

## **Building a Citizen and Inclusive Scientific Culture: Dialogue between Indigenous Knowledge and Education for Sustainable Innovation in the Lékoumou Department of the Republic of Congo.**

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### **Abstract**

This article explores the problematic dialogue between the traditional knowledge of the indigenous peoples of the Lékoumou and science education. It highlights a triple paradox: poverty that forces communities into unsustainable practices, a formal education system that marginalizes rather than integrates, and institutional failure that hinders the implementation of sustainable solutions. Drawing on field interviews and the work of researchers such as Amartya Sen, Paulo Freire, Pierre Bourdieu, and Elinor Ostrom, the study proposes that the solution lies in the co-construction of knowledge. This participatory development and education model aims to reconcile the peoples of the Lékoumou with their institutions and equip them to become agents of their own sustainable innovation, drawing on their rich cultural heritage and their knowledge of the environment.

**Keywords:** Indigenous peoples, Traditional knowledge, Science education, Sustainable development, Lékoumou

## Introduction

### *Context*

This article is titled “Building a Citizen and Inclusive Scientific Culture: Dialogue between Indigenous Knowledge and Education for Sustainable Innovation in the Lékoumou Department of the Republic of Congo”. The Lékoumou department in the Republic of Congo is a region where Bantu and indigenous peoples coexist. The latter, guardians of a millennia-old heritage, live in the heart of vast forests where they have developed ancestral knowledge about biodiversity, subsistence techniques, and social organization. However, like other indigenous communities around the world, they face poverty, marginalization, deforestation, and the effects of climate change, which threaten their way of life. In this same context, contact with modern lifestyles and the formal education system raises new questions about the transmission of their knowledge and their economic and social integration. Testimonies collected in the localities of Sibiti, Zanaga, and Mayeye, and in forest camps in the Lékoumou department, reveal a complex situation where immediate subsistence needs conflict with resource preservation and the transmission of intergenerational knowledge.

### *Issue*

In this context of transition and socio-environmental challenges, the question of education emerges as a crucial issue. However, an education that simply reproduces Western models risks devaluing indigenous knowledge and causing younger generations to lose their cultural heritage. There is an urgent need to reconsider the educational process so that it becomes a true lever for emancipation. This reflection leads us to the central question of this paper: How can science education in the Republic of Congo integrate the traditional knowledge of indigenous peoples to build a culture of sustainable, socially inclusive, and economically relevant innovation? This question aims to analyze the mutual contributions of traditional wisdom and scientific methodologies for endogenous and respectful development. Research Interest and *Main Question*

The significance of this research lies in offering a path to resolving the paradox of survival that drives indigenous people to destroy the resources on which they depend. The dialogue with the peoples of Lékoumou is exceptionally rich, as it exposes the underlying reasons behind their actions and aspirations. It highlights the systemic barriers—particularly corruption and the lack of monitoring of public policies—that transform development projects into sources of disillusionment. The objective is not to make science a force for assimilation, but a tool for emancipation. The research question that emerges from this analysis is: **What are the mechanisms, challenges, and opportunities for an educational model that combines indigenous knowledge and science to promote sustainable innovation and well-being within the indigenous communities of the Lékoumou department?**

### ***Study objectives***

The overall objective of this research is to analyze the potential and challenges of integrating traditional knowledge into science education in order to promote sustainable development and the autonomy of Indigenous peoples. From this overall objective, the following secondary objectives emerge:

- To identify and promote Indigenous knowledge related to environmental management, traditional medicine, and food security, as presented in the interviews;
- To analyze the social, economic, and institutional barriers that hinder access to quality education and undermine nature conservation efforts;
- propose concrete avenues of action for an adapted pedagogy, drawing on the skills and experience of indigenous peoples to co-construct a culture of sustainable innovation that is socially inclusive and economically relevant.

### ***Epistemological stance and methodological approach***

This research adopts a critical and interpretive (post-positivist) stance, structured around an inductive and abductive mode of reasoning that prioritizes understanding the social reality – the dilemma of survival and education in Lékoumou – through the interpretation of lived experiences and field testimonies (Sibiti, Zanaga, forest camps). Epistemologically, the study is founded on the framework of Participatory Action Research (PAR), inspired by Paulo Freire, which positions Indigenous peoples as co-researchers and agents of social transformation, rather than as mere objects of study. This approach aims to bring forth the real paradoxes and needs in order to co-construct theoretical and practical solutions. The analysis ultimately relies on an essential transdisciplinary approach, confronting empirical data with major theoretical frameworks (Sen, Bourdieu, Ostrom, Lévi-Strauss) to shed light on the mechanisms of marginalization and justify the proposal of an inclusive and relevant educational and development model.

