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The challenge of sustainability of the Moroccan Argan grove: a neo-institutional analysis

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ABSTRACT

This paper aims to analyze several issues related to the argan grove as a product of human construction and institutional arrangements. Despite its renowned resilience to drought, this ecosystem has experienced a decline due to various anthropogenic factors. Its contribution to ecological balance and biodiversity preservation has been seen to gradually slow down. Faced with the weight of various stakeholders' private interests involved in forest exploitation, informal forest governance institutions have gradually collapsed. At the same time, the existing relatively weak formal institutions have been inadequately effective in replacing the old ones. In addition, they were not renewed to adapt to the new situation of protecting the argan tree ecosystem. An institutional breakdown then occurred, paving the way for new irresponsible behaviors and harmful practices for the forest.

Keywords Argan grove, Sustainability, Biodiversity, Governance, Neo-Institutional

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1. Introduction

The Argan grove [1] is an original forest ecosystem located in the arid and semi-arid zones of South West Morocco. This ecosystem has long played a vital role in ensuring ecological balance and preserving biodiversity. It has always contributed to maintaining the fertility of the soil, the sustainability of flora, fauna and people (aligned with goals 15 and 2 of the MDGs). It also offers substantial usufruct entitlements to local populations. Such rights include picking Argan fruit, growing cereals, grazing livestock, gathering wood and collecting building materials.

Despite its strategic importance, the argan tree ecosystem is highly fragile and vulnerable to external threats. Approximately 600 hectares of argan grove are lost each year, leading to a significant reduction in the tree density. In less than a century, over half of the forest has vanished, and the average density of trees per hectare has dropped from 100 to 30 (M'hirit *et al.*, 1998). In reality, this ecosystem exhibits a high level of resilience to drought. Its degradation can only be attributed to long-term human impact on the natural environment. This pressure is largely caused by logging, deforestation, intensified agriculture, and overgrazing by both goats and camels.

In response to this ecologically worsening situation, Moroccan policymakers have historically supported an approach that involves delegating a part of forest governance to informal institutions. However, due to the combined impact of global warming and globalization, the various stakeholders involved have been compelled to disregard the customary rules that have long governed the proper management of the forest. As a result, these friendly informal institutions have gradually vanished, making room for new rules and practices that are hostile and detrimental to the forest.

With this in mind, our objective is to critically reassess the Moroccan governance system concerning the argan tree in the midst of an environmental crisis. The goal is to understand why, despite the expressed political willingness, this hybrid approach to governing the argan grove is no longer functioning effectively.

Our hypothesis is that, beyond external factors, the failure of the governance system for the argan tree in Morocco is related to the gradual decline of informal customary institutions and the inability of formal institutions to fill the gap. This has led to the rapid emergence of new specific customary rules, with all their detrimental consequences for the forest.

For this purpose, we have employed conceptual tools of the so-termed "neo-institutional economics", while relying on a "contextualizing approach". Such a heterodox branch of contemporary economics provides a suitable theoretical and methodological framework for gaining a deeper understanding of the governance systems of the argan grove, as a coùmunity-based resource. Specifically, we draw upon the research works by North (1990) regarding the dual nature of institutions (formal vs. informal institutions), and Helmke and Levitsky (2004), concerning typologies of informal institutions.

Several authors have applied this analytical framework to other contexts where forest landscapes have undergone significant transformations, particularly in Southeast Asia, Latin America, and sub-Saharan Africa. In a systematic review of 197 empirical studies, Kimengsi *et al.* (2023) demonstrated that profound institutional changes have occurred in countries of the Global South. These transformations are evidenced by the formation, reformation, disintegration, and modification of existing institutional arrangements (Kimengsi *et al.*, 2023, p. 308), largely driven by the growing impact of globalization and market pressures on traditional governance systems. Similar conclusions were reached by Friman (2020), Steenbergen and Warren (2018), and Faggin and Behagel (2018).

Focusing on Southeast Asia, Agrawal and Ostrom (2001) underscored the importance of informal institutional arrangements in managing forest resources in India and Nepal. First, these arrangements allow communities to adapt more effectively to local conditions. Communities living near forests often possess a deeper understanding of the distinctive ecological features, seasonal cycles, and conservation needs of their region. Second, local arrangements improve monitoring and control of resource use. When rules are locally established, community members are more motivated to abide by them and to oversee their implementation. The authors highlight that social and geographical proximity enables infractions to be detected more swiftly

and at lower cost. Finally, these local institutional arrangements offer more efficient mechanisms for resolving conflicts that may arise in forest areas.

Drawing on empirical data from 95 forests in the Indian Himalayas, Agrawal and Chhatre (2006) stressed that forest degradation is intimately linked to the weakening of traditional governance institutions, which have historically safeguarded ecosystem sustainability. They argue that such institutions should not be viewed in isolation, but rather as rules interacting with external forces (government and market). They advocate for a balanced approach that recognizes local institutions while simultaneously addressing the broader imperatives of commons management, promoting decentralized and participatory policies suited to each community's specific context.

In Latin America, the study of Pacheco *et al.* (2008) and Larson *et al.* (2019) underscores the central role of informal institutions in forest governance. These studies share the goal of examining how informal institutions interact with formal frameworks under complex socio-economic and environmental pressures. Their findings suggest that communities with strong informal governance systems, functioning in harmony with newly established formal rules, are often better equipped to manage forest resources both sustainably and equitably. Nevertheless, as Léonard *et al.* (2022, p. 592) emphasize, rights formalization initiatives — particularly collective land titling for Indigenous populations — have generated tensions within diverse socio-occupational groups (e.g., farmers, herders, fishermen).

