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Park dependency and its effect on park management attitudes: a case study of Pendjari Biosphere Reserve, Benin

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Abstract

Pendjari National Park, a biosphere reserve in north-western Benin, serves as an abundant source of ecosystem services to its surrounding population. Overexploitation of these resources has posed a threat on the park's biodiversity, creating a need for effective park protection management. African Parks, a non-profit conservation organisation, has been performing this task since May 2017. Their latest conservation measure has been the placement of a fence around the buffer zone, a protected area which was previously overused by the local communities. In response to its measures and approach, African Parks encounters resistance from the local communities. This study has analysed which factors influence whether someone agrees with the placement of a fence or not. One of these factors was assumed to be park dependency, in other words, for how much of their income someone is dependent on the park. This variable was analysed more thoroughly as a first part of this research. Data was collected by interviewing a sample of 150 respondents, spread over twenty-two villages surrounding the park. The survey covered socio-economic aspects, as well as spatial and study-specific variables, including opinion-based questions. The data was analysed using logistic regression modelling, where the outcome variables, park dependency and agreement with the fence, were transformed into binary variables. The first model showed that distance from the buffer zone and level of education are the only significant variables in explaining park dependency. The further away someone lives from the park, and the higher their educational level, the less likely they are of being highly park dependent. Against the expectations, the second model did not include park dependency as a significant variable in determining level of agreement with the fence. The only pertinent factors here were perception on biodiversity conservation and the importance someone attaches to arable land as a park resource. The more negatively someone feels about conservation of biodiversity, and the more importance they attach to arable land as opposed to other park resources, the more likely they are of resisting against the fence as a park protection measure. Keeping in mind that the success of protected area management partly depends on the support from local communities, African Parks can use these results to improve their decision making.

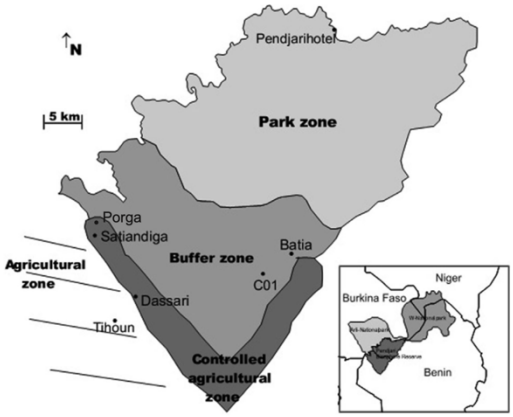
Key words: Park dependency, Biodiversity conservation, Household attitudes, Logistic regression, Pendjari National Park, Benin

Executive summary *(Dutch)*

Bossen bieden een hele resem aan voordelen voor de mens, gaande van hout voor constructie en verbranding, tot voeding en water voor zowel vee als voor huishoudelijk gebruik. Deze voordelen worden ook wel 'ecosysteemdiensten' genoemd. Ecosysteemdiensten worden gedefinieerd als de "directe en indirecte bijdragen van ecosystemen aan menselijk welzijn". In landelijke gebieden van lage-inkomenslanden zijn huishoudens vaak sterk afhankelijk van deze voorzieningen om te kunnen overleven. Hoge afhankelijkheid, in combinatie met bevolkingsgroei, zet druk op de biodiversiteit van deze bossen. Om deze druk tegen te gaan kunnen overheden beslissen om hun bossen tot beschermd gebied uit te roepen en beheerssysteem te installeren met als doel de flora en fauna te beschermen. Het nationaal park Pendjari, een biosfeerreservaat gelegen in het noordwesten van Benin, werd in 1954 beschermd gebied en heeft intussen al verschillende beheersystemen doorgemaakt. De meest gewaardeerde ecosysteemdienst in deze regio is landbouwgrond, aangezien 90% van de bevolking landbouw als hoofdactiviteit heeft. Elk jaar worden in Benin grote delen bos omgezet in landbouwgrond met biodiversiteitsverlies en erosie tot gevolg. Naast landconversie, vormen ook illegaal stropen en houthakken een bedreiging voor het park. African Parks, het meest recente parkbestuur, treedt resoluut op tegen deze overtredingen. Hun nieuwste maatregel is de plaatsing van een hek rondom het beschermd gebied.

Om beschermde gebieden succesvol te kunnen beheren is er nood aan steun van de lokale bevolking. Daarom is het nuttig te achterhalen welke factoren een invloed hebben op het al dan niet eens zijn met de aanpak van het parkmanagement. Het zijn deze onderliggende drijfveren waar het management zich op moet richten om de bewoners te overhalen. Verschillende studies hebben reeds aangetoond dat er een verband bestaat tussen iemands parkafhankelijkheid en zijn of haar attitude ten opzichte van het management. Met afhankelijkheid wordt hier de fractie van het inkomen bedoeld, waarvoor het huishouden afhankelijk is van het park. Deze afhankelijkheid wordt op haar beurt ook bepaald door allerhande factoren. Er worden in dit onderzoek bijgevolg twee hypotheses getoetst met behulp van logistische regressie. Als eerste wordt er verondersteld dat inkomensafhankelijkheid van Pendjari bepaald wordt sociaaleconomische variabelen zoals grootte van het huishouden en opleidingsniveau. Afstand tot het park wordt verwacht de grootste invloed te hebben. Ten tweede wordt ervan uit gegaan dat parkafhankelijkheid, in combinatie met nog enkele andere variabelen, bepaalt of iemand het eens is met het parkmanagement, meer bepaald met de plaatsing van de omheining.

Pendjari is een gebied van 4800 km^2 dat deel uitmaakt van het W-Arly-Pendjari Complex, een UNESCO werelderfgoedsite die verspreid is over de drie landen, namelijk Niger, Burkina Faso en Benin. Sinds 1961 is het officieel een nationaal park. Voordien was het de woonplaats van een groot deel van de lokale bevolking. Nu wonen deze 40.000 mensen aan de zijkanten van het park, verspreid over de assen *Tanguièta-Porga* en *Tanguièta-Batia.* De vaakst voorkomende etnische groepen in de regio zijn *Berba*, *Waama*, *Gourmantché* en de kleinere groep, *Peulh*. De meest frequent uitgeoefende activiteiten zijn akkerbouw, gevolgd door veeteelt en transformatie van grondstoffen naar verkoopbare producten. Een minderheid doet aan kleinschalige handel, werkt als zelfstandige of is werkzaam in het park, bijvoorbeeld als parkwachter. Sinds 1954, toen het park beschermd gebied is geworden, is het park al door verschillende types management bestuurd. Oorspronkelijk werd het beheerd



met macht en repressie. In 1993 is men overgestapt op een meer interactief beleid, waarbij de lokale bevolking meer betrokken werd bij de beslissingsprocessen. Dit heeft aanleiding gegeven tot het ontstaan van dorpsverenigingen via dewelke parkinkomsten, bijvoorbeeld van jachtvergunningen en -vlees, met de dorpelingen gedeeld worden. Sinds mei 2017 heeft African Parks het beleid van het park overgenomen. African Parks is een non-profitorganisatie die de conservatie van vijftien verschillende parken in Afrika op zich neemt. Het park is, zoals elk biosfeerreservaat, opgedeeld in drie zones, met verschillende niveaus van bescherming. De meest beschermde zone is het kerngebied, op de kaart wordt dit aangeduid als 'park zone'. Deze zone wordt uitsluitend gebruikt voor toeristische doeleinden. Daarnaast is er de bufferzone, waarvoor er toestemming nodig is om ze te mogen betreden. Dit is het gebied waarrond de omheining geplaatst wordt. Het minst beschermde gebied is de gecontroleerde toegangszone, beter bekend als de *Zone d'Occupation Contrôlée* (*ZOC*). Hoewel hier mensen wonen, maakt ze toch deel uit van het park. De focus binnen deze studie ligt op de afhankelijkheid van de *ZOC,* en in mindere mate ook de bufferzone.

Een steekproefgrootte van 150 respondenten, afkomstig uit tweeëntwintig dorpen rondom het park, werd geïnterviewd. Respondenten werden geselecteerd op basis van etniciteit, woon-parkafstand en voldoende spreiding over de twee assen. Door gebrek aan een steekproefkader werd convenience sampling als steekproefmethode gebruikt. De enquêtes werden afgenomen met behulp van een vertaler, die de Franse vragenlijst naar de plaatselijke talen vertaalde. Telkens werd eerst het dorpshoofd ondervraagd, vooraleer verder te gaan met andere respondenten uit zijn dorp. Voorafgaand aan de studieperiode was de enquête reeds getest in het gebied op duidelijkheid en volledigheid. Antwoorden op gesloten vragen werden geregistreerd in de Qualtrics Offline applicatie op een tablet. Bijkomende informatie werd apart neergeschreven om latere interpretatie van de resultaten te vergemakkelijken. De enquête werd opgesteld aan de hand van voorgaande onderzoeken in beschermde gebieden in lage-inkomenslanden. Ze bestond uit vier onderdelen: sociodemografische gegevens, ruimtelijke variabelen, economische eigenschappen en informatie specifiek voor dit onderzoek.

