with ≤ 2 children	5%	5%		
% of households with > 5 children			7%	5%
% of households with no dependents	6	3%	6	3%
presence of males over 18 years old	quent			quent

Table 2. Demographic Indicators by Village

Cross-analysis

These results indicate that households remain largely structured around traditional family models, but emerging tensions are evident: aging of household heads, youth detachment, and limited generational renewal. These societal dynamics undermine the sustainability of mountain farming systems, increasing dependence on external income sources and further marginalizing local productive functions.

3.1.3. Production Systems and Level of Intensification

Olive cultivation forms the core of agricultural systems across all surveyed villages. Depending on local agroecological conditions, it is often combined with fig production, vegetable gardening, and small-scale family livestock farming—particularly goat rearing on communal lands or forest pastures. This modest diversification serves to meet household needs while generating limited marketable surpluses.

Tazla stands out with a highly productive irrigated polyculture system that integrates vegetables, fruit trees, and fodder crops, made possible by greater water availability (40% of UAA irrigated). This model reflects an intensive, though not capital-intensive, use of local natural resources.

However, agricultural intensification remains generally low. Only 12 households reported using chemical fertilizers, mostly concentrated in Tazla. Mechanization is virtually nonexistent due to small plot sizes, land fragmentation, and challenging topography. Barriers to intensification also include limited access to credit, low short-term profitability, and an aging farming population, all of which hinder investment and technical innovation (Dufumier, 2004; Bessaoud, 2013).

Thus, despite certain adaptations to local conditions, production systems remain largely low-input, oriented towards subsistence, and weakly integrated into formal economic circuits.

3.1.4. Income Structure and Household Profiles

The average annual income per household is estimated at **335,718 Algerian dinars**, with substantial variation across villages. In **Tazla**, agriculture accounts for **75.6%** of total household income, compared to only **33.9%** in **Tiniri**, where it is largely marginalized in favor of non-agricultural sources (employment, trade, migration, remittances).

At the sample level:

- **Agriculture:** 51% of total income

- **Non-agricultural income** (wages, commerce, migration): 46%
- **Pensions and social assistance**: 3%

These figures confirm widespread **pluriactivity**, even among households deeply involved in agriculture. Economic decision-making reflects a need to ensure income security in an uncertain environment, marked by frequent climate shocks and price volatility (Ellis, 2000; Losch et al., 2012; Alary et al., 2021).

3.1.5. Means of Production: Low Capitalization of Farms

The analysis of technical capital assets among the 78 surveyed households reveals low capitalization levels in farm operations, reinforcing their vulnerability and limiting their ability to intensify or diversify production. Fewer than half of the farmers (**46%**) own productive assets beyond land, confirming the predominance of **low-capital, labor-intensive family farming** reliant on natural resources and manual labor (Dufumier, 2004; Ellis, 2000).

Farm Buildings: Marginal Presence

Storage and livestock infrastructure are scarce:

- Only **17 farmers (22%)** have a shed or storage facility,
- Just **2 households** possess dedicated livestock buildings (stable or sheepfold).

This lack of post-harvest infrastructure reflects a structural deficit in rural investment, limiting capacity for storage, sorting, or processing and thus reducing opportunities for **local value creation** (Bérard&Marchenay, 2004; Caron et al., 2017).

Farm Machinery: Virtually Absent

Motorized farm equipment is extremely rare:

- Only **2 tractors** were identified in the entire sample, along with a few pulled implements,
- Just **1 household** owns a vehicle for transporting agricultural goods.

In the absence of mechanization, producers rely on traditional methods, particularly **draft animals**, still used in **16 households in Belayel**, where oxen or mules serve for plowing or transport. Others rent teams at prohibitive rates:

- **1,500 DA/day** for renting a pair of oxen,
- **300,000 DA** to purchase one—a prohibitive investment for small-scale farms.

Irrigation Equipment: Virtually Nonexistent

Despite occasional access to water resources, only **3 farms** own irrigation equipment (pumps, pipes, reservoirs). Most depend on:

- **Seasonal rainfall**, or
- **Rudimentary irrigation systems** (gravity-fed canals, hand-dug wells).

This situation directly affects yield stability, precludes flexible cropping calendars, and limits opportunities for intensification or diversification.

Structural Consequences

The lack of productive assets has major implications for rural households' capacity for reproduction and adaptation:

- **Low intensification**: The absence of machinery or irrigation hinders productivity gains;
- **Underutilization of resources**: Water and land potentials remain untapped;

- **Market exclusion:** Limited logistical means force producers to sell via informal channels, often at the mercy of intermediaries.

This **low level of capitalization** reinforces **short-term survival strategies** at the expense of long-term sustainable development, especially in a context where **public support remains insufficient or poorly adapted** to the specific needs of mountain farming systems (Bessaoud, 2013; Sraïri et al., 2024; Scoones, 1998).

