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The Colonial Origins of Labour Market Duality in West Africa

A Spatial Econometric Analysis of the Enduring Impact of Colonial Cash Crop Cultivation on Contemporary Informal and Precarious Employment

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Abstract

This study examines the enduring impact of colonial cash crop cultivation on contemporary informal and precarious employment in West Africa. While the region's integration into the global capitalist economy during the age of New Imperialism fundamentally restructured labour markets, existing research has often overlooked the long-term implications of these colonial legacies. In particular, the effects of colonial cash crop production on present-day labour outcomes remain understudied, with most scholarship relying on qualitative accounts or country-level analyses that obscure sub-national variation. Addressing this gap, the study employs a novel geospatial dataset that links historical data on colonial-era cash crop cultivation with contemporary microdata to estimate the causal effects on labour informality and income insecurity. The findings reveal that workers residing in areas historically associated with high-export-value colonial cash crop production exhibit significantly lower levels of income insecurity and are less likely to be informally employed. The magnitude of these effects is comparable to those observed for colonial-era mineral extraction and infrastructure development. Spatial spillover analysis shows that improvements in labour market outcomes extend beyond core plantation zones, but are often accompanied by increased informalisation in the hinterland. This pattern reflects well-documented historical dynamics in which localised gains from colonial cash crop development were achieved at the expense of broader regional equity. Lastly, serial mediation analysis identifies one mechanism sustaining these historical effects: the persistence of unequal social policy responses, which not only fail to redress colonial-era disparities but may also inadvertently reinforce them. Collectively, these findings underscore the pivotal role of colonial legacies in shaping West African labour markets and point to the need for transformative policies that restructure production systems and extend social protections beyond the formal sector.

[*] This paper is drawn from the author's MSc dissertation in International Social and Public Policy (Development) at the London School of Economics and Political Science (LSE), awarded distinction in 2024. The author gratefully acknowledges the supervision and guidance of Professor Almudena Sevilla and thanks colleagues, peers, and faculty at LSE for their feedback and support throughout the research process. Thanks are also due to the Luxembourg Income Study (LIS) Database for access to supplementary data. For correspondence: johannes@macrofiscal.org

1. Introduction

The age of New Imperialism brought profound structural transformations to West Africa. Spanning the 19th and early 20th centuries, this period of territorial consolidation under European powers was marked by a significant expansion of agricultural exports, which profoundly reshaped the region's labour markets to support this burgeoning trade (Amin, 1972). Initially integrated into the global economy as a slave labour reserve for colonies across the Atlantic, West Africa's economic role began shifting towards the cultivation of export crops such as cotton, coffee and palm oil in the late 18th century (Inikori, 2007). The full onset of the Second Industrial Revolution and the abolition of the transatlantic slave trades in the 19th century accelerated the integration of West Africa into the world capitalist system, with commercial agriculture becoming central to its economy (Austin, 2014; Hopkins, 1973; Tosh, 1980). By 1957, the cash crops cotton, coffee, cocoa, and palm oil accounted for more than 73% of the total export value of West Africa (Roessler et al., 2022). This new economic orientation necessitated a dramatic restructuring of labour, including the disruption of pre-colonial trade, the imposition of foreign-controlled trade monopolies, labour migration to areas suitable for cash crop cultivation, and forced labour. Collectively, this restructuring established what Amin (1972) described as "*l'économie de traite*", a dual system composed of an export-oriented cash crop sector attached to the colonial state located in areas with favourable agricultural conditions, and a sizeable informalised sector outside of it (Amin, 1972). Whether this structural transformation has had enduring effects on West African labour markets, particularly in relation to informal and precarious employment, will become the primary subject of this paper.

Labour informality refers to *"all remunerative work (both self-employed and wage employed) that is not registered, regulated or protected by existing legal or regulatory frameworks"* (ILO, 2015). This contrasts with labour precarity, which describes the *"insecure, unpredictable, and insufficiently remunerated condition of work itself, regardless of whether it is formally or informally arranged"* (Campbell & Price, 2016; Standing, 2011). Understanding the nuances of labour informality and labour precarity is essential because these conditions interact with state policies, constrain the legibility of economies and impact the security of millions of livelihoods (Chen, 2012; Portes & Haller, 2005; Jerven, 2013). Close to 90% of the West African working-age population is informally employed, with informality showing persistent growth since the 1990s (Afrobarometer, 2024a; ILO and WTO 2009). Approximately 70% of working-age individuals in West Africa report going without an income more than twice a year (Afrobarometer, 2024). Understanding these phenomena helps contextualise persistent decent work deficits in West Africa and points to a critical opportunity for research to inform policy.

Despite the centrality of labour informality and precarity, existing research provides conflicting views regarding their causes, efficacies, and detriments for development[1]. This discord arises from several factors, including the widespread conflation of informality with labour precarity and the ahistorical framing of most mainstream development debates, which tend to overlook important structural causes (Peattie, 1987; Meagher, 2022). Furthermore, despite significant advances in research on colonial legacies in African development[2] and the continent's transition to commercial agriculture[3], the enduring effects of colonial cash crop cultivation on labour market outcomes remain understudied. Previous research has relied on isolated qualitative accounts and country-level comparative analyses, which fail to adequately address the endogenous factors associated with colonialism or to overcome the well-documented statistical limitations of many West African national datasets (Jerven, 2013; Roessler et al., 2022). Furthermore, much of colonial West Africa's history unfolded at the sub-national level, resulting in localised distortions in labour markets not easily captured by aggregated national statistics or country-level analyses (Roessler et al., 2022).

[1] See conflicting perspectives of Breman & Van der Linden (2014), Chen (2005), Jütting and De Leglesia (2009), LaPorta and Schleifer (2014), Ng'weno and Porteus (2018), Portes and Haller (2005). See Chen (2012) for all competing perspectives.
[2] Seminal papers are Acemoglu et al. (2001), Michalopoulos and Papioannou (2013), Nunn (2008), and Lowes and Montero (2017).
[3] See Austin (2014), Framkema et al. (2018), De Haas (2017; 2021) and Austin (2014)

By incorporating West African history of *l'économie de traite* into the study of informality and income insecurity, this research aims to make five contributions. First, it seeks to add to the literature on the path-dependent effects of colonialism on African development, which has yet to systematically study the aspects of labour informality and precarity in West Africa. Second, by considering the effects of cash crop cultivation on income insecurity and labour informality separately, it aims to offer improved conceptual clarity. Third, by employing micro-level spatial econometric analyses it seeks to estimate the relative effects of cash crop cultivation on informality and income insecurity compared to other geographical fundamentals, historical variables, and individual-level characteristics. Fourth, it sets out to reveal spatial spillover effects associated with colonial cash crop cultivation. Fifth, it aims to uncover mechanisms of path-dependence underlying these relationships.

In approaching these five contributions, this study draws direct inspiration from the work of Roessler et al. (2022), which examined the long-term impacts of cash crop cultivation on nighttime luminosity, infrastructure, and urbanisation across the African continent. Correspondingly, this analysis examines the enduring effects of cash crop cultivation on the individual-level labour outcomes of informality and income insecurity. The empirical approach follows Roessler et al. (2022) in assembling a unique geospatial dataset that matches contemporary data with historical data, including data on colonial cash crop cultivation in West Africa. The latter data is derived from a detailed collection of maps compiled by Hance et al. (1961), who brought together a variety of primary sources, including colonial reports, maps and agricultural yearbooks. Hance et al.'s (1961) collection documented the source locations and export values (standardised to 1957 USD) of 95.2% of 1957 exports in Tropical Africa. Roessler et al. (2022) validated, digitised, and aggregated this data into 0.25° raster cells. In addition to this historical data, a comprehensive set of controls derived from the geography and economic history literature are mapped onto the same raster.

The analysis reveals several significant relationships between the historical cultivation of colonial cash crops and contemporary labour market outcomes in West Africa. Baseline regressions indicate that individuals near higher-value source locations of colonial cash crop exports are less income insecure and less likely to be informally employed. Instrumental variable (IV) analysis, employing cash crop suitability as an instrument to address endogeneity, underscores colonial cash crops' significant causal effects on informality and income insecurity, with effect sizes comparable to other influential factors such as colonial mineral extraction and historical infrastructure. Spatial spillover analysis further elucidates the distance-dependent effects of colonial cash crop cultivation, revealing that improvements in labour market outcomes, specifically lower rates of informality and income insecurity, are most pronounced near historical cultivation sites. These effects attenuate with distance, and divergent patterns emerge in surrounding hinterland areas. These findings suggest that the mechanisms linking colonial cash crop production to contemporary labour outcomes vary spatially and are shaped by distinct institutional and structural factors. A serial mediation analysis offers preliminary insight into these pathways and highlights how social policies may reinforce path-dependent processes that sustain historical inequalities.

Collectively, these results underscore that *history matters* in understanding labour informality and income insecurity in West Africa. The region's biogeographical fundamentals, combined with the selective mercantilist interests of European colonialists, shaped the spatial distribution of cash crop cultivation and associated labour systems that persist today.

The paper begins with a comprehensive review of the historical evolution of labour restructuring in West Africa, leveraging the theories of world-systems and unequal exchange. Following this, the study employs exploratory spatial data analysis and econometric modelling, incorporating a combination of survey, geographic, and historical data. Finally, the case of Côte d'Ivoire is examined, uncovering the role of social policy in mediating the relationships between cash crops, income insecurity and labour informality.

2. Historical context and theoretical framework

2.1. A brief history of West Africa in the world economic system

The theories of World-Systems and Unequal Exchange, as developed by Immanuel Wallerstein (1974) and Arghiri Emmanuel (1972), respectively, provide a useful lens for understanding the structural transformation encountered in West Africa during the age of New Imperialism. World-Systems Theory posits a global economic system characterised by a hierarchical division of labour and power, elucidating how West Africa transitioned from an autonomous region to a dependent peripheral zone focused on cash crop cultivation (Wallerstein, 1974). Unequal Exchange Theory, which examines exploitative trade relationships between core and periphery countries, helps explain the economic rationale behind structural change (1972).

The pre-mercantilist period up to the 17th century saw West African societies develop relatively autonomously, although in tandem with the Mediterranean. This time witnessed the birth of many civilisations, most notably in the Sahel region south of the Sahara, benefiting from the trans-Saharan trade of gold with Northern Africa and the Mediterranean (Abu-Lughod and Hay, 1977). This trade integration laid the foundations for complex regional social and economic structures and even empires (Bah et al., 2019; Gomez, 2018). Whereas this pre-mercantilist trans-Saharan trade strengthened West African states, the advent of the First Industrial Revolution and the shifting of the world-mercantilist *centre* towards the Atlantic brought about their disintegration.

From the 17th to the 19th centuries, West Africa's pre-mercantilist trade linkages were substantially disrupted, relegating the region to the status of the *periphery of the periphery*. This shift transformed West Africa into a primary source of slave labour for European colonies in the Caribbean and South America, which themselves constituted a new *peripheral* zone (Inikori, 2007). The magnitude of the transatlantic slave trade was unprecedented, with estimates suggesting that West Africa's population was reduced by approximately 50 % by 1850 compared to what it would have been in the absence of the slave trade (Manning, 1990). The extensive, cross-ethnic, and violent nature of these trades is believed to have had profound and lasting impacts on the region's economic development and social fragmentation (Nunn, 2008; Nunn and Wantchekon, 2011). Alongside these evolving patterns of underdevelopment and rising dependence, the end of the 18th century saw the development of limited export markets for primary agricultural commodities such as cotton and palm oil in West Africa (Amin, 1972). However, it was not until the abolition of the slave trade and the acceleration of European capitalism through the Second Industrial Revolution that West Africa's role in the world system shifted once again.

