

Climate Change and Sovereign Debt: Assessing the Impact of Environmental Vulnerability on Madagascar's External Indebtedness

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Abstract

Madagascar is one of the most climate-vulnerable countries, facing recurrent cyclones, droughts, and floods that threaten its economic stability. Understanding how these shocks translate into debt is important because financing raised to cope with disasters can, if left unexamined, entrench the very vulnerability it is meant to relieve, with lasting consequences for fiscal sovereignty and long-term development planning across similarly exposed states. This article examines why climate change contributes to the country's rising external debt by exploring the links between environmental vulnerability, international financial mechanisms, and debt sustainability. Existing research highlights factors such as high post-disaster reconstruction costs, declining public revenues, and increased borrowing costs due to sovereign risk. However, these studies have yet to fully address how climate change structurally influences debt accumulation. Using the theory of debt accumulation, this study argues that climate-induced economic shocks weaken Madagascar's fiscal capacity, increasing its reliance on external financing from institutions like the International Monetary Fund (IMF) and the World Bank. Through a qualitative analysis of secondary data, preliminary findings suggest that while climate finance aims to enhance resilience, it paradoxically reinforces financial dependence and limits economic sovereignty. This article calls for structural reforms to integrate climate risk into sovereign debt frameworks, contributing to discussions on sustainable financial strategies for climate-vulnerable nations.

Keywords: Climate Change; Sovereign Debt; Madagascar; Environmental Vulnerability; Debt Accumulation Theory.

Introduction

Over the past two decades, the proliferation of severe climatic phenomena has significantly altered the economic trajectories of nations most susceptible to such events, particularly in regions characterized by limited institutional capacities and productive systems that are heavily reliant on precarious environmental resources (Bergholt and Lujala 2012). The literature on climate economics indicate that cyclones, droughts, and floods have transitioned from anomalous occurrences to integral components of a structural dynamic that persistently influences growth, fiscal equilibrium, and developmental outlook (Hsiang & Jina 2014; IPCC 2023). In numerous African nations, these successive perturbations of climate have exacerbated pressures on public finances by engendering recurrent economic losses that substantially surpass national crisis management capabilities, thereby intensifying reliance on external financing to address immediate exigencies and rehabilitate critical infrastructure (Collier et al. 2009). This development engenders new challenges for vulnerable nations, as it fundamentally alters the way they formulate their economic strategies and navigate their budgetary decision-making parameters in an environment of escalating climate uncertainties.

The research problem addressed in this article is that, while existing scholarship documents the fiscal costs of climate disasters and

the growing weight of external borrowing in vulnerable states, it has not established how these two dynamics interact structurally over time within a single country case. Studies on Madagascar have separately traced its exposure to cyclones and drought and its dependence on IMF and World Bank financing, but none have applied a debt accumulation framework to explain why each successive shock appears to deepen, rather than merely repeat, the country's reliance on external credit. This article addresses that problem directly.

Madagascar serves as a salient example of the tensions engendered by the escalation of climate-related risks, given that its economic framework is profoundly reliant on susceptible sectors, including rain-fed agriculture, coastal fisheries, and specific value chains that exhibit a strong dependency on climate conditions (Harvey et al. 2014). The proliferation of cyclones in the Indian Ocean, exacerbation of drought intervals in the southern regions, and heightened incidence of flooding in vulnerable urban locales have precipitated substantial economic detriment in recent years, undermining an already fragile infrastructure and disrupting both production and distribution networks (Bank 2024; FAO 2022). These events, which concurrently impact household income and public fiscal revenue, exacerbate the challenges associated with implementing sustainable development strategies and amplify the

nation's reliance on emergency financial mechanisms and international assistance. Consequently, these circumstances impose an almost perpetual state of crisis management on Malagasy authorities in a milieu where institutional and fiscal resources are already severely constrained.

The sequence of climatic perturbations exerts increasingly stringent fiscal constraints as their repercussions transcend the immediate devastation inflicted on infrastructure and economic activities (Bachner & Bednar-Friedl 2018). In Madagascar, each instance of extreme climatic events precipitates a contraction in agricultural revenue, disrupts logistical networks, and diminishes the capacity of households to engage in the formal economy, thereby constricting the tax base and exacerbating the strain on public finances (Azam et al. 2024). The research conducted by Cavallo and Noy (2011) elucidate that natural calamities engender enduring ramifications on public fiscal accounts, as expenditures related to relief and reconstruction frequently persist for multiple years after extreme occurrences, especially within low-income nations (Cavallo & Noy 2011). Additional investigations indicate that vital infrastructure, when subjected to damage in rapid succession, incurs higher maintenance costs, thus establishing a dynamic wherein public resources are incessantly reallocated toward immediate priorities, detracting from the

structural investments required for mitigating future vulnerability (Felbermayr & Groeschl 2011). In this framework, climatic shocks do not merely signify transient disruptions to economic operations; rather, they contribute to a substantial reconfiguration of budgetary governance, constraining governmental flexibility and rendering it increasingly susceptible to external variations.