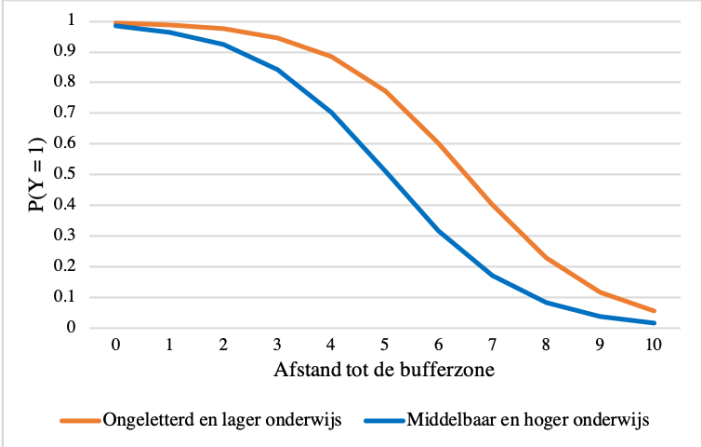
Met socio-demografische gegevens worden variabelen zoals leeftijd, etniciteit, opleidingsniveau en grootte van het huishouden bedoeld. Deze variabelen spelen meestal eerder een modererende, dan wel van een bepalende rol. Ruimtelijke variabelen hebben te maken met de locatie van de woning van de respondent: het dorp waarin hij of zij woont en de afstand van zijn of haar woning tot het park. Deze afstand werd door de onderzoekers zelf berekend aan de hand van de coördinaten van de respondenten en van de parkgrenzen. Deze werden geplot in Google Earth en met het liniaal werd de afstand in vogelvlucht ertussen gemeten. Het onderdeel 'economische eigenschappen', trachtte een schatting te maken van het inkomen van de respondent. De meerderheid van de respondenten deed aan landbouw voor eigen levensonderhoud, en dus niet voor verkoop. Dat maakt het moeilijk voor hen om hun inkomen als een monetaire waarde uit te drukken. Daarom werd elk aspect van hun inkomen apart bevraagd op een zeer eenvoudige en begrijpelijke manier. Om te peilen naar landbouwinkomsten, bijvoorbeeld, werd er gevraagd hoeveel zakken ze van elk gewas produceren en werd dit vermenigvuldigd met de marktprijs van dit gewas. Studie-specifieke informatie bevatte onder andere lidmaatschap van dorpsverenigingen en betrokkenheid bij parkactiviteiten. Met behulp van likertschalen werd er naar meningen gepeild omtrent conservatie van biodiversiteit en het parkmanagement. Ten laatste werd er aan de respondenten gevraagd honderd punten te verdelen over de verschillende ecosysteemdiensten, naargelang hun belang.

De dataset werd vanuit Qualtrics geëxporteerd naar STATA, het softwareprogramma waarmee de data werden geanalyseerd. Er werden twee logistische regressiemodellen opgesteld. Een eerste model had als uitkomstvariabele 'hoge parkafhankelijkheid' ($Y = 1$) of 'lage parkafhankelijkheid' ($Y = 0$). Hierbij werd er gekozen voor een afkapwaarde van 72,9%, omdat dit de gemiddelde parkafhankelijkheid voor de steekproef was. Ten tweede werd er een model opgesteld met als uitkomstvariabele 'eens met de plaatsing van de omheining' ($Y = 1$) of 'neutraal/oneens met de plaatsing van de omheining' ($Y = 0$). Dit werd bepaald aan de hand van hun antwoord op volgende stelling: "Het is goed dat er een omheining wordt geplaatst om het park te beschermen tegen vernieling door de mens". Antwoorden kon met behulp van een 5-puntenschaal, gaande van helemaal niet eens tot helemaal eens. Bij logistische regressie wordt het logaritme van de *odds* gemodelleerd als een lineaire functie van de onafhankelijke variabelen. Met *odds* wordt er bedoeld: de kans dat een gebeurtenis plaatsvindt, gedeeld door de kans dat die gebeurtenis niet plaatsvindt. Bijvoorbeeld, de kans dat iemand een hoge parkafhankelijkheid heeft over de kans dat die een lage parkafhankelijkheid heeft. De formule van dit model gaat dan als volgt: $logit = log(odds) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n$. De bèta's kunnen worden geïnterpreteerd als de verandering in de $log(odds)$ als gevolg van een toename in x_i met een eenheid. Om de robuustheid van de modellen te controleren werden er *model variety checks* uitgevoerd. Dit zijn aanpassingen op het model, om na te gaan of de significante variabelen ook significant blijven. Een eerste variant op het oorspronkelijk binaire logistische regressiemodel is het multinomiale regressiemodel. Hierbij worden de uitkomstvariabelen in drie, in plaats van twee, categorieën verdeeld. De tweede variant had als cutoff tussen hoge en lage parkafhankelijkheid 50%, in plaats van 72,9%. De laatste variant maakt gebruik van probit regressie, een modelleringstechniek gebaseerd op de inverse van de standaardnormale verdeling. De drie varianten vertoonden vergelijkbare resultaten met het oorspronkelijke model, wat wijst op voldoende robuuste variabelen.

Tabel 1 (p.8) toont de belangrijkste beschrijvende statistieken voor de steekproef. Hierbij kan opgemerkt worden dat 65% van de respondenten volledig afhankelijk is van het park voor zijn of haar inkomen, terwijl maar 19% geheel los van het park kan overleven. Gemengde landbouw is de vaakst voorkomende activiteit. Van de 102 respondenten die aangaven aan gemengde landbouw te doen, gaven 86 respondenten aan dat gewasbouw belangrijker is voor hen dan veeteelt. Tabel 2 (p.9) is een opsomming van alle variabelen die in de analyse gebruikt werden, samen met een beschrijving van de waarden die elke variabele kan aannemen.

Een eerste logistische regressie zocht naar de variabelen die een invloed hebben op het al dan niet afhankelijk zijn van het park. Er werd gestart vanuit een basismodel, bevattende de meest evidente socio-economische variabelen: leeftijd, grootte van het huishouden, opleidingsniveau, economische activiteit en afstand tot de bufferzone. Hiervan bleken alleen opleidingsniveau en afstand tot het park significant te zijn. De robuustheid van deze variabelen werd getest door de andere variabelen een voor een uit het model te laten vallen. Zo werd er een tweede model gecreëerd waarin alleen de twee significante variabelen overbleven. Een derde model ontstond door het toevoegen van twee nieuwe variabelen: 'landbouwoppervlakte' en 'hoeveelheid vee'. Hoewel deze variabelen in enkele voorgaande studies significant bleken in het bepalen van parkafhankelijkheid, was dit voor Pendjari niet het geval. Aangezien landbouw zowel binnen als buiten de parkgrenzen gebeurt zijn het geen goede variabelen om parkafhankelijkheid te verklaren. De resulterende logistische regressievergelijking is dan de volgende: $log(odds) = 5.2945 - 1.1768x_1 - 0.8132x_2$, met x_1 een dummyvariabele die stelt of een respondent secundair of hoger onderwijs heeft genoten (1) of niet (0), en x_2 de afstand van zijn of haar woning tot de bufferzone. Uit deze vergelijking kan afgeleid worden dat, hoe hoger het opleidingsniveau, hoe kleiner de kans op hoge

parkafhankelijkheid. Er geldt ook dat hoe verder iemand van het park woont, hoe lager de kans op parkafhankelijkheid. De grafiek van voorwaardelijke effecten schept een duidelijker beeld. De kans op een hoge parkafhankelijkheid wordt hier geschat aan de hand van de regressievergelijking, bij een laag en een hoog opleidingsniveau. Men kan waarnemen dat, bij eender welke afstand tot het park, de laagopgeleide meer kans heeft om een hoge parkafhankelijkheid te hebben dan een hoogopgeleide.



De tweede regressie is gebaseerd op de meningen van respondenten. Er werden aan de respondenten tien stellingen voorgelegd waarop ze steeds moesten antwoorden met 'helemaal niet akkoord' tot 'helemaal akkoord'. Vervolgens werden enkele van de stellingen, naargelang hun interne betrouwbaarheid (Cronbachs α), opgeteld om twee onderliggende concepten voor te stellen; enerzijds perceptie tegenover conservatie van biodiversiteit, en anderzijds attitude ten opzichte van het parkbestuur. Een van de stellingen – "Het is goed dat er een omheining wordt geplaatst om het park te beschermen tegen vernieling door de mens" – correleerde onvoldoende met de andere stellingen om het onder een van beide variabelen te plaatsen. Er werd beslist om deze statement afzonderlijk te modelleren om na te gaan welke variabelen bepalen of iemand wel of niet akkoord gaat met de plaatsing van een omheining. Een eerste model duidde op vijf significante variabelen: parkafhankelijkheid, perceptie tegenover conservatie, attitude ten opzichte van het parkbestuur, etniciteit en belang van landbouwgrond als parkvoorziening. Omdat de richting van causaliteit bij 'attitude ten opzichte van parkbestuur' niet eenduidig was, werd er besloten deze variabele uit het model te halen. Iemand kan het namelijk oneens zijn met het hek omdat ze niet tevreden zijn met het bestuur, maar ze kunnen ook ontevreden zijn met het bestuur en hierdoor tegenstander zijn van een omheining. In het tweede model is het opmerkelijk dat parkafhankelijkheid niet langer significant is, en ook etniciteit verliest aan verklaringswaarde. Daarom wordt er nog een derde en laatste regressiemodel gebouwd met als enige inputvariabelen 'perceptie tegenover conservatie van biodiversiteit' en 'belang van landbouwgrond'. De bètacoëfficiënten voor deze twee variabelen veranderen amper over de drie modellen heen, dit wijst op voldoende robuuste modellen. Het resultaat is volgende regressievergelijking: $log(odds) = -1.3319 + 2.64578x_1 - 0.9414x_2$, met x_1 een dummyvariabele die de waarden 1 en 0 aanneemt, voor respectievelijk een positieve of negatieve houding ten opzichte van biodiversiteitsconservatie. Ook x_2 is een dummyvariabele, die aangeeft of landbouwgrond voor de respondent wel (1) of niet (0) de belangrijkste grondstof van het park is. De vergelijking kan als volgt geïnterpreteerd worden: iemand die positief staat tegenover conservatie heeft meer kans om voorstander te zijn van het hek dan iemand die er negatief tegenover staat. Deze mensen erkennen dat een hek de flora en fauna van het park ten goede kan komen. Iemand voor wie landbouwgrond de belangrijkste parkvoorziening is, heeft meer kans om het oneens te zijn met het hek. In vele gevallen gaat de plaatsing van de omheining gepaard met grondverlies. Het is dus vanzelfsprekend dat een grondbezitter weigerachtig staat tegenover deze nieuwe maatregel.