The rise of Western monopoly capitalism, coupled with a significant surge in commodity prices forty years before the 1885 Scramble for Africa, influenced both the *centre's* availability of exportable capital and the economic rationale for expanding territorial control into the West African interior (Frankema et al., 2018). The subsequent partitioning of the African continent was accomplished through military force, political coercion, and the exploitation of social relations established during the slave trade (Amin, 1972). Protective trade policies, including restricting exports to bulk quantities and investments in infrastructure such as roads and railways, vertically integrated West Africa's economy with Europe and relocated forward production outside the region (Brooks, 1975; Roessler, 2022). These processes facilitated the development of an extractive economic system centred around export agriculture, which Amin (1972) characterised as "*l'économie de traite*".

2.2. Structural change under *l'économie de traite* in West Africa

L'économie de traite was characterised by five central processes that were both economic and political in nature. Firstly, it entailed dismantling existing African trade systems by imposing a monopolistic

cash crop economy centred around import-export houses. Secondly, colonial authorities enforced taxes in new currency, compelling labour to produce agricultural goods exclusively for trade monopolists that paid in this currency. Thirdly, colonial administrations formed strategic alliances with select social classes, granting them arable land and administrative roles in managing tribute collections. Fourthly, there was the organised migration of labour from deliberately underdeveloped regions, used as labour reserves, to areas more amenable to crop cultivation. Fifthly, when other measures failed, forced labour was employed (Amin, 1972). This five-step process, initially implemented in German Togoland and the British Gold Coast, was adopted later in French West Africa. The delayed implementation by the French reflected the later onset of French capitalism and early failures in French settler colonisation (Amin, 1972).

Beyond the timing of adoption, there were few distinctions between British indirect rule and French direct rule in implementing *l'économie de traite*. More critical were the variations in pre-colonial regional and theistic groupings, which influenced how colonial power was delegated and channelled towards import-export houses. Amin (1972) identified two primary models: The first, extending across the Sahel from Senegal to Sudan, emphasised cotton and groundnut production under the theocratic authority of Muslim brotherhoods. The Senegalese Mourid are a notable example, illustrating the interplay of power within *l'économie de traite*. In collusion with colonialists, these disrupted the expansive pre-mercantilist trade networks, redirecting trade flows towards coastal trading houses. This shift fostered uneven development, neglecting the interior, thereby driving migration to coastal areas and providing a steady, low-cost supply of labour for agriculture.

The second model, prevalent along the Gulf of Guinea, featured a small indigenous agrarian elite who was granted control over land and employed labour to cultivate tropical cash crops. In response to labour shortages, colonial states initiated large recruitment campaigns primarily targeting densely populated but less crop-suitable regions, such as those inhabited by the Mossi people of Upper Volta (Austin, 2014; Cordell, 1996; Lawler, 1990). The development of plantation economies in arable regions came at the expense of impoverishment and outmigration in the hinterland. Through both of these regionally distinct yet functionally equivalent models, West African economies were transformed into sources of dependent labour on the most advantageous terms for colonial cash crop agriculture, reinforcing their peripheral status in the world system (Amin, 1972).

2.3. Theorising spatial processes of informalisation and income insecurity

The historical analysis suggests that structural change experienced under *l'économie de traite* had both spatial determinants and spatial consequences. Firstly, biogeographic fundamentals determined where cash crops were cultivated, favouring regions with optimal agricultural conditions for crops demanded by European markets (Roessler et al., 2022). As a corollary to this conditional development, West African colonial states deliberately underdeveloped or neglected areas unsuitable for cash crops (Amin, 1972). It can be hypothesised that this resulted in the formation of cash crop clusters in regions favourable to cash crops.

Secondly, the bulk of economic gains resulting from commercial agriculture accrued to a minority of colonial exporters and indigenous or theocratic elites who became aligned with colonial interests and employed dependent labour in cash crop cultivation (Amin, 1972). This system of employment not only maintained productivity on favourable terms for European export markets but also led to the *de facto* formalisation of select economic activities. Further, colonial administrators sought only to control the 'interface' between national and world economies through key economic nodes such as ports and import-export houses. These nodes facilitated the organised delegation of authority to local elites and rendered trade in cash crops legible (Cooper, 2005). Thus, it can be

hypothesised that *l'économie de traite* introduced a duality in West African labour markets, formalising select activities in the cash crop sector and marginalising others peripheral to state interests.

Thirdly, local elites' capacity to mobilise and exert political influence through the channels of trade activated the formulation of labour laws aimed at buying social peace amidst labour exploitation (Kanbur & Ronconi, 2015). Conversely, activities outside the extractive sectors lacked means of political claim-making, leaving them largely unregulated and economically vulnerable, becoming reservoirs of precarious labour (Amin, 1972). Hence, labour market duality under *l'économie de traite* extended beyond aspects of formality, leading to a selective inclusion in labour rights. This lends support to the hypothesis that incomes in cash crop-producing areas became relatively more secure, leaving peripheral regions more exposed to economic vulnerability.

3. Empirical framework

3.1. Data

The subsequent empirical analysis investigates whether the three theorised processes have left a lasting imprint on contemporary labour markets in West Africa. It builds on the foundational work of Roessler et al. (2022), which established the long-term causal impacts of cash crop production on nighttime luminosity, urbanisation, and infrastructure investments across tropical Africa. Extending their approach, this analysis integrates gridded geospatial data on colonial cash crop cultivation with contemporary survey data on labour characteristics, complemented by historical and geographic control variables (Roessler et al., 2022). Table 1A in the appendix provides a complete list of these variables alongside relevant descriptive statistics.

The historical data on colonial cash crops are derived from the extensive mapping work of Hance et al. (1961), who documented the source locations and export values (in 1957 USD) of 95.2% of 1957 exports in Tropical Africa. This impressive undertaking involved consultation with hundreds of primary sources, including colonial reports, commodity board reports, administrative maps, and agricultural yearbooks. However, it is essential to note that while certain crops and territories offered a high degree of granularity in available data, others required significant interpolation (Hance et al., 1961). Furthermore, selecting 1957 as a reference year presents advantages and drawbacks. This year witnessed considerable devaluation of the French franc, resulting in the overvaluation of exports from French West African territories. This non-uniform overvaluation is embedded in the United Nations Statistical Yearbook, which Hance et al. (1961) utilised for currency conversion. On a positive note, 1957 marks the commencement of West African decolonisation, with Ghana being the first to gain independence. Consequently, this year plausibly represents the culmination of the West African *l'économie de traite* before the end of the colonial era. Roessler et al. (2022) validated, digitised, and assembled Hance et al.'s (1961) maps into a 0.25° raster, capturing the source locations and export values of West Africa's most traded cash crops - palm oil, cotton, cocoa, tea, tobacco, coffee, bananas, and groundnuts - in units of 289,270 USD. This data is used to construct the main explanatory variable in subsequent analyses.

In addition to the historical crop data, this paper utilises crop suitability scores from the FAO Global Agro-Ecological Zones (GAEZ) database (2024). The GAEZ data integrates biophysical factors with crop-specific parameters to estimate agricultural suitability across space (FAO, 2024). For this study, crop suitability scores are averaged across West Africa's top five cash crops (coffee, palm oil, cotton, cocoa, and groundnut) to construct a composite index of cash crop suitability. This procedure involves aggregating crop-specific suitability scores to 0.25° raster cells and then calculating mean suitability across the five crops for each cell. Figure 1 illustrates the spatial distribution of the suitability index alongside historical cash crop export value.

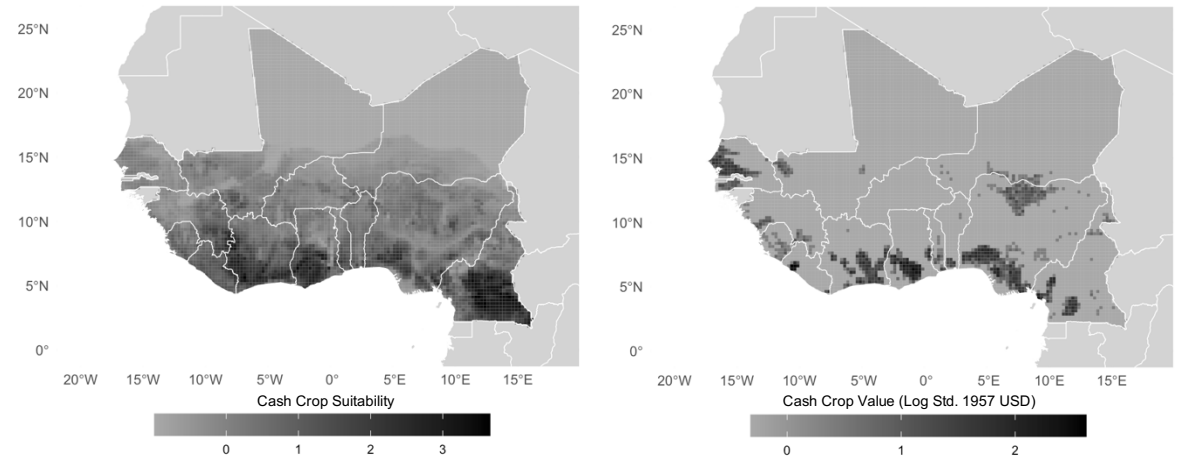

Fig. 1. Cash crop suitability and colonial cash crops. **Left-hand panel.** Log-standardised index of cash crop suitability derived from FAO (2024). **Right-hand panel.** Log export value and source locations of cash crops in 1957 USD and units of 289,270 USD from Roessler et al. (2022).

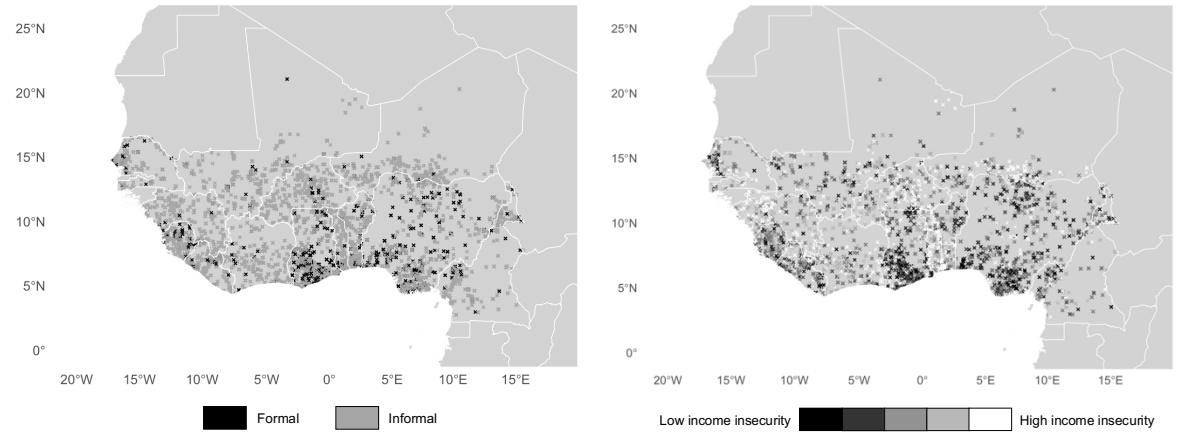

Fig. 2. Labour informality and income insecurity. **Left-hand panel.** Dummy variable of informal employment. **Right-hand panel.** Income insecurity score (Afrobarometer, 2024a).

Furthermore, this study draws on nationally representative and geocoded microdata from the Afrobarometer surveys to quantify informality and income insecurity. This dataset encompasses the West African countries of Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo and covers the years 2002, 2003, 2005, 2011, 2012, 2013, 2014 and 2015. All individuals aged 18 and up are included in the Afrobarometer's sampling universe. For this analysis, the sample will be further restricted to the working-age population between 18 and 64. The two primary variables of interest are a binary variable indicating whether an individual's main income-generating activity (self-employed or wage-employed) is informal and an ordinal variable measuring income insecurity on a Likert scale (Afrobarometer, 2024a). The income insecurity variable is based on the question: "How often, over the past year, have you or your family gone without a cash income?" with responses ranging from 0=never, 1=just once or twice, 2=several times, 3=many times, to 4=always (Afrobarometer, 2024a). For comparability purposes, later analysis will recode the Likert response levels from 0 to 4 into a scale from 0 to 1. Additional control variables include sex, level of education, age, and urban/rural residency. This survey data is merged with the gridded geographic and historical data by matching the coordinate locations of respondents to their nearest 0.25° raster-centroid. Figure 2 maps the spatial distribution of informality and income insecurity.

