



Darwin Initiative: Final Report

To be completed with reference to the “Writing a Darwin Report” guidance: (<http://www.darwininitiative.org.uk/resources-for-projects/reporting-forms>). It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

Darwin Project Information

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| Project reference | 24-029 |
| Project title | Enabling Baka attain food security, improved health and sustain biodiversity |
| Country(ies) | Cameroon |
| Lead organisation | Manchester Metropolitan University |
| Partner institution(s) | Zerca y Lejos, CIFOR |
| Darwin grant value | £301,768.00 |
| Start/end dates of project | 2017-09-01 - 2020-08-31 |
| Project leader’s name | Prof. Julia E. Fa |
| Project website/blog/social media | N/A |
| Report author(s) and date | Julia E. Fa, 29 Mar. 2021 |

1 Project Summary

Wildlife in tropical rainforests of southeast Cameroon is increasingly under pressure from overexploitation driven by a burgeoning human population, as well as by uncontrolled outside commercial interests. In this region, rural poor as well as indigenous peoples such as the Baka Pygmies, live precarious lives. The latter group are at an even greater social and political disadvantage since many have been displaced from the forest to settlements along the main roads. The health as well as livelihoods of these people is at risk. These communities are under huge political, economic, ecological and social pressures as they confront modern state laws and international development actors and agencies which could conflict with their ways of life. Inter-ethnic conflicts are also common. Issues resulting from the recent rise in the numbers of protected areas in the country have increased evictions, displacement and widespread multiple human rights violations. This impacts the Baka’s livelihoods, since these revolve mainly around hunting and gathering in their native forests. Despite that some Central African countries have recognized the rights of indigenous peoples in national law, Pygmies are still marginalised. With the development of new economic activities, Pygmy groups have witnessed the gradual reduction of access to forest resources, especially to game and edible wild plants. The expansion of protected areas has also contributed to the gradual reduction of access to forest resources. The relationship between the use of forest products, subsistence agriculture and human health remains largely unstudied in these communities. Often, assessments of the links between biodiversity and wellbeing centre upon single issues, e.g., how wild meat hunting affects people’s nutrition or income, without considering other intervening factors. A better understanding of the multiplicity of issues that affect people and wildlife will help generate interventions that result in long-term benefits for both.

In ten Baka villages (Fig. 1), along the Djoum-Mintom road in southeast Cameroon, we focused on understanding the use of domestic crops and wild foods to determine their relative importance

in satisfying the target populations' nutritional needs. In parallel, we assessed the health status of a large sample of villagers to determine levels of malnutrition and disease, and where possible to establish links with foods consumed. On the basis of the evidence collected in our project, we encouraged families to produce more and better locally grown food crops, so that these can bridge nutrient gaps unmet by natural resources. Underpinning our work is the observation that reliance on wild meat is inversely related to other incomes, suggesting a gap filling function¹. Thus, by enabling better domestic food production alongside encouraging the sustainable extraction of wild resources (wild meat and food plants) we aimed to improve the food security of the study populations at the same time as protecting biodiversity. Our project has moved closer towards achieving this by: 1) harmonising local production and consumption of domestic and wild foods across seasons; 2) generating domestic produce surpluses which can generate income to replace an over-reliance on wild meat trade, and this information will feed into 3) enabling hunting systems that encourage sustainable wildlife extraction as well as 4) understanding the status of, and pressures on, threatened species. Our findings and data can serve as a model that can be rolled out to other Baka villages in the region, improve agri-food systems, and as a result reduce the impact on wildlife. These communities can become empowered to steward their lands and the biodiversity within them, thus enabling their long-term protection.

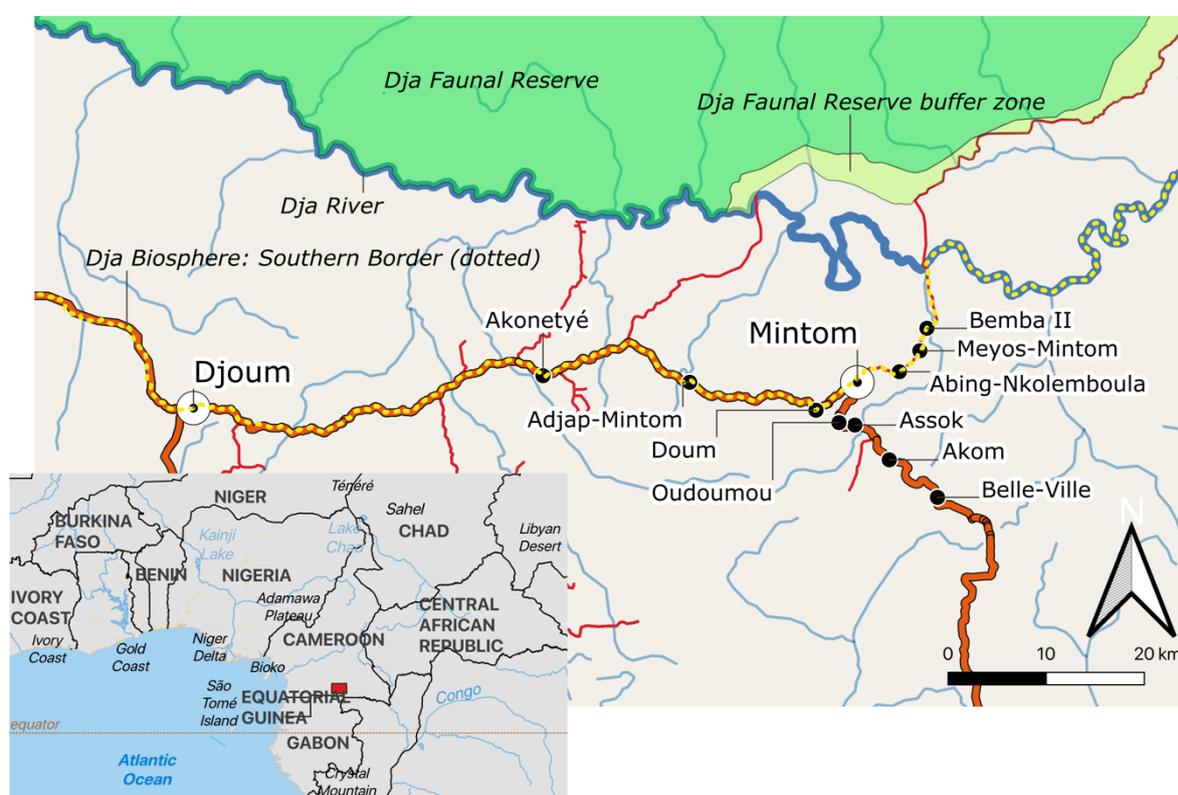


Fig. 1. Location map of Baka villages involved in Darwin Project 24-029, showing their proximity to the Dja Biosphere Reserve and Dja Faunal Reserve.

2 Project Partnerships

Our project is a collaboration between the international development NGO, Zerca y Lejos (ZyL), the country office of an international forestry research institution (CIFOR-Cameroon), the Cameroonian government body responsible for protection of forests and wildlife (MINFOF) and Manchester Metropolitan University (MMU). The partnership between MMU and CIFOR was in place by the time the project started and was formalized with the signing of a memorandum of understanding in Manchester in Feb. 2017. Under this MOU, the Darwin project was presented by CIFOR to MINFOF as part of their umbrella collaboration accord. Meetings between our in-

¹ This is based on Nielsen et al. (2018) study based on data from 7978 households in 24 countries in the Global South, see <https://doi.org/10.1016/j.ecolecon.2017.12.018>
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country leadership and MINFOF headquarters in Yaoundé were held at regular intervals throughout the duration of the Darwin project to update the national authorities of our progress.

The ZyL/MMU partnership has permitted the smooth operation of the project on the ground without any serious obstacles. A main achievement has been the integration of a variety of activities such as the health and agricultural extension work, which were directed by ZyL, and the ecological and wildlife use studies carried out by our in-country team. This collaboration has advanced through a clear and regular interaction between our In-Country Project Coordinator (ICPC) and the Project Leader (PL), with the support from ZyL headquarters in Madrid and the various MMU departments [Head of School of Science and the Environment (now Department of Natural Science), Accounts] in Manchester.

Our project was based on the clear commitment to promote the rights of Indigenous Peoples to fully participate in decision making of matters that affect their ways of life. Thus, all our work incorporated the perspectives, opinions and ideas of the Baka villagers involved in our project. We facilitated direct involvement of the Baka communities in all planned research and interventions. At the start of the project we organised a first meeting with village leaders, in the ZyL-Djoum headquarters (Mission Catholique de Djoum) to introduce the aims and aspirations of the Darwin project. This was followed by the formal launch of the project on 2 Dec. 2018, in which a total of 29 village representatives attended. This meeting was also held in Djoum.

We continued regular contact with *Mr. Richard Eba'a Atyi*, Coordonnateur Regional, CIFOR Afrique Centrale, and with the following authorities: 1) Madame la Ministre de la Recherche Scientifique et de l'Innovation in Yaoundé; 2) Préfet du Département du Dja et Lobo in Sangmélima; 3) Sous-Préfet de l'arrondissement de Djoum; 4) Sous-Préfet de l'arrondissement de Mintom; and 5) the department delegate MINFOF of Dja et Lobo, Sangmelima, conservator of the Dja Biosphere Reserve (DBR).

As part of our commitment to enable a functioning Community of Practice around our project, we have had regular meetings with international organisations (Zoological Society of London, Forest Peoples Programme, Centre Pour l'Environnement et le Développement) operating around the Dja Landscape [that includes the DBR and the Dja Faunal Reserve (DFR), see Fig. 1], as well with our sister Darwin project (#24005) working on bushmeat with communities along the NW periphery of the DL. We have also initiated research collaborations for the following of our sub-projects:

i) *Traditional use of medicinal and food plants by Darwin Baka communities*

Under the formal links established with *Prof. Jean Lagarde Betti* from the Higher Teacher Training College of Bertoua and University of Douala (now Head of the National Herbarium of Cameroon, Yaoundé) and our Darwin project, we completed field work and analyses of forest food plants gathered and consumed by our Baka communities (see below).

ii) *Environmental and health risks to humans and wildlife from lead-based ammunition*

We collaborated with *Dr. Pedro Mayor*, from the Autonomous University of Barcelona, to support a Spanish government-funded project. This project is part of a worldwide initiative to understand the impact of ammunition lead on wildlife and humans. Our contribution to the project was to engage hunters in five of our Darwin villages to offer voluntarily liver samples of hunted wild species (Appendix 2). This material was taken to our Village Reporters (VR) in each village and hunters were given a small incentive (500 FCFA/£0.68) for each sample they donated. All VRs were trained and supervised by *Mr. Robert Okale* (our Faunal Assistant) during one-day long sessions in December, January and February. During these meetings, the VRs were trained on how to safely store samples (these were kept in a formaldehyde solution in plastic vats) and on how to record the necessary information. All VRs had to follow clear health and security instructions when dealing with the samples.

We organised permits to collect biological samples through our link with CIFOR-Cameroon. A formal communication was sent by the CIFOR-Cameroon office on October 21st, 2019 to the various authorities in our study area and to the Ministry of Scientific Research and Innovation in the capital, Yaoundé. CIFOR-Cameroon office also visited the local administrations in Sangmelimá, Djoum and Mintom during the month of December to explain the nature of this collaboration. Data collection started during the first week of June 2020 without any obstacles.

iii) *Analysis of Baka agricultural practices*

Using part of our consultancy budget, we engaged the Tropical Forest and Rural Development Association (TR-RD), a Cameroonian NGO dedicated to environmental and social issues in the region, to assist us in understanding the extent and efficacy of the agricultural practices undertaken in our Baka communities. This information is vital to further understand ways of improving the production of food crops. The first phase of field work assessed the current state of local agriculture in five villages (July 2019). A second phase of field work phase was carried out in September 2019 to assess farmer perception through focus group discussions and meetings with local authorities about current policies to develop local agriculture. All data was compiled and analysed, and the first report delivered in October 2019.

