TRACKING AND ASSESSING THE SOCIO-ECONOMIC IMPACTS OF CONSERVATION FUNDING IN BENIN OVER THE LONG-TERM

BY

CHRISTHEL SONIA JESUGNON PADONOU

THESIS

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Associate Professor Daniel C. Miller

ABSTRACT

Funding is important for effective biodiversity conservation. Globally, conservation funding is well below estimates of need, particularly in low- and middle-income countries. However, detailed information about conservation funding flows—and their effects—is very limited. This lack of information on past and current funding sources, mechanisms, recipients, and impacts inhibits efficient allocation of scarce financial resources and knowledge of conservation effectiveness. This study addresses these gaps by focusing on a case study of Benin in West Africa. First, it identified and analyzed conservation funding flows from 1990 to 2019 through desk-based research and complementary research in the field. The results showed a total of 314 conservation projects amounting $301.04 Million (2015 Constant US Dollars), 96% of which derived from international sources and 4% from domestic ones. On average, funding flows increased over the years, but there were significant fluctuations. Conservation funding was concentrated largely in the country's protected areas. Findings can help inform better allocation of scarce financial resources and enable assessment of conservation impacts. The second core focus of this thesis was an assessment of the long-term social-economic impacts of one of the largest funded conservation efforts in Benin, the ECOPAS ("Ecosystèmes Protégés en Afrique Soudano-Sahélienne") project in the W National Park. This study assessed the project's impact on several socio-economic outcomes – agricultural land access, livestock resources access, water access, forest product access and change in income – at the household level around the Park. It compared outcomes in four purposively selected treatment villages that were affected by the project, which ran from 2001-2008, and four control villages not affected by the project but similar in key respects. Mahalanobis distance matching and regression-adjusted propensity-score kernel matching were used to estimate the average treatment effects of all outcomes of interest in

2011, the reference year, and 2019, the comparison year. Findings showed that, while the project had positive ecological impacts, evidenced in the literature, the socio-economic ones were largely negative (except for increased access to water for local communities)—and increasingly so over time. Overall, results show the importance of tracking and assessing biodiversity funding flows and the complex trade-offs between ecological goals and socio-economic outcomes that characterize conservation in Benin and other low-income country contexts.

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DEDICATION

In memory of my beloved daughter Godfavor Néria Agnon Hounnou (September 22, 2017-November 17, 2017) and to my baby that I will never know (December 2018).

You will both live in my heart forever.

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ABBREVIATIONS AND ACRONYMS

ABE	:	Agence Béninoise pour l'Environnement
ACED	:	Action pour l'Environnement et le Développement Durable
AFD	:	French Development Agency
AMAF-BENIN	:	Amis de l'Afrique Francophone- Bénin
ATT	:	Average Treatment Effect on the Treated
AVIGREF	:	Association Villageoises de Gestion des Reserves de Faune
BEES	:	Benin Environment and Education Society
AquaDeD	:	Aquaculture et Développement Durable
CBD	:	Convention on Biological Diversity
CBNRM	:	Community-Based Natural Resources Management
CENAGREF	:	Centre National de Gestion des Réserves de Faune
CF	:	Classified Forest
CIPCRE	:	Centre International pour la Promotion de la Création
CREDI	:	Centre Régional de Recherche et d'Education pour le Développement Intégré
DGFRN	:	Direction Générale des Forêts et des Ressources Naturelles
ECO-Bénin	:	Benin Ecotourism Concern
ECOPAS	:	Ecosystèmes Protégés en Afrique Soudano-Sahélienne
FFEM	:	French Facility for Global Environment
FNEC	:	Fonds National pour l'Environnement et le Climat
GBIF	:	Global Biodiversity Information Facility
GEF	:	Global Environment Facility
GIZ	:	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRABE	:	Groupe de Recherche et d'Action pour le Bien Etre au Bénin
HPI	:	Human Poverty Index
IAIA	:	International Association for Impact Assessment
ICCAs	:	Territories and areas conserved by indigenous peoples and local communities
IUCN	:	International Union for Conservation of Nature
Km	:	Kilometer
LaSEn	:	Laboratoire Société- Environnement
LMICs	:	Low- and middle-income countries
MBZ	:	Mohamed Bin Zayed
NBSAP	:	National Biodiversity Strategy and Action Plan
MDM	:	Mahalanobis Distance Matching
NGO	:	Non-Governmental Organization
ODA	:	Official Development Assistance
ODDB	:	Organisation pour le Développement Durable et la Biodiversité
OECD	:	Organisation for Economic Cooperation and Development
OECMs	:	Other effective area-based conservation measures
PAs	:	Protected Areas
PNP	:	Pendjari National Park
PNPG	:	Politique Nationale de Promotion du Genre
PSM	:	Propensity Score Matching

REDERC	:	Réseau de Développement des Réserves naturelles Communautaires
SDGs	:	Sustainable Development Goals
SGP	:	Small Grants Programme
SIGSTATFOR	:	Système National d'Information et de Gestion des Statistiques Forestières
SNV	:	Netherlands development Organisation
StdDif		Standardized mean difference
UIUC	:	University of Illinois at Urbana- Champaign
US	:	United States
WAP	:	W-Arly-Pendjari
WNP	:	W National Park

CHAPTER 1: INTRODUCTION

"*The world is experiencing unprecedented prosperity, while the planet is under unprecedented stress*" (UN, 2012, p.10). One of the major reasons why the planet is under stress is because biodiversity is declining rapidly primarily due to human actions like water and air pollution, habitat destruction, and other unsustainable forms of natural resource exploitation (Rawat and Agarwal, 2015; IPBES, 2019). In response, conservation actions have been devised and funded across the globe to halt biodiversity loss and maintain its services for human-wellbeing for present and future generations. Protected areas (PAs) remain one of the most prevalent conservation strategies by many countries to tackle biodiversity loss and reducing habitats loss (Palacin and Alonso, 2018; Coetzee et al., 2014; Gray et al., 2016), despite being just one aspect of conservation efforts (Seidl et al, 2021). Although the effectiveness of PAs for biodiversity conservation (Geldmann et al., 2013; Maiorano et al., 2015) and their social and economic benefits for local communities have been questioned (West et al., 2006; Adams and Hutton, 2007), they often represent the last safe havens for many species and are undoubtedly an essential part of successful biodiversity preservation strategies worldwide (Homewood, 2013; Krueger, 2016).

Funding is essential to effective PA management and all conservation efforts that limit direct (deforestation, pollution, overexploitation of resources.) and indirect drivers (demographic growth, international trade, cultural preferences) of biodiversity loss (Lindsey et al., 2018; Seidl et al., 2021; Richerzhagen et al., 2016). However, biodiversity funding remains well below estimates of need, especially in low- and middle-income countries (LMICs) (IPBES, 2019; Waldron et al., 2017). Though it is daunting to have an accurate figure of the current level of funding to biodiversity globally, the available conservation funding was estimated at US $52

billion annually in 2012 (UNDP, 2018; Parker et al., 2012) and between US$ 124 and US$ 143 billion in 2019 (Deutz et al., 2019). The estimates of biodiversity need for reversing biodiversity decline by 2030 is US$ 722-967 billion annually, which puts the biodiversity financing gap at approximately US$ 598-824 billion per year (Deutz et al., 2020). Currently, investments in biodiversity conservation come mostly from national governments in developed countries, and from international donor assistance, bilateral aid, multilateral aid in LMICs countries (Krueger, 2016). Despite the availability of estimates of conservation funding needs, detailed information about actual conservation funding flows globally (UNDP, 2018) and within countries—and their effects—is still very limited (Nakamura, 2017; Devkota, 2020). Information on current levels of conservation investments, needs, expenditures, aspirations and priorities at national scales has remained lacking (UNDP, 2018; Richerzhagen et al., 2016). This information constraint is particularly acute in many LMICs, especially African countries where the current level of existing funding for conservation as well as funding needs for effective PAs management is still unclear (Lindsey et al., 2018).

Such is the case in Benin, a francophone LMICs country located in western sub-Saharan Africa, home to globally significant biodiversity (Ilou et al., 2019) and where biodiversity makes a major socio-economic contribution through provision of food, medicines, climate regulation and cultural, religious and aesthetic services (Ilou et al., 2019). Several large 'charismatic' mammals, such as the African elephant (*Loxodonta africana*), the west African lion (*Panthera leo*) in Benin are critically endangered, with the conservation of many other species urgent (Butler, 2006; Henschel et al, 2014; Neuenschwander et al., 2011). National parks and other protected areas are the last refuge for many of these species and yet they are threatened by retaliatory killings, poaching, expansion of wildland fires, extensive livestock grazing, over-

extraction of timber stands, pesticide application, agricultural expansion, climate change and other threats (Harris et al., 2019; SPANB, 2014).

The analysis of several national plans[1] for biodiversity conservation in Benin revealed that new and additional financial resources from public sources, national private sector, and other innovative mechanisms, as well as from international sources are needed for the effective implementation of biodiversity goals in Benin over the long-term because national public resources have repeatedly failed to cover all management costs for biodiversity conservation (CBD 5th national report for Benin). The strategic goal H of the 5th strategic axis of the National Biodiversity Strategies and Action Plan (NBSAP) for Benin called for the development of sustainable funding mechanisms for biodiversity conservation in Benin. The estimated cost for the funding mobilization strategy was XOF 142 million ($US 257,000) (SPANB, 2014). However, it was noted in the NBSAP that a major drawback for having a biodiversity finance plan in Benin was the lack of knowledge on existing conservation funding sources in Benin. This dearth of information on past and current domestic and international conservation funding sources, allocation, and mechanisms is not typical for Benin alone, but for many other countries in Africa (Waldron et al., 2013; Lindsey et al., 2018).

Additionally, the country adhered to the Paris Declaration on aid effectiveness in 2005 which called for the participant countries to record aid flows in their budgets and to create frameworks for aid effectiveness monitoring and mechanisms to hold donors and recipient countries accountable for aid commitments and their results (OECD, 2005). Recording

[1] Stratégie nationale de conservation et de gestion des reserves de faune 2011-2020" (National conservation and management strategy for wildlife reserves 2011-2020); 5 eme rapport national sur la mise en oeuvre de la convention sur la diversite biologique au Benin (5th report of Benin to the Convention for Biological Diversity (CBD); Stratégie et Plan d'Action pour la Biodiversité 2011-2020 du Benin (National Biodiversity Strategies and Action Plans, NBSAP);

conservation aid flows in Benin is thus important. However, currently, there is no mechanisms or structure that I am aware of that identifies and analyzes conservation funding flows in Benin. There are several institutions working to create databases for knowledge and information sharing about biodiversity conservation like the Clearing House Mechanism of Benin for the Convention on Biological Diversity which is a national tool for the promotion of scientific and technical cooperation on biodiversity. Although this platform provides information on many conservation projects, it does not provide detailed information on many projects' budgets. Moreover, the "Annuaire des Statistiques Forestières du Benin" is an annual report that provides information on all the conservation projects in the country with their funding information, but the publication of those reports started in 2013 and only three annual editions are currently available. The publication of those reports came from the internationally funded project "Système National d'Information et de Gestion des Statistiques Forestières" (SIGSTATFOR), which ended in 2015. Since that time, no more such reports have been produced.

While several studies have estimated actual expenditures on global conservation (Miller et al., 2013; Waldron et al., 2013), targeted specific world regions like Africa (Brockington & Scholfield, 2010; Bare et al., 2015) or donor types (Hickey & Pimm, 2011; Massé and Margulies, 2020), few studies have analyzed conservation sources, allocation and impacts for multiple consecutive years in a single country, like Benin.

The second chapter of this master's thesis contributes to the knowledge on current conservation funding levels in Benin. It tracks biodiversity aid sources, mechanisms and uses in Benin from 1990 to 2019. Although the estimation of conservation funding needs for Benin is important, this study does not focus on the subject. Instead, it provides a much-needed starting point to understand the conservation funding landscape in Benin, which can then help enable

answer other important questions about conservation funding in Benin. These include: How much is needed for biodiversity conservation in Benin annually? What is the funding gap for biodiversity? Who should pay for conservation in Benin? How much is the country maxing out on funding opportunities? What is the local willingness to pay for conservation?

This research represents an important starting point for further analysis of the conservation funding field and needs in Benin. Knowing current conservation funding level at the country level can help with the estimation of funding gaps, given that funding needs are known (Bovarnick et al., 2010; Waldron et al., 2010). Information on funding gaps at the country level contributes to efficient and targeted investments by prioritizing urgent places and thematic for biodiversity conservation (Bovarnick et al., 2010; Waldron et al., 2010). Tierney et al (2011) emphasize the need for better information on development finance in LMICs to understand whether funds are being directed toward development and environment priorities and to assess their effectiveness. Knowledge on past and current funding sources can help identify and reach out for donors, international and domestic who are currently less present in the conservation field in Benin and thus opens the possibility for more funding sources.

This information on available funding, sources and allocations can guide future conservation investments and policies. This study provides an extensive database (1990-2019) for researchers, donors, non-governmental organizations, civil society, and public organizations on the funding landscape for biodiversity conservation in Benin. My study also provides a baseline database for future management of the WNP, as they can use the results to define a detailed biodiversity finance plan for Benin, diversify funding sources and target places and thematic that need urgent financial resources. Additionally, this study contributes to the literature on biodiversity conservation in a francophone setting in western sub-Saharan Africa.

This research is also timely, as its results can inform planning and management of conservation funding in Benin, particularly under the country's post-2020 NBSAP. Richerzhagen et al. (2016) argued that, despite increases in conservation aid since the 1980s, its effectiveness is not known in many countries and biodiversity is still in decline. Therefore, reliable information on the impacts of previous funded interventions is vital to future conservation funding decisions, investments, and knowledge (Campos et al., 2018; Siddig, 2019; Waldron et al., 2017). Tracking and reporting of successes, failures and lessons learned from the implementation of conservation projects remains limited, especially in developing countries (Rochette et al., 2019). Assessing the effectiveness of conservation projects and strategies can provide evidence-based insights for better projects design, improved cost effectiveness strategies and better funding allocation to projects with higher impact potential (Baylis et al., 2015; Ferraro & Pattanayak, 2006; Homewood, 2013) Conducting socio-economic impacts (ex-ante or post-ante) of conservation projects is useful in many ways as it can help enable donors to adjust their activities and support projects that will do no harm to local communities or exacerbate their precarious living conditions (Homewood, 2013).

Several impacts studies have been conducted on the short and medium terms about social effects of conservation strategies (Andam et al., 2010; Beauchamp et al., 2019; Canavire-Bacarreza & Hanauer, 2013; Clements et al., 2014,), on ecological effects (Andam et al., 2008; Miranda et al., 2016), and both outcomes (Jagger et al., 2018; Miller, 2013; Naughton-Treves et al., 2011; Sims, 2010). But there are fewer studies on long-term impacts of conservation, where the available studies mainly focused on ecological impacts (Burton, 2010; Sinclair et al., 2007) rather than social impacts (Mascia et al., 2017)

The third chapter of this study therefore assessed the persistence of social and economic impacts of a major conservation aid project in Benin, Ecosystèmes Protégés en Afrique Soudano-Sahélienne (ECOPAS) by answering the question: To what extent have the socio-economic impacts of the ECOPAS project endured a decade after its end in the W National Park and within the communities that live around the park?

This study is important because it provides much-needed empirical evidence of the long-term impacts of a major conservation project that targeted the twin-challenge of poverty alleviation and biodiversity conservation. Knowing the long-term impacts of such a project might give evidence-based insights to policies developers and funders, who might then make more informed decisions about financing projects like ECOPAS in the future or not. More generally, it also addresses a difficult, but important gap in conservation evidence over the long-term.

1.1. Thesis organization

The rest of this thesis is organized as follows: chapter 2 presents the results of the analysis of conservation funding level, sources, mechanisms and allocation in Benin from 1990 to 2019. This analysis includes temporal, spatial and thematic trends in conservation funding and identifies key funding and recipient organizations in Benin. Chapter 3 provides answers to whether social and economic outcomes of the conservation project, ECOPAS, have endured over a decade after the project ended in W National Park. Finally, chapter 4 presents general conclusion to the thesis and its implications for further research.

This research was conducted in full respect of the standards of the Institutional Review Board (IRB) of the University of Illinois. The IRB (#19516) approval notice is in appendix E.

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CHAPTER 2: BIODIVERSITY CONSERVATION FUNDING IN BENIN: ANALYZING THREE DECADES OF CONSERVATION FUNDING FROM 1990 TO 2019

2.1. Introduction

Biodiversity provides multiple direct and indirect ecosystem services that are vital to human well-being (MEA, 2005; IPBES, 2019). However, biodiversity loss is increasing due to human actions which have led conservation advocates worldwide to devise various strategies to halt its loss. Funding is essential to these efforts and for that reason, billions of US dollars have been spent on biodiversity conservation by domestic and international funders. In Africa, for example, international aid donors have allocated more than $3.4 billion since 1990 for biodiversity conservation (Bare et al., 2015). Despite such investment, biodiversity conservation funding levels remain below the international commitments (Miller et al., 2013; IPBES, 2019) and estimated levels of need (Waldron et al., 2013; Deutz et al., 2020). Many low- and middle-income countries (LMICs) in Africa and elsewhere lack the financial, technical, and institutional resources to effectively curb biodiversity loss (Stepping and Meijer, 2018) and thus require urgent financial attention. Although conservation funding amount data exists at country level for many of those countries (AidData, 2019), little is known on funding sources, locations and conservation actions that the funding is used for at country level (Waldron et al., 2013).

Thus, understanding past and current conservation funding trends can help policy planners and donors conduct effective assessments of financial needs and future investments for biodiversity conservation in all countries, especially in LMICs (Tierney et al., 2011). An informed decision on current and past biodiversity aid sources and mechanisms can also help donors and recipients by providing them with information that can guide future allocation of scarce financial resources (Miller, 2014). Additionally, analyzing funding of all conservation's

major donors and agencies could help identify the least funded Protected Areas (PAs) and thus lead to the reduction of the list of critical unfunded PAs by setting appropriate conservation priorities (Hartley et al.,2007; McClanahan and Rankin, 2016). Finally, mapping the funding landscape of biodiversity conservation can be an important step in understanding funders' motivation to fund biodiversity conservation. This can help recipients and donors to be on the same page concerning conservation priorities and thus could help enhance synergy of actions for biodiversity conservation (Dickovick, 2014; Devkota, 2020).

While several studies have estimated actual expenditures on global conservation (Miller et al., 2013; Waldron et al., 2013), targeted specific regions (Brockington and Scholfield, 2010; Bare et al., 2015; Young and Bakker, 2016) or donor types (Hickey and Pimm, 2011), few studies have analyzed conservation funding allocation and impacts for multiple consecutive years in a single country. Though Nakamura (2017) and Devkota (2020) conducted such study respectively in Peru and Bhutan, located respectively in South America and South Asia, there is a dearth of research on conservation funding allocation in African countries. This is especially true for West Africa, which is home to globally important and highly threatened biodiversity (Amin, 2014; Holmes et al., 2012). Beyond filling an important geographical gap, research in this context offers an opportunity to develop new theoretical and practical insights on conservation institutions, funding, practices, and outcomes.

My research project aims to address these gaps in knowledge by mapping and analyzing the conservation funding landscape in Benin over the past three decades from 1990 to 2019. Benin is a francophone country located in western sub-Saharan Africa, where the need for more effective management of biodiversity is emphasized in its 2014-2020 National Biodiversity Strategy and Action Plan (NBSAP) document. This document calls for adequate funding for

biodiversity conservation in the national budget and, for new and innovative financing mechanisms. But this plan of financial resource mobilization is hindered by many factors including the lack of information on existing domestic and international funding sources (SPANB, 2014). Thus, Benin presents an interesting case for understanding conservation funding mechanisms, sources, and allocation.

Biodiversity plays an essential role in Benin's economy by contributing annually to 6.64% to its Gross Domestic Product through the provision of timber and non-timber forest products, income, employment, trade, transportation, ecotourism and a haven for indigenous cultures practices and knowledge (DGFRN, 2014). For example, through the diversity of its ecosystems, the W National Park (WNP) in Benin, provides food, medicines, regulation of climate, cultural, religious, and aesthetic services for both riparian communities and animals (Ilou et al., 2019).

Benin is also important for biodiversity conservation in west Africa because large 'charismatic' mammals including several sub-species never seen in eastern Africa like the critically endangered west African lion (*Panthera leo*) are still present there (Butler, 2006; Henschel et al, 2014). Likewise, several other rare fauna species like the western topi (*Damaliscus lunatus korrigum*), the cheetah (*Acinonyx jubatus*) and the African hunting dog (*Lycaon pictus*) (Lamarque, 2004) and more than 670 flora species (Clerici et al., 2007) are in the WNP. However, due to human pressures (Harris et al., 2019), those diverse species face several threats including retaliatory killings, poaching, expansion of wildfires, extensive livestock grazing, over-extraction of timber stands, pesticide application, agricultural expansion, and climate change (SPANB, 2014). There is thus an urgent need for financial resources mobilization to conserve these species and their ecosystems and thus sustain the services that

they provide to people. Understanding how, when and where conservation funding has been allocated in Benin can be a step in the right direction for meeting the financial need for biodiversity conservation and for improved allocation of future investments.

2.2. Data and methods

Funding data

The mapping included all biodiversity conservation related projects from domestic and international sources from 1990 to 2019. The starting year 1990 was chosen because it was the year when Benin turned to a democratic regime after years of dictatorship and autocracy, which brought political stability and greater international investment (Gisselquist, 2008). Moreover, complete data on conservation projects are found after this year for Benin when a more serious management of PAs surged around 1990 after the United Nations environment conference at Rio, where international attention turned toward the environment leading to a spike in international conservation funding (Miller et al., 2013). The data collected for this study is summarized in figure 1 (detailed in the section database creation below), following Nakamura's method for conservation funding mapping in Peru (Nakamura, 2017).