These budgetary transformations, induced by the recurrence of environmental disturbances, necessitate a reevaluation of the significance of climate vulnerability in influencing public finances in susceptible nations (Raddatz & Melecky 2011). Indeed, contemporary analyses indicate that natural calamities are now integrated into broader economic cycles, in which their repercussions do not dissipate following the reconstruction phase but rather endure because of the inherent fragility of productive sectors and the inadequacy of institutional capacities to accommodate disruptions (IPCC 2023). In the context of Madagascar, these limitations manifest as an escalating challenge to sustain stable investment programs, as governmental priorities are perpetually redirected towards emergency management and the rehabilitation of vital infrastructure. While public expenditure mechanically escalates after each calamity, it invariably falls short of addressing the entirety of the damages, thus exacerbating the chasm between financing requirements

and genuinely available resources (Azam et al. 2024; Harvey et al. 2014). This dynamic is rendered even more problematic as economic losses accrue at a pace that outstrips national response capacities, engendering enduring budgetary pressure that progressively constricts the government's operational flexibility and renders reliance on external financing imperative.

In this context, it is becoming increasingly challenging to distinguish the direct repercussions of climate change from the progression of sovereign debt, as these two phenomena are becoming more closely interlinked. Numerous scholarly investigations reveal that the most susceptible economies are inclined to experience a persistent decline in their primary balance in the years following natural disasters, thereby fostering a scenario in which fiscal stability predominantly hinges on the accessibility of international credit (Noy & Nualsri 2011). International analyses also imply that these financial strains are intensified when shocks occur within fragile institutional landscapes, constraining a nation's capacity to diversify its revenue streams or establish social protection systems that could alleviate the economic ramifications of disasters (Bank 2024). Consequently, rather than being perceived as a sequence of discrete interruptions, the impacts of climate change play a significant role in reshaping a nation's developmental trajectory by concurrently affecting fiscal management, investment

priorities and financing approaches (Bowen et al. 2011). These advancements engender a pivotal inquiry: why does climate change contribute to the increasing external indebtedness of Madagascar?

Existing research on the interconnections between climate change and sovereign debt coalesces around the proposition that environmental susceptibility significantly impacts the fiscal trajectories of particularly vulnerable nations. A primary avenue of research explores how the recurrence of natural disasters compromises fiscal stability by diminishing public revenues while simultaneously escalating emergency expenditures, a phenomenon documented in various African nations confronting the exacerbation of climate-related adversities (Leykun 2024). A plethora of studies also emphasizes that international creditors are increasingly factoring these risks into their assessments of creditworthiness, which frequently culminates in more stringent financing conditions and a heightened reliance on external stakeholders (Egbétoké & Ureche-Rangau 2025). Consequently, this body of literature illustrates that climate vulnerability must be understood not merely as an environmental issue but as a pivotal factor influencing fiscal constraints and the progressive decline of public financial health in the most impacted nations.

The second body of research concentrates on the financial and institutional frameworks capable of alleviating the debt pressures

engendered by climate-induced shocks by proposing instruments aimed at providing enhanced budgetary flexibility to nations that are particularly vulnerable. Investigations into green bonds, debt-for-climate swaps, and catastrophe-linked financial instruments elucidate their potential to mitigate the repercussions of environmental crises while simultaneously fostering investment in resilience and ecological transition initiatives (Masamba 2024). Kling et al. (2018) underscore the increasing significance of explicitly incorporating environmental criteria into sovereign financing frameworks, contending that such an evolution could diminish the risk premiums levied on states that are highly susceptible to climate-related hazards (Kling et al. 2018). Nevertheless, the realization of these innovations is impeded by considerable challenges, including the lack of standardized regulatory frameworks, the constrained depth of local financial markets, and the enduring reticence of international investors towards instruments that remain inadequately standardized. Various studies indicate that climate risks exert a direct influence on market perceptions, prompting creditors to impose stricter conditions on nations with high exposure, a phenomenon that Zenios (2024) characterizes as a climate-debt doom loop, wherein the recurrence of disasters concurrently heightens budgetary vulnerability and reliance on external financing (Zenios 2024). These contributions illustrate that the interplay between climate

and debt is situated within a dynamic that is both structural and cumulative, a reality that existing mechanisms only partially address.

Despite the richness of this body of work, the existing literature is characterized by numerous constraints that hinder a thorough comprehension of the interplay between climate vulnerability and debt dynamics. Most investigations tend to tackle these concerns in a disjointed fashion, scrutinizing the fiscal repercussions of natural calamities, the viability of innovative financial instruments, or the progression of sovereign risk perceptions individually, without articulating a framework that cohesively integrates these facets within a genuinely unified framework. Furthermore, the proposed remedies frequently remain conceptual and inadequately evaluated within specific national contexts, especially in structurally vulnerable economies such as Madagascar. These deficiencies underscore the imperative for a more cohesive analytical paradigm capable of encapsulating the cumulative and systemic characteristics of climate-induced pressure on debt trajectories.