Later in the analysis, survey microdata from the 2015 Luxembourg Income Study (LIS) database will replace the Afrobarometer data for a country case study of Côte d'Ivoire. LIS is renowned for its high-quality, nationally representative data, encompassing a broad array of variables on income and employment. These detailed variables facilitate a nuanced investigation into the causal mechanisms linking colonial cash crops with informality and income security.

In addition, all econometric analyses will feature a variety of controls to account for confounding geographic, historical, and institutional effects mapped onto the 0.25° raster. The choice of control variables builds on the preceding analysis of West African history under *l'économie de traite* and other existing literature. Specifically, Roessler et al. (2022) provide a framework for controlling caloric suitability and the disease burden from tsetse flies and malaria. Additional geographic controls include terrain ruggedness and distances to natural trading advantages such as the coast and navigable rivers (Henderson et al., 2018; Ricart-Huguet, 2022). Historical controls encompass distances to colonial cities, distances to colonial roads as of 1900, distances to historic trade routes and distances to the first colonial capital (Roessler et al., 2022). The value of colonial mineral extraction and exposure to the slave trades are also included (Nunn & Wantchekon, 2011). Additionally, variables of precolonial centralisation are incorporated (Michalopoulos & Papaioannou, 2013).

3.2. Exploratory spatial data analysis

The mapping of raw data in Figures 1 and 2 suggests a degree of spatial association between the index of cash crop suitability, colonial cash crop cultivation, income insecurity and labour informality. In this section, both visual and numerical exploratory spatial data analysis (ESDA) techniques prevalent in the spatial economic analysis literature will be employed to examine these variables' geographic distribution further and refine the research hypotheses set out by the theoretical framework (Haining, 2003). Initially, global spatial autocorrelation indicators are constructed to assess overall spatial dependence within the data and identify the presence of clusters. Subsequently, local spatial statistics are used to localise the identified clusters.

Defining appropriate spatial weights is a critical step in decomposing data into smooth and rough components for ESDA (Tukey, 1977). This process also establishes the spatial structure underlying the econometric models in later analysis. Necessarily, the construction of weights matrices is defined exogenously based on the researcher's assumptions and can thus influence the inferences drawn from spatial models (Anselin, 2002; Dubin, 2009; Gibbons & Overman, 2012). In this ESDA, spatial weights are constructed differently for survey and raster data. For Afrobarometer data, a discrete, row-normalised k nearest-neighbours approach is used, setting k=8 to align with the Afrobarometer's sampling methodology, which samples eight households per sampling unit. Thus, respondents coded as neighbours are, by definition, in proximity (Afrobarometer, 2024b).

For rasterised cash crop, geographical and historical data, spatial weights are established by applying a second-order contiguity scheme, considering all cells within a 0.5° distance band around each raster cell. This distance aligns with the range where Roessler et al. (2022) observed positive spatial spillover effects of cash crops on population density and nighttime luminosity. Figure A5 in the appendix illustrates this approach effectively creates a weights matrix equivalent to an extended queen contiguity scheme (EQC) given the 0.25° raster structure while providing flexibility in border regions (Dubin, 2009; Gibbons et al., 2015). Consequently, most raster cells have 20 nearest neighbours, as detailed in Figure A6 in the appendix.

The positive global Moran's I indicators of Figure 3 provide an overview of the positive spatial association between cash crop suitability and crop cultivation; crop-suitable areas, and colonial cash crop cultivation cluster in space. By constructing Local Indicators of Spatial Association

(LISA) maps, Figure 4 localises these clusters. The left-hand panel of Figure 4 presents a univariate LISA map for the index of cash crop suitability. The right-hand panel combines colonial cash crop value and suitability in a bivariate LISA map. These maps demonstrate significant positive clustering of both variables along West Africa's tropical coast. Specifically, HH clusters, indicating high cash crop suitability and high colonial cash crop value, are predominantly found in coastal regions. Conversely, LL clusters, where both variables are low, are found in the Sahelian zones, corresponding with regions of the Sahara and semi-arid areas. This pattern supports the hypothesis that biogeographic fundamentals determined where colonial agriculture became established.

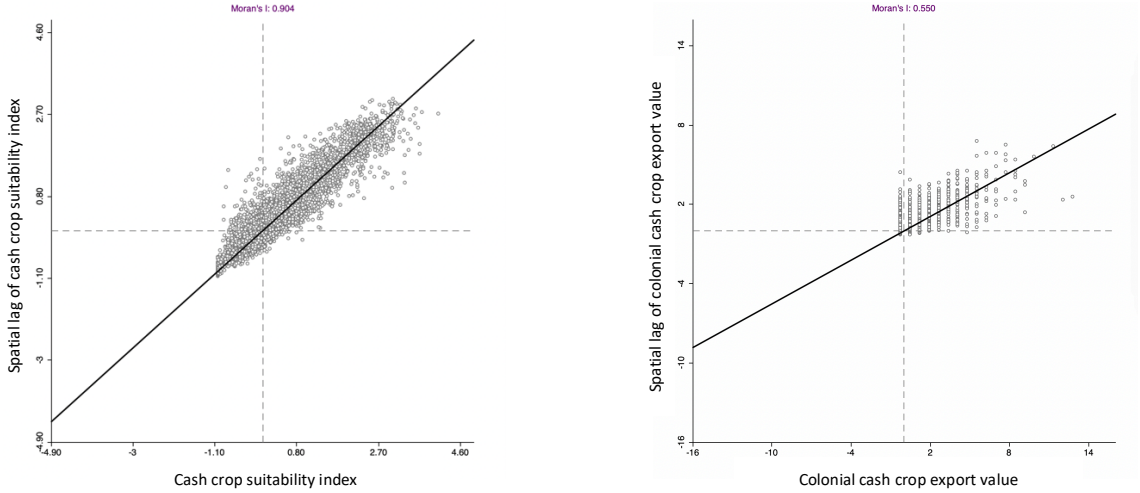

Fig. 3. Moran's I plot for cash crop suitability and colonial cash crops using EQC weights. **Left-hand panel.** Standardised index of cash crop suitability from FAO (2024) plotted against its spatial lag. **Right-hand panel.** Log-standardised export value of cash crops in 1957 USD in units of 289,270 USD derived from Roessler et al. (2022) plotted against its spatial lag.

Extending this analysis to labour market outcomes, Figure 5 integrates informality and income insecurity data with the cash crop data. The bivariate LISA map in the left-hand panel reveals that regions without substantial cash crop cultivation predominantly exhibit high informal employment (LL) levels. In contrast, areas with extensive cash crop activities tend to show higher levels of formal employment (HH). This suggests that the historical presence of cash crops has contributed to more structured labour markets in these areas. However, this relationship varies by country, and some regions show a mix of formal and informal employment, highlighting complex dynamics at play. The right-hand panel of Figure 5 reports the bivariate LISA map of income insecurity joined with colonial cash crop value. Regions with income security often coincide with historical cash crop cultivation (HH) areas, particularly in the southern parts of West Africa. However, income security is also observed in regions without cash crops.

ESDA, though merely descriptive, offers preliminary insights into the spatial nature of the colonial legacy of cash crop cultivation in West Africa. The clustering of cash crops in regions favourable to cash crops, alongside the clustering of labour formality and income security in these same regions, suggests that *l'économie de traite* left an enduring imprint on the structure of West African labour markets. This hypothesis will be tested in the subsequent empirical analyses.

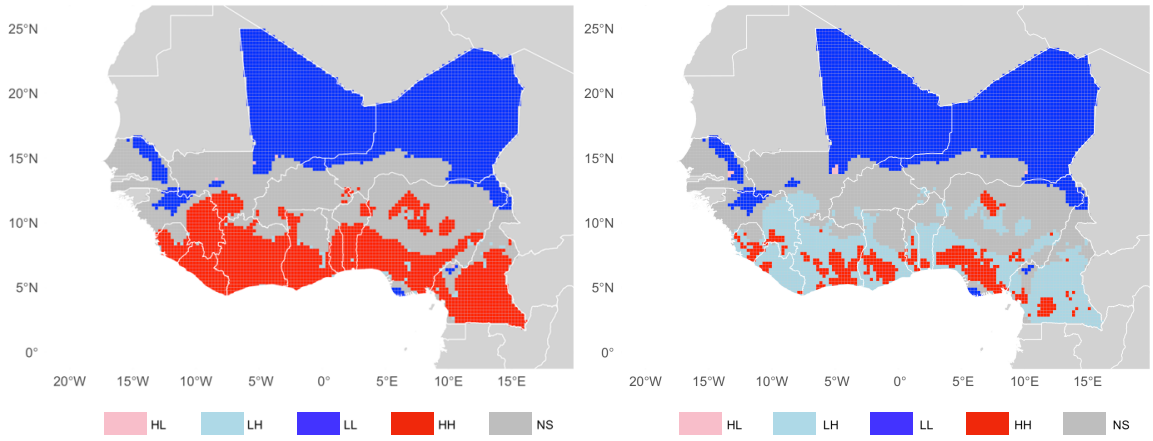

Fig. 4. LISA maps for cash crop variables. **Left-hand panel.** Univariate LISA map of cash crop suitability and its spatial lag (FAO, 2024). **Right-hand panel.** Bivariate LISA map of colonial cash crop value (Roessler et al., 2022) and the cash crop suitability index. Categories**:** HH (high-high), LL (low-low), HL (high-low), LH (low-high), NS (insignificant).

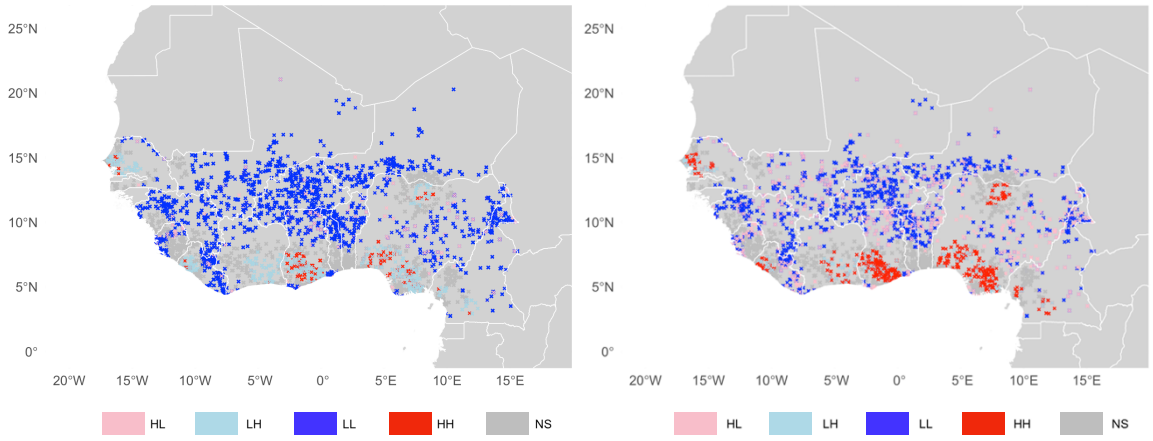

Fig. 5. LISA maps for labour variables. **Left-hand panel.** Bivariate LISA map of formality and colonial cash crop value. Categories: HH (formal-crops), LL (informal-no crops), HL (formal-no crops), LH (informal-crops). **Right-hand panel.** Bivariate LISA map of income security and cash crop value. Categories: HH (secure-crops), LL (insecure-no crops), HL (secure-no crops), LH (insecure-crops), NS (insignificant). *Note: Afrobarometer (2024a) & Roessler (2022) scales inverted for clarity.*