Turning to Africa, Kimengsi *et al.* (2022) reviewed the state of forest institutions across multiple regions of sub-Saharan Africa through a comparative regional analysis. Their results indicate that the transition from a system dominated by informal rules toward a more modern and formalized framework remains incomplete. This dualistic situation poses significant governance challenges, especially conflicts between customary law and modern legislation. A similar dynamic was observed by Ashu (2016) in Cameroon, where discrepancies between official and customary regulations frequently generate conflicts of legitimacy and authority, weakening both forest management efficacy and community participation. However, as Kimengsi and Silberberger (2022) note, such a general conclusion masks important regional variation. In areas influenced by British colonial structures (e.g., Kilum-Ijim), community institutions have remained relatively stable, whereas regions shaped by French colonial legacies (e.g., Santchou) have experienced a disorderly proliferation of institutional frameworks, resulting in overlaps and diminished effectiveness in forest conservation.

The remainder of this paper is structured as follows. Section 2 provides the theoretical background through a neo-institutional analysis of forest governance. Section 3 presents an overview of the Moroccan argan grove, which is seen here and hereafter as an endemic multifunctional ecosystem. Section 4 examines the issue of irreversible degradation of this ecosystem, with a specific focus on the role of anthropogenic factors. Section 5 analyzes the significance of the institutional dimension in understanding the governance failure of the argan grove ecosystem in Morocco. Lastly, the concluding section offers a summary and discusses potential implications for economic policy.

2. Theoretical background: neo-institutional analysis of forest governance

Neo-institutional economics, as a heterodox branch of contemporary economics, provides a suitable theoretical and methodological framework for gaining a deeper understanding of the governance systems of forest ecosystems as community-based resources.

2.1 Formal and informal institutions: what are we talking about?

Although the concept of institutions is quite frequent in the social sciences, its definition varies according to the disciplines or the contexts in which it is used. It remains polysemous, equivocal, and problematic (Loureau, 1970, p. 141). Without claiming to cover all definitional approaches, we focus here on the one developed in the literature on neo-institutional economics. This approach considers the concept of "institution" as "the rules of the game in a society, or more formally, are the humanly devised constraints that structure political, economic, and social interaction" (North 1990, p. 3).

Douglass North establishes a clear conceptual distinction between formal and informal institutions, grounded in two defining criteria:

(1) their degree of formalization (written versus unwritten rules); and

(2) their mechanisms of emergence and evolution.

Formal institutions are deliberately designed, officially sanctioned, and relatively malleable; they can be rapidly implemented or altered through political or legal

processes. In contrast, informal institutions emerge endogenously, reflecting deeply embedded cultural patterns. Their evolutionary trajectory is necessarily gradual, adapting incrementally to changing societal conditions through an organic process that typically lies beyond individual control. Once institutionalized within a society's normative framework, these informal rules exhibit significant path dependence and resistance to change.

When established by the relevant public authorities, formal institutions are made up of three interdependent elements. First, the constitutional and legal framework that defines the respective roles of the State, individuals, and organizations within society while establishing the political system's hierarchical structure. Second, clearly delineated property rights that serve as the foundation for market existence and efficient operation. Third, enforceable individual contracts that operationalize the incentive structures embedded within these property rights.

According to Mantzavinos (2001, pp. 90–92), informal institutions can be classified into three distinct categories:

(1) social conventions;
(2) moral rules; and
(3) social norms.

Social conventions — defined as socially ingrained, implicit, and impersonal patterns of behavior (Reynaud, 2004, p. 83) — emerge from shared justifications and function as solutions to recurrent coordination problems within societies (Lewis, 1969). These conventions reflect the regular pattern in the behavior of members of a society in their search for quick fixes to common and repetitive problems.

Moral rules derive from a set of feelings, ideas, beliefs, and conduct precepts (Durkheim, 2013) which contribute to the construction of socially beneficial behaviors. These rules embody a dual temporal dimension, reflecting both historical and contemporary collective realities that individuals are expected to uphold. As products of social organization, they arise organically as societal members internalize the long-term superiority of cooperative behaviors over self-interested actions (Egorova-Legon, 2013, p. 127).

Finally, social norms refer to "behaviour collectively approved by a group or population and enforced through sanctions" (Bicchieri, 2014, p. 3). By specifying the behavior that each individual must follow, these norms are internalized by individuals and play an integrating role through the values commonly shared and upheld within

society. Their legitimacy is typically derived from the prevailing value system operational in a given social context (Beitone *et al.*, 2009, p. 345).

Helmke and Levitsky (2004) developed a sophisticated typology of informal institutions based on institutional effectiveness and outcome convergence, providing four distinct categories: complementary (enhancing formal rule effectiveness), accommodating (working around constraints without violation), competing (directly contradicting formal rules), and substitutive (replacing ineffective formal institutions). This theoretical foundation proves particularly relevant for analyzing forest ecosystem governance because successful forest management fundamentally depends on the alignment between formal regulatory frameworks and deeply embedded informal practices that govern community resource use (Agrawal and Ostrom, 2001). When applied to forest governance, this typology illuminates how informal institutions can transform from complementary or substitutive arrangements that protect forest resources into competing or parasitic practices that undermine conservation goals (Osei-Tutu *et al.*, 2015). The framework thus offers crucial insights into institutional breakdown processes, where weakening informal institutions fail to constrain opportunistic behavior while formal institutions remain inadequately effective to fill the governance gap, leading to the emergence of what Helmke and Levitsky (2004) term "parasitic" informal institutions that extract benefits while contributing to resource degradation.

2.2 Institutional change and forest governance challenges

Contemporary neo-institutional analysis of forest governance emphasizes transaction costs, institutional design challenges, and the dynamic nature of institutional change processes that shape forest outcomes. Transaction cost economics, as developed by Williamson (1985) and applied to forest contexts, reveals how the specific characteristics of forest resources — particularly asset specificity, uncertainty, and frequency of transactions — create unique governance challenges that often favor hierarchical or hybrid institutional arrangements over pure market mechanisms (Gallemore *et al.*, 2015).

