ESJ Humanities Peer-reviewed

Factors of PONASI Ecological Complex Resource Degradation

Zougmore Wend-kuni Dina Antine
Phd in Geography, Virtual University of Burkina Faso
Kabore Oumar
Researcher at INERA/CNRST in Burkina Faso
Dipama Jean-Marie
Lecturer in Geography, Joseph KI-ZERBO University, Burkina Faso

Doi:10.19044/esj.2025.v21n26p123

Submitted: 24 January 2025
Accepted: 24 September 2025
Published: 30 September 2025

Cite As:
Zougmore, W.D.A., Kabore, O. & Dipama, J-M. (2025). *Factors of PONASI Ecological Complex Resource Degradation*. European Scientific Journal, ESJ, 21 (26), 123. https://doi.org/10.19044/esj.2025.v21n26p123

Abstract

PONASI is an ecological complex which is located in the southern part of Burkina Faso. It abounds with fauna and floristic species. But these resources are in a phase of degradation. The aim of this study is to analyze the main factors contributing to the degradation of the PONASI ecological complex. In order to assess the degradation factors, a systematic approach was used. It is an approach that takes into account the various phenomena responsible for degradation and the interactions. Data collection techniques focused on documentary research, interviews, field surveys, the use of the snowball sampling method, and the processing of some climatic parameters. For this research, a total of twelve (12) villages were surveyed. The results showed that anthropogenic and climatic factors contribute to the degradation of the resources of the PONASI ecological complex. The anthropogenic factors consist of vegetation fires, wood cutting, grazing, and picking immature fruit, and agricultural encroachment. These factors are exacerbated by the limits of governance which result in a lack of legal texts' application, a weak appropriation of the decentralization policy by the local authorities. The results of this study have demonstrated that there are a multitude of factors that contribute to the degradation of the PONASI ecological complex. It is urgent to take the necessary measures to reverse this trend of degradation.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Keywords: Governance, factor, degradation, decentralization, Burkina Faso

Introduction

In Burkina Faso, the forest domain consists of seventy-seven (77) classified areas, including sixty-five (65) classified forests. Within these classified forests, there are several factors of anthropization of classified forests, the most important factor of which is agricultural exploitation, followed by the construction of socio-economic infrastructure. This phenomenon is observed in more than 50% of classified forests. In addition to this illegal activity, there are also climatic conditions, green wood cutting, vegetation fires, overgrazing, and poaching, which contribute to a degradation of classified forests at 71 to 77% (MECV, 2007).

PONASI ecological complex is part of the Burkina Faso forest domain. It is located in the south-central region of Burkina Faso. It is made up of five large ecological entities, which are National Kaboré Tambi National Parc, Nazinga wild game ranch, the classified forest of Sissili, two corridors and 11 village areas of hunting interest. The Nazinga wild game ranch and the classified forest of Sissili are located in the Central-South of Burkina Faso, on the border of Ghana between the cities of Po in the East and Leo in the west. The map below (fig. 1) shows the five important ecological parts of the complex.

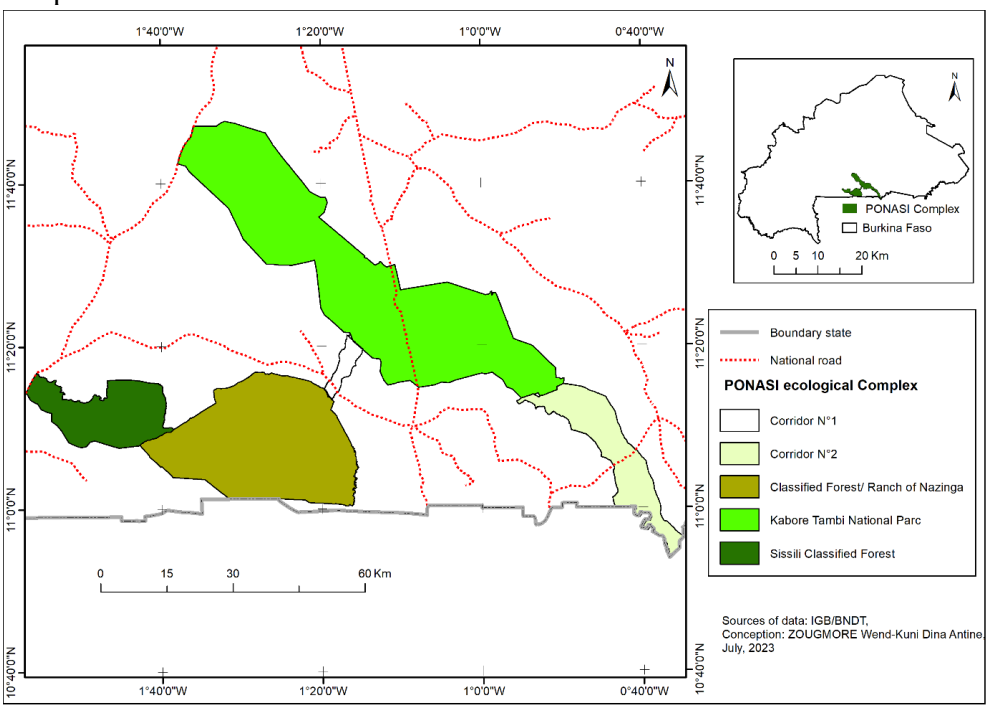


Fig 1: PONASI ecological main entities

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

It straddles three regions of Burkina Faso and it constitutes a reservoir of diversity of animal and plant species.