4. Spatial econometric analysis

4.1. Empirical model specification

ESDA has provided initial findings but faces potential limitations of endogeneity and omitted variable bias. Specifically, the historical analysis highlighted a range of confounding factors such as precolonial trade integration, political centralisation, the transatlantic slave trades, transport linkages, disease burden, and 'sorting' mechanisms such as the migration of labour, which may influence both the presence of colonial cash crop cultivation and contemporary labour market outcomes (Gibbons and Overman, 2012). Therefore, a more rigorous econometric approach is necessary to accurately estimate the relationships between colonial cash crop cultivation, labour informality and income insecurity. In this pursuit, the analysis employs a sequential approach, beginning with a reduced-form model to establish baseline associations, followed by instrumental variables analysis for improved identification, spillover analysis for spatial heterogeneities, and mediation analysis for mechanisms. This involves variations of the following reduced-form model.

$$L_{i,t,r,c} = \beta_0 + \beta_1 CashCrops_{r,c} + \gamma' X_{i,t,r,c} + \delta' Y_{r,c} + u_{i,t,r,c} \quad (1)$$

Here, $L_{i,t,g,c}$ represents the labour market outcome of either labour informality or income insecurity for individual i in year t residing in raster cell r within country c. $CashCrops_{r,c}$ denotes the historical export value of cash crop cultivation in raster cell r, nested in country c. The matrices $X_{i,t,r,c}$ and $Y_{r,c}$ encompass individual-level and cell-level control variables, respectively. The error term $u_{i,t,r,c}$ is unobserved and can be decomposed as follows.

$$u_{i,t,r,c} = \eta_c + \nu_{r,c} + \theta_t + \epsilon_{i,t,r,c} \quad (2)$$

With η_c denoting the country-specific time-invariant characteristics, $\nu_{r,c}$ accounts for raster cell-specific time-invariant factors, θ_t captures time-specific effects common to all observations, and $\epsilon_{i,t,r,c}$ is the idiosyncratic error term. To mitigate potential biases, the model incorporates time-fixed effects λ_t and country-fixed effects δ_c, to control for unobserved heterogeneity at these levels. Furthermore, raster cell-level controls $Y_{r,c}$ and individual-level controls $X_{i,t,r,c}$ are included to address the potential impact of unobserved confounders at the cell-level or the individual-level, of $\nu_{r,c}$ and $\epsilon_{i,t,r,c}$ respectively. This reduces sources of endogeneity in Equation 2 to $\nu_{r,c}$ and $\epsilon_{i,t,r,c}$. All models are estimated to have robust standard errors and are clustered at the country level. Furthermore, all independent variables are standardised to a mean of 0 and standard deviation of 1 to compare effect sizes. The final baseline model is specified as follows.

$$L_{i,t,r,c} = \beta_0 + \beta_1 CashCrops_{r,c} + \gamma' X_{i,t,r,c} + \delta' Y_{r,c} + \lambda_t + \delta_c + \nu_{r,c} + \epsilon_{i,t,r,c} \quad (3)$$

To address remaining endogeneity and establish causality, this research follows Roessler et al. (2022) in instrumenting the export value of colonial cash crop cultivation with the cash crop suitability index. The exogeneity assumption of the instrument is only valid conditional on the inclusion of overall caloric suitability as a control variable. This approach leverages that the cash crop suitability index captures variation exogenously set by European demands for cash crops, above and beyond the suitability for all other available crops at raster cell r.

Next, to examine spatial spillover effects, an array of spatial lags of the $CashCrops_{r,c}$ variable is constructed using varying distance bins around cell r in which individual i is nested. By replacing the main regressor of Equation 3 with these spatial lags, the analysis tests whether the effect of colonial cash crop cultivation on $L_{i,t,r,c}$ varies with distance, all other variables held constant. The researcher further constructs a set of constrained spatial lags, where only cash crops from raster cells with higher cash crop suitability than the central cell r are included in the binned spatial lags. This allows the modelling of isolated spillover effects resulting only from cash crop cultivation in regions with comparatively higher cash crop suitability.

4.2. Results

4.2.1. Baseline regressions

The baseline linear regressions presented in Table 1 demonstrate a significant relationship between the historical cultivation of colonial cash crops and contemporary labour market outcomes in West Africa. Specifically, in regions with higher export values of these crops, individuals are less likely to engage in informal employment and experience lower levels of income insecurity. The introduction of additional historical, geographic, and individual controls attenuates associations, suggesting that these variables play a significant role in explaining the observed levels of informality and income insecurity. The further weakening of these relationships upon including time and country-fixed effects indicates that the model successfully absorbs important unobserved time-

variant and country-level characteristics. The fully specified model in Column 5 shows that a one standard deviation increase in the export value of cash crops is associated with a 0.9 percentage point decrease in the probability of informal employment, controlling for historical and geographic factors. Similarly, Column 11 indicates that such an increase is linked to a 1.1 percentage point reduction in income insecurity on the 0 to 1 scale.

Furthermore, the standardisation of independent variables allows for a direct comparison of relative effect sizes across predictors, as shown in the comprehensive output Table A2 in the appendix. The estimates reveal that the impact of colonial cash crop cultivation on informality is comparable to that of other factors, such as colonial mineral extraction, historical road infrastructure, an individual's gender, and proximity to navigable rivers and the coast. Nonetheless, certain variables, such as exposure to the slave trades, the presence of pre-colonial institutions, and factors like education and age, exert a substantially larger influence, sometimes exceeding the effect of colonial cash crops by a factor of four. The same analysis for income insecurity identifies a different set of highly influential factors, including terrain ruggedness, pre-colonial institutions, urban residence, and educational attainment. Notably, variables indicating whether a raster cell is located within a pre-colonial state, chiefdom, or another form of governance exhibit the highest predictive power among all variables, underscoring the importance of pre-existing West African economic systems and social structures. This partially confirms the historical analysis, positing that colonialists selectively engaged with pre-existing institutions to establish *l'économie de traite*.

4.2.2. Causal inference and instrumental variables

To address remaining endogeneity concerns arising from the data's spatial structure and establish a causal relationship, the researcher instruments the cash crop variable using the index of cash crop suitability. This instrument is plausibly exogenous only when controlling for a general caloric suitability variable, which accounts for the overall agricultural potential of a given raster cell. The first-stage regression results demonstrate the significant strength of the instrument, with a coefficient of 0.413*** and an F-statistic of 3915.3. This high F-statistic far exceeds conventional thresholds, indicating that the instrument is strong and unlikely to suffer from weak instrument bias, thereby ensuring robust inference in the second stage. Moreover, Wu-Hausman test statistics of 8.74 for the informal employment model and 12.9 for the income insecurity model indicate a significant difference between the OLS and IV estimates, suggesting that the OLS estimates may be biased due to endogeneity. These results reinforce the validity of the IV approach.

The causal impact of colonial cash crop cultivation on contemporary labour conditions, as estimated through the IV strategy, reveals even stronger associations than the baseline OLS results. Specifically, a one standard deviation increase in the historical value of cash crops in an individual's vicinity, instrumented by cash crop suitability, leads to a 3.2 percentage point reduction in the probability of informal employment and a 4.3 percentage point reduction in income insecurity on the 0-1 scale. These findings underscore the significant and persistent causal effects of *l'économie de traite* in shaping contemporary labour informality and income insecurity in West Africa.

Table 1. Colonial cash crop cultivation and contemporary labour informality and income insecurity in West Africa

	Outcome											
	Informal						Income Insecure					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Col. Cash Crops	−0.044***	−0.051***	−0.031***	−0.027***	−0.009**	−0.032***	−0.063***	−0.057***	−0.028***	−0.022***	−0.011**	−0.043***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.009)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.01)
Cash Crop Suit. (Instrument)						0.413***						0.413***
						(0.007)						(0.007)
First-stage F-Stat.						3,915.3***						3,915.3***
Wu-Hausman						8.74***						12.9***
Geographic Contr.	✗	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Historical Contr.	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓
Individual Contr.	✗	✗	✗	✓	✓	✓	✗	✗	✗	✓	✓	✓
Country & Year FE	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓	✓
IV	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗
Num. Obs.	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187
Adj. R^2 (Within)	0.019	0.031	0.077	0.093	0.026	0.025	0.033	0.046	0.08	0.111	0.046	0.043

Please refer to Table A2 for full model outputs and descriptions in the appendix. Significance codes: *p < 0.1, **p < 0.05, ***p < 0.01.

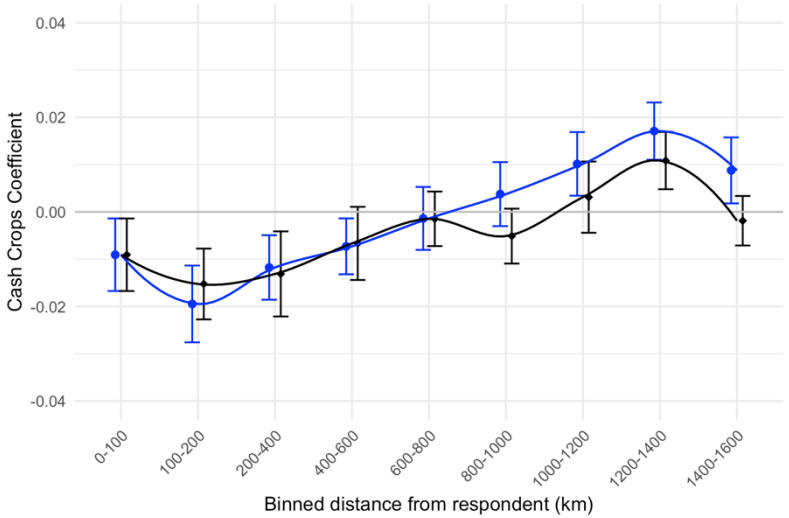

Fig. 6. Spillover effects of colonial cash crops on informality.
This figure displays cash crop coefficients on informality across varying binned distances, controlling for covariates and FE. The blue series represents binned unconstrained spatial lags while the black series illustrates the constrained spatial lag. Error bars indicate CI=95%.

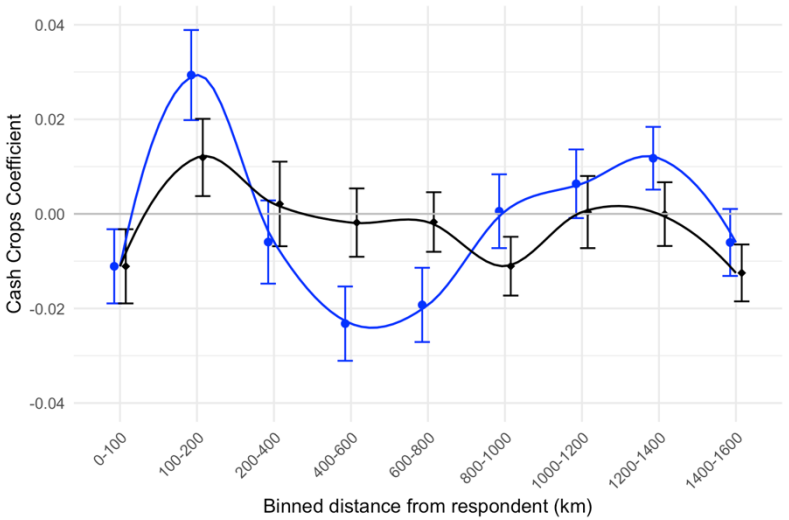

Fig. 7. Spillover effects of colonial cash crops on income insecurity.
This figure shows cash crop coefficients on income insecurity across binned distances, with controls and fixed effects held constant. The blue series denotes the unconstrained spatial lag, whereas the black series reflects the constrained spatial lag. Error bars indicate CI=95%.