Indicator	âa	la	iri	ayel	al
f households with equipment	31%	00%	56%	.00%	
rage sheds					
torized traction equipment					
ed implements					
nsport equipment					
ft animals (oxen, mules)					
epfolds					
bles					
ings / Wells					
gation equipment (pumps, pipes)					
ditional olive oil mill					

Table 3. Distribution of Agricultural Equipment and Infrastructure by Village

3.1.6. Household Head Status and Pluriactivity

The professional status of household heads is a key indicator for understanding the economic dynamics of mountain farming systems. It sheds light on labor availability, investment decision-making, and household strategies for social and economic reproduction (Ellis, 2000; Laurent & Rémy, 1998).

Three Functional Profiles

Data collected identify three main professional configurations of household heads:

1. **Full-time farmers:** Fully engaged in agricultural activities, these heads of household still represent a significant share in all four surveyed villages, especially where access to off-farm employment is limited.
2. **Part-time farmers:** They combine farming with informal or temporary economic activities, such as petty trade, craftsmanship, or day labor. This hybrid status reflects adaptive strategies in response to agricultural income instability (Dufumier, 2004; Losch et al., 2012).
3. **Salaried household heads:** These individuals hold regular off-farm employment (e.g., public service, teaching, retail, or private sector), while continuing to supervise their farming activities. Their salaries provide essential financial support to the household.

Statistical Distribution and Role of Pluriactivity

Survey results show:

- **Full-time farmers:** approx. **50%** of household heads,
- **Part-time farmers:** **26.92%**,
- **Salaried off-farm workers:** **23.07%**.

This confirms the structural role of pluriactivity as a livelihood strategy in low-productivity and climate-vulnerable environments (Scoones, 1998; Alary et al., 2021). It also highlights household adaptation to the seasonal nature of rainfed agriculture and integrated management of time and income sources.

Territorial Disparities

Spatial analysis reveals two contrasting territorial profiles:

- In **Kalâa** and **Tiniri**, most heads of household are full-time farmers, due to limited local alternatives. These villages rely heavily on family-based agriculture, sometimes supported by occasional remittances or pensions.
- In **Tazla** and **Belayel**, a higher proportion of household heads hold regular external jobs:
 - Around **33%** in Tazla,
 - Nearly **50%** in Belayel.

This is explained by better access to migration networks, vocational training, or employment opportunities in nearby urban areas. While non-agricultural income can finance farming activities, it also tends to increase inequalities between households, consolidating differentiated forms of domestic capitalism (Van der Ploeg, 2008).

3.2. Characteristics of Agricultural Systems and Household Income Structure

3.2.1. Orientation of Agricultural Systems

The analysis of agricultural systems across the four villages shows a predominant focus on **olive cultivation**, practiced by **75 out of 78** surveyed households. This near-monopoly is driven both by favorable agro-climatic conditions and the symbolic/patrimonial value of olive trees in Kabyle mountain societies (Bessaoud, 2013).

However, this specialization does not imply uniformity. Distinctive local resource endowments, water availability, and investment trajectories result in divergent system types.

- **Tazla** exhibits a diversified, integrated system including:
 - Upland olive farming,
 - Fig trees and traditional orchards,
 - Irrigated vegetable production,
 - Small-scale livestock farming (18 units: goats, poultry, sheep).

Vegetable farming is practiced by almost all households, mostly for self-consumption, with increasing but still marginal market orientation. This diversity, supported by irrigation and rural development programs (e.g. PNDAR), positions Tazla as a local resilience hub.

- In **Belayel**, olive farming also dominates, alongside:
 - Some cereal cropping,
 - Varied animal husbandry (37 units including beekeeping, rabbit, goat, and sheep farming),
 - Home gardening plots.
- **Kalâa** displays a fragmented profile. Traditional viticulture survives in a few plots but is declining. Cereal cropping is marginal. A modern orchard established under PNDAR funding was reported but had not yet yielded by the time of the survey—highlighting the slow materialization of public policy outcomes.
- **Tiniri** shows a highly specialized model centered almost exclusively on olives, with very limited diversification:
 - Only two cereal-growing farms,

- One instance of irrigated vegetable farming,
- Almost no organized livestock activity.

This specialization may reflect a combination of patrimonial attachment to olive trees and limited investment capacity due to infrastructure gaps, lack of technical support, and labor shortages.

3.2.2. Level of Agricultural Intensification

Despite localized efforts, farming systems across the villages remain **low-input and technologically underdeveloped**. Several indicators confirm this pattern:

- **Chemical inputs:** Only **12 households**, mainly in Tazla, reported using mineral fertilizers—usually in small amounts (3 to 6 quintals per season). Limited access, high cost, and lack of tailored technical advice explain this trend (Dufumier, 2004; Alary et al., 2021).
- **Organic manure:** Used by about **30 households**, it remains the main soil amendment. However, more than a third must purchase manure (1,500 DA per trailer), highlighting unequal access to livestock resources and varying household capital levels.
- **Pesticides:** Only **two cases** of use, both in Tazla, were recorded. This indicates an agricultural model that is largely non-chemical, either by necessity or by choice.

