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Research Article

Attribute patrimonialization and stakeholder diversity in the participatory management of Sahelo-Saharan biodiversity in the Termit and Tin Toumma mountain complex, Niger

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ABSTRACT

In Sahelian countries in general, and in Niger in particular, the sustainable management of natural resources is the Gordian knot of environmental challenges and sustainable development. For several decades, the management of natural resources in Niger was the exclusive responsibility of the State through legal and regulatory instruments, thus excluding local communities. In Niger, the Termit and Tin Toumma mountain range is a Sahelo-Saharan ecosystem with a natural heritage that can contribute to local development. The aim of this study is to highlight the natural resources that can contribute to the development of the Termit and Tin Toumma complex, to analyze the extent to which the local population has taken ownership of these attributes, and to describe the diversity of stakeholders and their roles in the participatory management of natural potential.

The methodology used in this study consisted firstly of a diagnosis of natural resources, followed by the identification of the main players and their roles in the participatory management of biodiversity in the study area. Indeed, the results of the present study reveal that this environment contains a remarkable biodiversity and an attractive, contrasting landscape. With the participatory approach to natural resource management initiated by the State of Niger in the 1980s, local communities have become increasingly involved in the management system, and are taking greater responsibility for the protection, conservation and use of natural resources. The patrimonialization of the latter by local actors, as well as the creation of the Termit and Tin Toumma National Nature Reserve (RNNTT), are favourable factors to the local development of the Termit and Tin-Toumma complex. However, the involvement of external players would make a significant contribution to the sustainable co-management of biodiversity in this Niger's Sahelo-Saharan environment.

Keywords: Niger, Termit and Tin Toumma, participatory management, biodiversity, local stakeholders

INTRODUCTION

In the southern countries in general, and the Sahel in particular, we are witnessing a real craze for natural heritage, due in particular to the desire to put in place effective policies for the protection, management and exploitation of the environment. Conflicts over the appropriation of natural resources, as well as the question of their sustainable use or conservation, have given rise to the notion of heritage. However, the polysemy of this notion (heritage), the diversity of the realities it covers, the multiplicity of the processes involved in its implementation, the plurality of actors and their strategies have been the subject of numerous works, including those by CHEVALIER, D. 2000; RAUTENBERG, M. et al., 2000 (in CORMIER-SALEM, M.-C. & al, 2002), CORMIER-SALEM, M.-C. & al., 2005.

In the Sahel, the State was historically responsible for the exclusive management of natural resources through legal and institutional arrangements. However, the latter had shown their limitations, resulting in the over-exploitation of natural potential and the multiplication of conflicts linked to the management of community resources. This would have led to the adoption of a policy of participatory management through the effective involvement of local communities, even if there is no watertight boundary between the natural resource management referents of the local population on the one hand, and those of the State and its agencies on the other. (WADE, R. 1987 ; BERTRAND, A.1998; ROCHEGUDE, A.1998; VINCENT, P.1998; RIBOT, C.J. 2009 ; TALL, S.M. et GUEYE, M.B., 2003 ; LAVIGNE DELVILLE, Ph.2009 ; GRANIER, L.2010).