Complementing this approach, Ostrom's (1990) seminal work on common pool resources established design principles for robust forest governance institutions, including clearly defined boundaries, congruence between rules and local conditions, and graduated sanctions, which have been extensively validated in forest contexts through the evolution of her Institutional Analysis and Development (IAD) approach

and Social-Ecological Systems (SES) framework (Cox *et al.*, 2010; Gibson *et al.*, 2005; Ostrom, 2009). However, critical institutionalist perspectives, particularly Cleaver's (2002, 2012) concept of institutional bricolage, challenge rational design approaches by demonstrating how forest governance institutions emerge through creative processes of "patching together" formal and informal arrangements, often producing hybrid governance systems that defy simple categorization (de Koning, 2014).

Institutional change mechanisms, as theorized by Mahoney and Thelen (2010) through their analysis of layering, drift, conversion, and displacement processes, provide crucial insights into how forest governance institutions evolve under political pressure and environmental change, with recent empirical evidence demonstrating how elite capture represents a particularly pernicious challenge, as decentralization increases elite capture risks over time while professional foresters can capture governance processes through technical expertise and regulatory control (Bofill Poch, 2020; Persha and Andersson, 2014). The interaction between formal and informal institutions adds another layer of complexity, with recent studies identifying multiple types of formal-informal institutional interactions — complementary, substitutive, competing, and neutral — that shape forest governance outcomes while revealing how actors strategically combine formal rules with informal practices to create hybrid governance arrangements that may either reproduce or challenge existing power structures (Fleischman *et al.*, 2014; Osei-Tutu *et al.*, 2015).

Additionally, recent advances in institutional change theory have revealed increasingly sophisticated mechanisms through which forest governance institutions adapt to contemporary challenges, with Baggio *et al.* (2016) fundamentally reconceptualizing Ostrom's design principles by demonstrating that configural rather than individual analysis of institutional elements is necessary for understanding governance success, as no single principle proves sufficient across diverse forest contexts.

Critical institutionalist perspectives have further advanced through Cleaver and de Koning's (2015) development of the Critical Institutional Analysis and Development (CIAD) framework, which explicitly incorporates power relations and meaning-making processes while addressing the predominantly qualitative limitations of bricolage studies through Kimengsi and Giessen's (2024) empirical identification of three distinct bricolage manifestations, aggregation, articulation, and alteration, each producing systematically different socio-economic and ecological outcomes. The integration of multi-level drivers including global environmental changes,

technological developments, and market pressures has revealed sequential institutional change patterns where layering precedes conversion, which then enables displacement, with recent evidence from Charmakar *et al.*'s (2024) 45-year analysis of Nepal's community forests demonstrating that endogenous institutions consistently produce positive ecological outcomes while exogenous formal institutions show mixed results, suggesting that successful institutional change increasingly depends on locally-embedded institutional configurations rather than externally-imposed institutional designs (Fischer *et al.*, 2023).

3. The argan grove in Morocco: an endemic ecosystem in central-west Morocco

The argan grove, known as "*Arganeraie*," is a natural ecosystem spreading over the arid and semi-arid regions of central-west Morocco, as well as isolated areas in southwestern Algeria (Morton and Voss, 1987). It covers an area of approximately 800,000 hectares (Msanda *et al.*, 2021). The dominant species in this forest is the thorny, wide-crowned tree Argania spinosa, which plays a crucial role in maintaining ecological balance, combating desertification, and preserving biodiversity.

3.1 A brief description of the argan tree

The argan tree is a significant and indigenous tree characterizing the abundant forest resources of west-central Morocco. One of its characteristics is that it bears thorny branches and a wide crown. It belongs to the order Ebénales and family Sapotaceae (Mezghenni *et al.*, 2014; Chakhchar *et al.*, 2022). At maturity, it can reach a height of up to 10 meters (Chakhchar *et al.*, 2017; Heuzé and Tran, 2020). The argan tree has well-developed, often spreading roots and a lifespan ranging from 125 to 150 years, with some of them living up to 250 years (Chakhchar *et al.*, 2017; Rieuf, 1962, p. 13). Its trunk is short (2 to 3 meters), twisted, and often composed of multiple intertwined stems.

The argan tree is well-known for its resilience, with a good adaptation to climatic changes from the Tertiary era to the present day. It is xerophilous, enabling it to withstand prolonged droughts; this explains its presence in continental areas with arid climates (Chakhchar *et al.*, 2017). Additionally, the argan tree is thermophilic, thriving

in high temperatures of up to 50°C and tolerating slight negative temperatures (Chakhchar *et al.*, 2018; Falasca *et al.*, 2018). However, its distribution is limited to around 1,300 meters in the Anti-Atlas and 900 meters in the High Atlas of Morocco.

Regarding air humidity, some studies reveal that the argan tree is found only slightly inland, beyond 150 kilometers from the Atlantic Ocean (Nouaim, 2005). The argan tree is adaptable to various soil types, including clay, limestone, and siliceous soils, with the exception of loose sand (Aafi and Benabid, 2015). It can even grow in nutrient-poor and slightly saline skeletal soils.

The argan tree can naturally regenerate through seed sowing, which is the most suitable method for maintaining and preserving the argan grove. However, natural regeneration is rare due to the challenging conditions for seed germination, as seeds are enclosed in a hard shell (Boudy, 1952). Furthermore, the systematic collection of the argan fruit by users, herds, and rodents dramatically hinders the regeneration process of the tree. Apart from seedling regeneration, the argan tree can also regenerate naturally through stump sprouting, which continues even at an advanced age (Rahmani and Benmessaoud, 2019). Artificial regeneration is also being increasingly utilized in protected areas such as the Admine forest, located approximately fifty kilometers east of the Moroccan city of Agadir.

The distribution of the argan tree forms a triangular shape, with a coastal segment stretching from north of Essaouira (Oued Tensift) to south of Agadir (Oued Noun), and extending inland towards Taroudant around Aoulouz, west of Jbel Siroua. The largest argan tree stands are mainly located in the northeast of Essaouira, extending to the Souss valley.

