



YOUTH IN JUST FOOD SYSTEMS TRANSITIONS:

BENIN

INCLUDE

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LIST OF ACRONYMS AND ABBREVIATIONS

ANPE	National Employment Agency
DPAF	Directorate of Planning, Administration and Finance (of MAEP)
DSA	Directorate of Agricultural Statistics (of MAEP)
EMICOV	Integrated Modular Survey of Household Living Conditions
ERI-ESI	Integrated Regional Survey of Employment and the Informal Sector
SSI	Semi-structured interview
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
INRAB	Benin National Institute for Agricultural Research
INStaD	National Institute of Statistics and Demography
MAEP	Ministry of Agriculture, Livestock and Fisheries
OECD	Organisation for Economic Co-operation and Development
FBO	Farmer-Based Organisation
SDG	Sustainable Development Goals
ILO	International Labour Organization
NGO	Non-Governmental Organisation
GDP	Gross Domestic Product
NAP	National Climate Change Adaptation Plan
UNEP	United Nations Environment Programme
PNOPPA	National Platform of Peasant Organisations and Agricultural Producers of Benin
PRISMA-P	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols
PSDSA	Strategic Plan for Agricultural Sector Development
RGPH4	General Population and Housing Census, 4th edition
SPSS	Statistical Package for the Social Sciences (Statistical Software)
RNA	National Agricultural Census

EXECUTIVE SUMMARY

Benin presents a paradox that is characteristic of many least developed economies in West Africa: sustained economic growth of approximately 5% per year coexists with a ranking of 173rd on the Human Development Index and a youth bulge in which 65% of the population is under 25 years of age. Agriculture contributes 25.4% of GDP and provides the primary livelihood for the majority of rural households, yet it is increasingly perceived by youth as a sector with limited prospects, insufficient remuneration, and low social status. Against this structural backdrop, the transition towards just and sustainable food systems offers a pathway to generate productive, green, and decent employment for young Beninese men and women.

This study was commissioned by INCLUDE to examine the determinants of green employment in agri-food value chains and to identify the justice gaps that prevent a more equitable distribution of these opportunities. The study pursues four interrelated objectives: (1) to map existing green job opportunities for youth across three selected value chains; (2) to identify the individual and territorial determinants of green employment using quantitative methods; (3) to characterise the profiles of youth engaged in green agri-food activities through qualitative inquiry; and (4) to formulate evidence-based recommendations structured around a four-dimensions-of-justice framework drawing on the work of Schlosberg (2007) and Fraser (2008), covering distributive, procedural, recognition, and restorative justice.

A sequential mixed-methods design was applied across three departments with contrasting agro-ecological and institutional profiles: Atlantique (Abomey-Calavi, Allada), Borgou (Parakou, N'Dali), and Couffo (Aplahoué, Djakotomey). The study combined: (1) a systematic literature review conducted under the PRISMA-P protocol (2010-2025); (2) a quantitative survey of 397 youth active in agriculture; and (3) qualitative data from 36 semi-structured individual interviews and nine focus group discussions involving 69 participants. Three value chains were selected as focal domains of green employment potential: organic and agro-ecological vegetable production (Value Chain 1), sustainable agri-food processing (Value Chain 2), and digital marketing of agricultural products (Value Chain 3). Statistical analyses integrated binary logistic regression, Poisson regression (intensity of green engagement), mediation analysis (Preacher and Hayes, 2008), principal component analysis, ascending hierarchical classification, and non-parametric tests (Kruskal-Wallis, Mann-Whitney U, Spearman correlations with Bonferroni correction).

Five major findings structure the evidence base of this report:

- (1) Widespread but unequal green engagement. 65% of surveyed youth are already engaged in at least one green practice, indicating significant momentum towards sustainable agri-food employment. However, engagement is profoundly unequal across territories, gender lines, and socioeconomic profiles.
- (2) The most powerful determinant of green employment is departmental location. Youth in Borgou are 7.49 times more likely to engage in green activities than their counterparts in Couffo with identical individual characteristics (OR = 7.49, $p < 0.001$), a result explained by the convergence of denser institutional infrastructure, active

cooperative dynamics, climate-driven agro-ecological diversification, and proximity to organised lead markets.

- (3) Women face a structural penalty of -13.7 percentage points in the likelihood of green employment (OR = 0.55, AME = -13.7 pp, $p = 0.002$). Income mediates only 19.2% of this effect, indicating that the gender gap is driven primarily by non-economic mechanisms: dual productive and reproductive burdens, mobility constraints, discriminatory access to productive assets, and entrenched social norms governing professional networks.
- (4) Three independent variables exert comparable marginal effects on green employment probability: land ownership (OR = 2.91, AME = +24.3 pp), specialised agricultural education (OR = 2.66, AME = +22.3 pp), and rural residence (OR = 2.71, AME = +22.8 pp). This convergence identifies three operational, complementary levers for public policy.
- (5) Access to credit is negatively associated with green engagement at the individual level (Cluster 2: 100% credit access, 53.7% green employment rate), revealing that existing financial products are structurally misaligned with green agri-food investment profiles. Furthermore, 61.8% of youth had never heard of the concept of green jobs, yet 91.1% considered it a major opportunity once informed, demonstrating a knowledge-action gap in which awareness is necessary but not sufficient in the absence of enabling conditions.

Recommendations are structured along the four dimensions of the justice framework:

- **Distributive Justice:** Priority reform of the Land Code to enshrine preferential youth and women's land allocation mechanisms; establishment of youth land banks managed by local authorities; design of green financial instruments adapted to agri-food investment timelines, including green micro-leasing, mutual guarantee funds, and gender-differentiated intra-group credit.
- **Procedural Justice:** Mandatory 30% youth representation (at least half women) in value chain governance bodies; reform of agricultural extension curricula to systematically integrate business management, digital marketing, financial literacy, and climate adaptation modules; national roll-out of a digital equipment programme for young rural agripreneurs, with priority for Couffo.
- **Recognition Justice:** Launch of a national campaign to promote green agri-food entrepreneurship as a viable and aspirational career pathway, in partnership with public media and youth organisations; repositioning of youth from passive beneficiaries to co-designers and evaluators of green employment programmes.
- **Restorative Justice:** Revision of the Land Code to incorporate restorative provisions for historically excluded groups; financing of programmes to restore degraded soils and ecosystems in Couffo and northern departments, systematically coupling ecological restoration with green job creation for youth. These recommendations are actionable within Benin's existing agricultural, employment, and environmental policy frameworks, and are aligned with the African Union's Agenda 2063 and the Sustainable Development Goals 1, 8, and 13.

1. GENERAL INTRODUCTION

1.1 Context and Rationale

The Republic of Benin is enjoying an exceptional economic boom, with Gross Domestic Product (GDP) growing by 7.5% in 2024 (IMF, 2025). However, this dynamic is struggling to deliver a proportional improvement in social well-being. The country ranks 173rd in the world on the Human Development Index (HDI of 0.515), reflecting a low level of human development (UNDP, 2025). The human development indicators reveal persistent structural weaknesses: poverty affects 36.2% of the population, with a marked disparity between urban (30.8%) and rural (40.6%) areas. Benin has a life expectancy of 60.8 years and an average length of schooling of just 3.2 years.

Despite an increase in social spending (46.8% of the national budget in 2024) in the context of the Government Action Programme (PAG 2021-2026), the security and climate crises in the Sahel, and particularly armed conflicts in neighbouring countries, cross-border displacements, and increasingly severe drought and flooding events are undermining the inclusion efforts promoted by the national authorities. The country is facing unprecedented demographic pressure: approximately 65% of Benin's population is under the age of 25, with a median age of 18.5 (United Nations World Population Prospects, 2024; UNFPA, 2024). Every year, some 106,000 young people join a labour market in which the formal sector is saturated (INSAE/ERI-ESI, 2018). This imbalance results in a statistical paradox: although official unemployment is low (1.7%), it conceals systemic job insecurity in the informal sector, which is often not included in the figures. 94% of workers in the informal economy work on an informal basis, and the NEET phenomenon affects 15% of young people in general (including 18% of young women): they are neither in employment, education or training. This situation is an obstacle to capturing the 'demographic dividend' and it keeps a large proportion of young people in rural underemployment (Ayamga et al., 2023). According to INStAD (2021), rural underemployment among 18-35 year olds exceeds 30% in agricultural areas and it is fuelled by seasonal work patterns and limited non-agricultural opportunities.

Agriculture remains at the heart of Benin's economy, contributing around 25.4% of GDP and 28% of total employment (World Bank, 2023). The sector provides rural livelihoods for over 70% of the population (MAEP, 2023). In the face of climate change (erratic rainfall, rising temperatures, increased pressure from pests (NAP 2023-2027; FAO, 2021; IPCC, 2022)) and the low productivity of family farms, the adoption of the integration of green renewable energy and digital technologies (hereafter referred to as 'green modernisation') would seem to represent an opportunity for job creation (FAO, 2018; IPCC, 2019). The International Labour Organization (ILO) predicts that 24 million green jobs will be created worldwide by 2030 (ILO, 2018). Regional projections suggest that Africa could generate up to 30 million green jobs through proactive transition policies (PMI, 2023), while FSD Africa (2024) estimates that there will be 3.3 million direct green jobs in African agriculture. However, in the absence of targeted policy interventions, Africa risks suffering net job losses as environmental degradation undermines existing agricultural livelihoods. For Benin, this transition is covered by strong commitments:

- The National Adaptation Plan (NAP 2022), which aims for climate resilience by 2030,
- The Nationally Determined Contribution (CDN) targeting a 20.15% reduction in greenhouse gas emissions.

This study will focus on three strategic value chains in Benin: organic vegetable production, sustainable agri-food processing, and the digital marketing of agricultural products.

Although the country has a robust strategic framework (PSDSA 2017-2025, PNJ, PAG), there is a critical information gap. There are no recent, accurate data about the actual number of jobs created by the green sectors in question, the nature of the skills concerned, the specific obstacles encountered by young entrepreneurs, or the precise geographical distribution of opportunities. This lack of data limits the effectiveness of public policies and the targeting of private investment. The aim of this study is therefore to draw up a dynamic map of green job opportunities. It will provide decision-makers with decision-support tools and give young people a clearer picture of an agricultural ecosystem that is undergoing profound change.

Global food systems are going through profound changes as a result of climate change, demographic shifts, urbanisation, technological innovation and changing consumer preferences. Those transitions are particularly acute in sub-Saharan Africa: the region is faced with the dual challenge of feeding a rapidly growing and urbanising population while adapting to climate variability and environmental degradation. West Africa's food economy accounts for approximately two-thirds of total employment, underlining the central role of the sector for livelihoods, economic development and social stability. Against this background, Benin, a small, densely populated country on the Gulf of Guinea (with a population of some 13.5 million in 2023), illustrates both the opportunities and the constraints of food system transitions. Despite the significant contribution made by agriculture to the country's economy, sector productivity is low (average cereal yield of 1.5 t/ha compared with a world average of 3-4 t/ha), with limited added value, inadequate infrastructure and vulnerability to climate shocks.

The Food Systems Transition (FST) concept recognises that food systems must meet nutritional, environmental and equity objectives at the same time (HLPE, 2017; Béné et al., 2019; Herrero et al., 2020). However, the transitions are not intrinsically fair: they can funnel benefits to actors with better resources, displace vulnerable groups, and reproduce or exacerbate existing inequalities. A transition in food systems therefore requires an explicit focus on the question of who benefits, who participates in decision-making, whose knowledge and aspirations are recognised, and how historical exclusion and environmental damage will be redressed.

Youth, broadly defined as individuals aged between 15 and 35 according to the African Youth Charter adopted at the Banjul Summit in 2006, are the demographic majority in sub-Saharan Africa and they are central to the future of the continent's food systems. In Benin, as in West Africa as a whole, young people face a paradox: while agriculture provides employment and entrepreneurial opportunities, young people increasingly see farming as an occupation that is unappealing and high-risk with a low social status. A number of factors shape this paradox. On the supply side, young people encounter obstacles to acquiring land (with a dominant role for inheritance and rising costs), limited access to finance and credit, training that is ill-suited to the requirements of modern agri-business, poor rural infrastructure and inadequate institutional support (Rosaire et al., 2022; Akrong et al., 2022; ElDidi et al., 2020; Yeboah et al., 2019). On the demand side, structural change is pushing employment away from primary production towards the non-farming segments of the food economy (processing, marketing, distribution and catering services), which are growing rapidly in urban and peri-urban areas (Allen et al., 2018).

The juxtaposition of the challenges of youth employment and environmental imperatives is resulting in both risks and opportunities. Climate change is threatening agricultural productivity and food security, disproportionately affecting smallholders and rural youth who depend on rainfed agriculture and whose capacity to adapt is limited. At the same time, green transitions (towards agro-ecology, smart climate practices, sustainable value chains and digital agricultural technologies) hold out the promise of creating new green jobs that are environmentally sustainable, economically viable and socially inclusive. However, achieving this promise requires targeted policy and programmatic interventions to ensure that green jobs are accessible to a range of youth populations, particularly rural youth, the poorest and young women, who face cumulative disadvantages. Gender dynamics further complicate the youth-agriculture-environment nexus. Young women in Benin and throughout West Africa are systematically excluded from agricultural roles with higher added value, management positions and decision-making processes. Reviews of research and innovation projects have shown that women and youth are often presented as 'helpers' rather than as the principal farmers, that gender inclusion is frequently project-linked and driven by donors, and that youth are less systematically targeted than other groups (Yami et al., 2024). Young women encounter intersectional barriers: age, gender and socio-economic status interact to restrict access to land, credit, training, cooperative membership and market opportunities (Yami et al., 2024).

This study will analyse the mechanisms for creating and accessing green jobs for youth in Benin's agri-food sector by identifying the drivers of an inclusive ecological transition. The goal of this analysis is to inform the implementation of Benin's National Strategy for Sustainable Development in Agriculture (PSDSA 2021-2025), which prioritises the modernisation of the agricultural sector and the inclusion of youth (MAEP, 2021). The study focuses on three value chains with high potential for the creation of green jobs: organic vegetable production, sustainable agri-food processing, and the digital marketing of agricultural products.

Despite a growing political focus on youth employment and green transitions in Africa, evidence on how to design and implement equitable, sustainable and scalable interventions continues to be fragmented and inadequately synthesised. Benin has articulated national priorities for agricultural development, youth employment and climate adaptation through policy frameworks such as the Strategic Agricultural Sector Development Plan (PSDSA 2021-2025), the National Adaptation Plan (NAP 2023-2027) and the Nationally Determined Contribution (CDN) in the context of the Paris Agreement. However, three critical knowledge gaps are hampering progress towards a just food system transition in Benin:

1. **The dimensions of equity and justice are under-analysed:** Most studies focus on results in the areas of employment, productivity or technology adoption without systematically assessing the implications in terms of distributive, procedural, recognition and restorative justice. The questions of who benefits from green transitions, who is excluded, and how power and resources are redistributed have still not been adequately explored.
2. **Evidence about effectiveness and scaling is inadequate:** Systematic reviews note a chronically inadequate evaluation of youth training and employment programmes, with a limited number of rigorous evaluations of the impact, few longitudinal studies and an inadequate focus on heterogeneity in terms of gender,

age, level of education and location (Maïga et al., 2020). There are promising pilot models in place but they have not been validated on a large scale.

3. **Cross-sectoral and cross-border synthesis is limited:** Studies specific to Benin are often sector-specific (looking at yam, cotton or rice, for example) or project-related, and comparative lessons from other West African countries are not systematically integrated in Beninese policies and practices.

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1.2 Research questions

Principal question: How do the dynamics of political economics shape employment opportunities for young people in the transition to more sustainable and fairer agri-food systems in Benin ?

Secondary questions:

- To what extent are green technological innovations transforming employment opportunities in the three value chains selected for this study (organic vegetable production, sustainable agri-food/agri-ecological processing, and the digital marketing of agricultural products) in Benin?
- What are the main structural and institutional obstacles (analysed through the four dimensions of justice) that limit youth green job opportunities in the agri-food sector ?
- How can public policies and private initiatives be conceived and coordinated to facilitate inclusive access for youth (and particularly young women), to green jobs resulting from the transition of food systems in Benin?

1.3 Research approach

To answer these questions, this study adopts a sequential mixed design combining three complementary approaches. The first component is a systematic review of the scientific and grey literature (2010-2025) in line with the PRISMA-P protocols, examining existing evidence using a four-dimensional analytical framework of justice as developed in the literature on social and environmental justice (Schlosberg, 2007; Fraser, 2008) and used in INCLUDE's fundamental research on inclusive development (INCLUDE, 2023). The second component is a quantitative survey of 393 young people (aged 18 to 35) working in agri-food value chains in six communes in three departments (Atlantique, Borgou, Couffo). The third component consists of qualitative research including semi-structured interviews with key actors from five institutional categories, as well as nine focus group discussions with young participants. The four dimensions of justice serve as a unifying analytical framework through the three components of the study, allowing for a systematic triangulation of quantitative results with the qualitative insights.

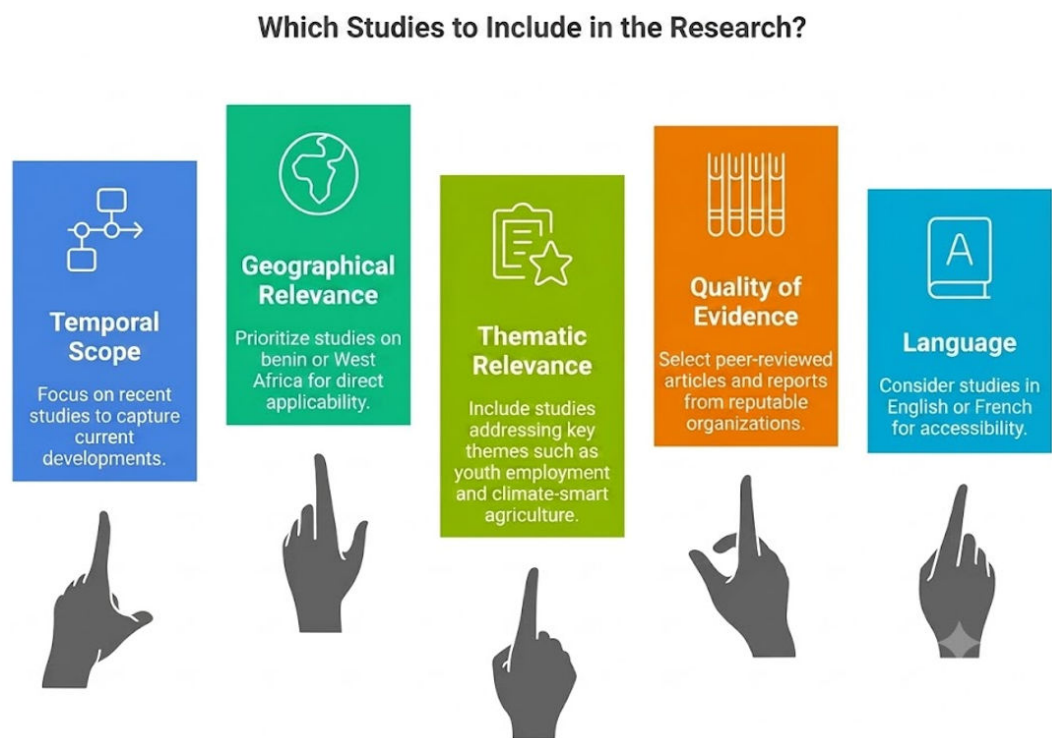
2. METHODOLOGY

2.1 Systematic literature review

The review adopts a mixed systematic-narrative approach that combines structured research procedures with an interpretative synthesis. In accordance with the PRISMA-P protocols, an exhaustive search was conducted in several academic databases (Google Scholar, Scopus, SciSpace, PubMed, ArXiv) using a multidimensional query framework integrating geographical scope (Benin, West Africa, sub-Saharan Africa), the thematic focus (youth employment, green jobs, just transition, value chains) and the specificity of agricultural value chains. The review is evidence-based and the sources are limited, drawing on a selected set of 30 articles identified by exhaustive database searches and artificial-intelligence-assisted relevance ranking. The inclusion criteria targeted empirical studies, policy documents, systematic reviews and grey literature published between 2010 and 2025, in English or French, and focusing on youth employment in agri-food systems covered by the geographical and thematic scope of the study (Fig. 1). The quality assessment used a multi-criteria framework to assess methodological rigour, relevance, recency and level of evidence. Each source was rated on a scale of 1 to 5 using four criteria, with a maximum composite score of 20. Sources with a score of less than 10 were excluded unless they addressed evidence gaps specific to Benin.