Naast de vragenlijst met gesloten vragen, werden er ook meer uitvoerige discussies gehouden met de respondenten. Op deze manier werden achterliggende redenen voor de gevonden relaties verduidelijkt. Dat afstand een relevante

variabele blijkt in het verklaren van parkafhankelijkheid, spreekt voor zich. Daarnaast heeft opleidingsniveau ook een significante impact. Volgens enkele van de respondenten is dit zo omdat ongeschoolden aangeen andere activiteiten kunnen deelnemen dan aan landbouw. En aangezien de meeste landbouw binnen de parkgrenzen gebeurt, zijn ongeschoolden dus ook meer afhankelijk van het park. Of de huidige oppervlakte aan landbouwgrond zal volstaan in de toekomst, daarover zijn de meningen verdeeld. Enerzijds zou er onvoldoende grond zijn om alle toekomstige generaties te voorzien van voedsel, gezien de enorme bevolkingsgroei. Anderszijds, zijn er steeds meer kinderen die naar school gaan. Deze kinderen worden verwacht het gebied te verlaten, op zoek naar werkgelegenheid. In dat geval zou de landbouwoppervlakte volstaan.

Bijna alle respondenten staan positief tegenover het beschermen van de biodiversiteit. De meerderheid kent conservatie een score toe tussen 16 en 20 op 20 op de beoordelingsschaal. De vaakst vermelde reden is dat toekomstige generaties ook de kans moeten krijgen om de dieren in het park te bezichtigen. De bescherming van planten wordt minder frequent aangehaald. Sommige respondenten erkennen dat Pendjari staatseigendom is en dus niet bestemd is voor het individueel nut. De plaatsing van een hek wordt beschouwd als de meest effectieve methode om het park te beschermen tegen de mens en omgekeerd. Een fysieke omheining doet de bevolking eraan herinneren dat het gebied beschermd is en iedereen die het park betreedt wordt aanzien als een dief. Dit verklaart het positieve verband tussen visie op conservatie van biodiversiteit enerzijds en het al dan niet eens zijn met de omheining anderzijds. Of de uitgesproken meningen ook overeenstemmen met hun werkelijke meningen is aan twijfel onderhevig. Er staan zware straffen op het betreden van het park. Respondenten hebben dan ook een motief om eerlijk op de stellingen te antwoorden.

Hoewel erkend wordt dat African Parks goed werk levert wat betreft conservatie – het aantal dieren in het park is toegenomen en de dieren zijn opmerklijk minder agressief – bestaan er toch discussiepunten tussen het bestuur en de lokale bevolking. Wat veel van hen stoort is dat African Parks een organisatie is die van buitenaf is gekomen en die, door hun strenge handhaving van de regels, de vrijheid van de plaatselijke bevolking doet afnemen. Deze negatieve houding ten opzichte van het management geeft automatisch aanleiding tot het afkeuren van nieuwe maatregelen. De vraag is of deze negatieve houding zich heeft gevormd voor of nadat de plannen voor de omheining bekend zijn gemaakt. Gezien de richting van causaliteit niet helemaal duidelijk is, kunnen er geen conclusies genomen worden. Het vaakst vermelde probleem met African Parks is de verdeling van land. Hoewel African Parks dezelfde parkgrenzen hanteert als hun voorgaander CENAGREF, werden deze grenzen voordien niet duidelijk gecommuniceerd. Bijgevolg eisten mensen delen van het beschermd gebied op en deden ze er aan landbouw. Met de plaatsing van het hek wordt er dus grond ‘afgenomen’ van vele huishoudens, wat voor heel wat weerstand zorgt.

Er werd verwacht dat er een verband zou bestaan tussen instemming met de omheining en afhankelijkheid van het park. Dan zouden huishoudens met een hogere parkafhankelijkheid afkeriger staan tegenover de omheining omdat deze hun toegang tot het park belemmert. Hoewel er inderdaad een negatieve correlatie gevonden werd ($r(148) = -0{,}19$, $p = 0{,}026$), bleek de variabele in de regressie niet significant. Vermoedelijk is dit omdat er in de steekproef te veel tegengestelde gevallen aanwezig waren. Medewerkers bij African Parks, bijvoorbeeld, zijn tevreden met de omheining omdat dit werkgelegenheid met zich meebrengt én ze zijn voor hun loon volledig afhankelijk van het park. Dit had opgelost kunnen worden door een onderscheid te maken tussen inkomen afkomstig uit de *ZOC* en inkomen van de bufferzone. In dat geval had er een omgekeerd evenredig verband kunnen bestaan tussen

afhankelijkheid van de *ZOC* en instemming met een hek. Een andere mogelijkheid was om een onderscheid te maken tussen inkomsten die het park schaden en inkomsten die het park ten goede komen. Parkafhankelijk inkomen wordt in het model dan vervangen door parkbedreigend inkomen.

Er heerst een gevoel onder de bevolking dat de biodiversiteit in het park beschermd wordt ten koste van de mens. Lage betrokkenheid van de gemeenschappen wekt weerstand op tegen de maatregelen van African Parks. Er werd tijdens de interviews herhaaldelijk aangehaald dat de gemeenschappen de aanpak van African Parks zouden steunen, op voorwaarde dat er naar hen geluisterd zou worden, er rekening zou worden gehouden met hun meningen en hun verliezen gecompenseerd zouden worden. De omheining heeft voor veel huishoudens een verlies teweeggebracht omdat ze geen toegang meer hebben tot stro voor het bouwen van daken, fruitbomen, vissen uit de rivier, enz. Dit verlies zou ofwel gereduceerd moeten worden, ofwel gecompenseerd. Met reductie wordt er bedoeld dat toegang tot het park mogelijk moet zijn, maar beperkt in tijd of in ruimte. Zo zou men tijdens bepaalde periodes van het jaar het park toegankelijk kunnen maken voor het verzamelen van grondstoffen. Of er zouden zones gecreëerd kunnen worden voor de verschillende types grondstof. Rotatie van deze zones zou de vegetatie tijd geven om te herstellen. Het eren van fetishes zou heel het jaar door mogelijk moeten zijn, aangezien dit van onschatbare waarde is voor de bevolking en geen schade toebrengt aan het park. Er bestaat reeds een procedure om een vergunning te krijgen om het park eenmalig te betreden, maar deze procedure verloopt momenteel omslachtig. De vergunning moet lang op voorhand aangevraagd worden, moet ingediend worden in *Tanguièta* – vaak ver van hun woning - en ze moeten steeds vergezeld worden door parkwachters. Deze procedure getuigt van weinig vertrouwen tussen de twee partijen. Er wordt voorgesteld om een verantwoordelijke aan te duiden per dorp, die de vergunningen verwerkt en de aanvrager het park in begeleidt via de meest nabijgelegen toegangspoort. Er zou telkens geregistreerd worden wie het park heeft betreden en welke grondstoffen er meegenomen werden. Hiervoor is er wel meer vertrouwen nodig tussen Afrikan Parks en de dorpen.

De tweede aanbeveling, compensatie, impliceert dat de bevolking iets in ruil krijgt voor de verminderde parktoegang om hun levensstandaard gelijk te houden. Er werden enkele alternatieve activiteiten voorgesteld zoals bijenteelt, viskweek en veeteelt. Bij veeteelt is het risico op besmettelijke ziekten heel groot, daarom zetten de meeste huishoudens in op akkerbouw. Vanuit African Parks zouden er vaccinaties kunnen worden voorzien om deze ziekten tegen te gaan en eventueel ook drink- en voederbakken. In dat geval zouden er veel mensen overschakelen op veeteelt als hoofdactiviteit, wat minder belastend zou zijn voor het land. Sensibilisering omtrent het meer duurzaam en efficiënt gebruik van landbouwgrond, zou ervoor kunnen zorgen dat er meer geoogst wordt op een kleinere oppervlakte. Dit kan dus ook aanzien worden als een vorm van compensatie.

Een laatste aanbeveling betreft de gelijke behandeling van dorpen. Sommige dorpen worden regelmatiger geïnformeerd dan andere. Dorpen als *Kuourou* beweren nog nooit bezoek te hebben gehad van African Parks, terwijl andere worden uitgenodigd op vergaderingen in *Tanguièta*. Er zou op eenzelfde manier gecommuniceerd moeten worden met alle dorpen die een impact ondervinden van de conservatiemaatregelen. Bovendien moet African Parks rekruteren op basis van capaciteiten en niet op basis van locatie. De meeste parkmedewerkers worden gerektruteerd in *Batia* en *Tanongou*, wat veel frustratie oplevert in andere dorpen. Ten laatste moet ook landverdeling op een eerlijke wijze gebeuren. Hoewel de meeste dorpen grond verloren zijn aan de omheining, beweert *Tchanwassaga* grond te hebben bijgekregen. Dit zorgt voor discussies en geweld tussen de dorpen onderling en verzet tegen African Parks.

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AVIGREF	Associations Villageoises de Gestion des Réserves de Faune
CENAGREF	Centre National de Géstion des Réserves de Faune
CPL	chasseurs professionnels locaux
NTFP	non-timber forest products
UNESCO	United Nations Educational, Scientific and Cultural Organisation
ZOC	Zone d'Occupation Contrôlée (Controlled Access Zone)

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1. Introduction

Forests offer a wide range of benefits to humans, such as wood for construction, non-timber forest products, meat from wild animals, food and water for livestock and domestic purposes. These naturally occurring resources are also called 'ecosystem services'. Ecosystem services are defined as the "direct and indirect contributions of ecosystems to human wellbeing" (TEEB, n.d.). In rural areas of low-income countries, households are often highly reliant on these provision services for their survival. High dependency, in combination with population growth, puts pressure on the biodiversity of these forests. In response to this deterioration, many governments have declared their forests protected areas and have put management systems in place, in charge of conserving their flora and fauna (Rahman et al., 2017). Conflicts regularly arise between park administrations and local communities, because of a predominant feeling among the locals that biodiversity conservation is prioritized over human welfare.