3.2 Ecological function and biodiversity of the argan grove

The argan grove serves important ecological functions and supports a diverse range of biodiversity. Ecologically, this forest plays a crucial role in mitigating the impacts of climate change. The argan trees help stabilize the soil, preventing erosion caused by rain and wind. Without the presence of these trees, water would seep into deeper soil layers or flow into the oceans, resulting in a harsh and arid environment. The argan grove thus acts as a protective barrier against desertification in the pre-Saharan regions of west-central Morocco (Karmaoui, 2016).

The argan tree is well-suited for arid and semi-arid regions, making it a valuable resource for sustainable land use practices. Its deep taproot allows it to access

groundwater up to 30 meters deep, which is crucial in areas with limited surface water (Ain-Lhout *et al.*, 2016).

Additionally, the argan tree can recover water due to the presence of microscopic fungi that grow in both the roots and the soil (endomycorrhiza) (Ganoudi *et al.*, 2023; Sellal *et al.*, 2017). Moreover, the argan tree serves a dual purpose in mitigating the effects of climate change. Firstly, it enhances soil fertility by enriching it with nutrients and, importantly, increasing its organic matter content, which aids in carbon sequestration (Naimi *et al.*, 2024). Similar to other trees, the argan tree absorbs CO_2 from the atmosphere and converts it into oxygen and plant material through photosynthesis. The tree's expansive canopy and dense foliage offer shade and encourage moisture retention, creating a microclimate that supports the growth of other plant species.

In terms of biodiversity, the argan grove encompasses a highly diverse ecosystem that serves as a habitat for a wide range of animal and plant species. The fauna in this ecosystem includes numerous mammals and other wild species. The rugged terrain provides a secure environment for significant populations of Cuvier's gazelle and the Barbary sheep (aoudad) that still reside in the wild. Other species, such as wild boar, the African wildcat (Felis lybica, now rare), and the golden jackal (Canis aureus), contribute to the forest's animal population in this region. Moreover, there are more than 83 species of terrestrial birds — including rare birds of prey — about 20 species of water birds, and around 30 species of reptiles and amphibians (Vernon *et al.*, 2005).

The flora in the argan grove is abundant and diverse. The argan tree coexists with over 300 plant species (Msanda *et al.*, 2021), including the Moroccan gum tree (Acacia gummifera), the dragon tree (Dracaena draco), and the date palm (Phoenix dactylifera), as well as aromatic and medicinal plants like sagebrush (Artemisia herba-alba), thyme (Thymus spp.), germander (Teucrium polium), wild sage (Salvia verbenaca), caper (Capparis spinosa), colocynth (Citrullus colocynthis), and lavender (Lavandula spp.). Other species, such as acacias and various Euphorbia, have also been observed in these regions.

3.3 Economic multifunctionality of the argan grove

Beyond its ecological functions, the argan grove in Morocco also has vital economic importance. The forest plays a crucial role in supporting a rural population of approximately 3.5 million people (UNESCO, 2025) by providing them with fruits, fodder, and wood. The fruit of the argan tree is highly prized due to its exceptionally

high oil content. This oil, often dubbed Morocco's "liquid gold", is one of the rarest in the world. It is rich in antioxidants and essential fatty acids, and has been utilized for centuries for culinary, cosmetic, and medicinal purposes (Feedipedia, 2015). Its scientifically recognized benefits include the prevention of cardiovascular disease and positive effects on skin health (Berrougui *et al.*, 2006).

People living in or near the forest utilize the timber from argan trees for various purposes. Due to its hardness, weight, and durability, argan wood is highly valued as structural timber and is considered one of the best ecological insulators for use in hot climates. In addition, its density, lightness, and slow-burning properties make it a popular choice for fuel in the form of charcoal. Locally, the energy yield of argan wood is considered superior to that of other available fuel sources (Benzyane, 1989).

When the soil is left uncultivated, the argan grove serves as a crucial fodder reserve for livestock, especially goats and camels, which graze there throughout the year, even during drought periods (El Aïch *et al.*, 2007). All parts of the argan tree are edible for livestock, including leaves, fruit pulp, undergrowth, and even by-products such as dried pulp and press cake, which are nutritious animal feeds (Fellat-Zarrouk *et al.*, 1987). Furthermore, the residual press cake, known as oilcake, contains fats and proteins, making it an ideal ingredient for fattening cattle (Charrouf, 1999).

In addition to these functions, the forest also serves a socio-cultural purpose. The argan forest is a recreational space for local communities, as well as for tourists and various development stakeholders operating in the region. It is regarded as an intangible cultural heritage of humanity and a traditional source of sustainable and resilient development. This importance has been acknowledged by UNESCO, which designated the endemic argan production area as the Arganeraie Biosphere Reserve in 1998 (UNESCO, 2025), and by the United Nations, which declared May 10th of each year as "International Argan Day" in 2021 (United Nations General Assembly, 2021).

4. The argan grove in Morocco: an endangered ecosystem

In recent decades, the argan forest ecosystem in Morocco has faced increasing degradation due to human activities. This irreversible degradation is fundamentally characterized by the gradual loss and decline of forested areas.

4.1 Overexploitation of the argan grove

Since the beginning of the 21st century, the value of argan products and by-products has experienced a significant increase. The labeling of argan oil and the restructuring of the industry around cooperatives have led to a surge in the prices of argan products, particularly argan oil (Grand View Research, 2024). For instance, the price of a liter of culinary argan oil has risen from 3 dollars in the late 1990s to over 35 dollars in 2022. Cosmetic oil is even more expensive, as a substantial portion of production is intended for export. It is projected that exports will increase from less than 40 tonnes in 2003 to over 1,500 tonnes in 2022 (Office des Changes, 2023).