Burkina Faso's main natural resources are land, water, forestry, wildlife, fisheries, pastoral and mining resources (MECV, 2005). But these resources are in a state of advanced degradation. The causes are mainly anthropogenic (MECV, 2005; MEEVCC, 2020).

Protected areas are the cornerstones of conservation efforts to mitigate anthropogenic pressures leading to biodiversity loss. They undergo rapid modifications. As an example, the study on the resistance capacity to habitat loss of 160,000 protected areas revealed that between 2003 and 2019, 1.14 million km^2 of habitat in 73% of protected areas were modified (Li *et al.,*2024).

The aim of this study is to analyze the factors linked to resource degradation in the PONASI ecological complex.

Its statutes, although different, give it different but complementary modes of operation. In order to help reverse the degradation trend, this study opted for a methodological approach based on a systemic approach.

Materials and Methods

The systemic approach

The methodology used in this study was based on the systemic approach. It is a method that takes into account all biophysical and human components and their interactions (Dipama, 2011). This approach has been relayed by techniques and tools for collecting and processing data related to surveys and spatial analysis (Kaboré and Dipama, 2014). It has been applied in this study because it takes into account the interconnection between biophysical parameters such as rainfall and temperature (Dipama, 2014).

It is an approach based on epistemology and a transdisciplinary methodology that is based on the concept of a system. This system represents a set of elements with enough interrelationships to form a relatively coherent and homogeneous whole.

This study supposes that there are several factors, including the mode of governance, climate, population growth, and anthropogenic factors that are responsible for forest dynamics, and these factors interact with each other. This justifies the adoption of the systems approach to analyze the interconnections between several factors to explain the causes of this degradation. The analysis of the factors that are at the origin of the dynamics of forest resources was made over a period of thirty (30) years.

Sampling methods

For this research, a total of twelve (12) villages were surveyed. In the urban municipality of Po, the villages of Bourou, Tiakané and Yaro were

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

surveyed. In Guiaro, which is a rural municipality, the survey was conducted in Kollo, Oualem and Saro. In the urban municipality of Sapouy, the study was undertaken at Baouiga, Gallo and Tiakouré. In the rural municipality of Nobéré, the survey was carried out in the villages of Seloghin, Soulougré and Tamsé.

In each village, 10% of households were surveyed, totalling 228 households surveyed using the snowball method.

The interviews were held at municipal, departmental, regional and national levels with the administrative authorities and local elected authorities.

- **Interview guides**

The interview guides were used to conduct individual interviews with the stakeholders involved in the governance of the PONASI forest resources of the ecological complex at the national, regional, communal and village levels.

- **The questionnaires**

Questionnaires were sent to the sample of people interviewed in twelve (12) villages bordering the ecological complex PONASI. To carry out this study, surveys were carried out in two urban and rural municipalities adjacent to the ecological complex PONASI.

Data processing tools

- The Excel 2016 software: This software was mainly used in the processing of statistical data and the design of some graphs.
- Sphinx V5 software was used to process the qualitative data collected during the survey.
- QGIS 2.18 software was used to design the map.

The Results

The results of this research reveal that there are direct and indirect factors that are responsible for the degradation and deforestation of PONASI'S forest resources.

Several anthropogenic indices were observed through many surveys on different dates. These include farms, footprints of cattle, direct contact with livestock, facilities and the presence of basic infrastructure (health centres, schools, drinking fountains, cabins or houses, trails), pedestrian tracks, bicycle tracks and other gear (NatuDev, 2018; Bouché, 2005).

Anthropogenic factors

Wildlife and floristic species are now threatened by the persistence of constraints such as poaching, overgrazing, degradation of wildlife habitat by wildfires and the collection of building materials (sand, gravel, stubble, etc.), cutting wood for construction and firewood (MECV-PAGEN, 2006). Rural activities such as vegetation fires, agriculture, pastoralism, and hunting are

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

also sources of degradation of natural resources (Dipama, 2011). Five (5) signs of poaching were observed, including one identified poacher and the remains of a dead elephant, dug holes and dog tracks (NatuDev, 2018).

Vegetation fires

According to 80% of the surveyed households bordering the ecological complex PONASI, vegetation fires are the primary factor in the degradation of forest resources. According to them, the fire is often caused by breeders to facilitate the regrowth of young herbs. Poachers often use this practice to remove small game from their habitat. These fires reduce the capacity of the production of non-timber forest products. This is also exacerbated by the level of competition between humans and wildlife for the use of these same products. Several indications of poaching have been observed in Corridor N°1. These include contact with poachers, animal carcass remains, and dog tracks (NatuDev, 2018). The photo below is an illustrative photo of the presence of vegetation fires within the complex (fig. 2).