The analytical framework applies four dimensions of justice (distributive, procedural, recognition, restorative) to summarise the results through the evidence base, enabling the systematic identification of equity gaps and policy implications. Full details of the documentation collection methods, the list of databases and the PICOS criteria can be found in Annex A.

Figure 1: Inclusion criteria



The mixed systematic-narrative approach is justified by the objectives of the review and the nature of the available evidence. A purely systematic review would be too restrictive given the diversity of the relevant types of evidence (quantitative surveys, qualitative case studies, policy documents, systematic reviews) and the need for an interpretative synthesis through the dimensions of justice. Conversely, a purely narrative approach would lack transparency and reproducibility. The approach adopted strikes a balance between rigour and flexibility, allowing for exhaustive coverage while maintaining methodological transparency. The focus on Benin, including the broader West Africa and sub-Saharan Africa context, reflects the review's political orientation. The primary focus is on country-specific evidence, but the regional studies provide an essential comparative context and identify patterns that may be applicable to Benin. The temporal scope (2010-2025) captures recent political developments, including the 2013 reforms to Benin's land code, while the focus on the period 2020-2025 ensures that the information is up to date.

2.2 Quantitative survey

The quantitative survey was conducted with a sample of 397 young people aged between 18 and 35 who are actively employed in sustainable agri-food value chains. This age category was chosen to ensure that respondents have the economic autonomy and social maturity required for entrepreneurial management. Eligibility was conditional on compliance with four cumulative criteria: age between 18 and 35 years; resident in one of the six target communes for at least the past six months; employment in at least one of the three targeted value chains; and informed consent.

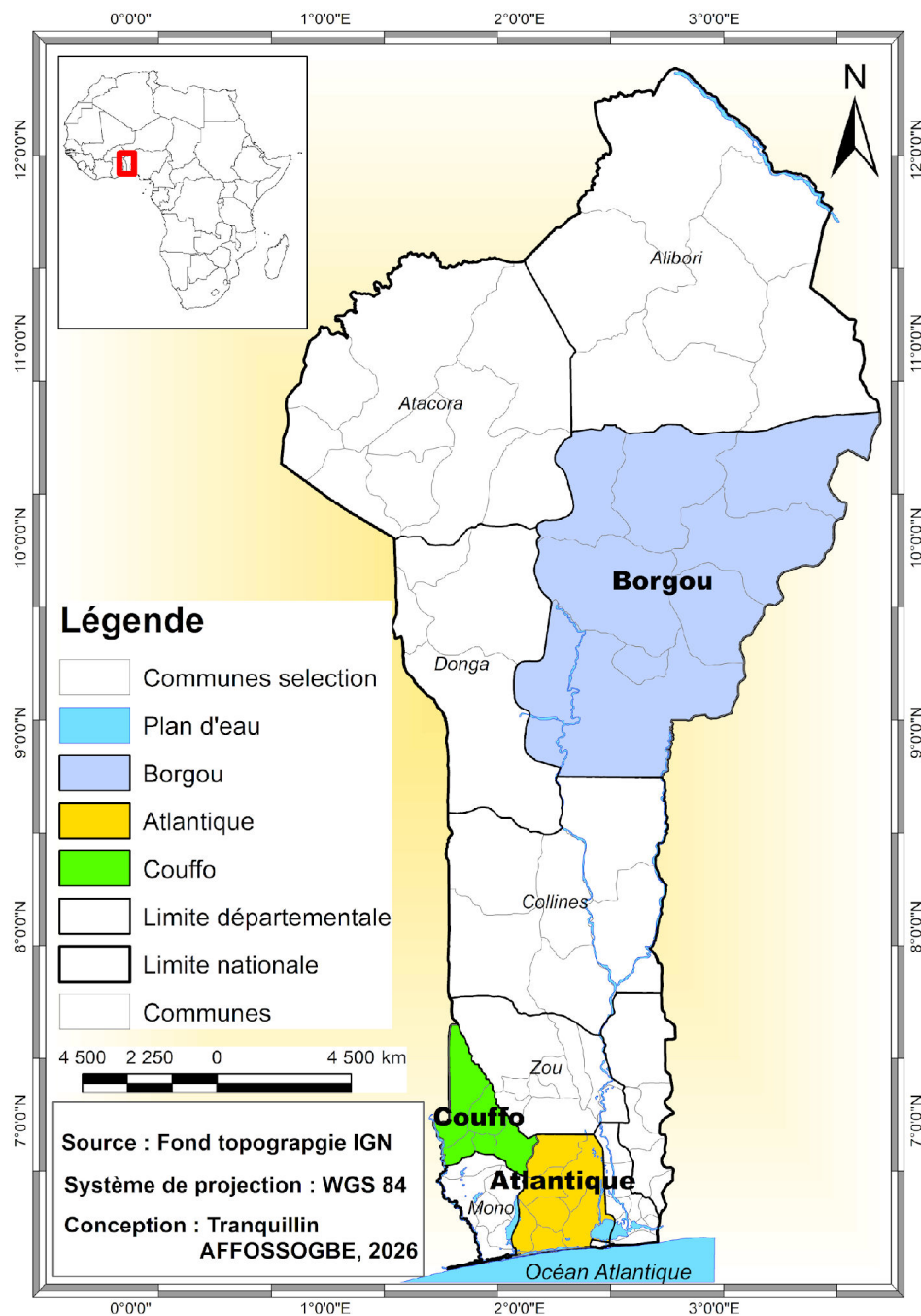
The initial sampling protocol aimed for 383 respondents, calculated using the modified Cochran formula for finite populations (margin of error $\leq 5.1\%$; 95% confidence interval; full details in Annex B). Implementation resulted in 397 young respondents, an implementation rate of 103.7% compared with the initial target. This excess, which is common in face-to-face surveys in African farming settings, is the result of the greater than expected availability of respondents in some communes and the field team's determination to achieve the statistical power of the multivariate analyses. All 397 valid observations were retained for analysis.

It is important to clarify the logic of the denominators used in this report in order to avoid any confusion when reading the results. $N=397$ is used for all socio-demographic analyses and for the M1 logistic regression model, in which the variable of employment in green jobs is imputed to zero for the 26 respondents not active in the agricultural sector. $N=374$ (active farmers, 94.2% of the total sample) is used to calculate the prevalence rates of green practices and for the Poisson model. The selection of this denominator is justified by the fact that agro-ecological practices can logically only be assessed in the sub-population that is actually active in the agricultural sector.

This study was conducted in six communes in three departments (Figure 2), which were selected in line with a multi-criteria grid combining agro-ecological representativeness, the dynamism of emerging green sectors and operational feasibility. The Atlantique (Abomey-Calavi, Allada), Borgou (Parakou, N'Dali) and Couffo (Aplahoué, Djakotomey) departments are Benin's three main agro-ecological zones, extending from the southern coastal plain to the northern semi-arid zone. The target population is estimated at approximately 125,000 young people (aged 18-35) who are active in the agri-food sector in

the six communes. The allocations by stratum were: Atlantique 140 (36%), Borgou 130 (33%), Couffo 123 (31%). The selection of these three departments was based on their agro-ecological and institutional complementarity: Atlantique represents the peri-urban profile with high institutional density, Borgou the semi-arid zone profile with high climate pressure, and Couffo the isolated rural profile with low institutional coverage. Some departments with high agro-climatic potential, such as Zou and Collines, were excluded due to operational constraints and the fact that the aim was to maximise the variability of institutional rather than production profiles.

Figure 2: Map showing the areas studied



The stratification is based on a weighted hybrid model (70% proportional, 30% reasoned) including a geographical stratification (department, commune, residential setting: urban, semi-urban, rural) and a thematic stratification (gender, with a minimum quota of 40% women in line with ILO standards and the SDGs relating to gender inclusion; and distribution in line with the value chains in accordance with their local economic importance).

2.3 Qualitative method

The qualitative component involved semi-structured interviews with 32 key informants in the three departments. The respondents were recruited from five actor categories: political decision-makers (n=3: departmental directors of the MAEP, MPME and ANPE), private sector and project actors (n=17: young successful entrepreneurs aged 25 to 35 with more than 3 years of experience, and coordinators of projects relating to green jobs), and representatives of research (n=9: INRAB researchers, project/programme trainers) and civil society (leaders of youth organisations: CJA, FéNOMA, FéNaFAB, AJAM etc.). The interviews were conducted using five checklists tailored to each category of stakeholder.

Table 1: Sampling matrix and profile of key actors

Category	Atlantique	Borgou	Couffo	Total	Profile of participants in SSIs
Political decision-makers	1	1	1	3	Departmental directors (MAEP, MPME, ANPE), Mayors
Private Sector & Projects	6	6	5	17	Young (25-35) successful entrepreneurs (≥ 3 years), coordinators of projects supporting green employment for youth.
Research & Civil Society	3	3	3	9	Researchers (INRAB), trainers, leaders of youth organisations (CJA, FENOMA).
TOTAL	11	11	10	32	

In addition to the interviews, there were nine focus group discussions. The groups were organised by age group (18-35), gender and main activity (production, processing or digital marketing). Each session followed a structured checklist and an anonymised participation form documenting the socio-demographic profile of the participants.

2.4 Data Analysis Plan

The study employed a two-phase protocol for data analysis. Phase I - Descriptive analysis: The database of 397 observations and 413 harmonised variables was cleaned up and standardised using Python 3.11. Descriptive statistics (frequency distributions, cross-tabulations, measures of central tendency and dispersion) were used to characterise the sample and explore the distributions of the variables of interest. Chi-square (χ^2) tests of independence were used to determine the significance of correlations between categorical variables. Phase II - Inferential analysis: A multivariate logistic regression was used to identify the determinants of employment in green jobs (binary variable). The quality of the model was assessed using the Hosmer-Lemeshow test, the AUC-ROC curve and McFadden's pseudo- R^2 . Ordinal logistic regression was used to model green job perception. A Principal Component Analysis (PCA, Varimax rotation) reduced the dimensionality for the perception and skills items. A Hierarchical Ascending Classification (Ward's method) was used to construct an empirical typology of youth profiles. Non-parametric tests

(Mann-Whitney U, Kruskal-Wallis H, Dunn test with Bonferroni correction) were used to verify the robustness of the parametric results.

3. BACKGROUND

3.1 Agricultural policies and employment strategies in Benin

Benin's agricultural policy landscape has evolved considerably over the past two decades, being shaped by national development priorities, donor involvement and regional integration efforts. The Strategic Agricultural Sector Development Plan (PSDSA) is the guiding framework for the agricultural transition. It focuses on improving productivity, developing value chains and involving the private sector. The Government Action Programme (PAG) articulates broader development objectives, including job creation for youth and climate resilience. Land policy is a critical area. The aim of the Benin Land Code (Law No. 2013-01, amended by Law No. 2017-15) is to modernise land administration by advancing the formal recognition of land rights through administrative certification (land ownership certificate). The code seeks to balance traditional land systems, which continue to dominate in rural areas, with formal registration mechanisms. However, implementation faces major challenges, in particular weak institutional capacity, corruption, oral clauses that compromise written agreements and limited awareness among rural populations. For youth, these weaknesses perpetuate the obstacles to accessing land, because inheritance continues to be the main way of acquiring land (55% of yam producers in the Collines), placing non-heirs and women at a disadvantage.

Youth employment strategies are the responsibility of several ministries. The Ministry of Youth, Sports and Leisure (MJS�) coordinates youth policy, while the Ministry of Technical Education and Professional Training (MESTFP) oversees skills development. Benin's Youth Employment Project, which is supported by the World Bank, provides young entrepreneurs, particularly those in the agricultural sector, with cash subsidies, as well as business management and life skills training. The Ministry of the Environment and Climate (MEHU) coordinates climate and environmental policy, with agricultural adaptation to climate change being included in the MAEP's strategies. Benin is committed to smart agriculture and agro-ecological transitions in the face of climate change, with national strategies focusing on soil and water conservation, improved varieties and sustainable intensification. Nevertheless, the transformation of political commitment into concrete implementation, particularly in the area of job creation for youth, continues to be patchy.

The reviewed literature provides a limited empirical assessment of the specific impacts of policies on green jobs for youth. Although policy frameworks are discussed, rigorous assessments of the impact are largely absent. This gap is an obstacle to the development of evidence-based policies.

3.2 Socio-economic profile of youth and women in the food economies

Benin's youth population (aged 15-35) is a significant demographic cohort and one that faces major employment challenges. The labour market is characterised by widespread informality and underemployment, with a disproportionate effect on youth and rural women. The gender division of labour reveals a profoundly unequal structure: women are concentrated in the low-productivity, low-pay segments of the value chain, while the higher

value-added segments remain predominantly male. The agricultural entrepreneurial profiles are heterogeneous, with three distinct groups:

- Informal for-profit agri-businesses are the largest group. They are characterised by unregistered status, low tax compliance and entrepreneurship driven by necessity.
- The new professional agri-businesses are mainly run by young university-educated entrepreneurs with an agricultural background, who are more inclined to adopt innovations and formalise their operations.
- Mature agri-businesses are established businesses with longer operational histories.

Critically, the involvement of women in the creation of new agri-businesses is low, reflecting intersecting barriers linked to gender norms, access to resources and social capital. Approximately half of the agri-businesses are unregistered, and only three out of ten comply with tax regulations, indicating a pervasive informality that limits access to formal finance and government support programmes. The predominance of the informal sector means that agricultural entrepreneurship among youth remains precarious. Many young farmers lack business management skills, and professional training and extension services do not meet all their needs.

3.3 Climate risks and environmental challenges affecting Benin's food systems

Climate change involves multiple threats to Benin's agri-food system and to youth employment prospects. The main risks include: the decline in soil fertility and land degradation resulting from intensive farming, inadequate rotation systems and low levels of organic matter input; competition for fertile land, which is intensifying as suitable plots become scarcer for yam growers; irregular rainfall and water stress, with the increased variability of rainfall and the frequency of droughts disrupting planting schedules; and pest and disease pressure, with changes in temperature and humidity modifying the dynamics of pests and diseases, resulting in losses that are difficult for young farmers to manage.

3.4 Review of the main value chains

The study focuses on three value chains selected for their potential to create green jobs:

- **Organic vegetable production:** this is a rapidly expanding sector, particularly in the peri-urban areas around Cotonou and the major cities (Monde et al., 2022). Young people and women are actively involved in production and marketing, with digital platforms providing market information. However, shortcomings in infrastructure, input quality problems and limited cold chain capability are constraints on added value (Monde et al., 2022).
- **Sustainable agri-food processing:** this includes the processing of staple food crops (cassava into garri/tapioca, maize, rice) and horticultural products using environmentally-friendly methods (Elbehri, 2023). Processing requires capital for equipment, compliance with quality standards and a knowledge of the markets, all of which represent obstacles that have a disproportionate effect on youth.
- **Digital marketing of agricultural products:** this value chain benefits from the 21 digital agricultural innovations identified in Benin (Ayamga et al., 2023), providing decision-making support, market information and trading platforms. However, the

material, infrastructural and skills constraints represent obstacles to adoption by youth, particularly rural youth and young women.

3.5 Institutional landscape: ministries, development partners and civil society

Benin's agri-food system involves multiple institutional actors, the coordination of which shapes policy outcomes and employment prospects for youth. The main government ministries are MAEP (agricultural policy, extension, value chains), MESTFP (professional training), MJSL (youth employment) and MEHU (environmental policy). Development partners such as the FAO, IFAD, World Bank, ADB, GIZ and USAID provide financial and technical support, although coordination challenges and donor-driven agendas can result in fragmentation (Yami et al., 2024). Civil society organisations, notably PNOPPA (Plateforme Nationale des Organisations Paysannes), CJA (Collège des Jeunes Agriculteurs), FENOMA (Fédération des Organisations de Maraîchage Biologique) and FENAFAB (Fédération des Femmes de Transformation Agro-alimentaire), provide platforms for collective action but youth representation in these structures remains weak. A detailed list of institutional actors can be found in Annex C.

4. RESULTS FROM THE LITERATURE REVIEW

This chapter summarises the evidence from the systematic literature review in line with the four dimensions of justice (distributive, procedural, recognition and restorative), including insights from regional studies but always prioritising the Benin context. The four dimensions of justice are not simply lenses for the organisation of the results but also interpretative frameworks allowing for analytical conclusions to be drawn about who benefits from the transition in food systems, who is excluded, and why.

4.1 Distributive justice

Distributive justice is about fairness in the allocation of resources and opportunities to different social groups. In Benin's agrifood system, the evidence shows a structural pattern of inequalities in access to land, finance, technology and market participation. Youth, particularly young women and rural youth, face the most severe constraints.

4.1.1 Access to production resources

Access to land is the fundamental production barrier. In the Collines, 55% of yam growers inherit their land (Rosaire et al., 2022), a traditional system that structurally favours male heirs to the detriment of non-heirs, women and migrants. Benin's land code (Law No. 2013-01, amended by Law No. 2017-15) aims to advance the formal certification of land rights (land ownership certificate) but its implementation is encountering serious obstacles: monolingual legal texts, oral clauses that invalidate written agreements, corruption in land administration and weak institutional capacity. These shortcomings perpetuate inequalities in access to land for youth. Exclusion is a particularly acute problem for young women: under traditional law, women do not generally inherit agricultural land, which limits their ability to invest in climate-resilient practices and generate sustainable livelihoods (Rosaire et al., 2022). The primary data in the present study confirm this structural pattern where land ownership is a significant determinant of employment in green jobs (OR=2.91, CI 95%: [1.35; 6.29], $p=0.007$; see Table 5, Section 4.2).