In Niger, environmental issues are a national concern, with management falling under the prerogatives of the State through legal and institutional texts which, in their application, are often poorly perceived by rural stakeholders. With its varied landscape, the country has undeniable natural potential in all its agro-ecological zones, some of which stand out for the richness and authenticity of their biodiversity. This is the case of the Termit and Tin Toumma complex, which is a rather special ecosystem, made up in part of endangered fauna and plant species characteristic of arid environments. As far back as the 1950s, the importance of biodiversity in this area was noted by a number of authors, including RIOU (in BELLO, I.N., 2013), Gouré Cercle Commander who, in his 1955 report, mentioned having observed large concentrations of *Oryx dammah*, *Gazella Dorcas* and *Nanger Dama* in the Termit sector, as well as the presence of a various fauna. In 1961, METZ. A. (in BELLO, I.N., 2013) stated in a report to IUCN that the Termit Massif was particularly rich in fauna, and already raised the need to create a Protected Area to safeguard this Saharan fauna, including emblematic species such as the *Addax nasomaculatus*.Indeed, the current management of protected areas in Niger does not encourage local residents to understand that these resources are first and foremost their property, their identity reference, a legacy bequeathed by nature and their ancestors - in short, their heritage, which they must contribute to preserving. For this reason, the involvement of local populations in the biodiversity conservation process is essential, as the patrimonialization of biological diversity by indigenous communities can have strong economic impacts and serve as a basis for local development. Through their close relationship with local populations, natural heritages contribute to the conservation of biological resources and associated traditional knowledge. (ALI DIALLO.B, 2004, ALHASSOUMI SOW. S. & al.2004, FULCONIS. R., 2009 ; MICHEL. V., 2011). The effective development of the assets of the Termit and Tin Toumma complex through the institution of a formal co-management plan can serve as a lever for the blossoming of local development of this environment considered to be an authentic national heritage. This requires local communities to take responsibility for biodiversity management and take ownership of biodiversity as a natural heritage. Indeed, certain harmful acts (poaching, abusive hunting) on natural resources observed before the creation of the reserve (RNNTT) were in reality a manifestation of the non-involvement of local actors in the management of the natural potential of their environment. The aim of this study is to highlight the natural resources that can contribute to the Termit and Tin Toumma complex development, to analyze the extent to which the local population has taken ownership of these attributes, and to describe the diversity of stakeholders and their roles in the biodiversity participatory management.

PRESENTATION OF THE STUDY AREA

Geographical location

Located in central-eastern Niger (Zinder region), the Termit mountain range, which backs onto the Tin Toumma desert, has an arid and semi-arid climate. Covering an area of 7,500 km², it stretches almost 180 km in a meridian direction on either side of the 16th parallel. Approximately 50 km wide, this massif marks the transition between the desert to the north and the Sahel to the south. Administratively attached to Tesker rural commune (department of the same name), this landscape unit is inhabited by a nomadic population estimated at between 1,800 and 2,000 in 2020 (field survey). The Figure No1 shows the Termit massif map.

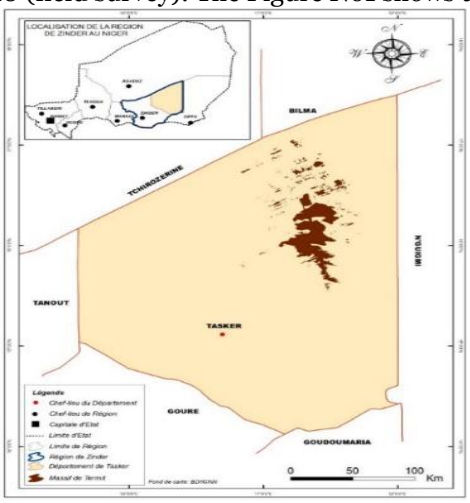

Figure No1: Location map of the Termit massif

The climate

The Termit and Tin Toumma mountain complex is crossed by the 100 mm interannual isohyet, which is the conventional boundary between the Saharan and Sahelian domains. (LEROUX, 1980, in ALI OMAR, M.,2009). This territory receives less than 100 mm of rainfall per year, characterized by high spatio-temporal variability. Climatic data are scarce, and the nearest climate station is Tesker, 150 km to the south of the massif, where annual average precipitation is 130 mm for the period 1980-2022. This value classifies the Tesker station in the Sahelo-Saharan zone, which corresponds to a transitional strip between the Sahara and the Sahel. The Figure No1 shows annual precipitation trends at Tesker from 1980 to 2022.