The necessity for a more cohesive framework appears increasingly pressing, as nations subjected to climatic disturbances accumulate vulnerabilities that interact in intricate manners, thereby eluding comprehension through isolated sectoral methodologies. In the context of Madagascar, the pressures imposed by natural disasters on public

fiscal stability are intricately linked to structural weaknesses associated with reliance on sensitive sectors, inadequate tax bases, and a lack of resilient infrastructure. International analysis indicates that when these factors converge, the fiscal leeway for maneuvering becomes substantially constrained over time, diminishing the state's ability to absorb successive shocks and formulate coherent developmental policies (Christou & Palomba 2023). Concurrently, the financial mechanisms designed to provide protection against these limitations remain challenging to activate, either because of their reliance on incomplete regulatory frameworks or because they require technical capacities that the most vulnerable nations do not consistently possess (Kling et al. 2018). These cumulative dynamics illustrate that comprehending climate-related indebtedness necessitates an approach that encapsulates not only the immediate impacts of disasters but also the set of economic, financial, and institutional processes that mutually reinforce one another over time. Furthermore, they suggest that neither a purely budgetary nor a solely financial response can adequately address the issue without a more comprehensive consideration of how climate vulnerability reshapes national debt-management strategies.

In this context, an analysis focused specifically on Madagascar provides an opportunity to enhance our understanding of how climate vulnerability relates to the debt dynamics of a nation subjected to

recurrent and cumulative risks. The existing literature recognizes that low-income nations are compelled to simultaneously address enduring fiscal pressures, constrained institutional capacity, and escalating climate risks. However, they frequently lack in-depth empirical investigations that facilitate the linkage of these dimensions within a cohesive framework. Madagascar exemplifies a particularly pertinent case for scrutinizing these interactions, given its high susceptibility to natural disasters and the ongoing fragility of its financial and institutional infrastructure. The nation's economy is substantially reliant on sectors vulnerable to climatic hazards, amplifying the effects of natural disasters and rendering them more pronounced and costly than those observed in more diversified economies. Furthermore, the historical reliance on international donors and concessional financing exacerbates the sensitivity of external debt to environmental perturbations. These characteristics underscore the necessity of a comprehensive understanding of Madagascar's debt trajectory through an analytical approach that transcends traditional evaluations focused exclusively on macroeconomic variables, thereby fully incorporating the climate dimension as a crucial factor.

Therefore, adopting a comprehensive framework is crucial to elucidate how climate-related risks influence Madagascar's external indebtedness. Numerous contemporary investigations advocate

transcending conventional macroeconomic paradigms to encompass the interplay between environmental susceptibility, financing requirements, and institutional capabilities, positing that these elements mutually reinforce each other in vulnerable nations (Beirne et al. 2021). This methodological perspective facilitates the contextualization of indebtedness within an expansive paradigm, wherein public policy decisions, limitations on external financing, and the repercussions of natural disasters are interrelated components of one system. In this regard, the analysis presented herein seeks to address the deficiencies identified in the existing literature by systematically investigating the various dimensions that contribute to the escalation of Malagasy debt as influenced by climate change.

The proposed study constitutes a vital component of the dynamic framework by establishing a rigorous analytical model that systematically correlates climate shocks, fiscal limitations, and the progression of external indebtedness in Madagascar. Grounded in the premise that environmental susceptibility represents a fundamental determinant of financial strain, this study illustrates that recurrent climatic phenomena disrupt macroeconomic equilibrium and influence medium-term debt trajectories. This methodological approach addresses the deficiencies identified in the existing literature by elucidating both the direct and indirect ramifications of natural disasters on the State's

capacity to fulfill its fundamental financial obligations, while simultaneously illuminating the mechanisms that compel it to increasingly depend on external financial resources. Consequently, this study paves the way for novel insights into how vulnerable nations can incorporate climatic risks into their debt-management frameworks more effectively.

Building on this perspective, the present analysis endeavors to elucidate that the mechanisms by which Madagascar accumulates external debt cannot be comprehensively understood without incorporating the structural limitations that influence the national response to climate-related hazards in Madagascar. Empirical studies on vulnerable economies reveal that the repercussions of natural disasters are exacerbated when public institutions possess a constrained capacity to absorb shocks, compelling governments to address urgent needs through a nearly systematic dependence on external borrowing. In Madagascar, where fiscal resources are persistently inadequate and resilient infrastructure remains insufficient, this dynamic is likely to intensify over time, engendering an environment in which climatic shocks and financial limitations mutually exacerbate one another. Furthermore, international creditors recalibrate their evaluations of sovereign risk considering climate consequences, thereby elevating financing costs and

constraining the state's capacity to devise long-term budgetary strategies (Bachner & Bednar-Friedl 2018). By synthesizing these diverse factors within a unified analytical framework, this investigation aspires to furnish a more holistic interpretation of a nation's debt trajectory and provide insights that facilitate a deeper understanding of the potential mechanisms for a strategy aimed at mitigating financial vulnerability in the context of climate change.