The first chapter of this presentation will focus on the indigenous peoples of Lékoumou facing the challenges of survival. It will analyze the testimonies of heads of households and residents to understand the economic and social constraints that force them to adopt unsustainable practices. The second chapter will address the paradox of education and integration. We will explore the dilemmas between the aspiration for schooling and the realities of the education system, as well as the loss of traditional knowledge about health and customs. The third chapter will examine the failure of institutions and the quest for justice. This chapter will focus on the virulent critique of development policies led by a local NGO representative, revealing the corruption and lack of monitoring that sabotage initiatives. The fourth chapter, entitled "Towards a Co-construction of Knowledge," will propose a theoretical framework for a more inclusive and participatory educational and development model. The fifth chapter will discuss the results and implications. This section will synthesize the findings of the first four chapters and put them into perspective with the theoretical frameworks to identify implications and possible solutions. Finally, we will

conclude with a summary of the findings and a proposal for a theoretical and practical framework for an educational model that integrates indigenous knowledge into a participatory scientific approach, paving the way for a true culture of sustainable, socially inclusive, and economically relevant innovation for the peoples of Lékoumou and beyond.

## **1- The indigenous peoples of Lékoumou and the challenges of survival**

### **1.1. The subsistence paradox: when survival leads to destruction**

The interviews reveal a striking paradox at the heart of the relationship between indigenous peoples and their environment. Their traditional knowledge of hunting, gathering, and fishing allows them to meet their needs, but economic pressures and poverty force them to adopt practices that jeopardize this balance. They recognize that cutting down trees to gather caterpillars (bidongolo) and digging the ground for mushrooms are practices that destroy and lead to the scarcity of these resources. One resident perfectly sums up this dilemma: *"We point out that if we cut down these trees, it's indeed to have a means of living with the children. There are times when we don't know what to do. We have to do this, even though we know the resources are disappearing. That's the problem, we know that next year we won't have anything left, but what can we do?"*

Far from being ignorant of the consequences of their actions, they are fully aware of the gradual disappearance of their natural heritage. The solution therefore lies not in simply raising awareness, but in implementing viable alternatives that would allow them to reconcile economic survival and environmental preservation.

### **1.2. From lack of alternatives to a vicious circle of poverty**

The interviews highlight that the destruction of nature is closely linked to the lack of economic opportunities. Indigenous populations are not averse to work or innovation; quite the contrary, they aspire to a better life. When asked what could help them, their response is as follows: *"Agriculture, but not work that we don't have the capacity to do. If we could get help to cultivate our land, we could earn money from our products. We're not asking for charity. We're asking for help to plant, to get seeds, to do a little of our farming so that it can earn us a living. It's better to leave it while it can still produce, but how do we get a little money?" This is what drives us toward the "bidongolo" and the mushroom."*

This testimony clarifies that their need is not to remain in a situation of welfare, but rather to be supported to develop the activities they already master. They are trapped in a vicious cycle. This vicious cycle manifests itself in the need for indigenous peoples to earn money for food, soap, and salt, pushing them into short-term activities, which destroys the resources that could provide them with sustainable prosperity. This existential paradox calls into question the urgency of creating solutions that address both poverty and environmental degradation.

### **1.3. From knowledge transmission in the face of modernity to a heritage in peril**

Traditional knowledge is the very foundation of indigenous culture, but the interviews we conducted reveal that its transmission is in jeopardy. A head of household explains that children are introduced to work from a very young age, "from the ages of 5 and 6," by accompanying their parents to the fields and fishing. It is a process of learning through observation and participation. However, with the gradual integration of these populations into modern life and the pressures of school, these transmission rituals are crumbling. Moreover, the scarcity of natural resources, mentioned above, means that some knowledge could disappear along with the species. A man expresses his concern as follows: *"We teach our children about plants, animals, how to behave in the forest, but with deforestation and schools that don't teach them anything about this, some of our children will no longer have the chance to see this." They will grow up without knowing their own culture, without knowing what lies in the forest."*

The disappearance of this knowledge is a threat not only to the survival of these communities, but also to the heritage of all humanity. This section highlights that science education must be designed not to replace indigenous knowledge, but to document, strengthen, and disseminate it, thus creating a link between generations and between cultures.