3.3. Household Income Structure and Disparities

3.3.1. Overall Income Levels

The analysis of total household income reveals significant heterogeneity between the surveyed villages. The **average annual income per household** is estimated at **335,718 DZD**, yet this figure conceals marked disparities:

- **Belayel** records the highest average income (**435,407 DZD**),
- followed by **Kalâa (308,722 DZD)** and **Tazla (295,652 DZD)**,
- while **Tiniri** lags significantly behind, with only **256,866 DZD**.

When adjusted for household size, the **average daily income per person** ranges from **1.15 USD (Tiniri)** to **1.99 USD (Belayel)**, based on the annual average exchange rate at the time of the survey. These figures place a substantial portion of the population **at or below the international poverty line**, in line with findings on marginalized rural areas in the Maghreb (Bessaoud, 2008; Sraïri et al., 2024).

Economic vulnerability in these mountain areas appears to be **structural rather than circumstantial**, driven by chronic factors such as land fragmentation, infrastructural deficits, and underemployment.

3.3.2. Income Distribution by Class

The distribution of annual income among households indicates a **clearly stratified socio-economic structure**. Nearly **59% of households earn less than 300,000 DZD annually**, with concentrations in **Tiniri** and **Tazla**. Conversely, a significant minority reports annual incomes **exceeding 500,000 DZD**, especially in **Tazla (25%)** and **Belayel (20%)**.

This uneven distribution reflects differentiated trajectories of accumulation, which are often shaped by:

- **Unequal access to productive resources**, particularly irrigable land and water;
- **Variably mobilized migration networks**, enabling remittances;
- **Opportunities for off-farm employment** or access to **profitable markets**.

These disparities suggest the coexistence of **contrasting household economies** within the same territories, ranging from subsistence-based livelihoods to more capitalized and market-oriented models. They also underline the need for **tailored public policies** capable of reducing income inequalities while supporting the potential for endogenous development in mountain contexts.

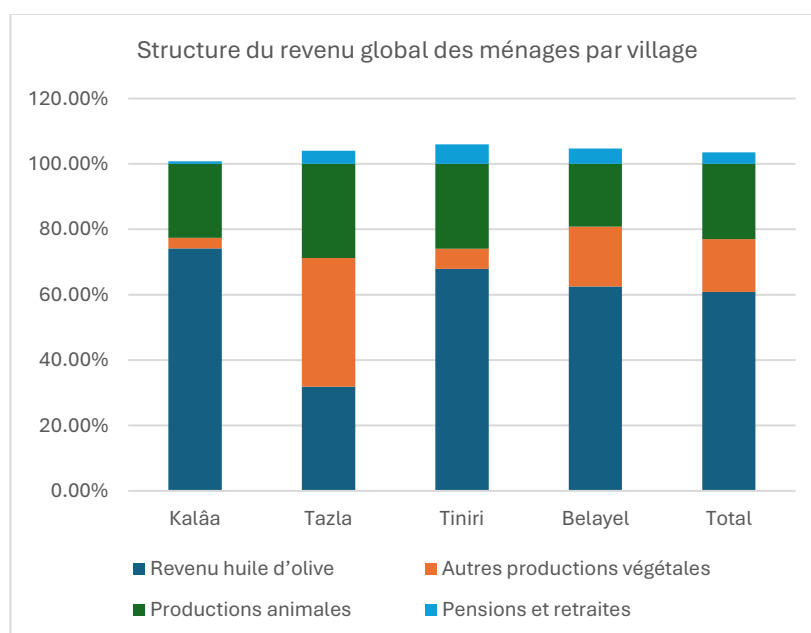


Figure 1: Distribution of Annual Household Income by Income Bracket

3.3.3. Income Composition by Source

Household income structures follow a **tripartite model**, reflecting the multifunctional nature of rural economies in mountain areas. On average, income sources are distributed as follows:

- **Agricultural activities:** 50.87%
- **Non-agricultural activities** (wage employment, informal jobs, crafts, trade): 45.53%
- **Pensions and retirement benefits:** 3.58%

However, this composition **varies significantly across villages**, depending on local resource endowments, accessibility to urban labor markets, and household integration into external income circuits.