Fig.2 : Traces of fire passage within the Nazinga wild game ranch in the part that borders the village areas of hunting interest of Koumbili. Photo credit: ZOUGMORE Wend-kuni Dina Antine April, 2019

Wood cutting

Cuts and piles of wood were observed in some places, especially in the south of the site . Some coal piles were observed in the north and south of the site.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Fig. 3 Wood Cutting at Kaboré Tambi National Park and Nazinga wild game ranch. Photo credit: ZOUGMORE W. Dina Antine

Figure 3 shows a karitier tree (*Vitelaria paradoxa*) that has been cut down. Beyond this, there is the cutting of green wood, which is strictly prohibited within the limits of protected areas, but these forbidden practices are observed and are very common within the complex protected areas. 19 signs of natural resource exploitation were recorded, including tree felling and the presence of charcoal pits. Each of these phenomena was observed seven (7) times, representing a percentage of 37% for each offence.

Grazing and picking immature fruit

The PONASI complex is faced with a strong presence of livestock within it. The inventory carried out by NatuDev (2018) revealed the presence of livestock in the corridor. 107 signs of encroachment have been observed (fields, livestock contact, presence of tracks) and 28 traces of livestock have been recorded. This represents 26% of the encroachment signs.

The presence of these livestock in these ecological entities creates competition between them and wild animals for the use of non-timber forest products. The riparian population that also exploits these same resources contributes to exacerbating this competition. According to 40% of the households surveyed, harvesting immature non-timber forest products is the third most important offence.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Fig. 4. Cattle herd in Corridor N°1. Photo credit: ZOUGMORE W. Dina Antine June, 2020

Figure 4 illustrates the presence of livestock in the Corridor N°1.

According to the breeders, the complex is a favourable area for grazing activities. Land pressures are very strong outside the PONASI ecological complex, and this does not allow them to graze their herds outside the complex. Also, this choice allows them to avoid conflicts with farmers, especially during the rainy season.

The agricultural encroachment

The boundaries of Corridor N°1 are adjacent to several agricultural fields. Large areas of village and hunting interest are being converted to agricultural land. This poses significant threats to the conservation of key ecological entities such as the Kaboré Tambi National Park and the Nazinga wild game ranch.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Fig. 5. Proximity between corridor N°1 and the field

Photo credit: ZOUGMORE W. Dina Antine, April, 2020

Fig. 6. Proximity of Nazinga wild game ranch boundaries to a field

Photo credit: ZOUGMORE W. Dina Antine, April, 2020

Figures 5 and 6 show the agricultural pressure on some entities of the protected areas.

The photo in fig. 5 was taken on the Po-Guiaro axis. To the right, the limit of corridor N°1can be seen, and to the left, the limit of an agricultural crops field.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Figure 6 was taken between the borders of the Nazinga wild game ranch and the village areas of hunting interest of Koumbili, part of which has been reconverted to the benefit of cultural practices. On the left and right are the Nazinga wild game ranch and the village areas of hunting interest of Koumbili, respectively. The inventory conducted by NatuDev (2018) provided figures on encroachment in the Corridor. This study revealed the presence of human activity in this ecological entity. Of the 107 signs of encroachment observed (fields, livestock contact, presence of tracks), 58 traces of human presence (farms, footprints or bicycle tracks, human installations) were recorded. This represents 54% of the encroachment signs.

These pressures are quite widespread between the Nazinga wild game ranch, the corridor and the village areas of hunting interest. These photos serve as an illustration of the land pressures facing the PONASI ecological complex. This calls for urgent measures to be taken for the conservation of the boundaries of the PONASI ecological complex.

Climate Factors

Rainfall and temperature are two main parameters for analysing changes in climate conditions over time (Ouédraogo, 2012; Karambiri, 2017). But temperature is the most sensitive parameter in the assessment of the climate. It is the one that influences the evolution of vegetation. They are also the climatic parameters whose dynamics are easily discernible by the population (Dipama, 2014). For the analysis of some climatic parameters, the data of the synoptic scale were retained for several reasons.