Access to finance and credit is a second barrier to distribution. A national survey of 819 agricultural entrepreneurs revealed that some 50% of agri-businesses are not registered and only 30% comply with tax obligations (Sossou et al., 2021), a level of informality that both reflects and reinforces financial exclusion. Microfinance institutions dominate the credit landscape in Benin but they generally impose requirements (guarantees, legal registration, credit history) that young entrepreneurs with no established assets cannot meet. In this study, 72.8% of the youth surveyed cited finance as their primary requirement for access to green jobs. On the climate front, the lack of capacity to raise capital also compromises the adoption of adaptation practices: investments such as solar irrigation pumps, agro-ecological greenhouses or composting equipment continue to be inaccessible for the vast majority of youth without the appropriate financing. Digital technology and extension services are a third dimension of distributive inequality. A study of 21 digital agricultural innovations in Benin identified equipment, infrastructure and skills constraints as the main obstacles to adoption by youth (Ayamga et al., 2023). Rural youth with low levels of education and limited connections are the most disadvantaged. In this study, only 3.8% of young people had received training in digital farming skills.

4.1.2 Income distribution and business viability

The most striking distribution finding in the Beninese literature relates to business viability. In the Atacora department, only 26% of the 140 young farmers' businesses that were assessed achieved viability when measured using the IDEA method (Sustainable Indicators for Agricultural Businesses), a composite tool that assesses farms using three complementary axes: 1) The agro-ecological axis (sustainable farming practices, natural resource management), 2) The socio-territorial axis (community integration, local contributions) and 3) The economic axis (profitability, financial autonomy) (Paule-Nabo et al., 2019). This finding means that the vast majority of youth agri-enterprises in Benin do not generate sustainable livelihoods. The positive determinants of viability identified include the use of salaried labour, capacity building, entrepreneurial experience and motivation (Paule-Nabo et al., 2019). This finding acquires particular resonance in the department of Couffo, where this study found a median monthly income that is 2.3 times lower than in the Atlantique region, and a green job employment rate of only 61.3%. The concentration of youth in the production segment limits income potential even further. Most young people in Benin are mainly involved in crop production, with limited involvement in processing, marketing or the provision of services, where profit margins are higher (Sossou et al., 2021). The income gap between departments and between genders is not just a statistical artefact: it reflects differences in access to production resources, proximity to markets and institutional support.

4.1.3 Social protection and spatial inequalities

Social protection for young farmers continues to be minimal. The informality of the labour market in Benin means that most young people have no formal social insurance, leaving them exposed to agricultural risks: crop losses, price volatility, climate shocks. Urban-rural and regional disparities aggravate distributional inequalities: the youth in rural areas systematically face greater obstacles in terms of access to finance, technology and markets (Ayamga et al., 2023), while business viability is lower in the northern and western departments, where institutional coverage is more limited.

Table 2: Analytical summary

Resources/ Result	Access	Inequality dimension	Policy implications
Land	55% inherited (Collines); weak formal certification	Young v. old; male heirs v. non-heirs; women excluded	Affirmative land reform; ownership for women and youth
Financing/ Credit	~50% unregistered agri-businesses; 30% tax compliant	Formal v. Informal; youth v. established entrepreneurs	Green finance adapted for youth; unsecured micro-credit
Business viability	26% viable (Atacora, n=140)	Viable v. non-viable; spatial (Atacora)	Targeted support for disadvantaged areas

Resources/ Result	Access	Inequality dimension	Policy implications
Value chain position	Youth concentrated in production	Production v. processing/marketing	Youth employment in segments with high added value
Social protection	Minimal coverage; uninsured risks	Formal v. informal employment	Agricultural insurance adapted for youth

In summary, unequal access to production resources (land, finance, technology) is the main factor excluding youth and particularly young women from the high-added-value segments of agri-food value chains. These inequalities are not random: they are produced and reproduced by institutional structures (traditional land law, formal banking requirements, cooperative governance) that systematically favour established actors.

4.2. Procedural justice

Procedural justice relates to the fairness of decision-making processes, governance structures and participation mechanisms in agri-food systems. In Benin, the evidence shows that youth (particularly young women) are systematically marginalised in the institutional processes that shape resource allocation, policy design and value chain governance.

4.2.1 Involving youth in policy-making

Youth representation in the development of agricultural policies in Benin remains largely symbolic. Research on gender and youth involvement in agricultural research and innovation indicate that the inclusion of youth in national policy processes is mainly linked to donor requirements rather than institutionalised in national mandates (Yami et al., 2024). In Benin, youth-focused programmes such as the ABEJ scheme run by the Ministry of Youth and the Youth Employment Project supported by the World Bank offer openings. However, their coordination with the governance of agricultural value chains remains weak. At the departmental level, the Territorial Agencies for Agricultural Development (ATDAs) formally include youth representatives in their consultative bodies but actual influence on resource allocation and policy design remains limited.

4.2.2 Representation in organisations and cooperatives

Farmers' organisations and cooperatives, including PNOPPA, CJA (Collège des Jeunes Agriculteurs) and FENOMA (Fédération des Organisations de Maraîchers Biologiques du Bénin), are the main platforms for collective action in Benin's agri-food sector. Although young people do join these structures, their leadership roles and decision-making powers remain limited, with gender patterns marginalising young women more (Yami et al., 2024). Paradoxically, company-level data show that membership of professional associations is negatively associated with company viability (Paule-Nabo et al., 2019). This raises questions about the quality and relevance of the services offered to young entrepreneurs by the organisations in place. In the present study, 55.2% of the youth surveyed stated that they were members of at least one organisation, but organisational membership was not significantly correlated with employment in green jobs (χ^2 $p=1.00$ bivariate; $OR=0.66$; $p=0.27$ multivariate), suggesting that formal membership alone does not translate into effective procedural empowerment.

4.2.3 Access to information, training, extension and digital platforms

Access to information, training and extension services is a critical procedural dimension. A systematic review of 57 studies in sub-Saharan Africa shows that vocational training programmes consistently improve youth's involvement in agri-entrepreneurship (Nkosi et al., 2022), confirming that procedural inclusion by improving skills generates substantial benefits. In Benin, however, opportunities continue to be profoundly unequal. Extension services are not adapted to the needs of youth: the content focuses on production techniques to the detriment of business management, links with markets, financial education and climate adaptation. In the present study, only 55.2% of young people had received agricultural training, and digital agricultural skills were found in only 3.8% of the sample.

Digital agricultural innovations (21 platforms identified in Benin by Ayamga et al. (2023)) offer the potential to democratise access to information. Nevertheless, hardware, infrastructure and skills constraints are creating a digital disparity that disproportionately excludes rural female and less-educated youth. Field data show that 71.5% of young people own a smartphone and 62.5% use the internet for their farming activities, but only nine respondents engage in digital farming practices. This result shows that there is a persistent gap between tool ownership and productive use.

4.2.4 Governance, transparency and accountability

The lack of transparency and accountability in land administration, agricultural programmes and value chain governance compromise procedural justice. The corruption found in Benin's land administration (Rosaire et al., 2022) favours capture by the elites and disadvantages the young people who lack the social capital and financial resources to navigate these systems. The challenges include the scarcity of the data, their poor quality and decision-makers' preference for trusted sources of research data (INSAE, 2021).

Table 3: Analytical table

Domain	Inclusion	Obstacles identified
Policy development	Little recognition; inclusion linked to donors	Intergenerational inequalities; donor agendas
Producer organisations	Weak representation; negatively associated with viability (Atacora)	Associations not serving youth effectively
Access to training	Positive impact confirmed (57 studies in SSA); unequal access	Infrastructure gaps; content mismatch
Extension services	Services not tailored to young people	Designed for established farmers; business management shortfall
Digital information	21 innovations in Benin; adoption constraints	Digital divide; infrastructure; education
Chain governance	Limited youth participation	Socio-cultural norms; power asymmetries

In summary, the evidence shows a consistent picture of procedural marginalisation. Youth participation in policy design is mainly symbolic and driven by the demands of donors rather than institutionalised. There is membership of cooperatives but this rarely translates into substantial influence over the allocation of resources. Digital platforms offer promising

avenues but the digital divide limits their scope. Remedying these gaps would require the strengthening of the institutionalised youth representation in the governance of the ATDA, reforming the services offered by farmers' organisations in the direction of mentoring and concrete business links, and expanding digital and extension services that are accessible and tailored to young people.

4.3. Recognition justice

Recognition justice relates to the social status, dignity and respect accorded to different groups and their contributions. For the young people in Benin's agri-food system, the lack of recognition operates at several levels and it is a powerful deterrent to youth involvement with the food transition.

4.3.1. Social status and decent working conditions

Agricultural work suffers from low social status in Benin and across sub-Saharan Africa. Young people have different perspectives: some see agriculture as a viable and profitable way of making a living; others associate it with poverty, hard physical work and limited social mobility (Nkosi et al., 2022; Sossou et al., 2021). This ambivalence is not just a question of attitude, it reflects the material reality of agricultural work in Benin: only 26% of young people's farms achieve long-term viability (Paule-Nabo et al., 2019); some 50% of agri-businesses operate in the informal economy (Sossou et al., 2021); and the median monthly income of the youth surveyed in this study was FCFA 62,500, which is below the threshold needed to support a household in most of the communes studied. In this context, agriculture is not perceived as bringing few rewards because young people are poorly informed: it is seen in this way because, structurally, it produces returns that are often precarious and inadequate. Recognition justice therefore requires material improvements as a priority, and not cultural reframing alone.

4.3.2. Youth innovation and entrepreneurial dynamism unrecognised

Despite the structural constraints, there is significant but under-recognised entrepreneurial dynamism among the youth in Benin's agri-food sector. The emergence of clusters of professional agri-businesses and the proliferation of 21 digital agricultural platforms identified in Benin (Ayamga et al., 2023) testify to genuine entrepreneurial vitality driven by youth. Programmes supported by donors targeting organic vegetable production and agro-ecological transitions (IFAD's PADAAM, GIZ/ProAgri, FAO pilots on Climate-Intelligent Agriculture) report short-term increases of 20 to 40% in incomes and better access to markets for young participants. However, systematic reviews have identified only sixteen rigorous evaluation studies, indicating that the evidence base for long-term outcomes is still weak (Nkosi et al., 2022). This suggests that institutional support for scaling up youth innovations continues to be structurally inadequate. The results of the present study reinforce this finding of a recognition deficit: 83.5% of the youth surveyed aspire to be entrepreneurs or self-employed within the next five years, and 92.1% want to set up their own farming business. However, 61.8% of respondents had never heard of green jobs before the survey. When the concept was explained to them, 91.1% saw it as an opportunity, indicating that the ambition exists and can be mobilised, but that the institutional channels for recognition and support have not yet reached the large majority of young people.

4.3.4. Gender inclusion and intersectional barriers

Young women in Benin's agri-food sector encounter multiple recognition deficits that operate at several intersectional levels. Institutionally, women's participation in agri-business creation is weak (Sossou et al., 2021), and the extreme segregation of the labour market confines most of them to low-productivity, low-remuneration activities (processing, petty trade) where their contributions as the main processors and holders of knowledge are under-recognised and underpaid. Reviews of the literature consistently show that women and youth are treated as 'helpers' or 'beneficiaries' rather than as leading farmers, co-designers or innovators (Yami et al., 2024).

The barriers are intersectional and mutually reinforcing. Given the traditional land system in Benin, women rarely inherit agricultural land (Rosaire et al., 2022). Without land ownership, they have no access to formal credit. Without credit, they cannot invest in improved technologies. Unpaid domestic and care work also limits their availability for business development and collective action. Social and cultural norms in many Beninese communities reinforce the perception that agricultural business management is a male domain. In this study, Couffo had the widest gender gap in terms of employment in green jobs: 47.3% of women are employed here, compared with 72.6% of men, a difference of 25.3 percentage points that is a direct reflection of these structural and cultural dynamics.

4.3.5 Cultural and traditional barriers

Cultural norms and traditional practices shape recognition patterns beyond gender. Age hierarchies in Benin's farming communities (where the authority of elders governs land allocation, collective decisions and social validation) systematically place young people in subordinate positions, regardless of their skills or entrepreneurial capacity (Rosaire et al., 2022). Where informal institutions value and legitimise agricultural entrepreneurship, young people are more involved, as illustrated by the 96.3% rate of employment in green jobs in Borgou, which this study associates with a more favourable institutional ecosystem. The stigma attached to agricultural work persists, particularly among young, educated urban dwellers, adding to migration pressures.

Table 4: Analytical table of recognition justice indicators

Dimension	Diagram/Result	Implications for young people
Social status of agriculture	Differing perspectives; stigmatisation among educated youth	Obstacle to participation; rural-urban migration
Decent working conditions	26% viability; ~50% not registered; widespread informality	Precarious livelihoods
Youth innovation	21 digital innovations; limited institutional support	Unrecognised potential; insufficient scaling
Gender inclusion	Low participation of women; extreme segregation	Cumulative recognition deficits for young women
Stigmatisation	Agriculture perceived as backward; internalised stigmatisation	Non-participation of educated youth

The evidence shows a paradox: the entrepreneurial aspirations of youth are high, but institutional recognition, cultural status and material returns that validate and sustain these aspirations remain insufficient. Closing the recognition gap requires simultaneous action targeting material conditions of agricultural work, the institutional status of youth innovation and the structural invisibility of young women's contributions through policy mechanisms.

4.4 Restorative Justice

Restorative justice relates to the resolution of historical inequalities, repairing past injustices, and healing social and environmental harms. Benin's land systems bear the marks of colonial and pre-colonial history: colonial interventions have codified and made rigid previously flexible arrangements, favouring male heads of households. The Land Code (2013-01, amended in 2017-15) encourages formal recognition but does not explicitly address historical exclusions or provide restorative mechanisms for systematically disadvantaged groups. Explicit restorative measures targeting historical injustices in Benin's agri-food system are largely absent. The Benin Youth Employment Project is a modest restorative effort that includes services to maximise female participation. Investments in soil and water conservation offer the potential to link environmental restoration and green employment for youth, but this link has not yet been institutionalised. Restorative justice requires explicit policy measures: affirmative action in land allocation, preferential access to credit for marginalised youth, and ecological restoration programmes designed to create jobs while repairing environmental damage

Table 5: Restorative justice indicators

Restorative dimension	Data/Pattern	Gaps identified
Land inheritance	Traditional predominance (55% inheritance); colonial impacts	No restorative provision in the Land Code
Restorative policy measures	Youth Employment Project: services for women only	No affirmative action or redistribution of assets
Environmental restoration	Soil conservation investments recommended	Not explicitly linked to green jobs for youth
Intergenerational equity	Little consideration of youth in R&I policies	No intergenerational redistribution policy

Restorative justice remains the least operationalised dimension in the Beninese policy framework and in the wider literature on youth employment in agri-food systems. Benin's land inheritance system, which has been shaped by the colonial codification of traditional systems, has made previously more flexible arrangements more rigid and favoured male heads of households (Rosaire et al., 2022) and, followed by post-independence oscillations between state control and market liberalisation, has produced a structural geography of exclusion that continues to disadvantage youth, non-heirs, women and migrants. The Land code (no. 2013-01, amended by no. 2017-15) represents a procedural step ahead towards the formalisation of land rights but contains no explicit restorative mechanism for historically excluded groups.

The environmental dimension of restorative justice is equally underdeveloped: 80.9% of the youth surveyed observe marked or moderate climate change in their area, and the link between ecological degradation and precarious livelihoods is tangible in the field data. Institutional frameworks have yet to operationalise the principle that those who have contributed least to environmental degradation and suffered most from it should receive priority support in the transition. Addressing restorative justice in Benin's food transition requires going beyond procedural land reform to adopt active mechanisms for redress: preferential land access programmes for excluded youth groups, support schemes indexed in line with climate vulnerability and participatory ecological restoration schemes co-designed with youth communities.

5. RESULTS OF THE PRIMARY DATA

Building on the insights from the literature review, this chapter presents the empirical results of the study in interconnected parts. Section 5.1 presents the results of the primary data (quantitative survey (n=397) and qualitative fieldwork (32 SSIs and 9 FGDs) relating to youth profiles, geographical and income distributions, and employment in value chains. Section 5.2 analyses the adoption of sustainable agricultural practices broken down by area and gender.

Throughout the chapter, the quantitative results are systematically compared with the qualitative insights gained from the FGDs and SSIs in order to shed light on the mechanisms and experiences underlying the statistics.

5.1 Profile and characteristics of the youth surveyed

The quantitative survey covered 397 young people aged between 18 and 35, of whom 371 (93.5%) were working in the agricultural sector at the time of the survey (Table 6). The final sample N=397 slightly exceeds the minimum target calculated with the modified Cochran formula for a finite population (n=385), in accordance with the sampling protocol designed to anticipate missing data and reinforce the power of the multivariate analyses. The geographical distribution is balanced between the three departments: Atlantique (n=143; 36.0%), Borgou (n=134; 33.8%) and Couffo (n=120; 30.2%). Rural areas accounted for 73.0% of the sample (n=288), compared with 27.0% in urban areas (n=109). The sample was predominantly male (67.8%; n=267), with an average age of 28.4 years (standard deviation=4.7 years; median=29 years). Figure 1 shows the full distribution of socio-demographic variables. The predominant level of education is secondary education (41.8%; n=166), followed by primary education (24.2%; n=96) and university (21.2%; n=84). Only 37.3% had received specialist education in agriculture, ICT or entrepreneurship (n=148). Ownership of a plot of land continues to be a minority characteristic (12.8%; n=51), highlighting the severity of the land ownership constraint in the sample.

Table 6: Socio-demographic characteristics of the sample (n=397). 95% CI calculated using Wilson's method.

Variable	Modality	eff.(%)
Sex	Male	269 (67.8)
	Female	128 (32.2)
Agricultural status	Active in agriculture	371 (93.5)
	Not active (imputation EV=0)	26 (6.5)
Department	Atlantique	143 (36.0)
	Borgou	134 (33.8)
	Couffo	120 (30.2)
Residence	Rural	288 (72.5)
	Urban	109 (27.5)
Level of education	None	33 (8.3)
	Primary	96 (24.2)
	Secondary	166 (41.8)
	University	84 (21.2)
	Professional training	16 (4.0)

Marital status	Single	134 (33.8)
	Married/common-law	259 (65.2)
	Divorced/separated	4 (1.0)
Farming organisation	Member of an organisation	221 (55.7)
	Non-member	176 (44.3)
Access to credit	Has applied for a loan	108 (27.2)
	Has not applied for a loan	289 (72.8)
Specialised education	Yes (agri/ICT/commerce)	148 (37.3)
	No	249 (62.7)
Own land	Possession of land	51 (12.8)
	No land owned	346 (87.2)

5.1.1 Geographical distribution and structural disparities

Table 7 shows the geographical distribution of young respondents by department and by status of the areas covered. The distribution between the three departments reflects contrasting structural profiles. Couffo has an entirely rural profile (100% rural residence) with the highest proportion of women (46.7%), which constitutes a configuration of cumulative vulnerability in line with the gender dimension of distributive justice. Atlantique is the most urbanised department (36.2% urban residence) and the most male-dominated (81.6% men). Borgou occupies an intermediate position (41.7% urban residents, 33.3% women).

Table 7: Geographical distribution by department

Department	% male	% female	% rural
Atlantique	81.6	18.4	63.8
Borgou	66.7	33.3	58.3
Couffo	53.3	46.7	100.0
TOTAL	67.9	32.1	73.0

Source: survey 2025-2026. male = Men, female = Women Median income = median monthly income calculated for employed respondents (n=374).

