Paris School of Economics (P.S.E) – Master 2 PPD

Natural Resources and Development: Reading on

"LA CONDITION TROPICALE." by Francis Hallé.

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1 Summary

Francis Hallé, a botanist and expert on tropical rainforests, presents in *La Condition Tropicale* an exploration of the intertropical zone. He employs a multidisciplinary perspective that bridges astronomy, climatology, biology, economics, and anthropology. The book delves into the distinctive traits of this region, its extraordinary biodiversity, and the socio-economic challenges it faces in a world largely shaped by Western viewpoints. Hallé begins by anchoring the tropics within a strictly astronomical framework. The intertropical belt, bordered by the Tropics of Cancer and Capricorn ($23^\circ \quad 27'$ latitude north and south), is uniquely characterized by its exposure to direct vertical solar radiation. The stability of day and night lengths (photoperiod) and the absence of marked seasonal changes create an environment distinct from the mid-latitudes, where seasonal variations dominate. This climatic steadiness positions the tropics as a global energy driver. Solar energy absorbed in this zone powers atmospheric and oceanic currents, significantly shaping global climates. The tropics also receive some of the heaviest rainfall on the planet, particularly in areas such as the Amazon and Congo basins. Tropical biodiversity, whether in rainforests or coral reefs, reaches unparalleled levels. Hallé emphasizes that the tropics are the evolutionary cradle of major biological groups, from flowering plants to mammals. The ecosystems here, shaped by intricate co-evolution among species, exhibit a complexity that challenges the limits of scientific understanding. In the tropical canopy, species density and diversity are at their peak. Similarly, coral reefs, concentrated within this zone, are the richest marine ecosystems, boasting dense yet fragile biomass. Both environments are critically endangered by deforestation, climate change, and human pollution. Modern humans, originating from Africa's tropical regions, developed within an environment teeming with biodiversity. This origin continues to influence the livelihoods of tropical populations, who remain deeply reliant on local natural resources and practical knowledge honed over generations. Hallé's photoperiod hypothesis suggests that variations in day length affect human behavior. In the tropics, the constancy of the photoperiod encourages societies to adopt a cyclical conception of time, contrasting with the linear perception prevalent in mid-latitudes. This difference may shed light on specific cultural and economic traits of tropical societies, such as their attachment to tradition and communal resilience. For the author, economic disparities are strongly linked to latitude. Tropical nations have historically been exploited by mid-latitude powers through colonization and slavery. These injustices have left enduring scars, exacerbated by globalized economic systems that reinforce inequalities. He also critiques the failures of international aid and globalization. Rather than narrowing the gap, these efforts have frequently benefited local elites or multinational corporations. The substantial migration from

tropical regions to wealthier latitudes directly results from these growing inequalities. Traditional tropical agriculture, particularly agroforestry, stands out as a sustainable model. It starkly contrasts with the monocultures imposed during colonization by preserving biodiversity and employing ecosystem-friendly methods. He also advocates for greater recognition and promotion of these practices, which provide viable solutions to global ecological and food crises. Ultimately, *La Condition Tropicale* is a compelling call to reimagine the tropics. Hallé urges a reassessment of their ecological and cultural significance and advocates for acknowledging their past and ongoing contributions. He challenges the unsustainable Western economic models and presents their limitations in addressing planetary-scale issues.

2 Mechanism: The Photoperiod Hypothesis and Its Implications

One of the most thought-provoking concepts Francis Hallé presents in *La Condition Tropicale* is the photoperiod hypothesis, which posits that the near-constant length of day and night in tropical regions profoundly influences human behavior and societal structures. This idea bridges biological rhythms and cultural tendencies, which offer a novel perspective on how natural environmental factors shape human development and societal organization. He describes the photoperiod as the relative lengths of day and night, as a key environmental parameter that varies significantly with latitude. In tropical regions, the photoperiod remains nearly constant throughout the year, with approximately 12 hours of daylight and 12 hours of darkness. This consistency starkly contrasts with mid- and high-latitude regions, where the photoperiod fluctuates dramatically between seasons, creating long summer days and short winter nights. At the core of this mechanism is the role of the pineal gland, a small structure in the vertebrate brain that regulates the production of melatonin, a hormone linked to sleep-wake cycles and seasonal behaviors. The duration and intensity of light exposure inform the gland's melatonin secretion patterns. In regions with significant photoperiodic changes, organisms including humans develop adaptive behaviors synchronized with seasonal variations. These may include changes in reproductive cycles, hibernation in some animals, and shifts in activity levels. In tropical regions, however, the near-constant photoperiod creates a different set of conditions. The absence of strong seasonal cues results in a weaker synchronization of behaviors to annual cycles. This, the author argues, fosters a cyclical perception of time rather than a linear one, profoundly influencing how tropical societies organize their activities, interact with their environment, and structure their economies.