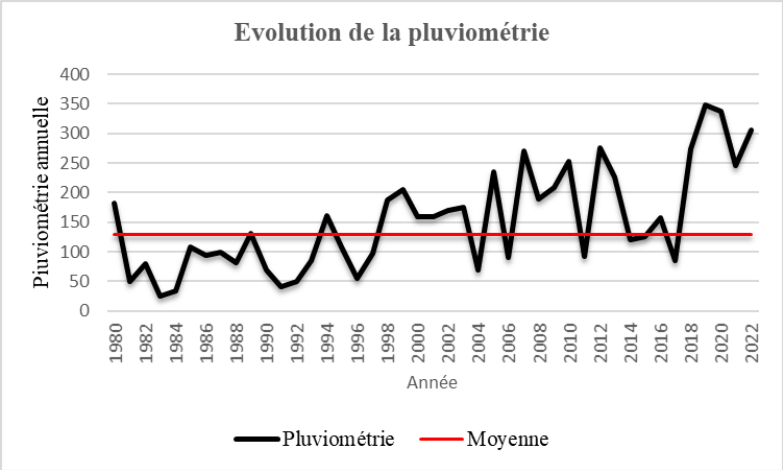

Figure No2: Change in annual precipitation at Tesker from 1980 to 2022

Source : Direction de la Météorologie Nationale/Nasa Power Access Data, 2024

An analysis of this curve reveals that from 1980 to 2022, rainfall trends will be up and down, with a period of drought (1981 to 1993), when rainfall is below average. This was followed by a relatively wet period (1994-2003) when rainfall was slightly above the general average (130). From 1998 to 2003, the area was characterized by relatively abundant, above-average rainfall, before beginning to fall in 2004. The period 2006-2014 is marked by rainfall in excess of 200 mm, though with pockets of drought (2006-2007). From 2008 to 2022, rainfall is relatively good, with the exception of 2011, 2013 and 2015, when rainfall is below average.

Termit and Tin Toumma landscapes

Although its aerial view gives a compact block impression, the Termit mountain range represents an ecosystem compartmentalized into several sub-units, on the edge of the Tin Toumma desert to which it backs. This rocky unit and its surroundings form a mosaic of landscape facies, made up of two distinct geomorphological ensembles, namely the Tin Toumma dune domain desert and the Termit massif rocky plateau. The area's very predominant first group in the landscape, forms a dune plateau with an altitude of between 300 and 500 m, cut by fossil valleys called Dillia that extend for hundreds of meters or even several kilometers. (SERVANT M.,1973; DEMANGEOT J.,1981). The second group is the Termit rocky massif, whose current morphology and scalloped appearance are the result of quaternary tectonic movements, and whose highest point reaches 710 m in altitude. Isolated mound-like reliefs, around 100 m high, emerge in places at the eastern edge of the area, forming an intermediate landscape between dune and rocky environments.

Flora and fauna

The plant formation in the study area is generally steppe-like, with *Acacia-Panicum* groupings to the south and west of the massif, while to the east and northeast we find herbaceous steppes, with annual and perennial species adapted to the arid climate, some of which are in a relict state. In 2007, Abdoul Moumouni University Botany Department in Niamey set up a herbarium of 101 plant species in the Termit and Tin Toumma complex. As far as the fauna is concerned, some twenty mammal species have been identified to date, including' *Nanger dama*, *Addax nasomaculatus* and *Acinonyx jubatus Heckel*, which are critically endangered. There are also a large number of resident birds such as bustards, shrikes, white sparrows, guinea fowl, etc., as well as a number of migratory birds, making the area a veritable refuge. More than a hundred species have been observed and identified in the area during the various inventories that led to the creation of the Reserve, including reptiles like turtles, monitor lizards, vipers, etc. (ASS Project, 2010).

Human environment

As in other pastoral areas, the demographic trends in the Termit and Tin Toumma complex analysis is very complex, given the many parameters that make it difficult to collect data on population numbers, including population mobility and spatial dispersion, belonging to an attachment point other than the territory where

the count is being carried out, the isolation and vastness of the area, etc. The analysis of demographic trends in the Termit and Tin Toumma complex is also very complex, given many parameters that make it difficult to collect data on population numbers, including population mobility and spatial dispersion, belonging to an attachment point other than the territory where the count is being carried out, the isolation and vastness of the area, etc. However, according to the results of surveys carried out by the ASS Project in 2011, the population is estimated at around 2,000 in the Termit massif, while information gathered in the field in 2022 extrapolates it to around 1,800. However, these figures are far from reflecting the actual demographic situation, as permanent mobility makes it difficult to assess the size of the population.

MATERIALS AND METHODS

Basic material and data used

The following appropriate hardware and software were used to carry out this study. These included interview guides for collecting survey data, a GPS receiver for taking coordinates, a camera for taking illustrative views, a pair of binoculars used for remote observations in the field, and a Cybertracker. This enabled us to map the itinerary followed for the various surveys and to monitor plant and wildlife species. Travelling cameras are also used, as well as topographic maps (sheets ND-32-XXIII and ND-32-XXIV, at 1/200000, from 1965 and ND-32-NE-V from 1987 at 1/500.000) and a Sentinel 2B image from 2024. SPSS software and Excel spreadsheets are used for data entry and graphing, while ArcGIS software is used for cartographic work.