From this perspective, this study formulates a comprehensive examination focused on the interplay of climate-induced shocks, fiscal limitations, and perceptions of sovereign risk, elucidating the influence these factors exert on Madagascar's debt trajectory by utilizing data sourced from international entities such as the International Monetary Fund (IMF), the World Bank, and domestic institutions. The methodological framework employed aims to synthesize these varied dimensions within a cohesive analytical paradigm, leveraging theoretical propositions and empirical data to illuminate the mechanisms through which natural catastrophes redefine external financing requirements and augment reliance on donor assistance. The inquiry commences with an exposition of the conceptual schema employed to comprehend the dynamics of debt accumulation related to climatic factors, prior to an analysis of the structural patterns pertaining to the nation's environmental susceptibility

and an evaluation of their financial repercussions. Subsequently, it investigates the institutional and fiscal responses enacted over time, underscoring the inherent limitations of existing sovereign risk management frameworks. Ultimately, this paves the way for a more expansive contemplation of how Madagascar might more effectively incorporate climate-related risks into its debt management strategy and the essential conditions required to disrupt the cycle of vulnerability that increasingly intertwines climate issues, public finances, and the sustainability of debt.

Methods

This study employs a qualitative descriptive methodology to analyse the relationship between climate vulnerability and sovereign debt accumulation in Madagascar. This approach aims to provide a detailed and contextualised account of the mechanisms through which environmental shocks affect fiscal behaviour and borrowing patterns. A qualitative descriptive approach is appropriate because it emphasises empirical interpretation and contextual understanding rather than statistical modelling, allowing the study to capture the concrete dynamics shaping fiscal outcomes. Data were collected from primary institutional sources, including reports from the Ministry of Economy and Finance, the International Monetary Fund, and the World Bank, complemented by secondary materials such as peer-reviewed studies

and documents from international organisations. The analysis focuses on three central variables: the magnitude of post-disaster fiscal deficits, the degree of dependence on external borrowing, and the role of multilateral institutions in structuring Madagascar's debt trajectory. These variables are interpreted through Antonio Mele's debt accumulation framework, which provides conceptual guidance for understanding how recurrent shocks become embedded in long-term fiscal patterns. By combining descriptive evidence with theoretical interpretation, this methodological approach captures the cumulative effects of environmental vulnerability on fiscal fragility and supports the identification of policy avenues to reinforce debt sustainability and economic resilience.

The theory of debt accumulation offers a vital basis for comprehending how developing nations, such as Madagascar, become ensnared in cycles of ongoing borrowing in response to both economic and environmental perturbations. According to Antonio Mele, the phenomenon of debt accumulation is not solely attributable to inadequate fiscal discipline or ephemeral policy choices, but rather to systemic conditions that constrain a state's capacity to maintain balanced budgets over extended periods. (Mele 2021) These conditions include susceptibility to external shocks, constrained fiscal capacity, and reliance on unstable income sources. Environmental

shocks exacerbate these limitations by concurrently diminishing revenue streams and amplifying expenditures, creating a sustained need for external financing (Raddatz & Melecky 2011). Mele's theoretical model elucidates that once this borrowing dynamic is initiated, it tends to perpetuate itself through cumulative mechanisms that become increasingly challenging to reverse. Each instance of borrowing implemented to address a crisis contributes to overall debt accumulation, and subsequent shocks exacerbate repayment difficulties, necessitating additional borrowing (Mele 2021). This cyclical phenomenon epitomizes the interplay between vulnerability and fiscal responsiveness, thereby transforming debt from a temporary adjustment mechanism into an enduring structural element of the national economy.

Within this theoretical framework, climate change exacerbates fiscal distress in nations that are already grappling with inherent structural deficiencies in their economies. The frequent occurrence of cyclones, droughts, and floods diminishes productive capacity, inflicts damage on infrastructure, and limits governmental revenue streams, while concurrently necessitating an increase in public expenditure to support the recovery and reconstruction. In this scenario, debt accumulation emerges not merely as a financial imperative but as a vital survival strategy that enables the state to

maintain its fundamental functions during periods of crisis. Mele’s analytical framework elucidates the rationale behind the persistence of such borrowing behaviors: once debt is incurred in response to external shocks, it becomes ingrained in fiscal practices and institutional anticipations. The state’s dependence on credit escalates as each successive disaster further undermines its fiscal foundation, culminating in a phenomenon that Mele characterizes as path dependence in the dynamics of debt (Mele 2021). The enduring nature of this occurrence accounts for the continued increase in debt levels within countries such as Madagascar, notwithstanding intermittent debt relief and restructuring efforts in the country. The theoretical implications also propose that, in the absence of substantial structural reforms, external borrowing will persist as the primary fiscal response to climate-induced stress, thereby perpetuating a precarious balance between financial necessity and fragility.