The cyclical notion of time in tropical regions, shaped by the unchanging photoperiod, contrasts sharply with the linear time perception prevalent in mid-latitude societies. In temperate zones, the stark division of the year into productive and dormant seasons due to variations in daylight and temperature has historically encouraged the accumulation of resources and the planning of activities across extended timeframes. This has reinforced behaviors like saving, long-term investment, and a focus on individual productivity, which are hallmarks of industrialized economies. In tropical societies, by contrast, the constancy of the environment fosters a more immediate engagement with daily cycles and natural rhythms. Hallé highlights how this cyclical time perception aligns with traditional subsistence economies, which often prioritize local sustainability and communal well-being over accumulation. Practices like agroforestry exemplify this mindset, where diverse crops are cultivated in harmony with natural ecosystems rather than being replaced with intensive monocultures designed for export. Hallé acknowledges that the photoperiod hypothesis challenges deeply entrenched assumptions, particularly in Western academic and economic paradigms. The idea that environmental factors like light cycles could significantly influence human behaviors and societal structures is often dismissed as deterministic. Critics argue that cultural and historical variables play a far greater

role in shaping societies than natural conditions. However, Hallé contends that the photoperiod hypothesis does not negate human agency or cultural evolution; rather, it provides a lens through which to understand broad patterns and tendencies. For instance, the absence of strong seasonal cues in tropical regions may help explain the slower pace of technological and industrial revolutions compared to mid-latitude societies. It also sheds light on the communal orientation of tropical societies, where traditions and collective decision-making often outweigh individualistic pursuits.

To conclude, Hallé advocates for a reevaluation of human systems to adapt to climate change, emphasizing the need for flexible, cyclical approaches to resource management, akin to those in tropical regions. His photoperiod hypothesis highlights the integration of ecological and biological insights into economic and political frameworks, promoting policies that respect regional differences over universal solutions. In *La Condition Tropicale*, Hallé's interdisciplinary exploration—spanning biology, astronomy, anthropology, and economics—demonstrates how natural rhythms like day length profoundly influence ecosystems, behaviors, and civilizations. This perspective challenges the dominance of Western paradigms, urging a deeper appreciation of environmental and cultural diversity.

3 Research Proposal

In his work, the author posits that the unique stability of tropical photoperiods may influence economic outcomes by shaping productivity cycles and human behavior, productivity patterns, and, consequently, economic outcomes. Despite extensive research on climatic factors like temperature and rainfall, the economic impact of photoperiod stability in tropical regions remains largely unexplored. This research aims to quantitatively test whether photoperiod stability directly or indirectly impacts economic growth. Specifically, the research question is: *To what extent does photoperiod stability affect GDP growth and sectoral productivity, particularly in agriculture and services, in tropical economies?*

The hypothesis rests on the premise that stable photoperiods foster consistent biological rhythms, shaping economic activities such as agricultural cycles, labor productivity, and long-term planning. Conversely, regions with pronounced seasonal changes face productivity fluctuations tied to the variability of daylight hours, which may impose adaptive challenges[1]. Understanding these dynamics could unlock insights into region-specific growth disparities, particularly in tropical economies that have historically been overlooked in global economic frameworks.