4.2.3. Spatial spillover analysis

Spatial spillover analysis further elucidates complex distance-dependent dynamics. Figures 6 and 7 present the coefficients of lagged cash crops on informality and income insecurity, along with their 95% confidence intervals. The figures display two series: the first, represented in blue, captures spillover effects from all surrounding raster cells (unconstrained), while the second, in black, isolates spillover effects originating from raster cells with higher cash crop suitability than the central cell *r* in which individual *i* is nested (constrained). Comparing the constrained and unconstrained spatial lag effects allows the researcher to assess the extent to which underlying conditions of cash crop suitability influence total spatial spillover effects. Spatial variations revealed through this approach aim to address hypotheses related to the unequal spatial processes of *l'économie de traite,* where development in cash crop zones occurred at the expense of peripheral regions.

The results reveal that colonial cash crop cultivation negatively affects informality and income insecurity only in areas near cultivation sites, with spatially divergent effects as distance increases. The pattern observed in Figure 6 suggests that cash crops are negatively associated with informality within a 0-to-800-kilometre radius, while individuals farther away experience the opposite effect. Within the 0-to-800-kilometer range, the unconstrained and constrained lags exhibit similar spillover patterns, but they begin to diverge beyond this distance. Here, the constrained lag follows a lower yet parallel trajectory in terms of effect sizes relative to distance, indicating that beyond 800 kilometres, spatial variations in crop suitability contribute less to the overall spillover effects.

Figure 7 presents a more irregular spatial spillover pattern for income insecurity, with a stronger divergence between the constrained and unconstrained spatial lags. While cash crops appear to be negatively associated with income insecurity within a 0-to-100-kilometer range, they seem to significantly increase it between 100 and 200 kilometres. This is followed by a decline in effect, shifting into negative territory between 200 and 1000 kilometres. The strong divergence between the constrained and unconstrained lags is particularly noteworthy. This suggests that spatial spillover effects of colonial cash crops on income insecurity are less dependent on underlying crop suitability, compared to informality. These distinct patterns underscore the necessity of further investigation into causal mechanisms underlying the observed effects.

5. Mechanisms of path dependence in Côte d'Ivoire

5.1. Social policy and colonial legacies

While the preceding analyses have elucidated overarching historical patterns and causal effects across the West African region, they have also raised critical questions about their underlying mechanisms. A focused case study of Côte d'Ivoire, with its distinct economic trajectory, provides a more suitable context to disentangle these causal processes and enables the identification of specific policies involved in persistence. The existing literature on Côte d'Ivoire's colonial legacies identifies various channels through which colonialism has shaped contemporary economic conditions[4]. This paper narrows its focus to one mechanism with direct and ongoing implications for labour informality and income insecurity, namely social policy.

Generally, social policy is seen as a means of decommodification in labour markets. However, critiques of conventional social policy frameworks also highlight their potential role in perpetuating structural inequalities rooted in Côte d'Ivoire's colonial past. The Transformative Social Policy

[4] See Mkandawire (2020) for state social policies, Roessler et al. (2022) and Huillery (2009) for public investments and instrastructure, Cogneau et al. (2021) for fiscal capacity and elite bias in state spending, Acemoglu et al. (2001) for extractive insititutions, Chlouba (2021) for private property and MacLean (2002) for informal institutions.

(TSP) approach, as articulated by Adesina (2011) and UNRISD (2016), critiques social policies that focus on alleviating symptoms and offering marginal improvements rather than addressing the root causes of precarity and informality. TSP literature further underscores the risk that "*palliative"* social policies can exacerbate disparities by *"depoliticising"* legitimate political claims to development (Nilsen, 2021). Côte d'Ivoire's social security and assistance system, historically designed to protect formal and state employees, exemplifies how policies have entrenched labour market duality. To examine this mechanism, the following analysis first reviews the history of social policy in Côte d'Ivoire and theorises its role in perpetuating labour market dualities from *l'économie de traite*, then uses empirical methods to test this role.

5.2 Historical justification of social policy as a causal mediator

The origins of state social policy in Côte d'Ivoire can be traced back to 1928 when French subsidies for social services were first directed to colonies through the "Fonds d'Investissement pour le Développement Économique et Social" (Yimam, 1990). These state expenditures were heavily skewed to favour French settlers, manifesting in elevated public sector wages and exclusive social services within formal sector enclaves (Cogneau et al., 2021). Workers with formal contracts, including civil servants, were entitled to benefits such as family allowances and pensions (MacLean, 2002). The sole policy addressing social needs outside the formal and public spheres was the "Sociétés de Prévoyance" established in 1916 (MacLean, 2002). This system targeted the agricultural sector, offering loans for agricultural development, farming tools, and aid for members affected by work-related accidents or illness. However, the programme soon became restricted to regions deemed economically viable, privileging cash crop zones over others (MacLean, 2002).

Broader claims to social policy in Côte d'Ivoire became more prominent as commercial agriculture expanded, and labourers, increasingly reliant on markets for their livelihoods, encountered new social vulnerabilities. Notably, the disruptions in cash crop markets during the Great Depression pressured the colonial state to introduce income-stabilising measures, such as marketing boards, representing the first broader instance of *"social protection by other means"* in Côte d'Ivoire (Mishra, 2004; Cooper, 1996). Following the Second World War, the declining legitimacy of French imperial rule spurred greater developmental ambitions in colonies (Cogneau et al., 2020). In 1950, Côte d'Ivoire became the first French colony to establish a government department for social services (MacLean, 2002). Furthermore, fiscal expansion made room for new high-skilled public sector jobs for Ivorians (Cooper, 1996). The gains remained skewed in favour of public workers, exacerbating rather than narrowing overall labour disparities (Cogneau et al., 2020; Frankema, 2011).

In the newly independent Côte d'Ivoire, the high wages of French colonial administrators were largely carried over (Cogneau et al., 2018). This solidified a 'bourgeoisie of the civil service', whose economic and political advantages enabled the creation of patron-client relationships within society, particularly in commercial agriculture (Fanon, 1963; Rice, 2020). By 1977, the state had heavily invested in cash crop industries, with 113 parastatal entities employing one-third of Côte d'Ivoire's labour force (Brou, 1997). Along with this came the expansion of a more generalised social service system, skewed towards state employees. Social security programmes exclusively benefitted formal and public employees, reinforcing dualism (MacLean, 2002).

The neoliberal turn of the late 20th century, epitomised by the World Bank and IMF Structural Adjustment Programmes (SAPs), entrenched labour informality through policies of privatisation, deregulation, and fiscal austerity in Côte d'Ivoire (World Bank, 1998; Mahieu, 1995). These measures, aimed at promoting export-led growth, deepened national reliance on cash crops where Côte d'Ivoire was deemed to have a 'comparative advantage' (Mahieu, 1995). State and formal job-losses, alongside the creation of new work lacking formal arrangements in liberalised sectors led

to widespread informalisation and precaritisation of labour (Meagher & Lindell, 2013). The 'administrative bourgeoisie', like its colonial predecessors, focused on controlling the 'interface' of the economy only through key formal segments of society (Cooper, 2005). Thus, while the cost-recovery mandates of SAPs stripped affordable public services from the less affluent, formal and political elites maintained privileges (Cogneau et al., 2018; MacLean, 2002; Rice, 2020).

Unifying this historical account through the lens of TSP, the social policies institutionalised in Côte d'Ivoire can be understood as mechanisms of path dependence, sustaining and reinforcing labour market dualities originating from *l'économie de traite.*

5.3. Causal mediation analysis

5.3.1 A stylised model of causal mediation

Figure 8 presents a path diagram illustrating the causal mechanisms explored in the Côte d'Ivoire case study. This diagram highlights six distinct pathways through which colonial cash crop cultivation is theorized to have enduring effects on labour market outcomes.

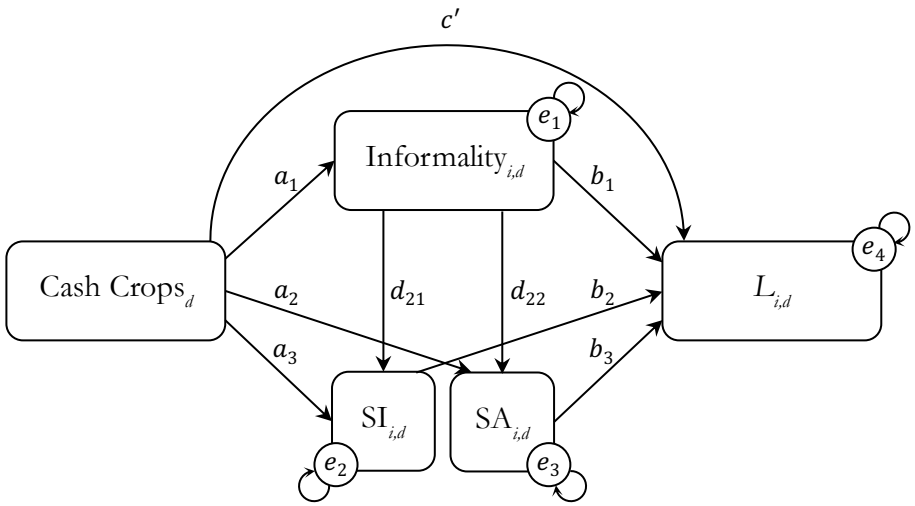

Fig. 8. Path diagram of structural continuity mechanisms in Côte d'Ivoire.
The above illustration displays proposed causal mechanisms experienced at the individual level, with Cash Crops$_d$ representing the extent of colonial cash crop cultivation in the department (*d;* a geographical unit) of an individual (*i*), SS$_{i,d}$ social security insurance, SA$_{i,d}$ social assistance, Informality$_{i,d}$ whether an individual is informally employed, and $L_{i,d}$ a given labour outcome such as income level. e signals the presence of endogenous variables.

First, colonial cash crop cultivation (Cash Crops$_d$) established a local elite in certain regions attached to the state and capable of making claims for labour rights. Thus, individuals working in cash crop regions received greater access to (a_3) social insurance (SI$_{i,d}$). Second, the same was the case for social assistance (SA$_{i,d}$), which disproportionately reached (a_2) cash crop regions. In turn, heightened access to social insurance (SI$_{i,d}$) and social assistance (SA$_{i,d}$) affect labour market outcomes ($L_{i,d}$) such as incomes via b_2 and b_3. Third, as discussed in section 4.2, the presence of colonial cash crop cultivation (Cash Crops$_d$) in specific regions led to formalisation in those regions and also informalisation (Informality$_{i,d}$) in areas peripheral to them (a_1). This in itself has consequences (b_1) for labour outcomes ($L_{i,d}$). Fourth, the status of Informality$_{i,d}$ of an individual also conditioned whether they would be included or excluded (d_{21}) in public social insurance (SI$_{i,d}$). Fifth, the same exclusion mechanism (d_{22}) applies to social assistance (SA$_{i,d}$). Sixth, other direct or indirect mechanisms such as infrastructure and informal institutions are captured through path c'.

5.3.2 Data preparation

Testing social policy mechanisms within the proposed causal mediation model necessitates detailed individual-level data. The analysis utilises 2015 LIS microdata on Côte d'Ivoire. Primary variables of interest include a dummy variable indicating whether an individual is informally employed, alongside several variables that disaggregate household-level and individual-level current incomes by source, such as transfer incomes from social assistance and social security. Additionally, the dataset includes the individual-level control variables sex, age, and years of education. As with the Afrobarometer data, all continuous variables are standardised, and income data undergoes log standardisation. Furthermore, the sample is restricted to individuals aged between 18 and 64. A significant limitation of LIS data is the absence of respondent coordinates. Instead, observations are coded based on identifiers for 107 sub-national departments. This imposes constraints on subsequent statistical analysis, necessitating data aggregation at the departmental level. For this, a nearest centroid spatial join is performed to associate each raster cell from the previous analysis with the closest administrative unit centroid.