Rainfall trends 1993 to 2023

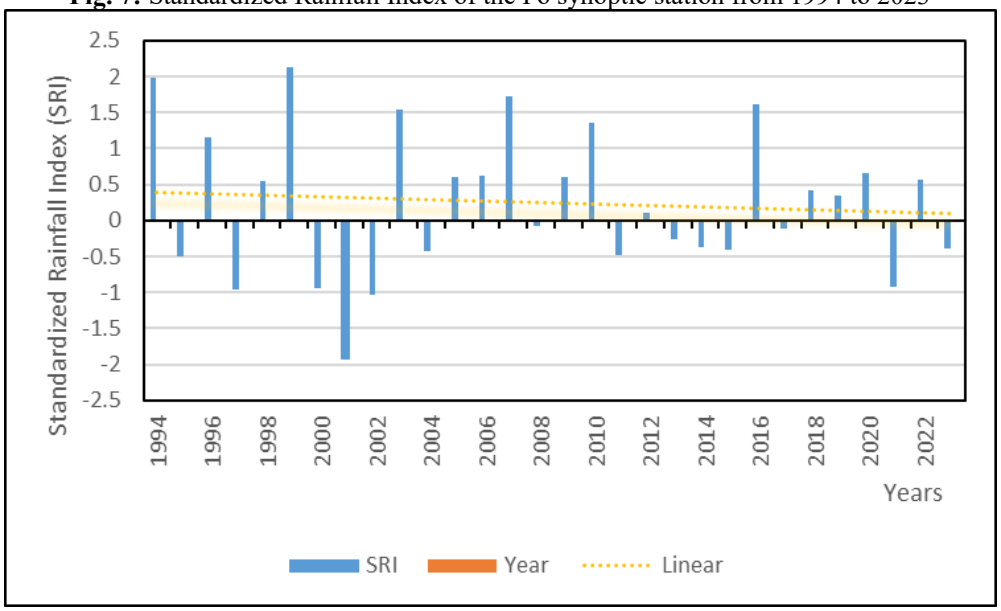
The Standardised Rainfall Index (SRI) and the shadow thermal diagram are tools for characterizing rainfall (Ouédraogo, 2012; Karambiri, 2017).

- **Standardized Rainfall Index (SRI) of Po synoptic station from 1993 to 2023**

The SPI highlights inter-annual variability and rainfall trends by distinguishing the rainy season's surplus and deficit. The surplus and deficit rainy seasons are above and below axis 0, respectively.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Fig. 7: Standardized Rainfall Index of the Po synoptic station from 1994 to 2023



Data Sources: National Meteorological Agency of Burkina Faso, 2023

Figure 7 shows the rainfall trends of the Po synoptic station from 1994 to 2023.

The SRI highlights inter-annual variability and rainfall trends by distinguishing the rainy seasons' surplus and deficit. This figure shows the rainfall trends of the Po synoptic station from 1994 to 2023. The bars above axis 0 represent positive SRI values and reflect years of rainfall surpluses. However, the bars below axis 0 are negative SRI values and correspond to years of poor rainfall. The analysis of this figure shows a succession of years of excess and deficit rainfall. First, from 1994 to 1999, the years of excess and deficit rainfall alternate with a continuation of the rainfall deficit over a period of two successive years from 2000 to 2003. From 2004 to 2023, the alternation of years of excess and deficit rainfall was confirmed with a succession ranging from two to three years in a row.

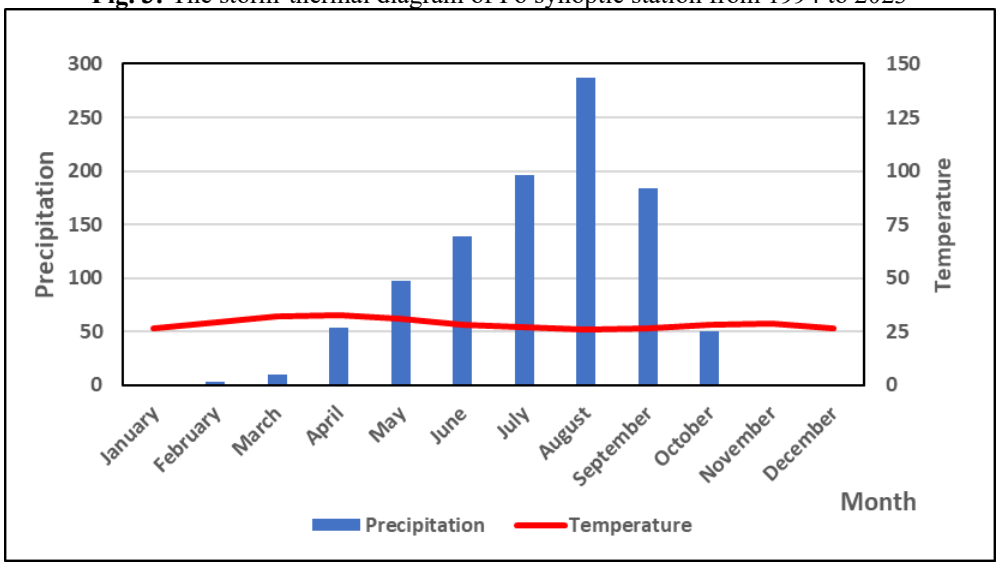
1999 was the year with the largest rainfall surplus and 2001 the year with the largest rainfall deficit. The trend curve is almost confused with axis 0 and is almost stationary. This reflects the fairly frequent succession and the equal number of years of excess and deficit rainfall.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

The Storm-Thermal Diagram

The dry season can be determined by defining the dry month, which corresponds to the month in which the monthly sum of precipitation in millimetres is less than or equal to twice the monthly average temperature in degrees centigrade. The formula is P < 2T, which allows to draw up BAGNOULS and GAUSSEN thermal shading diagrams.
In this type of diagram, the dry month is considered.