Methodology used

In the context of the Termit and Tin Toumma complex, the difficulty of undertaking a study lies not only in access to the area, linked to its isolation and vastness, but also and above all in the spatial dispersion and mobility of the populations living there.

The methodological approach adopted is structured around three main axes. The first was a literature search, which enabled us to establish the current state of knowledge on the topic in question and general information on the area.

In fact, the heritage process involves a number of fundamental stages, including invention, storytelling, heritage awareness, heritage enhancement, heritage conservation, and so on. (VALERIE Mt-C. & al,2003 ; FRANÇOIS, H., HIRCZAK, M. & SENIL, N. 2006).

The second axis of this methodology concerns data collection, which took place in three phases: direct observations, field surveys and group interviews. In order to better define the scope of this study, the scale of investigation was determined, and this was limited to the Termit mountain range and its immediate surroundings, which form an integral part of the Tin Toumma desert. Next, we identified the local stakeholders involved in participatory biodiversity management and assessed their degree of ownership of this biodiversity, in the same way as we assessed their natural heritage. Following a well-defined transect, the biodiversity and other resources present in the study area were surveyed and visually identified. But this inventory work complements those already carried out, in a fairly exhaustive manner, by Niamey University Botany Department (2007) and the SSA Project team between 2011 and 2016. The aim was to gather and analyze information from a wide range of sources and characteristics, in order to gain a better understanding of the process by which the biodiversity of the Termit and Tin Toumma complex has been given a heritage status by local communities. As for the group interviews, they concerned the populations living in the Termit massif and its immediate surroundings, and took place exclusively at the water points, in particular the wells at Termit Kaouboul (93 people), Termit Fini-Fini (60 people) and Termit Dougoulé (114 people) in October 2022, i.e., a total of two hundred and sixty-seven (267) people. The interviews took the form of focus groups. Indeed, the mobility of the camps in search of pasture made data collection difficult, and for socio-cultural reasons specific to this community (Toubou), interviews with the female class did not take place, which does not allow the gender aspect to be taken into account in the present study. The exclusively nomadic nature of the populations in the study area made it impossible to sample the target population, whose total size is difficult to define precisely. The data collected enabled us to assess the willingness of local populations to appropriate the biodiversity of this study area as their natural heritage. The main themes of the interviews related to the communities' opinions on the existence of the Reserve (RNNTT), their involvement in the process of its creation and the appropriation of its resources as natural heritage, among others.

The third aspect of the methodology is the processing of the information collected using SPSS and ArcGis software, as well as the Excel spreadsheet, the results of which are geospatialized, analyzed and interpreted.

RESULTS

The patrimonialization of the natural resources of the Termit and Tin Toumma complex implies ideas of consensus and awareness in the collective appropriation of biodiversity by the riparian community, with a view to establishing it as a natural heritage. This process could involve establishing rules for the conservation, protection and sustainable use of biological diversity. In the context of this work, the data collected mainly concern the landscape, flora, avifauna and fauna, with particular emphasis on wildlife resources.

Biodiversity (natural attributes) of the Termit and Tin Toumma complex

Two types of data were collected: firstly, the results of work carried out by the Project "Antilopes Sahélo Sahariennes (ASS Project)" and the Sahara Conservation Fund (SCF) as part of the creation of the "Réserve Naturelle Nationale de Termit et Tin Toumma (RNNTT)", then by Niamey University Biology Department, and secondly, those obtained as part of the present study. The aim was to draw up an inventory of the biodiversity of this characteristic Sahelo-Saharan environment, which, because of its content, constitutes a natural heritage for local populations that must be preserved in the long term. This complex is home to a remarkable desert flora, as well as endangered wildlife species that are well adapted to the harsh conditions of desert environments (*Addax nasomaculatus*, *Acinonyx jubatus hecki*, *Nanger dama*, etc.), making them emblematic and potentially heritage species.