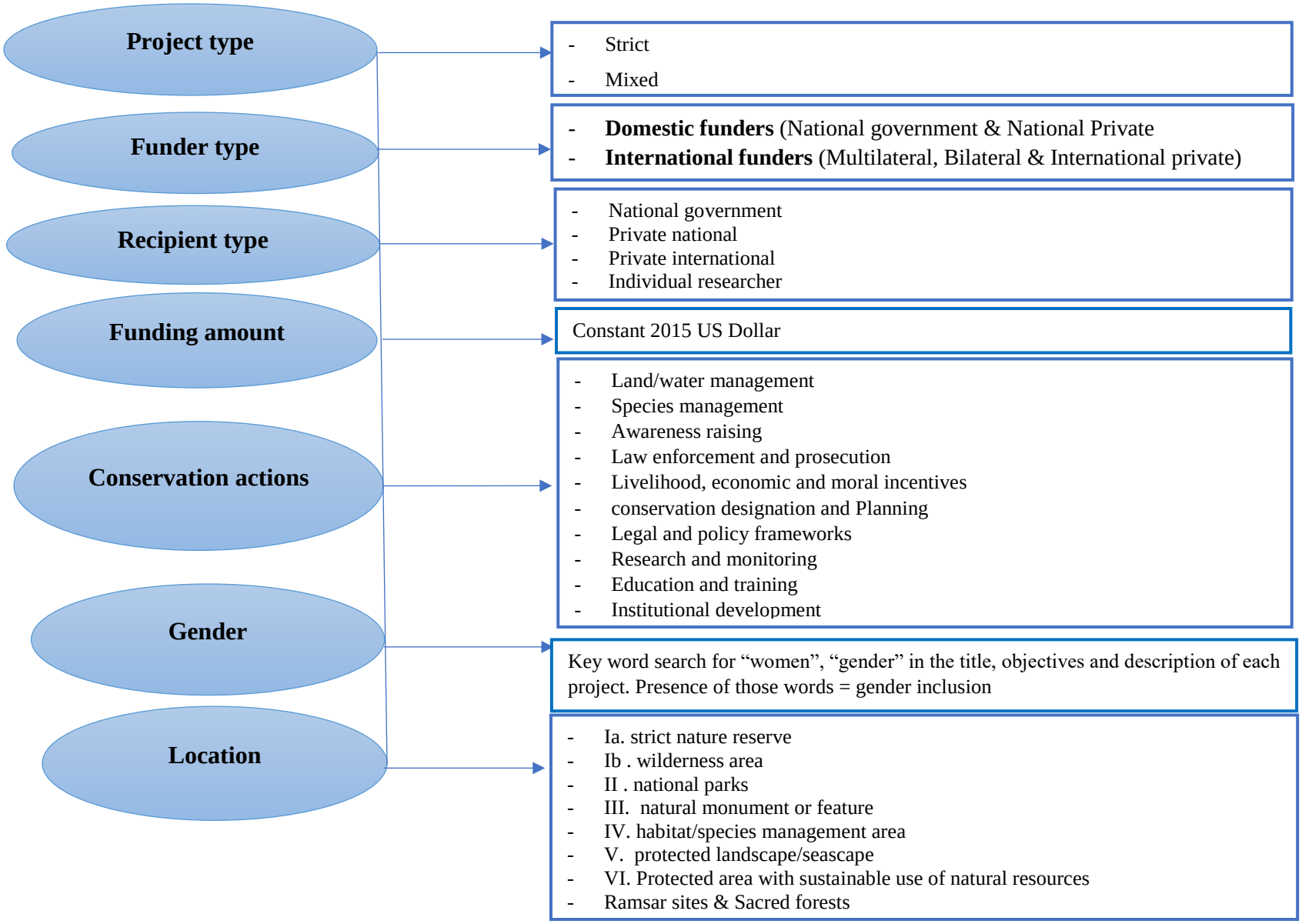

Figure 1: Summary of the information contained in Benin's conservation funding database

Data collection

The collection of funding data was primarily desk- and internet-based with complementary data collection conducted in Benin. The internet-based data, both from international and domestic sources, was collected from March 2019 to December 2019 from publicly available sources.

Although, I was able to collect most information on international funding online, my search for domestic funding data was not as fruitful. In fact, most of public offices that oversee biodiversity conservation in Benin did not display conservation funding data on their websites and when they did, the information was not up to date. Additionally, there are several NGOs that work in the biodiversity conservation field in Benin, but I could not access their detailed conservation funding information via their webpages. I contacted several of these NGOs via e-mail without much success. As noted by many authors, public conservation funding information sharing by recipients and donors can be challenging due to multiple reasons, including but not limited to the fear of data usage by commercial entities for profit, illegal data usage, loss of intellectual property, time and resources for data compilation (Castro et al. 2000; Halpern et al. 2006; Milam et al., 2016).

To overcome those limitations, a complementary data collection was conducted from November to December 2020 by a team from Act for Development (Act-Dev) NGO, a local conservation NGO. Though I planned to conduct this data collection myself, to confirm the internet-based funding information and consult with key conservation actors in Benin for the identification of additional relevant funding sources and funds, I was not able to do so due to the Covid-19 pandemic. However, the team that helped me collect the data in Benin was able to

collect additional domestic data (97 projects) mostly from key conservation NGOs in Benin and fewer from public institutions.

Database and description

Overall, 74 data sources related to environmental projects were consulted, but 35 sources yielded results with conservation projects in Benin with Seventeen international sources[2] and eighteen domestic sources[3]. The list of all the 74 sources consulted with the filters applied for the inclusion or exclusion of a project is presented in Appendix1.

When a data source was identified, I applied filters if available to narrow my search. The filters used for each source are detailed in appendix A. After applying the filters, I downloaded the projects and saved them. Then, I performed a preliminary categorization of the downloaded

[2] 1) AidData, 2) Organisation for Economic Cooperation and Development (OECD), 3) Global Environment Facility (GEF), 4) SGP-The GEF Small Grants Programme, 5) JRS Biodiversity Foundation, 6) Global Biodiversity Information Facility (GBIF), 7) the World Bank, 8) the directory of donors for conservation in West Africa ("Repertoire des bailleurs pour la conservation en Afrique de l'Ouest"), 9) Fondation Ensemble, 10) the Rufford Foundation, 11) the Mohamed Bin Zayed (MBZ) Species conservation Fund,12) Darwin Initiative, 13) the Foundation Center, 14) French Development Agency (AFD), 15) the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 16) Netherlands development Organisation (SNV) and 17) French Facility for Global Environment (FFEM).

[3] 1) "Direction Générale des Forêts et des Ressources Naturelles" (DGFRN)/ General Directorate of Forests and Natural Resources, 2) "Annuaire des statistiques forestières du Bénin" /Benin's Forestry statistics directory, 3) African Parks Network, 4) "Direction du Parc National de la Pendjari, Benin"/ Pendjari National Park (PNP) management office, 5) "Plan d'Aménagement et de Gestion de la Réserve de Biosphère de la Pendjari"/ Development and Management Plan of the Pendjari Biosphere Reserve, 6) "Fonds National pour l'Environnement et le Climat (FNEC)"/ The National Fund for Environment and Climate of Benin, 7) "Centre National de Gestion des Réserves de Faune" (CENAGREF)/ National Centre for Wildlife Reserve management, 8) Action pour l'Environnement et le Développement Durable (ACED), 9) Aquaculture et Développement Durable (AquaDeD), 10) Centre Régional de Recherche et d'Education pour le Développement Intégré (CREDI), 11) Benin Ecotourism Concern (ECO-Bénin), 12) Groupe de Recherche et d'Action pour le Bien Etre au Bénin (GRABE), 13) Organisation pour le Développement Durable et la Biodiversité (ODDB), 14) Amis de l'Afrique Francophone-Bénin (AMAF-BENIN), 15) Centre International pour la Promotion de la Création (CIPCRE), 16) Benin Environment and Education Society (BEES), 17) Réseau de Développement des Réserves naturelles Communautaires (REDERC), 18) Action plus ONG

projects by reading the title, description and or the objectives of the project when the information is available. Three categories of projects were determined based on those criteria:

- **Included projects:** the inclusion criteria are that the funding had to be directed to projects in Benin and had at least one biodiversity conservation component. Biodiversity or biological diversity is defined as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems" (UN, 1992).
- **Unclear projects:** projects without title, description or any specific identification were first classified under this category. Then, I conducted more a thorough research to find if I could trace and identify them. When I had enough information for the identification, the projects were either included or excluded in the database.
- **Excluded projects:** those projects having no relation with biodiversity conservation. The projects in this category included development projects without any conservation objective. A project was also put in this category when there was not enough information to identify the project. Dropped projects were also classified in this category. Finally, projects with no funding amount reported were discarded.

Database creation

The method used by Nakamura (2017) for the conservation funding mapping in Peru was adapted and used for the full identification of each conservation project included in the database and it followed 3 steps: first, I started with the definition of the type of data that needed to be included in the database (see coding scheme below). The detailed coding scheme is presented in

appendix B. Next, I proceeded to the removal of duplicates to avoid double counting. Finally, funding amounts were converted to 2015 constant US dollar amount to make them comparable throughout the different years.

Step 1. Coding scheme

The type of data included in the lists are the following:

Project identification

- **Project name in English and French:** each project title and its abbreviation were reported in English and French.
- **Project ID:** the code associated with each project was collected to ease the spotting of duplicated projects across the various databases sources.
- **Project objective and project type:** the project objective and its description were collected when available. These fields allowed to determine a project type, which was either categorized as "strict" or "mixed" following Miller (2014). A project was categorized as "strict" when its funding is specifically related to conservation objectives without a stated development component. When a project description features one or more of the following keywords: agroforestry, Reduce Emissions from Deforestation and Forest Degradation in Developing countries (REDD+), PAs management, species protection, forest protection, site preservation, capacity building for biodiversity protection, ex situ and in-situ conservation, conservation trust funds, invasive species mitigation, creation of national biodiversity management plans, and compliance with and participation in international biodiversity treaties and other conservation objectives.

A project was classified as "mixed" when both conservation and development objectives are present in the project. A project was classified as mixed when its description includes a biodiversity conservation objective and development keywords or group of words like poverty reduction, livelihoods, ecotourism, sustainable, resource use, health, or agriculture, integrated natural resources protection community-based natural resources management (CBNRM), village or community forestry, community fisheries, indigenous people, and eco-development or eco-forestry.

Duration of the project

The starting and/or year project funds were committed and the year each ended was included in the database. Knowing the duration of the projects helped with the conversion of funding amounts in constant prices.

Conservation actions

The ten domains of conservation actions used by the open standards for conservation practices (IUCN- Conservation Measures Partnership, 2016) were used to classify the conservations actions in this study. I read the project title, objectives and description to identify what the funding was used for. When a title or project description contains a word or group of words from the ten domains, I used the presence/absence categorization to classify a project conservation action (s). The ten domains are: 1) Land/water management; 2) species management; 3) awareness raising; 4) law enforcement and prosecution; 5) livelihood, economic and moral incentives; 6) conservation designation and planning; 7) legal and policy frameworks; 8) research and monitoring; 9) education and training and 10) institutional development.

Gender

"Gender refers to how a person identifies that could be different from their natal sex or with none at all" (Newman, 2021). Gender also refers to social constructs or norms in differences and relations between men and women, which vary from society to society (Newman, 2021). This definition of men and women social roles affect the structure, institutions and resources access and control within a society (MacGregor, 2017, Nightingale, 2017; UNDP, 2018). The inclusion of gender considerations in biodiversity conservation can promote human rights, help avoid discrimination in conservation actions, and strengthen biodiversity outcomes (Lau, 2020; Razavi, 2016). A keyword search was conducted using the words "women", and "gender" in the title, objectives, and description of each project. If a project included one or all those words, it is implied that it at least considered gender in its formulation, if not implementation. If those words were absent, then the project was assumed to not include gender.

There are multiple social markers that could have been studied in this research. The choice of gender is justified by the importance of biodiversity protection combined with the poverty level and the reliance of most of West Africa population, especially women, on ecosystem services (Fisher & Christopher, 2007; Luiselli, 2019; MacKinnon and MacKinnon,1986). Several studies have recognized the benefits of including local resources users, especially women in the management of protected areas. In fact, including all stakeholders reduces conflicts by ensuring participatory democracy (Pinkerton, 1989); empowers non-government actors (Greenwood et al., 1993); increases social learning (Blackstock et al., 2007); increases economic and social development of communities; promotes ecologically sustainable use of the environment, promotes social health and cultural sustainability of the local populations (Berkes et al., 1991) and has the potential to make protected areas management more effective

(Fedreheim and Blanco, 2017). Analyzing the presence or absence of gender in the projects under review can shed some light on the real participation of women in biodiversity conservation in Benin.

Funder identification

The identification of funders included the name of the funding organization or country, the funder type and the project implementation structure. Funders were classified in five categories: 1) national government; 2) multilateral donors; 3) bilateral donors; 4) national private donors; and 5) international private donors. The national government and the national private donors represent the domestic funders, while the multilateral, the bilateral and the international private donors represent the international donors.

Recipient identification

Data on the recipient of each conservation funding was collected. The name of the recipient organization, the recipient type and the executing agencies of each project were reported. The recipient organization contains four categories: 1) national government; 2) national Non-Governmental Organization (NGO)/private national organization; 3) international NGO/private international organization and 4) individual researcher.

Funding amount

This field displays the nature of the funds, the project commitment amount and currency, the actual amount disbursed and currency, the co-financing institutions and their financial contribution to each project and the total cost of each project. Disbursed funding amount was considered in this study.

Project location

The location(s) where a project was implemented was reported in this field. The project location can be a Protected area (PA) or not where a "Protected area" signifies a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives (CBD, 2006). When a project was conducted in a PA, I categorized it by using the six International Union for Conservation of Nature (IUCN) categories (Dudley, 2008) or other categories like buffer zone (Bennett and Mulongoy, 2006), biosphere reserve (Dudley, 2008), sacred forests (Padonou et al., 2019) and Ramsar sites (Ramsar, 2014; Dudley, 2008) (table1). The name of the project location and the complete geolocation (department, villages, hamlets and geographic coordinates) of each project were reported in this field when they were provided in the data source for each project or where this information could be deduced from other sources.

Table 1: Protected area categorization

Category	**Description**
Ia Strict Nature Reserve	"PAs set aside for biodiversity and geological/geomorphological features protection where human activities are strictly controlled and limited to ensure protection of the conservation values".
Ib Wilderness Area	**"PAs** usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition".
II National park	"PAs that usually combine ecosystem protection with recreation, subject to zoning, on a scale not suitable for category I".
III Natural Monument or feature	"PAs that are generally centered on a particular natural feature, so that the primary focus of management is on maintaining this feature, whereas objectives of Ia are generally aimed at a whole"
IV Habitat/Species Management Area	"PAs that protect fragments of ecosystems or habitats, which often require continual management intervention to maintain. Category IV protected areas are also often established to protect particular species or habitats rather than the specific ecological aims of category Ia".

Table 1 (cont.)

V Protected landscape/seascape	"PAs that are generally cultural landscapes or seascapes that have been altered by humans over hundreds or even thousands of years and that rely on continuing intervention to maintain their qualities including biodiversity".
VI PAs with sustainable use of natural resources	"PAs that contain natural areas where biodiversity conservation is linked with sustainable use of natural resources, which is incompatible with category Ia. However large category VI protected areas may contain category Ia areas within their boundaries as part of management zoning".
Biosphere Reserve	"UNESCO Man and the Biosphere (MAB) – biosphere reserves are sites where conservation is integrated with sustainable use; In general, a biosphere reserve would have: (a) a highly protected core zone (usually category I–IV); (b) a buffer zone which might be category V or VI or, alternatively, managed land/water that would not correspond to an IUCN category; and (c) a transition zone that would not correspond to an IUCN category".
Buffer zone	"Areas between core protected areas and the surrounding landscape or seascape which protect the network from potentially damaging external influences and which are essentially transitional areas that can be classified in the IUCN category V or VI"
Ramsar sites	"Wetlands of International Importance listed by the Ramsar Convention, where there is no *obligation* for them to be legally protected areas under national legislation".
Sacred forests	Sacred forests in Benin are areas whose status (fear of deities) limit human pressure and make them nurseries and genetic reservoirs for diverse animal and vegetal species

Source: Dudley (2008); Bennett and Mulongoy (2006); Padonou et al. (2019) and Ramsar (2014)

Data sources

The source of data (Urls) of each project was reported in this field. I added a coder confidence interval that rates the coder´s confidence on the project coding. Sometimes it is hard to code projects with confidence based on the limited information available. The coding is rated from 1 to 5 where 1 means low confidence (not sure about coding) and 5 means high confidence (good coding). The coder confidence variable was used by Nakamura (2017). Finally, a variable labelled as "Notes" was created to report any information worth noting about a project.

Step 2. Duplicate removal

After the collection of all funding data available, a standardization of the database was conducted to eliminate duplicates. I checked manually among the projects included in the mapping to spot projects which are duplicated across all the data sources. If the title of a project is repeated, I compared both projects funder and funding amounts, location and the starting and ending year. When all the data was similar for both projects, I retained the project which has the most complete and detailed information, and the other double is discarded.

Step 3. Conversion of all funding amount to 2015 constant US dollars

The funding data collected spanned from 1990 to 2019. Hence, the committed amount reported are in different currencies. Converting all the data to a standardized currency makes them comparable. The funding data collected was converted in constant 2015 US Dollar by using the method applied by Steward et al. (2015). The committed year of each project was used to find the appropriate official exchange rate for amount reported in currencies other than US Dollars. I used the official exchange rate from the World Bank (2020) corresponding to each year. Then, I calculated two deflation rates based on the funder type: Benin as a funder (domestic) and for international funders. The inflation rates for Benin were also taken from the World Bank (2020), and for international funders, the United States inflation rate World Bank (2020) was applied as a standard. When the committed year is unknown for a project, I used the year 2015 as standard to determine the appropriate deflation rate.

2.3. Data analysis

After the standardization of the database, the information collected was analyzed by using Excel and Stata (2017). Analysis yielded descriptive information on the types and sources

of funding donors, conservation funding flows, types of funding recipients (amount received and areas where funding were used), gender inclusion in projects, and areas where the conservation projects were conducted in Benin.

2.4. Results

Temporal trends: funding amounts, sources and change over time

The conservation funding database for Benin has 314 projects in total obtained for the years 1990 to 2019. Total conservation funding for the study period was $301.04 Million (2015 Constant US Dollars). The average funding amount per year was $12.04 million. The year 2017 saw an unusually large amount, of which $70 million went for a project financed by the World Bank that year to strengthen management of many of the country's forest reserves. (Figure 2). Nearly all of the identified funding (259 projects totaling $292.88 Million or 96% of the total) derived from international sources. Domestic funding identified was $ 8.16 Million (2015 Constant US Dollars), 4 % of the total amount, for 55 projects. Conservation funding from domestic sources came mostly from hunting and tourism revenues and fines from Benin's two national parks, and recent contributions of the government of Benin to the African Parks Network. No funding was found for the years 1990, 1991, 1993, 1995 and 1999. Conservation funding and the number of projects funded per year increased on average during the study period even though the flows of money fluctuated over time (Figure 2).

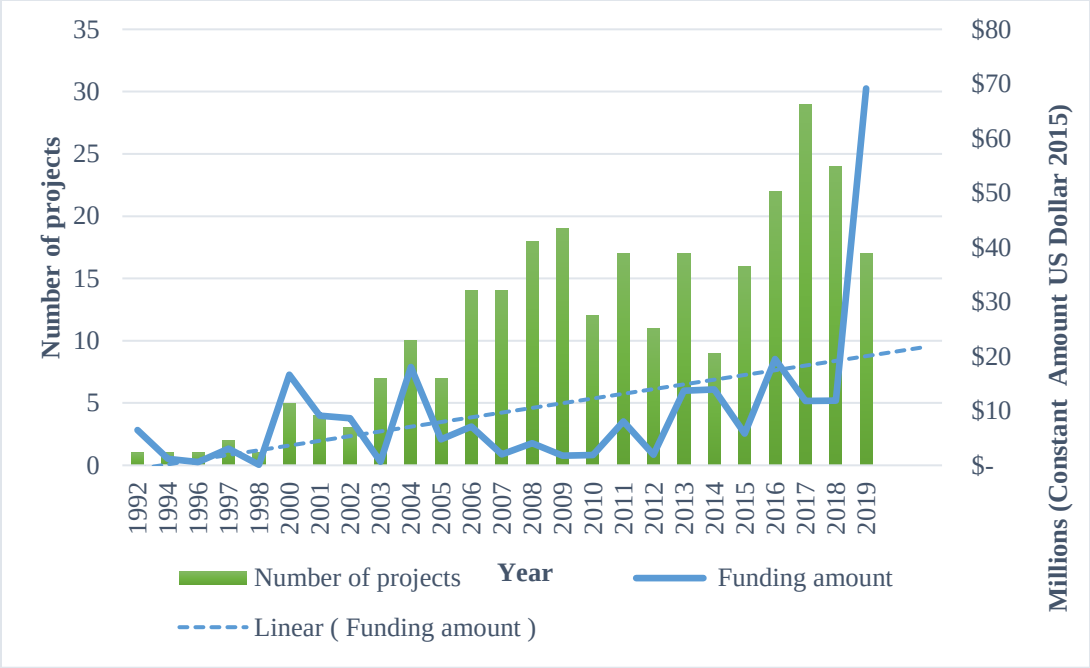

Figure 2. Conservation funding temporal trend in Benin from 1990 to 2019

To put these numbers in perspective, total Official Development Assistance (ODA) to Africa from 2010 to 2017 was 48.819 billion, with 1.1% for Benin's share, an estimate of 554 million (Constant Amount US Dollar 2016) (OECD, 2019). In Benin, our results show that conservation funding represents 1.54% of the total net ODA. This amount is a fraction of total ODA to the country but is significantly higher than the ratio of biodiversity funding to ODA found globally (less than 1%; Miller et al., 2013).

Types of conservation donors in Benin

My results show that 60 donors funded biodiversity conservation in Benin: 25 multilateral, 11 bilateral, 18 internationals private, 3 national public and 3 national private donors. Multilateral and bilateral donors were far and away the largest funders, representing 96% of all funding. Multilateral donors gave over $210 million in conservation funding and bilateral donors gave $79.27 million (Figure 3).

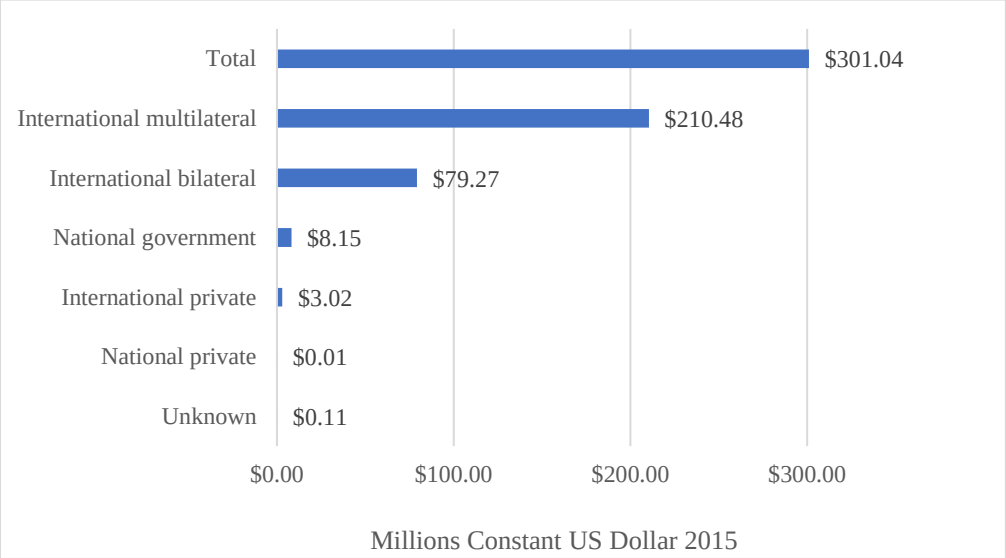

Figure 3: Conservation funders types in Benin

The World Bank, the Global Environment Facility (GEF), and the European Commission, were the top three multilateral donors for conservation funding in Benin. Germany, France and Netherlands were the top three bilateral donors for conservation funding in Benin (Table 2).