3 Project Achievements

Working closely with our 10 Baka communities, we generated key baseline data to understand their dependency on wildlife resources (primarily wild meat, but also forest food plants) and cultivated foods. We also obtained much needed (and completely new) data on the health status, nutritional status and poverty levels of these Baka groups. This information base was generated with the consent and direct participation of our communities. Alongside these activities, we trained a large number of inhabitants (both male and female) in three of the 10 communities to empower their knowledge and skills towards good agriculture practices to help them manage their land. Based on this evidence, we then engaged with all communities to determine ways of improving their future food security and health through the sustainable exploitation of natural food products and the production of subsistence food crops.

3.1 Outputs

The project set five main outputs as indicated in the log frame these are:

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| Output 1: Research outputs developed and shared with target audiences (local government, villagers and international development community) |
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Our research enabled us to understand the way of life and use of resources by Baka communities in our study area. Based on this reference information we were able to generate better ways of increasing food security and work towards the sustainable use of the environment by the participating Baka communities. Publication of these results in peer-reviewed journals was deemed important to help in the public understanding of the situation the Baka are experiencing and attract long-term support by international development agencies and national policy makers. By the end of our project we had produced a total of 10 papers on: 1) hunting and hunting sustainability by the Baka; 2) dietary and nutrition intakes of the Baka; 3) human health; 4) linkages between wild and domestic foods and human health in the Baka and 5) faunal status and changes over time in community areas inhabited by the Baka. Articles already published from our work have been forwarded to the relevant authorities, and other scientific papers (currently in press or under review) will be sent when available (see publication list). An end of project meeting was planned and prepared for May 2020 to present all our research findings to our partners. However, this was not possible due to COVID-19. All data gathered and analyses undertaken were shared with the participating villages with the assistance of *Mr. Rohan Fisher* from Charles Darwin University, Australia. We used Projection Augmented Physical Landscape technology to bring science and local Indigenous knowledge together in a way that facilitates

two-way learning between the Baka communities and the Darwin team (details in Y2 final report). The approach developed by Rohan, uses simulation games of landscape process projected onto 3D printed landscapes that are shaped to fit the terrain. A meeting and workshop were also held in Y2 to present our findings to our Community of Practice. We also had the opportunity of presenting some of the more salient results of our work in a workshop organized by *Prof. Matthias Waltert* of the Georg-August Göttingen University, at the Congo Basin Institute (CBI) facilities in Yaoundé in October 2019. The aim of this workshop was to discuss and agree ways for resolving conservation conflicts around West-Central African protected areas.

Output 2: Databases created and made available for use by nutrition practitioners and field managers.

All data generated by this project has been distributed freely amongst the relevant authorities in Cameroon, and with colleagues and partners working in development and conservation issues. Based on the nutritional surveys undertaken for Output 5, we were able to generate an electronic nutrient composition database of the 50+ consumed foods in the study area; this includes some wild animals and plants (indicator 2.1). Although the database has already been shared with the ZYL health department, all data will be made available in a paper that will be sent for possible publication in the *Journal of Human Nutrition and Dietetics*. Through external funding from CIFOR headquarters to the Project Leader this paper will be an Open-Access publication. We have published the results of our wildlife extraction and hunting territories (see Output 4 below), but have not distributed the GIS shapefiles or wildlife extraction data to any of our partners (indicators 2.2 and 2.3). We have made our colleagues aware of this information, and if required (under certain conditions of use), they can use our data but only in support of our Baka communities. A study of the consumption of wild plants by the Baka villages was undertaken in support of Output 5 to ascertain the importance of the village-adjacent forests for natural products other than wild meat. This work was undertaken by 4 pre-doctoral students (*Pascal Eric Billong Fils, Natacha Afiong Nana, Oumar Farick Njimbam, Stéphanie Tientcheu Womeni*) from the University of Douala, through our collaboration with *Prof. Jean-Lagarde Betti* (see above) and in fulfilment of indicator 2.6. The results of this work has been published in Billongs Fils *et al.* (2020)². Two other papers, one on use of fungi and another on the use of medicinal plants are being prepared for publication. We had planned to organise a final workshop in May 2020 to train practitioners (MINFOF, Forest Peoples Programme, Centre for Environment and Development, others) within our Community of Practice and open it to Cameroonian university students (indicator 2.4). The focus of this 2-day workshop would be on how to gather relevant data to understand conservation/development issues and using the results of our project to illustrate these. Unfortunately, this was not possible due to COVID. This workshop was meant to be a follow-up of the workshop organised in Y2 with our Community of Practice (indicator 2.5).

Output 3: Hunting use zones maintained with hunters and meat traders across 10 communities respecting agreed quotas.

In collaboration with the participating communities, this output aimed at generating evidence of wild meat offtake levels and hunting territories used. These data would allow the communities to understand their impact on prey populations and to be able to regulate their hunting towards more sustainable levels. We were able to count on the participation of an estimated 77% of potential hunters in the ten study villages, achieving more than planned in indicator 3.1. We were able to amass a significantly large volume of information over a short time period. We recorded not just information on numbers of animals hunted but also on the time invested in hunting trips (over 1,000 recorded). Each village was monitored daily over a five-month period according to the budget available for this activity within our project. We recorded wild species offtake of 121 hunters from a total of 1,946 recorded hunting trips. We also mapped village hunting areas using participatory meetings with hunters in all 10 villages, as well tracked individual hunter

² <https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-020-00413-0>

movements. Results of these investigations have already been published in Fa *et al.* (2021)³ and Avila Martin *et al.* (2020)⁴. Village hunting territories averaged around 200 km² (range 76.8–352.0 km²) with all villages covering as much as 2,052 km² of forest land. These territories and hunter home ranges fall within mining and logging concessions, meaning that the land supplying the communities with wild meat is not their own. As many as 2,245 carcasses of 49 species of 24 animal families were recorded in the study. Most hunted animals were mammals, with ungulates contributing the highest proportion. By species, just over half of the animal biomass extracted by all hunters in our study villages was provided by four mammal species. Most hunted animals were not classed as threatened or prohibited by Cameroonian law; 60-80% of carcasses belonged to the “least concern” category, followed by “near threatened”, “vulnerable” and, rarely “endangered”. Our results revealed that protected species are not important for the villagers’ food security or livelihoods. Given this, we do not consider it necessary to urge any compliance on this point. However, we recognise the importance of villagers respecting the Cameroonian hunting laws that prohibit the killing of protected species. Our results also suggest, although further study is necessary, that village hunting levels are not severely impacting prey populations (also further supported by our camera study results). We were able to discuss and socialise the above results with all communities (see Annual Report for Y2). At the end of April 2020⁵, we undertook a series of group exercises and applied open-ended questionnaires to know how best to move towards the establishment of community agreements to achieve sustainable hunting practices. We used a clear ethnoecological approach to explore communal rules and customs on hunting that the Baka have traditionally followed (and their current validity) particularly on use



Fig. 2. One of the village elders from Doum recounting traditional stories and legends about hunting by the Baka. The Darwin team recorded these tales to inform our knowledge and understanding of hunting practices in our study communities (photo R. Okale).

³ <https://www.nature.com/articles/s41598-021-83223-y>. This paper is Open Access thanks to funding from USAID via CIFOR to the Project Leader.

⁴ <https://peerj.com/articles/9906/>. This paper is Open Access thanks to funding from USAID via CIFOR to the Project Leader.

⁵ These activities were not reported in Y3 Annual Report because they took place after the report’s submission date. Darwin Final Report template 2020

of hunting grounds, hunting techniques used, prey selection, harvest distribution, hunter status, conflict resolution and traditional penalty systems as well as cultural values and taboos linked to hunting, among others. This exercise has provided the Darwin team with the ability to devise robust, culturally-appropriate agreements with our communities, at the same time as helping the community acknowledge collectively their traditional governance systems. We also spent much time listening to and recording traditional events and rituals that were related to us as stories (we recorded a total of 62 stories) which are passed down orally from generation to generation (Fig. 2). On many occasions these stories are shaped as myths and foundational legends that build the worldview of the Baka and at the same time, shape and explain cultural practices. This information was going to be used to develop a community-based sustainable hunting management plan, with all the communities (Indicators 3.2. and 3.3). Our intention was to hold planning meetings in May 2020, and distribute the agreed plan and accompanying information posters by the end of our project in August 2020. We have applied to the Darwin offices to be able to use funds that had been earmarked for this activity to be reallocated for later in 2021, if travel and the COVID situation has improved in Cameroon.

Output 4: Independent measures of population status of protected fauna available for management purposes.

We used camera trapping to record medium to large mammals and terrestrial birds in the hunting areas defined by our study communities. Our aim was to determine the state of hunted fauna in these sites by determining whether there has been selective local extinction of large-bodied species or populations (defaunation). As hunting intensifies, the first wildlife to be lost is commonly the more vulnerable larger-bodied species characterised by slower life histories (often frugivores) and usually of a high hunter or black market value. In Y1, *Dr. Selvino De Kort* and *Dr. Bradley Cain*, both from MMU, travelled to Cameroon to set up three camera trapping grids within community hunting areas. Before travelling to the field we held meetings with *Dr. David Olson* and *Dr. Thomas Bruce* from Zoological Society of London (ZSL)-Cameroon to ensure that our planned strategy was comparable to the trapping layout deployed by ZSL within the DL. Prior to this, we consulted *Dr. Rajan Amin* (who has developed camera trapping protocols for ZSL) followed by a number of planning and preparation meetings in Manchester with *Dr. Martin Jones* and *Dr. Robyn Grant*, also members of our faunal expert team, to finalise arrangements. We achieved a maximum of 5,436 trap nights, resulting in over 62,000 images, and more than 2,000 independent events. Using this information, we were able to generate information on richness, abundance, activity and community structure of larger-bodied mammals (on average 5 kg); some data on large birds has also been possible. We compared our findings with data obtained for the protected area (DBR) just north of our study area. Our results show that although most species in the protected area were found in our study area, larger-bodied animals such as buffalo and elephant were not detected during our study. Overall, most species encountered in our study area were less abundant than in the DBR though some, such as the mandrill (*Mandrillus sphinx*) and the agile mangabey (*Cercocebus agilis*), and water chevrotain (*Hyemoschus aquaticus*) and central chimpanzee (*Pan troglodytes*) were more abundant. Our conclusion is that our Baka villages' hunting territories are only moderately depleted, which links with our findings that offtake by hunters in these could be sustainable (see Output 3). Additional information was gathered to assess the hunters' perception of status of the hunted fauna (indicator 4.2). Most hunters suggested that game species were generally less abundant than a decade before due to various factors such as excessive and abusive hunting, hunting by neighbouring non-native and Bantu groups, the use of non-traditional hunting methods and even due to the dumping of toxic products into rivers by outsiders. Hunters suggested that many were subjected to abuses by neighbouring Bantu groups (e.g. game taken on credit and not reimbursed, prices are taxed, hunting fees not paid) and some alleged violence and exploitation by Eco Guards, including the entering homes at night and carrying out searches and illegal seizures without mandate. Most argued that hunting for their own consumption was progressively more difficult because hunters had to travel because of scarcity of species to hunt, thus increasing risks, bad weather and the likelihood of accident or disease.

Output 5: Improvement of human health and livelihoods achieved through an increase in dietary intake, nutritional status, and medical interventions.