Table 8 shows income by department and gender. The territorial gradient for income is statistically significant (Kruskal-Wallis test: $H=91.01$; $p<0.001$). The median monthly income in Atlantique (87,500 FCFA, approximately 133 euros) is 2.3 times higher than in Couffo (37,500 FCFA, approximately 57 euros), with Borgou in the middle (62,500 FCFA). There are significant disparities in income between departments (Atlantique median: 87,500 FCFA v. Couffo: 37,500 FCFA with a significant probability at 5% ($p<0.001$, $\eta^2=0.260$) and between the sexes (men: 62,500 v. women: 37,500 FCFA) with a significant probability at 5% ($p<0.001$). The Atlantique has a median income that is 2.3 times higher than in Couffo, reflecting differences in access to markets and urbanisation. The difference in median income between Atlantique (87,500 FCFA) and Couffo (37,500 FCFA) does not simply reflect a difference in individual agricultural productivity. It is the result of a territorial political economy: proximity to the urban markets of Abomey-Calavi and Allada gives youth in the Atlantique department access to premium buyers (hotels, supermarkets, exporters) and to

organic certification networks that youth in Couffo cannot access because of the lack of transport infrastructures, access to cooling and digital connections. This spatial asymmetry constitutes a territorial inequality in distributive justice, which requires geographically targeted policy interventions, in particular the creation of communal processing and marketing hubs in Couffo.

The Atlantic-Couffo income gap (ratio 2.3) is not simply a statistical result. The semi-structured interviews show that Couffo suffers from a structural combination of factors: subsistence food crops dominate the marketable sectors, there are few institutions (fewer training centres, few active agricultural projects) and access to urban markets is limited by the absence of asphalted road infrastructure linking the communes of Aplahoué and Djakotomey to the consumer centres of Cotonou and Porto-Novo. This cumulative territorial configuration is an expression of distributive justice in the spatial dimension

Table 8: Monthly agricultural income by category.

Category	Median (FCFA)	Average	Statistical	p-value
Overall	62,500	78,900	—	—
Atlantique	87,500	108,600	H=90.48	<0.001 ***
Borgou	62,500	72,300		
Couffo	37,500	42,100		
Men	62,500	88,200	U=17,980	<0.001 ***
Women	37,500	56,400		
Sustainable active farmers	62,500	84,700	U=13,560	<0.001 ***
Non-active farmers	37,500	55,800		

5.1.2 Prevalence and distribution of green agricultural jobs

A total of 260 young people out of 374 active farmers were involved in at least one green activity at the time of the survey, a participation rate of **69.5%** (95% CI Wilson: [64.7%; 74.0%]). This rate is calculated on the basis of the 374 respondents active in the agricultural sector, who constitute the benchmark denominator for all analyses relating to agro-ecological practices. Of the eight activities listed, organic and agro-ecological vegetable production dominated with a prevalence of **45.2%** of active farmers (n=169/374), followed by composting and organic fertiliser production (26.5%; n=99/374) and agricultural waste recycling (16.8%; n=63/374). Prevalences were intermediate for biopesticides (15.0%; n=56), agroforestry (13.4%; n=50) and the ecological processing of local products (11.0%; n=41) had intermediate prevalences. The prevalence rates for water-efficient irrigation (8.0%; n=30) and solar energy for irrigation and drying (7.0%; n=26) were lowest. The average number of green activities practised per active individual is **1.43** (standard deviation=1.43; median=1.0; interval: 0–7). The distribution by number of activities shows that **30.5%** of active farmers (n=114/374) did not practise any green activity, 32.9% (n=123/374) practised just one, and 16.3% (n=61/374) practised two; 9.1% (n=34/374) practised three, and 4.3% (n=16/374) five or more.

Table 9: Prevalence of green job types in the sample

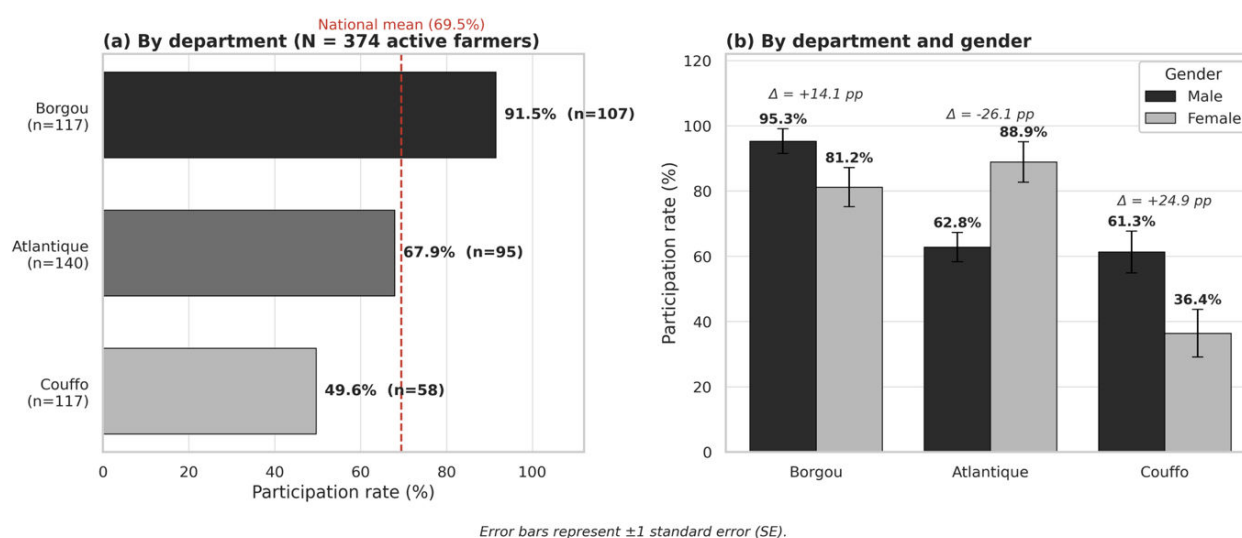
Type of green activity	n	Prevalence (%)
Organic/agro-ecological vegetable production	169	42.6
Composting and production of organic fertilisers	99	24.9
Recycling agricultural waste	62	15.6
Use of biopesticides	56	14.1
Agroforestry	50	12.6
Ecological processing of local products	40	10.1
Water-efficient irrigation	30	7.6
Solar energy (irrigation/drying)	26	6.5
TOTAL involved in at least one green activity	258	65.0
No green activity	114	30.5

Sources: 2025 INCLUDE survey. Several answers possible per respondent.

5.1.3 Territorial and gender disparities

Figure 3 shows the variation in the rate of youth employment in green jobs by department and gender. The analyses reveal very marked disparities between the departments. Borgou has the highest employment rate (91.5%; $n=107/117$), which is significantly higher than in Atlantique (67.9%; $n=95/140$) and Couffo (49.6%; $n=58/117$). The interdepartmental analysis ($\chi^2=48.71$; $df=2$; $p<0.001$; Cramer's $V=0.361$) confirms the statistical significance of these territorial disparities in green employment. The department-sex interaction reveals contrasting profiles. In Couffo, the rate of adoption of green practices among women is 36.4%, compared with 61.3% for men, a gap of 24.9 percentage points, the most unfavourable for women in the three departments. In Borgou, the difference favours men (95.3% compared with 81.2% for women, i.e. +14.1 pp). The situation in Atlantique is paradoxical: women (88,9%; $n=24/27$) outnumber men (62.8%; $n=71/113$), a result that should be interpreted with caution given the small proportion of women in this department.

Figure 3: Rate of participation in green jobs by department and gender (N=374).
(a) Overall rate by department. (b) Department × gender interaction with differences in percentage points (pp). Error bars=1.



5.2 Adoption of practices by value chain

5.2.1 Vegetable production

Organic and agro-ecological vegetable production is the most widespread sustainable practice in the sample. A total of 169 young people said they were engaged in this activity at the time of the survey. This proportion varies significantly between the three departments (Kruskal-Wallis test: $H=29.776$, $df=2$, $p<0.001$), indicating that there is a significant concentration in Borgou.

Table 10: Employment in organic/agro-ecological vegetable production by stratum.

Stratum	N employed	N total	% employed	SE (%)
Atlantique	60	141	42.6%	±4.2%
Borgou	78	132	59.1%	±4.3%
Couffo	30	120	25.0%	±4.0%
Total	168	393	42.7%	±2.5%
Men	128	267	47.9%	±3.1%
Women	40	126	31.7%	±4.1%
Rural	110	287	38.3%	±2.9%
Urban	58	106	54.7%	±4.8%

Key results on distributive justice

Borgou has a much higher employment rate (59.1% ±4.3%) than Couffo (25.0% ±4.0%), a difference of 34.1 percentage points. This spatial disparity shows distributive inequality in terms of access to sustainable practices that is linked to the availability of organic inputs, the proximity of supply circuits and technical support (INRAB, FAO). The gender gap (47.9% M v. 31.7% F, Mann-Whitney $U=19,545$, $p=0.002$) confirms persistent procedural discrimination, independent of

the department. It should be pointed out, however, that gender parity in terms of employment at the production level is not verified at the level of governance of farmer organisations and vegetable growing cooperatives: management positions and decision-making roles are still predominantly held by men, which is a major limitation to the genuine inclusiveness of the sector.

5.2.2 Sustainable agro-food processing

The ecological processing of local products is still not a widespread activity in the overall sample ($n=39$, i.e. $9.9\% \pm 1.5\%$). A processing activity is classified as ecological if it meets at least one of the following three criteria: (1) use of renewable energy sources in the transformation process (solar, biogas); (2) valorisation of by-products or processing waste (composting, animal feed); (3) use of biodegradable or recyclable packaging. This classification is based on the project's evaluation grids adapted from the FAO (2018) benchmarks on sustainable food value chains.

This sector is geographically concentrated in Atlantique ($15.6\% \pm 3.1\%$) due to its proximity to the urban markets of Abomey-Calavi and Allada and the higher density of artisanal processing units in this area. The difference between the departments is significant ($H=14.104$, $df=2$, $p=0.001$).

Table 11: Practice of ecological agri-food processing by stratum (n=393)

Stratum	n Practising	N total	% Practising	SE (%)
Atlantique	22	141	15.6%	$\pm 3.1\%$
Borgou	3	132	2.3%	$\pm 1.3\%$
Couffo	14	120	11.7%	$\pm 2.9\%$
Total	39	393	9.9%	$\pm 1.5\%$
Men	26	267	9.7%	$\pm 1.8\%$
Women	13	126	10.3%	$\pm 2.7\%$

Key results on recognition justice:

This sector is the only one of the three for which the gender gap is not significant (9.7% M v. 10.3% F, Mann-Whitney $U=16,724$, $p=0.859$). This result suggests greater gender inclusiveness in agri-food processing, which is consistent with the traditional role of women in processing local products in West Africa (Kossou et al., 2022). However, the low overall practise rate (9.9%) indicates that there is major development potential, particularly in Borgou (2.3%), which suffers from a lack of processing infrastructure. It should be noted, however, that this parity in employment rates does not necessarily translate into equality in governance or decision-making roles in the processing units, or in the distribution of added value between male and female players in the sector.

5.2.3 Digital agricultural marketing

Digital agricultural marketing (defined here as the combined use of at least one of the following tools: online sales of products, professional social networks/marketing, transactions involving Mobile Money) is practised by 199 young people ($50.6\% \pm 2.5\%$). This sector is

characterised by the largest urban-rural disparity: 75.5% of youth in urban areas use it, compared with 41.5% in rural areas ($p < 0.001$). An analysis of the profile of the 199 young people using digital marketing reveals a concentration of usage in the functions of disseminating information and contact via mobile money, while online sales in the strict sense (publication of products associated with an actual transaction) remain in the minority. This result confirms the existence of a gap between passive and productive use of digital technology, that support interventions should explicitly target by developing young people's transactional skills.

Table 12: Use of digital agricultural marketing by stratum.
Composite variable (online sales + social networks + Mobile Money).

Stratum	N active	N total	% active	SE (%)
Atlantique	81	141	57.4%	$\pm 4.2\%$
Borgou	81	132	61.4%	$\pm 4.2\%$
Couffo	37	120	30.8%	$\pm 4.2\%$
Total	199	393	50.6%	$\pm 2.5\%$
Men	146	267	54.7%	$\pm 3.0\%$
Women	53	126	42.1%	$\pm 4.4\%$
Rural	119	287	41.5%	$\pm 2.9\%$
Urban	80	106	75.5%	$\pm 4.2\%$

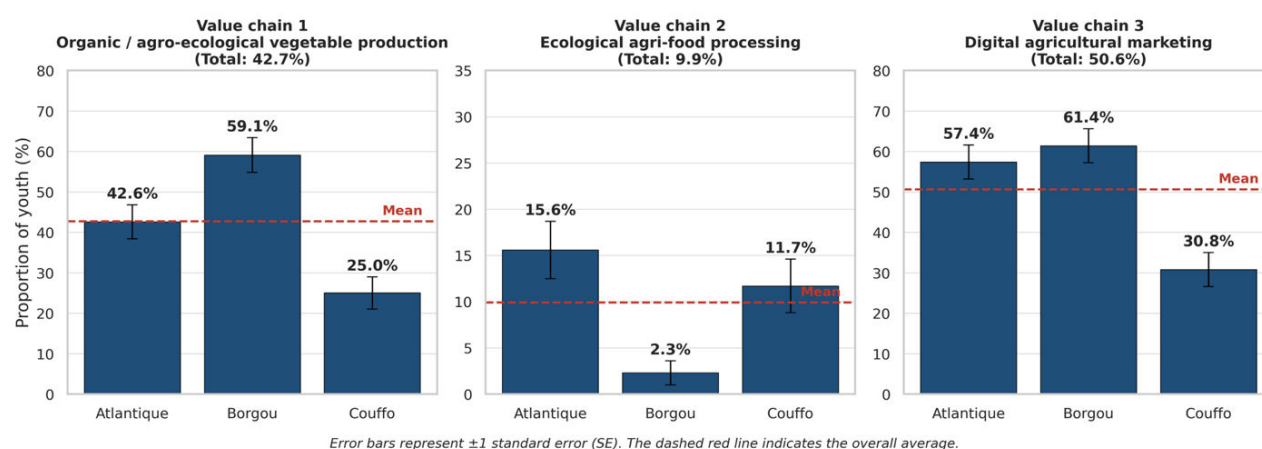
Key results on restorative justice:

Couffo has the lowest rate of digital marketing ($30.8\% \pm 4.2\%$), compared with 57.4% in Atlantique and 61.4% in Borgou ($H=27.450$, $df=2$, $p < 0.001$). This territorial digital divide (Mann-Whitney pairwise: Couffo v. Borgou, $p < 0.001$; Couffo v. Atlantique, $p < 0.001$) indicates that corrective measures are required that are specific to the department — in particular the extension of mobile network coverage, training in digital agricultural tools and subsidised access to equipment. These interventions are part of the restorative dimension of justice (Young, 1990), which is intended to correct accumulated structural disadvantages.

Spatial heterogeneity in the adoption of organic/agro-ecological vegetable production (59.1% in Borgou v. 24.2% in Couffo) illustrates how the political economy of value chains determines green job opportunities. In Borgou, de facto governance of the sector is exerted by traders, importers of certified inputs and institutional buyers, who establish the conditions for access to organic certification that are favourable to youth with connections. In Couffo, the absence of these structuring intermediaries means that youth have no access to certified inputs and no outlets for differentiated organic products. Without any targeted intervention in the governance of the sector, there is a risk that the green transition will reinforce the territorial inequalities in place.

Figure 4: Involvement in sustainable practices by sector and department (n=393).
Error bars represent ± 1 SE. The dotted red line indicates the overall average.

4



5.3 Determinants of youth employment in green jobs: logistic regression analysis

5.3.1 Overall prevalence of employment

Pearson χ^2 tests carried out on the entire sample (N=397) identified six variables that are significantly associated with employment in green jobs, ranked by decreasing magnitude of effect (Table 3). The correlation with being an active farmer was strongest ($\chi^2=48.63$; $df=1$; $p<0.001$; Cramer's $V=0.347$), confirming that the 26 non-active farmers are a structurally distinct group in the sample. Departmental affiliation was the second strongest correlation ($\chi^2=27.64$; $df=2$; $p<0.001$; $V=0.254$). Level of education ($\chi^2=17.29$; $df=4$; $p=0.004$; $V=0.209$) and monthly income ($\chi^2=21.86$; $df=6$; $p=0.003$; $V=0.200$) were moderately or strongly related. Specialised education ($\chi^2=12.61$; $df=1$; $p<0.001$; $V=0.171$) and gender ($\chi^2=9.49$; $df=1$; $p=0.002$; $V=0.146$) were correlated to a moderately significant extent. Ownership of one's own plot of land was correlated weakly but significantly ($\chi^2=3.99$; $df=1$; $p=0.046$; $V=0.087$). On the other hand, marital status ($p=0.368$), access to credit ($p=0.268$), membership of a farmers' organisation ($p=0.979$), place of residence ($p=0.937$) and age group ($p=0.703$) were not significantly correlated with employment in green jobs. (Table 13).

Table 13: χ^2 correlation tests with employment in green jobs, Cramer's V amplitude tests

Variable	Chi2	df	p-value	Sig.	Cramer's V
Active agricultural status	48.63	1	<0.001	***	0.347
Department	27.64	2	<0.001	***	0.254
Level of education	17.29	4	0.004	**	0.209
Monthly income (category)	21.86	6	0.003	**	0.200
Specialised education	12.61	1	<0.001	***	0.171
Sex	9.49	1	0.002	**	0.146
Own land	3.99	1	0.046	*	0.087
Marriage	2.00	2	0.368	ns	0.071
Access to credit	1.23	1	0.268	ns	0.056
Member of organisation	0.00	1	0.979	ns	0.000
Place of residence	0.01	1	0.937	ns	0.000
Age category	1.41	3	0.703	ns	0.000

Note. *** $p<0.001$; ** $p<0.01$; * $p<0.05$; ns: not significant. df: degrees of freedom.

5.4 Determinants of green job opportunities (logistic regression model analysis)

Table 14 presents the goodness-of-fit indicators for the M1 logistic regression model. The McFadden pseudo-R² obtained (0.138) indicates a moderate fit of the model, which is generally satisfactory for survey models for heterogeneous populations (Louviere et al., 2000). The AUC-ROC of 0.752 confirms adequate discrimination between people employed in green jobs, and those who are not, and the Hosmer-Lemeshow test ($\chi^2=12.098$, $p=0.147$) indicates good model calibration. The LRT test compared with the M2 model with interactions ($\chi^2=22.641$, $df=3$, $p<0.001$) indicates that the interactions make a statistically significant contribution, even though the M1 model remains the most parsimonious and interpretative.

Table 14: Quality-of-fit indicators for the M1 model

Indicator	Value
Log likelihood (LL)	-230.62
McFadden's Pseudo-R ²	0.138
AIC	461.24
BIC	497.10
AUC-ROC	0.752
Hosmer-Lemeshow test	$\chi^2=12.098$, $p=0.147$ (ns)
LRT M1 v. M2 (interactions)	$\chi^2=22.641$, $ddl=3$, $p<0.001$ ***

Note. AUC-ROC: Area under the ROC curve. LRT: M1 v. M2 likelihood ratio test. *** $p<0.001$; ns: $p>0.05$.