Income Source	Kalâa	Tazla	Tiniri	Belayel	Average
Overall agricultural income	55%	64%	32%	71%	57%
Non-farm activities	48%	29%	60%	56%	53%
Pensions / retirement	5%	5%	5%	2%	8%

Table 4: Household Income Composition by Source and Village

3.3.3. Income Composition by Source

- **Tazla** is the only village where agriculture remains the dominant income source, accounting for over 75% of total household income. This reflects a successful combination of water access, crop diversity, and continued livestock activity.
- In contrast, **Tiniri** relies almost 60% on off-farm activities, with agriculture marginalized—a sign of progressive disengagement from the land.
- In **Kalâa** and **Belayel**, income sources are more evenly balanced between farming and non-agricultural activities, revealing hybrid livelihood models based on multi-activity.

3.3.4. Relative Contribution of Crop and Livestock Production

Crop production clearly dominates household agricultural income, representing nearly **75%** for most households:

- This share reaches **77.78% in Kalâa** and **70.83% in Belayel**,
- It is lower in **Tazla and Tiniri** (around **50%**), reflecting a more balanced diversification with livestock production.

Animal production (goats, poultry, beekeeping) accounts for **20–29%** of agricultural income, with the highest share observed in **Tazla** (29%), highlighting its role in food security and economic resilience.

4. Typology of Farming Strategies

A cross-analysis of production systems, income structures, and socio-economic trajectories allows us to distinguish **four main livelihood strategies**, shaped by local conditions and family, land, and ecological configurations:

1. Intensive Agricultural Strategies

Mainly observed in **Tazla**, these systems rely on **irrigated polyculture** combined with **diversified livestock farming**, made possible by better water availability and more structured land tenure. Despite limited mechanization, these systems reflect a logic of **resource optimization** and **agricultural resilience through diversification**.

2. Specialized Extensive Models

In **Kalâa** and **Tiniri**, **olive growing dominates** almost exclusively in contexts of low intensification, limited diversification, and minimal capital investment. These systems reflect a certain **productive inertia**, often linked to **aging farming populations** and the lack of generational renewal.

3. Integrated Mixed Strategies

In **Belayel**, households combine **perennial crops**, **cereal production**, and **livestock**, aiming for economic security through diversified agricultural activities. This hybrid model shows **adaptability to local resources** while maintaining a primarily farming orientation.

4. Compensatory Pluriactivity

Predominantly seen in **Tiniri**, this strategy is based on **mobilizing off-farm income** (salaried work, trade, remittances) to compensate for **low agricultural profitability**. It indicates a **progressive retreat from agriculture**, while retaining land as a resource for food security or cultural identity.

A Dynamic Reading of Peasant Trajectories

These contrasting profiles reveal a deep heterogeneity in rural livelihood logics, shaped by economic trade-offs, land inheritance systems, demographic pressures, and uneven access to public policies. They also illustrate different dynamics of **resilience** (Béné et al., 2014), **capitalization** (Ellis, 2000), and **adaptation** to agro-climatic and institutional uncertainties.

In certain localities, **agricultural dependency remains structural**, yet there is little value added to local resources—particularly products with **territorial identity** (olive oil, figs, honey) and **traditional knowledge**. This mismatch constrains transitions toward **more sustainable and inclusive models**.

5. Discussion

5.1. Agriculture Remains Central but Structurally Constrained

The results demonstrate that despite income diversification, **agriculture remains the primary economic activity** in several settlements—most notably in Tazla, where it accounts for over 75% of total household income. This persistence of agriculture as a foundational livelihood source in

marginalized areas corroborates Scoones's (1998) assertion that farming continues to function as a structural safety net in rural diversified economies.

However, this localized agriculture remains **poorly intensified**, characterized by low input usage, scarce mechanisation and irrigation, and minimal productive capital. This echoes Bessaoud's (2008) findings on technological lag and inadequate technical support in Algerian mountain zones. Additionally, structural constraints—such as land fragmentation, unequal access to water, and an aging agricultural workforce—limit opportunities for modernisation.

Viewed through Turner et al. (2003)'s lens, these local constraints reveal the complex interplay of **environmental vulnerability**, **institutional factors**, and **social responses**. Thus, agriculture in these territories embodies a form of **adaptive resilience**—constrained yet active—mirroring the concepts described by Folke (2006) and Adger (2006), whereby socio-ecological systems persist despite disturbances.

In this respect, the households' adaptive strategies—characterised by prudent resource management, communal support mechanisms, and continuous adjustment of farming practices—align with **contextual resilience** as described by Osbahr et al. (2008). These authors underscore that local responses to environmental and economic change hinge on **social capacity**, **institutional integration**, and **endogenous knowledge systems**.

5.2. Strategies Differ According to Resource Endowment and Family Trajectories

The **Sustainable Livelihoods Framework** (Chambers & Conway, 1992; Ellis, 2000) helps to explain household decision-making based on endowments of natural, human, social, and financial capital. It demonstrates that adaptation strategies are not uniform but strongly conditioned by the households' resource availability and socio-economic history.