This is also what has occurred with Pendjari National Park, one of the last remaining intact ecosystems of West Africa and the home of a large part of West Africa's wildlife (African Parks, 2018a). The park was declared a protected area in 1954 and has gone through many different management types since. For people living in and around Pendjari, the most appreciated ecosystem service is arable land. More than 90% of the population has agriculture as their main economic activity. Most of the agriculture in the region is taking place within the boundaries of the park, where the soil is more fertile (Ogoudedjia et al., 2010). Large parts of forests are being converted into farmlands in Benin each year. These transformations lead to loss of biodiversity and land erosion (Floquet, 2011). In addition to land conversion, illegal poaching and timber logging also pose a threat to the park. African Parks, the most recent park directorate, is acting resolutely against these violations, their newest measure being the placement of a fence around the protected area. The aim of this fence is to prevent people from invading the park, in addition to preventing animals from destroying agricultural land and villages.

In the past, it has been proven that successful protected area management is dependent on the collaboration with and approval of communities (Wells et al., 1993). It is therefore useful to look into which factors determine whether a community approves of a certain park management approach or not. When these factors are known, park management can target those segments that are less likely to agree with the measure. Persuading these households to support their approach, can lead to a more successful implementation. Previous studies have shown a link between forest dependency and attitude towards park management (Adam et al., 2014; Rahman et al., 2017). Deriving benefits from a reserve – in other words, being dependent on the reserve for survival – influences someone's opinion on forest management (Ansong et al., 2011). Applied to the case of Pendjari Biosphere Reserve, it is assumed that a household's park dependency has an impact on their approval of the placement of an enclosure. This would imply that park management needs to tackle dependency in order to have everyone's support for their measure.

Using logistic regression analysis, two different hypotheses are tested. The first assumes that household reliance on Pendjari National Park is dependent on various socio-economic variables, such as age, education and household size. The distance from someone's home to the park is assumed to be the most decisive factor. Secondly, this dependency is presumed to have an impact on villagers' attitudes towards park management. In other words, someone who is more dependent on the park for their income will respond differently to policies in favour of biodiversity conservation than someone who is less dependent. Other variables which are assumed to play a role

in opinion forming are perception towards biodiversity conservation, the appreciation of different park resources and other socio-economic characteristics, such as ethnicity.

A framework exists for differentiating between various types of forest dependency (Beckley, 1998). According to this framework, reliance differs for varying levels of analysis or 'communities of interest' and for varying typologies of human use. The former means that dependency for regions cannot be generalized to dependency for countries and that groups with shared occupations or cultural attitudes have different forms and degrees of dependency. The latter suggests that when speaking of dependency, one needs to distinguish between different forest uses, ranging from timber dependency to recreational dependency. When situating this research within the framework, it can be placed at a regional level – it comprises the area surrounding Pendjari National Park - and is limited to income dependency. Since most residents live of subsistence farming, income is considered both the household's cash and non-cash revenues. Studies have shown that forest products are usually three to four times more valuable for non-cash purposes than cash (IUCN, 2011).

This research is part of EVAMAB (Economic valuation of ecosystem services in Man and Biosphere reserves), a research project funded by Belspo and UNESCO. This 30-month project is concerned with the valuation of ecosystem services in four African countries (EVAMAB, n.d.). Its aim is to formulate advice for the biosphere reserve managers on policies and stakeholder engagement (UNESCO, 2017). This thesis contributes to the EVAMAB project by trying to improve the protected area-people relationship. It does this by creating an understanding as to why individuals do not agree with certain park policies.

2. Research area

The setting for this research is Pendjari National Park, a 4800 km^2 area in the north-western part of Benin, Africa. It is part of the W-Arly-Pendjari Complex, which is spread across three countries, namely Benin, Niger and Burkina Faso. It is the largest site for threatened animals and rare vegetation in West Africa (IUCN, 2017). The reserve has been under protection since 1954, when it was first declared a state forest. Later, in 1961, it officially became a national park. Before this declaration, Pendjari served as a dwelling place for a large population of people. Today, the approximately 40,000 people are living adjacent to the park, in twenty-three villages along the two axes of *Tanguièta-Porga* and *Tanguièta-Batia* (Figure 1) (Idrissou et al., 2013). The dominating ethnic groups in these villages are *Berba*, *Waama and Gourmantché*, but there are also some minor ethnic groups such as the nomadic *Peulh*. Inhabitants perform different economic activities and prefer different natural resources depending on their ethnicity (Heubach et al., 2011). The most common economic activity in the region is crop cultivation, followed by livestock farming. Other, less frequent, economic activities include transformation of raw materials into saleable products, petty trade, self-employment (e.g. mechanics, carpenters) or paid employment, often inside the park (e.g. tourist guides, maintenance workers). Most trading happens at the market in *Tanguièta*, the economic centre of the region.

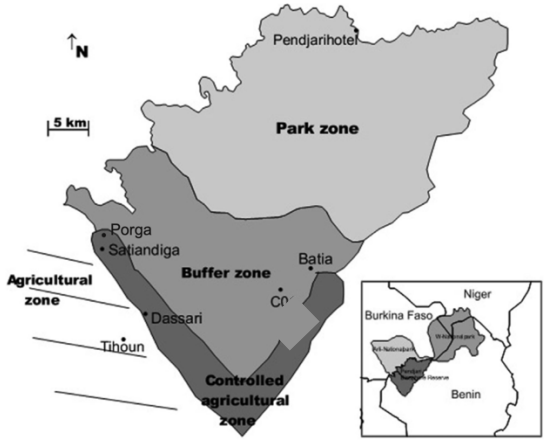

Figure 1: Map of Pendjari Biosphere Reserve

For some decennia, the park has been becoming increasingly threatened due to poaching, demographic pressure and damage to ecosystems. This elevated deterioration has created a need for effective park management. Since 1954, when Pendjari first became a protected area, it has gone through many types of protected area management. The park was originally managed with power and repression by the government until 1992. This lead to many conflicts between the forest administration and the local communities, due to lack of human consideration (Idrissou et al., 2013). Since 1993, park management has been trying to include the local population in the decision-making processes of the park. In response to this more cooperative approach, village associations (*Associations Villageoises de Gestion des Réserves de Faune*) were created to involve the villages in decision making and to share the benefits from the park, such as revenues from bushmeat, fines from illegal activities and hunting permits. In 1996 the *Centre National de Géstion des Réserves de Faune* (CENAGREF) was founded to replace the original government-assigned forest administration. This autonomous organisation was put in charge of the conservation of the protected area, in collaboration with the AVIGREFs (Vodouhê et al., 2010). Their surveillance teams were

made up of eco-guards, rangers hired from the AVIGREF villages, and *Chasseurs Professionels Locaux* (*CPL*), ex-poachers who were offered employment with CENAGREF in exchange for quitting their hunting activities.

In 2016 the Beninese government launched a new action plan*, Bénin Révélé*, of which Pendjari National Park was one of forty-five projects. The government's aim for Pendjari was to restore the wildlife and repair the local economies, in order to create a better existence for the surrounding villages of the park. Following this initiative, the government signed a long-term agreement with African Parks in 2017 (African Parks, 2018b), as a replacement for CENAGREF. African Parks is a non-profit organisation that, in collaboration with governments and local communities, takes responsibility for the recovery and management of national parks (African Parks, n.d.). Currently, they are active in nine different countries where they have taken over the management of fifteen parks. In addition to conservation efforts, African Parks is investing in improved touristic facilities and accommodations in order to raise the number of yearly park visitors. In January 2018 a partnership was established between African Parks, National Geographic and several other organisations. This collaboration is expected to contribute to making the objectives of the rehabilitation program more feasible. The partners are in charge of, among others, scientific research and developing technologies for protecting the area (National Geographic, 2018).

Pendjari National Park was designated a biosphere reserve by UNESCO in 1986, meaning that from then on, the reserve would promote solutions for biodiversity conservation through its sustainable use (UNESCO, 2015). Like all other biosphere reserves, Pendjari is divided into three different zones, each with different degrees of protection. The most strictly protected zone is the core area, on the map above marked called 'park zone' (Figure 1). In this – currently least damaged – area most activities are forbidden in order to conserve its biodiversity. This area is almost solely used for touristic purposes. Adjacent to the core area, closer to the villages, is the buffer zone. Within this zone there are varying degrees of protection. For example, in some areas hunting is allowed, in others it is forbidden. African Parks is currently placing a fence around the buffer zone to prevent villagers from entering. Entering this zone is rarely permitted, and only under guidance of park rangers and when requested in advance. The least protected area is the transition zone, otherwise known as the controlled access zone. In this zone, where many of the local communities live, agriculture and other economic activities are allowed (CENAGREF, 2009). On the map this is the darkest-coloured strip of land. By the local communities, this area is known as the *Zone d'Occupation Contrôlée* (*ZOC*). The soil in this area is more fertile then outside the park, therefore it is much desired by the locals for agriculture. The focus within this research lies on determining the factors that influence the households' dependence on the *ZOC* and, to a lesser extent, the buffer zone.

3. Methodology

3.1 Data collection

A sample size of 150 respondents was selected from twenty-two villages surrounding Pendjari National Park. Villages were selected based on their ethnicity – representative numbers of each ethnic group were desired – and an equal spread over the two axes. In addition, variation in distance from the park was aimed for. Due to lack of a sampling framework, respondents within the villages were chosen based on convenience sampling; people who were willing and had the available time to cooperate were interviewed. As a sign of respect, when entering a new village, the village chief was always the first person to be surveyed. At the same time, permission was asked to question other residents in the village. An equal distribution between male and female respondents was desired but not achieved.

Even though French is the native language in Benin, most residents do not speak French. Therefore, an interpreter was needed to translate the French questionnaire to the different locally spoken languages. The questions were read from an electronic tablet and the answers were recorded in the Qualtrics offline application. In most cases, interviews were carried out one-to-one in the vicinity of the respondent's home. Sometimes up to four respondents were interviewed simultaneously. When this was the case, they were encouraged to have discussions with one another to prevent them from giving the same opinions. When a respondent spoke French, they were taken aside to be interviewed without intermediation of the translator. This allowed for more thorough discussions.