National government contributed to conservation funding up to $8.15 million and national private donors gave $0.01 million. Although recent levels of conservation funding were low for national private donors, this result shows that more of them should be explored

The list of all funders of conservation funding in Benin is referenced in appendix C

Table 2: Conservation funding from top three sources by funder type

Funder type	Donors name	Number of projects	Funding amount (Millions Constant US Dollar 2015)
Multilateral donors	The World Bank	6	81.183
	Global Environment Facility (GEF) Trust Fund	62	73.845
	European Commission (EC)	6	26.980
Bilateral donors	Germany (GIZ, GTZ, kfw)	18	73.751
	France/ FFEM (Fonds Francais pour l'Environnement Mondial)	15	5.32
	Netherlands	8	3.864
International private donors	Evangelischer Entwicklungsdienst (EED)	2	0.790
	The Darwin Initiative projects	3	0.672
	Pain Pour le Monde (PPLM)	1	0.529
National government	Government of Benin	8	4.168
	Centre National de Gestion des réserves de Faune (CENAGREF)	42	3.945
	Fonds National pour l'Environnement et le Climat (FNEC)	2	0.034
National private donors	ECO-ECOLO	1	0.006
	Réseau de Développement des Réserves Naturelles Communautaires (REDERC-ONG)	1	0.002
	OeBenin (Organisation pour la promotion de l'education des filles au Benin)	1	0.001

Types of funding recipients

The recipients of conservation in Benin were the national government, national non-governmental organizations (NGO), international organization and individual researchers. The government of Benin and its executing agencies like DGFRN (Direction Générale des Forêts et Ressources Naturelles), CENAGREF (CENAGREF - CEntre NAtional de Gestion des REserves

de Faune) and ABE (Agence Béninoise pour l'Environnement) received nearly $261 million (87%) in conservation funding in the study period. National NGOs received $15.83 million (5%). Individual researchers, mostly from Benin, received $0.46 million (0.2%) in conservation funding for research related activities (figure 4). International organizations received $9.17 million (3%) in conservation funding in Benin.

Figure 4: Types of conservation funding recipients and amount received

Thematic trends: areas of conservation funding allocation in Benin

Type of projects funded by domestic and international donors.

Fifty seven percent of the conservation projects funded in Benin were strict aid projects and 43% were mixed aid projects. The total funding amount allocated for strict aid projects by international donors was $161.26 million (55%) with an average amount of $1.55million while

$131.62 million (45%) was allocated for mixed aid projects with an average amount of $0.93 million.

The total funding amount allocated for strict aid projects by domestic donors was under one million (1%) whereas $8.09 million (99%) was allocated for mixed aid projects (figure 5). The average amount for domestic funded strict aid projects is $0.01 million and the average for mixed aid projects was $0.16 million.

Overall, strict projects (biodiversity conservation objectives only) received more funds than mixed projects (conservation projects with biodiversity conservation objective (s) and at least one development objective) in Benin from international funders. But domestic donors spent more money for mixed aid projects than for strict aid projects.

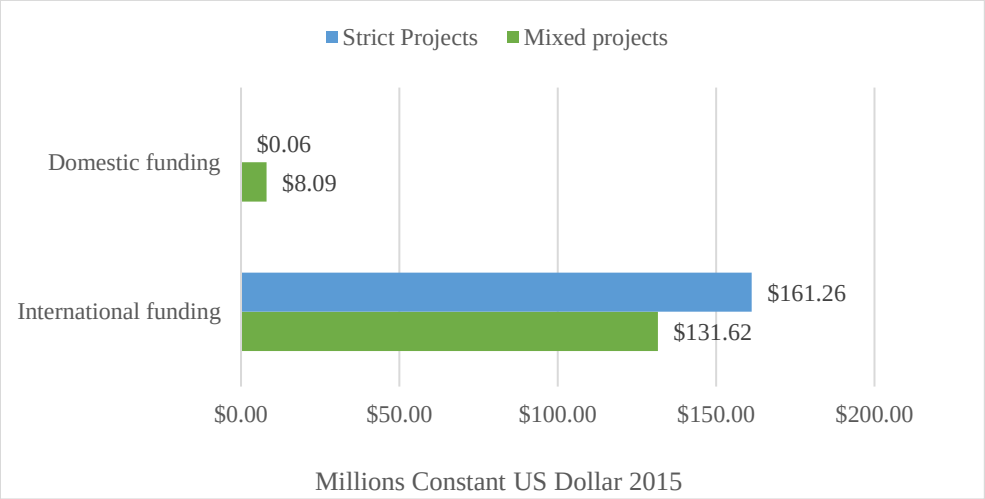

Figure 5: Project type by funder type in Benin

Conservation actions funded in Benin.

My results show that conservation projects targeted usually more than one conservation action. The minimum conservation actions per project was 2 and the maximum was 8. The

average number of conservation projects per project was 4. For this study, the five most common conservation actions targeted by many projects were: land and water management, research and monitoring, species management, education and training, and livelihood, economic and moral incentives. Law enforcement and prosecution appeared to be the least implemented conservation action (figure 6). This result may be explained in part by the fact that prior to 2000, the WNP which covers 8000 km^2 in Benin was nearly abandoned, with few large charismatic mammals, virtually no infrastructure and only 12 guards to ensure its protection (Miller, 2013; Blaszkiewicz, 2014). This means that prior to 2000, the number of guards available for the WNP was 0.15 guard per $100km^2$ which was significantly below the norm of 3 guards per $100km^2$ required for an effective protection in tropical parks (Bruner et al., 2001). To reverse the degraded state of the WNP, the European Union allocated $7.1 million to the government of Benin through the project ECOPAS from 2001 to 2008, with 90% of this fund used for enforcement. After the project, in 2011, the number of guards was 0.6 guard per $163km^2$ (Miller, 2013), which is still below the norm.

For 49 projects, I could not determine the type of conservation actions due to the lack of information. 46 of those projects are domestic funded projects. In fact, most of domestic funding came from the revenues issued from the management of the 2 national parks. There was no record of how and what those funds were used for, except for 30% of hunting revenues that went to the "Association Villageoises de Gestion des Reserves de Faune" (AVIGREF), which is a village level association tasked to help manage the two national parks in coordination with the state organization responsible of park management in Benin, CENAGREF. The allocation of the 30% started in 2000 (Tchabi et al., 2013).

Projects with unknown conservation actions accounted for $7.56 million.

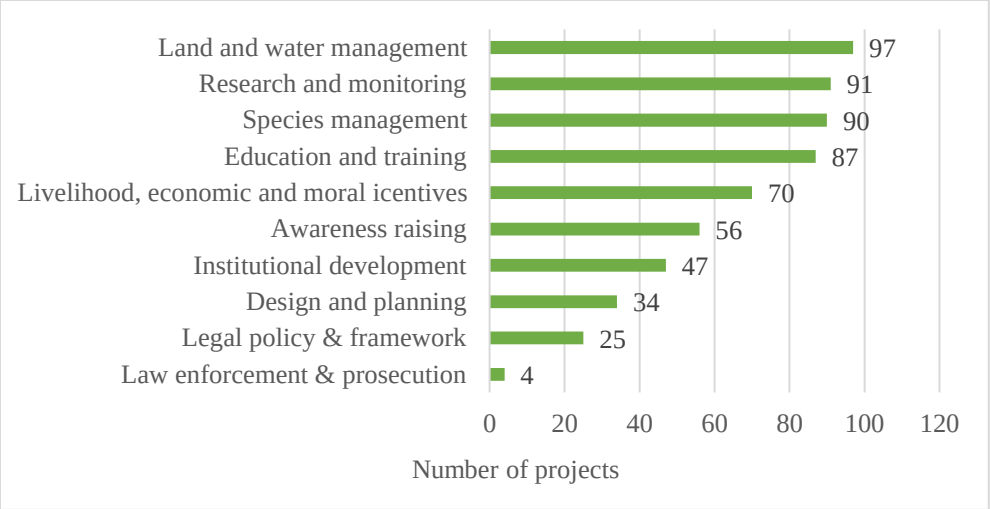

Figure 6: Conservation actions in Benin

Gender and conservation funding in Benin

My results show that only 28 projects out of 314 contained keywords related to gender. The amount of funding that was associated to those 28 projects was $89.76 million, 23% of the total conservation funding for Benin.

For 56 projects, mostly domestic funded projects, I did not have enough information to determine whether those words were included or not. However, the local populations living around the two national parks in Benin through the AVIGREF created in 1998 were included in the management of those park. They played a role in the reconversion of poachers into real partners of the forestry administration, in the protection and surveillance of the park and hunting zones, and in the management of tourist sites. Members of AVIGREFs have a representation on the Board of Directors of CENAGREF, the state organization in charge of the park's management. AVIGREFs members receive 30% of park revenue and 1/3 to 1/2 of the meat from sport hunting (Issa, 2007).

Most of AVIGREF members are men with 1 woman for 3.3 men; the low proportion of women was explained by the fact women "refuse to express themselves in front of their husbands", "show little interest in park management" and "are often absent from the villages due to agricultural work" (Tchabi et al., 2013). The low number of conservation projects that include gender related terms is the reflection of how gender is considered at the national level in Benin.

Benin ranked at the 109th place out of 129 countries for its 2019 Sustainable Development Goals (SDG) gender index[4] with a score of 49.9 out of 100, which indicates that the country has fared very poorly on gender equality (Equal Measures 2030, 2019) despite its ratification to multiple national and international legal frameworks and policies for gender equality. In Benin's "Plan National de Développement" (2018-2025), or the national development plan, the poor performance in terms of gender nationally was explained by the weak application of texts, the lack of control that women have over their resources, the lack of functional and operational mechanisms for gender implementation and the low budget allocated to gender aspects (less than 1% of Benin's national budget was allocated to gender implementation in all domains) (PNG, 2008).

The analysis of 4 national gender strategies reveals that in Benin, gender was mentioned in terms of women's participation in decision making, their access to and control of productive resources, their access to employment and income, and their access to education, health, loans, and microcredits (DGFRN, 2014; PNDP, 2018; PNPG, 2008; SPANB, 2014). Gender was also mentioned in relation to marriage, domestic violence, and participation of women to political

[4] http://www.data.em2030.org/2019-global-report

Countries failing on gender equality (scores of 59 or less out of 100); Countries "barely pass (scores of 60–69 out of 100); Countries with an excellent overall score (scores of 90 and above).

life. In the national development plan and the national gender policy document, there was no specific mention of biodiversity conservation. However, there was a mention that gender strategies in those documents were to be applied to all spheres of development in Benin. Gender in biodiversity conservation was mentioned in the National Biodiversity Strategies and Action Plan (NBSAP) document (2011-2020) and in the 5th national report to the Convention on Biological Diversity. While the 2011-2020 NBSAP of Benin did not feature the terms gender and women in relation to biodiversity conservation, the two primary guiding principles for the implementation of the strategy called for the (i) the adherence of all stakeholders to the common vision of Biological Diversity and (ii) real commitment and involvement of all stakeholders in a dynamic and synergistic planning / programming process (SPANB, 2014: 40). Those guiding principles advocated for a participative and inclusive approach to biodiversity management and an equitable sharing of benefits. The 5th national report to the Convention on Biological Diversity featured the terms gender, women, indigenous and local communities in relation to biodiversity conservation in Benin. In this document, gender in biodiversity was characterized in terms of the virtual absence of women in the management structures of the environment and natural resources, the need to involve women and vulnerable groups in forest management, the need to preserve wetlands ecosystems, whose degradation will negatively affect women and children more than other groups.

Overall, national gender strategies in Benin called for the inclusion of women, indigenous populations, vulnerable populations and all stakeholders in biodiversity conservation. However, the inclusion of gender in biodiversity conservation strategies in Benin can be improved. The analysis of 4 national strategies showed that while gender considerations are more included in the planning of education, access to resources and other domains, gender in biodiversity is yet to

be drafted in a specific way in Benin's national strategies. For example, in 2016 Benin's public office in charge of environment and natural resources management allocated no budget to gender, and no gender related activity was planned (FAO and CEDEAO, 2018).

Spatial trends

Location of projects funded in Benin

The total funding amount that went to PAs (n=153) is $231.89 million and funding that went to non-PAs (n=117) was $50.17 million. Conservation funding primarily went to state PAs: national parks and their buffer zones and forest reserves. Funding for state PAs was $221.06 million, while funding for territories and areas conserved by indigenous peoples and local communities (ICCAs), which are composed in this study of Ramsar sites and sacred forests was $10.84 million. For 44 projects, the location could not be determined. Table 3 shows the locations where the conservation projects were conducted in Benin.

Table 3: Location of conservation projects in Benin

Project location	**Designation**	**IUCN category**	**Area[5] (Km^2)**	**Nº of projects**	**Funding amount** ($millions)	**Funding/Km^2** ($millions)
PAs and ICCAs	National parks	II	8698.67	86	108.61	0.0125
	Forest reserves	II , IV, V	12925.43	26	104.5	0.0081
	Ramsar sites	V or VI	25873.42	18	10.37	0.0004
	Buffer zones/Hunting zones	VI	4436.79	6	7.95	0.0018
	Sacred forests	Ia or III	183.6	17	0.47	0.0026
Non-PAs	-	-	-	117	50.17	-
Unknown	-	-	-	44	18.99	-

[5] The sources of the data are Ramsar (2014) for the Ramsar sites areas and for the other PAs CENAGREF and PAPE (2013)

The national parks were classified in the IUCN category II, while their hunting and buffer zones were classified in the IUCN category VI. The forest reserves were primarily put in the category IV and V. However, there were 3 forests reserves which are classified as category II, Lama forest reserve, Monts Kouffe and Wari-Maro Forest Reserves, due to the goal of reversing the fragmentation of the first one and the exceptional richness in fauna of the latter two forests reserves (CENAGREF and PAPE, 2013). Sacred forests were classified under the category Ia or III depending on their degree of access. For example, access to some sacred forests in Benin is restricted to women only, while some are restricted to both men and women. More than 3000 sacred forests in Benin are yet to be integrated to the network of state PAs. Ramsar sites or wetlands of international importance of Benin can be classified under the IUCN category V or VI. 60% of conservations projects were in the two national parks and their buffer zones. While Benin has a large network of forest reserves, only 17% of conservation projects were implemented there. However, the funding amount for the National Parks and Forest reserves were approximatively the same. Since their establishment in 2000, all conservation funding for wetlands went to the Ramsar sites #1017 (Basse Vallée du Couffo, Lagune Côtiere, Chenal Aho, Lac Ahémé) and #1018 (Basse Vallée de l'Ouémé, Lagune de Porto-Novo, Lac Nokoué). There was no funding reported for the two most recent Ramsar sites established in 2007 (Site Ramsar du Complexe W and Zone Humide de la Rivière Pendjari). 18% of conservation projects were located in the Ramsar sites #1017 and #1018 with a funding of $7.95 million, while 11% of the projects went to sacred forests with a funding less than a half of million ($0.47 million).

The annual average of conservation funding per square kilometer ($/km^2) was $203 in Benin, when all PAs are considered. For an effective management of PAs in Sub-Saharan Africa, an average of $200-240 per square kilometer is estimated to be needed (James and al., 2001; Bell

and Clarke 1984; Leader-Williams and Albon, 1988). This means that the value found for Benin met the average needed for conservation of PAs in Benin. However, when I considered PAs according to their designation, national parks and forests reserves $/km^2 exceeded the average while the other PAs average falls under the Sub-Saharan Africa average. The map 1 (Figure 7) shows the network of PAs that received funding in Benin. Sacred forests were not represented in the map because I could not find any funding data that was specifically traceable to them.

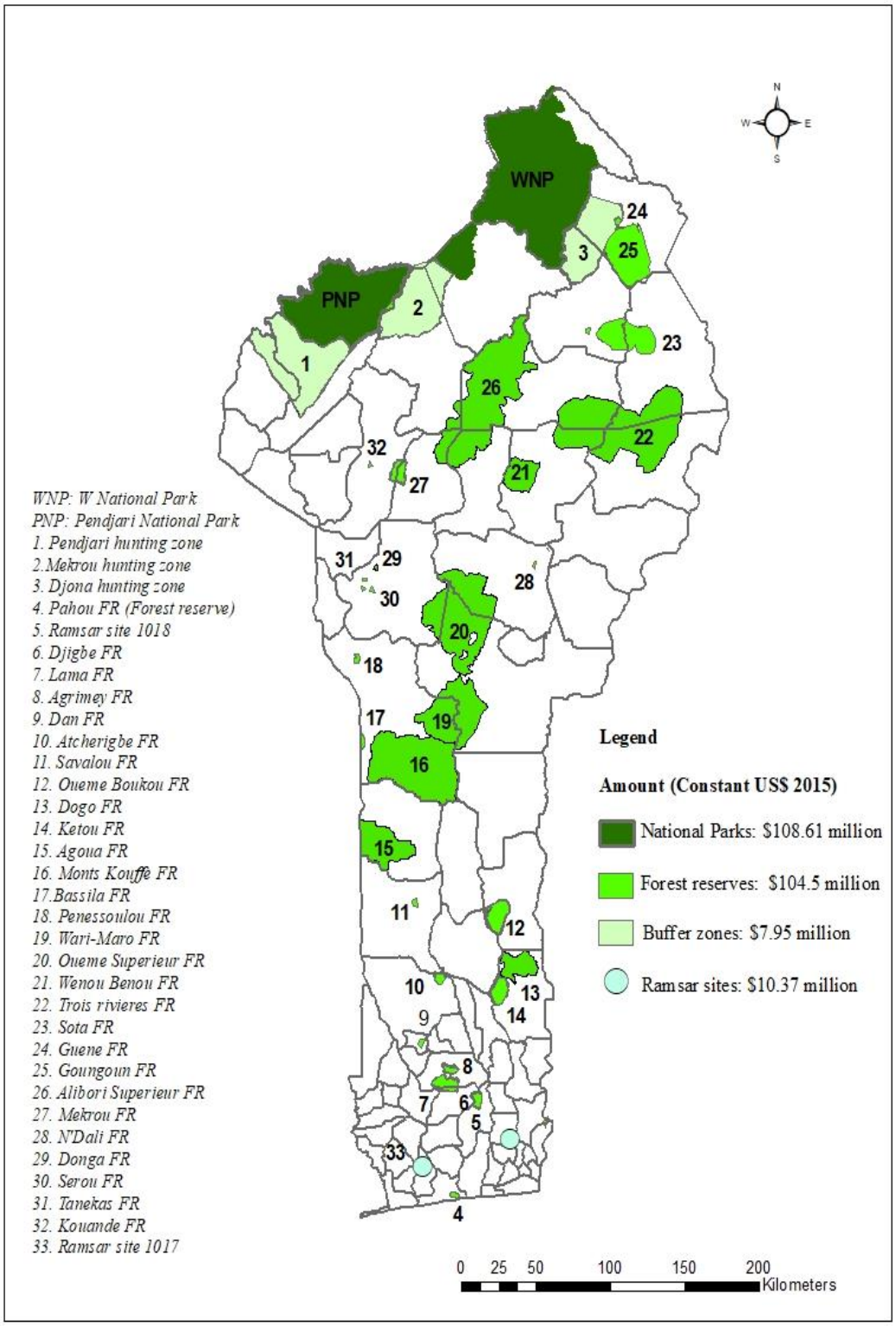

Figure 7: Georeferenced conservation funding for Protected areas in Benin

2.5. Discussion

Temporal trends

Based on the information available, the results of this study show that conservation funding in Benin had steadily increased from 1990 to 2019 without a particular trend, except in 2009 and 2010, where funding amounts from international donors dropped sharply. This drop could be explained by the worldwide 2008 recession, suggesting that funding conservation projects might be influenced by the economic fluctuations in donors' countries. This is consistent with Das and Dutta (2013) results, who found that macroeconomic conditions due to a global financial crisis in donors' countries negatively affect ODA amount to LMICs. A sharp decline in conservation funding might also be expected in 2020 and the subsequent years due to the Covid-19 global pandemic. This result suggests that conservation in Benin is subjected to internationally funded projects aims or the priorities and circumstances of external partners. This result was corroborated by Blaszkiewicz (2014) in the conservation field in Benin. She argued that "Benin is on a drip of international aid" (my translation from the original French)

Conservation funding for Benin was mostly provided by international donors. Ninety six percent of conservation funding was derived from international sources compared to 4% from domestic sources. There is a pattern of 80/20 for international/domestic that most conservation funding follow (Waldron et al., 2013). The 4% of domestic funding appeared to be lower than the expected 18-20% range for domestic funding. However, this result corroborates the fact that generally most conservation projects in LMICs are funded by international donors (Hein and al., 2013 and Waldron et al. 2013). "Aid is, and will likely continue to be, the main source of funding biodiversity conservation in developing countries" (Richerzhagen et al., 2016: 2). This result of major conservation donors being international was also found by Devkota (2020) in

Bhutan and Nakamura (2017) in Peru. The World Bank and GEF trust fund were the top multilateral donors for conservation in Benin, and Germany was the top bilateral donor. This result is consistent with Young and Bakker (2016), who found that GEF and Germany are the most important donors for biodiversity conservation in developing countries. The national private donors gave $0.01 million. Although current level of conservation funding was low for national private donors, this result shows that more of them should be explored for increasing domestic funding level in Benin.

Additionally, all the sources researched for this study that did not yield any results for Benin work in the field of biodiversity conservation and environment protection. Therefore, those sources could be explored and could potentially be donors for conservation in Benin. This could be done by creating a marketplace for biodiversity, where "buyers" and "sellers" of biodiversity projects are matched, as has been done in other LMICs like the Philippines (Deutz et al., 2020).

The average amount of conservation funding per year was $12.04 million. The estimation of the total cost for the implementation of the NBSAP (national plan for biodiversity conservation) objectives from 2014-2020 of Benin was XOF 35.892 billion ($US 65 million), an estimate of $US 9.25 million annually (SPANB, 2014). This result suggests that virtually, funding needs for biodiversity conservation in Benin are met. However, the funding needs reported in the NBSAP concerned only the 20 Aichi targets and hence might not reflect the full picture of conservation needs in Benin. For example, Lindsey et al (2018) found that $16.30 million is required annually for the conservation of lions in Benin, while funding level was $6.27million for the species. Therefore, not knowing the funding needs for each protected area, threatened and endangered species and other conservation areas and species in the country made

it quite impossible to conclude that the current conservation funding level of Benin is sufficient or low. Based on that figure for lions alone, we can speculate that funding level of Benin might not be enough to cover all costs for an effective conservation. Therefore, further studies are needed to evaluate in detail all conservation funding needs in Benin in order to make future investments more effective.

Conservation funding amounts in Benin are a fraction of overall ODA. This result is consistent with other findings, showing that, globally, biodiversity is significantly less funded than other development sectors like agriculture, education, health or water (Young and Bakker, 2016; Miller et al., 2013).