### **1.4. From cross-perspectives to contributions from academic research**

The observations and paradoxes described by the Lékoumou peoples resonate strongly in the work of many researchers in the social sciences and the environment. The subsistence dilemma, in which immediate survival takes precedence over long-term conservation, is central to analyses in political ecology and development economics. The work of authors such as Amartya Sen, with his capability theory ("Development as Freedom," 1999), reveals that the ability of indigenous peoples to preserve their environment is directly linked to their freedom of action, which is limited by poverty and a lack of alternatives. The lack of secure access to sustainable livelihoods makes them de facto dependent on activities that destroy the environment. Regarding the issue of the loss of traditional knowledge, it is widely documented in the literature on indigenous knowledge systems (IKS). Research by researchers such as Fikret Berkes ("Sacred Ecology," 2008) has revealed that this knowledge is not simply folkloric beliefs, but complex and dynamic systems based on empirical observations, holistic resource management, and collective wisdom passed down from generation to generation. The marginalization of this knowledge, fostered by formal educational models, is a loss for all of humanity. It is in this sense that Edgar Morin (1999) emphasizes the importance of a *"well-formed mind,"* capable of connecting different knowledge to understand the complexity of the world. He criticizes the fragmentation of knowledge that hinders complex thinking. In this context, ignoring the SKA would impoverish our own understanding of environmental and social challenges, depriving us of an entire strand of human wisdom. Thus, the testimonies of the Lékoumou peoples appear as empirical data that confirm the relevance of academic theories. They highlight the need for an approach that equips populations with the means

to build their own resilience, drawing on their culture. The challenge is to forge a link between scientific and indigenous knowledge, which are complementary and necessary to build a true culture of sustainable innovation.

## **2. The paradox of education and integration**

### **2.1. The aspiration for schooling is marred by a dream of integration and a reality of marginalization**

The indigenous peoples of Lékoumou are attached to their traditions. Nevertheless, they express a strong desire for formal education for their children. Interviews conducted in Sibiti and Zanaga reveal a shared conviction that schooling is a means of emancipation and integration into Congolese society. Parents are aware that "school is so we can develop," and they see education as a tool to ensure their children do not suffer the same precariousness as them. One head of household sums up this desire: *"We parents are very happy that our children are going to school. We want them to have a chance at a better life than we did, to be able to find work, and not to be like us, who live on almost nothing. But sometimes they don't feel like they belong at school. They are different, and other children make fun of them. We're afraid they'll be insulted and drop out. It's hard to see them suffer."*

However, this aspiration faces numerous obstacles, creating a paradox. Indigenous children often face marginalization and prejudice in schools. Access to school is also hampered by a lack of resources. As one testimony points out, parents often don't have "the money to buy notebooks and uniforms," which forces some children to drop out. This situation illustrates the concept of cultural capital theorized by Pierre Bourdieu (1979), referring to the fact that Indigenous children do not start out with the same advantages as Bantu children, because their culture and way of life are not valued by the education system. Parents' lack of knowledge about school curricula and the importance of homework reinforces this imbalance, making school integration a constant struggle. The idea of "decolonizing research methodologies," as Linda Tuhiwai Smith (1999) has put it, is a fundamental principle for understanding how Western knowledge has historically dominated and marginalized Indigenous knowledge systems.

### **2.2. From the loss of traditional knowledge to the downside of modernity**

Considered a lever for integration, school can also become a source of unlearning traditional knowledge. One parent laments the loss of knowledge about traditional pharmacopoeia: *"Our children have forgotten everything about healing plants. Before, our grandparents showed us which leaves to use for fever, which roots for coughs. Today, we send them to school, we teach them books, but they no longer know anything about our customs. It's as if we gave them one world so they could forget another. Soon, this knowledge will disappear with the elders."*