Results of the wildlife inventory of the Termit and Tin Toumma complex

The fauna in the study area is typical of Sahelo-Saharan environments. Observations have highlighted the existence of *Addax Nasomaculatus* (Picture No. 1:), which is an emblematic species of the area, but also other species such as the *Gazella dorcas* (Picture No. 2).

Picture No. 1: Addax on the edge of the Termit massif
Photo credit : ASS Project, 2009

Picture No. 2: Gazella dorcas at Termit.
Photo credit: K.Lawandi,2022

The *Ammotrogus lervia* (Picture No. 3) and the *Gazella dama* (Picture No. 4) are also present in the Termit mountain range, although they are difficult to observe, probably due to their permanent mobility in the different compartments of this environment.

Picture No. 3: Ammotrogus lervia at Termit

Picture No. 4: Nanger dama at Termit.
Photo credit: ASS Project, 2009

Carnivores have also been observed, notably the *Canis aureus* (Picture No. 6), present in all environments, but also the *Fennecus zerda*, *Vulpes ruepelli*, and *Vulpes pallida* more present in sandy environments. Also found here are the *Mellivora capensis*, *Hyæna hyæna*, *Felis margarita*, *caracal limpopoensis* and *Acinonyx jubatus* (Picture No. 5).

Picture No. 5: Acinonyx jubatus at Termit.
Photo credit: ASS Project, 2009

Picture No. 6: Canis aureus at Termit.
Photo credit: K.Lawandi,2022

The area is also home to a number of reptiles, including the *Cerastes cerastes*, the *Acanthodactylus aureus*, the *Varanus griseus*, the *Eryx jaculus* and *Centrochelys sulcata* (ASS Project, 2008). With regard to avifauna, more than a hundred species were observed and identified by the ASS Project in 2008, including twenty-seven (27) resident species such as *Torgos tracheliotos*, *Gyps rueppellii*, *Passer simplex* and guinea fowl, *Numididae*, as well as migratory species. The most emblematic for local populations are the *Neotis nub*) and the *Ardeotis arabs*.

Results of the floristic inventory of the Termit and Tin Toumma complex

The flora of the Termit and Tin Toumma complex varies according to landscape unit. The woody vegetation consists of *Acacia raddiana, Balanites aegyptiaca, Salvadora persica, Commiphora africana, Maerua cracifolia,* etc. and herbaceous around the massif. In the Tin Toumma desert, annual to multi-annual grasses, characteristic of Sahelo-Saharan environments, can be observed (*Panicum turgidum, Cyperus conglomeratus, Indigofera argentea, Aristida mutabilis, Stipagrostis vulnerans; Cornulaca monacantha*). Picture No. 7 illustrates some of the plant species found at Tin Touma.

Picture No. 7: *Stipagrostis acutiflora* (A); *Cornulaca monocanta* (B) et *Salvadora persica* (C) at Tin Toumma.
Photo credit: K.Lawandi,2022

The Figure No3 shows the distribution of biodiversity within the different landscape units of the Termit and Tin Toumma complex. This map shows that the most represented species is the Gazella Dorcas, which can be observed in almost all landscape units. As for the Addax nasomaculatus, it lives particularly in the eastern part of the massif, notably in the Tin Toumma desert. It often descends to the outskirts of the massif, especially during periods of extreme heat. The dunes are also home to carnivores (Canis aureus, Fennecus zerda, etc.) and avifauna, the most emblematic of which is the bustard.