Domestic funding was low for biodiversity conservation in Benin and remained low in comparison with other sectors in developing countries because there are challenges for governments in those countries to split their limited budgets between other competing, yet important sectors like health, education, food, and debt payments (Richerzhagen et al., 2016; Oktaviani et al., 2018). Moreover, the low contribution of biodiversity to Benin's Gross Domestic Product (GDP), which was less than 7% in 2018 compared to agriculture contribution, which was 35.2% employing 70% of people (FAO, 2018) might be one of the reasons why the contribution of domestic funding to conservation in Benin remains low.

In summary, the analysis of past and current conservation funding in Benin revealed that conservation was internationally funded and domestic funding is low compared to the suggested norm. These results pose many questions: who should finance biodiversity conservation? What level should domestic funding reach for effective biodiversity conservation? What mechanisms are needed to ensure a sustainable funding of biodiversity conservation in Benin that is

independent of external donors control and will? The answers to those questions are complex and remain for future studies to tackle.

Existing literature suggests some answers to these questions. Richerzhagen et al. (2016) argued that low- and middle-income countries budgets cannot be enough for biodiversity conservation because of other competing sectors. In 2020, the total budget for Benin was XOF1877.543 billion, an equivalent of $US 3.4 billion, of which an average of $US 177 million came from international donors (DGB-Benin, 2020). An average of 6% percent of the total budget was spent on environment protection and sanitation. Although the exact budget for biodiversity conservation and its allocations is unknown, it can be assumed that it represented a tiny portion of the 6% allocated for environment and sanitation. The increase of domestic funding for biodiversity conservation will less likely come from public sources alone in Benin in the foreseeable future (CBD 5th national report for Benin).

Based on the literature and the results of this study diversifying sources and increasing domestic funding level for biodiversity conservation can include several options. These include the expansion of conservation funding sources to the private sector (UNDP, 2018; Anyango-van Zwieten et al., 2019; Credit Suisse et al., 2014; Hamrick, 2016): the private sector can include private citizens, corporations, foundations, bequests and legacies (Anyango-van Zwieten et al., 2019). The inclusion of the private sector in biodiversity funding is deemed efficient and important when seeking out new sources of funding (Bos et al. 2015; McFarland, 2015) and could lead to better conservation management (Borie et al. 2014; Bruner et al. 2004; Rosendal and Schei 2014; Whitelaw et al., 2014). Some studies contend that doing so might render the conservation field neoliberal and detrimental for conservation goals (Anyango-van Zwieten et al., 2019; Fletcher et al., 2018). While debate continues about the most appropriate role of the

private sector, a range of private sector-oriented schemes have already been put in place in many countries. These include: public administration contracts with private sector actors and NGOS, management concessions (World Bank, 2012), natural capital accounting (like Payment for Ecosystem services (PES), (Fletcher et al., 2018), effective altruism, that promotes evidenced-based giving (Freeling and Connell, 2020; Singer, 2015; MacAskill, 2015) and the establishment of conservation trust funds (CFA, 2008).

A management concession is already implemented in Benin. The non-profit international organization African Parks Network now has exclusive rights to manage Benin's two national parks since 2017. The government of Benin had contributed to the budget of African Parks. The "Fondation des Savanes Ouest-Africaines"/ West African Savannah Foundation (FSOA) is a regional conservation trust fund set up by Benin in 2017 with the contribution of external partners that aims to promote conservation in the W-Arly-Pendjari (WAP) Complex. The National Fund for Environment and Climate (FNEC) is a national public funding mechanism that aims to finance projects related to in the environment protection, climate change and sustainable development. My research results show that FNEC financed two projects amounting $US 0.034 million, while no projects were reported for FSOA. The small number of projects funded by the conservation trusts funds in Benin called for further studies to analyze their effectiveness for conservation funding in Benin. Further studies are also needed to explore the feasibility of the other schemes in Benin. This task can be conducted by researchers and the agencies responsible for biodiversity conservation in Benin.

The exploration of innovative mechanisms might further include payments for environmental services (PES), creation of marketable products or services compatible with biodiversity projects (World Bank, 2012; Deutz et al., 2020), and sale of conservation license

plates that are more expensive than regular plates, with the surplus devoted to the protection of wildlife. These plates are already being sold in The United states of America and being tried in Malaysia for Tiger conservation (Deutz et al., 2020).

It is also possible for Benin to mainstream biodiversity conservation in policies and sector programs (Richerzhagen et al., 2016; Deutz et al., 2020) by better incorporating special measures and programs in all domains (finance, justice, economy). One way this measure could be applied in Benin is by the removal of harmful subsidies in the domain of agriculture for example, by promoting organic cotton in place of the conventional cotton culture (use of pesticides, clearing of land …) that is a driver for biodiversity loss.

In these and other ways, Benin might be able to increase domestic funding for the environment to at least a level of 20% (a norm found in other LMICs in the literature (Waldron et al., 2013) within the next decade by gradually increasing it at a level of 2% per year.

The collection of data for this study was time-consuming and domestic data collection was hard due to reasons that are unknown to me. Tracking funding sources, allocation and level can be made easier by using the method that we use in this research which can be standardized and used going forward by the CHM of Benin. This method was successfully used in Peru and Bhutan (Devkota, 2020; Nakamura, 2017). The database can be crowdsourced by donors, NGOs, public sectors, researchers, FSOA and all partners in biodiversity conservation. The records of funding data and their uses from previous projects could also be used as a requirement for funding seekers to benefit for future funds.

Although the private sector could be essential for conservation funding increase in Benin, the government of Benin can lead the way by nurturing a strengthened legal environment that

allows for the inclusion of more national private actors and sectors investments into biodiversity conservation as suggested by Deutz et al., 2020 and the world Bank (2012).

Thematic trends

Regarding the conservation project types, there were more strict aid projects than mixed projects. The funding allocated by international donors for strict projects ($161.26 million) is slightly higher than mixed projects allocation ($131.62 million), while domestic funding was spent more on mixed projects ($8.09 million). This result differs partially from the strict/mixed aid pattern in developing countries found in Miller (2014) which states that mixed conservation projects tend to receive more funding than strict projects. This result might be explained by the fact that donors responded to urgent biodiversity conservation needs in Benin, as found by Bare et al. (2015), to reduce human pressure on PAs (SPANB, 2014).

Land and water management, research and monitoring, species management, education and training, and livelihood, economic and moral incentives are the conservation actions implemented by many projects while law enforcement and prosecution appear to be the least conservation action implemented. This result can be explained by the desire of donors to shy away from the "fences and fines"[6] approach and to advocate for a more integrated conservation approach in African countries that promotes the linkage of conservation to economic and social growth (Newmark and Hough, 2000). This result can also be explained by the fact that the number of park rangers was low for Benin, especially in the WNP prior to 2000 and even after a major conservation project, ECOPAS, whose funding was primarily devoted to enforcement activities (see Chapter 3).

[6] Fences and fines approach refers to the strict management of protected areas that excludes the extraction and use of natural resources and characterized by repression, enforcement and fines (Oldekop et al., 2016)

However, enforcement activities and security have increased in the past two years because of the surge in poaching and the kidnapping and killings of tourists in the national parks in Benin. In May 2019, two French tourists were kidnapped in the Pendjari National Park (PNP) and their Beninese guide killed. Two French soldiers lost their lives in the rescue operation of the kidnapped tourists (Commission Europeene, 2019). Fifty-seven teams of 6 people composed of soldiers, park rangers and police officers were deployed in the WNP and 100 soldiers were sent to PNP to help secure the parks (Commission Europeene, 2019).

Detailed tracking of funds allocated to each conservation action was not feasible in my study because the data found was not detailed by conservation actions/ biodiversity components as found by Richerzhagen et al (2016). This renders difficult the determination of conservation actions with low funding. A standardized reporting methods of biodiversity aid by conservation actions could be useful for the identification of the actual funding that goes into each component. This can be a requirement from donors to funding seekers. Additionally, the current reporting systems used in many databases explored could be improved by reporting biodiversity aid by components, instead of just the total amount disbursed for projects.

Gender

The results presented here suggest gender considerations in biodiversity conservation in Benin are limited. Although national legal frameworks call for the inclusion of women and vulnerable populations in conservation management and benefits sharing, there is no legal framework or strategy devoted uniquely for the inclusion of gender in biodiversity. This absence of a framework tends to render the effective inclusion of gender in biodiversity conservation difficult. My findings of little focus on gender in funded conservation projects suggest the "real participation" of women remains minimal in conservation in Benin, a result found in other

studies in Benin (Dadjo, 2018). Further research on gender disparities in conservation in Benin is warranted to better understand the extent to which women and other marginal groups are disadvantaged in the process of biodiversity conservation in Benin (Lau, 2020: 1589). Specifically, future research can analyze the factors that affect women's effective participation in protected areas resource management and decision-making in Benin, and especially the participation of women in AVIGREFS, their roles and responsibilities. Findings of such studies could provide guidance to researchers, political decision makers, managers of PAs, local and international partners in their efforts to provide more equal opportunities for women and men, over the use and management of natural resources. Moreover, further studies on the ways that international gender norms are translated locally in biodiversity conservation field in Benin is needed. Such study was conducted by Devkota (2020) in Bhutan. The author found that gender norms were accepted and implemented when they generate instrumental benefits but resisted when those foreign norms were not adapted to the local context.

Spatial trends

Most projects were implemented in state recognized PAs, the national parks and the forests reserves. This result might be explained in part by the fact that attention is given more to PAs in conservation strategies than areas outside of PAs, which can also harbor biodiversity (Dudley et al., 2018). Other effective area-based conservation measures (OECMs), that are outside PAs network can present an opportunity for the conservation of more areas without the side effects of PAs establishment, like evictions, and should be considered in conservation strategies (Dudley et al., 2018).

Sacred forests in Benin offer such an opportunity. Over 3000 sacred forests with an area of 18360 ha existed in Benin (Agbo and Sokpon, 1998) and have been conserved for decades by

local communities without the official status of PAs (Padonou et al., 2019; Juhé- Beaulaton, 2008). However, the area covered by those forests decreased and was 3000 ha in 2005 (SPANB, 2014). Despite their sacredness (including fear of deities, which can limit human pressure), sacred forests in Benin are being cleared. Although sacred forests play social, economic, cultural and ecological roles in Benin (Padonou et al., 2019), they are not included in the PA network (CENAGREF and PAPE, 2013, SPANB, 2014), less studied, received less attention and are being lost. Those forests have received less than a half million from 1990 to 2019. The inclusion of sacred forests in the network of PAs and or their recognition as OECMs or ICCAs might represent an opportunity for increasing conservation areas in Benin. This strategy was also suggested by Dudley et al (2018), as "an ambitious area-based conservation target" (p. 4) that could expand PAs status to OECMs and other land and water management areas that work in synergy for biodiversity conservation. While efforts have been made in the country for the identification and a better conservation of sacred forests (Padonou et al., 2019; Agbo and Sokpon, 2018; national decree N°021/ MEHU / MDGLAT / DC / SG / DGFRN / SA of 16 November 2012), more studies and actions need to be implemented for a better conservation of those forests and the biodiversity that they contain. Additionally, if the project of creating a marine PA in Benin, "site marin de Avlékété" (Sohou, nd.) comes to fruition, it could contribute to more funding and more attention to PAs in Benin and their ecosystems.

However, socio-economic studies need to be conducted first to ensure that local communities who are managing those areas are not harmed. Muhumuza and Balkwill (2013) for example found that neglecting socioeconomic and related aspects of culture can lead to the failure of conservations actions. Moreover, increasing the size of PAs might not necessarily

contribute to more species being preserved as PAs size do not always predict reported species richness (Hoffmann et al., 2018).

Study limitations

This research presents some limitations that are worth mentioning for any person that will use its results. The limitations concern primarily the nature of funding data that was available for collection. Data collection was primarily desk based. While I was able to collect most available information on international funding online, my search for domestic funding data was not as fruitful. To mitigate that limitation, I tried to contact public services and NGOs responsible of biodiversity conservation in Benin. The complementary data collection allowed me to add 97 projects to the initial database. In total, I included 314 projects in the funding database. While I tried to include all biodiversity projects that I could find, there might still be conservation projects that are not represented in this database. Additionally, limited information on some projects made it hard to accurately categorize them. For example, when a project has only its code or title without the objectives or the description of the project, the classification of the project into mixed or strict projects, or the determination of the conservation actions for those projects might not be totally accurate. To address those limitations, I relied on the title to classify the projects and for the conservation actions, I classified them as "unknown". Finally, I imagine that some information may have been lost over time, especially when switching to newer digital/online databases.

Nevertheless, despite these potential limitations, this study did provide an overview of the conservation funding landscape in Benin that was as comprehensive as possible. It provides a useful list of the key organizations financing biodiversity conservation in Benin and an overview

of the funding trends in Benin over three decades. More domestic funding data would have made the results of this research more complete but remain for a future analysis.

2.6. Conclusion

This study, the first of its kind in the field of conservation in Benin, has mapped biodiversity conservation funding in Benin over a long period of time (three decades, covering the years 1990 to 2019). This research analyzed the temporal, thematic and spatial trends in biodiversity conservation in Benin and provides a database that can be used for other analyses. Total investment for the study period was more than $300 million (2015 Constant US Dollars), with that vast majority coming from international sources (96%) and the rest from domestic ones.

Funding flows from 1990 to 2019 did not follow a specific pattern but increased slightly over the years. Biodiversity conservation funding is 1% of the total Official Development Assistance of Benin with the rest going to other sectors. Further research is needed to understand and reduce the gaps between conservation funding needs and actual flows in Benin. Further research is also needed to inform efforts explore new funding schemes to attract more international funding and increase domestic funding in the conservation sector.

The conservations actions that were implemented in many projects were land and water management, research and monitoring, species management, education and training, and livelihood, economic and moral incentives. Law enforcement and prosecution appeared to be the least conservation action implemented. However, due to the surge in poaching and criminal activities in 2019 in the national parks in Benin, security in and around the national parks increased recently. Security remains a major concern in the national parks in Benin, especially in the WNP. If this situation persists, wildlife conservation will be at risk and domestic funding that

mainly comes from tourism, hunting and game viewing revenues will decrease. Further research can be conducted to evaluate the impacts of enforcement activities on wildlife after 2019.

Gender considerations in biodiversity conservation is still lacking in Benin. Specific laws and legal frameworks related to biodiversity conservation need to be devised, passed and followed for a better inclusion of gender aspects.

Conservation funding use is concentrated in the country PAs. The two national parks and the Lama forest reserve garnered more attention than the other protected areas in Benin. More attention needs to be devoted to all protected areas and "Other effective area-based conservation measures" (OECMs), especially sacred forests that are outside PAs need also attention, as they have the potential to increase biodiversity conservation in Benin. Future research can address the state of the less focused on PAs and the OECMs in order to better preserve them.

Overall, this study has painted a general portrait of biodiversity conservation financial trends in Benin. This study has also provided a list of past and current funding sources for conservation in Benin, which can be used as a tool to assess future financial needs and investment. Finally, this study provides an extensive and comprehensive database on the funding landscape for biodiversity conservation in Benin.

Finding and reporting conservation data has been a daunting process during this research. The development of a standard mechanism for reporting electronically in real time conservation funding data in Benin, particularly from domestic and private sources, would greatly aid future efforts to track and assess biodiversity conservation in that context.

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CHAPTER 3: ASSESSING THE LONG-TERM SOCIO-ECONOMIC IMPACT OF INTERNATIONAL CONSERVATION AID AROUND BENIN'S W NATIONAL PARK

3.1. Introduction

Reliable information on the impacts of previous conservation interventions can help inform more just and effective conservation investments (Campos et al., 2018; Stephenson, 2019; Waldron et al., 2017; Adams et al., 2019; Law et al., 2017). Yet, the tracking and reporting of successes, failures and lessons learned from the implementation of conservation projects remain limited, especially in developing countries (Rochette et al., 2019; Siddig, 2019). Assessing the effectiveness of conservation projects and strategies can provide conservation practioners, policymakers, and funders with evidence-based insights for better projects designs, improved cost effectiveness strategies and better funding allocation to projects with higher impacts potential (Baylis et al., 2015; Ferraro & Pattanayak, 2006; Stephenson, 2019). Monitoring and evaluating the impacts of conservation remains crucial for better conservation outcomes, as it ensures that scarce and low funding is not being funneled at programs and projects with negative impacts or with little or no conservation benefits (Huwyler et al., 2016). For that reason, a growing number of scholars and conservation practitioners worldwide have sought to collect evidence on conservation impacts, though progress has remained relatively slow (Baylis et al., 2015; Borner et al. 2020). In Low-and Middle-Income Countries (LMICs), especially in Africa, few studies can be found on short term and long term biological and social outcomes of conservation projects (Andam et al., 2010; Beauchamp et al., 2019; Canavire-Bacarreza and Hanauer, 2013; Clements et al., 2014,), on ecological effects (Andam et al., 2008; Miranda et al., 2016), and both outcomes (Jagger et al., 2018; Miller, 2013; Naughton-Treves et al., 2011; Sims, 2010; Quesne et al, 2019).

But there are fewer studies on long-term impacts of conservation, where the available studies mainly focused on ecological impacts (Burton, 2010; Sinclair et al., 2007) rather than social impacts (Mascia et al., 2017). These kinds of studies are rare because they take time and it can be challenging to evaluate a conservation action after a lengthy period has passed since its implementation (Miller, 2013; Bierschenk et al., 2000; Lewis & Mosse 2006). The paucity of evidence that a targeted conservation effect persists beyond an intervention suggests that empirical evidence has not been the main driver of conservation decisions and investments (Mihoub et al., 2017; Sutherland et al., 2004).

In Benin, unsystematic archiving of conservation studies and scientific records, inadequate and short-lived monitoring systems and lack of baseline references before the start of projects do not provide long-term series data, which are essential for biodiversity monitoring over time (Quesne et al., 2019). For example, in its 6th national report to the Convention on Biological Diversity (CBD) the country reported that there were no evaluation mechanisms planned for reviewing its National Biodiversity Strategies and Action Plans (NBSAPs) (CBD, 2018). Additionally, a study in Benin found that one of the main difficulties for biodiversity conservation is the lack of monitoring and evaluation systems of conservations projects and actions (FEM et al., 2008).

Thus, Benin presents an interesting case for building a body of evidence based on lessons learned from past and current conservation strategies and projects in order to efficiently use scarce resources and to avoid one-size-fits-all solutions for conservation problems.

The research presented in this chapter aims to assess the persistence of social impacts of the "Ecosystèmes Protégés en Afrique Soudano-Sahélienne" (ECOPAS) project around the W National Park (WNP) in Benin. It answers the following central question: To what extent have

the social impacts of the ECOPAS project endured in communities around the W National Park a decade after its conclusion?

The choice of the WNP for this study is justified by the fact that since its creation in 1954, the park was in a state of near abandonment until the year 2000, even after its classification by UNESCO as a World heritage site in 1996 (Blaszkiewicz, 2014; Miller, 2013). However, the classification of the WNP as a World heritage site helped to spur needed international donor investment in its conservation given budget constraints faced by the government of Benin in the 1990s and 2000s (Banegas, 2001). The largest investment came from the European Union via the ECOPAS project from 2001 to 2008. "ECOPAS can be considered as the founding moment of the dynamics of aid to the WNP and the project can be considered to this day as a reference for all conservation actions in the WNP since then" (Blaszkiewicz, 2014: 43; translation is mine from French to English).

This study advances knowledge by providing an empirical evidence of the long-term socio-economic impacts of a major conservation project that targeted the twin-challenge of poverty and biodiversity conservation in Benin.

Study Background

The International Association for Impact Assessment (IAIA) defined social impact assessment as "processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions" (IAIA, 2021). Economic impact assessment entails the measurement or estimation of change that occurs in a region after the implementation of an economic activity by a project, program, organization or a

specific economic intervention (Weisbrod and Weisbrod, 1997). “Social and socio-economic impacts are the ‘people impacts’ of development actions and their assessment focus on the human dimension of environments, seeking to identify the impacts on people, including who benefits and who loses” (Glasson, 2017).

In this study, social impacts and socio-economic impacts are referred to as socio-economic impacts for simplicity. Socio-economic impacts in this study refer to the changes, positive or negative in household income and in their access to key natural resources: water, land for agriculture, livestock and forest products after the intervention of the ECOPAS project. The region where the impacts were assessed in the WNP region in Benin.

Before the ECOPAS project, the WNP was near abandonment and conservation action in the Park was very minimal (Blaszkiewicz, 2014; CENAGREF, 1999). Indeed, the funding mapping results presented in Chapter 2 showed no project before 2000 for the WNP. Miller (2013) examined the ecological and socio-economic impacts of ECOPAS in the period shortly after the project ended. The evaluation of the medium term of the project ECOPAS revealed substantive gains for biodiversity goals while there were trade-offs for socio-economic/poverty reduction goals (Miller, 2013). Several authors corroborate the fact that the project ECOPAS reversed the degraded state of the WNP and enabled the recovery of wildlife by investing in enforcement activities and by reducing human pressure on the park (UICN-PAPACO, 2015; Amahowé 2013).

Since the end of the project ECOPAS, additional funding has gone to support conservation in the region, though this amount has been considerably smaller than the ECOPAS investment.

Projects at least partially implemented in the WNP after the ECOPAS project include:

- **Programme d'Appui aux Parcs de l'Entente (Peace Parks Support Program - PAPE)**: this project was implemented from 2011 to 2014 in the W-d'Arly-Pendjari and Oti-Kèran-Mandouri (WAPO) complex spanning a contiguous area in Benin, Burkina Faso, Niger, and Togo. Its objectives were to strengthen the regional institutional framework for the conservation of PAs and to reduce negative pressures exerted by the nearby populations on the park. The PAPE project was financed by the European Union. The funding amount for the duration of the project in all countries was $1.59 million (2015 Constant US dollar). This means that the annual funding amount for the project was roughly $0.53 million (2015 Constant US dollar) for the 4 countries. Therefore, $0.13 million (2015 Constant US dollar) went for the WNP and PNP in Benin annually, and an estimate of $65,000 went for the WNP in Benin annually. This suggests that only a small fraction of the total funding went to the study area.

- **Programme d'Appui à la Gestion des Aires Protégées (PA management support program - PAGAP)**: this project was implemented from 2011 to 2017 in the 2 national parks of Benin, PNP and WNP. Its objectives were to enhance biodiversity protection by reducing human pressure on Benin's parks through the funding of income generating activities (IGAs) for the population living around the parks and by helping the government of Benin for the salaries of conservation workers. The funding amount for this project came from GEF and was $4.07 million (2015 Constant US dollars) for the duration of the project. The estimated annual amount of this project devoted to WNP was roughly $300,000 annually during that period.

- **W-Arly-Pendjari (WAP) project:** this project aimed to enhance the effectiveness and catalyze the sustainability of the PA system in the three national parks of the WAP complex

in Benin, Burkina-Faso and Niger. Implemented from 2010-2015, its objectives were to reduce human pressure on the complex by investing in the periphery of the PAs, primarily to the benefit of the local population. This project was funded by GEF with a total funding of $5,15 million for the three countries for the duration of the project. An estimate of $1 million was thus spent annually by the three countries. A total budget of $420,000 was expected to finance 13 IGAs in the 3 countries for the duration of the project. (Amahowé et al., 2013). This means that a small amount of funding, roughly $330,000 annually went to the WNP and PNP on Benin side and an even smaller amount went to IGAs. An estimation of the annual funding for the WNP in Benin would be $167,000 annually.