Building on the linked dataset, spatial lags of the gridded data are calculated for two reasons. First, to reflect the spatial extent within which the spatial spillover analysis demonstrated a significant impact of cash crops on informality and income insecurity; and second, to account for spatial spillovers, which otherwise might treat departmental borders as arbitrary cut-offs. The spatial lags are calculated using the same k nearest-neighbours approach as before, with k=20. Following the computation of spatial lags, population-weighted aggregates are derived for each administrative unit. Population weights are calculated based on the 2010 population distribution and applied to the raster within each administrative unit (SEDAC, 2010). For each variable, the weighted mean is computed across all grid points within an administrative unit, weighted by the population share of each point. The result of this aggregation procedure for colonial cash crops is shown in Figure 9.

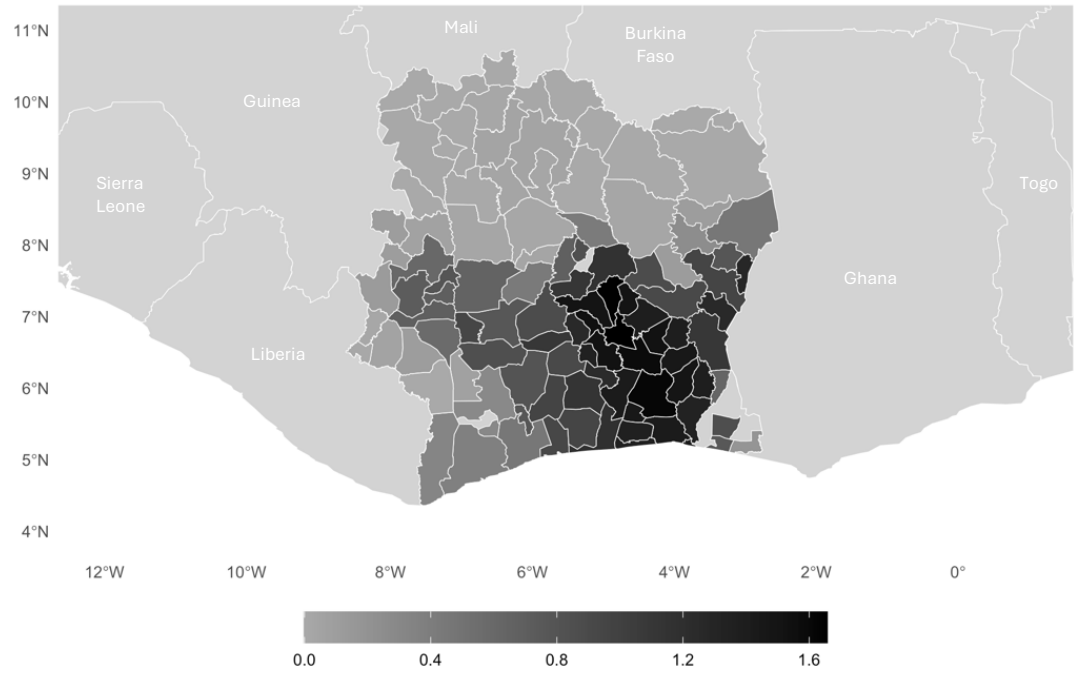

Fig. 9. Log population-weighted department mean of colonial cash crop export value 1957 USD and units of 289,270 USD derived from Roessler et al. (2022). Note, aggregation included cross-border spatial lags by k=20, equivalent to a radius of 0.5°. Further note the exclusion of four departments due to uncertain border changes and missing 2015 LIS data.

5.3.3 Constructing a serial mediation model

A serial mediation model is constructed to explore the causal mechanisms through which social policies mediate the enduring effects of colonial cash crops. A serial mediation model is a type of structural equation model (SEM) that facilitates the examination of multiple mediators, which sequentially transmit the effect of an independent variable onto a dependent variable (Tofighi and Kelley, 2020). This approach facilitates understanding the pathways through which colonial legacies of cash crop cultivation influence modern labour market outcomes through social policy.

The serial mediation model is specified and estimated using maximum likelihood (ML) estimation with the NLMINB optimisation method of the lavaan package in R. To account for the non-normality of indirect effects, bootstrapping is employed to calculate standard errors. Optimally, estimation would be conducted using clustered standard errors (SE) at the department level, given the multilevel nature of the data. Unfortunately, this feature is unavailable for lavaan within LIS's secure data analysis interface, introducing some bias in SE estimates.

Given the model's complexity and the potential for multicollinearity among predictors, ridge regularisation is applied (ridge=0.01). Furthermore, the control variables included in the model ($X_{i,d}$) correspond to those used in the full model specification of Column 4 in Table 1, apart from distance to the coast, distance to the colonial capital, malaria suitability, precolonial chiefdom, and distance to trade routes. These variables were excluded due to concerns about multicollinearity (VIF>3). Additionally, due to the incompatibility of lavaan SEM estimation with dummy variables, a propensity score for informality was generated and included, which may induce some mechanical endogeneity from overlapping predictors of the propensity score and control variables in the SEM. However, sensitivity analyses with reduced-form SEM, excluding control variables or using various control configurations, yielded similar results to the main model. The final SEM is as follows:

Labour Market Outcomes ($L_{i,d}$):

$$L_{i,d} = c \cdot \text{CashCrops}_d + b_1 \cdot \text{Informal}_{i,d} + b_2 \cdot \text{SI}_{i,d} + b_3 \cdot \text{SA}_{i,d} + \gamma' X_{i,d} + \epsilon_{L,i,d} \quad (4)$$

Informal Employment ($\text{Informal}_{i,d}$):

$$\text{Informal}_{i,d} = a_1 \cdot \text{CashCrops}_d + \delta' X_{i,d} + \epsilon_{\text{Informal},i,d} \quad (5)$$

Social Insurance ($\text{SI}_{i,d}$):

$$\text{SI}_{i,d} = d_{21} \cdot \text{Informal}_{i,d} + a_3 \cdot \text{CashCrops}_d + \phi' X_{i,d} + \epsilon_{\text{SI},i,d} \quad (6)$$

Social Assistance ($\text{SA}_{i,d}$):

$$\text{SA}_{i,d} = d_{22} \cdot \text{Informal}_{i,d} + a_2 \cdot \text{CashCrops}_d + \psi' X_{i,d} + \epsilon_{\text{SA},i,d} \quad (7)$$

The direct effects listed below represent the immediate impact of one variable on another, and indirect effects capture the mediated relationships where the influence of an independent variable is transmitted through one or more mediators before affecting the dependent variable.

Direct effects:

a_1: Cash Crops$_d$ →Informality$_{i,d}$
c': Cash Crops$_d$ → $L_{i,d}$

d_{21}: Informality$_{i,d}$ → SI$_{i,d}$
d_{22}: Informality$_{i,d}$ → SA$_{i,d}$
b_2: SI$_{i,d}$ → $L_{i,d}$
b_3: SA$_{i,d}$ → $L_{i,d}$
a_3: Cash Crops$_d$ → SI$_{i,d}$
a_2: Cash Crops$_d$ → SA$_{i,d}$
b_1: Informality$_{i,d}$ → $L_{i,d}$

Indirect effects:

Path 1: $a_1 \cdot d_{21} \cdot b_2$
Cash Crops$_d$ → Informality$_{i,d}$ → SI$_{i,d}$ → $L_{i,d}$
Path 2: $a_1 \cdot d_{22} \cdot b_3$
Cash Crops$_d$ → Informality$_{i,d}$ → SA$_{i,d}$ → $L_{i,d}$
Path 3: $a_1 \cdot b_1$
Cash Crops$_d$ → Informality$_{i,d}$ → $L_{i,d}$
Path 4: $a_3 \cdot b_2$
Cash Crops$_d$ → SI$_{i,d}$ → $L_{i,d}$
Path 5: $a_2 \cdot b_3$
Cash Crops$_d$ → SA$_{i,d}$ → $L_{i,d}$

5.3.4 SEM Results

Three variations of the SEM are estimated, each using different labour market outcomes ($L_{i,d}$): log standardised total household current income (THCI$_{i,d}$), log standardised total individual current income (TICI$_{i,d}$), and log standardised net hourly individual income (NHII$_{i,d}$). Goodness-of-fit statistics and effect estimates for direct, indirect, and total effects are reported in Table A3 (appendix) and Table 2.

Table 2: Effect estimates of the serial mediation model

	$L_{i,d}$: THCI$_{i,d}$			$L_{i,d}$: TICI$_{i,d}$			$L_{i,d}$: NHII$_{i,d}$		
	Est.	SE	p	Est.	SE	p	Est.	SE	p
Direct effects									
a_1	−0.029**	0.002	0.000	−0.028***	0.002	0.000	−0.031***	0.002	0.000
c'	0.002	0.018	0.928	0.218***	0.018	0.000	0.277***	0.030	0.000
d_{21}	−0.153	0.149	0.305	−0.143	0.152	0.345	−0.150	0.149	0.313
d_{22}	−0.253*	0.164	0.122	−0.247*	0.162	0.128	−0.225*	0.184	0.167
b_2	0.069***	0.013	0.000	−0.028***	0.013	0.034	0.022	0.023	0.338
b_3	0.040	0.050	0.417	0.016*	0.011	0.153	0.000	0.024	0.987
a_3	−0.040*	0.025	0.110	−0.028	0.023	0.214	0.031	0.028	0.273
a_2	−0.021	0.023	0.362	−0.020	0.021	0.35	0.003	0.023	0.907
b_1	−0.569***	0.073	0.000	−0.558***	0.066	0.000	−0.384***	0.115	0.001
Indirect effects									
Path 1: $a_1 \cdot d_{21} \cdot b_2$	0.000	0.000	0.324	−0.000	0.000	0.400	0.000	0.000	0.586
Path 2: $a_1 \cdot d_{22} \cdot b_3$	0.000	0.001	0.600	0.000*	0.000	0.199	0.000	0.000	0.987
Path 3: $a_1 \cdot b_1$	0.016***	0.002	0.000	0.016***	0.002	0.000	0.012***	0.004	0.001
Path 4: $a_3 \cdot b_2$	−0.003*	0.002	0.142	0.001	0.001	0.352	0.001	0.001	0.540
Path 5: $a_2 \cdot b_3$	−0.000	0.003	0.553	−0.000	0.001	0.424	0.000	0.001	0.990
Total indirect	0.013	0.004	0.002	0.016***	0.002	0.000	0.013***	0.004	0.001
Total indirect + direct	0.014	0.017	0.414	0.234***	0.016	0.000	0.290***	0.030	0.000
Proportion mediated	0.886	24.618	0.971	0.069***	0.012	0.000	0.043***	0.015	0.043

Significance codes: *p < 0.20, **p < 0.10, ***p < 0.05

The negative coefficients for a_1 across all models reaffirm that regions with higher colonial cash crop presence exhibit lower informal employment rates. The positive and significant direct effect c' of cash crops on TICI$_{i,d}$ and NHII$_{i,d}$ suggest mechanisms beyond the scope of social policies that are not included in this mediation model. Effects d_{21} and d_{22} indicate that informality

negatively impacts access to social insurance and assistance, though these effects are only marginally significant. The direct effect of social insurance on income (b_2) is positive for $THCI_{i,d}$ but varies across other outcomes, suggesting that while social insurance generally boosts household income, its effect on individual income is more complex. The effect of social assistance on income (b_3) is mostly insignificant, aligning with critiques in the TSP literature about the marginal impact of social protection. The direct effects of cash crops on social insurance (a_3) and social assistance (a_2) are small and statistically insignificant, challenging the hypothesised direct influence of cash crops on social policy outcomes. Instead, the negative and significant coefficients for b_1 confirm that informality is directly associated with lower income levels.

Path analysis reveals that indirect effects via informality and social insurance (Paths 1 and 2) are generally insignificant. In contrast, Path 3 indicates a significant indirect impact of cash crops on income through reduced informality. Paths 4 and 5 show minimal influence of cash crops on income through social insurance and assistance. These findings suggest that the enduring impact of colonial cash crops on current labor market outcomes operates primarily through mechanisms outside the model (c') and via reduced informality. The role of social policies is less clear, likely due to marginal effects and potential bidirectional relationships between informality and social policy access. While informality may limit access to social policies, these policies might also perpetuate informality and precarity by rendering labour more exploitable.