To empirically investigate the proposed hypothesis, the research employs panel data analysis and causal inference methods. Fixed effects are included to account for unobserved country-specific factors The relationship between photoperiod stability and economic outcomes will be evaluated using the following panel regression model:

$$y_{i,t} = \alpha + \beta_1 \text{Photopériode}_{i,t} + \beta_2 X_{i,t} + \lambda_i + \delta_t + \epsilon_{i,t}$$

Where, $y_{i,t}$: Economic outcome (e.g., GDP per capita, economic growth rate) for country i in year t, $\text{Photopériode}_{i,t}$: Proxy for photoperiod stability derived from latitude and solar exposure data, $X_{i,t}$: Vector of control variables, including governance quality, R&D investment, infrastructure, and educational attainment, λ_i: Country fixed effects capturing unobserved, time-invariant heterogeneity (e.g., cultural or institutional factors), δ_t: Year fixed effects accounting for global economic trends or shocks (e.g., financial crises), $\epsilon_{i,t}$: Error term.

[1] Jeffrey D. Sachs (2001). *Tropical underdevelopment*

To isolate the effect of photoperiod stability amidst other climatic factors, the Difference in Difference method will exploit climatic shocks. Climatic shocks such as El Niño[2] alter rainfall and temperature patterns[3] without affecting photoperiod, offering a quasi-experimental setting to isolate the impact of photoperiod stability on economic performance as quasi-natural experiments. These events disrupt temperature and precipitation patterns without altering underlying photoperiod stability. The model compares tropical countries ($\text{Tropical}_i = 1$) to temperate ones before and after such shocks:

$$y_{i,t} = \alpha + \beta_1(\text{Post}_t \times \text{Tropical}_i) + \beta_2 X_{i,t} + \lambda_i + \delta_t + \epsilon_{i,t}$$

Where,Post_t: Indicator variable for the post-shock period and Tropical_i: Dummy variable indicating whether the country is tropical. This approach will help to capture the differential impact of climatic shocks on economic outcomes while controlling for broader economic trends.

To address endogeneity concerns, such as reverse causality between economic performance and environmental factors latitude (Latitude_i) will be used as an instrument for photoperiod stability. Latitude serves as a natural proxy for photoperiod stability, as it determines solar exposure patterns. We will validate this instrument by checking its correlation with agricultural cycles and its exogeneity regarding economic outcomes. The estimation follows a two-stage least squares (2SLS) approach:

First Stage: Predict photoperiod stability:

$$\text{Photopériode}_{i,t} = \gamma_0 + \gamma_1 \text{Latitude}_i + \gamma_2 Z_{i,t} + \nu_{i,t}$$

Where $Z_{i,t}$ includes other exogenous controls, such as infrastructure quality and labor market characteristics. *Second Stage*: Estimate the effect of predicted photoperiod stability:

$$y_{i,t} = \alpha + \beta_1 \hat{\text{Photopériode}}_{i,t} + \beta_2 X_{i,t} + \lambda_i + \delta_t + \epsilon_{i,t}$$

This strategy isolates the exogenous variation in photoperiod stability attributable to latitude, mitigating bias from omitted variables.

This study bridges environmental sciences and economics, offering empirical evidence on how natural factors, such as photoperiod stability, influence economic outcomes. Policymakers could leverage these findings to design tailored strategies for tropical economies, such as aligning agricultural planning with predictable solar patterns or investing in renewable energy. In fact, it presents photoperiod stability as an overlooked yet potentially significant factor that influences economic -activities, such as temperature and precipitation effects. The findings can inform policymakers in tropical regions about how to leverage stable solar cycles to optimize agricultural planning, labor productivity, and renewable energy strategies. These insights could also help design interventions to mitigate structural challenges faced by tropical economies. The study also supports global objectives like (SDG 8) as it promotes sustainable economic growth by identifying opportunities tied to natural advantages.(SDG 10) in the sense of reducing inequalities by addressing structural barriers specific to tropical economies. And, (SDG 13) to develop climate-responsive strategies that integrate natural patterns into economic planning. The results can guide (international development agencies, NGOs, and investors) in prioritizing resource allocation and projects in tropical regions. For example, initiatives that support climate-resilient agriculture or solar energy infrastructure could be particularly impactful.

[2] Climate-change vulnerability in rural Zambia: the impact of an El Niño-induced shock on income and productivity

[3] Dell, M., Jones, B. F., & Olken, B. A. (2012). Temperature Shocks and Economic Growth. *American Economic Journal: Macroeconomics.*