In **Tazla**, where irrigated polyculture is well-developed, combining vegetables, orchards, and forages, and agriculture accounts for 75.6% of household income, **diversification and intensity** reinforce resilience against climatic and economic shocks. The relatively better water access (40% of utilized agricultural area under irrigation) reduces reliance on rainfall—a key advantage in the context of increased climate variability (IPCC, 2022). This exemplifies Turner et al.'s (2003) “differentiated adaptive capacity,” wherein social units with better resources are more capable of absorbing shocks.

Yet, over-reliance on a single income source, even within diversified agriculture, may expose households to **sectoral vulnerabilities**, such as crop disease, market instability, or ecosystem degradation. Limited mechanisation and low input use negatively affect both productivity and the ability to recover after shocks, aligning with Adger's concept of **weak adaptive resilience** (2006).

Conversely, households in **Kalâa**, **Belayel**, and especially **Tiniri** pursue income diversification through **remittances**, **pluriactivity**, and **informal work**. In Tiniri, agriculture is strongly marginalized, with **over 60% of income originating off-farm**, a pattern that signals **transformative resilience** where households redefine livelihood foundations in response to the limits of local agriculture (Folke, 2006).

However, as Osbahr et al. (2008) stress, the **nature and stability** of off-farm activities are critical. In Belayel, pluriactivity is underpinned by **stable external employment** (public sector, small commerce), which provides significant security and reduces vulnerability. In contrast, in Kalâa or Tiniri, these activities tend to be **precarious, informal, or migration-dependent**, exposing households to structural vulnerabilities linked to **unstable migration flows and diminishing local solidarity**.

These disparities illustrate a plurality of adaptive trajectories: households build resilience based on their resource combinations, family history, and territorial conditions. These findings echo Vanier (2008)'s work on **differentiated territorialisation of resources**, and Berkes & Ross's (2013) emphasis on **social capital and community safety nets** in rural adaptation strategies.

5.3. Pluriactivity as a Pillar of Adaptation

The **significant reliance on external income** (45.5% on average) underscores that **pluriactivity** has become a key mechanism for social reproduction, compensating for low agricultural profitability. Losch et al. (2012) describe this shift as a “silent transformation” of rural economies, characterized by **hybrid livelihood strategies** that combine agriculture, wage labor, small-scale commerce, and remittances.

This observation aligns with Scoones (2009) and Bebbington (1999) who emphasise the importance of **multi-capital strategies**—mobilising social, human, and economic capital—across divergent rural trajectories. Here, pluriactivity is more than a survival strategy; it is a **proactive adaptation tool** to socio-environmental and economic change. According to Turner et al. (2003), these strategies reflect forms of **differentiated vulnerability**, where capability is constrained by unequal access to structural resources such as employment, education, and migration networks.

However, the nature of pluriactivity varies spatially: in **Belayel**, it leans on stable employment (public sector, local commerce), which affords economic security. In **Kalâa** and **Tiniri**, it depends on precarious or migration-based activities, reminiscent of Adger (2006)’s findings on **inequality in adaptive capacity**—where institutional and human capital define the success of livelihood diversification.

These structural inequalities echo the resilience spectrum outlined by Folke (2006) and Osbahr et al. (2008): some households possess **adaptive leeway**, while others remain trapped in cycles of vulnerability, lacking recovery capacity. In this sense, **pluriactivity** both portends resilience and signals precarity, depending on how and where it is enacted.

Far from being a mere sign of successful adaptation, pluriactivity emerges as a **mirror of social and territorial fractures**, highlighting growing gaps between households pursuing secure strategies and those compelled into informality or necessity migration. It embodies the **differentiated territorialisation of livelihoods**, as described by Vanier (2008), and underscores the need for **more nuanced policies** that recognise diverse family trajectories and local adaptation strategies.

5.4. Weak Valorization of Intangible Capital and Local Resources

The data reveals a marked decline in formerly prominent activities such as the processing of agricultural products (dried figs, table olives, cheeses) and traditional crafts (pottery, weaving, woodworking), which have virtually disappeared in several localities. This finding raises concerns about the underutilization of intangible capital and territorial heritage, even though these resources could serve as powerful levers for economic differentiation, territorial anchoring, and value creation.

This situation echoes the observations of Bérard&Marchenay (2004) regarding the gradual abandonment of local heritage resources in the absence of institutional and market mechanisms to recognize, certify, and promote them. Traditional knowledge and terroir products represent territorially specific resources (Pecqueur, 2000) that can be mobilized to support endogenous development dynamics.

The decline of these activities also reflects a lack of coherent public policies in support of small-scale processing, rural crafts, or identity-based agriculture. Contrary to international recommendations—such as those of the FAO (2015) or the Slow Food Movement—which emphasize the importance of valuing culturally and ecologically embedded products, Algeria remains characterized by a centralized policy approach that often overlooks local specificities.