3.2 Development of the instrument

The survey used to interview the local communities, was based on previous research in protected areas in developing countries. Only closed-ended questions were asked and recorded in Qualtrics. This allowed for easier statistical analysis. Additional information and more profound opinions were written down separately, to facilitate interpretation of the results. Before going on the field, the survey was pretested to make sure all questions were well understood, and multiple-choice questions included all the options possible. The survey was made up of four sections; socio-demographic measures, spatial variables, economic characteristics and study-specific variables (Appendix).

Socio-demographic measures include some of the respondent's personal characteristics, such as their age and gender, the number of members within their household, the ethnic group they belong to, and whether they are the household head or not. Factors like age and gender are assumed to have little impact on someone's park dependency. Previous studies have shown that socio-demographic factors often play a moderating, rather than a determining role (Allendorf et al., 2006). Household size and educational level could potentially play a bigger role. The more educated someone is, the higher the chance of finding employment opportunities away from the park. Having more household members means there are more mouths to feed, food for which the household might be dependent on the park.

Spatial variables are related to the location of the respondent's home. These include the village they live in and their distance from the controlled access zone and the buffer zone. Originally these distances were asked directly to the respondents. Due to inconsistencies in their answers, however, the researchers were compelled to calculate the distances themselves (Figure 2). Firstly, the respondents' coordinates were plotted in Google Earth. Then, a shapefile of the fence line, which was sent to the researchers by African Parks' project manager, was imported into the map. The distances were then measured using Google Earth's ruler tool. This was done for the controlled access zone as well as the buffer zone. Even though these distances are not perfectly accurate, these estimations are better than the answers given by the respondents.

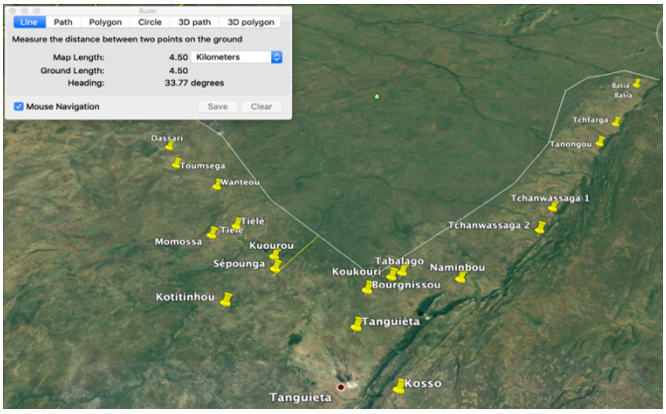

Figure 2: Distance calculation using Google Earth

Also, for the household's economic characteristics some calculation efforts were required. The majority of respondents are doing agriculture for subsistence purposes only. This means that it is difficult for them to assign a monetary value to their annual income, let alone their annual park-dependent income. For this reason, all components of their income were asked separately and in a way that made it easy for them to respond. For example, their revenues from crop farming were determined by multiplying the number of bags harvested each year per crop by the market prices for these crops. Their revenue from livestock farming was determined in a similar way. These market prices were retrieved from those respondents that are able to sell part of their produce. Since most farm products are sold on the markets in the larger towns, prices are relatively uniform within the region. Respondents who receive their income from paid employment were able to, quite accurately, indicate how much they earn from these activities. Also, the costs of their farm inputs were estimated by multiplying the unit prices of fertiliser, pesticides and machinery by the amounts needed per year.

Study-specific variables are those variables which are relevant to Pendjari only and are assumed to have an influence on park dependency. Respondents were asked about their involvement in park activities and associations, such as their membership of AVIGREF. Using a constant sum scale, their appreciation of the different park ecosystem services was surveyed. They were asked which of the park's resources they use and what their importance is. In practice, this was done by giving them ten stones to divide among the different resources they use. The provisions listed were feed for livestock, arable land, water, bushmeat, ceremony sites/fetishes and non-timber forest products. Lastly, their perceptions towards conservation and their attitudes towards the park management were surveyed using five-point Likert-scale questions. For each statement the respondent had to state to which extent they agreed with the statement. After testing for internal reliability between the statements, using Cronbach's alpha, they were combined into more comprehensive variables. The resulting scale is what is called a multiple-item Likert's summated rating scale (Wadkar et al., 2016).

3.3 Regression analysis

Logistic regression modelling was used to determine which characteristics influence someone's dependency on the park. Park dependency is described as the proportion of the income for which someone is dependent on the park, in their total income. Since logistic regression is a way of predicting the outcome of a binary variable, two levels of dependency were distinguished: 'high dependency' ($Y = 1$) and 'low dependency' ($Y = 0$). The cut-off between the two was chosen as the average park dependency for the sample, in this case 72.9%. This method was previously used for similar studies (Garekae et al., 2017; Jain et al., 2016). Therefore, someone who retrieves less than this cut-off value of their income from the park has a low park dependency. Anyone who has a dependency of 72.9% or higher will be classified as being highly dependent on the park.

A second regression model was constructed for evaluating the effect of certain characteristics on someone's level of agreement with park management. As mentioned earlier, in the section describing the study area, African Parks is currently placing a fence around the buffer zone. At the time of data collection, poles had already been parked to indicate the location of the upcoming fence. Changes like these naturally provoke resistance among the population. Respondents were asked to which extent they agreed with the statement "It is a good thing that a fence is being placed to protect the park from human deterioration". The two levels that were distinguished in this case are 'agreement with the placement of a fence' ($Y = 1$) – these are the respondents who agreed or strongly agreed with the statement – and 'indifferent about/disagreement with the placement of a fence' ($Y = 0$) – these are the respondents who answered 'strongly disagree', 'disagree' or 'neutral'.

In logistic regression, the natural logarithm of the odds is modelled as a linear function of the independent variables. The odds are the probability of an event, divided by its complement. In other words, the probability that someone is highly dependent on the park over the probability that someone has a low dependence on the park. Analogously for attitude; the probability that someone feels positively about the placement of a fence, over the probability that they feel negatively, or neutral. The logarithmic transformation of these odds gives the formula for a logistic regression model.

$$odds = \frac{P(Y = 1)}{1 - P(Y = 1)} = \frac{P(Y = 1)}{P(Y = 0)} = \frac{P(high\ park\ dependence)}{P(low\ park\ dependence)}$$

$$logit = log(odds) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$$

In this formula, x_i are the independent variables and β_i the corresponding parameters. In the case of logistic regression, β_i can be interpreted as the relative change in the $log(odds)$ when x_i increases with one unit.

To check for robustness of the models, model variety checks were carried out. Changes to the models were made to find out whether regressors remained significant. A first alternative model was created by using multinomial logistic regression instead of binary logistic regression. For this alternative, the dependent variables were split into three groups instead of two. For park dependency, the chosen categories were independent (0%), partly dependent and fully dependent (100%). For the multinomial model, attitude was categorised into negative, neutral and positive, whereas previously negative and neutral were put together into one group. Another simple change was made by adapting the dependency cut-off value from 72.9% to 50%. A last way of confirming the logistic regression results was by performing a probit regression. Probit regression is a way of modelling dichotomous outcome variables by using the inverse standard normal distribution of the probability. All three variations showed similar results to the original models, implying sufficient robustness of the variables (Appendix).

4. Descriptive statistics

Data was collected from a sample of 150 respondents, of which the most important characteristics are displayed in Table 1. Looking at park dependency, it is important to notice that the majority of the sample is fully dependent on the park for their survival (65%). Only a small minority is able to succeed without the use of park provisions (19%). The location of their home probably plays a large role in this; 61% of participants lives within the boundaries of the park. A combination of crop and livestock farming is the most common economic activity in the area (68%). Out of 102 respondents 86 indicated that crop farming is their most valued form of agriculture.

Table 1: Variable statistics

Variable		*n*	*%*	*Variable*	*n*	*%*
Gender				**Location**		
	Female	17	11.3	Axis Tanguièta - Batia	70	46.7
	Male	133	88.7	Axis Tanguièta – Porga	65	43.3
				Tanguièta	15	10.0
Age groups						
	≤ 30	38	25.3	Respondents living within	92	61.3
	31 – 45	44	29.3	park boundaries (*ZOC*)		
	46 – 60	49	32.7			
	> 60	19	12.7	**Main activity**		
				Mixed farming	102	68.0
Level of education				Specialised farming	41	27.3
	Illiterate	85	56.7	(crop/livestock)		
	Primary education	41	27.3	Paid or self-employment	3	2.00
	Secondary education	21	14.0	Transformation of raw	3	2.00
	University	3	2.0	materials		
				Fishery	1	0.7
Household size						
	1 – 5	24	15.6	**Annual park-dependent income**		
	6 – 10	64	41.6	0 CFA	28	18.9
	11 – 15	40	26.0	1 – 200,000 CFA	21	14.2
	>15	22	14.2	200,001 – 750,000 CFA	40	27.0
				750,001 – 1,500,000 CFA	29	19.6
Ethnicity				> 1,500,000 CFA	30	20.3
	Berba	97	64.7			
	Gourmantche	17	11.3	**Annual park-independent income**		
	Waama	33	22.0	0 CFA	96	64.9
	Peulh	3	2.0	1 – 200,000 CFA	15	10.1
				200,001 – 750,000 CFA	21	14.2
Involvement with the park				750,001 –1,500,000 CFA	12	8.1
	Connected to AVIGREF/AP	81	55.2	> 1,500,000 CFA	4	2.7
	No connection with AVIGREF/AP	69	44.8			

1000 CFA = €1.52

Table 2 lists all the variables used in the analysis, each with a description of the different possible values. For each variable the mean and standard deviation for the sample are given.