Increasing demand for raw materials from cooperatives and private companies has resulted in intensified exploitation of the argan trees, accompanied by destructive human practices. This overexploitation has taken the form of deforestation with severe consequences for the natural regeneration of the argan grove. Normally, ripe argan fruits naturally fall to the ground and are collected. However, predatory harvesting involves violently knocking down the fruits from the trees, causing damage to flower buds and blossoms, and leading to injury and disease as sticks are used to hit the branches. The rate at which argan fruits are harvested exceeds the trees' natural regeneration rate, which is already low or non-existent. These actions contradict the

traditional agro-sylvo-pastoral systems and the local governance model of the argan tree (Simenel *et al.*, 2009), effectively transforming local populations into agents of destruction (Faouzi and Martin, 2014).

Additionally, the flora in areas dominated by the argan grove has faced significant pressure due to overgrazing. The local population, whose history and culture are closely tied to goat herding, have customary rights to utilize forest resources. However, the number of goats has increased substantially, leading to a detrimental impact on the vegetation, especially young argan trees. Goats feed on the foliage of the trees and other shrubs that are vital components of the forest ecosystem's structure. Young argan shoots, with their delicate and unprotected leaves and stems, are particularly vulnerable to being consumed by goats. These agile animals are well-known for their ability to climb trees to reach the highest leaves (Feedipedia, 2024). Additionally, goats contribute to soil degradation by damaging other shrub and herb species and trampling on argan seedlings.

The issue of overgrazing is exacerbated by the progressive reduction of fallow land and the recurrence of drought cycles. The sale or movement of livestock from areas severely affected by drought adds to the already excessive grazing pressure in regions with relatively better water resources. Transhumant camel herds also contribute significantly to this grazing pressure. As early as the beginning of the 21st century, the overall load on the pastoral land in the argan forest was estimated to be between 1.5 to 4 UBP/ha (Unité Bétail Tropicale per hectare), depending on the forest zone — nearly three times the sustainable carrying capacity (Bouzemouri, 2007). Presently, the situation is likely even more concerning. Despite being illegal, this excessive pastoral activity is often tolerated due to the strong influence of herd owners, who are typically powerful individuals (senior civil servants, businessmen, parliamentarians, local elected officials, political figures, tribal leaders, and major traders in southern Morocco) (Boubrik, 2022, p. 8).

Excessive timber harvesting is another factor contributing to the overexploitation of the argan grove. While cutting down argan trees is not as common as it once was, wood collection continues to contribute to deforestation and forest degradation. Overharvesting wood also hampers the natural regeneration process. The imbalance between the argan grove's natural wood production potential (approximately 350,000 m^3/year) and the actual extraction (around 1,150,000 m^3/year, which is over three times its potential) inevitably results in the depletion of the forest's wood resources (Charrouf, 2007, p. 17).

4.2 Forest clearance

The argan forest ecosystem is severely impacted by the clearing of land for agricultural expansion, especially in areas where arable land is limited. Although this practice is a violation of forestry laws, it is widely tolerated by public officials (Laaribya, 2017). Both local community members — who hold traditional usage rights — and large-scale farmers engage in forest clearing to gain new agricultural lands.

Taking advantage of the authorities' leniency, small farmers have entered into a competition to clear land and claim ownership of it. This has led to an increase in individual or family appropriation of what used to be collective or state-owned land. As a result, traditional practices like crop rotation have been abandoned by local small-scale farmers in favor of continuous cultivation. They often prioritize water-intensive crops and remove argan trees to facilitate mechanized agriculture.

The argan grove is also facing a newer form of clearing by large agribusinesses. Starting in 1983, some large-scale farmers were granted permission to cultivate intensive citrus orchards and commercial vegetable crops for export on argan land. In the plain of Houara, for instance, countless argan trees were cut down in the 1980s to make way for citrus groves. Some of the communal argan lands were privatized through dubious means. In addition to depleting the water table at an alarming rate, the industrial agriculture practiced on these reclaimed lands has led to the irreversible destruction of crucial biodiversity (flora and fauna) that underpins sustainable development in the affected areas (Assab, 2024).

Clearing the argan grove has numerous consequences for the ecosystem. The most evident consequence is the threat it poses to biodiversity. As noted earlier, the argan grove is a habitat that supports a diverse range of plant and animal life. Human activities that destroy this natural environment put many of these species at risk. Additionally, clearing the forest weakens the soil. In a healthy state, the forest enriches the soil with organic matter and makes it more resistant to weathering and erosion. When a forested area is destroyed, the soil gradually becomes more fragile, leaving the ecosystem more susceptible to natural disasters like landslides or floods. Lastly, the destruction of argan trees significantly reduces the ecosystem's capacity to store CO_2, undermining its role in carbon sequestration (Naimi *et al.*, 2024).

4.3 Uncontrolled urbanization

Urbanization is another significant threat to Morocco's argan forests. Typically, when considering urbanization, one imagines the expansion of cities, towns, and villages

into previously forested regions. However, the development of human infrastructure such as roads, bridges, and airports also contributes to the degradation of the argan tree's natural habitat by fragmenting and reducing forest cover.

Urban expansion and the conversion of land to built environments are gradually causing the disappearance of argan trees and other associated plant and animal species. Moreover, the proliferation of infrastructure leads to the fragmentation of natural habitats, creating isolated pockets of biodiversity. Consequently, some species are unable to find sufficient territory or food and face local extinction, while others, freed from their natural predators, may proliferate and become invasive. This observation aligns with the empirical findings of other authors, such as Allen and Barnes (1985) and Tole (1998), in the context of developing countries.

A case in point is the rapid expansion of the city of Agadir on the Souss plain, which has encroached upon areas once occupied by argan forest. Since the relocation of the Agadir airport to an 815-hectare site within the forest in 1991, numerous industrial zones, residential districts, major infrastructure projects, and even informal settlements (such as the quarter of Kliaa) have gradually replaced argan stands. In the province of Chtouka Aït Baha, the construction of a new cement factory near the rural commune of Imi M'Korne led to the uprooting of many hectares of argan trees. Similarly, in the Agadir Ida-Outanane prefecture, thousands of argan trees were cleared to build the initial section of the Agadir-Marrakech highway in the rural commune of Amskroud. The construction of the Agadir–Taroudant expressway, which cuts through the Admine forest via Al Massira airport, has also resulted in the destruction of extensive areas of argan trees.