As Fonte (2008) and Wiskerke (2009) have shown, the institutional recognition of terroir products and traditional skills is not solely an economic matter but also a social and cultural dynamic linked to the requalification of place-based identity. In their absence, local resources tend to be marginalized, losing both economic and symbolic value.

Ultimately, this underutilization contributes to a growing disconnect between local resources and economic valorization circuits, a phenomenon analyzed by Ray (1998) through the lens of the new rural development paradigm based on territorial identity-building. It signifies a weakening of cultural capital and territorial memory—critical elements in any strategy aimed at differentiated and resilient rural development.

5.5. Resilience Indicators Specific to Mountainous Areas

Beyond income levels and livelihood diversification, other indicators are crucial for assessing resilience in mountain regions, where ecological constraints, remoteness, and territorial imbalances amplify vulnerabilities. Resilience, understood here as the capacity of households to anticipate, absorb, adapt to, and transform in the face of shocks (Adger, 2006; Folke, 2010), must be assessed through a set of integrated dimensions:

- **Diversity of Livelihood Capitals**

Households' ability to mobilize and trade off among different types of capital—natural, physical, human, financial, and social—is a core resilience indicator, consistent with the frameworks proposed by Scoones (1998) and Ellis (2000). In Tazla, for instance, access to water (natural capital) and the mastery of polyculture practices (human and cultural capital) illustrate effective use of endogenous resources, aligning with the notion of adaptive capacity (Turner et al., 2003).

- **Adapted Production Systems**

The flexibility of agricultural systems—irrigated polyculture, diversified land access (communal ownership, private holdings, shared family use)—reflects the organizational resilience of farms, as discussed by Carpenter et al. (2001). These flexible systems enable better responses to climate variability and land constraints in mountainous regions.

- **Social and Family Networks**

The density of social ties and the activation of migratory or family networks serve as safety nets during crises (illness, poor harvests, economic shocks). The importance of community solidarity is emphasized by Berkes & Ross (2013), who identify social capital as a core component of community resilience. Family structure (number of working-age members, presence of adult sons) directly impacts a household's capacity to absorb and recover from crises.

- **Human Capital and Training**

Education level, migration experience, and ability to navigate administrative and economic systems influence access to non-agricultural income sources. However, the low prevalence of young household heads and reluctance to transfer farming responsibilities may indicate an intergenerational rupture in agricultural knowledge—a phenomenon Brown (2014) identifies as structural erosion of rural resilience.

- **Access to Support Mechanisms**

Resilience is also shaped by institutional environments. The absence of extension services, appropriate credit schemes, agricultural insurance, or storage infrastructure constitutes a structural vulnerability. As Folke et al. (2002) argue, resilience cannot be sustained without institutional capacity to support local responses. In mountainous areas, these deficits exacerbate already pronounced territorial imbalances.

- **Diversification of Crops and Livestock Activities**

Productive diversity enables risk distribution (pests, climate shocks, price volatility), contributing to ecological resilience. Polyculture combined with various forms of livestock (sheep, cattle, poultry) helps stabilize farm income and buffer sectoral shocks, echoing the work of Walker et al. (2004) on resilient agroecological systems.

In summary, resilience in mountain areas cannot be reduced to income diversification alone. It is underpinned by a multifaceted integration of social, productive, cultural, and institutional factors, all of which must be carefully considered when designing development policies tailored to these vulnerable territories.

5.6. Study Limitations and Future Research Directions

This study is based on an in-depth analysis of four villages and a targeted sample of households, selected for their diversity in terms of resource access, economic trajectories, and family configurations. While this

approach helps identify significant trends, it remains grounded in a localized context and should not be generalized without caution.

From the standpoint of external validity (Yin, 2003), expanding the study to other mountainous zones—particularly those with varied agroecological and institutional contexts—would be essential for testing the robustness of the household typologies identified here and refining the understanding of differentiated adaptation mechanisms. Such an approach would also provide insights into the territorialization effects of public policies on rural livelihoods, echoing Bessaoud's (2013) work on the heterogeneity of rural trajectories in the Mediterranean region.

Moreover, a longitudinal approach could deepen our understanding of adaptation trajectories by capturing the long-term evolution of rural transformations. This would allow for the analysis of delayed effects from public policies or climatic events, as well as intergenerational and migratory reconfigurations—central elements in the structural resilience of territories (see Adger, 2006; Berkes& Ross, 2013).

Finally, the integration of participatory tools (community diagnostics, social mapping) and fine-grained qualitative indicators could strengthen future research by capturing the diversity of local perceptions of vulnerability and resources. This would align with participatory research-action approaches (Chambers, 1994) and endogenous development methodologies, enhancing both the legitimacy and accuracy of rural development strategies.