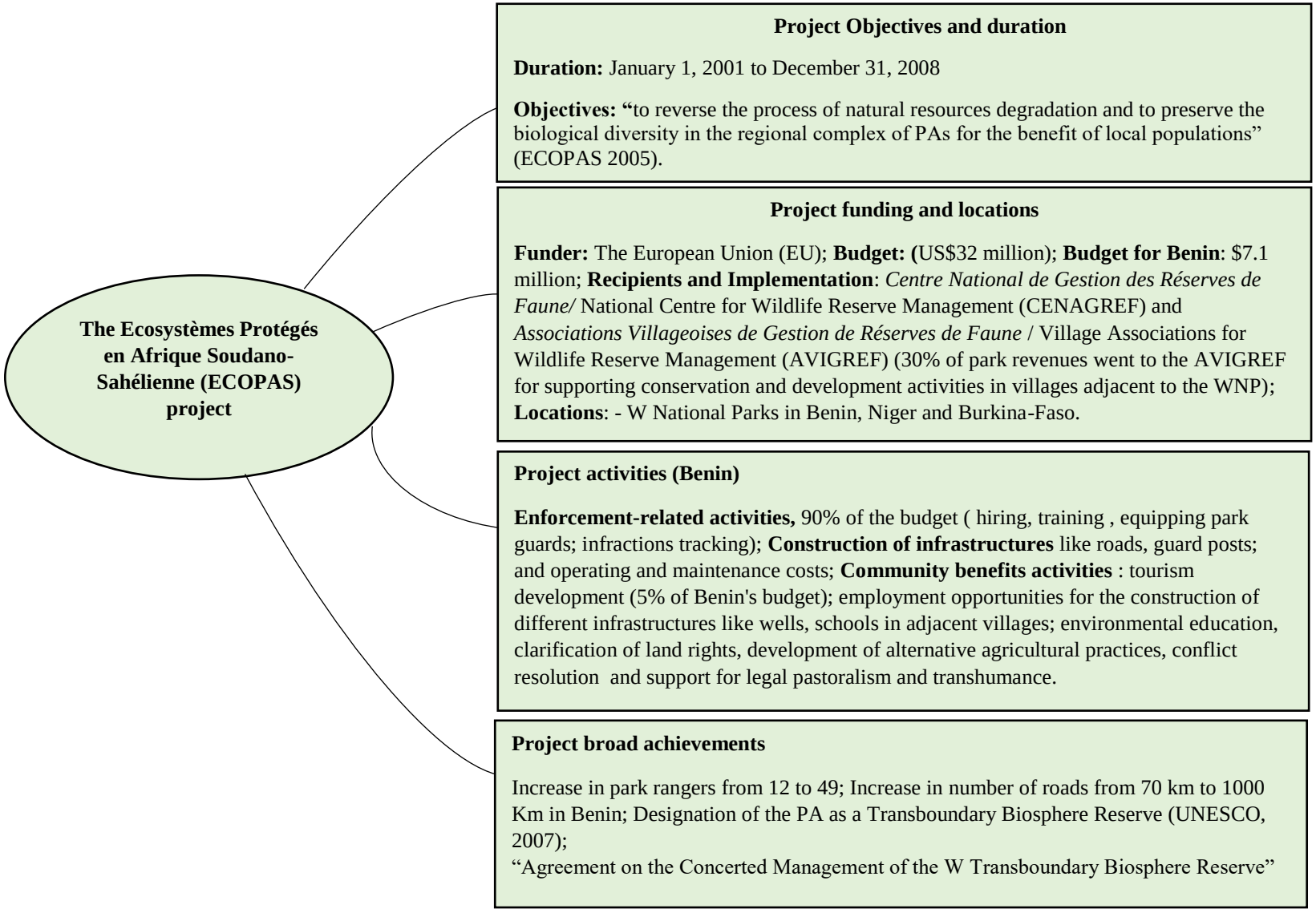
In total, the funding from these three projects devoted to WNP in Benin was $532,000 annually, which represents the half of the ECOPAS project annually ($1million). Though relatively small in scope, these three projects did seek to change the behavior of people living around WNP in Benin and may be expected to have had at least some socio-economic impacts beyond the ECOPAS project. They need to be considered in assessing the long-term impacts of the larger ECOPAS project.

3.2. Data and methods

The ECOPAS project

The project ECOPAS was implemented from 2001 to 2008 in Benin, Burkina-Faso and Niger. The project ECOPAS sought to reverse the degradation of biodiversity in the WNP in a way that was beneficial for local populations (ECOPAS 2005). The achievements that the project hoped to accomplish in Benin was: the technical and operational improvement of WNP agencies; the strengthening of monitoring and enforcement of the park; the inclusion of the local population in the management of the park and a sustainable preservation of natural resources

while contribution to a sustainable development of the local population in the WNP region (Aveling et al. 2008; ECOPAS 2005). In Benin. the activities and funds (90%) of the project were directed mainly toward enforcement and management of the park, while 5% ($ 350,000) were directed toward tourism and its related activities in order to benefit local populations, who were expected in return to support and participate in conservation activities. Other than tourism, the project activities included research, environmental education, clarification of land rights, development of alternative agricultural practices, conflict resolution, and support for legal pastoralism and transhumance (Miller, 2013). Figure 8 presents a summary of the ECOPAS project activities in Benin.



Source: ECOPAS (2005)

Figure 8: The ECOPAS project

Study area

Benin is classified as a low-income country by the World Bank that is located in west Africa in the tropical zone between the equator and the Tropic of Cancer (between the parallels 6 ° 30 'and 12 ° 30' of north latitude and the meridians 1 ° and 30 ° 40 'of east longitude). The country is bordered to the south by the Atlantic Ocean, to the west by the Republic of Togo, to the east by Nigeria, to the north-east by Niger and to the North-West by Burkina Faso and has twelve departments subdivided into 77 Communes (UN and GEF, 2019). Benin covers an area of 114,763 km² with a population of 11.80 million in 2018. The percentage of people living below the national poverty line in the country was 38.5% in 2018 (World Bank, 2020). The official language is French. The country has a network of 56 Protected Areas (PAs) which are all terrestrial. PAs in Benin cover 32368 km2 (28%) of the total land area. Although Benin has a total marine area of 35173Km2, there is no marine PA (DOPA, 2021). The network of PAs is composed of 2 national parks, the W National Park, and the Pendjari National Park, 3 hunting zones, 7 reforestation areas and 44 forest reserves (CHM-Benin, 2021). The country also has several territories and areas conserved by indigenous peoples and local communities (ICCA consortium), which are composed of 3000 sacred forests (Agbo and Sokpon, 1998). Benin also has 4 sites designated as wetlands of international importance (Ramsar sites), with a surface area of 25873.42km2 (Ramsar, 2014).

The WNP in Benin, the study area for this study, is the largest of three WNPs (The other two are in Niger and Burkina Faso), covering an area of 8000 km^2 between 11°53'35"N and 02°42'32"E in the northern part of the country (UNESCO, 2007). The WNP complex in Benin is composed by the WNP park, the Djona Hunting zone and the Mékrou hunting zone (Figure 7). The WNP in Benin is part of the transboundary W-Arly-Pendjari (WAP) Complex, which is to

date the largest intact ecosystem in West Africa and a UNESCO World Heritage Site (African Parks, 2020; ECOPAS, 2005). Through the diversity of its ecosystems, the WNP in Benin provides food, medicines, regulation of climate, cultural, religious and aesthetic services for both riparian communities and animals (Ilou et al., 2019). The climate in the WNP is dry and the vegetation is composed of grasses, grassy savannas, gallery forests and tree/shrub, where populations of elephants, hippopotami, buffalo, lions, panthers, leopards, hyenas, roan antelopes, hartebeest, topi sassabies, aardvarks, pythons and more than 350 species of birds can be found (https://www.goethe-university-frankfurt.de/50800848/Generic_50800848.pdf).

Study villages

This study was focused in eight (8) villages all located in the department of Alibori. The population of Alibori was 867,463 in 2013 (INSAE, 2016). The estimated population in 2019 based on the annual growth rate in Benin (2.7%) was 1,007,992 people. The dominant ethnic groups are the Bariba, Dendi and Peulh. The dominant religion is Islam. Human Poverty Index (HPI) for the department of Alibori was 56,6% in 2013 while Benin's HPI was 36.6% (INSAE, 2016). Social and demographic characteristics of people living in the department of Alibori and Benin are presented in table 4.

Table 4: Socio-demographic characteristics of people living in the department of Alibori and Benin for the year 2013

Socio-demographic indicators		Benin	Alibori
Population		10,008,749	867,463
Density (inhabitants / km²)		87	33
Migrant population (%)		1.9	3.3
Dominant social groups (%)		Fon & related: 38	Bariba & related: 37
		Adja & related: 15	Dendi & relayed: 20
		Yoruba & related: 12	Peulh: 27
Dominant religion (%)	Islam	28	81
	Catholicism	26	9
Human poverty index		36.6	56.6
Non-monetary poverty		24.6	26.5
Source of energy (for cooking)	Fuelwood	56	77
	Charcoal	29	10
Access to water (%)	Tap water:	29	6
	Rural water pumps	23	32
	Uncovered wells	27	27
	Public covered well	5	13
	Pond/river	7	11

Source: INSAE (2016)

This study used a quasi-experimental research design. It builds from earlier work conducted by Miller (2013), which used a similar design and collected baseline data in the same focal villages as this study. It focused on outcomes in four treatment villages, where the treatment is the ECOPAS intervention. The treatment villages – Alfakoara, Boiffo, Kandèrou and Pétchinga – were purposively selected (George and Bennett, 2005) from among the possible universe of villages affected by ECOPAS based on their proximity to the WNP, location in 4 different subnational government units (communes) bordering the park, and comparatively large

investment by ECOPAs in community development. The logic is that such villages are more likely to represent the different realities of the many dozens of villages around the park and where ECOPAS is more likely to have had positive socio-economic impact given comparatively large investment.

Four control villages, Gnampagou Wibara, Sendé, Koara Tèdji and Foué, were chosen to be as similar as possible to treatment villages but far enough from the ECOPAS zone of influence so as not to be affected by the project (Table 5). Each was relatively near other PAs, Goungoun classified forest (CF) and Alibori superieur CF (figure 9).

Table 5: Descriptive information on ECOPAS treatment and control villages

	Village	Commune	Population (2013)	Population (2019)[7]	Distance to WNP complex
Treatment villages	Alfakoara	Kandi	5659	6576	0.1
	Boïffo	Malanville	3488	4053	0.1
	Kandèrou	Banikoara	5912	6870	0.1
	Petchinga	Karimama	5287	6143	1.2
Control villages	Foué/Fouay	Kandi	3060	3556	38
	Sendé Koara Tédji	Malanville	4613	5360	58
	Sendé	Malanville	3562	4139	58
	Gnampogou Wibara	Banikoara	-	-	25

Source: (Miller, 2013; INSAE, 2016). The population data from 2013 came from the fourth general population and housing census of Benin (RGPH4)

[7] This is an estimation based on the fertility rate for Benin that is 2.7% annually

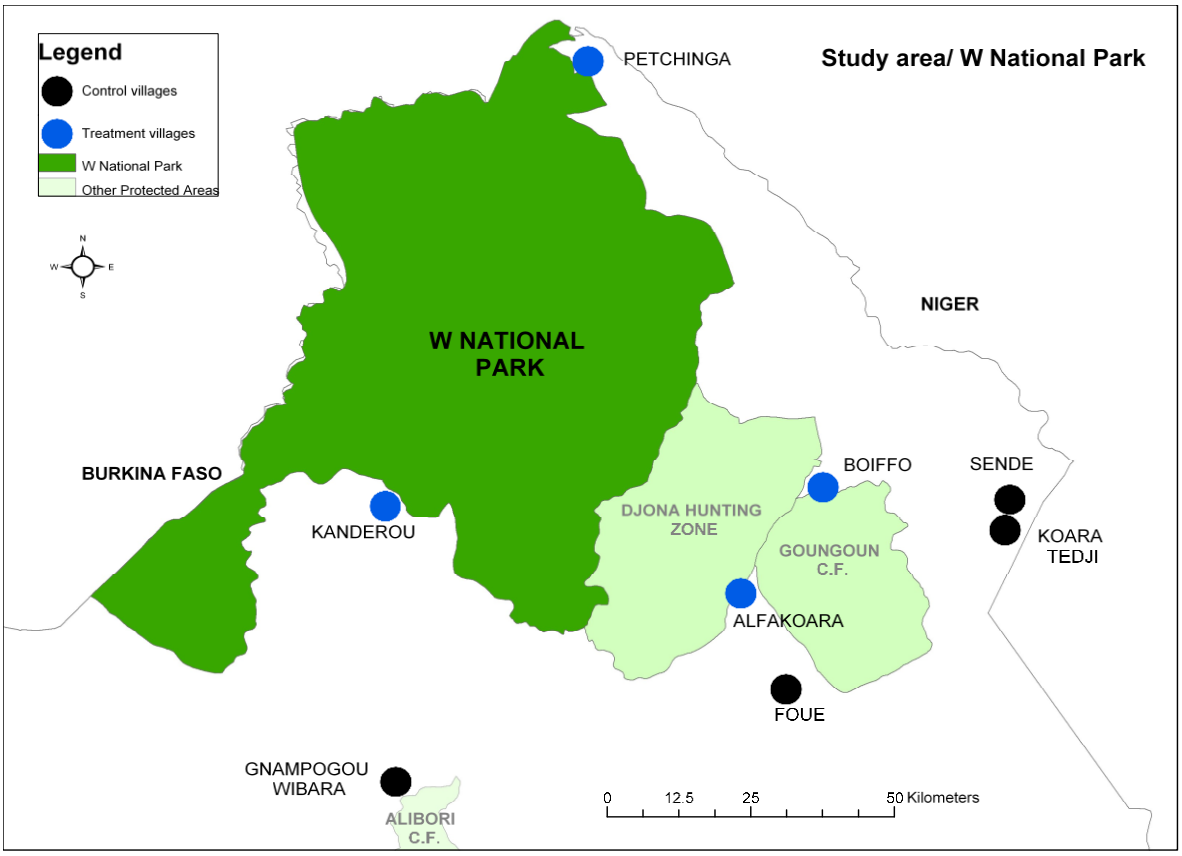


Figure 9: The W National Park in Benin and the study villages

Data collection

I used two datasets to assess the long-term social impacts of the ECOPAS project on livelihoods outcomes of people living around the WNP. The first dataset (wave 1) came from a household survey conducted by Miller (2013) during fieldwork in Benin from September 2010-August 2011. The second dataset (wave2) was derived from implementation of the same household survey with the same households in the same control and treatments villages, conducted in 2019. The second survey was implemented by many of the same research team members who carried out the first survey. Survey respondents gave their consents.

Sampling

In 2010-2011 (wave 1), four treatment and four control villages were selected with 281 household heads interviewed. Household heads surveyed were selected randomly by using the Probability Proportional to size (PPS) method (Bernard, 2006). In 2019, an attempt was made to interview all 281 household heads again. Of these, 180 household heads were found and interviewed; 101 households were lost due to attrition (death, displacement, or uncontactable), of which 46 wherein treatment villages and 55 in control villages (table 6).

Table 6: Comparison of 2011 and 2019 survey datasets

Villages		**Wave 1 (n)**	**Wave 2 (n)**	**Attrition reasons**			
				Deceased	Moved	Missing[8]	Total
Treatment villages (n=4)	Alfakoara	39	24	6	8	1	15
	Boïffo	34	31	1	1	1	3
	Kandèrou	37	23	2	8	4	14
	Pétchinga	40	26	4	9	1	14
Total Treatment		**150 (53%)**	**104 (57%)**	**13**	**26**	**7**	**46 (48%)**
Control villages (n=4)	Foué	33	24	3	3	3	9
	Gnampagou Wibara	34	18	2	4	10	16
	Sendé	33	17	11	4	1	16
	Sendé Kora Tédji	31	17	7	7	0	14 -
Total Control		**131 (47%)**	**76 (43%)**	**23**	**18**	**14**	**55 (52%)**
Total		**281**	**180**	**36**	**44**	**21**	**101 -**

[8] The reasons why people were unavailable across villages related mostly to travel, such as for transhumance or work in the park.

Variable definition

The sustainable livelihoods framework (Ellis, 2000; Scoones, 1998) was used to assess the long-term socio-economic impacts of the project ECOPAS at the household level around the WNP. This enables analysis of the factors shaping livelihood opportunities and shows how they relate to one another. It is used in planning development activities as well as in assessing how such activities affect the sustainability of livelihoods (Serrat, 2017). Two socio-economic indicators were chosen from the sustainable livelihoods framework: financial capital and natural capital following Miller (2013). These two indicators are especially relevant as households in the region as they are largely dependent on natural resources (ECOPAS 2005; Miller 2013) and they represent two asset categories that can be expected to have been affected by ECOPAS activities.

The financial capital indicator was measured through changes in household income from all monetary and non-monetary sources. A 10-point scale was used for this variable, where 1 means that the income has "decreased greatly" and 10 that it "increased greatly". The natural capital was measured through changes of the household heads in access to water, agricultural land, livestock and forest products. The dependent variables of interest, agricultural land access, livestock resources access and forest product access were measured through a 5-point scale, where 1 means access to the resources has "decreased greatly" and 5 means that it has "increased greatly". The outcome water access was measured through a 10-point scale, where 1 means that the access has "decreased greatly" and 10 that it "increased greatly".

The outcomes of interest here were: increased wealth and better access to water, agricultural land, livestock and forest products.

In this study, the independent variables were age, sex, migration status, education, economic status and ethnicity. The choice of these independent variables related to both treatment and control groups was based on previous research (Rubin, 2001; Miller, 2013). Additionally, those variables were chosen because they were not affected by the treatment (Rosenbaum, 1984; Frangakis and Rubin, 2002; Greenland, 2003; Ho et al., 2007; Rothman and Greenland, 1998).

However, the variable "economic status" might be influenced by posttreatment bias in 2019 because the ECOPAS project promoted income-generating activities that may have affected economic status in the treatment group. Omitting or including such variable, qualified as "bad control" (Angrist and Pischke, 2008: 64), can respectively create omitted variable bias and posttreatment bias (Aklin and Bayer, 2017) for the treatment effect. This means that the estimation of the effect of the project ECOPAS on household income in 2019 might be biased. I decided to keep the variable economic status as a covariate in the matching because in 2011, Miller (2013: 64) in his study of the medium-term impacts of the project ECOPAS in Benin showed that "there was no differentiation among wealth groups in terms of access to resources". Additionally, the same study results showed that when the aggregate effect of the treatment was considered, there was no perceived effect of the project ECOPAS on household income although at the village level, there were two treatment villages where households experienced increase in income, while two other experienced decrease in income. Since I am considering the aggregate treatment effect of the project ECOPAS, I decided to keep the variable economic status, as I expected that it will not bias the estimation of the treatment effect.

Table 7 presents the dependent and independent variables used for this study and their definition.

Table 7: Variables definition

	Variables	Definition
Outcome variables		
Natural capital indicators:	Agricultural land access	Capacity to access land for agriculture (1= decrease greatly; 2= decrease slightly; 3=no change; 4=Increase slightly; 5=Increase greatly)
	Livestock resources access	Capacity to access resources for livestock (1= decrease greatly; 2= decrease slightly; 3=no change; 4=Increase slightly; 5=Increase greatly)
	Forest product access	Capacity to access fuelwood and non-timber forest products (1= decrease greatly; 2= decrease slightly; 3=no change; 4=Increase slightly; 5=Increase greatly)
	Water access	Capacity to access water (for drinking, livestock, fishing or other purposes) (1= decrease greatly; 5= No change; 10 =increase greatly)
Financial indicators/Household wealth measures	Change in income	Household income level from all sources (monetary and non-monetary) (1= decrease greatly; 5= No change; 10 =increase greatly)
Control variables		
Household characteristics	Age	Age of household head
	Sex	Sex of person responding to the questionnaire (female=1; male=0)
	Migrant	Whether or not the household head is a migrant to the community (0=no; 1=yes)
	Education	The highest level of formal education achieved by a household member (0=no formal education; 1 up to high school; 2= High school and above)
	Economic status	Economic status of the household (number of cattle owned: 0=no cattle; 1=1-2 cattle; 2 = 3-6 cattle; 3 = 7 or more cattle)
	Ethnicity	Ethnic group of the household head (1 = Adja; 2 = Arabe; 3 = Bambara; 4 = Bariba; 5 = Baribari; 6 = Dendi; 7 = Djerma; 8 = Fon; 9= Foulmangani; 10 = Gao; 11 = Goubè; 12 = Gourmantche; 13 = Haoussa; 14 = Mokolè; 15 = Mossi; 16 = Peul; 17 = Songhai; 18 = Sonrai; 19 = Tchanga; 20 = Touareg; 21 = Yoruba)

3.3. Data analysis

The design of this study used a quasi-experimental method, before and after intervention (BACI) involving a non-random selection of treatment villages, where control villages were chosen to be similar as possible to treatment villages. However, the household heads were selected randomly in both groups. Quasi-experimental methods are often used for ex-post impact evaluation designs when the treatment or control groups selection is not random (White and Sabarwal, 2014). These methods help in controlling for confounding variables and in accounting for spillover effects in the control group (Börner et al., 2020).

To reduce selection bias in the control group and to improve causal inferences, when treatment or control groups selection are not random, matching methods based on statistical techniques can be used (White and Sabarwal, 2014; Ho et al., 2007; Morgan and Winship, 2014). Researchers often used matching methods in observational studies when the outcome values exist or not: in the first case, matching is used for selecting follow-up subjects while in the second case, it is used for reducing bias in the estimation of the treatment effect (Reinisch et al., 1995; Stuart and Ialongo, 2009; Althauser and Rubin, 1970; Rubin, 1973a,b). In the conservation field, matching is used to reduce selection bias that might arise from randomly assigning protection to an area (Ferraro, 2009; Ferraro and Pattanayak, 2006). Although matching can reduce the number of observations that are used to estimate a treatment effect, it can yield efficient estimates (Smith, 1997) and improved balance (Ho et al., 2007).

In this study, household heads were selected randomly while the treatment and control villages were purposively selected. We chose to use statistical matching to improve the comparability of the control group to the treatment group and to reduce bias in the estimation of the treatment effects. Several statistical matching methods are used like the Propensity Score

Matching (PSM) (Rosenbaum and Rubin, 1983), the most popular among researchers (Pearl, 2009), Mahalanobis Distance Matching (MDM) (Cochran and Rubin, 1973) and other matching techniques. MDM and PSM are both classified as Equal Percent Bias Reducing and affinely invariant matching methods, which means that they yield the same matches following an affine (linear) transformation of the data (Rubin, 1976, Stuart, 2010)

For this study, I used MDM as my primary matching technique and PSM as a robustness check with bootstrap for my matching results while keeping in mind that with any method chosen, it is impossible to eliminate all bias, especially bias generated by unobservable confounding factors (Becker and Ichino, 2002). Nevertheless, the best model can be determined through a method that yields the best balance and leaves the highest number of observations after matching (Harder, Stuart and Anthony, 2010; Ho et al., 2007; Rubin, 2007; Stuart, 2010). Balance is defined as "the similarity of the empirical distributions of the full set of covariates in the matched treated and control groups" (Stuart, 2010: 13).