Another critical component of Mele’s debt-accumulation framework is the interplay between domestic fiscal architecture and international credit markets (Mele 2021). In developing nations, the cost of borrowing is frequently dictated by external risk perceptions rather than intrinsic economic fundamentals. When recurrent natural disasters disrupt production and fiscal equilibrium, international lenders and investors recalibrate their

evaluations of sovereign creditworthiness, imposing elevated interest rates and more stringent lending conditions. This phenomenon exacerbates the fiscal pressures induced by environmental shocks, as a greater portion of public revenue must be allocated toward debt servicing rather than developmental expenditures (Cormier 2024). Thornton & Vasilakis (2017) elucidate that the simultaneous existence of elevated debt levels and constrained growth potential perpetuates a self-reinforcing cycle of fiscal dependency, wherein sluggish growth necessitates increased borrowing, and the accumulation of additional debt stifles growth (Reinhart & Rogoff 2010). In the context of Madagascar, this mechanism has become increasingly pronounced as recurrent climate shocks have compelled the government to incur debt on less advantageous terms to facilitate the recovery and reconstruction. Mele's theoretical model encapsulates this feedback loop by demonstrating how exogenous shocks escalate borrowing costs and entrench structural dependence within national fiscal frameworks. Over time, debt forfeits its developmental function and transforms into a structural impediment that constrains the policy autonomy of the state, while exacerbating its economic vulnerability (Mele 2021).

The theoretical framework also emphasizes the global aspect of debt accumulation, elucidating the significant impact of both multilateral and bilateral creditors on determining fiscal pathways

(Mele 2021). International financial entities, including the International Monetary Fund and the World Bank, play a pivotal role in aiding nations confronting debt crises by providing concessional loans, debt restructuring initiatives, and policy-oriented support (Bøås 2022). These interventions are intended to stabilize fiscal equilibrium and avert macroeconomic disintegration; however, they often prioritize immediate liquidity solutions over long-term resilience. (Eichengreen 2002) Mele’s analytical framework posits that while such interventions are critical, they frequently neglect to tackle the fundamental vulnerabilities that precipitate recurrent borrowing. Consequently, fiscal dependency becomes entrenched, with developing nations oscillating between crises, external assistance, and renewed indebtedness (Mele 2021). The case of Madagascar exemplifies this phenomenon: post-disaster financial aid from international donors has afforded temporary stabilization, yet it has not mitigated the nation’s susceptibility to future borrowing exigencies. The recurrence of this trend suggests that debt relief and concessional financing, in isolation, are inadequate for fostering fiscal independence in the long run. Thus, Mele’s theoretical lens advocates for a reconceptualization of debt sustainability that incorporates climate risk considerations into fiscal strategy. By aligning global assistance with objectives aimed at fostering resilience, international financial frameworks can transition from being merely reactive mechanisms for crisis mitigation to proactive

instruments that promote long-term stability and structural transformation.

Results and Discussion

1. Environmental Shocks as Catalysts of Structural Fiscal Deficits

Madagascar is positioned among the nation's most susceptible to climate change, and this vulnerability has transformed into a fundamental factor driving fiscal strain and the accumulation of public debt (Nematchoua et al. 2018). The nation is subjected to recurrent environmental perturbations that traverse various regions, characterized by extended droughts in the Grand Sud and increasingly severe cyclones impacting the eastern and southeastern coastal areas. As reported by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the successive tropical cyclones Batsirai and Emnati in 2022 adversely impacted more than 423,800 individuals, resulting in substantial damage to livelihoods, housing, and critical infrastructure (OCHA 2023). Concurrently, the Grand Sud endured its most severe drought in four decades in 2021, resulting in over one million individuals being plunged into severe food insecurity. In addition to their immediate humanitarian ramifications, these occurrences precipitate significant economic losses, disrupt productive activities, and diminish the tax base, thereby exerting persistent pressure on public finances (ROSEA 2022). Each environmental shock precipitates

cascading fiscal requirements that surpass domestic capabilities, compelling the government to swiftly mobilize external resources to maintain emergency responses, reconstruction efforts, and the provision of essential services. Consequently, climate-related disasters function not solely as environmental crises but as structural catalysts for primary fiscal deficits, entrenching Madagascar in a recurrent cycle wherein disaster-induced expenditure accelerates dependence on external borrowing and exacerbates long-term fiscal vulnerability.