Table 2: Model regressors

Variables	Description	Mean (SD)
Dependency *(continuous)*	Park-dependent income divided by total income, value between 0 and 1	0.73 (0.42)
Dependency *(binary)*	1 if respondent is highly dependent on the park (dependency ≥ 0.73), 0 if respondent has a low dependence on the park (dependency < 0.73)	0.70 (0.46)
Agreement with fence	1 if respondent agrees with the placement of a fence for protection of the buffer zone, 0 if respondent does not agree with or is indifferent towards the placement of a fence	0.64 (0.48)
Age	Discrete variable in years	43.41 (15.41)
Education	0 if respondent has not attended school, 1 if respondent has attended primary school, 2 if respondent has attended secondary school or university	N/A
Ethnicity	0 if respondent is Berba, 1 if respondent is Gourmantché, 2 if respondent is Peulh, 3 if respondent is Waama	N/A
Economic activity	1 if the respondent's main activity is mixed farming, 2 if specialised farming (crop or livestock), 3 if self-employment or paid employment, 0 if other activity	N/A
Distance to buffer zone	Distance from the respondent's home until the boundary of the buffer zone	4.36 (2.00)
Perception on conservation	1 if respondent has a positive perception on conservation, 0 if respondent has a negative perception on conservation	0.93 (0.26)
Attitude towards park management	1 if respondent feels positively towards African Parks, 0 if respondent feels negatively towards African Parks	0.37 (0.48)
Importance of arable land	1 if arable land is the respondent's most important park resource, 0 if arable land is not the respondent's most important park resource	0.66 (0.48)
Agricultural land	The surface area of agricultural land owned by the respondent (ha)	5.08 (4.00)
Livestock population	The number of livestock the respondent owns	23.75 (31.24)

5. Regression results

5.1 Park dependency

A first logistic regression looks at the parameters which influence whether someone is likely to be dependent on the park for their income or not. A baseline model was started with (Table 3), using the respondents' most basic socio-economic characteristics; age, household size, education, economic activity and distance from the buffer zone.

Table 3: Park dependency - Model 1

Variables	*Estimate*	*Odds ratio*	*SD*
Age	-0.0189	0.9813	0.0158
Household size	0.0352	1.0358	0.0465
Education			
Primary education	-0.9739*	0.3776	0.5792
Secondary/university education	-1.8255***	0.1611	0.6808
Economic activity			
Mixed farming	1.5868	4.8879	1.3331
Specialised farming	1.1639	3.2025	1.3715
Self-employment/paid employment	1.9527	7.0479	1.8809
Distance from buffer zone	-0.8296***	0.4362	0.1532
(Intercept)	4.4689***	87.2642	1.6729

*Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

The only significant variables in this first model were 'education' and 'distance from buffer zone'. The coefficient estimates of these variables can be interpreted as follows: firstly, the higher the educational level someone has achieved, the less likely they are of being dependent on the park for their income. Someone who has attended secondary school or university, has a higher chance of being involved in park-independent employment. Secondly, the further away someone lives from the park, the higher the probability of having a low park dependence. For inhabitants of the *Zone d'Occupation Contrôlée*, for example, it is rare to obtain revenues from outside of the park's boundaries. To check for robustness of these two regressors, the insignificant variables are removed one by one (Model 2). Education and distance remain significant. However, there is no longer a significant difference between 'primary education' and the reference group, 'illiterate or no formal education' (Table 4).

A third and last model is generated by adding two new regressors, agricultural land and livestock population. Some of the research that has been done into forest dependency shows an inversely proportional relationship with agricultural land ownership (Jain et al., 2016). These studies suggest that people who engage in agricultural activities are less reliant on the forest's resources. Looking at the third model, however, this relationship does not hold for Pendjari. Most agriculture in the region, both crop cultivation and livestock farming, is done within the boundaries of the park. This means that the majority of agricultural income is dependent on the park. The area of agricultural land is therefore not a good variable in explaining forest dependency. Livestock population, too, has previously been identified as being significant in explaining park dependency. For Pendjari this does not appear to be the case.

Table 4: Park dependency - Models 2 and 3

	Model 2			Model 3		
Variables	*Estimate*	*Odds ratio*	*SD*	*Estimate*	*Odds ratio*	*SD*
Education						
Primary education	-0.8331	0.4347	0.5463	-0.6331	0.5310	0.6770
Secondary/university education	-1.1768***	0.1707	0.5758	-1.3502*	0.2592	0.6993
Agricultural land (ha)				0.0457	1.0468	0.0853
Livestock population				-0.0048	0.9952	0.0098
Distance from buffer zone	-0.8132***	0.4434	0.1513	-0.9665***	0.3804	0.1879
(Intercept)	5.2945***	199.2478	0.8404	6.1463***	466.9763	1.1700

*Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

In this third model, the significance of the variable education is reduced further (p = 0.054 for secondary/university education). However, it assumed that this is the result of a reduced number of observations, as opposed to the other two models. Livestock population was not recorded for the first 32 respondents, resulting in 32 missing values for this variable. The signs and magnitudes of the parameter estimates for education and distance remain relatively constant. They are perceived to be the only two robust regressors for determining park dependency. The following regression equation is formed: $log(odds) = 5.2945 - 1.1768x_1 - 0.8132x_2$, with x_1 a dummy variable that states whether the respondent has received secondary or university education (1) or not (0), and x_2 the distance from the respondent's home to the park. Looking at the odds ratio, someone who has attended secondary school or university has 0.17 times the odds of having high park dependency, as opposed to less educated people. For each unit (km) increase in distance from the buffer zone, the odds of high dependency decrease by a factor of 0.44. The following conditional-effects plot (Figure 3) shows these relationships more clearly.

The graph shows the estimated probability of high park dependency based on educational level and distance from the park. The upper line refers to a low educational level – illiterate, no formal education or primary education – and the lower line refers to a high educational level – secondary or university education. It is clear that, at the same distance from the park, higher educated people have a lower probability of being highly dependent on the park than lower educated people. According to this regression model, the difference between the educational levels is highest at a distance of 6km from the buffer zone. A highly educated person then has a probability of 32% of being highly dependent from the park, whereas a lowly educated person has a 60% probability.

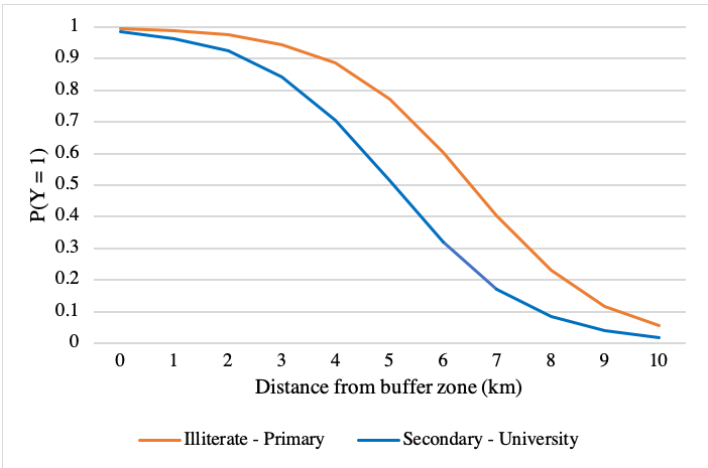

Figure 3: Predicted probability of high park dependency

5.2 Attitude towards new park measure

Ten Likert-scale questions were asked to decipher the respondents' opinions on biodiversity conservation, on the one hand, and park management, on the other hand (Appendix). The responses to these ten statements were grouped to quantify the two underlying constructs. This was done using reliability analysis; removing statements one by one until the internal reliability (Cronbach's α) can no longer be improved. Based on this analysis, statements 5, 6, 7 and 9 were summated to form the variable 'Perception on conservation' (Cronbach's $\alpha = 0.8473$), for which possible values range from 4 to 20. A binary variable was created, with 12.5 being the cut-off between a 'positive' and 'negative' perception on conservation. A similar method was used for the creation of the variable 'Attitude towards African Parks', for which statements 1, 2 and 3 were summated (Cronbach's $\alpha = 0.778$). The values 3 to 9 were classified as 'negative attitude towards African Parks', whereas the values 10 through 15 were classified as 'positive attitude towards African Parks'. Statement 8 – "It is a good thing that a fence is being placed to protect the park from human deterioration" – showed too little correlation with the other statements to be included in either of the constructs. It was decided to model the outcome of this statement separately, to find out which factors influence whether someone agrees with the placement of a fence around the buffer zone or not.

Table 5: Attitude towards new park measure - Model 1

Variables	*Estimate*	*Odds ratio*	*SD*
Dependency	-1.2376**	0.2901	0.5839
Perception on conservation	2.6470**	14.1122	1.2565
Attitude towards African Parks	2.3883***	10.8955	0.6115
Ethnicity			
Gourmantché	1.8916**	6.6299	0.7783
Peulh	-1.1121	0.8939	1.3197
Waama	-0.2392	0.7871	0.7281
Importance of arable land	-1.0412*	0.3530	0.5352
(Intercept)	-1.3318	0.2640	1.2204

*Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

A first regression model (Table 5) shows five significant independent variables: park dependency, perception on conservation, attitude towards African Parks, ethnicity and importance of arable land or, in other words, whether arable land is the respondent's most important park resource. Logical interpretations for each of the variables can be given.

The negative sign for park dependency implies that people who are highly dependent on the park are less likely to be in favour of the fence. The fence prohibits them from entering the park, meaning they can no longer retrieve their resources from within the park's boundaries. This confirms the hypotheses which was formulated at the start of this research. A positive perception on biodiversity conservation can be associated with a positive attitude towards the placement of a fence. These respondents recognise that a fence is needed for the protection of the park's flora and fauna. Also ethnicity appears to be a relevant variable. The ethnic group *Gourmantché* is, in general, more positive about the new measure. It can be noticed that, most of *Gourmantché* respondents that were interviewed, live in *Batia* (9 out of 17) and *Tanongou* (5 out of 17). These are the two villages where most African Parks employees are recruited. The placement of a fence, therefore, offers many of them employment

opportunities. Lastly, respondents for whom arable land is the park's most important resource are less likely to be in favour of a fence. These are the respondents that gave arable land an importance of 50% or more, as opposed to other park resources. For many respondents, the placement of a fence means giving up some of their land. For others, there is uncertainty as to whether they will have to give up land in the future. This explains their aversion towards a fence.