Mahalanobis distance use is recommended in the literature when there are few covariates on which to match (Gu and Rosenbaum, 1993). MDM is also expected to perform better than PSM because "it approximates a fully blocked experimental design" (Iacus et al., 2011: 349) that includes adjustable parameters that can be set to produce the same result as exact matching (King and Nielsen, 2016). The choice of MDM for this study was based on the literature and on the fact that I had few covariates to use for the matching. Additionally, I chose MDM because the number of observations remaining after matching was superior compared to PSM (Ho et al., 2007; Stuart, 2010).

The software STATA 16 was used for data analysis. "KMATCH" (Jann, 2017), Stata's module for Mahalanobis distance matching and propensity-score matching were used for

matching and for the estimation of the treatment effects in both methods PSM and MDM. The model based on the Epanechnikov kernel finds matches for treated and control observations by taking in account covariates and, provides estimates of treatment effects after matching if outcome variables are available and specified (Jann, 2017). Kernel based matching methods are like regression on a constant term and use all treated in the treatment group and match them with a weighted average of all controls (Khandker et al., 2010; Jann, 2017).

Mahalanobis distance matching and Propensity score matching

Definition and formula

MDM is a method where distances are calculated between groups in a multidimensional space (Guo and Fraser, 2015). The matching process starts with the random selection of a control group based on covariates and the estimation of the distances between the treatment group and the control group. This first step is defined as "closeness definition" by Stuart (2010). The formula for the estimation of Mahalanobis distance (Stuart, 2010) for this study was $D_{ij}=(X_i - X_j)' \sum^{-1} (X_i - X_j).$ with

Dij	Distance between individuals *i* and *j* for matching
Σ	Variance-covariance matrix of X in the control group
X_i	Treatment matrix with covariates
X_j	Control matrix with covariates.

Observations in MDM are randomly ordered and the distance between the first treated household head and all controls was calculated (Baser, 2006). The control with the smallest distance d (i, j) was matched with a treatment household head. Then the matched pairs were removed from the pool and the process continued until all treated subjects were matched (Olmos

and Govindasamy, 2015). Fifty replications were conducted using the model for each outcome variable. The Mahalanobis distance was calculated for data from both 2019 and 2011. The model output for the outcome agricultural land access is presented in appendix D

The Propensity score is a popular method used in non-randomized research, that aims to reduce bias in control groups selection (Rosenbaum and Rubin, 1983). The PSM method uses a propensity score or index, which is the probability of receiving a treatment from a project, to statistically create a comparison group based on observed characteristics that were not affected by the treatment. The treatment group is then matched to the control group based on the propensity scores (Rosenbaum and Rubin, 1983; Khandker et al., 2010). The propensity score is estimated by a multiple logistic regression model with the formula: $P(X) = \Pr(T = \frac{1}{X})$ with:

P	Propensity score
X	Observed characteristics
T	Treatment
Pr	Probability.

In this study, the observed characteristics unaffected by the treatment, i.e., the control variables, were age, sex, migration status, education, economic status and ethnicity (see table 7 above). The propensity scores generated were used to match households in the treatment group to households in the control group. Smaller difference between the scores indicates that both groups are more similar and thus comparable.

Covariates balance tests

The statistical comparison among the matched samples were then performed to see if the matching gave satisfactory results by performing an assessment of the covariates balance. I used

the standardized mean difference (StdDif) (Flury and Riedwyl, 1986) to evaluate the covariates balance between treated and untreated subjects in the matched sample with that in the unmatched sample. Across different scenarios, absolute standardized difference is better in terms of bias reduction and variance among the different balance measures that exist (Ali et al, 2014). Moreover, sample size does not influence the StdDif and this statistical test can be performed with variables in different units (Austin, 2009). The StdDif is "the absolute difference in proportions of the confounder between treated and untreated subjects standardized to the variation in the confounding variable (i.e., the standard deviation). It has a minimum value of 0 which indicates ("perfect" balance) but no maximum value" (Ali et al., 2014: 803). While the StdDif value which indicates a perfect balance is known and agreed upon by researchers, the value that indicates imbalance varies among researchers. Some have proposed that a StdDif of 0.1 (10 per cent) indicates meaningful imbalance in the baseline covariate (Austin, 2009). Other researchers have proposed a value superior to 0.5 (50 per cent) to indicate imbalance in the baseline covariates and 0.15-0.5 for proper balance (Dong et al., 2020).

Moreover, I used the variance ratio as a second method for the evaluation of covariates balance. Some researchers have recommended its use in addition to StdDif because variances comparison between treated and control group before and after matching can characterize on a larger scale the resemblance of continuous covariates between two groups (Imai et al., 2008; Ho et al., 2007; Austin, 2009). The "variance-ratio test" or "*F*-ratio test" or *F*-test compares the variance of two populations or groups (Rayat, 2018). A value of 1 for the variance ratio in the matched sample means that the matching was good and any value under 2 is generally acceptable (Zhang et al, 2019). The KMATCH module was used for the covariate balance tests. Table 8

shows the StdDif values and variance ratio for the year 2019. Table 9 shows the same results for the year 2011.

Table 8: Baseline characteristics of the study sample before and after matching (2019)

Covariates	Raw/unmatched (Mean) n=180		**StdDif**	**Variance ratio**	Matched (Mean)n=148		**StdDif**	**Variance ratio**
	Treated	Control			Treated	Control		
Age	56.76	49.48	**0.52**	**0.99**	55.94	50.30	**0.40**	**1.03**
Sex	0.04	0.09	**-0.23**	**0.41**	0.05	0.05	**0.02**	**1.12**
Migrant	0.75	0.70	**0.12**	**0.88**	0.76	0.75	**0.01**	**0.98**
Education 1 (up to high school)	0.23	0.12	**0.28**	**1.63**	0.20	0.14	**0.15**	**1.31**
Education 2 (high school and above)	0.43	0.6	**-0.34**	**1.02**	0.48	0.59	**-0.23**	**1.03**
Economic status1 (1-2 cattle)	0.23	0.49	**-0.57**	**0.70**	0.28	0.42	**-0.31**	**0.82**
Economic status2 (3-6 cattle)	0.33	0.26	**0.16**	**1.15**	0.33	0.29	**0.08**	**1.06**
Ethnicity	5.70	5.83	**-0.04**	**1.16**	5.57	5.87	**-0.09**	**1.12**

StdDif: Standardized mean difference. Results came from the Stata output (Full output is in appendix D, table 12).

The analysis of the table 9 showed that the absolute values of the standardized mean difference before matching were between 0.04 and 0.57. The largest absolute standardized difference was for economic status 2 (0.57). The other value that is superior to 0.5 was for age (0.52). After matching, the absolute values of the StdDif were between 0.01 and 0.40. The largest StdDif value was for age (0.40) in the matched sample. The analysis of those values in the matched sample showed that the matching balanced the covariates. This means that in the matched sample, covariates are very similar between treatment and control group.

The analysis of the variance ratio before and after matching showed that all values are below 2. This means that before and after matching the covariates remain similar between the treatment and control group.

Table 9: Baseline characteristics of the study sample before and after matching (2011)

Covariates	Raw/unmatched (Mean) n=281		**StdDif**	**Variance ratio**	Matched (Mean) n=272		**StdDif**	**Variance ratio**
	Treated	Control			Treated	Control		
Age	47.76	40.98	**0.52**	**0.99**	46.13	41.80	**0.33**	**0.90**
Sex	0.07	0.10	**-0.08**	**0.78**	0.09	0.09	**0.00**	**1.00**
Migrant	0.76	0.68	**0.16**	**0.85**	0.75	0.72	**0.08**	**0.92**
Education 1 (up to high school)	0.34	0.30	**0.08**	**1.06**	0.34	0.29	**0.09**	**1.08**
Education 2 (high school and above)	0.43	0.57	**-0.28**	**0.99**	0.48	0.57	**-0.18**	**1.02**
Economic status1 (1-2 cattle)	0.20	0.29	**-0.20**	**0.79**	0.22	0.26	**-0.09**	**0.89**
Economic status2 (3-6 cattle)	0.27	0.21	**0.13**	**1.17**	0.26	0.24	**0.06**	**1.07**
Ethnicity	6.03	5.20	**0.27**	**1.28**	5.76	5.23	**0.16**	**1.22**

StdDif: Standardized mean difference. Results came from the Stata output (Full output is in appendix D, table 13).

The analysis of table 9 showed that the absolute values of the standardized mean difference before matching were between 0.08 and 0.52. The largest absolute standardized difference was for age (0.52). After matching, the absolute values of the StdDif were between 0 and 0.33. The largest StdDif value was for age (0.33) in the matched sample. The analysis of those values in the matched sample showed that the matching balanced the covariates. This means that in the matched sample, covariates are very similar between treatment and control group for the year 2011.

Like in 2019, the analysis of the variance ratio before and after matching showed that all values are below 2. This means that before and after matching the covariates remain similar between the treatment and control group in 2011.

Overall, the covariance balance tests showed that the covariates were more balanced after matching for 2011 and 2019. This implies that the estimation of the treatment effects can be conducted.

Estimation of the average treatment effects

After the covariates balance test, the treatment effects of the project ECOPAS were estimated in 2019 and 2011. The average treatment effect of a program is the mean difference in outcomes across treatment and control groups (Khandker et al., 2010). The average treatment of the project ECOPAS in this study referred to the mean difference in all outcomes of interest (see table 7) across treatment and control groups.

The average treatment effect (ATE) and the average treatment effect on the treated (ATT) can be estimated. The ATT refers to the effect on the treatment group, while the ATE refers to the effect on all individuals, treatment and control (Imbens, 2004; Kurth et al., 2006; Imai et al., 2008; Khandker et al., 2010).

In this study, I estimated both treatment effects. However, the results of this study were presented for the ATT only, given my interest in understanding the effects of the treatment and as is typically used in impact evaluation literature (Khandker et al., 2010; Stuart, 2010). The ATT was estimated for each outcome of interest in 2019 and 2011. The ATT obtained in 2019 were compared to the ATT obtained for all outcomes in 2011 to estimate the long-term socio-economic impact of the ECOPAS project.

The ATT estimates are unbiased if two assumptions are met: (1) conditional independence or ignorability: the treatment is unaffected by unobserved factors, which means that any difference noted between treatment and control group is based only on observed characteristics and (2) sizable common support (i.e., there are enough subjects in the control group to be matched with subjects in the treatment group) (Khandker et al., 2010, Stuart, 2010). Those assumptions when covariates are well selected and well balanced in the matched sample

and robustness check of the ATT results are conducted (Khandker et al., 2010). The second assumption holds when the common support is large, which means that observations are dropped in both treatment and control groups to achieve the common support (Ravallion, 2008; Heckman et al., 1997)

The covariances balance tests results were discussed in the previous section. Based on the results of the tests, I can assume that the assumption for the matching methods selected were met. This implies that the ATT estimations are reliable.

3.4. Results

Socio-economic impacts for the year 2019

The average treatment effect obtained for the outcome agricultural access in 2019 using the Mahalanobis metric was -0.91. This means that households in the treatment villages experienced a decrease of 91% in their ability to access agricultural land. The ATT values for the outcome livestock resources access was -0.50 and -0.73 for the outcome forest product access. These values are all negative and showed that in 2019 access to livestock resources and forest products by households in the treatment group has decreased respectively at 50% and 73%. The ATT obtained for the outcome water access was 1.45 in 2019. This result implies that access to water has increased at about 145% for households in the treatment group. For the Change in income outcome, the ATT value was -1.65. This means that household income in the treatment villages has decreased at about 165%. The P value for each outcome showed that all the results obtained were highly significant at less than 1%. Table 10 shows the results for the ATT estimations in 2019.

Table 10: Average treatment effect estimation with the Mahalanobis metric for 2019

Outcome of interest	n. Treated	n. Control	ATT	Bootstrap Standard errors	Z	P value
Agricultural land access	83	63	**-0.91**	0.18	-5.14	**0.000**
Livestock resources access	83	63	**-0.50**	0.11	-4.60	**0.000**
Forest product access	81	63	**-0.73**	0.16	-4.48	**0.000**
Water access	71	44	**1.45**	0.47	3.08	**0.002**
Change in income	83	63	**-1.65**	0.46	-3.61	**0.000**

Socio-economic impacts for the year 2011

The average treatment effects obtained for all outcomes of interest except for the outcome water access were negative in 2011. In 2011, the households in the treatment villages experienced a decrease of 72% in their ability to access agricultural land. Access to livestock resources and forest products by households in the treatment group has decreased respectively by 36% and 86%. Access to water has increased at about 423% for households in the treatment group. Households income in the treatment villages has decreased at about 48%. The P value for each outcome showed that all the results obtained were highly significant at less than 1%. The table 11 shows the results for the ATT estimations in 2011.

Table 11: Average treatment effect estimation with the Mahalanobis metric for 2011

Outcome of interest	n. Treated	n. Control	ATT	Bootstrap Standard errors	Z	P value
Agricultural land access	143	129	**-0.72**	0.11	-6.27	**0.000**
Livestock resources access	116	95	**-0.36**	0.13	-2.81	**0.005**

Table 11 (cont.)

Forest product access	129	121	**-0.86**	0.12	-7.10	**0.000**
Water access	132	68	**4.23**	0.34	12.32	**0.000**
Change in income	145	130	**-0.48**	0.35	-1.38	**0.167**

The tables 14 and 15 in appendix D show the Stata outputs for the outcome agricultural land access for 2019 and 2011.

Socio-economic impacts comparison between 2019 and 2011

The results in figure 10 show that in the treatment group, the decrease in household access to agricultural land and livestock resources was greater in 2019 compared to 2011 although the difference was not substantial. Decrease in household income and their access to forest products was less in 2019 compared to 2011. The difference between 2019 and 2011 in term of decrease in income was substantial (117%), while the difference of decrease in forest product access was comparatively small (13%). Household access to water was still up in 2019 but had decreased significantly compared to 2011.

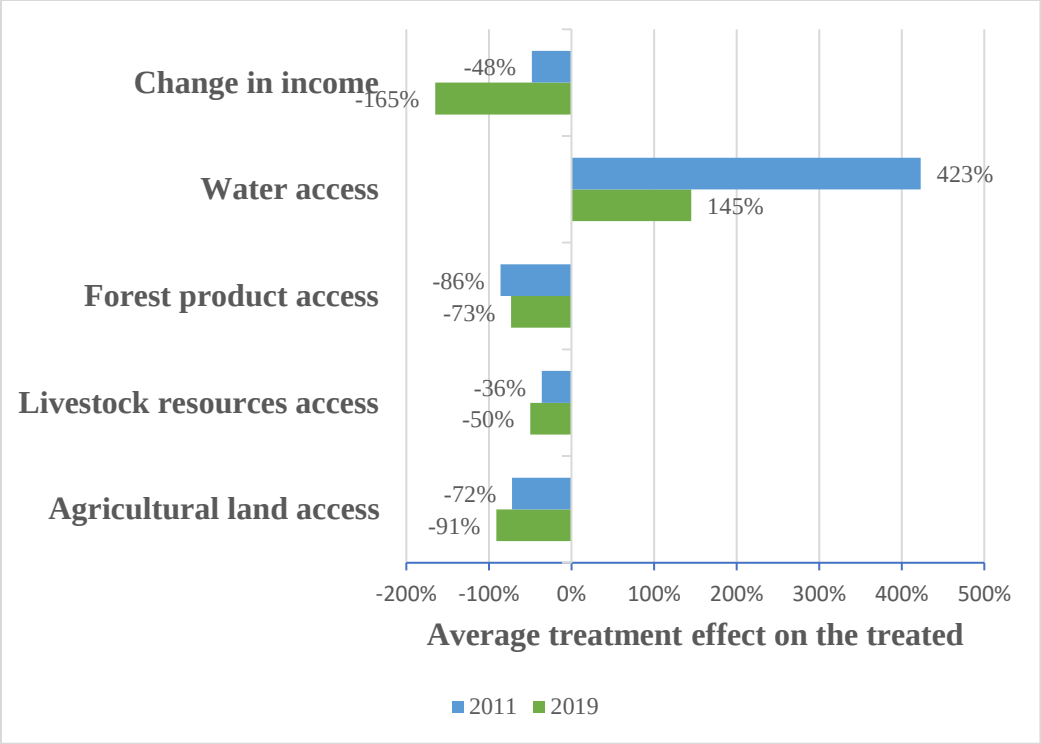


Figure 10: Socio-economic impacts of the project ECOPAS in 2011 and 2019

Long term socio-economic impacts of the project ECOPAS

The project ECOPAS sought to halt biodiversity degradation in WNP while benefitting the local population in the WNP region. My results suggest that households continued to have reduced access to resources generally and specifically in WNP. These findings may have positive effects on biodiversity, at least just after the end of the project (Amahowé et al., 2013; UICN-PAPACO, 2015) and in the medium term, 3 years after the end of the project (Miller, 2013). It was beyond the scope of this study to investigate biodiversity outcomes in 2019 to confirm whether previous biodiversity gains remained. However, regardless, in this region where livelihoods are so dependent on natural resources, the findings suggest significant hardship for treatment households. Results suggest that access to agricultural land and land for grazing

livestock were restricted in 2011 and 2019, but that access to forest products had increased somewhat during that time. This decrease in access to natural resources might be a cause of the substantial decrease in income found in 2019.

In the treatment villages, household ability to assess water was still positive, but less than 2011. This suggests that a decade after the end of the project, the wells and other water infrastructure constructed by ECOPAS may still have been in use by the local population.

Overall, the negative socio-economic impacts of ECOPAS appear to have persisted and even become more detrimental to livelihoods a decade after the project ended. This finding holds even given the presence of subsequent projects designed to benefit communities around the park. It is possible that an ECOPAS project legacy was to contribute to the negative socio-economic effects found, but it is also possible that implementation of intervening projects described above also contributed in part or in whole to such effects. The negative socio-economic impacts found may have come with benefits for biodiversity conservation, but research is needed to verify this supposition and, regardless, the negative social impacts found raise major questions about social justice and sustainability of any conservation gains that may have resulted.

Robustness check results

The results obtained using the propensity score method were similar to the results obtained through the Mahalanobis metric (Figure 11). However, the values of the ATT estimations with the Propensity score method are slightly lower. However, there were more observations dropped in the control group with the PSM method compared to the MDM method (Table 18 and table 19 in appendix D). The tables 16 and 17 in appendix D show the Stata output for the PSM method for the outcome agricultural land access for the years 2019 and 2011.

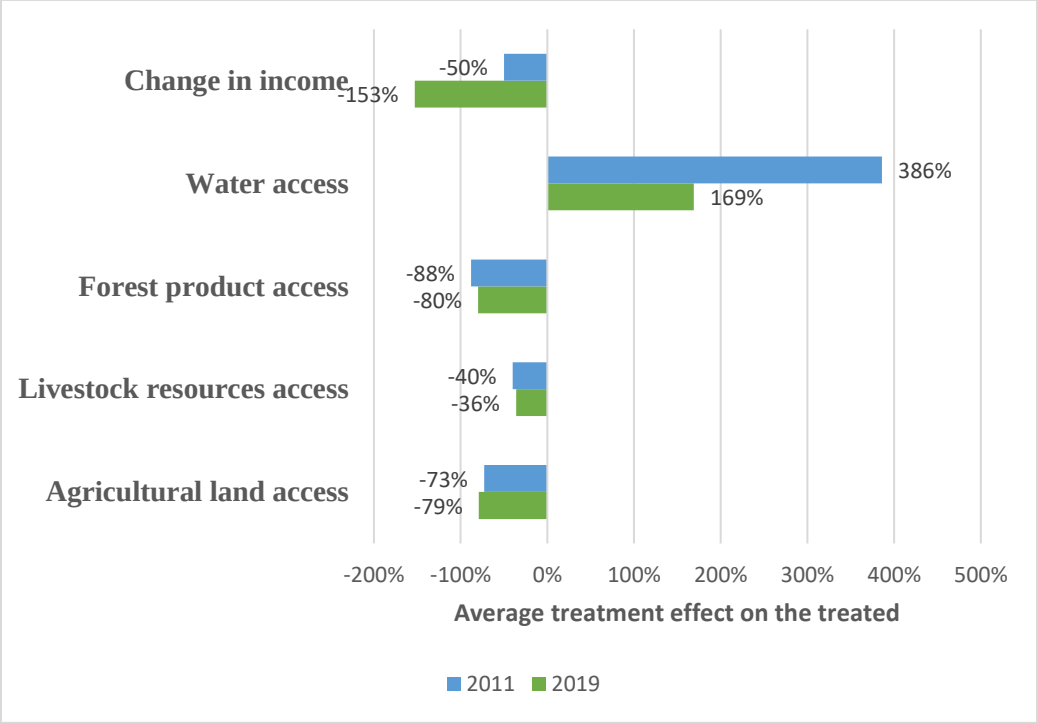


Figure 11: Socio-economic impacts of the project ECOPAS in 2011 and 2019 (PSM)

3.5. Discussion

The results of this study indicate that the ECOPAS project impact that pertained to human pressure reduction on the WNP in Benin was still present a decade after the project ended. In 2019, households' access to agricultural land and livestock resources has decreased at a greater level than it was in 2011. The same goes for households' income that has decreased significantly compared to 2011. Household ability to access water appeared to be the sole social advantage that the project ECOPAS left after a decade from its end in Benin, although this accessibility to water was low compared to 2011. Thus, there appears to have been a trade-off between recovering degrading biodiversity in the WNP (at least in the near term) and the long-term social and economic wellbeing of local populations in the wake of ECOPAS. Whether this

trade-off holds for the long-term post-ECOPAS period remains to be examined, with updated results on biodiversity outcomes in the post-2010 period missing.

I did find trade-offs among socio-economic outcomes themselves as households in the treatment villages reported persistent positive gains in access to water, but not to other livelihood resources. These results were also found by Miller (2013) in Benin, regarding the medium impacts of the project ECOPAS on the WNP region. The mixed results and trade-offs yielded by conservation projects appear to be common for many conservation intervention outcomes, (McShane et al., 2011; Woodhouse et al., 2018; Reid et al., 2014; Dawson et al., 2018), particularly relating to state-managed protected areas (Oldekop et al., 2016).

Trade-offs between conservation goals and socio-economic outcomes

These results are expected in the case of the WNP region in Benin because trade-offs situation between conservation outcomes and socio-economic outcomes often occur in the case of severely degraded ecosystems by poaching and illegal activities when options are limited and resulting ultimately in access restrictions to human (Oldekop et al., 2016; Woodhouse et al.,2018; Billé et al.,2012). This was the case for the WNP in Benin. Therefore, the ECOPAS project primarily targeted enforcement activities and park management to recover a severely damaged protected area while restricting human activities in the park.