Each significant climatic shock engenders immediate fiscal exigencies that governmental authorities can only mitigate through considerable escalations in expenditure, a substantial portion of which necessitates external financing, thus exacerbating the fundamental fiscal deficit (Lis et al. 2010). The dynamic elucidated by Antonio Mele's theoretical construct regarding debt accumulation and deficit cycles serves to elucidate this phenomenon. Mele (2021) posits that governments exhibit a proclivity to sustain short-term deficits when the marginal cost of borrowing remains relatively subdued and the risks associated with default are perceived as manageable (Mele 2021). The fiscal conduct of Madagascar in the wake of severe climatic disturbances closely mirrors this rationale: emergency responses invariably supersede fiscal consolidation, and the recurrent emphasis on crisis-induced expenditures entrench deficit financing within the fiscal

architecture of the nation. In the aftermath of the cyclones in 2022, for instance, Madagascar procured a financing package amounting to 415 million dollars from the World Bank to facilitate a post-disaster recovery initiative estimated at nearly one billion dollars (Ben Ahmed 2022). This external financial assistance was imperative for the rehabilitation of compromised infrastructure, the restoration of access to essential services, and the support of displaced households; furthermore, the 2022 Supplementary Finance Laws explicitly recognized that heightened external borrowing was essential to address the escalated social and infrastructural demands associated with the consequences of the cyclones. Concurrently, humanitarian efforts necessitated an unprecedented mobilization of resources: the 2022 Flash Appeal garnered 309.6 million dollars out of the 385.4 million dollars required to effectively respond to the intersecting crises of drought and cyclone (Government of Madagascar 2021). These expenditures, while indispensable for alleviating immediate disaster repercussions, exacerbate a structural vulnerability when they are habitually financed through debt instead of resilient domestic revenue streams. As articulated in the IMF's 2023 Country Report for Madagascar, the public investment prerequisites after shocks have persistently surpassed fiscal capacity, culminating in recurrent modifications to the fiscal framework (IMF 2023). The inflexibility that ensues from these obligatory

expenditures constrains the opportunities for long-term developmental investment and further undermines macroeconomic stability.

2. External Borrowing as a Response to Climate-Driven Budgetary Gaps

Madagascar's extreme vulnerability to climate shocks is not solely evidenced by the expansion of fiscal deficits; it concurrently perpetuates an ongoing cycle of reliance on external borrowing to mitigate the fiscal shortfalls exacerbated by recurrent disasters (Azam et al. 2024; Haque et al. 2016). In instances where cyclones, droughts, or floods occur, the government encounters immediate financial demands that considerably surpass domestic capabilities, thereby instigating a systematic inclination towards multilateral lenders such as the International Monetary Fund (IMF) and the World Bank. This trend was particularly pronounced in 2022, when the catastrophic repercussions of Cyclones Batsirai and Emnati necessitated nearly one billion dollars in recovery expenditures, with 415 million dollars being sourced through the support of the World Bank (Bank 2022). The role of IMF financing has been supplementary, particularly through the Extended Credit Facility (ECF) programs sanctioned in 2021 and 2023, which aimed to stabilize the balance of payments and facilitate the maintenance of critical public spending in the wake of climate-induced upheavals (IMF 2023). These measures illuminate the degree to which climatic shocks influence

Madagascar's financial strategy, effectively binding the nation into a reactive borrowing framework where external loans emerge as the predominant mechanism for addressing abrupt fiscal deficiencies.

This dependence on external financing is closely aligned with the theoretical framework articulated in Mele's (2021) exploration of deficit cycles; wherein governmental entities typically opt to maintain expenditure levels rather than implement domestic adjustments when borrowing conditions are advantageous (Mele 2021). Madagascar's debt trajectory exemplifies this phenomenon with remarkable precision: despite the accumulation of external public and publicly guaranteed (PPG) debt, which escalated from 2.3 billion dollars in 2013 to 4.5 billion dollars in 2023, the marginal cost of borrowing has remained minimal due to the presence of concessional interest rates and extended maturities (IMF 2024a). As evidenced by data from the World Bank, the proportion of debt service relative to export earnings has exhibited relative stability, even as the total debt nearly doubled; this divergence serves to bolster Mele's assertion that debt accumulation persists as long as its short-term macroeconomic impact is deemed manageable. This trend is further substantiated by recent data indicating that, between 2015 and 2023, Madagascar's external debt stock surged by nearly 100 percent while debt service escalated at a more moderated rate, illustrating the mitigating influence of substantially concessional

multilateral financing. Mechanisms such as the IMF's Catastrophe Containment and Relief Trust (CCRT) and the World Bank's Crisis Response Window (CRW) occupy a pivotal role in this interplay by offering post-disaster liquidity that is crucial in the short term yet exacerbates long-term indebtedness. With over 60 percent of external public debt owed to multilateral creditors as of 2023, the structural composition of the nation's debt is increasingly influenced by the availability of concessional financing, as well as by susceptibility to fluctuations in donor priorities, global interest rates, or geopolitical shifts (Bank 2025). While this borrowing strategy is essential for addressing immediate climate emergencies, it raises significant concerns regarding long-term sustainability, as Madagascar remains at moderate risk of debt distress, with external shocks identified as the primary exacerbating element. Absent a transformation in the climate finance architecture towards a more grant-oriented support model, the trajectory of the country's external debt is likely to continue ascending in concordance with increasing environmental vulnerabilities, thereby intensifying the accumulation cycle articulated by Mele (Mele 2021).