Attitude towards African Parks is the most determining factor ($p < 0.001$). However, it is unclear in which direction this relationship applies. Someone could be discontent with African Parks because they disagree with the new measure, or they could disagree with the new measure because they feel negatively towards African Parks. Therefore, a second model (Table 6), excluding this variable, was generated to check for robustness. For this second model, it is remarkable that dependency is no longer significant in explaining someone's level of agreement. This means that there may not be a true causal effect between park dependency and satisfaction with the fence. Ethnicity too, has become less significant in explaining the dependent variable ($p = 0.095$ for *Gourmantché*). A third, and last regression model, excludes the regressors park dependency and ethnicity. Both perception on conservation and importance of arable land remain significant in all three models. In addition, the sign and magnitude of their beta coefficients show little change. They can therefore be seen as the most robust variables in explaining whether someone is likely to agree with the placement of a fence or not. Even when importance of arable land is changed into a continuous variable – a percentage – and perception is changed into a variable with three categories – negative, neutral and positive – both variables remain significant. The resulting regression equation is the following: $log(odds) = -1.3319 + 2.64578x_1 - 0.9414x_2$, with both x_1 and x_2 dummy variables. x_1 is equal to 1 when the respondent feels positively about biodiversity conservation, and 0 if they feel negatively. x_2 is 1 if the respondent's most important park resource is arable land, and 0 if it is not their most valued resource.

Table 6: Attitude towards new park measure - Models 2 and 3

	Model 2			Model 3		
Variables	*Estimate*	*Odds ratio*	*SD*	*Estimate*	*Odds ratio*	*SD*
Dependency	-0.7368	0.4786	0.2451			
Perception on conservation	2.8626**	17.5066	21.0418	2.6457**	14.0929	15.8552
Ethnicity						
Gourmantché	1.2064*	3.3413	2.4135			
Peulh	-1.0354	0.3551	0.4600			
Waama	0.5729	1.7734	1.1059			
Importance of arable land	-1.0241**	0.3591	0.1728	-0.9414**	0.3901	0.1805
(Intercept)	-1.1353	0.3213	0.3771	-1.3319	0.2640	0.2932

*Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

6. Discussion

The regression results indicate that education and distance from the park are the most important factors in explaining park dependency. Park dependency, in turn, has little effect on tolerance of park management measures. The latter is mostly determined by someone's perception on biodiversity conservation and the importance they attribute to arable land as a park resource. More elaborate discussions were held with the respondents to detect the underlying reasons for the observed relations.

Besides distance from the park, which is a very logical variable in explaining park dependency, also level of education has a significant impact. When having attended secondary school or university, one is more likely to find employment away from the park. Some respondents mentioned that, without schooling, the only economic activity they are able to do is agriculture. Since most of this agriculture is taking place within the park's boundaries, these unschooled villagers are highly dependent on the park. Opinions on whether the available agricultural land will suffice in the future are divided. On the one hand, population is increasing rapidly and there is not enough land to provide all future generations with enough food. On the other hand, one respondent said, there is an increasing proportion of children going to school. These children are expected to leave the area to find employment. In that case, the current land surface will be sufficient. Following this reasoning, a possible solution for reducing park dependency could be by encouraging households to send their children to school. Many households do not have the means to this. However, it is the few children that go to school that are privileged by African Parks. They have the opportunity to visit the national park during educational visits, their schools receive funding for improved facilities, and only schooled children are recruited to work for the park. Therefore, priority should go to the schooling of children. However, this may be the government's task, rather than that of African Parks.

Almost all respondents felt positively about conservation of biodiversity (Figure 4). The majority of their scores lie between 16 and 20 on the summated rating scale. The most frequently mentioned reason was that animals should be protected for future generations. Future generations should be able to see and learn from the animals in the bush. The importance of conserving vegetation was less emphasized. A few respondents mentioned that Pendjari and its animals are state property and should therefore not be destroyed for individual utility. The placement of a fence is seen as the most effective solution for protecting the park from human deterioration, as well as protecting the humans from animals. A physical fence reminds the villagers that the area is protected and trespassing the fence is considered theft. This explains the positive relationship between perception on conservation and agreement with the fence. This means that raising awareness about the importance of biodiversity conservation could lead to more support for African Parks' approach. Whether the responses to the statements reflect the respondent's true opinions is doubtful. Entering the park is heavily penalised, so despite thorough emphasis on their anonymity, respondents had little incentive to answer honestly. Asking some probing questions on their liking and consumption of bushmeat sometimes revealed their true opinion.

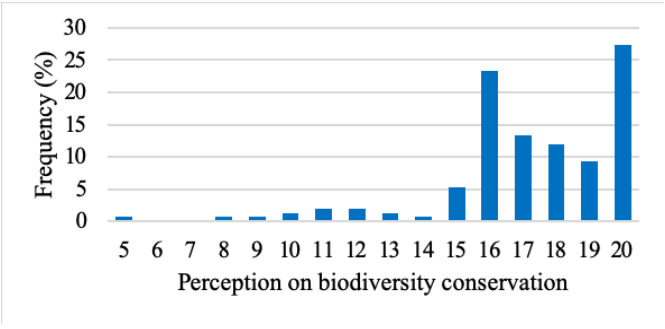

Figure 4: Perception on biodiversity conservation

Notwithstanding the fact that African Parks is considered excellent at conservation – the number of animals in the park has increased and the animals have become less aggressive – some disputes exist between the park management and the local communities. Many villagers cannot accept that an outside organisation has come to take over the management of the park, with the population no longer having a say over their own lives. They feel that African Parks' strict enforcement of the rules imposes a restriction on their freedom. Having a negative attitude towards the organisation automatically results in a rejection of the new park measure, the fence. The question is, however, whether this negative attitude was formed before or after the announcement of the new measure. Perhaps the negative feelings have evolved since the plans for the fence were made public. Since the direction of causality is not clear, no conclusions could be made.

The most commonly mentioned problem with African Parks is land allocation. African Parks has maintained the same park boundaries as CENAGREF, but previously these boundaries were not well communicated to the population. This resulted in villagers taking ownership of parts of the buffer zone and using them for crop farming. These areas are now being separated from their 'owners' by a fence, leaving many people with a loss of income. People for whom arable land is the most important park resource, therefore feel more negatively towards the placement of a fence. Either because part of their land has already been taken away from them, or they feel uncertain about whether part of their land will be taken away in the future. Especially in *Porga*, people are dissatisfied with African Parks' approach, since they have a very small surface of land between the country border and the park limit. Recently the park entry gate in *Porga* was closed due to threat of terrorism from Burkina Faso. This has resulted in income loss from tourism, in addition to the loss from agriculture. *Porga* advocates equal distances to the fence for all villages. Currently, negotiations are taking place in *Tanguièta* to address this issue. In some cases, holders of agricultural land are pleased with the existence of a fence. Previously, destruction of crop fields by elephants was commonplace. With a fence in place, their land is protected from this kind of devastation.

Even though ethnicity can hardly be considered a decisive factor, deviating points of view can be encountered for two of the ethnic groups. The *Peulh* ethnic group feels most negatively towards the new park measure. This group is known for its nomadic existence. They move around every three to four years and their main source of income is their cattle. They have suffered a lot from the new park measure, since the controlled access zone offers too little feed and water for their cattle. Previously they were allowed to guide their cattle to the river in the buffer zone, where water and feed were abundant. With their cattle visibly losing weight and dying due to malnourishment, the *Peulhs* are the most disadvantaged by the fence. For the studied sample, the ethnic group which was most in favour of the fence was *Gourmantché*. However, this trend is probably due to their location rather than their ethnicity. Most interviewed *Gourmantchés* lived in *Batia* and *Tanongou*, the villages where most park employees are recruited. Unlike in other villages, the placement of a fence offers them more employment opportunities. Unfair recruitment was regularly mentioned among respondents as a disadvantage of African Parks.

In the hypothesis, dependency was considered a decisive factor in explaining acceptance of a fence. Higher park dependency was assumed to result in a more negative attitude, since the presence of a fence limits the respondents' park access. A negative correlation can, indeed, be found between the two variables ($r(148) = -0.19$, $p = 0.026$). However, in the regression, dependency appeared insignificant. A reason for this could be that there were also many cases where the opposite relationship was true. For example, people working for African Parks in the buffer

zone – people who are pleased with the placement of a fence – have very high park dependency. Their income of 4000 CFA per day, is fully earned within the park's boundaries. This mistake could have been avoided by making a distinction between income coming from the controlled access zone and income from the buffer zone. Income from the *ZOC* should then have shown an inversely proportional relationship with fence acceptance. Another solution would have been by differentiating between income which puts pressure on the park, and income which the park benefits from. Instead of modelling dependency as the proportion of park-dependent income, the proportion of park-destructing income in their total income would be modelled.

There is a predominant feeling among respondents that flora and fauna are being conserved and protected, at the expense of humans. Low involvement with the local communities, results in resistance against African Parks' decisions. Often during interviews, respondents said that they would agree with African Parks' approach, on the condition that their opinions and suggestions were heard, and villagers were compensated for their losses. During these interviews, many of their opinions and suggestions were recorded by the researchers, resulting in a series of recommendations. Taking these recommendations into account, could provide African Parks with more support and, consequently, a more successful implementation of their conservation plans.

There is an almost unanimous agreement with the ban on hunting in the park. The ability of seeing animals on a regular basis is what makes living near the park so valuable to most respondents. However, by banning park entry also many other valuable resources are taken away from the population. Straw, for example, is needed for making houses and can readily be found inside the buffer zone. Firewood and fruits, also, are plentily available within the protected area. The Pendjari river, as a source of fish and drinking water for livestock, is no longer accessible to the public. The fence has therefore created a huge loss for many households. This loss could either be reduced or compensated. Reduction could mean that park access is limited instead of restricted. This can be a limitation in time – for example, only allowing access during certain periods of the year – or in area – for example, creating zones for collecting medicinal plants, for non-timber forest products, etc. These zones can be moved around frequently, to allow the vegetation to recover. The ceremony sites should be accessible all year round. Honouring fetishes should always be possible, since this does no harm to the park's biodiversity and is emotionally valuable to the people. Anyhow, a system needs to be put in place that registers who enters the park and which raw materials are collected. In this way, equal treatment of households can be guaranteed.