It should be noted that while the affected forest areas may not have been densely covered with argan trees, the failure to replace the felled trees raises serious ethical and environmental concerns. Despite the state's efforts to discourage local residents from cutting down trees, it paradoxically partakes in this disrespectful act toward nature when pursuing public works. Civil society, which ideally should advocate for forest protection, has remained insufficiently engaged — partly due to disorganization and, more significantly, due to its subordination to political power structures.

5. Understanding the governance failure in Morocco's argan forest ecosystem: an institutional response

As we outlined in Section 2, the term "institutions" is used here to refer to the humanly devised constraints that structure the interactions among the different stakeholders involved in the exploitation of the argan forest, whether directly or indirectly. Such rules consist of both informal constraints (morals, taboos, customs, traditions, belifs and codes of conduct that transcend generations), and formal rules (written constitutions, laws, property rights and regulations enforced by official authorities). The purpose of these institutions is to establish order and define the guidelines for sustainable and inclusive governance.

5.1 Inefficiency and ineffectiveness of formal institutions

The argan grove ecosystem is unique and distinct from other types of forests in Morocco. This distinctiveness is reflected in the specific forestry regulations that apply to it, particularly the Royal *Dahir* (decree) of 1925. This law established the principle of the State's superior right over the Arganeraie while also guaranteeing the rights of local populations to enjoy its resources. According to this decree, these rights are exclusively reserved for the indigenous tribes and communities who have traditionally utilized the argan groves (Romera *et al.*, 2021). These rights encompass activities such as collecting dead wood, harvesting fruit, grazing livestock, cultivating the land, gathering firewood, producing charcoal and timber, cutting branches for fencing, and extracting earth, sand, and stone.

In contrast to these extensive usage rights, the restrictions imposed in the name of ecosystem protection are relatively limited and, more significantly, ambiguous. Thus,

the argan ecosystem can be described as quasi-privatized, governed by formal rules that are exceedingly generous and lenient toward local use. It is important to acknowledge that these rules were established nearly a century ago in a very different context. At that time, population density was low, urbanization was minimal, climatic conditions were generally favorable, and — most notably — the colonial administration aimed to appease nationalist sentiments among indigenous populations to reduce the risk of uprisings against the French protectorate. (As evidence of this, the architects of the law intended for its implementation to occur gradually and only in regions where the political situation would permit it.)

Interestingly, since independence, the Moroccan government has made no effort to revise the 1925 *Dahir* to strengthen its provisions, despite the ongoing deterioration of the argan grove. In our view, this inertia can be attributed to the emergence or reinforcement of rent-seeking behavior. The primary actor capturing this rent is the State itself, which exploits the notion of serving the "general interest" to justify the annual felling of thousands of argan trees. This is done to accommodate urban expansion and to create space for public infrastructure projects such as dams, airports, highways, roads, and industrial zones (IWGIA, 2023). Another group of rent seekers consists of large transhumant camel herders, who exploit the forest's grazing lands by asserting a historical right to share these natural pastures with local communities. However, the increasing size of their camel herds is causing significant damage to the entire ecosystem. The rapid mobility of these herds and their extensive use of grazing areas affect not only land cover but also vegetation density and condition (Moukrim *et al.*, 2019). These new camel owners form a powerful and cohesive interest group originating from the Saharan regions. They receive implicit support from the government, even when conflicts frequently arise between them and the local population. These herders often seek — illegally — to extend their grazing territory without regard for the forest's ecological capacity or the rights of local villagers.

A final group of argan rent seekers comprises argan oil extractors. Traditionally, oil extraction was carried out by local villagers, often organized into cooperatives (the only form of organization permitted by the government for this activity). However, the international success of argan oil has attracted numerous entrepreneurs who circumvent the spirit of the law by setting up ostensibly cooperative enterprises that are mostly composed of phantom members. These new private investors procure their argan fruit supply through networks of intermediaries who traverse villages buying fruit directly from small farmers, who lack bargaining power. The processed oil generates exceptionally high revenues, while the raw material is bought very cheaply

and this informal sector escapes taxation. Another consequence of this rent-seeking economy is the increase in uncontrolled fruit picking. Impoverished families compete intensely to collect as much fruit as possible, which they then sell to middlemen. This, of course, harms the trees, which grow increasingly weak due to the widespread use of inappropriate harvesting techniques such as knocking down very young fruits (Lybbert *et al.*, 2011).

The penalties for violating the established rules in the argan grove area (for example, illegal logging and land clearing) are relatively insignificant compared to the severity of the damage caused. Fines are very low, and imprisonment is only mandated in serious cases like setting forest fires. Moreover, effective enforcement relies on the availability of human resources to monitor the forest and record infractions. Unfortunately, the number of forest rangers is insufficient to adequately protect the argan heritage (Nadir, 2008, pp. 96–97).

The governance rules for the argan grove, established by the 1925 decree, were later supplemented by the provisions of Law 22.07 on protected areas. The revision of this law in 2010 allowed for its extension to include the Arganeraie Biosphere Reserve. The updated regulations aim to safeguard the area by preventing degradation and any actions that may disrupt its diversity, composition, appearance, or natural evolution (Planchet, 2015). This approach frames the management of protected areas as a means to conserve biodiversity while promoting sustainable development.

Notably, even though the law concerning the Arganeraie Biosphere Reserve was enacted in 2010, its implementing decree has not yet been issued. Such a decree is necessary to delineate the responsibilities of various stakeholders, establish operational guidelines (for instance, rules for optimal use of the biosphere and limits on the number of goats grazing in the forest), and clarify mechanisms for mobilizing financial and human resources.