General Conclusion

This research, conducted in four villages of the Ighil Ali municipality in the mountainous region of Béjaïa (Algeria), has provided an in-depth exploration of the social, economic, and territorial dynamics at play in rural mountain areas. By mobilizing the Sustainable Livelihoods Approach (SLA) (Chambers & Conway, 1992; Scoones, 1998), it revealed the diversity of household profiles, production systems, livelihood strategies, and forms of adaptation to multiple constraints—ecological, economic, and institutional.

The findings highlight the continued centrality of agriculture—particularly olive cultivation—in rural livelihoods, although its relative importance varies significantly between villages, reflecting inequalities in access to natural, human, and social resources. In areas where resources are available and effectively utilized (as in Tazla, with access to irrigation), households manage to sustain more diversified and resilient agricultural systems. Elsewhere, the progressive abandonment of agricultural and artisanal practices signals a deep erosion of local economic foundations and an underutilization of intangible capital.

Pluriactivity emerges as a structuring adaptive strategy, enabling households to secure their income in the face of climatic uncertainty and low agricultural profitability. However, it is practiced under highly unequal conditions depending on locality, migratory trajectories, and access to resources. It simultaneously illustrates differentiated resilience and vulnerability among households, in line with the work of Turner et al. (2003), Adger (2006), and Berkes& Ross (2013) on adaptation inequalities and the importance of context-specific approaches.

The study further underscores the weak valorization of local resources—agricultural products, traditional knowledge, landscapes—and the lack of public policies to support transformation and territorial qualification of products. This deficit in the territorialization of public action contributes to the socio-economic marginalization of so-called peripheral areas, despite their largely untapped potential for endogenous development (Pecqueur, 2000; Ray, 1998; Bérard&Marchenay, 2004).

Beyond economic dimensions, this research calls for a rethinking of the notions of poverty, vulnerability, and development. Poverty cannot be reduced to a single monetary metric; it is also expressed through the loss of control over resources, institutional marginalization, dependence on external aid, or the erosion of local knowledge transmission. Conversely, resilience lies not only in the ability to withstand shocks, but also in the capacity to reorganize, innovate, and redefine the foundations of livelihood using territorial resources (Folke, 2010; Scoones, 2009).

Ultimately, this study advocates for rural development policies that are better adapted to the specificities of mountain areas. This implies moving away from top-down, sectoral approaches toward territorialized,

integrated, and participatory strategies—ones that recognize the diversity of local trajectories, enhance endogenous resources, and involve residents as full actors of development. It also suggests that the evaluation of territorial resilience should go beyond economic indicators to incorporate social, cultural, institutional, and environmental dimensions.

In conclusion, the mountainous territories studied are not merely spaces of crisis or backwardness, but also sites of social recomposition, quiet innovation, and silent resilience. Rethinking their development requires an approach that is at once critical, engaged, and contextual—one capable of reconciling territorial justice, sustainability, and the recognition of local capacities to construct a viable future.

Références bibliographiques

- [1] Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, 16(3), 268–281. <https://doi.org/10.1016/j.gloenvcha.2006.02.006>
- [2] Alary, V., El Shater, T., Sadok, R., & Mahdi, M. (2021). Heterogeneity of resilience of livelihood strategies in Morocco. *Frontiers in Sustainable Food Systems*, 5, 651682. <https://doi.org/10.3389/fsfs.2021.651682>
- [3] Balsiger, J., & Debarbieux, B. (2011). "Major Challenges in Mountain Governance and the Way Forward". In Price, M. F., Borowski, D., Macleod, C. J. A., Rudaz, G., Scheurer, T., Veit, B., & Wymann von Dach, S. (Eds.), *Mountain Futures: A Blueprint for Research and Action* (pp. 23–28). Bern: Centre for Development and Environment (CDE), Swiss Agency for Development and Cooperation (SDC), and Geographica Bernensia.
- [4] Baroud, K., Colin, J.-P., & Daoudi, A. (2018). *La politique d'accès à la propriété privée des terres mises en valeur en zones arides en Algérie : éléments de discussion. Économierurale*, 363, 81–98.
- [5] Bebbington, A. (1999). Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty. *World Development*, 27(12), 2021–2044. [https://doi.org/10.1016/S0305-750X\(99\)00104-7](https://doi.org/10.1016/S0305-750X(99)00104-7)
- [6] Bérard, L., & Marchenay, P. (2004). *Les produits de terroir : Entre cultures et règlements*. CNRS Éditions.
- [7] Berkes, F., & Ross, H. (2013). Community resilience: Toward an integrated approach. *Society & Natural Resources*, 26(1), 5–20. <https://doi.org/10.1080/08941920.2012.736605>
- [8] Bessaoud, O. (2008). *Les politiques de développement rural en Algérie : Éléments de diagnostic et enjeux d'avenir*. CIHEAM–IAMM.
- [9] Bessaoud, O. (2013). Les politiques de développement rural au Maghreb. *Options Méditerranéennes*, (B66), 11–33.
- [10] Bessaoud, O. (2013). Politiques agricoles et développement rural en Algérie. *CIHEAM–IAMM*.
- [11] Brown, K. (2014). Global environmental change I: A social turn for resilience? *Progress in Human Geography*, 38(1), 107–117. <https://doi.org/10.1177/0309132513498837>
- [12] Caron, P., Valette, E., Wassenaar, T., Coppens d'Eeckenbrugge, G., & Papazian, V. (2017). *Territoires et développement durable : De la compréhension des systèmes agricoles aux politiques publiques*. Éditions Quae.
- [13] Carpenter, S. R., Walker, B., Anderies, J. M., & Abel, N. (2001). From metaphor to measurement: Resilience of what to what? *Ecosystems*, 4(8), 765–781. <https://doi.org/10.1007/s10021-001-0045-9>
- [14] Chambers, R. (1994). Participatory rural appraisal (PRA): Challenges, potentials and paradigm. *World Development*, 22(10), 1437–1454. [https://doi.org/10.1016/0305-750X\(94\)90030-2](https://doi.org/10.1016/0305-750X(94)90030-2)
- [15] Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century* (IDS Discussion Paper 296). Institute of Development Studies.
- [16] Debarbieux, B., & Rudaz, G. (2010). *Les faiseurs de montagne. Imaginaires politiques et territorialités*. Genève : CNRS Éditions / Université de Genève.