Table 15 shows the odds ratios (OR), 95% confidence intervals, p-values and average marginal effects (AME) from the M1 logistic regression model. Figure 4 shows these results in the form of a forest plot, allowing for an immediate visual reading of the size and direction of the correlations. The analysis shows that the Borgou department is the most powerful territorial determinant of employment in green jobs, with an odds ratio of 7.49 (95% CI: [3.74; 15.01], $p<0.001$), and an average marginal effect of +45.8 percentage points (pp). This exceptional result suggests that contextual factors specific to Borgou (drought pressure, local cooperative dynamics, institutional support) play a determining role in the adoption of agri-ecological practices. Land ownership (OR=2.91, 95% CI: [1.35; 6.29], $p=0.007$) and rural areas (OR=2.71, 95% CI: [1.51; 4.88], $p<0.001$) significantly increase the probability of employment, with AMEs of +24.3 pp and +22.7 pp respectively.

Specialised education (OR=2.66, 95% CI: [1.55; 4.58], $p<0.001$, AME=+22.3 pp) emphasises the importance of specific human capital in the adoption of green technologies, a result that concurs with the literature on the knowledge gap in sustainable agriculture (Knowler & Bradshaw, 2007). Female gender is a significant inhibiting factor (OR=0.55, 95% CI: [0.33; 0.92], $p=0.021$, AME=-13.7 pp), meaning that women are 45% less likely to be employed in green jobs, given equivalent characteristics, which highlights the persistent gender inequalities in access to agro-ecological practices. Residence in the Atlantique department was also positively associated (OR=1.94, $p=0.049$), while income and membership of a farmers' organisation were not significant in the multivariate analysis ($p=0.360$ and $p=0.202$ respectively), suggesting a confounding effect absorbed by the territorial variables.

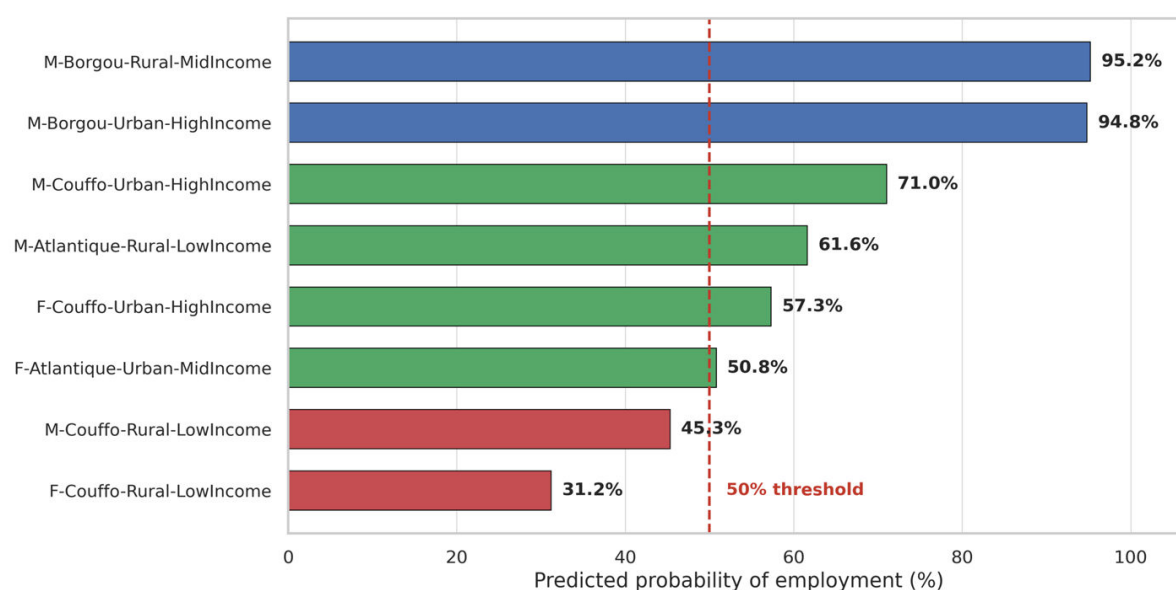
Table 15: Results of the M1 logistic regression model

Variable (reference)	OR	95% CI lower	95% CI higher	p-value	AME (pp)
Borgou (ref. Couffo)	7.49** *	3.74	15.01	<0.001	+45.8
Atlantique (ref. Couffo)	1.94*	1.00	3.74	0.049	+15.0
Rural environment (ref. Urban)	2.71** *	1.51	4.88	<0.001	+22.7
Specialised education (ref. None)	2.66** *	1.55	4.58	<0.001	+22.3
Land ownership (ref. None)	2.91**	1.35	6.29	0.007	+24.3
Female (ref. Male)	0.55*	0.33	0.92	0.021	-13.7
Income (ordinal level)	1.09 ns	0.90	1.32	0.360	+2.0
Member of organisation (ref. None)	0.73 ⁿ s	0.44	1.19	0.202	-7.3

OR=Odds Ratio; AME=Average Marginal Effect in percentage points (pp); *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns=not significant. AUC-ROC=0.752; McFadden Pseudo- R^2 =0.138; Hosmer-Lemeshow test: $p=0.147$.

Figure 5 shows the predicted probabilities of employment for eight typical profiles. The highest probabilities were observed for young men in Borgou in middle-income rural areas (95.2%) and high-income urban areas (94.8%). By contrast, young women in rural Couffo with low incomes have a predicted probability of only 31.2%, well below the 50% threshold. The maximum value of the observed VIF is 5.80 for ordinal income, which is considered acceptable in the context of this model.

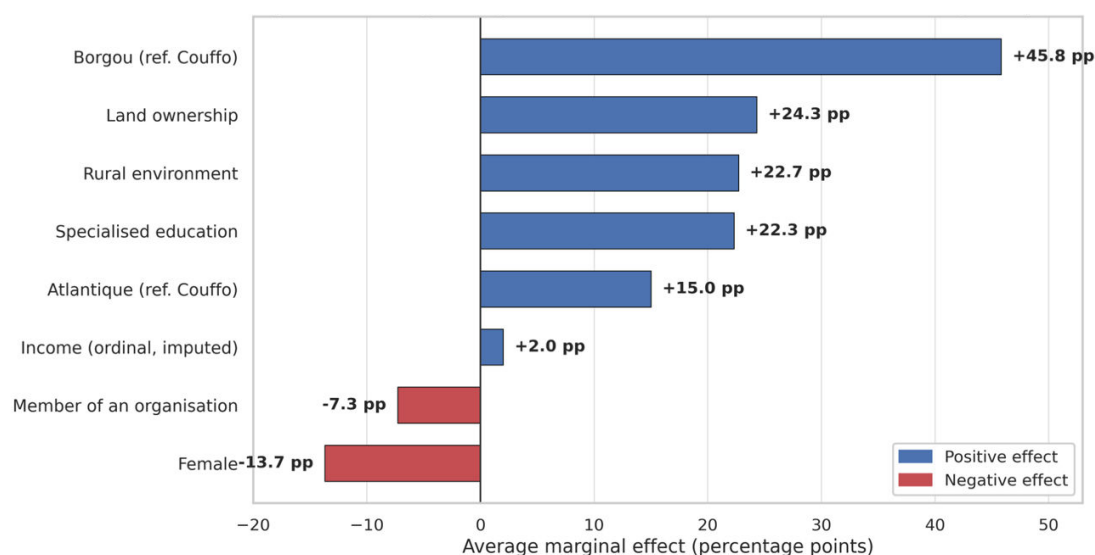
Figure 5: Predicted probabilities of employment in green jobs by typical profile



M = Male; F = Female.

Figure 6 summarises the average marginal effects (AME) for each determinant. Borgou (+45.8 pp) and own land (+24.3 pp) emerge as the most powerful determinants, followed closely by rural area (+22.7 pp) and specialised training (+22.3 pp). The negative AME for women (-13.7 pp) is a central equity issue for policies designed to include women in green agri-food chains.

Figure 6: Average Marginal Effects (AME).



5.4.1 Mediation analysis: Gender, Income and Green Jobs

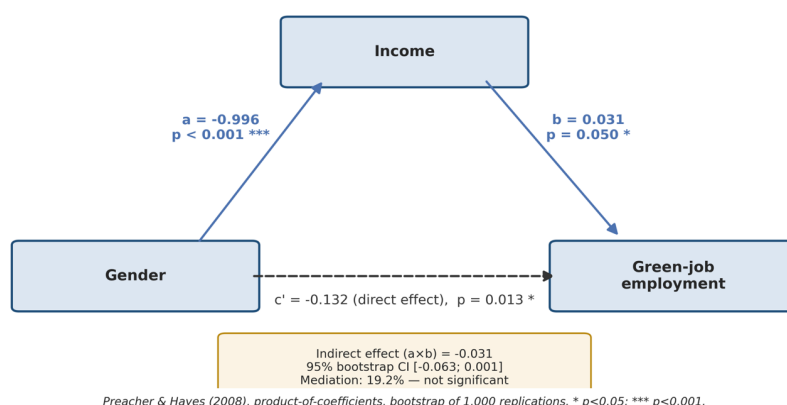
Table 16 and Figure 7 present the results of the mediation analysis testing whether the relationship between gender and youth engagement in green jobs is partially or fully mediated by monthly income, following the framework of Preacher and Hayes (2008) with bootstrap of 1,000 replications. Path “a” (gender to income) is strongly negative and significant ($\beta = -0.996$, $p < 0.001$). This path indicates that, on average, women have an income approximately one ordinal step lower than men with equivalent characteristics. This confirms the gender wage penalty documented in the African agri-food sector (Doss et al., 2018). Path “b” (income to green-job engagement, controlling for gender) is positive and marginally significant ($\beta = 0.031$, $p = 0.050$). The total effect of gender on green-job engagement (path “c”) is negative and significant ($\beta = -0.164$, $p = 0.001$). The direct effect of gender controlling for income (path “c”) is also significant ($\beta = -0.132$, $p = 0.013$), but smaller, suggesting partial mediation. The indirect effect ($a \times b = -0.031$, or 19.2% of the total effect) does not reach the threshold of significance based on the 95% bootstrap confidence interval (CI: [-0.063; 0.001], including zero). This result indicates that income is not a statistically established mediator of the gender–green-job engagement relationship, even though it captures a substantial part of it. Other potential mediators (access to land, mobility constraints, social norms, domestic burden) could explain the engagement penalty for women and would merit further exploration in future research.

Table 16: Results of the mediation analysis (Gender, Income, Green Jobs)

Path	Description	Coefficient	p-value
a	Gender (Female) → Monthly income	-0.996***	<0.001
b	Monthly income → Employment in green jobs Gender	0.031*	0.050
c'	Gender → Employment in green jobs (direct effect)	-0.132*	0.013
c	Gender → Employment in green jobs (total effect)	-0.164**	0.001
a×b	Indirect effect (mediation)	-0.031	—
95% CI	Bootstrap (1,000 replications)	[-0.063; 0.001] ^{ns}	—
% mediated	Proportion of mediated effect	19.2%	—

Note. Mediation analysis using Preacher & Hayes (2008), product of coefficients method with bootstrap of 1,000 replications. 95% CI bootstrap: 95% confidence interval by percentile. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Figure 7: Mediation model Gender - Income - Green Jobs



5.4.2 Intensity of employment in green jobs

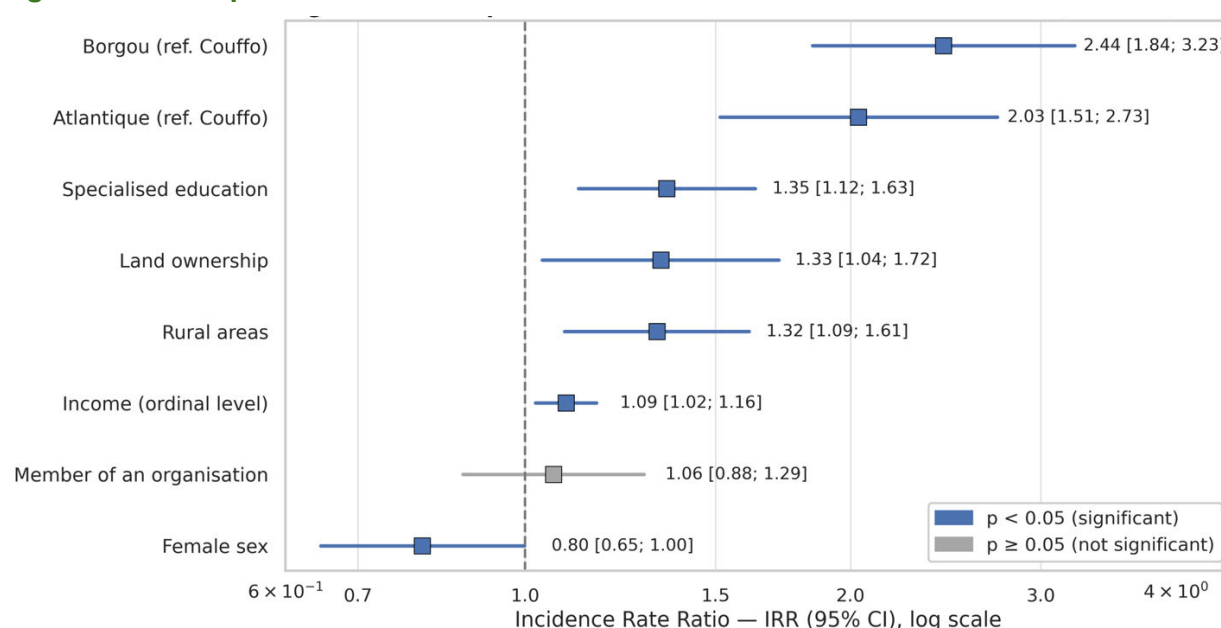
Table 17 and Figure 8 show the results of a regression with a Poisson distribution model adjusted for the intensity variable (i.e. the number of green activities practised by each young person). The results are consistent with the logistic regression. Borgou has the highest IRR (IRR=2.44, 95% CI: [1.84; 3.23], $p < 0.001$), meaning that youth in Borgou are employed in 2.44 times more green activities on average than those in Couffo with a comparable profile. This result concurs with the logistic regression. The effect of income, which was not significant in the logistic model, becomes significant here (IRR=1.09, $p = 0.010$), suggesting that income has a larger influence on intensity than on the simple probability of employment. Female gender remains an inhibiting factor for intensity (IRR=0.80, $p = 0.048$), while the fact that young people have had education (IRR=1.35, $p = 0.002$) and have land (IRR=1.34, $p = 0.025$) contributes significantly to a greater diversity of green practices.

Table 17: Incidence Rate Ratios (IRR)

Variable	IRR	95% CI lower	95% CI higher	p-value
Borgou (ref. Couffo)	2.438^{***}	1.844	3.225	<0.001
Atlantique (ref. Couffo)	2.034^{***}	1.514	2.734	<0.001
Rural areas	1.324^{**}	1.087	1.611	0.006
Specialised education	1.352^{**}	1.120	1.633	0.002
Income (ordinal level)	1.091[*]	1.022	1.164	0.010
Land ownership	1.335[*]	1.037	1.717	0.025
Female sex	0.803[*]	0.647	0.998	0.048
Member of an organisation	1.062 ^{ns}	0.876	1.288	0.541

Note. IRR: Incidence Rate Ratio= $\exp(\text{Poisson coefficient})$. 95% CI calculated by exponentiation of the coefficient CIs. Dependent variable: n_jobs_green (0 to 7). *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns: not significant.

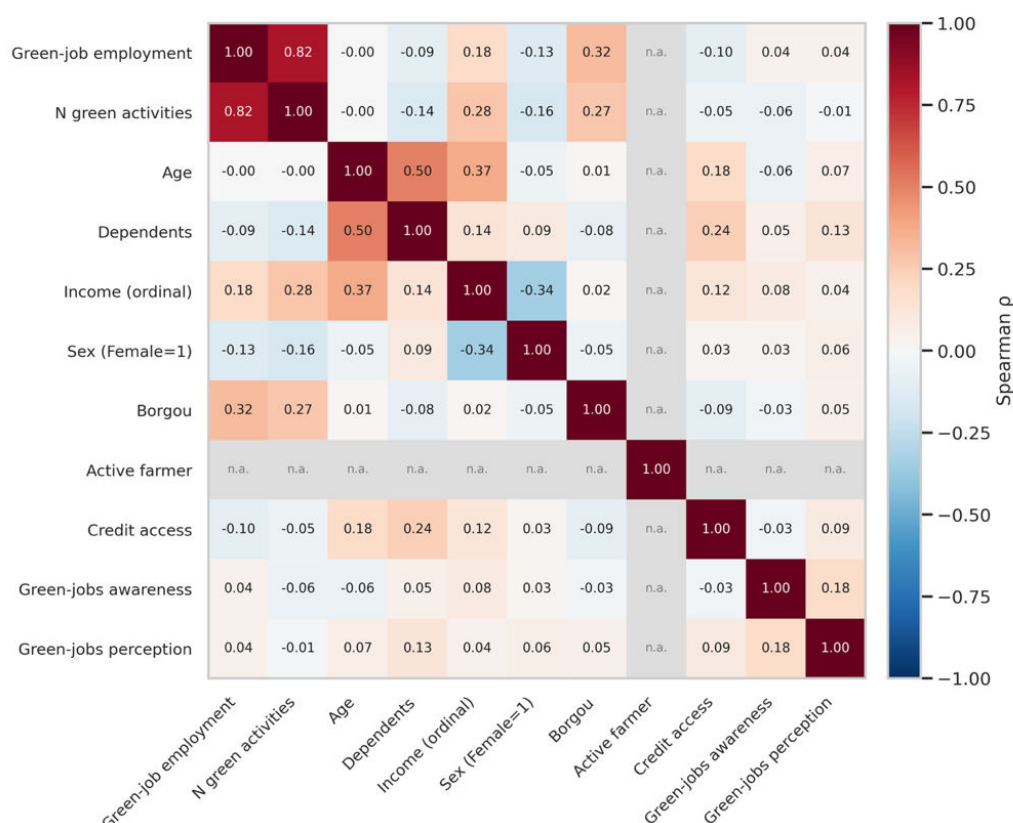
Figure 8: Forest plot for IRRs



5.4.3 Spearman correlations and association structure

Figure 9 shows the Spearman correlations between the main variables in the study, with the Bonferroni correction for multiple comparisons applied (adjusted threshold: $p < 0.00091$ for 55 pairs). The correlation matrix reveals a structure of associations consistent with the multivariate results. The strongest and expected association is between employment in green jobs and the number of green activities ($\rho = 0.822$, $p < 0.001$, sig. Bonferroni), confirming the internal consistency of the two employment measures. Youth residence in the Borgou department was strongly associated with employment ($\rho = 0.323$, $p < 0.001$, sig. Bonferroni) and the intensity of practices ($\rho = 0.269$). The gender-income relationship is strongly negative ($\rho = -0.339$, $p < 0.001$, sig. Bonferroni), reflecting the pay penalty for women. Income is positively linked to employment ($\rho = 0.182$) and green job intensity ($\rho = 0.280$, sig. Bonferroni). It is worth noting that knowledge about, and the perception of, green jobs are not associated with actual employment ($p > 0.05$).