These remarks highlight the loss of traditional and cultural capital marked by young indigenous people who, captured by the formal school curriculum that does not take indigenous knowledge

into account, distance themselves from ancestral knowledge. In this sense, Martha C. Nussbaum (2011) approaches education not as a simple transmission of facts, but as a means of "building capacities," allowing individuals to live lives they have reason to value. Education for the peoples of Lékoumou must therefore equip them to value their culture and identity. This disconnect is particularly dangerous for the culture of sustainable innovation. Traditional knowledge in forest management, agriculture, and health are applied sciences developed over thousands of years, as demonstrated by Claude Lévi-Strauss (1962), for whom this knowledge is based on its own rationality and complexity. By ignoring it, the education system deprives young people of valuable intellectual capital. The challenge is therefore to create an education that values this knowledge and integrates it as legitimate subjects, so that young people can combine it with the tools of modern science. Robin Wall Kimmerer (2013) has also explored this bridge between indigenous wisdom and science, showing how these two approaches can coexist and reinforce each other. This would help train a generation capable of developing sustainable innovation that, beyond reproducing foreign technologies, draws on local genius to find original and adapted solutions.

### **2.3. Education for sustainable innovation: a bridge between two worlds**

Beyond the issue of access to schooling, the challenge of education in Indigenous communities is fundamentally linked to the culture of sustainable innovation, which requires the ability to adapt and invent solutions that meet social, economic, and environmental needs in a balanced manner. The interviews demonstrate that this culture of innovation must be co-constructed with communities and cannot be the product of something imported. Traditional knowledge on forestry, for example, could be combined with scientific data on climate to develop more resilient forest management practices. Knowledge of traditional pharmacopoeia could be studied and leveraged through scientific research for drug development. This is where the real challenge of socially inclusive and economically relevant education lies. By integrating indigenous knowledge, schools would become a framework for recognizing an identity, promoting a heritage, and strengthening the dignity of indigenous peoples. This would provide them with the necessary tools to develop economic activities that respect their culture and environment, creating a virtuous cycle of development. In this sense, education would move from being an instrument of marginalization to a catalyst for endogenous, just, and sustainable development.

## **3. The failure of institutions and the quest for justice**

### **3.1. From the sabotage of development policies to a harsh criticism of NGOs**

The issue of education and survival cannot be understood without an analysis of institutional frameworks and their impact on the ground. A representative of a local NGO, speaking on condition of anonymity, paints a damning picture of development policies and the inability of institutions to honor their commitments. He denounces a system riddled with corruption, where funds allocated to projects never reach their intended recipients. He uses the term "*cash flow*" to

refer to the misappropriation of resources, resulting in poorly funded, poorly executed projects with no real impact on the population, as stated in the following statement: *"We see projects launched with grand announcements and speeches on TV, but on the ground, it's chaos. Follow-up is zero; when we arrive, we hand over the grant, and then it's up to the people to sort things out. Funds disappear along the way, materials never arrive, and promises are never kept. The people only see the crumbs. After that, how can you expect them to trust us when we present them with a new project? It's impossible, because they've seen failure time and time again."*

This lack of institutional accountability creates a climate of deep mistrust within indigenous communities. Far from being naive, they have learned to distrust the promises of state and non-state actors and to rely only on themselves. Chinua Achebe's novel *The Trouble with Nigeria* (1983) is a powerful example of the impact of corruption and inefficiency on a nation's development. This disillusionment fuels a sense of marginalization and a perception of injustice, making future collaboration increasingly difficult.

### **3.2. The limits of theoretical mechanisms for living together in the face of realities on the ground**

The NGO's criticism, beyond simple corruption, points to a fundamental disconnect between the way projects are designed and the realities on the ground. The representative protests against a top-down approach where "they don't know what the people want." Programs are often developed in offices in capital cities, without consulting communities, making them ill-adapted to their real needs and knowledge. This failure is particularly glaring in a department like Lékoumou, where socioeconomic realities are complex and varied, as the NGO representative emphasizes in the following words: *"We come up with plans that look great on paper, with tables and statistics. But when we confront them with the reality of the people, it doesn't work. People have their own way of doing things, they have knowledge that has been passed down through generations. We can't just come and tell them 'this is how you should do it' without consulting them. It's like telling a farmer to plant without giving them the land. It's an insult to their intelligence and their experience."*

The quest for social justice and the dignity of indigenous peoples therefore requires an overhaul of governance and the implementation of development policies. It is not enough to propose solutions; it must be done collaboratively, recognizing that communities, more than just beneficiaries, are essential partners.