Given that we had insufficient time, as well as the problem of the lack of applicability of simple survey tools such as the USAID Household Food Insecurity Access Scale (HFIAS), we were not able to produce baseline and 3-years after data on food security to measure the impact of our interventions in our communities. This drawback actually meant we are not able to assess the percentage improvements we were aiming for in the outcome for this project. Nonetheless, we obtained important insights into the poverty levels and generated crucial information on nutritional intake and foods consumed, to determine dependence on agriculture and gathered foods from the forest (indicator 5.1). This work was co-led with a Baka woman, *Mrs. Suzanne Abolo*, from Akom village. We were not able to directly link nutritional intakes with the health status of the study populations, again because of time constraints in undertaking a pre- and post- intervention assessment. However, we were able to advance understanding of the precarious nutritional and health situation our Baka communities are currently experiencing; this will allow us to measure changes in nutritional status of these populations in the future. We carried out two intensive medical campaigns during the project, but were unable to organise a third because of COVID. Through this work we show that Baka children have one of the highest global rates of stunting relative to the WHO child growth standard with 57.8% for 2-to-12 year olds and 64% and 73% for 2-to-4 year old girls and boys, respectively, being recorded by our team. Frequencies of wasting, overweight, and low BMI were low at 3.4%, 4.6% and 4.3%, respectively, for 2-to-12 year olds. Underweight was at 25.5%, in the upper range for sub-Saharan Africa. Oedemas indicated that severe malnutrition (0.3%) was rare. We also showed that differences in the body mass index (BMI) between Baka and their Bantu neighbours indicate that there is a declining or stagnant trajectory of Pygmy BMI over the whole age range which is not found in the other group. Our results therefore do not reflect the influence of ethnicity per se, but the fact that Pygmy populations are socially and materially deprived groups. These findings are fully aligned with the extraordinary high premature death rate among the Baka and need to be addressed for further initiatives to be effectively implemented. These findings have already been published⁶

Outputs 5.2 and 5.3 have been successfully achieved through the implementation of our agricultural extension programme in 4 villages (Akom, Assok, Doum, Bemba, Nkolemboula) in close collaboration with our partner ZyL. The Darwin project initiated support for Baka communities so they can produce their own food, namely subsistence crops like cassava (a main staple as shown in our nutritional surveys) for two reasons: 1) increase individual caloric intake in families; and 2) to reduce the Baka's economic and nutritional dependence on Bantu farmers, by becoming autonomous food producers. Through our project we were able to train a total of 59 farmers (31 women) to grow a variety of food crops. ZyL provided seed plants of plantain, manioc, taro (known locally as macabó) and peanuts and helped farmers clear 0.25 ha for agricultural land chosen by the farmers themselves. Farmers were also trained on how to process and store seeds including the building of rodent-proof stores. Because opening up agricultural fields requires the cutting down of adjoining forest lands (albeit secondary forest near villages), our project investigated the application of agroforestry techniques so as to reduce the need for further forest clearing. We have some evidence that indicates that households who grow their own crops for their own consumption and sale, dedicate less time to hunting for sale of wild meat. Results from interviews showed that 80% of respondents answered that agriculture was important as "access to food", and 36% suggested that agriculture conferred them "autonomy". As many as 14% of respondents stated that agriculture allowed them to sell produce and to use proceedings to improve their access to health and schooling for their children. Almost all respondents (94%) answered that before our programme was started, food crops were obtained by exchanging Non-Timber Forest Products (NTFP), hunted game or by doing "petit jobs" (offer of labour to Bantu farmers). Most respondents (71%) actually acquired agricultural products through "petit jobs" and only 7% grew their own crops. After the start of our programme, 80% of respondents confirmed they have regular access to agricultural products; bananas (59%), taro (59%), peanuts (50%) and especially cassava (73%). We also started rural farm schools and organised 97 training

⁶ <https://link.springer.com/article/10.1007/s10745-020-00161-5>;
<https://link.springer.com/article/10.1007/s10745-020-00151-7>

meetings between 2018 and 2019. A total of 118 persons participated; 56 men and 62 women. The average number of meetings attended per person in each village varied from 3 (out of 5 meetings held) in Nkolemboula to 8 (out of 16 meetings) in Doum. Percentage attendance went up from 13% to 17% between the 2018 and 2019 training sessions. Additionally, a total of 11 separate agricultural workshops focusing on topics such as: 1) seed selection and conservation (cocoa), 2) organization of agricultural work, 3) land selection, 4) cleaning and preparation of fields, 5) sowing, 6) field maintenance, 7) crop protection against pests, 8) seed selection and conservation, 9) pests and diseases, and 10) assessing land quality and site selection. Knowledge retention was tested at the end of the March and August agricultural campaigns. Memorisation of main practices was average to poor, but from our focus group discussions participants found the agricultural programme important as well as instructive. Other means of support to farmers, such as the provision of financial support to farm village groups, encouragement of farm cooperatives, implementing community savings and development of communal seed storage facilities allowed the Baka communities to increase their farming activities and ultimately food production. As a result of our agricultural programme, the number of participants involved, particularly women has increased significantly. We have been able to achieve nine times more persons involved in agricultural extension work during the lifetime of the project, involving as many as 77 participants (more than 50% of the village inhabitants). More specifically, 11 women were engaged in our agricultural training activities at the start of the Darwin project in 2017 but by 2019 a total of 68 women were involved, surpassing the target set in indicator 5.2 of a minimum of 30 women farmers trained (see YR2 final report for more details). In total, 70 households in the 4 agriculture-training communities, or 59% of all households, were producing their own food crops by the end of 2019.

3.2 Outcome

Outcome: Food security and health improved in 10 Baka settlements (~190 households) in southeastern Cameroon, through the sustainable use of wildlife resources, and implementation of environmentally-friendly agricultural systems. (Note that these 10 settlements are representative of the overall Baka population in the Djoum-Mintom area of 2,000 inhabitants).

Throughout the duration of our project we have worked towards ensuring that there is a sustainable use of wildlife resources, namely wild meat and forest plants, but also improve the agricultural systems currently used for the production of subsistence crops. In order to achieve this, we have proceeded along two main fronts: 1) gathering of data on health, food access and consumption, extent of hunting territories and overlap with other land uses and 2) actively supporting communities to organise themselves in cooperatives to enable better food production systems.

We have made substantial progress by learning more, and engaging better with our communities. However, we are cognisant that targets set at the start of the project, to demonstrably show a positive impact on the food security and health of the communities, were arguably too ambitious. We discuss progress towards each outcome indicator below:

Indicator 0.1 By end of Y2, at least a 10% increase in food security, 15% increase in dietary diversity in monitored households.

To determine food security changes in our study population we needed to collect information on dietary diversity and nutrient intake at the start and end of the project. In early Y1 we tried to use a simple food insecurity assessment instrument - the USAID Household Food Insecurity Access Scale (HFIAS) survey tool. The idea was to apply a quick survey in a representative number of households without going into more detailed procedures such as 24-hour recalls. However, we found that the HFIAS questions related to perceptions of food insecurity (e.g. "In the past four weeks, did you worry that your household would not have enough food?") were not understood by our participants. Given this, we decided to undertake 24-h recalls. These took longer and as a result we were not able to apply them pre- and post- interventions. Despite these drawbacks we can show, from our hunting and forest plant use data, that access to food is relatively steady

and regular throughout the year. From our 24-h recall data we can demonstrate that caloric and micronutrient intake is significantly low and therefore insufficient to meet their dietary needs. The impact of such food intake levels is also reflected in the reported BMI levels from our health and medical surveys. Thus, although we are not able to suggest that we have fulfilled our expectation of increasing dietary diversity or food security by 10% or 15%, respectively, we have made inroads into this, as shown in indicators 0.4 and 0.5. By promoting community mechanisms that establish strategies such as: a) training farmers to conserve seeds, b) diversifying agricultural varieties, c) establishing seed banks where farmer can stock and loan seeds to other farmers and d) improving savings, we are effectively allowing these communities to become more resilient and in turn improve their food security. Additionally, it is important to highlight that ZyL's education programme, as promoted by our livelihoods' intervention activities, is encouraging farmers to provide corn for nutritional porridge for children in nursery schools every morning. The lesson learnt is that the impact of our interventions require more time to measure and more resources.

Indicator 0.2 By end of Y3 there is a 10% reduction of revenues from the hunting of resilient species in catchment areas and a 10% decrease in number of protected species hunted.

At the start of the project we had assumed that it was necessary to reduce hunting of wildlife in the territories used by our Baka villages. The information gathered during Y1 and Y2 on hunting offtake, territories and the sale and consumption of species hunted leads us now to suggest that animal biomass extracted by the 10 Baka villages is likely to be sustainable if it remains at the same level. We also show from our studies that a very small proportion of protected species are hunted (see our paper Avila Martin *et al.* 2020, and Fa *et al.*, 2021). We are aware that we have only measured extraction in our villages (although a large sample of hunters participated) and that other hunters, especially from outside the villages, are exercising pressure on the animal populations in the area. If outside hunters are prohibited from entering the Baka territories and the lands used by our villages (and other Baka villages in the region) are respected, we believe that the current hunting practices fall within acceptable levels. Further analyses of the data gathered, in line with information obtained in our study on customary laws, will allow us to recommend a way forward. We are aware that this indicator was not appropriate. However, without prior knowledge of levels of wild meat extraction it is impossible to ascertain whether reductions were needed. A more suitable indicator would have been to determine offtake levels and based on these suggest appropriate actions by hunters and the communities.

Indicator 0.3 By end of Y3, a 10% decrease in anaemia rates in pilot Baka communities from a current 60%, as a result of encouraging adequate nutrition.

We have been able to assess levels of malnutrition during two major clinical campaigns in 2018 and 2019. This was not possible for 2020 due to the COVID-19 crisis. Our findings, some of which have already been published, suggest that malnutrition is rife among the study villages (see above for further details). However, we have discovered that the malnutrition assessments (following WHO standards) that have been undertaken for Pygmy populations are compromised by not taking into account the genetic component of stature in Pygmies (see our papers, Funk *et al.* 2020a,b). Our intention at the start of the project was to measure the impact of our intervention around the improvement of food production on anaemia rates. Although we are still analysing our data to determine e.g. whether families that grow their own crops are nutritionally better off than those with no access to their own food crops, linking a lowering of anaemia rates as a result of our activities may be premature. We have advanced our understanding of the relationship between wild and domestic foods and health, but we are aware that we fall short of the intention of our indicator. As mentioned above for Indicator 0.2, it was unrealistic due to a lack of sufficient time and resources, for us to assume we could generate enough information on anaemia rates and compare these pre- and post- project to see if our interventions were positive. We still believe this is an appropriate indicator though more time is definitely needed to measure impact. In retrospect, we should not have used this indicator given that our project was only for three years (and further truncated by COVID).

Indicator 0.4 At least 50% of target communities involved in agricultural extension work are participating in project (against baseline of e.g. 13%).

This indicator has been achieved. As a result of our agricultural programme, the number of participants involved, particularly women increased significantly (Table 1). We have been able to achieve nine times more persons involved in the agricultural extensions work during the lifetime of the project, as many as 77 participants (more than 50% of the village inhabitants). More specifically, from 11 women involved at the start of the project, by 2019 a total of 68 women were included in our agricultural training activities. The composition of participation was the following:

- Doum: 16 households, of which 9 households are composed by couples and 7 were women.
- Akom: 16 households, of which 11 households are composed by couples, 3 households composed by women and 2 composed by men.
- Bemba: 14 households composed by couples.
- Nkolemboula: 6 households, of which 3 are households composed by couples, 1 by a man and 2 by women.
- Assok: 18 households, of which 15 households are composed by couples and 3 by women.

Table 1. Changes in number of persons participating in the ZyL/Darwin project agricultural programme.

| Village | 2017 | | | 2019 | | | Increase |
|-------------|------|-------|-------|------|-------|-------|----------|
| | Men | Women | TOTAL | Men | Women | TOTAL | |
| Akom | 10 | 5 | 15 | 13 | 14 | 27 | 12 |
| Assok | 5 | 3 | 8 | 15 | 18 | 33 | 25 |
| Doum | 9 | 3 | 12 | 9 | 17 | 26 | 14 |
| Bemba | 7 | | 7 | 14 | 14 | 28 | 21 |
| Nkolemboula | 4 | | 4 | 4 | 5 | 9 | 5 |
| TOTAL | 35 | 11 | 46 | 55 | 68 | 123 | 77 |

Indicator 0.5 By end of Y3, there is a 10% increase in income from agriculture in 10 study villages.

Out of 111 households involved in our agricultural programme, as many as 30 were able to sell agricultural products from their fields. The most common crop sold was plantain, followed by banana and cassava. The average income per farmer derived from the last agricultural campaign is 27,534 FCFA ± 34,144 FCFA. In turn, from focus group discussions, some participants affirmed that *“We find a profit from agricultural products because we are already starting to sell our plantains, which allow us to get some foodstuffs, medical care, and pay somewhat the children's pension”*. More detailed analyses of income from agricultural products are been completed and will be published. Our intention is to achieve this by mid-2021.