Fig. 3: The storm-thermal diagram of Po synoptic station from 1994 to 2023



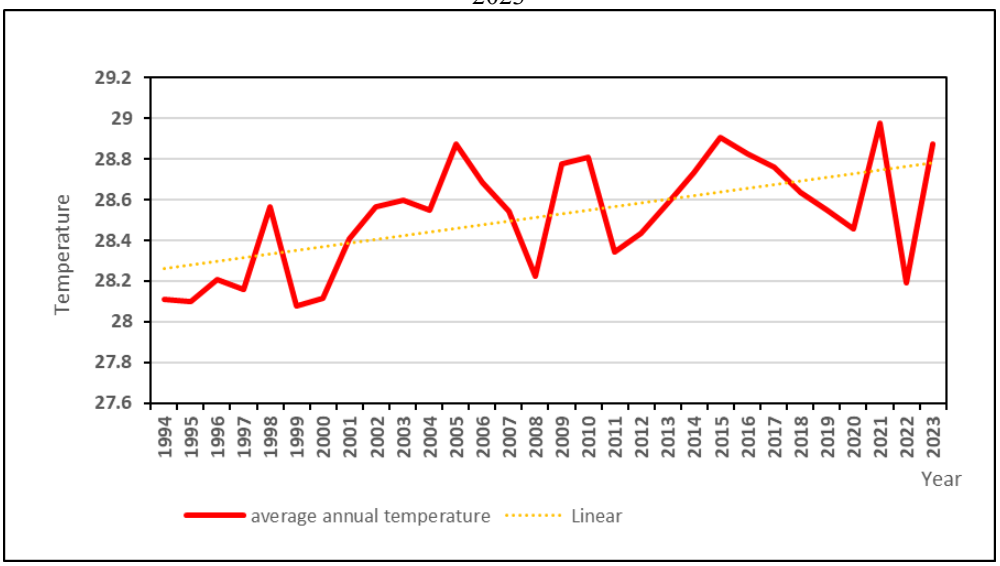
Data Sources: National Meteorological Agency of Burkina Faso, 2023

Figure 3 indicates that the months of January, February, March, April, October, November, and December are dry months. Therefore, it can be deduced that during the period of 1994 to 2023, the dry season generally lasted for a period of seven (7) months on the area which is covered by the Po synoptic station. On the other hand, the rainy months are those of May, June, July, August, and September. Therefore, the rainy season is shorter than the dry season.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Temperature

Fig. 4: Annual average evolution of temperatures of the Po synoptic station from 1994 to 2023



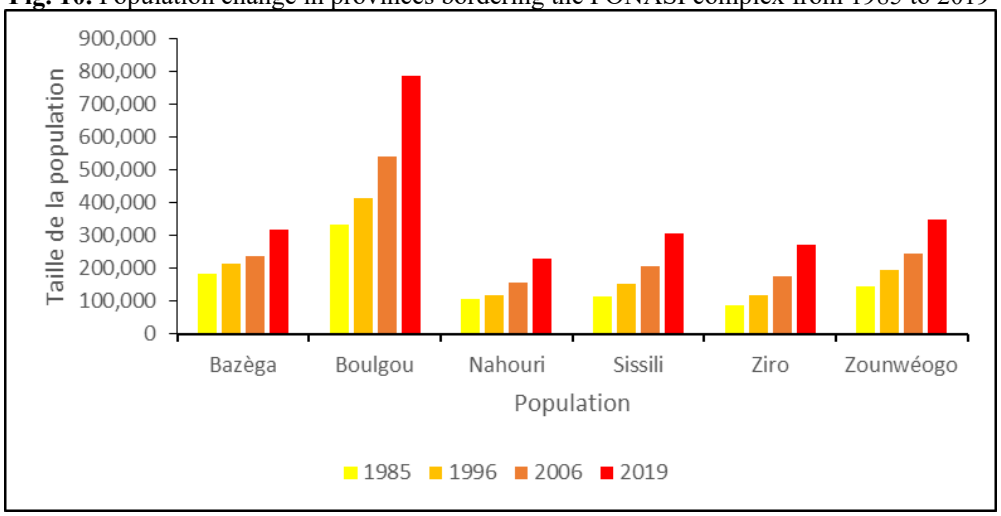
Data Sources: National Meteorological Agency, 2023

The curve has been plotted using data from the monthly average temperatures of the Po synoptic station from 1994 to 2023. It reflects a fairly large increase in inter-annual variability. The trend line confirms this because its growth is continuous throughout the analysis period. In 1989, the trend line indicates that the annual average temperature value is between 28, 0 and 28, 1°C. It continued to oscillate and reached almost 28,8 in 2018. This upward trend in temperature contributes to the wilting of vegetation (Dipama, 2014).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Demographic factors

Fig. 10. Population change in provinces bordering the PONASI complex from 1985 to 2019



Sources of data: INSD 1985, 1996, 2006, 2019

Figure 10 summarizes the population growth of the six (6) provinces bordering the PONASI ecological complex between 1985 and 2019.

Figure 10 shows that the population sizes of the six 6 provinces bordering the PONASI ecological complex increased steadily from 1985 to 2019. On average, the size of these populations has doubled in some areas. This is explained by the convergence of the mass of migrants towards these areas. They are looking for agricultural land. In fact, non-native populations who are looking for better living conditions are the main actors responsible for the change in land use. They switch from subsistence agriculture to cash crop farming in order to increase their income. These new behaviours contribute significantly to the emergence of new areas occupied by plant formations.

