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The Chronicles of Kunene: The Lion, the Omuhimba and the Drone

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Abstract. Many technology projects are driven by (hidden) agendas which prioritize the one or the other stakeholder or the technology itself, thereby creating tensions and compromising important perspectives. In the field of digital conservation and wildlife management, the focus has often been on safeguarding wildlife (the lion), not incorporating socio-economic factors of communities (the Omuhimba), by exploiting technologies concerned with wildlife data collection only (the drone). Concerned with reconciling heterogeneous perspectives the authors present the development and conceptualisation of an integrated wildlife monitoring system in Southern Africa. The authors postulate that a community-based co-design approach, grounded in the Ubuntu philosophy, leads to novel and innovative technology designs embracing ecocentrism.

Keywords: African Indigenous Knowledge System, Community-based co-design, Innovation, Conservation technologies, Human-Wildlife Conflict, Rural Communities, Chronicles of Kunene, Digital Platform, Southern Africa, Innovation practices

1 Introduction

Many a time technology projects are driven by (hidden) agendas which prioritize the one or the other stakeholder or the technology itself, thereby neglecting important points of views and needs. In the field of digital conservation and wildlife management, the focus has often been on safeguarding wildlife (the lion), not incorporating socio-economic factors of communities (the Omuhimba), by exploiting technologies concerned with wildlife data collection only (the drone). The authors are concerned with reconciling those different viewpoints within an integrated ecological approach.

Framed in an ecocentric paradigm, the authors postulate that a community-based co-design (CBCD) approach, grounded in the Ubuntu philosophy considering local indigenous practices, leads to novel and innovative technology designs embracing multiple perspectives. Thus the objective of this chapter is to demonstrate that a participatory approach, such as CBCD contributes towards a

digital transformation of indigenous communities in the global south, embracing ecocentrism and yielding in novel locally situated technology developments.

In this chapter, the authors present a case study demonstrating the tensions between communities, technologies and animals as well as the conceptualisation and development of an integrated wildlife monitoring system in Southern Africa, considering heterogeneous perspectives. The case study was part of a recently concluded multinational and multidisciplinary project in Iona National Park (Angola), and adjacent to the Skeleton Coast National Park in Namibia that form part of Iona-Skeleton Coast Transfrontier Conservation Area (TFCA). The project aimed “to strengthen cross-border ecosystem management and wildlife protection through co-designing and implementing conservation monitoring technology with the park authorities and surrounding communities” [36].

2 Theoretical and Methodological Framing

Ecocentrism in alignment with African indigenous perspectives builds this case study’s theoretical frame deploying a community-based co-design methodology.

2.1 Ecocentrism

Ontologically, humanist approaches view design as an exclusively human endeavour, therefore amplifying human values and perceptions [58]. However, it is imperative to think beyond anthropocentrism, and evaluate the inclusion of other species [2] and objects, at least conceptually. The de-centring from the human is referred to as posthumanism [18], rooted in the fundamental ecocentric entanglements with the world [58].

Ecocentrism, as a philosophy, builds on the accentuation of non-human nature, with specific emphasis on decision making diverging from an anthropocentric stance [31, 45]. Ecocentrism goes above the advocacy of living things, as prescribed by biocentrism, to include the entire ecosystem and its abiotic nature [31]. According to Payne [39], “ecocentrism provides a way into making meaning of the many moral stances, value positionings and existential conditions we ordinarily occupy or create as pedagogues, researchers, scholars and policy-makers”. Mainstream technology design has not yet mastered the inclusion of other beings [2]. Aspling [2] maintain that the involvement of nonhuman species in technology design contexts leads to novel concepts and possibilities. To bask in the current and future possibilities of ecocentrism, futuring is endorsed. According to Hoffman et al [19], futuring is the active process of imagining the future, in which we find a conglomerate of approaches that are concerned with “future alternatives” [26]. Specifically, design futuring approaches seek to re-envision and envision optimum futures and alternatives [26, 32], including ecocentric futures.

2.2 African Indigenous perspectives

African philosophy accords itself with biocentrism and ecocentrism [16]. Indigenous worldviews are holistic, wherein all species are interconnected, as opposed

to an individualistic perspective that views the world in separate spectrums [3]. Indigenous communities place great emphasis on living harmoniously with the environment [48]. This is articulated in the African philosophy of *Ubuntu*, a word derived from the *Nguni languages* which means "humanness" [14], in its wider sense. Ubuntu is well-known for the short phrase: *Umuntu ngumuntu ngabantu* which translates to "A person is not a person without other people" [33], emphasizing the interconnectedness. Innately, Ubuntu is more than a word, it is an African way of living, in kindness, harmony, consideration, respect, peace, love and care - embedding sharing, altruism, social maturity and sensitivity, virtuosity and striving for conciliation [29]. Thus, local indigenous communities have formed inseparable relationships with different species that inhabit the same physical contexts as them [28]. As a result, indigenous communities have gained an understanding of wildlife behaviour, phenology and abiotic indicators, allowing for effective conservation and sustainable use of natural resources, and organisation of ecological knowledge [57, 1, 15, 25]. It is imperative to leverage this indigenous knowledge and local expertise in the development of ecological strategies, tools and technologies through the involvement of indigenous community members [69, 25, 34].