Figure 9: Spearman correlation matrix



Coefficients reconstructed from values reported in the text (Bonferroni-adjusted threshold $p < 0.00091$). 'Active farmer' is constant within the analysis subset (n.a.).

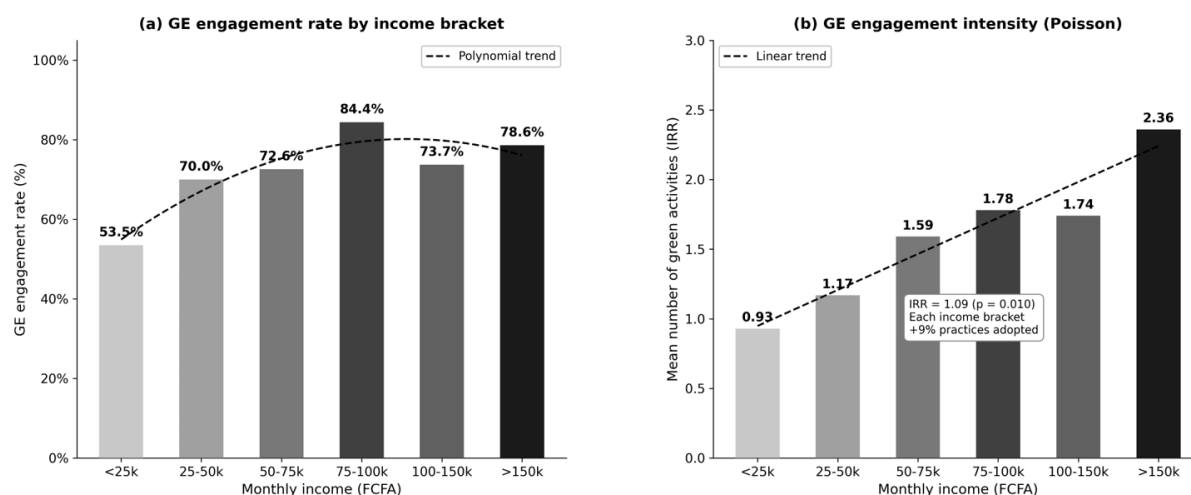
5.4.4 Analysis of the income gradient and employment in green jobs

To analyse the determinants of the number of green activities practised simultaneously (count variable, $n=272$ young people involved), a Poisson regression model was applied after checking the equidispersion hypothesis (Cameron and Trivedi test, 1990). Borgou has the highest Incidence Rate Ratio (IRR) (IRR=2.44; 95% CI: [1.84-3.23]; $p<0.001$), meaning that youth in Borgou work in 2.44 times more green activities on average than their counterparts in Couffo. It is worth noting that income, which is not significant in the logistic model, becomes significant in the Poisson model (IRR=1.09; 95% CI: [1.02-1.16]; $p=0.010$): each additional income level increases the average number of green activities undertaken by 9%. This result indicates that financial constraints are less of a barrier to entry into green jobs than the diversification and deepening of practices.

Figure 10 shows the income gradient and its link with employment in green jobs and the intensity of practices. The analysis shows an increasing, albeit non-linear, relationship between income level and the rate of employment in green jobs. Youth with the lowest incomes (less than 25,000 FCFA) have the lowest employment rate (53.5%), while those on higher incomes (100,000 to 149,999 FCFA) achieve 84.4%. This gradient is confirmed by the Poisson model (IRR=1.09, $p=0.010$), which indicates that each additional income level raises the average number of green activities practised by 9%. This result suggests that financial constraints are a barrier to the adoption of agro-ecological technologies, particularly those with a higher initial investment cost.

Figure 10: Income gradient and employment in green jobs (N=374 active farmers).

(a) Rate of employment in green jobs by income bracket with polynomial trend line. (b) Employment intensity (average number of activities) by income level with results from the Poisson model (IRR=1.09; p=0.010).



Before the survey and the definition read out by the interviewer, 61.8% of respondents said they had never heard of 'green jobs' or 'sustainable agriculture'. Only 15.0% (n=59) said they were familiar with the concept. This lack of awareness is particularly strong in Borgou (76.5%) compared with Couffo (45.8%), a finding that can probably be explained by less exposure to awareness campaigns in the northern savannah areas of Borgou.

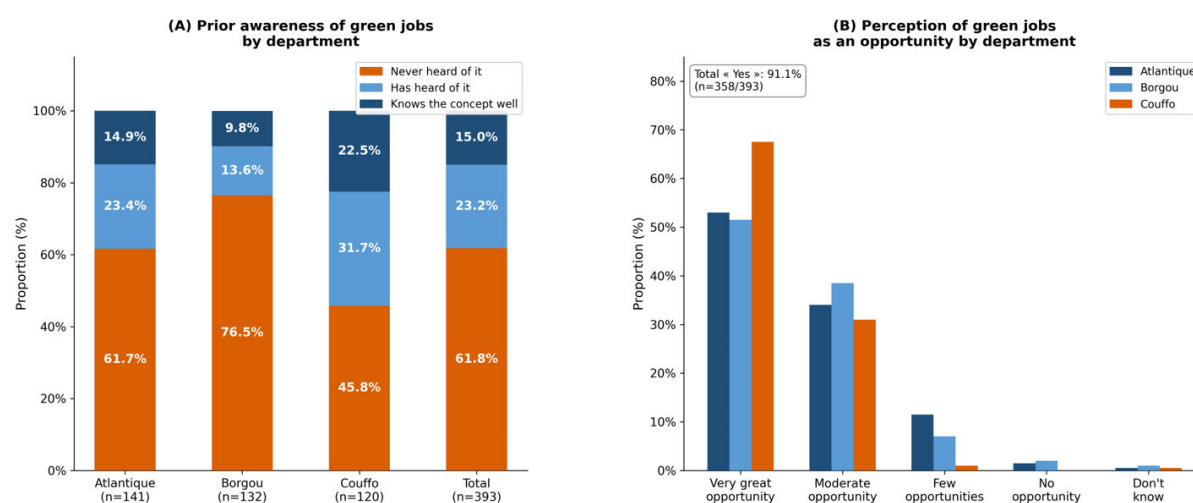
Table 18: Prior awareness of green jobs by department.

Level of awareness	Atlantique (141)	Borgou (132)	Couffo (120)	Total
No, never heard of it	61.7% (87)	76.5% (101)	45.8% (55)	61.8%
Yes, have heard of it	23.4% (33)	13.6% (18)	31.7% (38)	23.2%
Yes, familiar with the concept	14.9% (21)	9.8% (13)	22.5% (27)	15.0%

After the interviewer had read the definition of green jobs, 91.1% of respondents (n=358/393) agreed that green jobs represented an opportunity for youth in Benin, including 57.3% (n=225) who felt that it was a 'very big opportunity'. This rate is particularly high in Couffo (99.2%±0.8%), indicating that the weakness of green practices in this department (see previous sections) is not linked to a lack of interest or aspiration but to structural constraints on access (training, funding, infrastructure).

Key figure: 91.1% of youth see green jobs as an opportunity once they have been informed, despite a low initial awareness of 61.8%. This gap between aspiration (high) and actual access (low) is the central 'opportunity gap' that public policies must address.

Figure 11: Prior awareness of green jobs (3A, stacked bars) and perception of opportunity after definition (3B, grouped bars) by department.



5.4.5 Principal Component Analysis and Ascending Hierarchical Classification

Figure 12 shows the biplot and the scree plot for the Principal Component analysis. The Principal Component Analysis (PCA) conducted on twelve active variables describing agro-ecological practices and digital uses (N=361 observations after the exclusion of incomplete cases) meets the dual objective of reducing dimensionality and visualising the latent structure of the adoption profiles. The validity of the PCA is confirmed by the KMO test (0.71, 'good') and the Bartlett test ($p < 0.001$). The first five components extracted explain 63.2% of the total variance, which breaks down as follows: PC1=22.8%, PC2=13.0%, PC3=9.6%, PC4=9.0% and PC5=8.8%. The PCA biplot (axes PC1 $\times$ PC2) shows three distinct, albeit partially overlapping, departmental configurations, illustrating intra-departmental heterogeneity. Borgou is concentrated in the quadrant of high levels of organic practices with no dominant digital systems, Atlantique has a more balanced profile combining organic and digital practices, and Couffo has the highest inter-individual spread, reflecting the heterogeneity of the local circumstances in this department.

Figure 12: Principal Component Analysis: biplot and scree plot

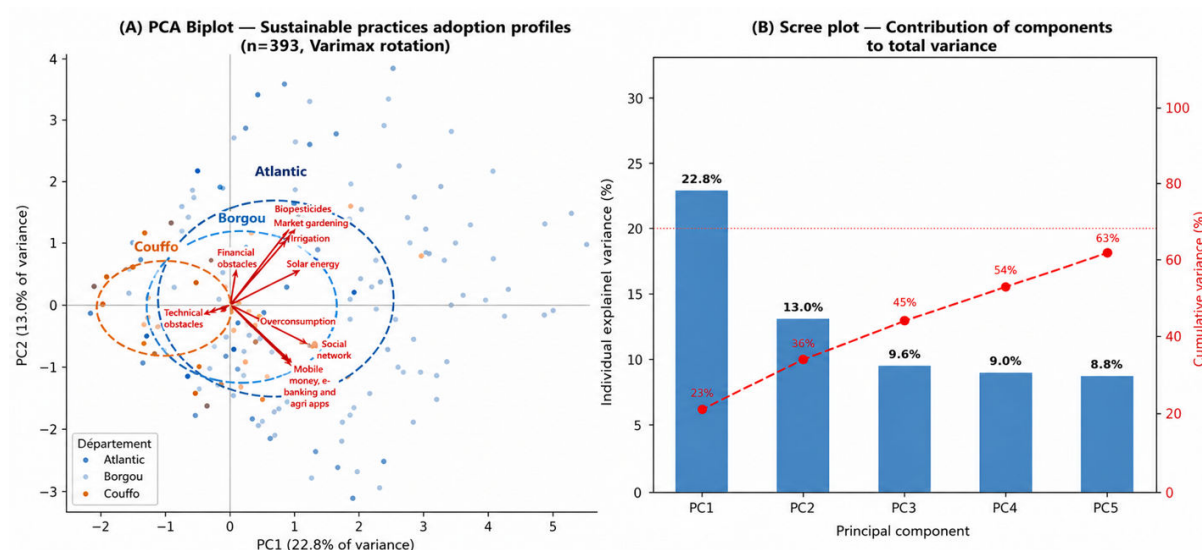


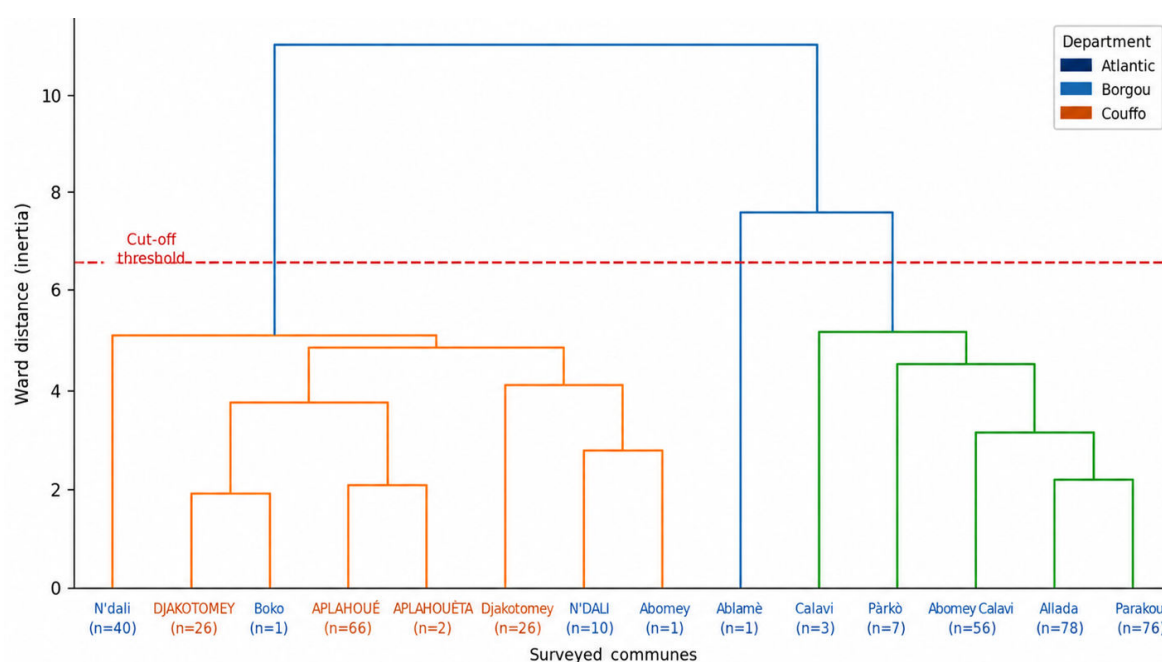
Table 19 and Figure 13 show the results of the Ascending Hierarchical Classification (Ward's method) conducted on the standardised PCA coordinates. Three clusters were selected in line with the visual criterion of the dendrogram (cut-off at Ward level maximising intra-class homogeneity). Cluster 1 (youth under 27, women at 40.8%, low income, no credit, employment in green jobs=65.9%) shows that youth starting out in the sector face limited access to resources. Cluster 2 (approximately 29 years of age, average income, 100% systematic access to credit, employment in green jobs=53.7%) paradoxically has the lowest employment rate, possibly because credits obtained are invested in conventional sectors that are more profitable in the short term. Cluster 3 (over 30, 90.9% male, high income, 50% from Borgou, employment in green jobs=91.0%) consists of accomplished young agricultural entrepreneurs with the highest level of employment in green jobs in the sample. This profile is the typical 'young green entrepreneur': men, older, high income, based in Borgou.

Table 19: Profile of the three AHC clusters (Ward's method)

Cluster	Profile	Average age	No. of dependents	Ordinal income	Women	Credit	Employment Green Jobs
Cluster 1 (N≈88)	Young women, low income, no credit	26.6	2.2	2.48	40.8%	0.0%	65.9%
Cluster 2 (N≈182)	Average profile, systematic access to credit	29.3	4.0	3.00	34.1%	100.0%	53.7%
Cluster 3 (N≈91)	Men, high income, 50% Borgou	30.9	4.1	3.91	9.0%	18.0%	91.0%

Note. Note. AHC: Ascending Hierarchical Classification. Ward's method for standardised PCA coordinates. k=3 clusters according to the dendrogram criterion.

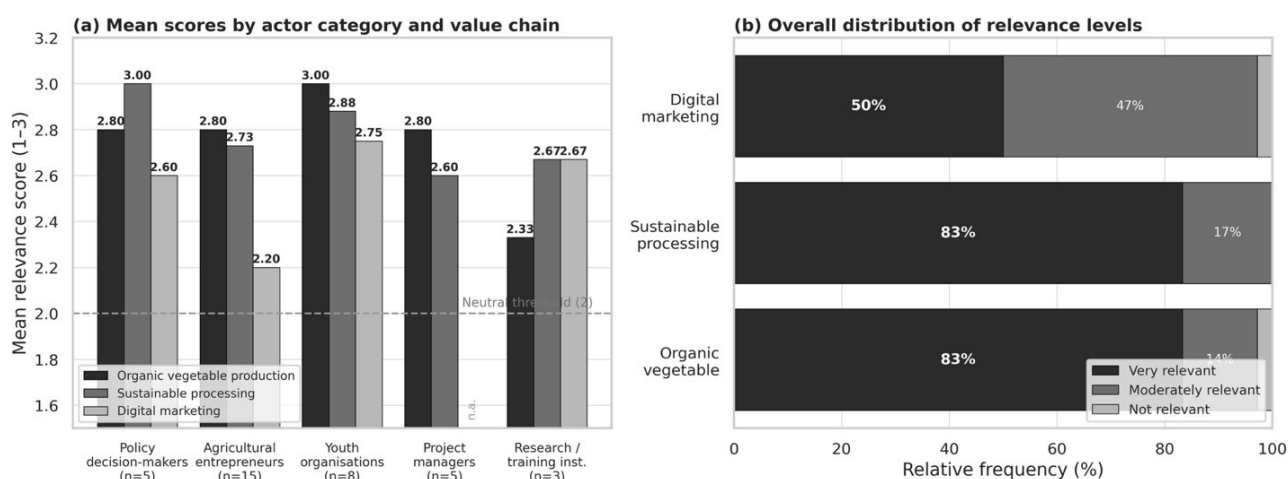
Figure 13: AHC (Ward) dendrogram and projection of clusters in AC space



5.5 Strategic relevance of agri-food value chains

The assessment of the three priority AVCs by the 36 SSI respondents reveals a remarkable consensus between the actors. The Kruskal-Wallis test does not detect any significant difference between the actor categories for any of the three AVCs (vegetable production: $H=2.63$, $p=0.621$; processing: $H=3.67$, $p=0.452$; digital commerce: $H=6.27$, $p=0.180$). The Friedman test on the 36 complete pairs shows a significant difference between the AVCs ($\chi^2=13.853$; $p=0.001$): agro-ecological vegetable production (average=2.81; 83.3% 'very relevant' scores) and sustainable agri-food processing (average=2.83; 83.3%) are considered to be a much higher priority than agricultural digital commerce (average=2.47; 50.0% 'very relevant' scores). Figure 14 shows these results in a bipartite format.

Figure 14: Assessment of the strategic relevance of agri-food value chains according to actor categories during the SSIs. Average scores by actor and AVC (grouped bar plot). Overall distribution of relevance levels p



Friedman test $\chi^2 = 13.853$, $p = 0.001$. One score (project managers, digital marketing) was not legible in the source (n.a.).

5.6 Obstacles to the inclusion of youth in green jobs

The she stakeholders shed light on the institutional mechanisms underlying the quantitative results revealing that financing (18 cumulative references in SSIs + FGDs), land (16 references) and skills (15 references) constitute the dominant triad of barriers (Figure 15).