6. Limitations

To derive robust policy implications, it is essential to acknowledge the conceptual and methodological limitations of the preceding analyses. Despite rigorous validation efforts, potential inaccuracies remain, particularly in the historical data on colonial cash crop production from Hance et al. (1961). Although the analysis integrates diverse global perspectives, including insights from African scholars like Samir Amin, the researcher acknowledges that their positionality and reliance on secondary sources may introduce bias. Another significant conceptual limitation is the inherent negation in the term "informality", which often focuses on what it is not, reinforcing a binary perspective that limits our understanding of its origins and dynamics. This challenge, built into all research on informality, tends to reaffirm dualistic notions rather than clarify specific mechanisms of informality (Meagher, 2020). By employing dummy-coded variables to quantify informality, this paper sometimes risks falling victim to this fallacy. This is also why significant efforts have been made to disentangle the concept, explore its complexities, and its role as an outcome and mediator in qualitative and quantitative analysis.

Several technical limitations merit consideration. Firstly, omitted variable bias may influence the results, alongside challenges of reverse causality and simultaneity, particularly in models not employing instrumental variables. Secondly, the exogeneity of the instrument, while conceptually robust, relies heavily on controlling for overall caloric suitability. There remains a question of whether the residual cash crop suitability beyond caloric suitability accurately reflects exogenous European demands during cash crop colonialism or if these demands have since become endogenous. Another concern is the potential underestimation of standard errors in the structural equation model (SEM) due to the inability to cluster at the department level within lavaan. Additionally, mechanical bias may arise from data aggregation and the conversion of the informal dummy variable into a propensity score for SEM. The unidirectional causal assumptions within SEM might further oversimplify complex relationships, and multicollinearity remains a concern.

Specific spatial risks include the modifiable areal unit problem (MAUP), evident in both the rasterisation process and aggregation at the department level, where outcomes of spatial analysis can depend on the scale or boundaries of spatial units. The imposition of other spatial structures, such

as distance bins, spatial weights, and population-weighted aggregation, introduces further complexity. For example, spatial aggregation for SEM can obscure intra-departmental variations and introduce border effects. The decision to model spatial spillovers within a data buffer around Côte d'Ivoire during aggregation partially addresses border effects but introduces new mechanical endogeneity. Although all these choices were carefully guided by prior research, they are nonetheless subject to the arbitrary nature of spatial structuring imposed by the researcher.

7. Policy implications and conclusion

Given the scope of this research, two broad areas of policy reform emerge. The first concerns the productive structure of the economy and the role of the state in shaping long-term development outcomes. West African states need not remain passive in the face of market forces that continue to reproduce the uneven spatial and sectoral patterns inherited from *l'économie de traite*. Addressing these legacies calls for a more active role in reconfiguring both the geography and logic of productive investment. This includes reducing excessive reliance on export-oriented commodity production, such as cash crops, and placing greater emphasis on sectors driven by domestic and regional demand. Such a reorientation can help counter the historical concentration of development in cash crop areas and support the emergence of more diversified and spatially balanced internal markets. Public investment, alongside strategic industrial policy, can play a central role in nurturing emerging sectors, while selective protection for infant industries may further facilitate inclusive structural transformation. By broadening the base of productive employment and reducing spatial dependency, such a strategy lays the groundwork for addressing entrenched patterns of labour informality and precarity. These structural gains provide the foundation for effective social policy, which must respond to the evolving needs of workers in a diversifying and still highly unequal labour market.

The second area of reform concerns the role of Transformative Social Policy in addressing these labour market challenges. Existing West African social protection systems remain limited in scope and often reinforce inequality by primarily serving workers in historically privileged, formalised sectors. To counter this, social policy must address the structural conditions that exclude precarious and informal workers by expanding access to labour rights, ensuring fairer employment conditions, scaling up redistributive transfers, and strengthening inclusive public services. Rather than narrowly pursuing formalisation or adding incremental benefits, such measures should reflect the lived realities of employment outside the formal sector. This also requires recognising, as evidenced in this study, that informality and precarity are distinct challenges shaped by different institutional, economic, and spatial factors, and should be addressed by differentiated policy tools.

In conclusion, this study has analysed the enduring effects of colonial cash crop cultivation on informal and precarious employment in West Africa. By linking historical data with contemporary microdata, it shows that regions historically engaged in high-value cash crop production exhibit lower rates of informality and income insecurity today. These effects are comparable in magnitude to those associated with colonial mineral extraction, infrastructure, coastal proximity, and gender, with multiple identification strategies supporting a causal interpretation. The spatial analysis reveals that these effects extend beyond plantation cores, yet are often accompanied by increased informalisation in the hinterland. This reflects a pattern of historically uneven development in which localised gains came at the expense of broader regional equity. Serial mediation and the case of Côte d'Ivoire further demonstrate how weak and unequal social protection systems have sustained these spatial disparities over time. These findings expose the depth of colonial legacies in shaping West Africa's contemporary labour markets and make clear that without structural economic change and the adoption of Transformative Social Policies, historically rooted inequalities will continue to be reproduced through existing institutional arrangements.

8. Reference list

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9. Appendix

Table A1: Descriptive statistics for merged data used in spatial econometric analysis

Category	Variable	N	$\bar{X}$ (%)	SD	Min	Max
Outcomes						
	Labour Informality	19187				
	Informal	*16965*	88.42%			
	Formal	*2222*	11.58%			
	Income Insecurity	19187	0.56	0.35	0.00	1.00
Main Predictor	Col. Cash Crops	19187	45.33	56.48	0.00	320.00
Geographic Controls	Caloric Suitability	19187	3092.37	776.88	0.00	4595.68
	TseTse Suitability	19187	0.73	0.41	0.00	1.00
	Malaria Suitability	19187	20.54	8.97	0.00	38.08
	Ruggedness	19187	26.89	34.31	0.13	420.47
	Distance to River	19187	4.62	1.11	0.03	6.82
	Distance to Coast	19187	4.84	1.73	0.10	7.27
Historical Controls	Col. Minerals	19187	0.46	4.14	0.00	117.00
	Distance Col. Cities	19187	4.95	1.27	1.24	7.14
	Distance Col. Capital	19187	5.16	1.20	1.23	7.22
	Distance Col. Road	19187	21.02	36.25	0.04	581.10
	Dist. Trade Route	19187	3.70	1.15	0.00	6.29
	Slave Trade Exposure	19187				
	Medium	*2316*	12.07%			
	High	*12132*	63.23%			
	Low	*4739*	24.70%			
	Precolonial Institution					
	State	2558	13.33%			
	Chiefdom	13189	68.74%			
	Other	1,672	8.71%			
	Missing	1768	9.21%			
Individual Controls	Sex	19187				
	Female	*10160*	52.95%			
	Male	*9027*	47.95%			
	Age	19187	36.27	14.64	18.00	120.00
	Urban	19187				
	Urban	*8030*	41.85%			
	Rural	*11157*	58.15%			
	Education Level	19187	2.11	1.04	1.00	4.00

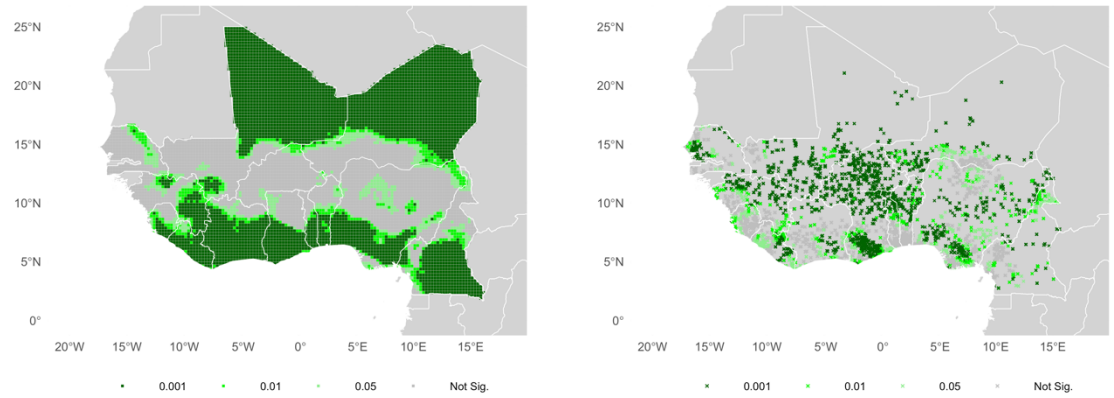

Fig. A1. LISA bivariate and univariate significance maps of cash crop suitability (left) and colonial cash crop cultivation (right)

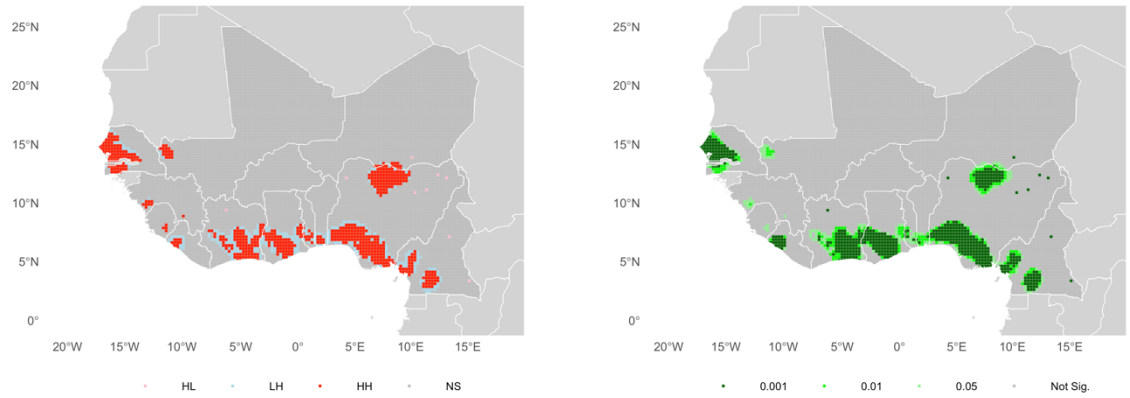

Fig. A2. Univariate LISA (left) and LISA significance (right) maps of colonial cash crops.

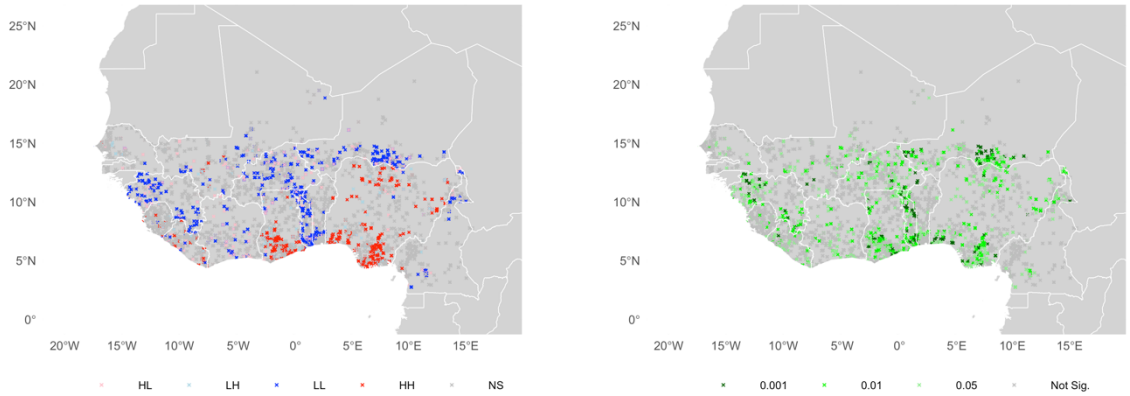

Fig. A3. Univariate LISA (left) and LISA significance (right) maps of income security.