Indicator 0.6 Cameroonian practitioners and university students trained on how to generate evidence for better decision-making when dealing with conservation-development interphases at the end of Y3.

Four pre-doctoral Cameroonian students, working with *Prof. Jean Lagarde Betti* from the Higher Teacher Training College of Bertoua, participated in data collection and analyses of the use of forest plants (see above).

3.3 Monitoring of Assumptions

Assumption 1: System is in place to allow continuous data analyses to disseminate project learning before publications appear.

Comments: No issues. Analyses of all datasets undertaken, and results communicated to the relevant partners.

Assumption 2: Written papers are used to disseminate results of project and used to further discussions with appropriate authorities.

Comments: By the end of the project we produced a total of 10 peer-reviewed publications. All papers have been sent to our partners for review before publication, and will be deposited in MINFOF, CIFOR-C and affiliated Cameroonian universities.

Assumption 3: Nutrient composition database supervised by the project's Food and Nutrition expert, Dr. L. O'Connor at MMU. Our nutritional work has been supported by Prof. Barrie Margetts (Univ. of Southampton).

Comments: Dr. O'Connor is no longer involved in our project since she has relocated to Ireland. Nutritional support has been given by *Prof. Margetts* and *Dr. Amy Ickowitz* from CIFOR and more recently by *Mrs. Fernanda Lacerda*, a qualified dietitian.

Assumption 4: CIFOR-C intervention consultant supports the project to better understand outcomes and future prospects.

Comments: There has been an excellent level of support from CIFOR-Cameroon, helping us obtain permits to work in the study area, and providing a sounding board to discuss our methods and results.

Assumption 5: MINFOF is able to send ecoguards to attend the training workshops.

Comments: We were in discussions with MINFOF to ensure the participation of Eco Guards in a second COP meeting at the end of the project. This has not been possible because of COVID-19.

Assumption 6: Local research assistants employed to support data gathering.

Comments: Assumption discarded because not necessary. Participation of local hunters and villagers in our project has been more than expected.

Assumption 7: Hunters motivated to contribute to the project.

Comments: As in Assumption 6, a large number of hunters have participated in our project.

Assumption 8: Conditionality of no hunting of protected species created in line with health and agricultural support provided via Output 5.

Comments: Through our study of offtake and hunting territories we have established that hunting of protected species is not a major issue. We have revised the issue of conditionality – we are not withdrawing support if hunting of protected species occurs – but our work in Y3 with hunters to review their customs and governance issues. will reinforce a way forward.

Assumption 9: Hunting information obtained can estimate level of protected species offtake. Use of indirect methods to determine veracity of reports. Use of targeted interview techniques can verify if hunters participating in the project are taking protected species.

Comments: Our data shows that hunting of protected species is low. We consider that the data gathered by Village Reporters to quantify hunting levels was not flawed by hunters giving us false information on animals hunted, this is because Village Reporters regularly checked the quarry brought to the village.

Assumption 10: Increase in populations of protected species can be linked to the project's activities.

Comments: This assumption is still valid, though means of verifying this will take longer than the length of our project. Given that our camera trap data shows that numbers of large animals is still relatively high in the hunting territories, and that numbers of protected species hunted is low, we

are confident that the situation of most species (particularly large primates, giant pangolins and large duikers) is reasonably good. However, this should be investigated over a longer time period.

Assumption 11: Food security measured as “physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”.

Comments: This has been done and supported by the data obtained on nutritional intake and access to food sources.

Assumption 12: Baseline information on health available from ZyL medics. Ethical premises of use of persons’ medical records are clear.

Comments: We now have health data on all Darwin villages for 2018 and 2019, and ZyL has allowed us to access data from health campaigns going back to 2007 when these started. The older data has not yet been analysed.

Assumption 13: Agricultural extension programmes and training of women farmers will continue to be operated by ZyL.

Comments: Our discussions with ZyL confirm that the NGO will continue these activities in the Darwin villages beyond the lifetime of our project.

Assumption 14: Information of food production by families gathered at the start of the project.

Comments: This has been done.

3.4 Impact: Achievement of Positive Impact on Biodiversity and Poverty Alleviation

Our stated impact “*Hunting and agriculture are managed sustainably to improve food security and health of rural populations through the effective and sustainable management of domesticated and wild food resources*” has been attained when the following results of our project are considered, namely that: 1) hunting by our study villages did not significantly impact threatened or protected species, as evidenced from direct information gathered by the Darwin project on species and number of animals hunted. Given this, we considered it unnecessary to modify current natural resource extraction practices. However, in workshops with hunters in the last year of the project we have examined governance issues, motivations and hunting territory designation to develop a long-term management plan for the resources our villages were using and would like to continue to use in the future. Unfortunately, the elaboration of the management of hunting activities in our communities was planned for May 2020, but was not possible due to COVID; 2) we have increased the potential for our Baka villages to improve their food security and income by directly improving their agricultural practices. We show that households who participated in our farming workshops and farm school increased the amount of food available to their families; 3) we have to note that this is not research for research’s sake, but the Darwin’s team commitment to producing well-gathered data and communicating results from these promptly – 10 papers were produced during the life-time of the project - have allowed us to better understand the health and nutritional status of our Baka communities. This information permits us to clearly denounce the rather appalling poverty and malnutrition that these Indigenous Peoples are facing. Although we were not able to change this situation in a three-year project, an achievement that would be remarkable for any development project to achieve in this time period, we do take pride in the fact that we have generated new invaluable data which can be used to improve the lives of these peoples. We are very satisfied with the outputs achieved in our Darwin project being able to move closer to our stated outcome, though not actually achieving the aspiration percentage change of reducing food insecurity in our communities.

4 Contribution to Darwin Initiative Programme Objectives

4.1 Contribution to Global Goals for Sustainable Development (SDGs)

Our project has contributed towards five separate Global Goals for Sustainable Development Goals, particularly:

Goal 1 (No Poverty) – Pygmy populations, including our Baka communities are amongst the poorest and most deprived groups in Africa. Our Darwin project aims to ultimately reduce poverty amongst these communities by increasing income from family-based agricultural production and ensuring that through the sustainable use of wildlife resources, some trade of wild meat is possible.

Goal 2 (Zero Hunger) – Although previous reports have indicated that Pygmy populations exhibit high levels of under- and malnourishment, through our Darwin project we unmistakably show that Baka children have one of the highest global rates of stunting, and the body mass index of adults declines significantly with age, something which is not typical of non-Pygmy groups. Lack of access to sufficient amounts of food and nutrients is at the root of these issues. Our project has highlighted these deficiencies and has attempted to increase caloric intake of Baka families by promoting small scale family-based farming of staple food crops such as cassava and plantain.

Goal 3 (Good Health and Well-being) – Fundamental baseline information on health and well-being of our Baka communities was obtained during our project. As for the above goals, by promoting better access to wild and domestic foods we are able to ensure that the communities (especially children) have sufficient and year-round access to food.

Goal 5 (Gender Equality) – Gender equality has been central to our work with the Darwin project. Women participating in our agricultural programme increased during the life of our project. Inequalities and sexual violence still exist among our Baka communities, our project has encouraged women to participate openly in our meetings with all communities and some have been even supported to assume important roles within the project (e.g., as co-lead in our nutritional surveys, see above).

Goal 15 (Life on Land) – Our project has acted, albeit indirectly, to protect the forest lands in which our Baka communities live. These forests provide foods, medicines and construction materials, crucial for the many Indigenous and rural peoples living within them. They are also important habitats for many tropical forest species that are only found in the Congo Basin. Learning from the Baka communities themselves, our project has been able to promote a greater respect and better protection for these lands. Research findings (and dissemination of these via meetings, publications and reports to our Community of Practice) from our project of the use made of forest products by the Baka, the lands used by them, as well as the animals and plants species in the area, can generate a national and international understanding of the value of south Cameroon forests and recognising the need to support the Indigenous and rural peoples that rely on them. Our results can be used by advocacy groups (e.g. Forest Peoples Programme, who work with us) to form the basis for actions against uncontrolled industrial exploitation of natural resources in the area.

4.2 Project support to the Conventions or Treaties (e.g. CBD, Nagoya Protocol, ITPGRFA, CITES, Ramsar, CMS, UNFCCC)

The project contributes to the implementation of a number of articles within the CBD:

Article 8

c: Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;

- d: Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;**
- i: Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components;**
- j: Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices;**

Our project has worked with Baka communities to ensure the protection and use of biological resources within their territories. These lands are found immediately outside the DBR and south of the DFR (see Fig. 1). These protected areas are part of one of the largest and best-protected rainforests in Africa, with 90% of its area left undisturbed.

By working directly with our Baka communities so that they do not overexploit species hunted for wild meat or forest plants for food, medicine or materials, we are able to promote the protection of ecosystems, habitats of viable populations of game species. We have also worked with our communities for them to help them understand the existing national legislation against the killing of protected species. Fundamental to our interactions with the Baka communities is the understanding of, and integration of their traditional ecological knowledge.

Article 10

- a: Integrate consideration of the conservation and sustainable use of biological resources into national decision-making;**
- c: Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements;**

All our findings and work have been shared with the national authorities that are responsible for the protection of biological resources in the country. Making sure that this knowledge is used to inform fair and adequate laws that respect and safeguard the future needs of Pygmy peoples and their lands, is a long process and one that goes beyond the lifetime of our project. However, because our findings are novel, they will be invaluable in encouraging the customary use of biological resources in Cameroon.

Article 17

- 1: Facilitate the exchange of information, from all publicly available sources, relevant to the conservation and sustainable use of biological diversity, taking into account the special needs of developing countries.**
- 2: Such exchange of information shall include exchange of results of technical, scientific and socio-economic research, as well as information on training and surveying programmes, specialized knowledge, indigenous and traditional knowledge as such and in combination with the technologies referred to in Article 16, paragraph 1. It shall also, where feasible, include repatriation of information.**

All information gathered in our project has been shared in formal meetings with our Baka communities, our Community of Practice and internationally in the publications that we have been able to produce. All our publications are Open Access. We also planned to undertake a major training session with national entities, see above, to instruct researchers and field staff on methods to evaluate use and status of wildlife. This was not possible due to COVID.

4.3 Project Support to Poverty Alleviation

Our target communities are Baka groups in southeastern Cameroon that have been displaced from their traditional hunter-gatherer lifestyles to live in roadside villages. In socio-economic and political spheres, the Baka are amongst the most underprivileged in Africa and are comparatively

more disadvantaged compared to the neighbouring Bantu peoples in the country. Thus, our project is directly aimed at improving the lives of these Indigenous Peoples by working towards ensuring a sustainable supply of domestic and wild foods, and by so doing improve their food security. We have also worked towards raising farm production and incomes, so as to provide our communities with safety nets and opportunities for self-sufficiency. All work and efforts in our project are ultimately aimed at improving the lives of the Baka in terms of livelihoods and health, and move towards the alleviation of poverty.

4.4 Gender Equality

Our project encompasses a vehicle for women's empowerment given that many women in our target villages are involved in our agricultural instruction programme. Also, as household and food managers, women have worked closely with our team on nutritional matters by providing essential information on food insecurity issues, foods consumed and their preparation. This results in their empowerment and encourages their active participation in our project. Moreover, the recruitment of a female Baka assistant (see above) to assist us with our work in the villages engenders further trust in our project. This also promotes active participation in community group discussions and makes sure that their points of view are considered.

4.5 Programme Indicators

Did the project lead to greater representation of local poor people in management structures of biodiversity?

Our project enabled local Indigenous Peoples to fully participate in our project, support the collection of data and jointly discuss and plan better ways of using biodiversity in their lands.

Were any management plans for biodiversity developed and were these formally accepted?