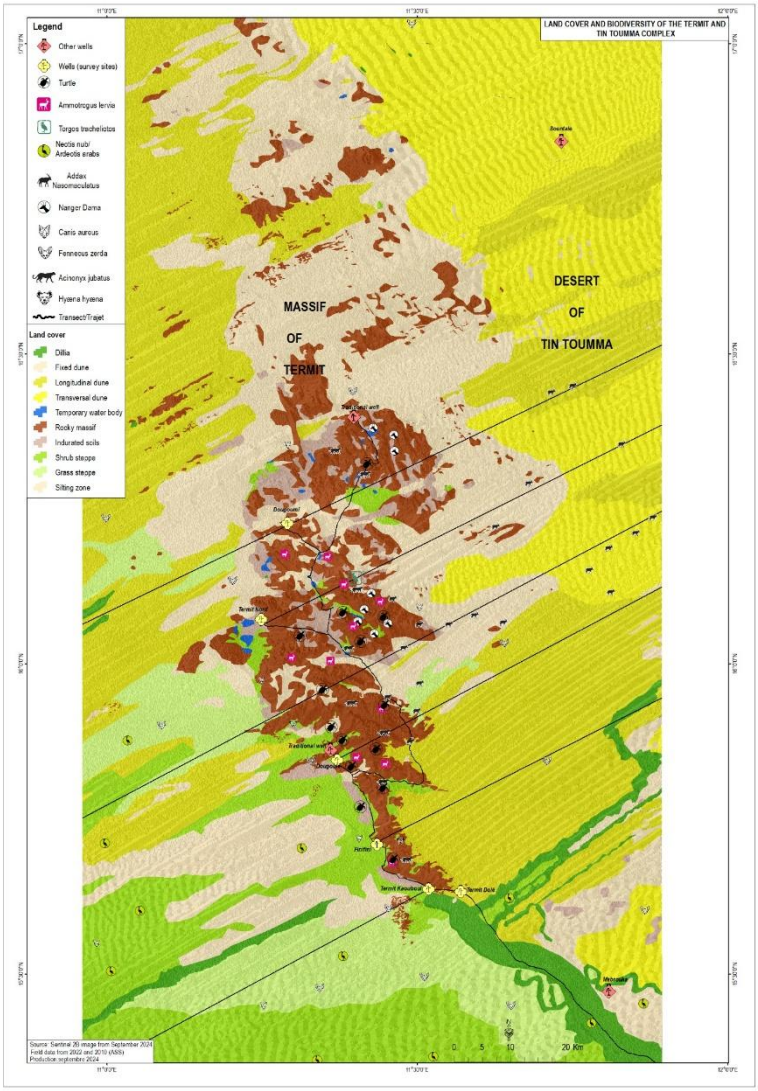

Figure No.3: Fauna distribution in the surrounding units of the Termit massif
Source: Field data 2022/ ASS Project 2010/Sentinel 2B image of September 2024.

Local actors at the Termit and Tin Toumma complex

Participatory management of biodiversity in the Termit and Tin Toumma complex involves several players, including the State, local and administrative authorities, NGOs and local communities. In terms of biodiversity heritage, the people living near the complex are considered to be the key actors at local level. Made up exclusively of the Toubou community (whose interviewees ranged in age from 35 to 70), they are a key player in the preservation of the complex natural heritage of Termit and Tin Toumma, and as such, their participation would be necessary as the repository of traditional know-how. Involved in decision-making and empowered in the management of biodiversity, its commitment is an important asset given the roles it will be called upon to play. Indeed, it has demonstrated its ability to contribute to the success of local development actions initiated by the State and NGOs, including collaboration in the protection of the area's pastoral systems and its participation in the process of creating the Termit and Tin Toumma National Nature Reserve (RNNTT). In fact, certain aspects of the conservation of the natural attributes of the study area depend on the local population's heritage and ability to play an active role in the biological diversity management. The local population had already committed to contributing to the protection of wildlife alongside the ASS Project, which was working to safeguard the area's biodiversity. The role of the local authorities has been decisive in both decision-making and implementation, as they have a strong influence and esteem among their constituents. Their contact with local residents makes it easier to raise their awareness and integrate them into the decision-making and participatory management system for the area's more sustainable natural heritage. The Picture No. 8 shows a maintenance view of the Termit Dougoulé well.

Picture No. 8: Maintenance at the Termit Dougoulé well. Photo credit : K. Lawandi, 2022

Biodiversity patrimonialization of the Termit and Tin Toumma complex

A reading of the existing literature reveals an abundance of points of view on the subject of patrimonialization, most of which focus on the processes involved in constructing heritage and the collective appropriation of what is considered a *"common good"*.