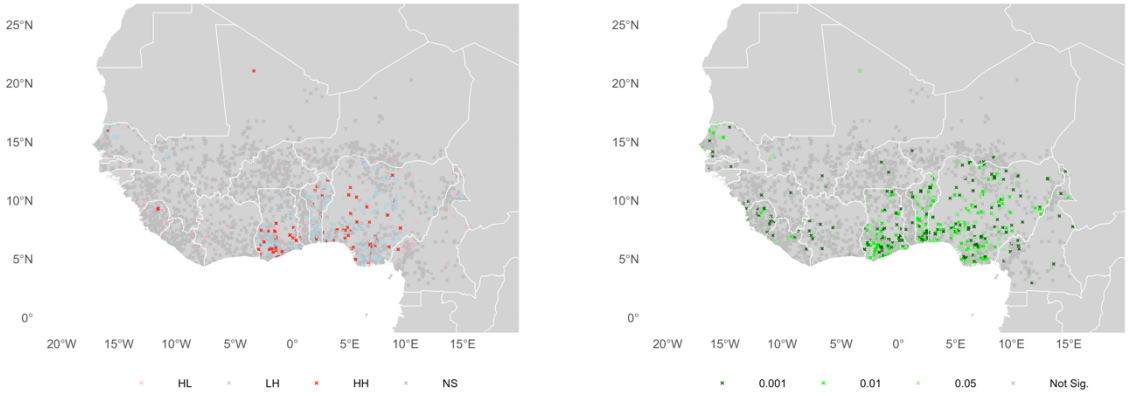

Fig. A4. Univariate LISA (left) and LISA significance (right) maps of labour formality.

Table A2: Colonial cash crops, informal employment and income insecurity

	Outcome											
	Informal						Income Insecurity					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Col. Cash Crops	−0.044***	−0.051***	−0.031***	−0.027***	−0.009**	−0.032***	−0.063***	−0.057***	−0.028***	−0.022***	−0.011**	−0.043***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.009)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.01)
Caloric Suit.		−0.027***	−0.005*	−0.008**	0.005	−0.001		0.005	0.019***	0.014***	0.005	−0.003
		(0.003)	(0.003)	(0.003)	(0.003)	(0.004)		(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
TseTse Suit.		0.004	−0.024***	−0.015***	−0.011***	−0.011***		−0.002	−0.013***	0.001	0	0.001
		(0.002)	(0.003)	(0.003)	(0.003)	(0.003)		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Malaria Suit		−0.019***	−0.001	−0.010**	−0.006	−0.001		−0.008**	−0.001	−0.019***	−0.002	0.005
		(0.003)	(0.003)	(0.004)	(0.004)	(0.004)		(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Ruggedness		0.010***	0.017***	0.018***	0	0		−0.014***	0	0	−0.020***	−0.020***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Dist. River		0.009***	0.011***	0.007**	0.007**	0.010***		0.029***	0.037***	0.029***	0.020***	0.024***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Dist. Coast		0.019***	−0.010**	−0.013***	−0.010**	−0.014**		0.032***	0.014**	0.012**	−0.013**	−0.017***
		(0.004)	(0.004)	(0.004)	(0.004)	(0.005)		(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Col. Minerals			−0.003	−0.004	−0.008*	−0.001			−0.034***	−0.039***	−0.009*	0.001
			(0.003)	(0.003)	(0.004)	(0.005)			(0.003)	(0.003)	(0.004)	(0.005)
Dist. Col. Cities			0.073***	0.066***	0.023***	0.022***			0.051***	0.035***	0.015***	0.013***
			(0.004)	(0.004)	(0.005)	(0.005)			(0.003)	(0.003)	(0.004)	(0.004)
Dist. Col. Capital			−0.023***	−0.023***	0.006	0.001			−0.027***	−0.029***	0.017***	0.011**
			(0.003)	(0.003)	(0.004)	(0.004)			(0.003)	(0.003)	(0.004)	(0.004)
Dist. Col. Trade			0.022***	0.019***	0.001	0.002			0.039***	0.034***	0.009***	0.010***
			(0.003)	(0.003)	(0.002)	(0.002)			(0.002)	(0.002)	(0.003)	(0.003)
Dist. Col. Road			0.001	−0.002	−0.006**	−0.009***			0.013***	0.004	−0.009***	−0.012***
			(0.002)	(0.002)	(0.002)	(0.002)			(0.003)	(0.003)	(0.003)	(0.003)
Slaves (Med.)			0.015*	0.019**	−0.006	0			−0.010	0.001	0.007	0.015
			(0.008)	(0.008)	(0.007)	(0.008)			(0.009)	(0.009)	(0.009)	(0.009)
Slaves (High)			0.024***	0.017**	0.022***	0.031***			0.009	−0.001	0.018**	0.031***
			(0.006)	(0.006)	(0.006)	(0.007)			(0.006)	(0.006)	(0.007)	(0.008)
Precol. State			−0.106***	−0.116***	−0.039***	−0.040***			−0.004	−0.024**	0.044***	0.044***
			(0.011)	(0.011)	(0.011)	(0.011)			(0.01)	(0.01)	(0.011)	(0.011)
Precol. Chiefdom			−0.057***	−0.064***	−0.045***	−0.039***			−0.050***	−0.066***	−0.005	0.003
			(0.008)	(0.008)	(0.009)	(0.009)			(0.008)	(0.008)	(0.009)	(0.009)
Precol. Centr. NA			−0.039***	−0.041***	−0.041***	−0.028**			−0.078***	−0.084***	0.031**	0.049***
			(0.01)	(0.01)	(0.011)	(0.012)			(0.013)	(0.012)	(0.014)	(0.015)
Sex				0.006	0.010**	0.010**				−0.007	−0.006	−0.006
				(0.005)	(0.004)	(0.004)				(0.005)	(0.005)	(0.005)
Age				−0.024***	−0.021***	−0.021***				0.007**	0.005*	0.005*
				(0.002)	(0.002)	(0.002)				(0.003)	(0.002)	(0.002)
Urban				−0.020***	−0.001	−0.002				−0.079***	−0.062***	−0.063***
				(0.006)	(0.005)	(0.005)				(0.006)	(0.005)	(0.005)
Education				−0.040***	−0.037***	−0.037***				−0.045***	−0.037***	−0.037***
				(0.003)	(0.003)	(0.003)				(0.003)	(0.003)	(0.003)
Cash Crop Suit. (Instrument)						0.413***						0.413***
						(0.007)						(0.007)
First-stage F-statistic						3,915.3***						3,915.3***
Wu-Hausman						8.74***						12.9***
Geographic Controls	✗	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Historical Controls	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓
Individual Controls	✗	✗	✗	✓	✓	✓	✗	✗	✗	✓	✓	✓
Country & Year FE	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓	✓
IV	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓
Num.Obs.	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187	19187
R2 Adj. (Within)	0.019	0.031	0.077	0.093	0.026	0.025	0.033	0.046	0.08	0.111	0.046	0.043

The dependent variable in columns 1 to 6 is a dummy variable indicating whether an individual is informally employed. The dependent variable in columns 7 to 12 is a five-step Likert variable with the values 0, 0.25. 0.5, 0.75 and 1 indicating the degree of income insecurity experienced by the given individual. Individuals are matched to the raster cell in which they are nested, allows for raster-level control variables; Geographic control variables include overall caloric suitability, malaria suitability, TseTse fly suitability, ruggedness, logged distances to the next river and coast. Historical control variables include the export value of colonial minerals, logged distance to trade routes in 1900, cities in 1900, and the first colonial capital, as well as exposure to the transatlantic slave trades, precolonial institutions and distance to the next colonial road. Individual-level controls include sex, level of education, age, and urban/rural residence. Standard errors are clustered at the country level. Significance codes: *p < 0.1, **p < 0.05, ***p < 0.01.

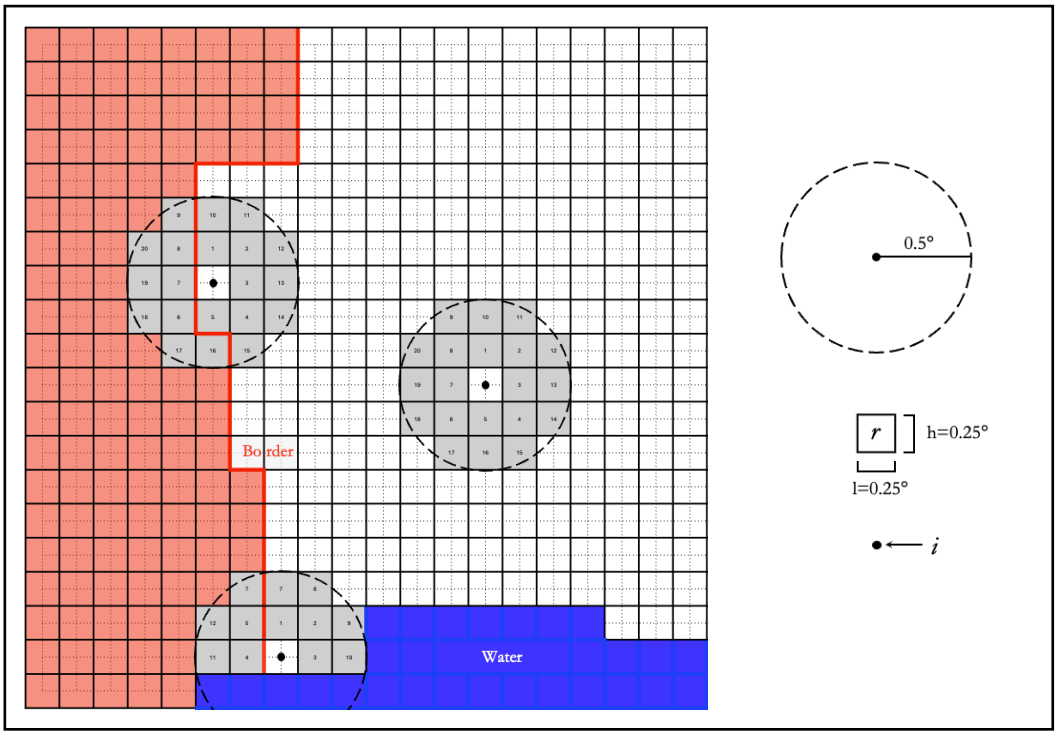

Fig. A5. Construction of second order extended queen contiguity scheme (EQC) capturing raster cells *r* within a 0.5° distance band around individual *i*.

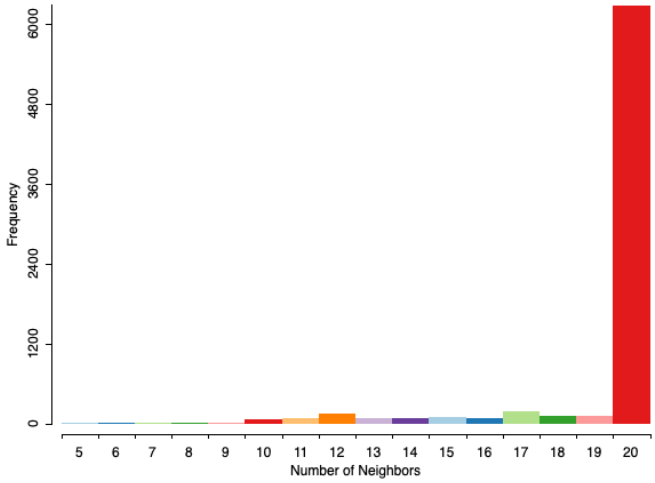

Fig. A6. Frequency distribution of k nearest neighbours in raster within a 0.5° distance band.

Table A3: Goodness-of-fit statistics and criteria for serial mediation model

Num. Obs	Parameters	X^2	CFI	RMSEA
2850	58	25.48	0.996	0.043
3025	58	35.309	0.995	0.051
2279	58	39.217	0.975	0.062

X^2, chi-square statistic; df, degrees of freedom; CFI, comparative fit index; SRMR, root mean square error of approximation; RMSEA, standardised root mean square residual.