The last stage of our project was to develop management plans for the use of wildlife by the Baka communities involved in the Darwin project. Relevant information (e.g. traditional hunting rules, rights and responsibilities of members of communities, impact of outside hunters on Baka lands) was gathered through meetings with the communities at the end of Y2 and early Y3. However, we were not able to finalise these management plans or have them formally accepted, because this final stage was planned for May-August 2020, and therefore affected by COVID.

Were they participatory in nature or were they 'top-down'? How well represented are the local poor including women, in any proposed management structures?

All discussions affecting the use of resources by our Baka communities were always participatory in nature. Planning meetings, training workshops and devolution of information gathered were undertaken with the local communities (examples of these gatherings are given in our annual reports). As mentioned above, the development and consolidation of our management plans would have been also organised as a participatory exercise at the end of Y3. The communities we have worked with in the Darwin project are all extremely poor, see above, and are the direct beneficiaries of our planned management plans.

How did the project positively influence household (HH) income and how many HHs saw an increase?

As the direct result of our agricultural support programme, we were able to confirm that 30 (27%) out of 111 households were able to sell their own-grown agricultural products and positively increase their income.

How much did their HH income increase (e.g. x% above baseline, x% above national average)? How was this measured?

The average income per farmer derived from the last agricultural campaign was 27,534 FCFA ± 34,144 FCFA, from no income at all at the start of the campaign i.e. a year before.

4.6 Transfer of Knowledge

Our plan was to organise a final workshop in May 2020 to train national practitioners (e.g. MINFOF, Forest Peoples, Centre for Environment and Development and others) and Cameroonian university students on how to gather relevant data to understand conservation/development issue linked to wildlife resources. This was not possible because of COVID. We had planned to deliver a 2-day training containing topics such as: 1) The importance of wild meat and fish to Indigenous Peoples and rural communities; 2) How to understand the concept of hunting/fishing sustainability; 2) Assessing wild meat/fish offtake; 3) Determining wildlife abundance; 4) Community-based sustainable wildlife management and 4) Effective governance systems. Day 2 would have been dedicated to break-out groups and to exercises around the topics dealt with during the first day. Certificates of attendance, endorsed by MMU, CIFOR-Cameroon and MINFOF, and containing the Darwin logo, would have been awarded to all participants. The PL had discussions with the African Wildlife Foundation in Washington DC who were interested in co-delivering this training with the Darwin team. We had suggested training up to 20 professionals from the organisations listed above and including a good representation of women. We will be suggesting to the Darwin offices that the unused funds be used and we will put together materials for an online course.

4.7 Capacity building

This Darwin project did not particularly target individuals of national or government organisations in Cameroon to improve their own effectiveness. Our work was focused on improving the management of wildlife resources and improving the production of own-grown subsistence food crops by Baka communities. However, from the outset of the project (indicator 2.4), we had planned a final workshop that would help strengthen the skills and abilities of relevant Cameroonian organisations (NGOs and government) to understand issues of natural resource management by local communities. Some details of this “capacity-building” exercise are given in the previous section of this report.

5 Sustainability and Legacy

The predicament of the Baka people, as indeed of all Indigenous Peoples in the Congo Basin, will not be solved without political will or the long-term commitment of local administrations. The support of international organisations and governments is fundamental. Darwin, through our project, has enabled a better understanding of the living conditions of a relatively small population of Pygmies in Cameroon, and have put in place mechanisms that will help in increasing the food security of these communities. We are aware that our work has contributed to our stated outcome (see below on lessons learned) even though we have fallen short of our stated percentage targets. However, we know that our findings and relentless teamwork with our Baka communities will be used to guide future actions. We have laid firm foundations for better data gathering (on health, use of resources) as well as how to improve agricultural production, which will help our in-country partner ZyL, who still remains in-country, to build upon. ZyL has, in fact, reorganised their food and health operations to continue improving the lives of the Baka. This new approach has been based on the results of our Darwin project and is evidence of the legacy of our efforts. Further evidence of this can be provided, on request.

6 Lessons Learned

- It is possible to develop and implement projects that lead to a good evidence-base and practice to benefit poor communities and improve their livelihoods and health. We do not ascribe to the dichotomy that research and development work cannot be intertwined.
- Our intention was to use our experienced team of biologists to undertake camera-trapping operations in Cameroon. Our budget could only stretch to bring the UK team to the field for the setting of the traps but not for retrieving them. We were fortunate to be able to employ an excellent Cameroonian biologist (*Mr. Fabrice Kentachime*) to take down the traps, and within budget. This person had worked before for ZSL and was recommended to us by them. Operations, such as camera-trapping, which are very intense and costly, should be undertaken by locals, if the expertise is available.
- All ten Baka communities in our project engaged with us enthusiastically and freely, without any major issues. This is, without any doubt in large part, the result of the confidence and trust that these communities already had placed on our in-country partner (ZyL). This NGO had been working with these villages for over a decade and our project was largely successful because we planned to work with them.
- We are fully cognisant that our targets of reducing food insecurity by a stated percentage, as laid out in our outcome statement, were not correct. We are aware now that these have to be seen as aspirational targets and our outcome should have been, as stated correctly by the Y3 annual report reviewer, “insights in[to] the linkages between food production, wildlife use and human health”. We recognise that our outcome indicator “By end of Y2, at least a 10% increase in food security, 15% increase in dietary diversity in monitored households” was unachievable given our Darwin budget.
- There were issues with some of nutritional survey methods originally planned for the project. In particular, rapid survey tools for the assessment of food insecurity in households were found to be inappropriate in the case of the Baka (see above). Because of this, we had to resort to the application of 24-h dietary recalls, which were more expensive and time-consuming to employ. In the future, if 24-h recalls are to be used, sufficient budgetary provision should be included.
- Our links with Cameroonian universities and national organisations were important and allowed to advance our knowledge of use of plants by the Baka communities and to understand better traditional agricultural practices. We commend the excellent collaboration of these organisations (see above).

6.1 Monitoring and Evaluation

The logframe indicators were reviewed in detail with the project team and the Reviewer (Victoria Pinion, LTS International) during the Mid Term Review (MTR) of this project, carried out in February 2019. The full report is available from LTS International (the MTR report focused on ensuring that all indicators captured change and that the outputs reflected any potential shifts/adaptation in the project since the original proposal was written and approved. Following feedback received at the funding stage, this project was provided with support in developing its logframe in advance of the submission of AR1 – however these changes were not formally approved via the change request process in advance of AR1 submission. The change request was submitted after the MTR combined changes made to the logframe before AR1 with the further refinement made during the MTR and discussions following. Given updates in understanding of the project context since the proposal was originally written, some indicators were found to no longer be appropriate or else could be improved based on this stronger understanding of the context following collection of baseline information. The wording of some indicators was adjusted in cases where they read as activities and Means of Verification were also updated to better reflect evidence which can be provided in support of achievement of indicators. Specific changes are outlined in full in accompanying logframe with tracked changes but in summary:

The following changes were made to the original logframe, the updated version of which appears in Annex 1.

Outcome:

- Some tightening up of timeframes (e.g. to the end of Yr2 rather than just Yr2) to make clearer when indicators are expected to be met.
- **Removal of reference to elephants and great apes specifically under indicator 0.2 and addition of assumption** “Rates of protected species bycatch (due to indiscriminate snaring technique of hunting) are not significant”. Following initial analysis of bushmeat offtake data it does not appear that the target communities involved in the project are targeting apes and elephants (2 records for chimp have been found). However, offtake of other protected species is more significant and so the removal of direct reference to great apes and elephants removes this specificity so that the – i.e. under Class A of Cameroon protect species (including all primates, pangolin, apes and elephant).
- **Outline logic behind larger changes to each Outcome indicator:**
- Under indicator 0.5, remove reference to an increase in income from bushmeat sale as this contradicts Theory of Change for this project (whereby an increase in agricultural income will lead to a reduction in income from sale of bushmeat, as captured under indicator 0.2 and outlined in new assumption – supported by literature [add ref] – at the Outcome level).

Output 1:

- 1.5 – change of journal article focus. Compare with ZSL data.
- **To action:** Consider how uptake of the research outputs could be measured and how this uptake could be measured through the MoV. Some notes in the logframe.

Output 2:

- Output itself made more specific. Reference to “learning opportunities” changed to “databases”.
- Indicators made timebound.
- Q – Creation of nutrient database and creation of shapefiles already captured as activities 2.1-2.4. Could indicators 2.1 2.2 better capture the “sharing”/“made available to use” by appropriate stakeholders rather than creation along?
- Q - Do Output 2 activities capture all project activities (e.g. practitioner workshops under indicator 2.4, the project review workshops captured under indicator 2.5, student projects under indicator 2.6) – see some specific notes on these indicators.

Output 3

- At the moment it is possible that the project will not suggest the creation of hunting quotas as the data suggests this may no longer be an appropriate management strategy. Reference to hunting quotas specifically have been removed from the output wording, indicators, and means of verification where needed (important note – hunting quotas may still be proposed during developing of community-based management plans, however the projects wants to maintain flexibility to include other hunting zone management strategies such as shifting zones/no take zones, or a combined strategy).
- Reference to meat traders removed from the output. This wording was originally included in an attempt to emphasise the link to traders i.e. to capture the fact that hunting isn't just for subsistence. However meat traders aren't a distinct role within the community – hunting is primarily for subsistence with trade occurring when surplus is caught.
- The order of indicators has been changed to improve logical flow (i.e. establishment of community-based strategy will now fall before monitoring of adherence to strategy).
- Removal of previous indicator 3.2 “illegal hunting and sales of protected wildlife reduced by 50%” – baseline studies have found that the levels of hunting of endangered species is low (for example only 2 chimp found....) and that overall hunting is focused on non-threatened, resilient species (Q – level of chimp offtake low but what about offtake of other threatened species e.g. pangolin? Should this indicator remain or is it still not appropriate, given that in the final year you are hoping to emphasise the link of the project to reduced pressures on hunting of threatened species).

Output 4:

- “Prey” changed to “hunted” species to clarify these are species hunted by Baka hunters.

- Timeline of second wave of camera trapping data collection shifted to year 3 due to need to move budget around during the 2nd FY of the project
- Indicators reworded so that they read less like activities.
- The output includes the phrase “available for management purposes” Q – who are the users of this data? Are the management purposes the management plan proposed under Output 3 or something else in addition?

Output 5

- Removal of indicator 5.2 on anaemia rates in children as this change already captured at the Outcome level - indicator 0.3.
- Reference to measures of food quality and harvest amounts removed because of the difficulty in obtaining this information.
- New Means of Verification to be suggested for indicator 5.1 – may also need to revisit indicator 0.1 and its Means of Verification
- at the same time.

6.2 Actions taken in response to annual report reviews

We have addressed reviewer comments relating to all aspects of the project brought to attention in the feedback from annual reports in the relevant sections. In particular, we have paid particular attention to the results of the MTR, for which we are most grateful. Reviewer comments made on our Y3 annual report were very useful in completing this final report. All reviews were extensively discussed with our partners and other collaborators.

7 Darwin Identity

The project partners have referenced the Darwin Initiative at the project launch event and at project presentations to beneficiaries and key stakeholders and the Darwin logo has been displayed on all published material and project vehicles. Acknowledgement of the Darwin funding is included in all scientific papers published. The partners have explained the aims and objectives of the Darwin Initiative more fully to government stakeholders, the British High Commission in Yaoundé, as well as national and local conservation actors working in Cameroon.

8 Impact of COVID-19 and Other Restrictions on Project Delivery

As recommended by the Spanish embassy, our ex-pat field team (ICPC - Guillermo Ros and the HO - Eva Avila, both Spanish nationals) were unable to travel to Cameroon due to potential security risks during the elections period in February 2020. Furthermore, as a result of COVID-19, further travel restrictions were imposed after March 2020, and neither the ex-pat field team nor the Project Leader were able to join field operations in Cameroon. The Project Leader had organised to travel to Cameroon in May 2020. Closure of the project was undertaken remotely. COVID has stopped us from properly ending our project as planned. However, it is our intention to complete the last phase of our project i.e., to finalise the community-based sustainable hunting plan and engage with our Community of Practice, when conditions are appropriate. We have submitted a change request to use the unused funds of the project to achieve this.