“The big problem is skills, followed by financing and land. How can a young person acquire land? The State does not encourage people who do these green jobs.” (FGD participant, Borgou, 2026)

“Authorisation for marketing usually takes eight months. The tax arrangements are not tailored to youth. Certification and education systems are inadequate.” (Education institution (SSI), Atlantique, 2026)

“Young people see vegetable farming as hard work because of the physical strength required for production activities. There is also a lack of training, no access to water and limited financing resources.” (Agricultural contractor (SSI), Atlantique, 2026)

Figure 15: Frequencies of barriers to the inclusion of youth in green jobs (thematic content analysis, SSIs N=36 + FGD N=9 sessions). Barriers listed in ascending order of frequency. The vertical dashed line shows the barrier threshold

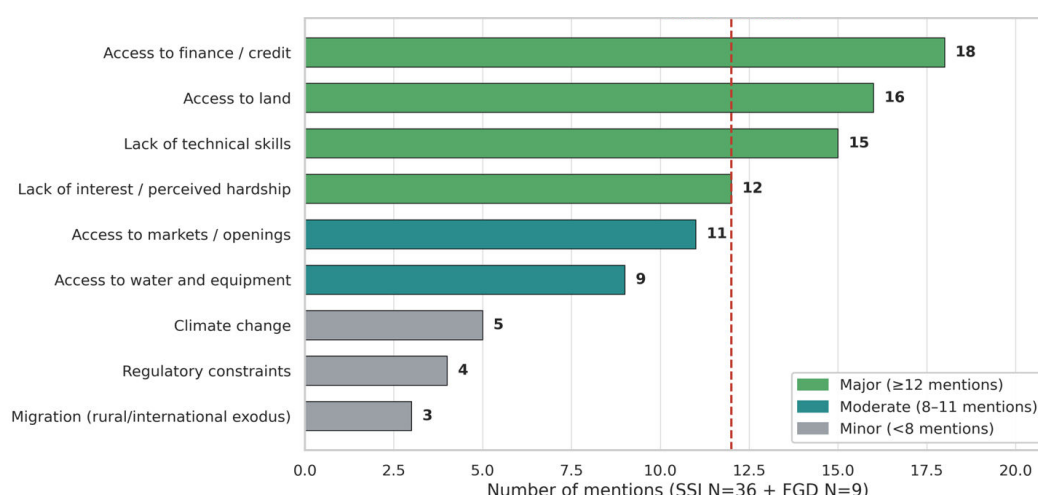


Table 20: Frequency of barriers to youth inclusion (thematic analysis)

Identified barrier	SSI (n)	FGD (n)	Total	Justice dimension
Access to finance/credit	11	7	18	Distributive
Access to land	9	7	16	Distributive / Restorative
Lack of technical skills	9	6	15	Procedural
Lack of interest / perceived hardship	8	4	12	Recognition
Access to markets/openings	6	5	11	Distributive
Access to water and equipment	5	4	9	Distributive
Regulatory constraints	3	2	5	Procedural / Restorative
Climate change	2	3	5	Restorative

Attribution to INCLUDE justice dimensions in line with Schlosberg (2007) and INCLUDE (2021).

6. SUMMARY AND DISCUSSION

6.1 The dominant territorial effect, a structural determinant of green jobs

The principal aim of this study was to examine the territorial, socio-economic and gender determinants of the employment of young Beninese farmers in green agri-food jobs. The results show that 65.0% of the youth surveyed were employed in at least one green activity, with distinct territorial heterogeneity: youth in Borgou were 7.49 times more likely to be employed in green jobs than those in Couffo, an effect that persisted after controlling for all individual covariables. This result qualifies the initial hypothesis that green job opportunities are mainly structured along socio-economic lines: territory is the dominant determinant, far more than education, income or land. These results are in line with those of Ndaha et al. (2025) in West Africa, which showed that regional differences in the adoption of agro-ecological practices can be explained by differences in the local institutional environment, extension services and different climate pressures, independently of the individual socio-economic profile of the producers. Similarly, Zagre et al. (2024) found, in a logistic regression study of farmers in Senegal, that institutional variables at the local level explained a substantial proportion of the variance in the adoption of climate-smart practices, over and above household characteristics.

In the Benin context specifically, Assogba et al. (2020) observed comparable disparities in the adoption of agro-ecological practices between departments, even though their study was limited to the Atlantique department and did not include a multivariate analysis of territorial determinants in the strict sense. However, these results differ to some extent from those of Agyei-Holmes et al. (2024), whose systematic review of 57 studies in sub-Saharan Africa identifies individual factors such as education, access to finance and attitudes as the primary determinants of employment in agribusiness. This difference may be due to the fact that the majority of the studies in this review focused on the adoption of specific agricultural practices rather than on employment in green job sectors in the institutional ILO/FAO sense, and that they operate on a less heterogeneous geographical scale than the present study.

The exceptional size of the Borgou effect ($OR=7.49$) in our results can probably be explained by the convergence of several specific contextual factors: a denser agricultural institutional infrastructure (ATDA, Agricultural Projects, training centres), higher climate pressure specific to the Sudano-Sahelian region that encourages agro-ecological diversification, and more active local cooperative dynamics, in line with the theoretical framework of Wezel et al. (2023) on the decisive role of the territory in agro-ecological transitions. In theoretical terms, these results help to confirm the spatial justice approach to the analysis of green jobs in agriculture: unequal green job opportunities are not solely a question of individual resources but also of structural territorial inequality that is not addressed by undifferentiated individual support policies. In practical terms, these results suggest that green employment support programmes should adopt an explicit spatial approach by prioritising investment in the institutional infrastructure of disadvantaged departments such as Couffo rather than focusing solely on the individual attributes of beneficiaries.

6.1 The triad of socio-economic determinants: land, education and rural environment

In addition to the territorial effect, individual land ownership ($OR=2.91$, $p=0.007$, $AME=2.91$ pp), access to specialised education ($OR=0.007$, $p<0.001$, $AME=+22.3$ pp) and rural

residence (OR=2.71, $p<0.001$, AME=+22.7 pp) constitute a triad of socioeconomic determinants of comparable and converging size. Land ownership extends the decision-making horizon for young farmers, making it rational to invest in agro-ecological practices, the benefits of which, in terms of soil fertility and carbon sequestration, are deferred over time. In terms of the security of land ownership, these results corroborate the observations of Msangi et al. (2024) in Tanzania, who showed, using longitudinal panel data, that young formal owners of land were significantly more inclined to invest in long-term sustainable agricultural practices, including soil conservation and agroforestry.

Similarly, Noufé (2023) found, in a sample of 15,627 farming households in Burkina Faso, that traditional security of land tenure improved agricultural productivity by at least USD 86.4 per active farmer per season, confirming the mediating role of the time horizon in the tenure-investment relationship. Furthermore, a recent study focusing specifically on Benin (Frontiers in Sustainable Food Systems, 2025) found that secure land rights strengthen social cohesion and long-term investment, particularly for marginalised groups such as youth and women. Nevertheless, it should be noted that the estimated value of our OR (2.91) is lower than that reported by fundamental studies of the tenure-investment relationship (Goldstein & Udry, 2008, implicit OR higher than 4.0 in the Ghanaian context). That may be attributable to the low proportion of young formal landowners in our sample (12.8%), which may have limited the statistical power of the estimator.

With respect to specialised education, these results are in line with those of Agyei-Holmes et al. (2024), who identify agricultural education as the most frequently cited determinant of youth employment in sustainable agribusiness in sub-Saharan Africa. It operates through two complementary channels: the acquisition of technical skills and the strengthening of professional networks. These results are also consistent with those of Geza et al. (2022), whose review conducted in South Africa concludes that specialised education is the primary condition for a setting that enables the sustainable participation of youth in agriculture. The education-employment gradient highlighted by our bivariate analysis (39.4% for youth with no education to 87.5% for graduates from professional education) is also consistent with the work of Schultz (1961) on the human capital theory, and with the results of the review of Frontiers in Sustainable Food Systems (2025), which reports adoption rates for climate-smart practices of 56.7% in East Africa compared with 38.9% in West Africa that are in part attributable to differences in access to education services.

These results suggest that investment in specialised agricultural education and in securing land rights for youth work as a dual and consistent lever for the acceleration of the green transition in agri-food chains. Benin's public policies should integrate these two levers in a complementary way, prioritising the targeting of disadvantaged departments where access to education and secure land ownership are both limited.

6.3 Gender barriers: inequality is partially, but not significantly, mediated by income

The results indicate that female gender was associated with a significantly reduced probability of employment in green jobs (OR=0.55, $p=0.021$, AME=-13.7 pp) and this effect remains significant after controlling for income, territory and education. The mediation analysis conducted using the Preacher and Hayes (2008) framework showed that revenue captured the total effect of gender on employment in green jobs. However, it did not exceed the threshold of statistical significance (indirect effect=-0.031; bootstrap 95% CI=[-0.063;

0.001]). These results therefore indicate a partial and non-significant mediation of income, which means that the employment penalty for women is only partly attributable to their income disadvantage, and that other structural mechanisms operate independently of the difference in incomes. These results are consistent with those of Van den Broeck et al. (2023), which show, on the basis of a panel of sub-Saharan African countries, that women's participation in sustainable agriculture is systematically lower than that of men, and that this gap is mainly attributable to differences in income and access to production resources. Similarly, the results of Van den Broeck et al. (2023), which are based on representative data from Malawi, Tanzania and Nigeria, demonstrate that the gender gap in sectoral participation is mainly due to an economic and sectoral composition effect and not to direct discrimination. However, the remaining 80.8% of the total gender effect that remains unexplained by income in our study suggests that additional unmeasured mediators are at play, in line with the work of Quisumbing and Doss (2022), who identify women's dual production and reproductive burden, mobility constraints in rural Benin and social norms governing access to professional agricultural networks as the primary determinants of gender disparities in African agriculture.

The study by Peterman et al. (2011) corroborates this plurality of causes: gender inequalities in access to agro-ecological innovations are the result of a range of structural constraints that cannot be addressed by correcting income disparities alone. In terms of policy implications, these results suggest that programmes designed to include women in green agrifood chains cannot be limited to income transfers or credit targeting women. They also need to address structural mediators, including domestic burdens, mobility constraints and social norms governing access to networks, in line with Mwaura and Glover's (2021) recommendations on green job policies for young rural women in Africa. Future initiatives should include a mixed support component, including childcare services, integrated group education and the strengthening of the organisational capacity of women's groups.

6.4 Income as a determinant of intensity rather than green job opportunities

One analytically important result is the dissociation between the determinants of access to, and the determinants of the intensity of, employment in green activities. Ordinal monthly income was not significantly associated with employment in green jobs (OR=1.09, $p=0.360$) but with the number of green activities practised (IRR=1.09, $p=0.010$). The income gradient confirms this dissociation: the employment rate varies from 53.5% at the lowest level (less than FCFA 25,000) to 84.4% at the highest (FCFA 100,000-149,999), while the average intensity varies from 0.93 to 2.36 activities depending on the level. These results suggest that income is an enabling condition for diversifying and intensifying green practices rather than for crossing the initial employment threshold. This result is consistent with the findings of INCLUDE et al. (2024), who emphasise that financial constraints are a barrier to the intensification of agro-ecological practices, particularly those with a high initial cost, but that the initial employment threshold is influenced more by institutional and territorial factors than by income alone.

These results extend the conclusions of Kassie et al. (2015), who demonstrated that, in Eastern and Southern Africa, the adoption of a portfolio of sustainable intensification practices was positively correlated with household economic resources, showing that this income-intensity relationship is also seen in a context of agri-food green employment in West Africa. In contrast, Frontiers in Sustainable Food Systems (2025) reports, in a

systematic review of the adoption of climate-smart practices in sub-Saharan Africa, that access to raised the probability of the adoption of specific sustainable technologies by 20%, a result that our study did not reproduce (cf. subsection 4.5). These results imply that programmes to support the intensification of green practices among youth who are already employed should prioritise improving net farming income, for example through access to certification markets, premiums for sustainable production and cooperative economies of scale. It is recommended that new intervention projects/programmes in Benin should, in their intervention reasoning, distinguish between mechanisms targeting the recruitment of new participants, and mechanisms for deepening the work of existing participants, which are related more to income and the diversification of activities.

6.5 The paradox of access to credit

Access to credit was not significantly associated with employment in green jobs in the bivariate analysis ($\chi^2=1.23$, $p=0.268$), and youth who had applied for credit even had a slightly lower rate of employment (60.2%) than those who had not (66.8%). This result, which the statistical report itself describes as counter-intuitive, merits a rigorous interpretative analysis. It can be explained by the nature of the activities financed by the credit: in a context where conventional sectors offer more immediate and predictable returns on investment than green sectors, young borrowers tend to allocate any credit obtained to conventional activities that are more profitable in the short term, in line with the logic of minimising the financial risk associated with repayments. This result differs from those of Frontiers in Sustainable Food Systems (2024), which reported in a systematic review on the determinants of the adoption of climate-smart practices in Africa that access to credit was positively and significantly associated with the adoption of several sustainable technologies, raising the probability of adopting certain practices by 20%. This discrepancy may be explained by the nature of the studies included in the review, which focus mainly on technologies with identifiable initial installation costs that can be financed by credit (irrigation, improved seeds, organo-mineral fertilisers), whereas our dependent variable captures employment in a broader spectrum of green activities, many of which do not necessarily require external financing (composting, biopesticides, agroforestry). Similarly, Sahai (2024) points out that, in the African contexts with a predominantly informal economy, agricultural credit is often diverted to non-agricultural uses or to conventional activities with faster returns, reducing its impact on the adoption of sustainable practices. The youth in group 2 of our hierarchical classification, which had 100% systematic access to credit and paradoxically the lowest rate of employment in green jobs (53.7%) provides an empirical illustration of this substitution phenomenon. These results suggest that simply widening access to agricultural credit is not enough to promote green employment among youth in rural Benin. It is recommended that financial products dedicated to the green transition should be conditional on targeted investment plans in identified green activities, and accompanied by technical monitoring that reduces substitution by short-term conventional investments.

6.6 Knowledge-action gap

One of the most conceptually significant results of this study is the absence of any significant association between awareness of green jobs and actual employment ($p>0.05$), as well as between the positive perception of their importance and employment in green jobs ($p>0.05$). Knowledge and perception scores were comparable between young people who were employed and those who were not (Mann-Whitney test not significant). This result indicates that an awareness of green jobs, in the absence of enabling socio-economic and institutional

conditions, does not translate into effective adoption. These results are fully consistent with the concept of the 'knowledge-action gap' documented by Blake (1999) and systematically confirmed in recent agricultural literature. Ndaha et al. (2025), in participatory workshops in two contrasting regions of Burkina Faso, found that the barriers to the adoption of agro-ecological practices were mainly economic and institutional (limited access to markets, inadequate training services, weak local institutional support) rather than cognitive: farmers knew about and valued these practices but did not have the resources to adopt them. Similarly, the systematic review in *Frontiers in Environmental Economics* (2024) looking at the determinants of the adoption of climate-smart practices in Africa concludes that the barriers to adoption are mainly related to access to resources (finance, extension services, inputs) and not to the lack of information or awareness alone, with institutional and economic factors being the primary enabling conditions for action. These results extend the conclusions of Knowler and Bradshaw (2007), who, in their pioneering review of the adoption of conservation agriculture, established that knowledge and willingness did not suffice in the absence of practical resources and skills, a conclusion that proves to be applicable, two decades later, to the context of agri-food green jobs in francophone West Africa. These results imply that awareness programmes targeting green jobs should not be designed as stand-alone interventions but as elements of an integrated approach that combines training in technical skills, access to inputs and markets, and the securing of the basic conditions for investment (land, income, institutional support). It is particularly important to note that this conclusion contradicts the communications approaches in the area of behaviour change that still dominate many agricultural development projects in sub-Saharan Africa.

6.7 Characteristics of young farmers and implications for the interventions

The ascending hierarchical classification identified three distinct profiles, the composition of which confirms and enriches the conclusions of the multivariate analysis. Youth group 3, which consists of young men, average age 30.9, high income, 50% resident in Borgou, employment in green jobs rate 91.0%, provides a picture of the typical young Beninese green entrepreneur: the convergence of economic capital, territorial capital and human capital generates the optimal conditions for multiple and intensive involvement in green jobs. In contrast, Group 2, with systematic access to credit (100%) and the lowest rate of employment in green jobs (53.7%) provides a direct empirical illustration of the credit paradox discussed earlier. These results are consistent with the findings of CABI Bioscience (2025) on green employment patterns among young Africans, which show that the profiles of established green entrepreneurs invariably include a combination of social capital, access to markets and membership of supportive institutional networks, over and above simple access to finance. Similarly, Mwaura and Glover (2021) find that the young people who are most involved in the African green economy combine technical training, collective organisation and strong territorial roots, a profile that is exactly the same as our Cluster 3. The presence of an intermediate profile of youth with no access to credit but with a rate of employment in green jobs comparable to Cluster 1 confirms that credit is not a differentiating factor between the employment groups. These results indicate that interventions to support green employment would benefit from being tailored to the identified profiles. The youth in Group 1 require interventions that target fundamental barriers: land security, income support and initial education. Those in group 2 need their access to credit to be redirected towards specific green sectors, in conjunction with technical support. Those in Group 3, who are already employed and performing well, are a priority target for scale-up programmes with the aim of pooling their experience and setting up peer training networks.

7. LIMITATION OF THE STUDY AND FUTURE RESEARCH

The present study suffers from several limitations. Firstly, the cross-sectional nature of the survey design makes it impossible to establish strict causality between the determinants identified and employment in green jobs. The correlations found, while robust and consistent with plausible theoretical mechanisms, can be interpreted only in terms of conditional correlation, not as causal relationships in the sense of modern causal inference.

Secondly, the measurement of income with a seven-category ordinal variable limits the precision of the estimates of the income effect, particularly for the mediation analysis, where a continuous variable would have made it possible to estimate the indirect effect with greater statistical power. The report itself notes a slight over-dispersion of the count variable (variance/mean=1.52), which could have justified the use of a negative binomial model in sensitivity analysis in accordance with the recommendations of Cameron and Trivedi (1990).

Thirdly, the mechanism in which residence in Borgou generates an OR of 7.49 for employment in green jobs is unclear to some extent because the contextual variables specific to Borgou (institutional infrastructure, cooperative dynamics, climate pressure) were not measured directly in this study. This is a major limitation because it prevents us distinguishing between competing explanatory hypotheses for the territorial effect, and reduces the scope of the programmatic recommendations for disadvantaged departments.

Fourth, it should be noted that the 26 imputations of the green jobs variable to zero for non-farmers in the sample introduces a strong hypothesis, the potential compromise of which would slightly lower the overall estimates of the employment rate. These limitations open up precise and soundly based research avenues in the form of longitudinal or quasi-experimental studies. An impact assessment with a counterfactual group looking at interventions to secure land tenure or transfer income to young women would make it possible to estimate the causal effects of the identified determinants. In-depth qualitative studies in the department of Borgou would make it possible to identify and document the institutional factors that explain the exceptional size of the territorial effect and, in turn, to identify lessons that could be replicated for other departments.

Finally, the inclusion of a continuous measure of income and explicit indicators of women's dual productive and reproductive burden in future surveys would make it possible to break down the gender penalty mechanism more rigorously and to test mediation by variables other than monthly income alone.

7.1 Integrated Analysis of the Dimensions of Justice

The primary data and the literature review converge, demonstrating that the inequalities observed (income, sustainable practices, access to value chains) are not independent: they are mutually reinforced through deep-rooted institutional and cultural mechanisms. Distributive justice is the dimension that suffers most: youth, particularly women and rural dwellers in Couffo, are systematically excluded from production resources (land, finance, technology), and they are therefore confined to the lower value-added segments of value chains. This distributive exclusion is reproduced by procedural shortfalls (poor representation in the governance of chains and policies) and recognition gaps

(stigmatisation of agriculture, invisibility of women's contributions). The restorative dimension continues to be the least developed, with a virtual absence of political measures targeting the historical injustices that have structured these inequalities.