### **3.3. From cross-phase perspectives to the contributions of academic research on institutional failure**

The criticisms expressed by the NGO representative echo major works in political science and the sociology of development. The importance of institutions for development is a central theme among authors such as Francis Fukuyama (2011), who argues that the prosperity and stability of societies depend on the capacity of institutions to be effective, legitimate, and accountable.

Similarly, Daron Acemoglu and James A. Robinson (2012), who have extensively analyzed the links between institutions and prosperity, show that inclusive and just institutions are essential for long-term development. In the case of Lékoumou, the lack of accountability and ineffectiveness of institutions are major obstacles to community empowerment. Similarly, the disconnect between development plans and the reality on the ground is a topic explored by James C. Scott (1998), who describes how modern states seek to simplify reality to make it readable and manageable, creating standardized projects that fail miserably because they ignore local complexity and knowledge. This analysis applies perfectly to the context of Lékoumou, where, by imposing "off-the-shelf" solutions, institutions undermine the ability of communities to find endogenous solutions, which not only leads to project failure but also reinforces the marginalization and sense of powerlessness of indigenous peoples. Thus, institutional failure is not simply a "disease" of the system; it is a direct cause of the paradox of subsistence and educational marginalization. The absence of trust and justice makes future collaboration difficult and pushes communities to withdraw into themselves. The work of Walter Rodney (1972) also provides a historical analysis of how external economic and political structures have historically contributed to the underdevelopment of African nations, a concept that resonates with the current situation.

#### **4. Towards a co-construction of knowledge**

##### **4.1. From the co-construction of knowledge to a theoretical framework for emancipation**

The first three chapters of this paper have highlighted the limitations of an approach to development and education that ignores the realities on the ground and the knowledge of indigenous peoples. To overcome the paradox of survival, educational marginalization, and institutional failure, it is imperative to adopt a new paradigm: that of the co-construction of knowledge. This concept goes beyond simple "awareness-raising" or "valorization" of traditional knowledge to propose an equitable partnership between communities, scientists, educators, and development stakeholders. It is a collaborative process in which indigenous and scientific knowledge are brought into dialogue to create a new, hybrid body of knowledge that is relevant and adapted to the specific challenges of the Lékoumou region. This model is in line with participatory action research (PAR), a methodology in which the subjects of the study are no longer mere objects of observation, but active co-researchers who participate in all stages of the process, from problem identification to the implementation of solutions. This concept was popularized by Paulo Freire (1970), who advocated an educational process based on dialogue and awareness-raising to enable communities to become agents of their own emancipation. It is by recognizing that local wisdom is an indispensable intellectual asset that development can become a true lever for social transformation. Dipesh Chakrabarty (2000) proposes a postcolonial perspective that challenges the supremacy of European thought and paves the way for the promotion of non-Western knowledge and histories.

#### **4.2. A pedagogy of relevance in schools as a bridge**

In the context of education, the co-construction of knowledge must translate into a redesign of the school curriculum. Schools must move beyond being places of assimilation to become a bridge between indigenous culture and universal science. Concretely, this means that traditional knowledge, such as pharmacopoeia, agroforestry, hunting, and social organization, must be integrated into the curriculum. Elders and heads of families, who hold this knowledge, should be recognized as legitimate educators and invited to co-teach with teachers. For example, a biology lesson could begin with the study of medicinal plants used by local healers, followed by an analysis of their chemical properties using scientific tools. Similarly, a social studies course could explore traditional governance structures and compare them to state models. This approach would help educate young people who, far from denying their heritage, value it and use it as a foundation for their development. This pedagogy of relevance is the key to resolving the paradox of cultural capital and training a new generation of "organic intellectuals," in the sense defined by the philosopher Antonio Gramsci (1971), capable of using knowledge to organize, transform, and defend their community.