9 Finance and Administration

9.1 Project Expenditure

| Project spend (indicative) since last annual report | 2019/20 Grant (£) | 2019/20 Total actual Darwin Costs (£) | Variance % | Comments (please explain significant variances) |
|-----------------------------------------------------|-------------------|---------------------------------------|------------|-------------------------------------------------|
| Staff costs (see below) | | | | |
| Consultancy costs | | | | |
| Overhead Costs | | | | |
| Travel and subsistence | | | | |
| Operating Costs | | | | |
| Capital items (see below) | | | | |
| Others (see below) | | | | |
| TOTAL | | | | |

| Staff employed (Name and position) | Cost (£) |
|----------------------------------------------------|----------|
| MMU – Julia E. Fa (PI) | |
| ZYL -Guillermo Ros (In country coordinator) | |
| ZYL -Eva Ávila (Head officer) | |
| ZYL -Loreto Rebollo - International coordinator | |
| ZYL -Okale Robert – Faunal assistant | |
| Aboulou Susanne Taylor –Health Officer assistant-. | |
| TOTAL | |

| Capital items – description | Capital items – cost (£) |
|-----------------------------|--------------------------|
| | |
| TOTAL | |

| Other items – description | Other items – cost (£) |
|---------------------------|------------------------|
| Bank charges | |
| TOTAL | |

9.2 Additional funds or in-kind contributions secured

| Source of funding for project lifetime | Total (£) |
|----------------------------------------|-----------|
| MMU project overheads | |
| | |
| | |
| | |
| | |
| TOTAL | |

| Source of funding for additional work after project lifetime | Total (£) |
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| | |
| TOTAL | |

9.3 Value for Money

This project is the first to be funded by Darwin that focuses directly on supporting a Pygmy population in the Congo Basin. Through our work we have demonstrably increased our understanding of one of the most underprivileged peoples in Africa (and possibly the world) and helped them improve their food security and livelihoods. A large number of individuals and households have been assisted by our project and outputs produced has been significant. The Darwin project has also been able to stimulate and leverage collaborations with institutions not originally linked to it e.g., Charles Darwin University, ZSL, University of Barcelona and others, see above for details) adding even more value for money.

10 OPTIONAL: Outstanding achievements of your project during the (300-400 words maximum). This section may be used for publicity purposes

I agree for the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

Annex 1 Project’s original (or most recently approved) logframe, including indicators, means of verification and assumptions.

Note: Insert your full logframe. If your logframe was changed since your Stage 2 application and was approved by a Change Request the newest approved version should be inserted here, otherwise insert the Stage 2 logframe.

| Project summary | Measurable Indicators | Means of verification | Important Assumptions |
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| Impact: Hunting and agriculture are managed sustainably to improve food security and health of rural populations through the effective and sustainable management of domesticated and wild food resources. (Max 30 words) | | | |
| <p>Outcome: (Max 30 words)</p> <p>Food security and health improved in 10 Baka settlements (~190 households) in southeastern Cameroon, through the sustainable use of wildlife resources, and implementation of environmentally-friendly agricultural systems. (Note that these 10 settlements are representative of the overall Baka population in the Djoum-Mintom area of 2,000 inhabitants).</p> | <p>1.1 By end of Y2, at least a 10% increase in food security, 15% increase in dietary diversity in monitored households.</p> <p>1.2 By end of Y3 there is a 10% reduction of revenues from the hunting of resilient species in catchment areas and a 10% decrease in number of protected species hunted.</p> <p>1.3 By end of Yr3, a 10% decrease in anaemia rates in pilot Baka communities from a current 60%⁷, as a result of encouraging adequate nutrition.</p> <p>1.4 At least 50% of target communities involved in agricultural extension work are participating in project (against baseline of e.g. 13%).</p> <p>1.5 By end of Y3, there is a 10% increase in income from agriculture in 10 study villages.</p> <p>1.6 Cameroonian practitioners and university students trained on how to</p> | <p>1.1 Household surveys in 50% of the 190 households (around 700 persons) of the 10 study villages. Description of food consumed, analyses of food types and nutrient intake (using 24-hour recalls), and food-insecurity questionnaires, undertaken in around 25% of all households (total 50 households).</p> <p>1.2 Hunting zones from hunter participatory mapping exercises, direct hunter offtake data and hunter territory maps.</p> <p>1.3 Medical records from all ZyL clinics. Consumption rates of macro- and micronutrients from dietary records. Impact of parasite reduction and malaria suppression.</p> <p>1.4 Surveys of fields dedicated to agriculture. Analysis of detailed records of agricultural production of all managed fields determined in Y1 as baseline, and production records kept during Y2 and Y3. Minutes of meetings.</p> | <p>Relevant government authorities support project interventions.</p> <p>Government authorities have sufficient authority and presence in the area to control the exploitation of protected species but allows hunting of fast-breeding taxa.</p> <p>Improvement in anaemia rates result from both better nutrition from the project’s intervention and lowering of disease. The latter currently being undertaken by ZyL.</p> <p>Supply chains are open and supported by local institutions.</p> <p>Local markets are open to surplus subsistence crops (e.g. cassava, peanuts) and cash crops (e.g. cacao) cultivated in study communities .</p> <p>Rates of protected species bycatch (due to indiscriminate snaring technique of hunting) are not significant.</p> |

⁷ZyL health data of Baka populations in the study region (see <http://zercaylejos.org/proyectos/health-en/?lang=en>) indicate that 78%, 79% and 60% of children (6 months – 12 years) suffer from high intestinal parasite loads, malaria and anaemia, respectively.

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| | generate evidence for better decision-making when dealing with conservation-development interphases at the end of Y3. | <p>1.5 Income change from different sources calculated from data obtained in baseline household survey in Y1 and from two subsequent follow up surveys, at the end of Y2 and Y3.</p> <p>1.6 At least 10 MINFOF and university students trained on conservation/livelihoods methods.</p> | Published evidence ⁸ shows that among the poorest households, reliance on wild meat income is inversely related to domestic animal income and revenue from agriculture. This is the basic tenet and assumption in our project. |
| <p>Outputs:</p> <p>1. Research outputs developed and shared with target audiences (local government, villagers and international development community)</p> | <p>1.1 Hunting offtake data and faunal abundance shared with MINFOF and other local and international conservation partners to increase uptake of results. COP meetings organised to disseminate and discuss results of project.</p> <p>1.2 Journal article of hunting pressures and hunting sustainability of bushmeat species submitted to open access journal by end of Y2.</p> <p>1.3 Journal article on dietary intakes and food sources of key nutrients prepared by end of Y2.</p> <p>1.4 Journal article on links between forest, domestic crops and general health, especially of vulnerable groups (children, aged <5) completed by end of Y3.</p> <p>1.5 Journal article on differences in large mammal abundance in community hunting areas vs non-hunted areas submitted by Y3.</p> <p>1.6 Report on land use and landscape analysis presented to project partners (Community of Practice, COP, collaborating universities, MINFOF) to</p> | <p>1.1 Reports presented to MINFOF and other stakeholders. Meeting minutes and participant lists attending COP meetings.</p> <p>1.2 Data analyses and project records on hunting and faunal abundance made available to MINFOF before publication.</p> <p>1.3 Draft versions of papers made available for national and international peer review before being sent to relevant journals.</p> <p>1.4 Draft versions of paper, letters/emails showing stakeholders have been consulted, evidence of submission to journal.</p> <p>1.5 Draft versions distributed to stakeholders and partners for comments and analysis of implications.</p> <p>1.6 Draft versions distributed to stakeholders and partners for comments and analysis of implications. 3D Augmented Landscape analyses, undertaken in conjunction with Rohan Fisher from Charles Darwin University, Australia, to be made available to COP members.</p> | <p>System is in place to allow continuous data analyses to disseminate project learning before publications appear.</p> <p>Written papers are used to disseminate results of project and used to further discussions with appropriate authorities.</p> |

⁸Nielsen, M.R. et al. (2018). The importance of wild meat in the global south. *Ecological Economics* 146, 696–705.

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| | understand conflict areas between extractive industries and livelihoods of study communities. | | |
| 2. Databases created and made available for use by nutrition practitioners and field managers. | <p>2.1 Electronic nutrient composition database of consumed foods in study area made available from MMU server and disseminated widely to potential users by Y3. [note creation of the database itself is activity 2.1]</p> <p>2.2 Spatial data on wildlife extraction patterns stored in GIS shapefiles by end of Y2.</p> <p>2.3 Wildlife use and extraction data stored in electronic database for use by project partners [by when?].</p> <p>2.4 In Y3, final workshop organised to train practitioners (e.g. MINFOF, Forest Peoples, Centre for Environment and Development, others) and Cameroonian university students on how to gather relevant data to understand conservation/development issues using our project area as a model.</p> <p>2.5 In Y1 and Y3, baseline and post-project review workshops respectively, organised with project partners and other stakeholders.</p> <p>2.6 At least 4 Master's student projects, a minimum of 2 from Cameroon, resulting from research undertaken for Outputs 3-5 completed by end of Y3.</p> | <p>2.1 Nutrient composition database, dissemination statistics..</p> <p>2.2 Copies of shapefiles stored by MMU and ZyL and made available to COP members. All non-sensitive spatial data will be shared via Google Drive.</p> <p>2.3 Copies of databases open to use by all project partners and shared via Google Drive. All hunter data will be anonymised.</p> <p>2.4 Training manual produced on conservation/livelihoods data generation methods and analyses. Workshop proceedings and list of attendants.</p> <p>2.5 Reports on baseline analysis in Y1, and future directions reports produced at the end of Y3.</p> <p>2.6 Research proposals, Master's theses.</p> | <p>Nutrient composition database supervised by the project's Food and Nutrition expert, Dr. L.O'Connor at MMU. [Note: this has not held true as LOC is no longer involved in the project. She was involved at the start] Our nutritional work has been supported by Prof. Barrie Margetts (Univ. of Southampton).</p> <p>CIFOR-C intervention consultant supports the project to better understand outcomes and future prospects.</p> <p>MINFOF is able to send ecoguards to attend the training workshops.</p> |

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| <p>3 Hunting use zones maintained with hunters across 10 communities</p> | <p>3.1 By Y2, 70% of households in study communities (approx. 190 total families) participate in monitoring of wild species offtake. [note due to FPIC procedure followed, full participation cannot be guaranteed]</p> <p>3.2 By mid-Y3, community based management plan for hunting resilient, fast-breeding species established in conjunction with at least 80% of participating hunters</p> <p>3.3. By end Y3, all participating hunters commit to complying with the community-based management plan developed between them and the Darwin project</p> | <p>3.1 List of participating hunters in the project. Datasheets. Database. Hunting zone maps. Data reports.</p> <p>3.2 Community based management plans, reports/participation lists/photographs [per village probably – note communities share hunting areas, between each other and also with Bantu]</p> <p>3.3 TBD depending on the community based management plan (likely to include e.g. offtake data)</p> <p>Data reports, electronic databases. Graphical representation of trends. Hunting zone maps. Written accounts of hunter workshops. Signed declaration by hunters.</p> | <p>Local research assistants employed to support data gathering.</p> <p>Hunters are motivated to contribute to the project.</p> <p>Conditionality of no hunting of protected species created in line with health and agricultural support provided via Output 5. [future reporting should explore how this will be carried out through the project – including when and how]</p> <p>Hunting information obtained can estimate the level of protected species offtake. Use of indirect methods to determine veracity of reports. Use of targeted interview techniques can verify if hunters participating in the project are taking protected species [</p> |
| <p>4. Independent [i.e. not linked to wild meat offtake] measures of population status of protected fauna available for management purposes</p> | <p>4.1 Abundance and distribution of hunted and protected species determined through analysis and interpretation of camera trapping data throughout Y1 and Y3.</p> <p>4.2 Status of fauna determined using traditional ecological knowledge (TEK) methods through hunter perception surveys undertaken during Y1 and Y2.</p> | <p>4.1 Faunal status survey reports which determine changes in fauna during project.</p> <p>4.2 Reports of status of hunted and non-hunted prey species including analyses of depletion zones derived.</p> | <p>Increase in populations of protected species can be linked to the project's activities.</p> |