Currently, a cumbersome procedure exists for requesting a park entry permit. According to the respondents the procedure takes too long, the request needs to be filed at *Tanguièta* –, often far away from their homes –, and the park entrant is accompanied by two rangers. The accompaniment of rangers shows a lack of confidence between the two parties. Assigning one inhabitant per village to handle requests is proposed by many as a good solution. This responsible person could then accompany the entrant through the village's own entry gate – also a recurring suggestion – into the park. However, this solution needs to be preceded by serious trust building. Many respondents are not even aware these park entry permits exist. This is a sign for African Parks to be more transparent about their rules and visiting the villages more frequently to update them on new information.

Compensation for the loss of park access means offering the residents something in return, in order to keep their quality of life equal. Many suggestions were made with regard to alternative activities. African Parks could invest in facilities for beekeeping, fishing and livestock keeping. Many respondents are afraid of having livestock as their main activity, because the risk of disease is too high. However, in contrast to crop farming, livestock is available

all year round and would be preferred over crop farming by many if disease was not an issue. Providing vaccinations, feeding and drinking troughs for animals could solve this issue. Beehives and tanks for keeping fish could also start a transition away from crop agriculture. One respondent mentioned that the available agricultural land would suffice if it was used more thoughtfully. In response to this, African Parks could offer trainings on efficient land use and fertilisers. In this case, the same amounts of produce could be retrieved from smaller land surfaces.

A last suggestion involves the equal treatment of villages. Some villages are informed more regularly than others. *Kuourou* and *Toumsega*, for example, claim to have never been visited by African Parks. They were not aware of African Parks' plans to put up a fence. Other villages are invited to meetings in *Tanguièta* and receive explanations on conservation projects. Especially the villages which are further away from the park receive little attention. Residents from *Kotitinhou*, a village at about 4 km from the *ZOC*, made explicit that they would like to be part of AVIGREF, in order to receive updates on what is going on within the park, since also they feel the impact of park measures. As has been brought up earlier, also equality in recruitment is necessary to get the whole population on board. Park employees should be recruited based on skills, rather than location. In this way, all villages benefit from employment opportunities. Lastly, land allocation should happen in a fair way. *Tchanwassaga* received more land after placement of the fence, whereas most villages lost surface area to the fence. This results in conflicts between villages and resistance against African Parks.

These are just a few of the suggestions which were made by the interviewees. Overall, it can be concluded that the population asks for more involvement in decision making, and that their opinions are listened to and taken into account. Imposing new measures on the population, without their participation, bears resemblance to the management by power from the past, even though this approach has been proven to be unsuccessful.

7. Conclusion

This research studied the influence of various factors on park dependency and, in turn, the influence of park dependency on the tendency to agree with park management measures. Dependency is seen as the proportion of the total income for which someone is dependent on the park, including the controlled access zone. Income is estimated by summating the cash and non-cash incomes from all of the respondents' income sources. Dependency, a value between 0 and 1, was categorised into a binary variable: low park dependency and high park dependency. Using logistic regression, the impact of many different variables on dependency was analysed. Distance from someone's home to the buffer zone and educational level appeared to be the most significant variables. The further away someone lives from the park, the lower the probability of high dependency. A similar reasoning applies to education: the higher the educational level, the less likely they are of being highly dependent on the park.

Later, the effect of park dependency on someone's attitude towards a park protection approach was analysed. The measure, in this case, was the placement of a fence around the protected area. Respondents were asked to which extent they agreed with this new measure, on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Anyone answering 'agree' (4) or 'strongly agree' (5) was classified as having a positive attitude. Again, binary logistic regression was used to analyse the impact of various factors on attitude. Park dependency was found to be insignificant in explaining level of agreement, whereas perception on biodiversity conservation and importance of arable land as a park resource did matter. The more someone is in favour of biodiversity conservation the more likely they are to agree with the placement of a fence. The more importance someone attaches to arable land as a park resource, in comparison to other resources, the less likely they are to agree with the protection measure.

In response to these results, there are two things that park management can do in order to raise support for their approach and, consequently, achieve a more successful implementation of their plans. A first action they could undertake is raising awareness about the importance of biodiversity conservation, with a focus on vegetation. Understanding why biodiversity is needed and what the consequences are of their destructive activities will also increase their understanding of why a fence is needed. Secondly, park management should encourage a transition away from crop farming as a main activity, towards other economic activities. Subsidising other – less land intensive – activities reduces the pressure on biodiversity and reduces the population's dependency on agricultural land. Park management's measures will, as a result, encounter less resistance.

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9. Appendix

9.1 Survey

I.	***Personal characteristics***
1.	Are you the household head? Yes / No
2.	Which gender are you? Male / Female
3.	What is your age?
4.	What is your highest level of education? Illiterate / No formal education / Primary school / Secondary school / University
5.	Which ethnic group do you belong to? Berba / Gourmantché / Waama / Peulh / Other
6.	What is your household size?

II.	***Spatial variables***
7.	In which village do you live?
8.	Do you live inside the Zone d'Occupation Contrôlée?
9.	What is the distance from your home to the controlled access zone (in kilometres)?
10	What is the distance from your home to the buffer zone (in kilometres)?

III.	***Economic characteristics***
11.	What is your **main** occupation/profession? What is your secondary activity? • Fisheries sector • Crop farming • Livestock keeping • Petty trade • Transformation of raw materials • Self-employment in the non-farm sector (e.g. barbers, tailors, etc) • Wage employment (e.g. government officials or employment by an NGO/private company)
12.	What is your average annual income (in West African CFA)?
13.	For how much of this income (in West African CFA) are you dependent on Pendjari?
14.	What are your sources of income? • Income from crop farming/planted fruit trees • Income from livestock keeping • Income from hunting • Income from fishing • Income from self-employment and/or wage employment • NTFP income (e.g. firewood, construction wood, locally brewed drinks, mustard, etc.) • Others
15.	If they answered 'crop farming' to Q14: How much of the following crops (in kilograms) do you sell per year? Fill in the table below.

	Planted surface (ha)		Yield	Portion consumed	Portion sold
	Inside ZOC	Outside ZOC	(kg/ha)		
Corn					
Cotton					
Rice					
Sorghum					
Yam					
Peanuts					
Soy					
Other					

16.	If they answered 'livestock keeping' to Q14: How many of the following animals do you own, and do you sell per year? Fill in the table below.

	Nr. animals you currently own	Nr. animals you sell per year
Sheep		
Goats		
Dogs		
Rabbits		
Pigs		
Cows		
Ducks		
Guineafowl		
Chickens		

17. Where do these animals graze and drink? In the *ZOC* / Outside the park
18. If they answered 'fishing' to Q14:
    How many kilograms of fish do you sell per year?
19. If they answer 'self-employment and/or wage employment' to Q14:
    How much do you earn per year from self-employment and/or wage employment?
20. If they answer income from NTFP to Q14:
    Which types of the following NTFP do you sell per year? And how much do you earn from this per year (in West-African CFA)?
    - Firewood: …
    - Wild foods: …
    - Medicinal plants: …
    - Forage: …
    - Shea butter: …
    - Sesame oil: …
    - Neem oil: …
    - Local drinks: …
    - Others: …
21. How much do you spend on farm inputs every year (e.g. fertilizers, labour, etc.)?

IV.	***Study-specific information***						
Perception towards park management		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion
22.	There is good cooperation with African Parks for protected area management						
23.	African Parks discusses/gets opinions from local communities						
24.	African Parks shares their latest information with the local people						
25.	African Parks, the current park management, is better than CENAGREF, the former park managers.						
Perception on conservation		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No opinion
26.	Wildlife should be conserved for future generations						

27.	Hunting should not be allowed inside the park						
28.	People who poach should be punished						
29.	It is a good thing that a fence is being placed to protect the park from human deterioration						
30.	It is important to protect plants and trees in the park						
31.	The existence of the park is good for the surrounding inhabitants						

32.	Is someone close to you member of AVIGREF/African Parks? Yes / No (Who?)
33.	AVIGREF or African Parks? AVIGREF / African Parks
34.	Are you involved in park activities (e.g. tourism, conservation, maintenance, etc.)? Yes / No
35.	Which resources from the controlled access zone do you use? And what is their importance? Divide 100 points between the resources according to their importance. • Livestock grazing • Arable land • Water • Timber/firewood/charcoal • Hunting • Ceremony site • NTFPs • Others

9.2 Robustness checks

Park dependency

Table 7: Robustness checks - Park dependency

Variables	*Original logistic regression*	*Different cut-off value*[1]	*Multinomial LG*[2]		*Probit regression*
			Y = 0	*Y = 1*	
Primary education	-0.8331	-0.2945	0.5698	0.70949***	-.4873
Secondary/university education	-1.7678***	-1.2580*	2.0551***	2.0922***	-1.0088***
Distance from buffer zone	-0.8132***	-.8772***	1.0935***	0.5391***	-.46483***
(Intercept)	5.2945***	6.3842***	-7.2625***	-4.2702***	3.0293***

[1] *Cut-off value 50% park dependency, instead of 72.9%*

[2] *Three categories: no park dependency (Y = 0), partially dependent (Y = 1), full dependency (Y = 2), base outcome = 2*

Attitude towards new park measure

Table 8: Robustness checks - Attitude towards new park measure

Variables	*Original logistic regression*	*Multinomial LG*[1]		*Probit regression*
		Y = 0	*Y = 1*	
Perception on conservation	2.6457**	-2.6300**	-2.6600**	1.6199**
Importance of arable land	-0.9414**	1.3030**	0.5960	-0.5695**
(Intercept)	-1.3319	0.4036	0.8323	-0.8190

[1] *Three categories: disagreement with measure (Y = 0), neutral (Y = 1), agreement (Y = 2), base outcome Y = 2*

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