Discussion

Factors of natural resource degradation can be categorized as direct (proximate) and indirect (underlying) factors (Arouna, 2012; Geist and Lambin, 2002). According to Mengistu and Woldetsedik (2018), changes in land use are caused by a synergy of factors at different levels. The interactions between proximate and underlying factors are complex (Geist and Lambin, 2002). Direct factors are those whose effects directly contribute to the degradation of plant resources. They include agriculture and charcoal production (Odum, 2024). The indirect causes, which operate at a much wider scale are boost the direct causes (Geist and Lambin, 2002). Indirect factors influence direct factors and contribute to intensifying them (Brun *et al.,* 2020). This study highlighted three main factors of degradation and deforestation

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

within the PONASI ecological complex, namely anthropogenic, climatic, and demographic factors.

The investigations carried out have revealed that vegetation fires, excessive logging, harvesting of immature fruits and grazing are the anthropogenic causes that degrade the resources of the PONASI ecological complex. Grazing poses a threat to the protection of biodiversity. The successive practices of agriculture and grazing contribute to soil erosion. This is a factor that limits natural regeneration. Inventory work conducted as part of the PAGEN project also confirms the presence of active fires and late burns in the Kaboré Tambi National Park (Bouché, 2005). Anthropogenic factors are part of direct factors. Several authors also concluded from the results of their research that these factors contribute to reducing the potential of protected areas. In fact, Mchedluri *et al.* (2024), have confirmed that grazing leads to direct and indirect effects on the conservation of natural habitats and promotes the migration of species towards better-adapted ecosystems. Kaboré and Dipama (2014), through their research, have also proven that pastoral practices are unfavourable to the conservation of plant resources. In fact, there is increasing pressure due to the large number of livestock. This is a source of overexploitation of plant resources and the induration of plant soils. The findings of Li *et al.* (2024) corroborate the results of this study. According to them, protected areas prove to be vulnerable in the face of increased agricultural land, grazing and urbanization. These factors contribute to the destruction of natural habitats in these entities.

This study also raised that climatic factors are also a part of the causes that degrade the resources of the PONASI ecological complex.

These results are also corroborated by many authors. According to them, climate change negatively influences forestry production through variations in bioclimatic factors. The rising level of CO_2 in the air contributes to the increase in gross photosynthesis and biomass. But rising of temperatures and reduced rainfall levels or even increased drought can be a barrier to the harmonious development of tropical forests (Bernard, 2010). Climate change can be a barrier to the harmonious development of trees in the forest. It could manifest itself in increased drought waves, floods, variations in temperature of rainfall quantities and durations (Dipama *et al.,* 2011). Rainfall deficits and their unequal distribution have negative consequences on the evolution of natural vegetation (Bernard, 2010).

The variation in temperature is felt by the population through increased heat, dust winds, destruction of vegetation cover, reduced soil fertility, and early river drying-up (Dipama *et al.,* 2011).

Climate influences the distribution of animal and floristic species. Climate variability may be a factor that harms the ability of protected areas to provide the necessary conditions and be appropriate for species conservation

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

(Deshaies, 2014). They contribute to the degradation of plant and wildlife resources (Dipama, 2016).

In addition to the anthropogenic and climatic factors, the demographic factors are also responsible for the degradation of the protected areas. The results show that the population has doubled in some areas from 1985 to 2019. The growth of the population increases the demand for protected areas' resources. Population growth leads to increased demand for farmland. The shift from subsistence to cash crops has resulted in an increase in the area planted. This exacerbates land pressure and contributes to the degradation of plant resources. This result is corroborated (Dipama, 2016; Bouko *et al.,* 2007).

Indirect factors can include political, institutional, and technological factors (Odum, 2024).

The indirect factors of deforestation and forest degradation promote the appearance of one or more direct factors (Geist and Lambin, 2002). They can be summarized as the constant increase of a poor rural population, the lack of actors' capacity and land use planning tools, the low level of capitalization of good forestry practices, and difficulties in applying the legal and regulatory frameworks of the forestry sector.

Decentralization is very limited in terms of the transfer of authority, management power and powers from the central government to local communities and the current implementation of decentralization does not allow local communities to effectively take over the management of natural resources. The result concerning the weak appropriation of the decentralization policy by the local authorities are in line with those obtained by Dipama (2011). Also, the limits of governance and the lack of enforcement of laws contribute to illegal exploitation of forest resources. This has been confirmed by Bérenger *et al. (*2015). The effective involvement of local and regional authorities in the management of forest resources is confronted with the lack of effective transfer of responsibilities for the management of natural resources from the State to local and regional authorities. Anticipatory measures are poorly taken by municipalities because they are poorly equipped in terms of human, financial and material resources. Unclear property and resource rights are causes of deforestation and degradation. Clear and secure tenure is necessary to make some investment in forestry and create better conditions to make decisions for forest protection. These results are corroborated by Dipama (2011) and Siry *et al.* (2015). According to Mengistu and Woldetsedik (2018), for the sustainable development of land resources, it is essential to take action to minimise the effects of changes in land use. To limit agricultural encroachment, it is necessary to secure the boundaries of this ecological complex at the legal level and by increasing the level of surveillance. It would also be beneficial to enhance the level of consultation