Indeed, the creation of the Termit and Tin Toumma National Nature Reserve (RNNTT) was carried out in a way that involved the local population at every stage. This involvement can be seen as a first step in the process of conscious appropriation of biodiversity by the local population as a *"collective asset"* to be preserved and bequeathed to future generations. During field interviews, ninety-six percent (96%) of respondents stated that the local population had been involved right from the start of the process of classifying the Reserve (RNNTT). One of the assets of this population is its perfect knowledge of the content (biodiversity) of its living environment, and its jealousy to preserve it. This demonstrates an awakening of awareness and a clear desire to make the biological diversity of the Termit and Tin Toumma complex part of their heritage, as opposed to the protectionist approach to natural heritage management once advocated by the State, which had cultivated a sense of frustration within local communities. This was also the case in the Termit and Tin Toumma complex prior to the creation of the RNNTT, where the local population contributed to the destruction of the fauna through activities unorthodox to the sustainable management of this natural heritage (poaching, abusive hunting, etc.). But the local population has now become aware of the importance of this natural wealth, especially its wildlife. However, the true awareness of the population in this area reached its peak with the intervention of the Sahelo-Saharan Antelope Project, which pleaded with local communities for their real involvement in the protection of biodiversity. To this end, the workshop organized at the Termit Dolé well from May 11 to 13, 2007 by the ASS Project is the trigger for the process of patrimonialization of resources, especially when local populations and customary authorities declare that: "*Aware that the future of livestock breeding and pastoralism is linked to the preservation of our heritage, we are prepared to spare no effort in working alongside the Antelope-Sahelo-Saharan Project and all development partners to achieve the new objectives we have set ourselves"*. Picture No. 9 shows an awareness-raising session with the local population at the Termit Dolé well.

Picture No. 9: Awareness-raising with the local population at the Termit Dolé well. Photo credit: ASS Project, 2007

The second act of resource patrimonialization by the natives of the Termit Tin Toumma complex is the *"Declaration of Dougoulé"*. From June 24 to 25, 2010, at the Dougoulé well (Termit), some fifty participants from the Toubou camps on the outskirts of the massif took part in the second workshop on the preservation of wildlife heritage, under the aegis of the ASS Project. At the end of the meeting, the population felt involved and empowered in protecting the biodiversity of the Termit and Tin Toumma complex, and committed to its preservation. They have reaffirmed their awareness and desire to protect this natural heritage in the following terms: *«For us, the Bustards are our chickens, the Gazelles are our sheep and goats, the Addax our cows, the jackals our dogs……If we have pasture and rain today, it's thanks to wildlife and flora. They are essential to our diet and to the treatment of certain diseases. Their disappearance would be a threat to us, and so we consider them our common property»*. During group interviews at the Dougoulé well, one of the respondents stated that "the presence of wildlife is for us an indicator of the excellent health of our herds, to which we are attached for our survival. The destruction of this wildlife will have a very negative impact on our local way of life. Better still, the presence of wildlife is also synonymous with abundant rainfall for us". Indeed, one of the striking aspects of this environment is the cohabitation between wildlife and domestic animals, although for the latter certain carnivores pose a threat to livestock, the most dreaded of which is the jackal. Field interviews showed that 94% of respondents were very much in favor of classifying their living environment as a Protected Area (RNNTT), compared with 04% who felt that the creation of the Reserve was not a good option for them, on the grounds that access to and management of their natural resources would henceforth be restricted, while 02% had no opinion.

The people who live around the Termit and Tin Toumma complex are proud of the new status of their living environment and the authenticity of their natural heritage, embodied in the biodiversity, especially of the fauna. A strong sense of collective duty to preserve and bequeath this heritage to future generations is expressed by the community living along the Termit massif and its surroundings, and this desire presupposes the patrimonialization of biodiversity.