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| <p>5. Improvement of human health and livelihoods achieved through an increase in dietary intake, nutritional status, and medical interventions.</p> | <p>5.1 By Y3, food security in households participating in agricultural scheme has improved from initial baseline estimates in Y1.</p> <p>5.2 By Y3, at least 30 women farmers trained in agricultural improvement and farming techniques.</p> <p>5.3 Number of households producing their own food and commercial crops will increase by 10% compared to baseline.</p> | <p>5.1 Reports of food types consumed and origin of foods. Nutritional intake data. Household surveys of income and expenditure to assess links between food security and wealth status.</p> <p>5.2 Agricultural extension programme reports and manuals. Testimonials from people involved in the project (stories of change) to capture e.g. increased participation.</p> <p>5.3 Crop production records for all farmers participating in agricultural expansion programme.</p> | <p>Food security is measured as “physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”.</p> <p>Baseline information on health available from ZyL medics. Ethical premises of use of persons’ medical records are clear.</p> <p>Agricultural extension programmes and training of women farmers will continue to be operated by ZyL.</p> <p>Information of food production by families gathered at the start of the project.</p> |
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Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

Output 1. Research outputs

- 1.1 Assembling project resources (in-country).
- 1.2 Project launch meeting (in-country) for partners and target communities.
- 1.3 Identification and establishment of agreed parameters.
- 1.4 Establishment of Community of Practice (COP).
- 1.1 Partnership agreements between project, communities, CIFOR-C, MINFOF representatives.
- 1.2 Ongoing monitoring of data collection by communities and local partner with monthly reports.
- 1.7 Monthly reports published on website and dissemination of project newsletter.
- 1.8. Six-monthly review (data collection) of biological indicators and socio-economic surveys.
- 1.9 Six-monthly analysis of data by MMU.
- 1.10 Annual meetings of COP.
- 1.11 Six monthly project review meetings with local communities, hunters and traders and local game guards to enable feedback from beneficiaries.
- 1.12 Development of publication drafts and circulation for internal peer-review.
- 1.13 Submission of final publications to peer-reviewed journals.

Output 2. Database creation and sharing

- 2.1 Development of an electronic nutrient composition database of wild and domestic foods consumed in study area.

- 2.2 Collection of samples for nutrient composition database of foods
- 2.3 Preparation of nutrient composition database of foods for use in planned diet studies.
- 2.4 Spatial data on wildlife extraction rates, and areas hunted stored in GIS shapefiles and analysed (cross ref. Activity 3.4)
- 2.5 Results of all information gathered by the project presented to COP members and communities at end of Y1 and end of Y3.
- 2.6 Presentation of completed Masters' theses by the end of Y3.

Output 3. Hunting use zones

- 3.1 Focus group discussions with hunters to establish working practices (cross ref. Activities 1.4 and 1.8)
- 3.2 Hunter interviews to establish hunting volumes and intensity
- 3.3 Training of village reporters to document hunted prey volumes and frequency.
- 3.4 Monthly village reports of animals hunted and numbers.
- 3.4 Participatory mapping of hunting zones around target villages.

Output 4. Protected fauna

- 4.1 Baseline survey of wildlife status from hunter interviews.
- 4.2 Capacity-building training for local members of monitoring networks.
- 4.3 Camera trapping grids operational in identified hunting zones in Activity 3.4.
- 4.4 Camera trapping data analysed by MMU to detect changes in presence and abundance large-bodied/protected analysed.

Output 5. Human health and livelihoods

- 5.1 Training of household and farming survey assistants.
- 5.2 Baseline survey of home-produced foods and trade in sample households,
- 5.3 Socioeconomic surveys of sample households.
- 5.4 Baseline survey of health status in sample households
- 5.5 Nutritional assessment of sample households based on dietary recalls.
- 5.6 Baseline survey of agricultural production and activity in sample households.
- 5.7 Training of women farmers
- 5.8 Six monthly monitoring of agricultural production changes.

Annex 2 Report of progress and achievements against final project logframe for the life of the project

| Project summary | Measurable Indicators | Progress and Achievements | Actions required/planned for next period |
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| <p>Impact: Hunting and agriculture are managed sustainably to improve food security and health of rural populations through the effective and sustainable management of domesticated and wild food resources.</p> | | <p>This project can provide us with unprecedented insights in the linkages between food production, wildlife use and human health.</p> | |
| <p>Outcome: Food security and health improved in 10 Baka settlements (~190 households) in southeastern Cameroon, through the sustainable use of wildlife resources, and implementation of environmentally-friendly agricultural systems. (Note that these 10 settlements are representative of the overall Baka population in the Djoum-Mintom area of 2,000 inhabitants).</p> | <p>1.1 By end of Y2, at least a 10% increase in food security, 15% increase in dietary diversity in monitored households.</p> <p>1.2 By end of Y3 there is a 10% reduction of revenues from the hunting of resilient species in catchment areas and a 10% decrease in number of protected species hunted.</p> <p>1.3 By end of Yr3, a 10% decrease in anaemia rates in pilot Baka communities from a current 60%⁹, as a result of encouraging adequate nutrition.</p> <p>1.4 At least 50% of target communities involved in agricultural extension work are participating in project (against baseline of e.g. 13%).</p> <p>1.5 By end of Y3, there is a 10% increase in income from agriculture in 10 study villages.</p> <p>1.6 Cameroonian practitioners and university students trained on how to generate evidence for better decision-making when dealing with conservation-development interphases at the end of Y3.</p> | <p>Progress towards the attainment of these indicators is explained more in detail in the sections above.</p> | <p>We need to complete some analyses and preparation of publications and a major final report to distribute to all our national partners, as well as international collaborators.</p> |

⁹ZyL health data of Baka populations in the study region (see <http://zercaylejos.org/proyectos/health-en/?lang=en>) indicate that 78%, 79% and 60% of children (6 months – 12 years) suffer from high intestinal parasite loads, malaria and anaemia, respectively.

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| <p>Output 1. 1. Research outputs developed and shared with target audiences (local government, villagers and international development community)</p> | <p>1.1 Hunting offtake data and faunal abundance shared with MINFOF and other local and international conservation partners to increase uptake of results. COP meetings organised to disseminate and discuss results of project.</p> <p>1.2 Journal article of hunting pressures and hunting sustainability of bushmeat species submitted to open access journal by end of Y2.</p> <p>1.3 Journal article on dietary intakes and food sources of key nutrients prepared by end of Y2.</p> <p>1.4 Journal article on links between forest, domestic crops and general health, especially of vulnerable groups (children, aged <5) completed by end of Y3.</p> <p>1.5 Journal article on differences in large mammal abundance in community hunting areas vs non-hunted areas submitted by Y3.</p> <p>1.6 Report on land use and landscape analysis presented to project partners (Community of Practice, COP, collaborating universities, MINFOF) to understand conflict areas between extractive industries and livelihoods of study communities.</p> | <p>10 scientific papers written - five submitted for publication and two already published and another three in preparation (see Publications List).</p> <p>All planned scientific outputs will be shared with our collaborators before publication.</p> |
| <p>Activity</p> <p>1.1 Assembling project resources (in-country).</p> <p>1.2 Project launch meeting (in-country) for partners and target communities.</p> <p>1.3 Identification and establishment of agreed parameters.</p> <p>1.4 Establishment of Community of Practice (COP).</p> <p>1.5 Partnership agreements between project, communities, CIFOR-C, MINFOF representatives.</p> | | <p>1.1 Achieved</p> <p>1.2 Achieved</p> <p>1.3 Achieved</p> <p>1.4 Achieved</p> <p>1.5 Achieved</p> <p>1.6 Achieved</p> |

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| <p>1.6 Ongoing monitoring of data collection by communities and local partner with monthly reports.</p> <p>1.7 Monthly reports published on website and dissemination of project newsletter.</p> <p>1.8. Six-monthly review (data collection) of biological indicators and socio-economic surveys.</p> <p>1.9 Six-monthly analysis of data by MMU.</p> <p>1.10 Annual meetings of COP.</p> <p>1.11 Six monthly project review meetings with local communities, hunters and traders and local game guards to enable feedback from beneficiaries.</p> <p>1.12 Development of publication drafts and circulation for internal peer-review.</p> <p>1.13 Submission of final publications to peer-reviewed journals.</p> | <p>1.7 No specific website for the project developed since it was not considered high priority. Instead, popular articles prepared in its place.</p> <p>1.8 Achieved</p> <p>1.9 Regular review of data gathered by PL and MMU staff.</p> <p>1.10 No regular meeting organised. Partners have met <i>ad hoc</i> but COP meeting organised with all partners in March 2019. Next COP meeting cancelled due to COVID-19.</p> <p>1.11 Weekly meetings held with all project collaborators but stopped after March 2020 due to COVID-19..</p> <p>1.12 Publication drafts sent to collaborators before sent to journal.</p> <p>1.13 7 out of 10 scientific papers either published or submitted to journals.</p> | |
| <p>Output 2. Databases created and made available for use by nutrition practitioners and field managers.</p> | <p>2.1 Electronic nutrient composition database of consumed foods in study area made available from MMU server and disseminated widely to potential users by Y3.</p> <p>2.2 Spatial data on wildlife extraction patterns stored in GIS shapefiles by end of Y2.</p> <p>2.3 Wildlife use and extraction data stored in electronic database for use by project partners from end of Y3,</p> <p>2.4 In Y3, final workshop organised to train practitioners (e.g. MINFOF, Forest Peoples, Centre for Environment and Development, others) and Cameroonian university students on how to gather relevant data to understand conservation/development issues using our project area as a model.</p> <p>2.7 In Y1 and Y3, baseline and post-project review workshops respectively, organised with project partners and other stakeholders.</p> | <p>2.1 Nutrient composition database from other sources to be completed by end of project and shared with relevant national authorities, no bromatological analyses of wild meat and plants possible due to cost of exporting biological samples;</p> <p>2.2 All participatory hunting maps for Phase I and Phase II villages stored as GIS shapefiles available in the project's Google Drive; maps included in publication.</p> <p>2.3 Gathered hunting data (offtake and hunter follows) during Y1 and Y2 stored in Excel datasheets and deposited in the project's Google Drive; analyses included in publication.</p> <p>2.4 Practitioners' workshops planned for Y3 not possible due to COVID-19.</p> <p>2.5 Final post-project workshop cancelled due to COVID-19.</p> |

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| | 2.8 At least 4 Master's student projects, a minimum of 2 from Cameroon, resulting from research undertaken for Outputs 3-5 completed by end of Y3. | 2.6 MSc students could not be recruited but four pre-doctoral students from the University of Douala via our colleague (Dr. Jean-Lagarde Betti) from the Higher Teacher Training College of Bertoua trained and completed consultancy of use of forest plants for the Darwin project. Field work completed and publication submitted to journal. |
| Activity 2.1 Development of an electronic nutrient composition database of wild and domestic foods consumed in study area. 2.2 Collection of samples for nutrient composition database of foods 2.3 Preparation of nutrient composition database of foods for use in planned diet studies. 2.4 Spatial data on wildlife extraction rates, and areas hunted stored in GIS shapefiles and analysed (cross ref. Activity 3.4) 2.5 Spatial analyses of hunting areas and hotspots undertaken by MMU. | | 2.1 In progress. To be completed. 2.2 Not possible due to high export costs. 2.3 In progress. To be completed by end of project. 2.4 Spatial data on hunting zones and hunter follows stored in GIS platforms. Data shared between field team and MMU. To be shared with MINFOF and other organisations such as Forests Peoples Programme. 2.5 Done. |
| Output 3. Hunting use zones maintained with hunters and meat traders across 10 communities respecting agreed quotas. | 3.1 By Y2, 70% of households in study communities (approx. 190 total families) participate in monitoring of wild species offtake. [note due to FPIC procedure followed, full participation cannot be guaranteed] 3.2 By mid-Y3, community-based management plan for hunting resilient, fast-breeding species established in conjunction with at least 80% of participating hunters 3.3. By end Y3, all participating hunters commit to complying with the community-based management plan developed between them and the Darwin project | 3.1 Full participation of inhabitants of all villages achieved. We obtained data on 1,946 hunting trips by 133 hunters (130 men, 3 women). This met the target of 70% of all households involved in this part of the project. 3.2 Discussions with hunters on setting hunting goals and manage hunting practices started in Y2 and completed during Y3. This information will set the basis for a way forward for all communities to manage their wildlife resources. Full report will be available by the end of the project. 3.3 Offtake data on hunting of protected species collected during Y1 and Y2 shows that protected species are not important for villagers' food security or livelihoods. Given this result, we do not consider it necessary to urge any compliance on this point. However, in the document to be produced in 3.2. we recognise the importance of villagers to respect the Cameroonian hunting laws that prohibit the hunting of protected species. |
| Activity 3.1 Focus group discussions with hunters to establish working practices 3.2 Hunter interviews to establish hunting volumes and intensity | | 3.1 Achieved. 3.2 Achieved. |