5.2 Informal institutions in crisis

Historically, Moroccan local communities have established unwritten rules that contributed to an effective system of community governance in the argan grove area. These rules are socially shared, typically unwritten, and are created, communicated, and enforced outside of officially sanctioned channels (Helmke and Levitsky, 2004, p. 727).

Specifically, three main informal customary institutions have emerged as key elements of good argan forest governance: the *Jmaâ*, the *Agdal*, and the *Mouchâ*. The

Jmaâ, as the first institution, is a traditional local governance assembly developed to maintain social cohesion, manage internal village affairs, ensure adherence to customary rules, and settle conflicts. It possesses social and cultural legitimacy, as well as an organizational structure that helps prevent opportunistic behavior (in the sense described by Williamson, 1985).

The second institution, known as the *Agdal*, refers to the practice of seasonally prohibiting access to certain areas for grazing and harvesting, providing a form of biological rest for the forest. It consists of a set of community rules that determine specific periods of opening and closing the argan forest to designated rights-holders, along with various usage regulations (Cordier and Genin, 2008; Auclair and Alifriqui, 2012). For example, the forest is traditionally placed under the *Agdal* regime around May 15 (after the fruit harvest) to allow herds to graze on agricultural residues outside the forest. From that date, grazing and collecting argan nuts in the forest are prohibited. The reopening dates of the forest vary each year: late August if rainfall has been insufficient, or late October if rainfall has been adequate (Bourbouze and El Aich, 2005).

By contrast, the *Mouchâ* refers to areas where no single person or family holds exclusive rights to the argan trees; instead, grazing rights are communal, shared among all village inhabitants. These areas were exclusively managed by the *Jmaâ*, which regulated livestock access and the harvesting of fruit and wood (IWGIA, 2023).

This tripartite institutional arrangement, rooted in local customs, played a crucial role in regulating the argan ecosystem for a long time. It was instrumental in preserving biodiversity and vegetation cover, achieved through three legitimizing functions:

(1) exercising public authority independently of the state and its official institutions;
(2) providing specific local services and resource management; and
(3) exerting authority over a well-defined territory and a clearly identified community of villagers.

Generally, individuals adhered to these informal institutions not only because of the functions they fulfilled, but also due to rational cost–benefit considerations, the effectiveness of community enforcement and sanctions, or simply habit and social pressure.

Regrettably, the advent of globalization has significantly disrupted these traditional governance practices in the argan grove, upsetting a long-standing balance that had

functioned effectively for over a century (Faouzi, 2016). On one hand, globalization has fostered individualism within village communities, where collective interests are increasingly overshadowed by individual pursuits. On the other hand, globalization has commodified the forest, turning it into an economic resource for extraction and trade. It has greatly amplified the promotion of argan oil's benefits in international markets, leading to a surge in demand and prices for this product (Perry, 2020). Consequently, villagers have become more individualistic in their behavior. In pursuit of better living standards, they are now willing to flout established social norms and adopt more aggressive exploitation of the argan tree.

Meanwhile, the existing informal rules no longer sufficiently protect villagers' traditional resource rights (rights of use) in the face of incursions by transhumant camel herders who ignore customary boundaries during the argan fruiting season. With grazing land becoming scarce and herd sizes growing, coexistence between local communities and these outsider herders has become increasingly difficult. In these circumstances, acting rationally and out of self-interest, villagers often opt to harvest all the fruit from their trees as quickly as possible — even before it is fully ripe — for fear it will otherwise be eaten by the camels. In both scenarios (market-driven over-harvesting by locals and outsider encroachment), the consequences are devastating for the forest ecosystem.

In fact, once-effective informal institutions no longer inspire the necessary trust that underpins cooperative behavior in a society (Brunetto and Farr-Wharton, 2007). As a result, these institutions are no longer respected and have lost their ability to shape individuals' behavior. The community-based system of sanctions enforced by the *Jmaâ* no longer provides a sufficient deterrent, because the perceived benefits of violating social norms now outweigh the expected punishment. Consequently, these traditional institutions are gradually being supplanted by new, destructive practices such as predation, vandalism, looting, and pillaging of forest resources. These behaviors are driven by pragmatism and self-interest, as individuals turn to them as a means of improving their standard of living. Given the inefficiency and ineffectiveness of formal institutions, these illicit practices represent a second-best strategy for the people involved (Helmke and Levitsky, 2004).

Obviously, these emerging practices cannot be considered fully established *institutions* in the sense defined by North, as they are not yet widely shared and deeply ingrained in society. However, they are gradually undermining and displacing the once-effective ethical rules and norms (the customs and values that safeguarded the forest), rendering them ineffective. This harmful institutional dynamic can be

attributed not only to the growth of a highly profitable argan oil market but also to the difficulties of addressing ecological and biodiversity concerns within rural communities.

5.3 Interactions between formal and informal institutions

As demonstrated by Ostrom (2009), the successful governance of common-pool resources fundamentally depends on effective interactions between formal and informal institutions. This insight is particularly relevant to the case of Morocco's argan forest, especially in the period before the 1980s. The argan grove was perceived as a space where two institutional logics coexisted, maintaining a certain equilibrium that was both rational from a human use perspective and ecologically sustainable. On one hand, formal institutions at the time were designed in a way that limited the State's direct involvement in day-to-day forest governance — the State's ownership was largely nominal, and it did not heavily intervene in resource management or exploitation (including argan oil production). On the other hand, robust informal institutions had developed within village communities, facilitating coordination among resource users. These community institutions provided an innovative model for conserving argan stands and promoting sustainable forest use.

However, as the commercial success of argan oil has increased, urbanization has accelerated, and the influence of transhumant camel herders has grown, the institutional framework governing the forest has undergone a gradual but profound transformation. While formal institutions have started to adapt and, albeit cautiously, take measures to protect the argan ecosystem, the once-robust informal institutions that effectively safeguarded this ecosystem have been significantly weakened, leaving room for predatory practices to take hold. Referring to Lauth (2000), the relationship between these two types of institutions in the current context can be described as "conflictual": they are incompatible and pursue different objectives. In this dynamic, informal institutions persist at the expense of formal ones, partially displacing or completely infiltrating them — thus acquiring the status of "parasitic" informal institutions. Osei-Tutu *et al.* (2015, p. 27) use the concept of "void subversion" to characterize this situation.