Restriction of access to livelihoods resources

The trade-offs between conservation goals and socio-economic outcomes can also be explained by the fact that in the WNP region, most of the population depends on agriculture and livestock for their livelihoods (de Haan 1997; ECOPAS 2005). In Benin's WNP, 65% of household heads were farmers and 20% were livestock breeders (ADAPT-WAP, 2019).

Therefore, restricting the access of these populations to agricultural land and livestock resources without enough compensation will inevitably render them vulnerable in their ability to meet their basic needs (ADAPT-WAP, 2019). For example, in the commune of Karimama, the WNP occupies the five-sixth (5/6) of the total area of this municipality (Ahoyo Adjovi, 2006), forcing the population to manage a very limited land split between habitations, farms, pasture and the Niger River, 470 km² of the 6,102 km² of the total area (Edoun and Mongbo, 2020). This pressure on agricultural land and pastures is exacerbated by a high density of population (141.18 inhabitants / km2), the near desert agroecological conditions of Karimama, which translates in insufficiency of food production (Edoun and Mongbo, 2020). Additionally, cotton production and transhumance represent the main activities for cash in the WNP. Local populations were often faced with heeding the words of the government that encourages them to produce more cotton and at the same time restrict their access to agricultural land by preventing them to encroach on the park and its buffer zones (Blaszkiewicz, 2014).

Although Park officials allowed local communities to fish or gather forest products in buffer zones (CENAGREF 1999; Kleitz 2002), agriculture and livestock grazing are prohibited. A study conducted by Blaszkiewicz (2014) in the WNP in Benin revealed that local population do not understand the logic of preserving an area in the "populations' primary interests", when their survival depends on the multiplication of more cultivated areas in the case on an extensive agriculture. This is one of the reasons why ECOPAS implemented some livelihoods activities to reduce the negative effects of its actions in the WNP on local populations livelihoods. However, this study finds that these efforts might have been insufficient.

Compensation for local populations

In the case where negative social and economic impacts are expected of a conservation project, the project usually plans activities that will compensate the loss incurred by local populations because of their restricted access to a protected area. Those activities can include income generating activities, tourism and its related activities and other activities that empower local populations and reduce economic and social inequalities (Andrade and Rhodes, 2012; Fedreheim and Blanco, 2017; Ferraro et al., 2015; Oldekop et al., 2016; Zegeyer, 2017). The ECOPAS project emphasized tourism, income generating activities, research, environmental education, clarification of land rights, development of alternative agricultural practices, conflict resolution, and support for legal pastoralism and transhumance (Miller, 2013) to offset the negative impacts of the project on local populations and to reduce human pressure on the park. However, the little amount of money spent on those activities could not guarantee their effects in either the short or long term. This was evidenced by the fact that in 2011, local populations income had decreased less compared to 2019. Moreover, the growing threat of terrorism and instability in the broader WAP complex (Commision Europeene, 2019) has contributed to the dwindling of tourism revenues when tourism was the main vector for population to compensate for their loss of access to agricultural land and livestock resources.

Additionally, 30% from park revenues are designed by law to go to local populations through the AVIGREFs (Village Associations for the Management of Wildlife Reserves). Although this research did not study how the 30% of revenues were spent, a question can be asked on whether the money benefitted all local populations and not just local elites. For example, in the Pendjari National Park, a positive perception of the co-management of the park is reported by the members of the AVIGREF more frequently than those in communities who are

not members (Vodouhê et al., 2013). This finding further implies that the compensation offered to local populations might not be sufficient to reduce or replace their loss of livelihoods. Restrictions on access to resources and insufficient revenues from tourism suggest local population needs for food and other necessities for their wellbeing have been restricted, as found in other cases (Bluwstein et al., 2016; Dawson and Martin, 2015).

Trade-offs between socio-economic outcomes

The results regarding trades-offs between socio-economic outcomes mean that gains in access to water do not necessarily compensate for lost agricultural land and livestock resources (Woodhouse et al., 2018). The results obtained in 2019 showed a decrease in water access compared to 2011. This could be justified by the fact at the end of the project and despite funding from other projects that were implemented in the WNP area, the infrastructure built during the project ECOPAS had degraded. Amahowé et al (2013) noted that after the end of the ECOPAS project in Benin, the infrastructures built by the project as well as enforcement actions that were financed stopped. For example, before the project ECOPAS in 1995, there were more than 120,000 cattle reported in WNP (Sinsin and Hessou 1999). ECOPAS succeeded in eliminating nearly all cattle found in the WNP (ADAPT-WAP, 2019; Miller, 2013; Amahowé et al., 2013) during its implementation. However, by 2012, four years after it ended, the number of cattle in the park had quadrupled (IUCN/PAPACO, 2015). This situation questions the fate of the gains of conservation projects after their end, but also poses the question of whether restricting access to local populations translates necessarily to enduring conservation outcomes. For example, Woodhouse et al (2018) and Milner-Gulland (2012) note that negative socio-economic impacts of conservation actions can potentially translate in local population disinterest for conservation, which can in turn hurt any gains in biodiversity conservation in the long run. For

this reason, studies are needed at the start of all projects to analyze any intended or unintended trade-offs between conservation outcomes and socio-economic outcomes, as well as trade-off between socio-economic outcomes to ensure an acceptable balance between ecological and social outcomes during and especially after the end of projects.

This study used only five sustainable livelihoods indexes to evaluate the socio-economic impacts of the project ECOPAS in the long term. Further studies are need on more broader dimensions of social and economic impacts for a thorough appreciation of the impacts of the project, because narrowing socio-economic impacts to material definitions of poverty and livelihoods gives only a small picture on the intended and unintended effects of a conservation project, whether there are positive or not (Woodhouse et al., 2018; Dawson, 2015; Schreckenberg et al., 2016).

Although the project ECOPAS led to few socio-economic gains in the study villages, the project did make a difference at reversing the degraded state of the WNP in Benin just after the end of the project and 3 years later. However, further studies are needed to see if the biodiversity gains have endured after 2011. Nonetheless, these gains in terms of conservation seem to have faded after 2011 (e.g. given grazing and reported increases in poaching and illegal timber extraction reported by the literature (IUCN-PAPACO, 2015). This situation raises the problem of insufficient domestic funding for conservation actions discussed in chapter 2. Dependable funding mechanisms are needed in the country to at least retain the gains occurred by a major project like ECOPAS. This suggestion also poses the question of who is accessing the parks? Because my results show that local population access to forest and other productive resources was still in the decline. This question could find some explanations in the fact that the news reported that extremist groups are profiting of the W park for their fallback bases and for food

through poaching (Matongbada, 2019). This was the case in the Boucle du Baoule park in Mali, where heavily armed groups decimated wildlife through poaching (Brottem, 2021). Additionally, could it be that the elites from AVIGREFs or some wildlife workers are granting access to the park for some and restricting it to others? Or perhaps corruption and bad governance of the park might also be at play? Moreover, there is an ongoing conflict between the government of Benin and wildlife workers and local communities over the management concession entrusted to African Park, a South African NGO (Matongbada, 2019). The local communities and workers might be reacting to the possibility of losing their jobs and local communities about the loss of access that was granted to them for fishing and gathering non-timber forest resources by resisting once accepted laws and encroaching to the park? Brottem (2021) gave another explanation for the hypothetical biodiversity gains fading as the author reported that after a visit to the park W in 2019, he noticed agriculture has expanded to the park buffer zone and witnessed an elephant viewing station in disrepair because gains from tourism might not have materialized. Therefore, further studies are needed to evaluate those possible threads and to see why cattle had started to appear in the park again.

Furthermore, further studies are needed to improve land access and access to fodder for local populations living near the WNP, especially in Karimama, where the park occupies 5/6 of its territory. Agriculture and cattle rearing intensification could be potential solutions to the lack of agricultural land and pastures. An extension of the livelihoods activities implemented should be continued after the end of projects to help increase the positive outcomes of PAs and their impacts on local population.

3.6. Conclusion

This research evaluated the long-term socio-economic impacts of a major conservation aid project in Benin, ECOPAS. This study analyzed the impacts that the project ECOPAS had on social and economic outcomes for local populations ten years after its end.

The findings of this study showed not only trade-offs between ecological goal and socio-economic outcomes, but also trade-offs between socio-economic outcomes. Although this study did not focus on the ecological impacts, the literature suggests gains that ECOPAS had were related to biodiversity conservation and not much to socio-economic outcomes. Indeed, the effect, both in the long and short term was largely quite negative for people living near WNP.

Overall, this study gave an overview on the socio-economic impacts of the project ECOPAS in the WNP region in Benin and pointed to a thorough analysis of positive and negative, intended and unintended trade-offs between conservation outcomes and socio-economic outcomes, as well as trade-off between socio-economic outcomes. Results can be used to inform strengthened efforts to offset negative impacts of conservation in the W region on local populations and to help maintain over the long-term biodiversity gains. How such mitigation efforts can be fairly and effectively implemented is an important topic for future research.

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CHAPTER 4: CONCLUSION

This research based on quantitative and qualitative methods aimed to track biodiversity conservation funding in Benin from 1990 to 2019 and to examine the long-term socio-economic impacts of a major conservation project, ECOPAS, in the country's largest protected area, the W National Park. Five main findings can be taken away from this research.

First, the main source of conservation aid in Benin was international, 96%, with only 4% from domestic sources. The total amount provided during the last 30 years was $301.04 Million (2015 Constant US Dollars). Biodiversity funding levels were low, compared to other sectors, and stayed at 1% of the total Official Development Assistance of Benin. Second, conservation funding by international donors went more to strict biodiversity only projects while funding by domestic donors went more to mixed conservation and development projects with the government of Benin as primary funding recipient. The least commonly implemented conservation action was law enforcement and prosecution while the top five conservation actions implemented were land and water management, research and monitoring, species management, education and training, and livelihood, economic and moral incentives. Third, gender considerations as a transversal topic, were not often present in the projects tracked. Fourth, conservation funding use was concentrated in the two national parks, W National Park and Pendjari National Park and the Lama forest reserve, with little funding to other protected areas.

Fifth, the findings of this study showed two kinds of trade-offs pertaining to the long-term socio-economic impacts of the project ECOPAS: trade-offs between ecological goal and socio-economic outcomes, but also trade-offs between socio-economic outcomes. This implies that the negative socio-economic impacts of the project ECOPAS on local populations in the WNP region in Benin have worsened with time in 2019 with local populations having less access

to agricultural land, livestock resources and more decreased income than they did in 2011. Access to forests products by local populations remained low, but slightly higher in 2019 than it was in 2011. The only socio-economic advantage of the project ECOPAS still present after ten years following its end in Benin was the ability of local population to access water. However, its level was lower than 2011's level.

By tracking the past and current funding sources, thematic, locations of conservation projects in Benin over three decades, this thesis was successful at showing the conservation funding landscape of Benin and at providing an extensive and detailed database on conservation projects in Benin. Also, by estimating and comparing the average treatment effects on the treated of 219 to the ones in 2011, this study was successful at answering the question of the persistence of ECOPAS projects regarding the social and economic aspects.

Based on the findings of this research, the knowledge on conservation funding is important to use scarce financial resources efficiently. However, knowing and anticipating on the intended and unintended negative impacts of conservation projects on local populations should also be a top priority among domestic and international donors to maintain biodiversity gains for the long term without worsening the livelihoods conditions of local populations.

Appendix A: List of the data sources consulted for Benin's conservation funding mapping

	Database	Pathway	Filters	URLs
1	**Convention on the Conservation of Migratory Species of Wild Animals (CMS)**	Activities> Projects	Status: Any Target region: Africa Type: any Search: Benin	https://www.cms.int/
2	**Conservation, food & health foundation**	Past grants (2019- 2018 (conservation only)	No filters available	http://cfhfoundation.grantsmanagement08.com/
3	**Fondation Ensemble**	The foundation> All projects supported	Focus sectors: 8/8 selected Implementation country: Benin Status: check all	https://www.fondationensemble.org/
4	**Fondation Nature & Découvertes**	Les projets> Les projets soutenus	Year: 2019	https://fondation.natureetdecouvertes.com/
5	**Fondation Nicolas Hulot pour la Nature et l'Homme**	La foundation> Les projets soutenus> Recherche: Benin	Domaine: Biodiversité Contenus: projets soutenus	http://www.fondation-nicolas-hulot.org
6	**Fondation MAVA pour la nature**	What we do> Programmes>	Coastal West Africa	https://mava-foundation.org/programmes/
7	**Fondation Prince Albert II de Monaco**	Activities> Projects	Projects: Development of marine protected areas/ conservation of endangered species/ Increased knowledge of biodiversity/ Make a commitment against deforestation	https://www.fpa2.org/home.html
8	**Fondation Yves Rocher**	-	Search: Benin	https://www.yves-rocher-fondation.org/en/spots/france/
9	**Critical Ecosystem Partnership Fund (CEPF)**	Grants>Grantee projects	Country: Benin	https://www.cepf.net/
10	**Instituto Marquês de Valle Flôr**	-	Environment and sustainability: All projects	https://www.imvf.org/en/environment-and-sustainability/
11	**The Nando Peretti Foundation**	Projects> Environmental conservation	Continent: Africa	https://www.nandoandelsaperettifoundation.org/en/
12	**OAK Foundation**	Grant-making> Grand database	Country: Benin	https://oakfnd.org/
13	**Padi Foundation**	Grant recipients	Year: 1995-2019 Control F: Benin on the PDF documents for each year	http://www.padifoundation.org/
14	**Prince Bernard Nature Fund (PBNF)**	-	-	http://www.pbnf.nl/ Inaccessible link/donor
15	**The Rufford Foundation**	-	Country: Benin	https://www.rufford.org/projects/byCountry/bj

Appendix A (cont.)

16	**The Mohamed Bin Zayed Species conservation Fund**	Case studies & projects> Supported projects	Order: continent: Africa All awarded amounts/ All IUCN classification Country: Benin All species types/ Accepted in all years/ Accepted in all months	https://www.speciesconservation.org/
17	**Save Our Seas Foundation**	Projects	Projects (Benin's map is empty)	https://saveourseas.com/
18	**Wetlands International**	Search: Benin	-	https://www.wetlands.org/
19	**Birdlife International**	-	Where we work: Africa	http://www.birdlife.org/africa
20	**Royal Society for the Protection of Birds (RSPB)**	-	Countries: Benin	https://www.rspb.org.uk/our-work/conservation/projects/ecology-of-migrant-birds-in-africa/
21	**West African Primate Conservation Action (WAPCA)**	Projects		https://www.wapca.org/
22	**Centre de Recherches pour le Développement International**	What we do> where we work	Region: Sub-Saharan Africa Country: Benin Topic: Environment Project status: closed	www.crdi.org
23	**Darwin Initiative**	-	Country: Benin	https://www.darwininitiative.org.uk/project/location/country/benin/
24	**Fondation de France**	-	Our areas of actions: environmental conservation & biodiversity> No intervention in Benin	https://www.fondationdefrance.org/en
25	**Fondation d'entreprise Veolia Environnement**	-	Country: Benin Domain: Environment & biodiversity	https://www.fondation.veolia.com/en/supported-projects
26	**Fondation Marie & Alain Philippson**	-	No filter available	http://www.philippsonfoundation.org/
27	**Fondation pour une Terre Humaine**	-	Projets subventionnes: Projets par pays	http://www.terrehumaine.org/index.php
28	**International Institute for Environment and Development (IIED)**	-	Search site: Benin	http://www.iied.org/general/about-iied/about-iied
29	**Manos Unidas**	Development cooperation > Projects	Area: environment and climate change Country: Benin Year: any	http://www.manosunidas.org/
30	**Swissaid**	Projects	No intervention in Benin	www.swissaid.ch
31	**The John D. and Catherine T. Mac Arthur Foundation**	-	Search: Benin Topic: conservation	https://www.macfound.org/our-work
32	**The Rockefeller Foundation**	-	Search by keyword: Benin	http://www.rockefellerfoundation.org/

Appendix A (cont.)

33	**The United Nations Educational, Scientific and Cultural Organization (UNESCO)**	Home>In brief > Transparency) Funding needs & data> Explore all projects	Beneficiaries countries: Benin	https://en.unesco.org/
34	**Fonds pour l'environnement Mondial (GEF) et son Small Grants Programme/ SGP (The GEF Small Grants Programme)**	-	Country: Benin; Area of work: Biodiversity; start date: 2013 and earlier up to 2019.	https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results.html?view=allprojects&limit=50&limitstart=0&paging=1
35	**Commission européenne:**	Find funded projects> Advanced search	Country: Benin Keywords: environment/ biodiversity	https://ec.europa.eu/info/funding-tenders/projects_en
36	**Global Environment Facility (GEF) medium and full-sized projects; enabling projects**	Try faceted search	-Country: Benin - Focal areas: biodiversity, land degradation, climate change, international waters and persistent organic pollutants -Agencies: all - Project type: all	https://www.thegef.org/projects
37	**The foundation Center**	-	- Subject area: Forestry, Biodiversity, Climate change, Environmental education, Environmental justice, Land resources, Water resources, Philanthropy. - Geographic focus: Benin (All depatments)	https://fconline.foundationcenter.org/fdo-search/search/?view_all=1&collection=grants&view_all=1&collection=grants&geographic_focus=2395170&quicksearch=Benin&activity=quicksearch&government_grantmaker=1
38	**JRS Biodiversity Foundation**	-	-Project locations: Benin - Projects: All	https://jrsbiodiversity.org/our-grants/
39	**Global Biodiversity Information Facility (GBIF)**		-Country: Benin	https://www.gbif.org/resource/search?contentType=project&contractCountry=BJ
40	**The World Bank**	-	Country: Benin ; Theme: Environmental policies and institutions/ Biodiversity/ Gender/ climate change/other environment and natural resources management/water resource management	https://datacatalog.worldbank.org/dataset/world-bank-projects-operations
41	**AidData**	Project level aid> advanced search	- Recipient: Benin -Sectors: 310-Agriculture, Forestry and Fishing and 410- General environmental Protection -Year" 1990s, 2000s, 2010s	https://www.aiddata.org/datasets

Appendix A (cont.)

42	**Agence Française de Développement (AFD)**	Menu> Sur le terrain>carte des projets emblématiques >Vue Liste> Liste des projets>	Votre recherche: Benin Thematique: biodiversité	https://www.afd.fr/fr
43	**The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)**	Worldwide> Africa>Benin>Project data> Project details	Sectors: 312-Forestry/322-Natural resources and mining/410-General environment protection All clients	www.giz.de
44	**Deutscher Entwicklungsdienst (DED)**	Countries> search country list> Benin> content of this page> German development cooperation with Benin	-	www.bmz.de/
45	**Coopération américaine/United States Agency for International Development (USAID)**	Where we work> Africa> Benin	-	https://www.usaid.gov/
46	**Netherlands development Organisation (SNV)**	Our projects	Country: Benin Show active and completed projects	https://snv.org/projects
47	**Direction du Développement et de la Coopération Suisse (DDC)**	Projets> Quels projets figurant dans la banque de données> Liens> Liste de tous les projets suisses sur le site de l'OCDE http://www.oecd.org/fr/cad/financementpourledeveloppementdurable/	-	www.ddc.admin.ch
48	**Fonds Français pour l'Environnement Mondial (FFEM)**	Découvrez nos projets> Vue liste	Géographie: Bénin	http://www.ffem.fr
49	**Ambassade de France au Bénin**	Coopération française (AFD, IRD, CIRAD)		https://bj.ambafrance.org/
		Centre de Coopération International en Recherche Agronomique pour le Développement (CIRAD)	Recherchez un projet: par axe de recherche: Agriculture, environnement, nature et sociétés Par pays: Benin	https://afrique-ouest.cirad.fr/recherches-en-partenariat/principaux-projets
		Institut de Recherche pour le Développement Durable (IRD)	Recherche: Projets Thematique: Vivant: Biodiversité -88/ Ecosystèmes -91/ Zone géographique: Bénin	https://benin.ird.fr/

Appendix A (cont.)

50	**Coopération espagnole : Agencia Española de Coopéración International para el Desarrollo (AECID)**	Where we cooperate> Sub-Saharan Africa	Where we cooperate> Sub-Saharan Africa	www.aecid.es
51	**Coopération japonaise : Japaneze International Cooperation Agency (JICA)**	Countries & regions> Africa> Benin> More on JICA's activities in Benin> Map of JICA Major projects in Benin	Countries & regions> Africa> Benin> More on JICA's activities in Benin> Map of JICA Major projects in Benin	http://www.jica.go.jp/english/
52	**Coopération Italienne au Développement (Cooperazione Italiana)**	Countries> OPENaid map>Africa Sub-Sahariana	Countries> OPENaid map>Africa Sub-Sahariana	https://www.aics.gov.it/home-eng/aics/profile-and-goals/
53	**Danish cooperation (Danida)**	Search: Benin> Show advanced search criteria>	Period: 1992-2019	www.um.dk/en/
54	**Organisation for Economic Cooperation and Development (OECD)**		- Donor: DAC countries, Total - Sector: 312- Forestry total/ 410- general environment protection - Flow: Official Development Assistance - Channel: all channels - Flow type: Commitments - Type of aid: All types, Total - Amount type: Constant prices Years: 2010 to 2019	https://stats.oecd.org/Index.aspx?datasetcode=CRS1
55	**Open. Enabel-Belgian Development Agency**	-	Pays: Bénin Secteur: 41000-General environment protection/ 31200- forestry/ 31000- Agriculture forestry and fisheries Bailleur: tous les bailleurs Statut: tous les statuts	. https://open.enabel.be/fr/projects/2
56	**The West African Savannah Foundation (WSAF)/ Fondation des Savanes Ouest Africaines (FSOA)**	-	Projects	http://fsoa-conservationtrustfund.org
57	**The directory of donors for conservation in West Africa ("Repertoire des bailleurs pour la conservation en Afrique de l'Ouest")**		The document intended to national NGOs is a compilation of names, acronyms, logos, conservation fields, intervention areas and websites links of 48 potential international donors for biodiversity conservation in west African countries (Dia and Meriaux, 2014).	http://www.rampao.org/IMG/pdf/repertoire_bailleurs_vf_adb_gcajouts01_2014et02_2014.pdf
58	**"Direction Générale des Forêts et des Ressources Naturelles" (DGFRN)/ General Directorate of Forests and Natural Resources**			http://dgfrn-bj.org/

Appendix A (cont.)