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| <p>3.3 Training of village reporters to document hunted prey volumes and frequency.</p> <p>3.4 Monthly village reports of animals hunted and numbers.</p> <p>3.5 Participatory mapping of hunting zones around target villages.</p> | | <p>3.3 Achieved.</p> <p>3.4 Achieved.</p> <p>3.5. Achieved.</p> |
| <p>Output 4. Independent [i.e. not linked to wild meat offtake] measures of population status of protected fauna available for management purposes</p> | <p>4.1 Abundance and distribution of hunted and protected species determined through analysis and interpretation of camera trapping data throughout Y1 and Y3.</p> <p>4.2 Status of fauna determined using traditional ecological knowledge (TEK) methods through hunter perception surveys undertaken during Y1 and Y2.</p> | <p>4.1 All camera trapping data for 3 grids in hunting zones analyses and prepared for publication.</p> <p>4.2 Questionnaires analysed and data prepared for publication.</p> |
| <p>Activity</p> <p>4.1 Baseline survey of wildlife status from hunter interviews.</p> <p>4.2 Capacity-building training for local members of monitoring networks.</p> <p>4.3 Camera trapping grids operational in identified hunting zones in Activity 3.4.</p> <p>4.4 Camera trapping data analysed by MMU to detect changes in presence and abundance large-bodied/protected analysed.</p> | | <p>4.1 Hunter/fisher surveys not undertaken in Y2. Further interviews planned for early Y3.</p> <p>4.2 To be undertaken in Y3.</p> <p>4.3 No camera trapping undertaken during Y2. Y1 camera trap data analysed and prepared for publication.</p> <p>4.4 Achieved. Two MMU MSc students involved in the data analyses.</p> |
| <p>Output 5. Improvement of human health and livelihoods achieved through an increase in dietary intake, nutritional status, and medical interventions.</p> | <p>5.1 By Y3, food security in households participating in agricultural scheme has improved from initial baseline estimates in Y1.</p> <p>5.2 By Y3, at least 30 women farmers trained in agricultural improvement and farming techniques.</p> <p>5.3 Number of households producing their own food and commercial crops will increase by 10% compared to baseline.</p> | <p>5.1 Baseline estimates of human health, food consumption and nutritional intake completed.</p> <p>5.2 From 11 women participating in our agricultural programme in 5 villages at the start of the programme in 2017, as many as 68 women were trained the programme in 2019. Women participation by 2019 was 55%.</p> <p>5.4 Baseline information of number of households producing their own crops obtained.</p> |

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| Activity | |
| 5.1 Training of household and farming survey assistants. | 5.1 Achieved. |
| 5.2 Baseline survey of home-produced foods and trade in sample households, | 5.2 Achieved. |
| 5.3 Socioeconomic surveys of sample households. | 5.3 Achieved. |
| 5.4 Baseline survey of health status in sample households | 5.4 Achieved. |
| 5.5 Nutritional assessment of sample households based on dietary recalls. | 5.5 Achieved. |
| 5.6 Baseline survey of agricultural production and activity in sample households. | 5.6 Achieved. |
| 5.7 Training of women farmers | 5.7 Achieved. |
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Annex 3 Standard Measures

| Code | Description | Total | Nationality | Gender | Title or Focus | Language | Comments |
|--------------------------|----------------------------------------------------------------------------------------------------------|-------|-------------|---------|------------------------------|--------------|----------|
| Training Measures | | | | | | | |
| 2 | Number of Masters qualifications obtained | 6 | Cameroonian | 4F/2M | Use of forest plants by Baka | French | |
| 6a | Number of people receiving other forms of short-term education/training (e.g., not categories 1-5 above) | 30 | Cameroonian | 62F/56M | Agricultural training | French/Bolou | |

| Research Measures | | Total | Nationality | Gender | Title | Language | Comments/ Weblink if available |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------|-------|-------------|-------------|-------------|-------------|-----------------------------------|
| 11b | Number of papers published or accepted for publication elsewhere | 10 | See Annex 5 |
| 12a | Number of computer-based databases established (containing species/generic information) and handed over to host country | 3 | | | | | |

| Dissemination Measures | | Total | Nationality | Gender | Theme | Language | Comments |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------|--------|----------------------------------------|----------------|----------|
| 14a | Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work | 2 | Cameroonian/ Spanish/British | 5F/20M | Community of Practice meetings | French/English | |
| 14b | Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated. | 1 | Spanish, Cameroonian | 2 F/1M | Talk in Congo Basin Institute, Yaoundé | French/English | |

| Physical Measures | | Total | Comments |
|--------------------------|------------------------------------------------------------------------|--------------|-----------------|
| 20 | Estimated value (£s) of physical assets handed over to host country(s) | £ | 2 Vehicles |

Annex 4 Aichi Targets

| | Aichi Target | Tick if applicable to your project |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 1 | People are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably. | X |
| 2 | Biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems. | X |
| 3 | Incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions. | |
| 4 | Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits. | |
| 5 | The rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced. | |
| 6 | All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits. | X |
| 7 | Areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity. | X |
| 8 | Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity. | |
| 9 | Invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment. | |
| 10 | The multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning. | |
| 11 | At least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes. | |
| 12 | The extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained. | |
| 13 | The genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity. | |
| 14 | Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, | X |

| | | |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| | taking into account the needs of women, indigenous and local communities, and the poor and vulnerable. | |
| 15 | Ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification. | |
| 16 | The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation. | |
| 17 | Each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan. | |
| 18 | The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels. | X |
| 19 | Knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied. | X |
| 20 | The mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties. | |

Annex 5 Publications

| Type * (e.g. journals, manual, CDs) | Detail (title, author, year) | Nationality of lead author | Nationality of institution of lead author | Gender of lead author | Publishers (name, city) | Available from (e.g. web link, contact address etc) |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------|--------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Journal | Diet and nutrition of sedentarised Baka Pygmies in southeastern Cameroon, Ávila Martín, E., Ros Brull, G., Funk, S.M., Fa, J.E., to be submitted | Spanish | Spanish | Female | <i>Journal of Human Nutrition and Dietetics</i> , Wiley | In preparation |
| Journal | Wild meat hunting and use by sedentarised Baka Pygmies in southeastern Cameroon, Ávila Martín, E., Ros Brull, G., Funk, S.M., Luiselli, L., Okale, R., Fa, J.E., 2020 | Spanish | Spanish | Female | <i>PeerJ</i> , O'Reilly and SAGE | https://peerj.com/articles/9906/ |
| Journal | Ethnobotanical study of edible wild plants used by Baka in the Mintom subdivision, South Cameroon, Billong Fils, P.E., Afiong Nana, N., Betti, J.L., Farick Njimbam, O., Tientcheu Womeni, S., Funk, S.M., Ávila Martín, E., Ros, G., Okale, R., Fa, J.E., Funk, S.M., 2020 | Cameroonian | Cameroonia n | Male | <i>Journal of Ethnobiology and Ethnomedicine</i> , Springer Nature | https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-020-00413-0 |
| Journal | Status of hunted fauna in non-protected areas in southeastern Cameroon. Rivers, R., Cain, B., de Kort, S., Jones, M., Ros Brull, | British | British | Female | <i>Oryx</i> , Cambridge University Press | In preparation |

| | | | | | | |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|--------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| | G., Ávila Martín, E., Okale, R., Fa, J.E., to be submitted | | | | | |
| Journal | Hunting territories and land use overlap in sedentarised Baka Pygmy communities in southeastern, Fa, J.E., Ros Brull, G., Ávila Martín, E., Okale, R., Fouda, F., Fáfán, M.A., Fisher, R., Funk, S.M., 2021 | British | British | Female | <i>Scientific Reports</i> , Springer Nature | https://www.nature.com/articles/s41598-021-83223-y |
| Journal | Understanding growth and malnutrition in Baka Pygmy children. Funk, S.M., Palomo Guerra, B., Bueno Zamora, A., Ickowitz, A., Afoumpam Poni, N., Aminou Abdou, M., Hadam Sibama, Y., Penda, R., Ros Brull, G., Abossolo, M., Ávila Martín, E., Okale, R., Ango Ze, B., Moreno Carrión, A., García Sebastián, C., Ruiz de Loizaga García, C., López-Romero Salazar, F., Amazia, H., Álvarez Reyes, I., Sánchez Expósito, R., Fa, J.E., 2020 | German | British | Male | <i>Human Ecology</i> , Springer | https://link.springer.com/article/10.1007%2Fs10745-020-00161-5 |
| Journal | Divergent trajectories of BMI over age for adult Baka Pygmy people and their sympatric non-Pygmy populations. Funk, S.M., Palomo Guerra, B., de Mena Martínez, N., Ickowitz, A., Fa, J.E. | German | British | Male | <i>Human Ecology</i> , Springer | https://doi.org/10.1007/s10745-020-00151-7 |
| Journal | Traditional hunting rules and governance in Baka communities in southern Cameroon. Ros Brull, | Spanish | Spanish | Male | <i>TBA</i> | In preparation |

| | | | | | | |
|---------|-----------------------------------------------------------------------------------------------------------------|---------|---------|--------|------------------------------------------------|----------|
| | G., Ávila Martin, E., Funk, S.M., Fa, J.E., in preparation | | | | | |
| Journal | Poverty and health in Baka Pygmy populations. Ros Brull, G., Funk, S.M., Ávila Martin, E., Okale, R., Fa, J.E. | Spanish | Spanish | Male | <i>Journal of Poverty</i> , Haworth Press Inc. | In press |
| Journal | The COVID-19 pandemic endangers Africa´s indigenous Pygmy populations, Fa, J.E., Nasi, R., Funk, S.M., in press | British | British | Female | <i>EcoHealth</i> , Springer | In press |

Annex 6 Darwin Contacts

| | |
|-------------------------------|-------------------------------------------------------------------------------|
| Ref No | 24-029 |
| Project Title | Enabling Baka attain food security, improved health and sustain biodiversity |
| Project Leader Details | |
| Name | Prof. Julia Elizabeth Fa |
| Role within Darwin Project | Main Project Coordinator |
| Address | |
| Phone | |
| Skype | |
| Email | |
| Partner 1 | |
| Name | Ms. Loreto Rebollo |
| Organisation | Zerca y Lejos |
| Role within Darwin Project | Responsible for coordination of activities in Cameroon |
| Address | |
| Fax/Skype | |
| Email | |
| Partner 2 etc. | |
| Name | Mr. Richard Eba'a Atyi |
| Organisation | Coordonnateur Regional, CIFOR Afrique Centrale |
| Role within Darwin Project | Logistical and administrative support of Darwin project in-country activities |
| Address | |
| Fax/Skype | |
| Email | |

Annex 7 Supplementary material (optional but encouraged as evidence of project achievement)

3 Checklist for submission

| | Check |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Is the report less than 10MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line. | X |
| Is your report more than 10MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line. | |
| Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report. | X |
| Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic. | |
| Have you involved your partners in preparation of the report and named the main contributors | X |
| Have you completed the Project Expenditure table fully? | X |
| Do not include claim forms or other communications with this report. | |