#### **4.3. Towards a participatory governance promoting reconciliation and justice**

Finally, the co-construction of knowledge cannot be effective without a transformation of relationships between institutions and indigenous peoples. To overcome mistrust and corruption, development projects must be co-managed by joint committees where the voice of communities has equal weight with that of the state and NGOs. Elinor Ostrom's theory of commons governance (1990), Nobel Prize winner in economics, offers us a relevant model. She has demonstrated that communities are often more effective than the state or the private sector in managing natural resources sustainably, provided they have the capacity to define their own rules and enforce them. Empowering the peoples of Lékoumou to take charge of their destiny not only combats corruption and inefficiency, but also restores justice and dignity. Jared Diamond's work in *Collapse* (2005) shows that societies that fail to address their environmental and social problems are often those that lack effective governance and citizen participation. A culture of sustainable innovation will not emerge from bureaucratic schemes, but from renewed trust and a sense of belonging. The following words from a householder illustrate this analysis:

*“We don't want anyone to tell us what to do. We know what's good for our forest, for our children. We just want to work with you. We want to be partners, not subjects of your study or beneficiaries of your projects. We want to be listened to, to have what we know taken into account. That, for us, is true justice.”*

## 5. Discussion of results and implications

The interviews and theoretical analysis presented in the preceding sections reveal a complex and interconnected picture of the challenges facing the indigenous peoples of Lékoumou. Far from being isolated problems, the paradox of survival, educational marginalization, and institutional failure are manifestations of a single, profound divide: the gap between "top-down" development policies and the communities' realities. Environmental destruction is a rational response to the absence of viable economic solutions, beyond being a lack of ecological awareness on the part of the communities. As Amartya Sen theorized, the freedom to act sustainably is directly linked to the ability to escape poverty. Testimonies about the need to cut down trees to meet immediate needs illustrate the failure of systems that do not provide alternatives. This situation is exacerbated by the crisis of trust in institutions. The NGO representative's remarks, by pointing to corruption and lack of monitoring, reveal that the state and external actors have lost their legitimacy in the eyes of the population. The failure of development projects is a direct consequence of the centralized and bureaucratic model that James C. Scott described as seeking to simplify a complex reality. Achille Mbembe (2001) also analyzes these postcolonial power dynamics, where state structures continue to exert control over populations in ways disconnected from local realities. The issue of education is another aspect of this divide. School, which could be a place of integration and transmission, becomes a source of marginalization. The failure to recognize traditional knowledge reinforces young people's sense of alienation and devalues their heritage. Current schools reproduce inequalities, as demonstrated by Pierre Bourdieu's concept of cultural capital, by valuing only Western knowledge. This reality leads us to a fundamental question: for whom and what is education designed? If it does not aim to strengthen dignity and equip communities to face their specific challenges, it will fail to achieve its goal. It is in this context that the co-construction of knowledge emerges as the only relevant theoretical and practical framework. Inspired by Paulo Freire's pedagogy of emancipation, this approach proposes to recast education and development based on dialogue, participation, and mutual recognition. The integration of elders into schools is not a symbolic gesture, but a concrete strategy to bridge the divide between indigenous and scientific knowledge. The concept of "postmodern grassroots development," advocated by Gustavo Esteva and Madhu Prakash (1998), maintains that solutions must emerge from the communities themselves, rejecting one-size-fits-all development models. Similarly, involving communities in the management of their own resources, as Elinor Ostrom has demonstrated, is the only way to restore trust and ensure the sustainability of projects. In sum, the results of our research show that the problems of the Lékoumou are not the result of the ignorance or culture of indigenous peoples. On the contrary, they reflect a systemic failure. The solution requires a paradigm shift, where the peoples of the Lékoumou cease to be objects of development and become full partners.

### **General conclusion and outlook**

This paper has analyzed the complex challenges facing the indigenous peoples of the Lékoumou department. The first three chapters highlighted a set of paradoxes marked by survival that leads to the destruction of nature, an education that marginalizes rather than integrates, and institutions that betray the population's trust. These challenges are interdependent and rooted in a deep divide between two systems of thought. The solution is not to force indigenous peoples to conform to Western models, but to create a space for dialogue and the co-construction of knowledge. This is the only way to build a culture of sustainable innovation that is socially inclusive (by promoting cultural heritage), economically relevant (by drawing on local skills), and environmentally friendly (by reconciling humanity with nature). Wolfgang Sachs's (1992) writings on the "dictionary of development" remind us that the very terms of development must be reevaluated to include the perspectives and values of marginalized communities. This research project aims to lay the foundations for a collaboration that would transform these challenges into opportunities, making the people of Lékoumou the actors and beneficiaries of their own development.

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