59	**"Annuaire des statistiques forestières du Bénin" /Benin's Forestry statistics directory**			http://bj.chm-cbd.net/ressources/rapports/annuaires-statistiques-forestieres
60	**African Parks Network**			https://www.africanparks.org/sites/default/files/uploads/resources/2019-06/AFRICAN%20PARKS%20-%202018%20Annual%20Report%20-%20Full%20-%2005062019%20-%20Digital_0.pdf
61	**"Direction du Parc National de la Pendjari, Benin"/ Pendjari National Park (PNP) management office**		"Plan d'affaire 2007-2011" (business plan) for PNP. In the annex 3	http://aires-protegees.uemoa.int/sites/default/files/AiresProtegees/Pendjari_affairesParc_Pendjari.pdf.
62	**"Plan d'Aménagement et de Gestion de la Réserve de Biosphère de la Pendjari"/ Development and Management Plan of the Pendjari Biosphere Reserve**		In the annex 7 of this document, funding data on tourism and hunting was collected from 2003 to 2008	https://rris.biopama.org/sites/default/files/2019-03/PN_Pendjari_PAG_qsvBo2o.pdf.
63	**"Centre National de Gestion des Réserves de Faune" (CENAGREF)/ National Centre for Wildlife Reserve management**		Data from this domestic source was collected in Benin. The team for my complementary data collection met with a representant of CENAGREF. Additionally, I was able to assess fines, hunting and tourism revenues of WNP for the period 2002-2011. This Park revenues data came originally from CENAGREF, but was collected by Miller (2013).	
64	**Action pour l'Environnement et le Développement Durable (ACED)**		Funding data was collected in person by a team in Benin	
65	**Aquaculture et Développement Durable (AquaDeD);**		Funding data was collected in person by a team in Benin	
66	**Centre Régional de Recherche et d'Education pour le Développement Intégré (CREDI)**		Funding data was collected in person by a team in Benin	
67	**Benin Ecotourism Concern (ECO-Bénin)**		Funding data was collected in person by a team in Benin	
68	**Groupe de Recherche et d'Action pour le Bien Etre au Bénin (GRABE)**		Funding data was collected in person by a team in Benin	
69	**Organisation pour le Développement Durable et la Biodiversité (ODDB)**		Funding data was collected in person by a team in Benin	

Appendix A (cont.)

70	**Amis de l'Afrique Francophone- Bénin (AMAF-BENIN)**		Funding data was collected in person by a team in Benin	
71	**Centre International pour la Promotion de la Création (CIPCRE)**		Funding data was collected in person by a team in Benin	
72	**Benin Environment and Education Society (BEES)**		Funding data was collected in person by a team in Benin	
73	**Réseau de Développement des Réserves naturelles Communautaires (REDERC)**		Funding data was collected in person by a team in Benin	
74	**Action plus ONG**		Funding data was collected in person by a team in Benin	

Appendix B: Coding scheme

	Fields
Project identification	Project name in English
	Project name and abbreviation in French
	Project ID: code associated with each project
	Project type: Strict aid or mixed aid (1: strict; 2: mixed)
	Year committed: the number of years committed by the funder
	Actual starting year of the project (month and date are reported if available)
	Actual ending year of the project (month and date are reported if available)
	Conservation project objective
	Description of project
	Conservation actions: A key word search was conducted for all the conservation actions. A column is created for each conservation action. The number 1 is assigned to each conservation action if the title, objective and description of a project feature the key words in bold (below) and 0 if not. When there is not enough data to determine a conservation action, it is classified as Unknown. The ten domains used for the Conservation Actions classification are the following (IUCN-Conservation Measures Partnership, 2016). **1. Land/Water Management:** Actions directly managing or restoring sites, ecosystems and the wider environment. Subcategories: Site/Area Stewardship, Ecosystem & Natural Process (Re)Creation. **2. Species Management:** Actions directly managing or restoring specific species or taxonomic groups. Subcategories: Species Stewardship, Species Re-Introduction & Translocation, Ex-Situ Conservation. **3. Awareness Raising:** Actions making people aware of key issues and/or feeling desired emotions, leading to behavior change. Subcategories: Outreach & Communications, Protests & Civil Disobedience. **4. Law Enforcement and Prosecution:** Actions monitoring and enforcing compliance with existing laws and policies at all levels to deter threats or compel conservation action. Subcategories: Detection & Arrest, Criminal Prosecution & Conviction, Non-Criminal Legal Action. **5. Livelihood, Economic and Moral Incentives:** Actions using livelihood, other economic and moral incentives to directly influence attitudes and behaviors. Subcategories: Linked Enterprises & Alternative Livelihoods, Better Products & Management Practices, Market-Based Incentives, Direct Economic Incentives, Non-Monetary Values. **6. Conservation Designation and Planning:** Actions directly protecting sites and/or species. Subcategories: PA Designation &/or Acquisition, Easements & Resource Rights, Land/Water Use Zoning & Designation, Conservation Planning, Site Infrastructure. **7. Legal and Policy Frameworks:** Actions developing and influencing legislation, policies and voluntary standards affecting conservation. Subcategories: Laws, Regulations & Codes, Policies & Guidelines. **8. Research and Monitoring:** Actions collecting data and transforming it into information to support conservation work. Subcategories: Basic Research & Status Monitoring, Evaluation, Effectiveness Measures & Learning. **9. Education and Training:** Actions enhancing the knowledge and skills of specific individuals. **10. Institutional Development:** Actions creating the institutions needed to support conservation work (International Organizational Management and Administration: The basic work needed to establish and operate conservation organizations; External Organizational Development and Support: Creating or providing non-financial support & capacity building for conservation organizations; Alliance and Partnership Development: Forming and facilitating partnerships, alliances, and networks of organizations; Financing Conservation: Raising and providing funds for conservation work)

Appendix B (cont.)

Gender	A key word search is conducted with the words "women", "gender" "local communities" in the title, objectives and description of each project. If a project includes one or all of those words, it is implied that they included gender, and if they don't, it is implied as no gender project.
Funder identification	Funder name: Name of funder Organization
	Funder type: the funding organizations are classified as follow: national government; multilateral donor; bilateral; national (private); international (private funder country)
	Implementation structure: The structure or organization commissioned by the funder to oversee the accomplishment of a project or program objectives (World bank; United Nations Development Programme…)
Recipient identification	Recipient name: name of the recipient organization
	Recipient type: the recipient organization contains 5 categories: National government; Subnational government; National NGO/Private national organization; International NGO/Private international organization; Individual researcher.
	Executing agencies: the structure or organization in the recipient country responsible for the implementation of the project
Funding amount	Type of funding: This field displays the type of funding. 2 types of funding are identified: 1. Credit; 2. Donations/ Grant; 3. Cannot determine
	Project commitment amount
	Project commitment amount currency
	Amount granted in original currency
	Original currency
	Amount granted in Constant US$
	Amount reported by the donor (found on the donor website or other databases)
	Currency of the amount reported by the donor
	Co-financing institutions/agencies
	Co-financing amount
	Co-financing amount currency
	Other fees not included in the grant like project preparation fees or agency fees, or any other fees not included in the grant, but part of the total cost of the project
	Project fees currency
	The total cost of the project (includes grant, co-financing and other fees)
	Currency of the project total cost
	The total cost of the project converted in 2016 Constant US $

Appendix B (cont.)

Project location	Project location: the location (s) where the project was implemented within the recipient country are reported in this field
	IUCN category: If the project was implemented in a PA, it is classified into the appropriate 6 IUCN categories (Dudley 2008) or other categories like buffer zone or other • Category Ia (Strict Nature Reserve) • Category Ib (Wilderness Area) • Category II (National Parks) • Category III (Natural Monument or feature) • Category IV (Habitat/Species Management Area) • Category V (Protected landscape/seascape) • Category VI (PA with sustainable use of natural resources) • Biosphere Reserve • Conservation Corridor • Private PA • Buffer zone • Ramsar sites • Sacred forests • **None:** No IUCN category because it is not a PA.
	PA name (or name of area if not protected)
	Location: Department
	Location: Commune
	Location: Village
	Location: Hamlet (Specific location: Name of community, forest, river or the most specific location reported)
	Geolocation: Coordinates of project funding area
Data source	Information source of data (URLS)
	Source ID
	Coder confidence Interval: Rate the coder´s confidence on the project´s coding. Sometimes it is hard to code projects with confidence based on the limited information available. Rate the coders´ coding from 1 to 5. 1 means low confidence (not sure about coding) and 5 means high confidence (good coding).
	Notes: to report any information worth noting about a project
	Project document: This field will inform about the existence or not of a project document (for ongoing projects) and end of project document (implementation results) for closed projects.

Appendix C: List of donors for conservation funding in Benin

Funder type	Donors name	Number of projects	2015 Constant US$ amount (million)
Multilateral donors	Global Environment Facility (GEF) Trust Fund	62	73.845
	European Communities (EC)	6	26.980
	International Union for Conservation of Nature (IUCN) Netherlands	8	0.718
	PNUD à travers le progamme SGP/FEM et co-financé par UICN Pays-Bas	1	0.027
	PMF/FEM/PNUD- CISV & UICN_Pays Bas	1	0.057
	UICN NL/ EGP	1	0.017
	UICN NL, TETRAKTYS, BEES ONG	1	0.118
	France embassy and Taronga conservation society, Australia	1	0.022
	Germany (embassy) and LVDI International	1	0.008
	Fond Français pour l'Environnement Mondial (FFEM) and Association des Français Volontaires du Progrès (AFVP)	1	0.040
	Mohammed Bin Zayed Species Conservation Fund; Conservation des Espèces et Populations Animales (CEPA) & Conservatoire pour la Protection des Primates & Zoological Society for the Conservation of Species and Populations (ZGAP)	1	0.010
	African Biodiversity Network (ABN)	1	0.015
	Forum des Organisations Issues de Migration (FORIM); Agence Française pour le Développement (AFD); Conseil des Béninois de France (CBF)	1	0.015
	African Biodiversity Network, IUCN Netherlands	1	0.033
	FAO	1	0.005
	European Union/GBIF	5	0.080
	Avifauna Nature Tours/African Bird Club (ABC)	1	0.003
	FFEM/ Fondation TOBE/ DAGRIVEST	1	0.053
	Wallon and ECO-Benin/U_AVIGREF/La perle de l"Atacora/APEC-TINFI	1	0.222
	Pain Pour le Monde (PPLM)/ DM-echange et mission (Suisse)	1	0.502
	The World Bank	6	81.183
	Wallon and ADG	1	0.244
	United Nations Development Programme (UNDP)	5	0.284
	ORGANISATION INTERNATIONALE DES BOIS TROPICAUX and Government of Benin	1	0.180
	African Development Fund (AFDF)	1	20.425

Appendix C (cont.)

Bilateral donors	Cooperation Suisse	1	0.038
	GIZ	6	18.296
	France/ FFEM (Fonds Francais pour l'Environnement Mondial)	15	5.317
	Italy	2	0.174
	United Arab Emirates	1	0.006
	Canada	4	0.577
	Fédération Wallonie-Bruxelles de la Coopération Internationale (Belgium)	1	0.091
	Netherlands	8	3.864
	United States (State department)	4	0.238
	SNV	1	0.587
	Germany	12	55.455
International private donors	JRS Biodiversity Foundation	2	0.356
	LVDI International	1	0.003
	Artist's Project Earth (APE)	1	0.022
	International Primatological Society (IPS)	1	0.002
	Fondation Nature and Découvertes, FRANCE	3	0.021
	The states of Guersney Overseas Aid & Développement commission (GAIA Foundation)	1	0.022
	Fondation Nicolas Hulot, France	1	0.013
	Evangelischer Entwicklungsdienst (EED)	2	0.790
	The Mohamed bin Zayed species conservation fund	6	0.048
	The Darwin Initiative projects	3	0.672
	Global Nature Fund (GNF)	1	0.006
	Institute for Global Environment Strategies (IGES)	1	0.013
	University of Frankfort	1	0.003
	Goodplanet	1	0.075
	Van Tienhoven Foundation	1	0.016
	Pain Pour le Monde (PPLM)	1	0.529
	BIOTA	1	0.002
	The Rufford Foundation	63	0.447
National government	FNEC	2	0.034
	Government of Benin	8	4.168
	CENAGREF	42	3.945
National private donors	OeBenin (Organisation pour la promotion de l'education des filles au Benin)	1	0.001
	Réseau de Développement des Réserves Naturelles Communautaires (REDERC-ONG)	1	0.002
	ECO-ECOLO	1	0.006
	Unkown	2	0.108
	Total	**314**	**301.035**

Appendix D: Stata output for the KMATCH model

Table 12 Summary of covariate balance test before and after matching for the year 2019:

```
. // some balancing statistics
. kmatch summarize
(refitting the model using the generate() option)
```

	Raw			Matched(ATE)		
Means	Treated	Untreated	StdDif	Treated	Untreated	StdDif
hhage	56.75904	49.47692	.5215037	55.93925	50.29131	.4044737
sex_nb	.0361446	.0923077	-.2289426	.0544218	.0479452	.026401
village_life_nb	.746988	.6923077	.1211164	.7573809	.7509579	.0142268
educ1	.2289157	.1230769	.2787735	.1999987	.1419476	.1529036
educ2	.4337349	.6	-.3351021	.4774465	.5896354	-.2261132
cattle_num_n0	0	0	.	0	0	.
cattle_num_n1	.2289157	.4923077	-.5663938	.277386	.4204944	-.3077381
cattle_num_n2	.3373494	.2615385	.1649575	.3310049	.2946484	.0791083
Ethny_nb	5.698795	5.830769	-.0410816	5.569567	5.868706	-.0931178

	Raw			Matched(ATE)		
Variances	Treated	Untreated	Ratio	Treated	Untreated	Ratio
hhage	194.9656	195.0034	.9998064	172.1317	167.1413	1.029857
sex_nb	.035263	.0850962	.4143901	.0520876	.0463827	1.122996
village_life_nb	.1913018	.2163462	.8842394	.185996	.1900366	.9787379
educ1	.1786659	.1096154	1.629934	.1619505	.1237629	1.308554
educ2	.2486042	.24375	1.019915	.2525339	.2458682	1.027111
cattle_num_n0	0	0	.	0	0	.
cattle_num_n1	.1786659	.2538462	.7038353	.2028874	.2476092	.8193857
cattle_num_n2	.2262709	.1961538	1.153538	.2241411	.2111828	1.061361
Ethny_nb	11.0911	9.549038	1.161488	10.52212	9.420677	1.116918

Table 13: Summary of covariate balance test before and after matching for the year 2011

```
. kmatch summarize
(refitting the model using the generate() option)
```

	Raw			Matched(ATE)		
Means	Treated	Untreated	StdDif	Treated	Untreated	StdDif
hhage	47.75524	40.9845	.5213254	46.13309	41.80413	.3333161
sex_nb	.0769231	.1007752	-.083593	.0882353	.0876018	.0022203
village_life_nb	.7552448	.6821705	.1624554	.7530568	.7170271	.0800995
educ1	.3426573	.3023256	.0860461	.341038	.2944877	.0993131
educ2	.4265734	.5658915	-.280349	.4841882	.5737519	-.1802284
cattle_num_n0	.2447552	.3333333	-.19561	.2837211	.3044254	-.0457218
cattle_num_n1	.2027972	.2868217	-.1956276	.2243041	.2648191	-.0943279
cattle_num_n2	.2727273	.2170543	.1292602	.2592799	.2351724	.0559723
Ethny_nb	6.027972	5.20155	.2674454	5.763303	5.279304	.1566313

	Raw			Matched(ATE)		
Variances	Treated	Untreated	Ratio	Treated	Untreated	Ratio
hhage	167.6509	169.7029	.9879086	149.2516	164.795	.9056802
sex_nb	.071506	.0913275	.7829618	.0810164	.0805521	1.005763
village_life_nb	.1861519	.2185078	.8519234	.1872719	.2044844	.9158249
educ1	.2268295	.2125727	1.067068	.2263137	.2093879	1.080835
educ2	.2463311	.2475775	.9949657	.2515088	.2464713	1.020438
cattle_num_n0	.1861519	.2239583	.8311898	.2046546	.2134049	.9589969
cattle_num_n1	.162809	.2061531	.7897481	.1752171	.196211	.8930034
cattle_num_n2	.1997439	.1712694	1.166256	.1934063	.1812716	1.066943
Ethny_nb	10.73161	8.36531	1.28287	10.05847	8.215033	1.224398

Table 14: Multivariate-distance kernel matching with Mahalanobis metric- Stata output for the year 2019

- **Impact of ECOPAS on Agricultural land access (2019)**

```
Multivariate-distance kernel matching           Number of obs     =        148
                                                Replications      =         50
                                                Kernel            =       epan
Treatment   : ecopas_dummy = 1
Metric      : mahalanobis
Covariates  : hhage sex_nb village_life_nb educ1 educ2 cattle_num_n0 cattle_num_n1 cattle_
```

Matching statistics

	Matched			Controls			Bandwidth
	Yes	No	Total	Used	Unused	Total	
Treated	83	0	83	63	2	65	3.556633
Untreated	64	1	65	83	0	83	3.809727
Combined	147	1	148	146	2	148	

Treatment-effects estimation

agri_acces~b	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal-based [95% Conf.	Interval]
ATE	-.8790538	.1675655	-5.25	0.000	-1.207476	-.5506314
ATT	-.9129471	.1776197	-5.14	0.000	-1.261075	-.5648188
NATE	-.8537535	.1809049	-4.72	0.000	-1.208321	-.4991864

Table 15: Multivariate-distance kernel matching with Mahalanobis metric- Stata output for the year 2011

- **Impact of ECOPAS on Agricultural land access (2011)**

```
Multivariate-distance kernel matching          Number of obs     =       272
                                               Replications      =        50
                                               Kernel            =      epan
Treatment   : ecopas_dummy = 1
Metric      : mahalanobis
Covariates  : hhage sex_nb village_life_nb educ1 educ2 cattle_num_n0 cattle_num_n1 cattle_num_n2 Ethny_nb
```

Matching statistics

	Matched			Controls			Bandwidth
	Yes	No	Total	Used	Unused	Total	
Treated	143	0	143	129	0	129	3.778516
Untreated	129	0	129	143	0	143	3.537158
Combined	272	0	272	272	0	272	

Treatment-effects estimation

agri_acces~b	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal-based [95% Conf.	Interval]
ATE	-.7513357	.1116487	-6.73	0.000	-.9701631	-.5325083
ATT	-.7174548	.1144709	-6.27	0.000	-.9418137	-.493096
NATE	-.726568	.113381	-6.41	0.000	-.9487906	-.5043454

Note: Mahalanobis distance matching with age, sex, migration status, education, economic status and ethnicity as covariates. In 2019, 2 control observations went unused, while 0 treatment observation went unused in the matching. ATT: average treatment effect on treated; NATE: non-matched average treatment effect; ATE: Average treatment effect. KMATCH (Jann, 2017), Stata's module for multivariate-distance and propensity-score matching were used for the estimation.

Table 16: Propensity-Score kernel matching– Stata output for the year 2019

- **Impact of ECOPAS on Agricultural land access (2019)**

```
Propensity-score kernel matching                Number of obs     =       148
                                                Kernel            =     epan
Treatment   : ecopas_dummy = 1
Covariates  : hhage sex_nb village_life_nb educ1 educ2 cattle_num_n0 cattle_num_n1 cattle_num_n2 Ethny_nb
PS model    : logit (pr)
```

Matching statistics

	Matched			Controls			Bandwidth
	Yes	No	Total	Used	Unused	Total	
Treated	82	1	83	53	12	65	.0210056
Untreated	61	4	65	82	1	83	.0646458
Combined	143	5	148	135	13	148	

Treatment-effects estimation

agri_acces~b	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATE	-.8736982	.202289	-4.32	0.000	-1.273468	-.473928
ATT	-.7862422	.2255333	-3.49	0.001	-1.231949	-.3405359
NATE	-.8537535	.1877253	-4.55	0.000	-1.224742	-.4827645

Table 17: Propensity-Score kernel matching– Stata output for the year 2011

- **Impact of ECOPAS on Agricultural land access (2011)**

```
Propensity-score kernel matching              Number of obs     =       272
                                              Kernel            =      epan
Treatment   : ecopas_dummy = 1
Covariates  : hhage sex_nb village_life_nb educ1 educ2 cattle_num_n0 cattle_num_n1 cattle_num_n2 Ethny_nb
PS model    : logit (pr)

Matching statistics
```

	Matched			Controls			Bandwidth
	Yes	No	Total	Used	Unused	Total	
Treated	135	8	143	124	5	129	.0220295
Untreated	121	8	129	127	16	143	.010923
Combined	256	16	272	251	21	272	

Treatment-effects estimation

agri_acces~b	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATE	-.8106262	.130063	-6.23	0.000	-1.066688	-.5545639
ATT	-.7277524	.1248089	-5.83	0.000	-.9734707	-.4820341
NATE	-.726568	.1187238	-6.12	0.000	-.9603063	-.4928297

Note: Regression-adjusted propensity-score kernel matching with age, sex, migration status, education, economic status and ethnicity as covariates, based on a logit model where the treatment is the intervention of the project ECOPAS. In 2019, 1 treatment household and 4 control households could not be matched. 12 control observations were not used while 1 treatment observation went unused. ATT: average treatment effect on treated; NATE: non-matched average treatment effect; ATE: Average treatment effect. KMATCH (Jann, 2017), Stata's module for multivariate-distance and propensity-score matching were used for the estimation.

Table 18: Average treatment effect estimation with the Propensity score for 2019

Outcome of interest	n. Treated	n. Control	ATT	Standard errors	t	P value
Agricultural land access	82	53	**-0.79**	0.23	**-3.49**	**0.001**
Livestock resources access	82	53	**-0.36**	0.17	**-2.17**	**0.032**
Forest product access	81	56	**-0.80**	0.18	**-4.34**	**0.000**
Water access	71	38	**1.69**	0.63	**2.68**	**0.008**
Change in income	82	53	**-1.53**	0.53	**-2.80**	**0.006**

Table 19: Average treatment effect estimation with the Propensity score for 2011

Outcome of interest	n. Treated	n. Control	ATT	Standard errors	t	P value
Agricultural land access	127	124	**-0.73**	0.12	-5.83	**0.000**
Livestock resources access	110	90	**-0.40**	0.16	-2.57	**0.011**
Forest product access	117	112	**-0.88**	0.15	-5.71	**0.000**
Water access	127	64	**3.86**	0.71	5.40	**0.000**
Change in income	126	113	**-0.50**	0.38	-1.33	**0.185**

Appendix E: IRB Approval Notice

ILLINOIS

OFFICE OF THE VICE CHANCELLOR FOR RESEARCH

Office for the Protection of Research Subjects
805 W. Pennsylvania Ave., MC-095
Urbana, IL 61801-4822

Notice of Approval: New Submission

March 8, 2019

Principal Investigator	Daniel Miller
Protocol Title	*Building knowledge of the long-term impacts of international conservation funding in Benin's National Parks*
Protocol Number	19516
Funding Source	University of Illinois at Urbana-Champaign College of ACES, Office of International Programs
Review Type	Exempt 2, 4
Status	Active
Risk Determination	No more than minimal risk
Approval Date	March 8, 2019
Closure Date	March 7, 2024

This letter authorizes the use of human subjects in the above protocol. The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) has reviewed and approved the research study as described.

The Principal Investigator of this study is responsible for:

- Conducting research in a manner consistent with the requirements of the University and federal regulations found at 45 CFR 46.
- Using the approved consent documents, with the footer, from this approved package.
- Requesting approval from the IRB prior to implementing modifications.
- Notifying OPRS of any problems involving human subjects, including unanticipated events, participant complaints, or protocol deviations.
- Notifying OPRS of the completion of the study.