3. Sovereign Risk Perception and the Rising Cost of Debt Servicing

The Madagascar's increased vulnerability to climatic shocks increasingly influences the way global investors assess its sovereign

creditworthiness, thereby contributing to an upward trajectory in the marginal cost of borrowing in recent years. (Republic of Madagascar 2023) Extreme meteorological phenomena, such as tropical cyclones and extended periods of drought, do not merely disrupt economic operations; they also precipitate budgetary deficits, diminish external revenue streams, and compromise macroeconomic stability. As reported by the IMF (2025), the repercussions of recurrent climate shocks are already evident in fiscal projections, with external public debt anticipated to escalate to 41.6 percent of GDP by 2026, while the debt service-to-export revenue ratio has surged from 13.1 percent in 2022 to 17.5 percent in 2023, thereby signifying increasing strains on external accounts (IMF 2025a). The underlying mechanism characterized by this trend corroborates the conclusions of Kling et al. (2018), who assert that nations with significant exposure to climate-related perils encounter elevated sovereign spreads, as lenders recalibrate their expectations even in the absence of substantial deterioration in macroeconomic fundamentals (Kling et al. 2018). In this context, the premium that Madagascar incurs on international borrowing cannot be solely attributed to deficiencies in fiscal management; rather, it constitutes a financial sanction linked to climate-induced vulnerabilities that undermine sovereign credibility. The conduct of credit rating agencies further reinforces this phenomenon. Despite Madagascar's irregular issuance of Eurobonds, the 2023 issuance of 420 million dollars in

private, non-guaranteed external loans, predominantly short-term commercial instruments illustrate a prudent diversification of financing sources. These borrowings, executed without sovereign guarantees, were likely priced at elevated rates due to environmental, political, and repayment uncertainties (IMF 2024a). Zenios (2024) frames this dynamic as a climate-debt doom loop, a self-perpetuating cycle wherein climate shocks instigate financial distress, which consequently constricts borrowing conditions, further inhibiting the state's ability to meet existing obligations (Zenios 2024). As disasters proliferate in frequency, investor confidence simultaneously diminishes, engendering an environment where escalating borrowing costs are intrinsically linked to climate exposure as well as to traditional economic indicators.

These shifting perceptions of risk have exacerbated Madagascar's reliance on multilateral institutions, such as the International Monetary Fund (IMF) and the World Bank, which currently serve as the primary sources of long-term external financing for the nation. By the year 2023, official creditors constituted nearly 89 percent of the long-term external debt, with multilateral lenders alone accounting for over 70 percent of the aggregate, particularly through mechanisms such as the Extended Credit Facility (ECF) and the Resilience and Sustainability Facility (RSF) (IMF 2025b). While these financial instruments provide concessional terms, they increasingly impose policy conditionalities that

influence domestic economic governance, including automatic adjustments in fuel prices, commitments to fiscal consolidation, and restructuring mandates for state-owned enterprises such as JIRAMA. Mele (2021) posits that governments facing fiscal constraints tend to postpone internal adjustments for as long as concessional external resources remain available, and Madagascar exemplifies this rationale: reforms are frequently implemented in a gradual manner and under the compulsion of donor pressures instead of through proactive institutional discipline (Mele 2021). Concurrently, the expense associated with servicing external debt is escalating in real terms. Interest payments on external public debt more than doubled from 2019 to 2023, reaching 47.9 million dollars compared to 22.8 million dollars in 2017, despite the country's limited engagement in private capital markets. This trend is indicative of increased debt volumes, a greater dependence on short-term private borrowing, and the overarching tightening of global liquidity conditions that have diminished the generosity of concessional financing. The IMF (2025) cautions that this accumulating interest burden threatens to constrain vital public investment, particularly in sectors such as climate adaptation, infrastructure, and human capital (IMF 2025b). This scenario aligns with Mele's (2021) theoretical framework, wherein escalating debt servicing costs gradually undermine the productive capacity of the state, ultimately leading to long-term stagnation in the provision of public goods (Mele 2021). At a

structural level, Madagascar's situation illustrates the limitations inherent in the existing international financial architecture, which continues to evaluate low-income nations utilizing classical debt indicators that fail to account for the fiscal repercussions of recurrent climate-related disasters. Although global dialogues regarding climate-contingent debt instruments and debt-for-climate swaps are progressing, Madagascar has yet to benefit from these frameworks due to restricted market access and a precarious credit profile. As Mele (2021) underscores, the lack of creditor adaptation to climate vulnerability restricts nations like Madagascar to debt trajectories that are influenced more by external environmental shocks than by excessive domestic expenditures (Mele 2021). This predicament necessitates a reconfiguration of global financing regulations to more effectively incorporate the costs associated with climate fragility, particularly for nations grappling with escalating debt burdens that stem from vulnerabilities they did not instigate.