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

among the different actors who gravitate around the complex. For the sustainability of this ecological entity, income-generating activities must be diversified in order to prevent the population from rushing to this complex to meet their subsistence needs. This will reduce factors contributing to degradation, such as agricultural encroachments, poaching, and cutting of green wood. For instance, the diversification of income-generating activities can be achieved through the construction of dams to boost off-season activities. This is in accordance with the recommendations made by the authors Li *et al.* (2024), who say that each protected area may have specific weaknesses. Therefore, the management must be adapted to the different pressures in order to mitigate them. Protected areas must be drivers of sustainable development while maintaining their conservation capabilities.

Conclusion

Climate, vegetation, and man are important elements of the environmental system. Spatial-temporal changes in vegetation can be explained by several direct and indirect factors.

The management of protected areas faces political, human, financial, institutional, legal, regulator,y and communication challenges among local residents.

The results of this study have demonstrated that there are a multitude of factors that contribute to the degradation of the PONASI ecological complex. These factors are essentially vegetation fires, wood cutting, grazing, agriculture encroachment, climate, demographic and political factors. Indirect factors such as political factors, population growth and climate change contribute to increasing the intensity of degradation caused by direct factors. Also, the limits of governance and the lack of enforcement of laws contribute to illegal exploitation of resources. Therefore, it is urgent to take the necessary measures accordingly to the different pressures to reverse this trend of degradation.

To limit the factors of degradation, it is necessary to secure the boundaries and enhance the level of consultation among the different actors who gravitate around the complex. In order to promote better conservation of the complex's resources, it would be advisable to diversify the income-generating activities around the complex. It emerges from the interviews with officials of the local authorities that it is necessary to clarify the roles and responsibilities of each stakeholder in the management of the PONASI ecological complex.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Funding Statement: The authors did not obtain any funding for this research.

References:

1. Arouna O. (2012). Cartographie et modélisation prédictive des changements spatiotemporels de la végétation dans la commune de Djidja au Bénin : implications pour l'aménagement du territoire. Thèse de Doctorat Unique en Dynamique des Ecosystèmes et Aménagement du Territoire : Université d'Abomey-Calavi (Bénin). 161 p. + annexes.
2. Bagnouls, F. et Gaussen, H. (1957). "Les climats biologiques et leur classification". *Annales de géographie Mai – juin*. pp :193-220.
3. Bernard S. (2010). Le changement climatique : conséquences pour les végétaux, *Quaderni Hiver 2009-2010. volume 7*. http://journals.openedition.org/quaderni/525. DOI : https: // doi.org/10.4000/quaderni. 525
4. Bouché P. (2005). Inventaire aérien des populations de grande faune dans les sites du PAGEN : Forêt Classée et Réserve Partielle de Faune de Comoé-Léraba ; Forêt Classées de Boulon et de Koflandé ; Réserve de la Biosphère de la Mare aux Hippopotames ; Parc National Kaboré Tambi. Rapport définitif. 80 p. Ministère de l'Environnement et du Cadre de Vie- Projet de Partenariat pour l'Amélioration de la Gestion des Ecosystèmes Naturels-(PAGEN).
5. Bouko B. S., Sinsin B., Soulé B.G. (2007). Effets de la dynamique d'occupation du sol sur la structure et la diversité floristique des forêts claires et savanes au Bénin. *In TROPICULTURA*, *2007. Tome 25* (4), pp 221-227.
6. Brun L. E., Sinasson G. Azihou F. A., Gibigaye M., Tente B. A. H. (2020). Perceptions des facteurs déterminants de dégradation de la flore des zones humides dans la commune d'Allada, Sud – Bénin, *Afrique SCIENCE, 2020. 16*(4) - ISSN 1813-548X, http://www.afriquescience.net. pp 67-52
7. Deshaies M-E. (2014). Expérimentation d'une nouvelle approche de conservation : L'aire protégée polyvalente et le rôle d'un comité d'experts. Mémoire de Maîtrise en sciences forestières Maître ès sciences (M.Sc.). Université LAVAL- Québec, Canada. 81 p + Annexes.
8. Dipama J-M. (2009). Les grands épisodes de sécheresse et leurs implications écologiques au Burkina Faso de 1970 à 2000. *In Cahiers du CERLESHS : Lettres, Sciences Humaines et Sociales. Ouagadougou (Burkina Faso), 2009. Tome XXIV* (34), pp 31-48. http://www.cerleshs.univ-ouaga.bf
9. Dipama J-M. (2011). Approche participative et gouvernance locale des ressources forestières dans la forêt classée de Tuy : Atouts et

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

contraintes. *In Cahiers du CERLESHS : Lettres, Sciences Humaines et Sociales. Ouagadougou (Burkina Faso),* (2011)*, Octobre 2011. Tome XXVI* (40), http://www.cerleshs.univ-ouaga.bf Université de Ouagadougou pp : 1-17.