- [17] Deverre, C., & Mathieu, N. (2002). *Les agricultures en Europe : Diversité, mutations et perspectives*. CNRS Éditions.
- [18] DFID.(1999). *Sustainable livelihoods guidance sheets*. Department for International Development. <https://www.enonline.net/attachments/872/dfid-sustainable-livelihoods-guidance-sheet-section1.pdf>
- [19] Dufumier, M. (2004). *Agriculture et paysannerie des Tiers Mondes*. Karthala.
- [20] Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford University Press.
- [21] FAO. (2015). *Developing sustainable food value chains: Guiding principles*. Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/i3953e/i3953e.pdf>
- [22] Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, 16(3), 253–267. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>
- [23] Folke, C. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4), 20. <https://www.jstor.org/stable/26268226>
- [24] Fonte, M. (2008). Knowledge, food and place: A way of producing, a way of knowing. *Sociologia Ruralis*, 48(3), 200–222. <https://doi.org/10.1111/j.1467-9523.2008.00462.x>
- [25] Jollivet, M. (2001). *Pour une sociologie des mondes ruraux*. Armand Colin.
- [26] Laurent, C., & Rémy, J. (1998). Pluriactivité et recompositions des mondes ruraux. *Économie Rurale*, 245, 4–15. <https://doi.org/10.3406/ecoru.1998.5155>
- [27] Losch, B., Fréguin-Gresh, S., & White, E. (2012). *Structural transformation and rural change revisited: Challenges for late developing countries in a globalizing world*. World Bank.
- [28] Messerli, B., & Ives, J. D. (Eds.). (1997). *Mountains of the World: A Global Priority*. New York: The Parthenon Publishing Group / London: United Nations University.
- [29] Pecqueur, B. (2000). *Le développement territorial : Une réponse émergente à la mondialisation*. Syros.
- [30] Price, M. F., Jansky, L., & Iatsenia, A. (Eds.). (2013). *Mountain Geography: Physical and Human Dimensions*. Berkeley: University of California Press.
- [31] Ray, C. (1998). Culture, intellectual property and territorial rural development. *Sociologia Ruralis*, 38(1), 3–20. <https://doi.org/10.1111/1467-9523.00060>
- [32] Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis* (IDS Working Paper 72). Institute of Development Studies.
- [33] Scoones, I. (2009). Livelihoods perspectives and rural development. *The Journal of Peasant Studies*, 36(1), 171–196. <https://doi.org/10.1080/03066150902820503>
- [34] Sraïri, M. T., Hilali, M. E., & Benjelloun, R. (2024). Farming systems in arid Maghreb: Between climate constraints and institutional fragmentation. *Cahiers Agricultures*, 33, 19. <https://doi.org/10.1051/cagri/2024019>
- [35] Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Schiller, A. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences*, 100(14), 8074–8079. <https://doi.org/10.1073/pnas.1231335100>
- [36] Van der Ploeg, J. D. (2008). *The new peasantries: Struggles for autonomy and sustainability in an era of empire and globalization*. Earthscan.
- [37] Vanier, M. (2008). *Le pouvoir des territoires : Essai sur l'interterritorialité*. Éditions de l'Aube.
- [38] Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, 9(2), 5. <https://www.jstor.org/stable/26267673>
- [39] Wiskerke, J. S. C. (2009). On places lost and places regained: Reflections on the alternative food geography and sustainable regional development. *International Planning Studies*, 14(4), 369–387. <https://doi.org/10.1080/13563471003642803>
- [40] Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Sage Publications.