The analysis of the political economy reveals that these four dimensions of justice are linked to specific power structures. In the organic market garden chain, governance is effectively delegated to input traders and importers, who set prices and control access to urban markets. Young producers, even if they adopt sustainable practices, have little negotiating leverage. In agri-food processing, established private processors capture most of the added value, while youth without access to capital have access only to the low-margin stages of processing. Digital marketing offers most potential for the disruption of these power relationships, but only for youth with a reliable Internet connection and adequate digital skills, which excludes a majority of the target population in Couffo.

7.2 Tensions and Synergies in the Just Transition

A central tension is emerging between the green transition agenda (which tends to favour capital-intensive practices and well-connected actors) and the imperatives of justice (which require the inclusion of the most vulnerable young people). Without targeted mechanisms for redistribution and inclusion, there is a risk that the transition will most benefit the young entrepreneurs with the most resources and the best connections to urban markets, excluding the rural population of Couffo and young women. An important synergy has been identified between the adoption of sustainable practices and income: sustainable practitioners have a median income of FCFA 62,500 compared with FCFA 37,500 for non-practitioners ($p < 0.001$, $U = 13,560$). This indicates that green jobs are not only environmentally desirable but also that they make good economic sense for youth. Removing the barriers preventing access to sustainable practices (financing, training, markets) is therefore a strategy with a double dividend.

7.4 Avenues for further research

Several empirical gaps should be remedied by future research: longitudinal impact assessments of green job programmes for youth; specific studies of the dynamics of value chain governance at the meso level (sector coordinators, producer associations); in-depth qualitative analyses of the mechanisms of gender discrimination in access to digital markets; and international comparative studies of successful restorative policies in other West African contexts.

8. POLICY AND PRACTICE RECOMMENDATIONS

The recommendations below are based directly on the empirical results and the literature review. They are broken down in line with the dimensions of justice and identify the institutional actors responsible, as well as the concrete instruments for implementation.

8.1. Recommendations relating to Distributive Justice

Access to land: affirmative land reform

Priority reform of the Land Code to provide explicitly for preferential allocation mechanisms for youth (aged 18-35) and women: quotas in public land allocation programmes, recognition of usufruct rights for youth with no inherited land. Actor responsible: MAEP in collaboration with the Ministry of Justice. Instrument: legislative revision of the Land Code + multilingual awareness campaigns.

Establishment of 'youth land banks' that allow local authorities to offer public land with long-term leases (10-15 years) to young qualified agricultural entrepreneurs, with priority for women. Actor responsible: Commune authorities in partnership with local professional agricultural organisations. *(Based on results: OR land=2.91, AME=+24.3 pp; Table 15)*

Access to finance: green instruments tailored to youth

Design and deploy financial products specifically tailored to young agripreneurs in the green sector: green micro-leasing (leasing of solar and irrigation equipment with low down payments), mutual guarantee funds (sharing of risk between the State, development partners and microfinance institutions) and intra-gender group loans. **Responsible actor:** ANPE, MESTFP, microfinance institutions, with financial support from donors including the ADB, LuxDev and IFAD.

Make access to existing government agricultural subsidies conditional on the adoption of at least one sustainable practice (agro-ecology, composting, agroforestry), with an additional bonus for women and youth in Couffo. **Actor responsible:** MAEP, MEHU.

(72.8% of young people refer to financing as their primary need; Table 6)

Inclusion of youth in high-value-added segments

Strengthen sustainable agri-food processing hubs at the local level: locate them in facilities with equipment (mills, solar drying units, cold rooms) shared and managed in cooperatives by groups of young people. Each hub should include training in business management, quality and marketing. Actor responsible: MESTFP, ATDA, projects/programmes, NGOs, INRAB, local authorities, with the support of GIZ.

Development of subsidised training programmes that allow youth to acquire skills in the processing and marketing segments of the value chains in question with a guaranteed minimum wage during the training period. Actor responsible: MESTFP, private sector.

8.2. Recommendations relating to Procedural Justice

Institutionalisation of the participation of youth in the governance bodies of agri-food sectors (inter-professions, value chain management committees): a minimum of 30% of seats for young representatives (aged 18-35), at least half of whom must be women. Actor responsible: MAEP, PNOPPA, CJA.

Reform of the curricula of agricultural extension services to systematically include modules on business management, financial literacy, digital marketing and climate adaptation, with priority being given to the communes of Couffo and Aplahoué. Deployment of extension workers specifically trained in the green economy for youth. Actor responsible: MAEP/DSA, INRAB. *(Based on results: specialist training OR=2.66, AME=+22.3 pp; Table 15)*

Roll-out of a national digital equipment programme for young rural agripreneurs (Couffo, remote areas): robust tablets, training in digital marketing platforms (e-agriculture), Wi-Fi access points in rural markets. Actor responsible: MESTFP, Ministry of Digital Technology, with support from the World Bank.

8.3. Recommendations relating to Recognition Justice

Launch of a national campaign to promote green entrepreneurship among youth in partnership with the public media and youth organisations: annual national awards for young agro-ecological innovation, testimonials from young successful entrepreneurs, inclusion in school curricula. Actor responsible: MJSL, MAEP, public media.

Overhaul of support programmes by repositioning youth as co-designers and innovators (not just as beneficiaries): involvement of groups of young people in the design, monitoring and evaluation of green employment projects. This participatory approach improves the relevance of interventions and strengthens the institutional recognition of youth potential. Actor responsible: All development partners working in the sector.

8.4. Recommendations relating to Restorative Justice

Revise the Land Code to explicitly include restorative provisions for historically excluded groups: land restitution or compensation mechanisms for youth, in particular those dispossessed by discriminatory traditional land ownership processes. Actor responsible: Ministry of Justice, MAEP, civil society organisations.

Design and financing of programmes to restore degraded soils and ecosystems in the worst-affected areas (Couffo, northern departments), with the systematic inclusion of a green jobs component for youth: soil and water conservation works, reforestation, development of micro-watersheds. Actor responsible: MEHU, MAEP, local authorities, with support from UNEP and climate donors.

9. CONCLUSION

To our knowledge, this study is one of the first mixed quantitative-qualitative analyses of the determinants of green jobs for youth in agrifood value chains in Benin, combining a survey of 397 young farmers, 36 semi-structured interviews and 9 focus group discussions of 69 participants in three departments with contrasting institutional and agro-ecological profiles.

The most important result of the study is the dominant territorial effect: inequalities in green job opportunities in Benin are first and foremost territorial inequalities shaped by profoundly different institutional environments. A young farmer from Borgou is 7.49 times more likely to take up a green job than a young person from Couffo with the same individual characteristics, an exceptional result that can be explained only by the convergence of contextual factors: density of support services, active cooperative dynamics, climate pressure encouraging agro-ecological diversification, and proximity to lead markets. This territorial inequality cannot be reduced to differences in individual characteristics. It reflects the political and economic structures that determine who has access to markets, certified inputs, agricultural projects and institutional networks. The land-education-rural environment triad constitutes a second level of converging socio-economic determinants, with similar marginal effects (between +22 and +24 percentage points), offering three operational and complementary levers for action for public policies. The employment penalty for women (-13.7 pp; $p=0.021$), which is partly mediated by income (19.2%) but mainly driven by extra-economic mechanisms – dual productive and reproductive burdens, mobility constraints, social norms for access to professional networks – commands gender-sensitive policies that go beyond the financial dimension alone.

The credit paradox, which is demonstrated empirically by Cluster 2 of the hierarchical classification (100% systematic access to credit but rate of employment in green jobs of only 53.7%), is a reminder that access to financial resources alone is not sufficient: the structure of the incentives, the conditionality of financial instruments and the quality of technical support are decisive. Similarly, the absence of any significant association between the awareness of green jobs and actual employment confirms the presence of a structural knowledge-action gap: awareness-raising alone, without enabling conditions (land, training, markets), does not result in adoption. The architecture of inequalities described in this study results in a consistent picture: without specific interventions targeting the territorial institutional infrastructure, the mechanisms for asset redistribution, and the processes of the social and political recognition of youth contributions, there is a risk that the agro-ecological transition will mainly benefit profiles that are already advantaged. The predicted probability of employment can be as high as 95.2% for young men in middle-income Borgou, compared with 31.2% for young rural women in low-income Couffo, a difference of 64 percentage points in the same generation and the same country. These results argue in favour of an explicitly spatial, gender-based and justice-based approach to the green transition. The aim is to move away from a logic of individual intervention, focused on education and raising awareness among beneficiaries, to a systemic logic that simultaneously targets territorial enabling conditions, mechanisms for asset redistribution, and processes for recognising the contributions of youth. In the Beninese context, green employment is not solely an environmental objective: it is a composite indicator of economic inclusion, social justice and resilience in the face of climate change.

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APPENDICES

Annex A: Detailed methodology of the literature review

A.1 Documentary collection methods

The exhaustive search strategy used a multidimensional query framework integrating four complementary dimensions: geographical scope (Benin, West Africa, sub-Saharan Africa), thematic focus (youth employment, green jobs, just transition), specific research domains (unemployment patterns, entrepreneurship, access to land, financial inclusion, gender, social protection, informality, migration, vocational education), and agricultural value chains (cotton, cashew nuts, cassava, maize, rice, yams, vegetables, cross-sectoral dynamics).

Eight strategic agricultural value chains were selected for specific queries. The search terms were systematically combined using Boolean operators (AND, OR) in order to construct search chains that captured the intersection of geographical, thematic and value-chain dimensions. A total of 308 sources were initially identified.

A.2 Databases and sources used

Principal databases: SciSpace, Google Scholar, Scopus, PubMed, ArXiv, AJOL (African Journals Online), JSTOR, Web of Science, World Bank Open Knowledge Repository, FAO Document Repository, ILO publications.

Grey literature sources: government policy documents (MAEP, INStAD), reports from development partners (FAO, IFAD, World Bank, GIZ), NGO publications, conference proceedings, working papers.

A.3 PICOS framework

Population: youth aged 15 to 35 involved in agri-food value chains in Benin and comparable contexts in West Africa.

Intervention/analysis: Sustainable (green) farming practices, climate-smart agriculture, digital innovations, employment programmes.

Comparison: Between groups of young people (gender, age, location, level of education, level of wealth); between formal and informal sectors.

Results: Job creation, income, business viability, equity and justice dimensions.

Study types: Empirical studies, systematic reviews, public policy documents, grey literature.

A.4 Quality assessment

Each source was evaluated on the basis of four criteria (each on a scale of 1 to 5 with a maximum composite score of 20): methodological rigour, relevance to research questions, current issues and recency, and level of evidence (systematic review > randomised controlled trial > quasi-experimental > observational > expert opinion).

Sources with a score of less than 10 were excluded, except where they filled specific gaps relating to Benin.

Benin's Development Strategies: Geographic, Thematic, and Specific Focus

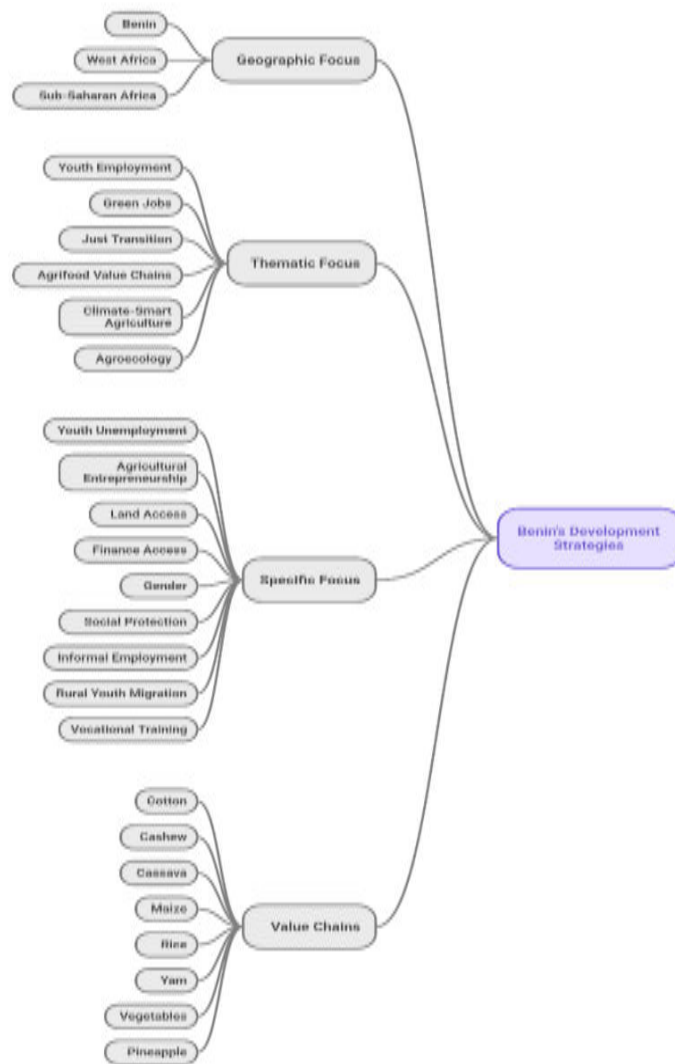


Figure 1: Multidimensional conceptual framework guiding the systematic documentary research strategy for the analysis of green job opportunities for young people in Benin's agri-food value chains.

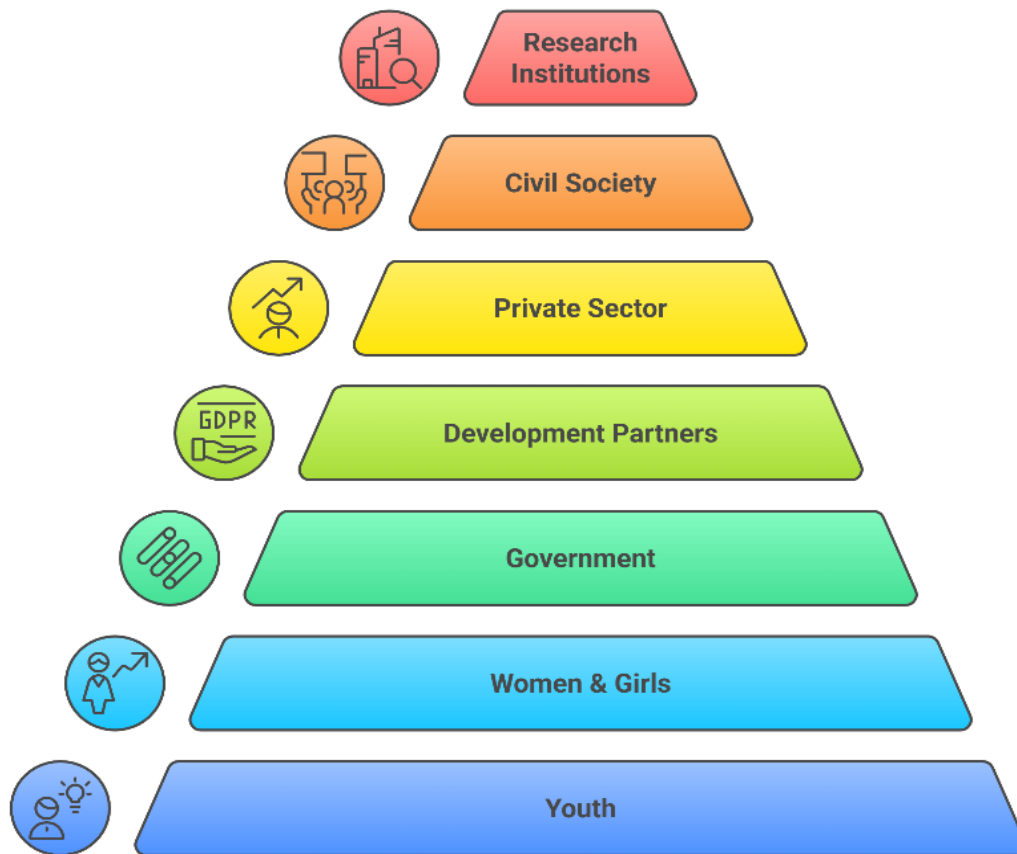


Figure 1: Key players considered

Annex B: Detailed sampling methodology

B.1 Cochran formula and sample size calculation

Sample size calculated using the Cochran (1977) formula modified for finite populations: 2026-05-08

$$n = Z^2 pq / e^2 \times [1 + Z^2 pq / (e^2 N)]$$

where $Z=1.96$ (95% confidence interval), $p=0.5$ (conservative value), $q=0.5$, $e=0.05$ (5% margin), $D=1.2$ (design effect), $N=125,000$.

Theoretical size: 461. After arbitration for budget constraints: $n=383$ (margin of error $\leq 5.1\%$).

B.2 Demographic projection methodology

Population projections from RGPH4 (2013) to 2024 follow INStAD standard methodology:

$$P_{2024} = P_{2013} \times (1 + r)^{11}$$

where r = average annual growth rate by department. These projections were cross-referenced with RNA (2018) farmer counts, DSA/MAEP (2024) agricultural employment data, and ANPE registers.

Table B.1: Projected population 2024 of study communes

Department	Commune	Pop. 2013	Growth %/year	Pop. 2024
Atlantique	Abomey-Calavi	656,358	6.93	1,363,912
	Allada	127.512	3.87	193.561
Borgou	Parakou	255.478	4.68	421.283
	N'Dali	113.604	—	187.333
Couffo	Aplahoé	171.109	2.88	233.564
	Djakotomey	134.028	—	182.948
TOTAL		1,458,089		2,582,601

Source: IFDC calculated on the basis of the RGPH4 (2013) and INStAD demographic projections (2022).

B.3 Details of the basic sample size distribution

Allocation formula:

$$n_{\square} = n \times [0,70 \times (N_{\square}/N) + 0,30 \times I_{\square}]$$

where $n=383$, $N_{\square}/N$ =population weighting, $I_{\square}$ =index of strategic importance (0-1).

Table B.2: Distribution of the sample by stratum

Dept.	Commune	Urban	Semi-urban	Rural	Total
Atlantique	Abomey-Calavi	45	25	15	85
	Allada	15	20	20	55
Subtotal		60	45	35	140
Borgou	Parakou	40	25	15	80
	N'Dali	10	15	25	50
Subtotal		50	40	40	130
Couffo	Aplahoé	25	20	20	65
	Djakotomey	8	15	25	48
Subtotal		33	35	45	113
TOTAL		143	120	120	383

Annex C: Institutional actors

- **Public institutions:** MAEP (agricultural development); MESTFP (agricultural vocational education and skills development); MJSL (youth employment policies and programmes); MEHU (environmental policies and strategies for adapting to climate change).
- **Development partners:** FAO, IFAD, World Bank, ADB, GIZ, USAID, as well as bilateral donors providing financial and technical support.
- **Civil society organisations:** PNOPPA (National Platform of Farmers' and Agricultural Producers' Organisations); CJA (Young Farmers' College); FENOMA (National Federation of Biological vegetable production Organisations); FENAFAB (National Federation of Women in Agrifood); various local cooperatives and youth associations, AJAM (Association des Jeunes Agriculteurs Modernes du Bénin).
- **Research institutions:** INRAB (Benin National Institute for Agricultural Research); Universities of Abomey-Calavi and Parakou; IFPRI, IITA and other international research centres.
- **Private sector:** agri-businesses, input suppliers, processors, traders, financial institutions and digital platform providers.

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