10. Dipama J-M. (2014). Approche spatiale du phénomène du réchauffement climatique à l'échelle du Burkina Faso et perception des populations. *In LACEEDE : Laboratoire Pierre PAGNEY Climat, Eau, Ecosystème et Développement, Climat* et Développement. *Cotonou (Bénin), Juin 2014. Volume n°16*, pp. 36-49.
11. Dipama J-M. (2016). Changement climatique et agriculture durable au Burkina Faso : Stratégies de résilience basées sur les savoirs locaux. Burkina Faso. Recherche pour des futurs résilients au climat. PRESA/IED. 36 p.
12. Dipama J-M., Vissin W. E., Hedible S., Boko M., (2011). Analyse des stratégies des pratiques agricoles face aux changements climatiques dans la Kompienga (Burkina Faso) et le Mekrou (Benin). *In Annales de l'Université de Ouagadougou. Ouagadougou (Burkina Faso), Décembre 2011. Série A, vol. 13*, pp : 51-74.
13. Geist, H. J. and Lambin, E.F. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation. *BioScience, 2002. 52*(2). pp :143-150.
14. Kaboré O., Dipama J-M. (2014). Les déterminants socio-économiques de la dégradation des ressources naturelles dans le bassin versant de la Kompienga (Burkina Faso). *In Annales de l'Université de Ouagadougou. Décembre 2014. Série A, Volume 019*, pp. 147-167.
15. Kaboré O., Ouedraogo L., Ouedraogo B., Dipama J-M., DA E. D. (2015). Analyse des facteurs d'évolution de l'utilisation des terres dans le bassin versant de la Kompienga (Burkina Faso). *In Revue scientifique semestrielle Territoires, Sociétés et Environnement, Presses Universitaires de ZINDER, Niger, juillet 2015. Volume n°005*, pp. 61-74.
16. Karambiri B., L., C., N. (2017). Variabilité climatique et gestion intégrée des ressources en eau dans le bassin-versant du SOUROU au Burkina Faso. Thèse de Doctorat unique de Géographie, Gestion des Ressources Naturelles : Université Professeur Joseph KI-ZERBO. 215 p. + annexes.
17. Li G., Fang C., Watson J. E. M., Sun S., Qi W., Wang Z., Liu J. (2024). Mixed effectiveness of global protected areas in resisting habitat loss. *Nature Communications, 2024.* 15:8389. https://doi.org/10.1038/s41467-024-52693-9.
18. Mchedluri T., Koptonashvili L., khokhobashvili T. (2024). Degradation processes caused by the impact of anthropogenic factors

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

on the ecosystem of tusheti protected areas. *Web of Scientists and Scholars : Journal of Multidisciplinary Research, 2024. Volume 2,* Issue 1, January, 2024 ISSN (E): 2938-3811 pp 15-21. Webofjournals.com/index.php/12

19. MECV (2005). Politique Nationale en matière d'environnement. 30 p.
20. MECV, (2007). Situation des forêts classées du Burkina Faso et plan de réhabilitation Burkina Faso. 43 pages.
21. MECV-PAGEN (2006). Plan d'aménagement et de gestion participatif du Parc National de Pô dit Kaboré Tambi (PNKT). 89 pages + annexes.
22. MEEVCC (2020). Tableau de bord de l'Environnement 2018. Burkina Faso. 35 p.
23. Mengistu A., Woldetsedik M. (2018). Proximate causes and underlying driving forces of land cover change in southwest Ethiopia. *Journal of Sustainable Development in Africa, 2018. Volume 20* (1) ISSN: 1520-5509. pp 232-244.
24. NatuDev (2018). Rapport de l'inventaire de la flore ligneuse et de la grande faune mammalienne diurne du corridor situe entre le Parc National de Pô Dit « Kabore Tambi » et la Forêt Classée et Ranch de Gibier de Nazinga. 70 p.
25. Odum, P. (2024). Land Use and Forest Dynamics in the Context of Redd + : Pathway to Sustainable Environmental Management. *Open Journal of Forestry,2024. Volume 14,* https://doi.org/10.4236/ojf.2024.141008. *pp* : 117-126.
26. Ouédraogo L. (2012). Gestion de l'eau et adaptation des populations au changement climatique dans le bassin versant de YAKOUTA (sahel du Burkina Faso). Thèse de doctorat de Géographie : Université ABDOU MOUMOUNI. Niger. 231 p. + annexes.
27. Siry, J. P., McGinley, K., Cubbage, F. W., & Bettinger, P. (2015). Forest Tenure and Sustainable Forest Management. *Open Journal of Forestry, 2015. Volume 5,* http://dx.doi.org/10.4236/ojf.2015.55046. *pp* 526-545.
28. Tchatchou B. , Sonwa D J., Ifo S., and Tiani A. M. (2015). Deforestation and forest degradation in the Congo Basin. Center for International Forestry Research (2015). Report Subtitle: State of knowledge, current causes and perspectives https://www.jstor.org/stable/resrep02255.8