In response to the weakening of informal institutions that traditionally protected the argan ecosystem (like the *Jmaâ* and *Agdal*), one would expect formal institutions to step in, either to replace them or to rejuvenate them through collaboration with local communities. Unfortunately, this has not occurred. The State did encourage the

establishment of modern local NGOs to fill the void left by the decline of the *Jmaâ*, but this initiative has not revived the spirit of collective action in village communities. Instead, it has inadvertently facilitated the development of rent-seeking behavior connected to argan tree exploitation (Romagny *et al.*, 2018).

The current formal institutions are not strong enough to modify the individual behaviors driving the new predatory practices in the forest. These practices have proven persistently resilient. It appears that all the actors involved in exploiting argan resources are benefiting, in the short term, from the status quo. Firstly, local villagers continue to over-harvest the trees to maximize immediate fruit collection. Secondly, industrial firms (often masquerading as cooperatives) reap excessive profits by processing the fruit into high-value cosmetic oil. Thirdly, large-scale transhumant camel breeders continue overgrazing the land. Fourthly, the State maintains a lax stance toward these activities and even undertakes deforestation for the expansion of towns and other infrastructure.

In sum, the erosion of traditional governance and the weakness of current formal governance have together created an institutional void in which exploitative behaviors prevail, posing a dire threat to the sustainability of Morocco's endemic argan forest ecosystem.

6. Conclusion

The argan grove serves as a model devoted to understand the interactive dynamics between the natural and socio-economic environments. It also helps to test the hypothesis that ecosystem degradation is due to the development of human activities associated with harmful and opportunistic institutional dynamics. Four main human factors have contributed to the triggering and acceleration of this dynamic: the high demand and increasing prices of argan products, the growth of extensive transhumant camel farming, the expansion of intensive agriculture, and the uncontrolled expansion of urban centers at the expense of the forest.

The area occupied by the argan tree is not just a natural forest, but primarily an institutional and human creation. In the face of the influence of private interests from stakeholders involved in these factors, the informal institutions of forest governance gradually deteriorated. Simultaneously, the already weak formal institutions were not effective enough to replace them. They were also not updated to adapt to the new situation and enforce collectively desirable outcomes in the space of the argan ecosystem. Then, an institutional breakdown occurred, leading to irresponsible behaviors and practices that harm the forest.

Given the new constraints imposed by globalization, it appears challenging to restore the informal institutions that effectively governed the argan forest for over a century. Their complete collapse seems irreversible. This is because the ecosystem's stakeholders have adopted predatory rules of conduct that align with their own private interests. However, the incentive and sanction mechanisms established within the framework of informal institutions are not strong or credible enough to encourage these stakeholders to abandon these new rules of conduct. In these circumstances, only

the State has the ability to develop a new, sustainable, and inclusive mode of governance. This mode of governance should be based on reclaiming the old informal rules and integrating them into a new forest law that combines prevention and enforcement. Additionally, this mode of governance should be founded on the principle of co-governance, which brings together decision-makers, scientists, experts, and local populations.

We believe that new formal institutions must evolve beyond merely incorporating traditional frameworks, recognizing the argan tree's elevated status as global heritage. This international recognition, marked by UNESCO's 1988 designation of the argan forest as a biosphere reserve and the United Nations' establishment of International Argan Day on May 10, provides a foundation for enhanced conservation measures. A key initiative that should be integrated into these new formal institutions is the principle of "one tree felled equals at least 10 trees planted", which could significantly contribute to restoring the argan heritage. The Moroccan National Motorway Company has already demonstrated the viability of this approach, having successfully planted approximately 200,000 argan trees across 910 hectares by 2021. On an experimental basis, the National Agency for the Development of Oasis Zones and the Argan Tree (ANDZOA) has also launched projects focused on the establishment of large-scale agriculture for the development of a modern horticultural industry. The aim is to promote the domestication of this species through the adoption of water-saving technologies coupled with a solar pumping system (ANDZOA, 2020).

The case of the argan grove also offers valuable insights for policy development in similar contexts worldwide. Drawing from Berkes's (2017) work on adaptive co-management, the integration of traditional ecological knowledge with modern conservation approaches emerges as a crucial strategy. This integration is particularly relevant where formalization initiatives must balance market demands with conservation goals, as highlighted by Lambin and Thorlakson (2018) in their analysis of sustainable value chains for non-timber forest products. The experience of the argan ecosystem suggests that successful governance frameworks must combine robust market regulations with equitable benefit-sharing mechanisms while maintaining strong connections to local institutional arrangements.

Governance systems must evolve dynamically to address complex economic and socio-ecological changes (Folke *et al.*, 2005). Since the foreign demand for argan oil is expected to increase in the future, this species offers significant potential for domestication programs, as for other indigenous African fruit and nut trees (Leakey *et al.*, 2012). This measure can play a crucial role in reducing anthropogenic pressure

on the natural forest, while enhancing local livelihoods by maintaining a certain sustainable balance between the traditional model of fruit harvesting in the forest and the modern horticultural industry. This suggests that the argan grove's challenges reflect a broader pattern in resource management under globalization.

Looking forward, our research suggests several promising avenues for future investigation. We propose conducting detailed case studies examining stakeholder engagement in forestry activities while carefully considering the unique characteristics of various natural environments and tribal structures. These studies would deepen our understanding of the complex dynamics at play and contribute to developing multi-level governance strategies. By focusing on these aspects, we can work toward establishing more effective approaches to reversing the degradation of the argan grove while strengthening its long-term resilience.

Note

[1.] The term “grove” is most appropriate to describe the aragnier area because the density of argan trees in the forest area is not very high (between 30 and 100 trees per hectare).

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