DISCUSSION

The Termit and Tin Toumma complex is a Sahelo-Saharan ecotone with remarkable biodiversity and a landscape that is characteristic of both ecosystems. With regard to fauna, our results support those of certain authors who have long asserted the richness of this zone, including the accounts and studies from the 50s and 60s by RIOU, M. (1955), cited by BELLO, I.N. (2013) and METZ, A. (1961). These authors mentioned having observed high concentrations of *Nanger dama*, *Gazella dorcas* and *Oryx leucoryx* in the Termit area, as well as the presence of a varied fauna. The Termit Massif was also particularly rich in fauna, and already raised the need to create a Protected Area to safeguard this Saharan fauna. Several rare species have been observed, notably the *Addax nasomaculatus*, considered endangered or extinct over most of its historical range (NEWBY, J.E.& MAGIN, C.1990; C.1990; PFEFFER, P. 1995, BEUDELS-JAMAR, R.C.& al.1999 EAST, R.1999), as are the *Hyæna hyæna*, the *Ammotrogus lervia*, the *Acinonyx jubatus*, the Canis aureus, etc., which are still present in this area (TUBIANA, J. 2002; CLARO, F. & al. 2007, RABEIL, T. & VINCENT, T.2016). Avifauna is also present in the area, with species such as *Ardeotis arabs*, *Neotis nuba*, *Torgos tracheliotos, Gyps rueppellii, Passer simplex,Numididae,* etc., as well as migratory birds. These results confirm those of ASS Project and SCF 1996; BELLO, I.N. (2013); RABEIL, T. & VINCENT, T. (2016), KANEMBOU, L. (2016).

Despite its desert character, the Termit and Tin Toumma complex boasts a diversity of flora, with woody vegetation, herbaceous and annual to multi-annual grass species typical of arid environments. Some of these relict species are still found in the area, making it a place of scientific interest and biodiversity conservation. The results of the present study corroborate those of ASS Project and Sahara Conservation Fund (1996); the Botany Department of the University of Niamey (2007), BELLO, I.N. (2013); MH/E, (1996); RABEIL, T. & VINCENT, T. (2016), and KANEMBOU, L. (2016) who have shown the floristic richness of the Termit and Tin-Toumma complex. In terms of biodiversity heritage, the massif and its immediate surroundings are inhabited by the Toubou community, estimated at 1,800 to 2,000 inhabitants (2022 field survey, ASS, 2008), who are the main local players in the participative management of biodiversity in the study area, for the sustainable conservation of this natural heritage.

Numerous studies have demonstrated the need for participatory natural resource management in the face of the shortcomings observed in state management systems (WADE, R.1987, BERTRAND, A.1998, ROCHEGUDE, A.1998; VINCENT, P.1998; NDAME, J.P. 2002; RIBOT, C.J. 2009; TALL, S.M. et GUEYE, M.B.2003, DJIRE, M.2003; BANZHAF, M.2005; LAVIGNE DELVILLE, Ph, 2009, GRANIER, L.2010). In the case of the Termit and Tin Toumma complex, the effective involvement of the local population can make an effective contribution to the sustainable management of biodiversity. For this reason, it is essential that the biological diversity of this study area be given a heritage status in order to conserve this natural potential within the framework of participatory management. This corroborates the view of some authors that natural heritage, through its close relationship with populations or population groups, contributes to the conservation of biological resources and associated traditional knowledge (AMADOU, B. and LUXERAU, A. 2004; ALI DIALLO, B.2004, FULCONIS. R., 2009; ALHASSOUMI SOW, S. & BOUTRAIS, J.2004; MICHEL. V., 2011). In the present study area, the local population is aware of the importance of the biodiversity of their environment and expresses a sense of ownership of it, hence an awakening of spirit for a desire for sustainable conservation. These results confirm those of other studies carried out in the area (ASS Project and Sahara Conservation Fund,1996; MH/E., 1996; BAROIN, C.2003.; BELLO, I.N. 2013; KANEMBOU, L.2016). Also, the success of sustainable biodiversity management depends in part on the involvement of local authorities, as this will generate a collective dynamic and create a synergy tending to preserve natural attributes. This proves the plurality of actors and strategies mentioned by some authors, including CHEVALIER, D. 2000; RAUTENBERG, M. et al., 2000, M.-C. CORMIER-SALEM, et al., 2002&2005.

CONCLUSION

The Termit and Tin Toumma complex is home to a biodiversity characteristic of arid environments. It is made up of a rich flora and fauna, and a contrasting landscape.

However, the fragile biological diversity of this environment requires protection for conservation and sustainable management. With participatory management now underway, local stakeholders' ownership of this biological diversity is a guarantee of protection and sustainable management. This is why the appropriation of this biological diversity by the local population as local natural heritage is an essential factor for its conservation, and this was the case for the present study area.

The various awareness-raising campaigns carried out among the inhabitants of this complex have raised their awareness of the importance of biodiversity, with a strong sense of ownership of the natural resources it expresses.

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