4. Structural Dependence and the Delayed Onset of Fiscal Adjustment

Madagascar's structural reliance on external financing exacerbates the propensity to defer fiscal adjustments; moreover, this phenomenon becomes increasingly entrenched as climate shocks recurrently disrupt reform schedules and reinforce the state's

dependence on multilateral assistance. The previously described cycle is intensified by the evolution of IMF arrangements into the predominant stabilizing mechanism for the nation, influencing not only fiscal policy decisions but also the pace of reform initiatives. The successive Extended Credit Facility (ECF) programs sanctioned in 2021 and 2024, in conjunction with the Rapid Financing Instrument (RSF) arrangement, enabled the government to alleviate expenditure pressures stemming from disasters without necessitating abrupt domestic fiscal adjustments (IMF 2021). Nonetheless, this incremental approach has resulted in a fiscal environment wherein external borrowing consistently supplants internal consolidation efforts, propelling public debt towards the 53.5 percent of GDP threshold anticipated for 2026 (IMF 2024b). The protracted execution of reforms, such as the implementation of automatic fuel pricing or the restructuring of JIRAMA, illustrates how political incentives and social vulnerabilities intersect to postpone consolidation as long as concessional financing remains accessible. This aligns closely with Mele's conceptualization of delayed austerity, wherein governments strategically defer expensive reforms until external circumstances render adjustments imperative (Mele 2021).

The consequences of this deferred adjustment become increasingly apparent when scrutinizing the more extensive fiscal

framework. The observation that external borrowing and grants collectively constituted over five percent of GDP in 2023 indicates an institutionalized reliance that stabilizes the financial plan yet diminishes long-term robustness. Social expenditures, encompassing nutritional assistance and educational as well as healthcare services, have been largely safeguarded due to the ongoing financial contributions from external partners (Sakuragawa & Sakuragawa 2020). However, this safeguarding is tenuous, as it is inherently reliant on the priorities of donors and the broader geopolitical landscape. The unpredictability of climate-related disruptions exacerbates this vulnerability by necessitating recurrent reallocations of fiscal resources toward emergency interventions, detracting from structural investments. The delay in implementing fiscal reforms after cyclones Emnati and Batsirai exemplifies how environmental disturbances directly influence the sequencing of macroeconomic policies, rendering austerity politically unfeasible even when previously agreed upon with creditors (IMF 2024c). In this regard, environmental disruptions serve both as a catalyst and justification for continued external dependence, thus reinforcing the fiscal inertia that Mele denotes as a precursor to long-term debt unsustainability. Absent a transition toward more robust domestic revenue generation, adaptive investments, and innovative climate financing mechanisms, Madagascar faces the peril of remaining ensnared in a trajectory where vulnerability fosters dependence, and

dependence accelerates debt accumulation, progressively undermining fiscal sovereignty and constricting the scope for independent policy formulation.

Conclusion

This study demonstrates that climate change has emerged as a pivotal determinant of fiscal instability and external indebtedness in Madagascar. Recurrent environmental shocks, notably cyclones, droughts, and floods, escalate public expenditure while simultaneously diminishing state revenues, engendering enduring fiscal deficits that are predominantly financed through external borrowing mechanisms. Over time, this phenomenon has exacerbated a structural cycle of dependency, wherein each significant calamity contributes to debt escalation and constrains fiscal elasticity. Although international financial instruments provide indispensable assistance for recovery, their loan-oriented characteristics frequently exacerbate long-term indebtedness instead of fostering resilience. Additionally, the perception of elevated sovereign risk associated with climate susceptibility amplifies borrowing costs and restricts fiscal capacity. The ongoing dependence on external aid, coupled with the protracted implementation of fiscal reforms, intensifies these vulnerabilities, hindering the establishment of a self-sustaining fiscal framework. Addressing this issue necessitates a comprehensive approach that amalgamates climate

adaptation, debt management, and institutional reform. For Madagascar, bolstering domestic revenue mobilization, enhancing expenditure efficiency, and establishing contingency funds are critical measures for diminishing reliance on external financing. At the macroeconomic level, reforming climate finance to encompass debt-for-climate swaps, resilience bonds, and grant-based instruments is essential to ensure that assistance for vulnerable economies fosters sustainable development, rather than perpetuating financial instability.

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Declaration of Conflict Interest

The Author declare that there is no conflict of interest regarding the publication of this article.