2.3 Community-Based Co-design

Community-based co-design (CBCD), conceptualised by Winschiers-Theophilus et al [63], is based and refined on empirical work with indigenous and marginalised communities in Southern Africa [64], framed within an Afrocentric research paradigm [35] and Ubuntu epistemology [54]. CBCD is methodologically derived from action research and participatory design. The fundamental embodiment of CBCD is based on the established premise of co-creating locally appropriate applications [64], enabling designers and stakeholders to work in tandem as co-designers while developing solutions that address local challenges [51].

CBCD focus on community values, and a realization that communities are organised by protocols and culture. Any collaborative technology effort with a community in the Global South necessitates a continuous negotiation of how the collaboration must respect local views and values [62]. Kapuire et al [23] observe that Ubuntu values, such as togetherness and care are practised by local African communities, and therefore can and should be incorporated into technology design processes simply by respecting and acknowledging communities design inputs. Through embracing Ubuntu in CBCD, technology developers are 'being participated' by immersing in the community, following local and newly negotiated protocols thereby incorporating local values and practices Winschiers-Theophilus et al [62]. Blake [4] further suggest a paradigm shift, integrating Ubuntu values in Software Engineering methods through allowing for and learning from unintended uses of software by communities. Ssozi-Mugarura et al [50], working on ICT enabled water management in Uganda stated: "CBCD has offered us a basis for continuous engagement with communities to understand their context, their needs and aspects in their environment that easily affect technology adoption and use." CBCD encompasses what Crabtree et al [9] call "invisible

work”, where the respect for local protocols is essential to ensure collaboration and technology adoption [38]. Of significance in CBCD is the concept of reciprocity [6], ensuring all stakeholder benefit from the participation. Rizzo et al [44] specifies how an approach such as CBCD facilitates an environment where technology appropriation, in essence technology innovation, can occur, as users are given a voice in design activities. CBCD has found many applications in the technology and service sector [12], allowing for situated innovation practices.

3 Case study context

3.1 Communities

The majority of TFCA inhabitants are of the Ovahimba tribe. The Ovahimba are semi-nomadic pastoralists who place emphasis on ownership of substantial numbers of livestock. It is common practice for a patriarch in the Ovahimba community to own herds of more than a thousand goats and cattle. The Ovahimba live in conservancies, which were gazetted by the Namibian government. Conservancies are land zones implemented to enable the protection and growth of natural resources such as wildlife and plants [7]. Administration of the conservancies is in the form of Community Based Natural Resource Management (CBNRM), on the basis that communities who are dependent on natural resources for their livelihoods are usually motivated to conserve such resources [69, 22].

3.2 Tensions and challenges

CBNRM has had ambivalent results, considering some communities have not been able to fully comprehend the management of their conservancies [52]. The challenges include inconsistent and negligible data collection through an array of tools and practices that are not intuitive. Additionally, limited technical skills, insufficient wildlife monitoring mechanisms, drought, illegal plant and tree felling, encroachment, lack of diversified livelihood alternatives, dwindling species populations, and primarily Human-Wildlife Conflict (HWC), further escalate the diminution of wildlife and biodiversity populations [42, 66, 60].

Non-lethal methods such as translocation of animals, livestock guarding dogs and herding are used to mitigate HWC [46]. However, such methods tend to be one-sided and ineffective, as wildlife continue to suffer the obstructive consequences of human growth and development [59]. Equally current policies have not taken into consideration the perspectives, desires, capabilities, environment, as well as previous and current undertakings of the affected communities [36]. With an obvious conflict of habitats between wildlife and humans and the consequent tensions in strategies prioritizing the one over the other, the authors postulate that an ecocentric paradigm should be applied in the development of technologies mitigating HWC.

3.3 Wildlife Monitoring

The task of wildlife protection is tedious, taxing, and requires tremendous human effort together with computed oversight to be effective [56]. It requires systematic and effective monitoring, collection of data and responsiveness [30]. Specific understanding of fundamental ecological factors such as animal habitat use, animal movement and activities, through wildlife monitoring and data collection, is necessary to address HWC and other resounding environmental challenges that persist, resulting in the preservation of endangered species [37].

However, there is a lack of monitoring methods that offer long term, real-time and efficient data [27]. Traditional methods of monitoring usually require researchers and game guards to walk extensive distances, to track animals and collect desired data [37]. While monitoring technology such as camera traps exist, they require exacting manual data collection [11]. Hence, for enhanced and convenient use, wildlife monitoring systems should allow for a collective configuration and integration of technologies as per the needs, values and ecological perspectives of conservationists [40]. .

3.4 Towards an integrated wildlife monitoring system

The authors argue that an integrated wildlife monitoring system, needs to reconcile the aspects of protecting wildlife with socio-cultural practices of the community as well as a sustainable deployment of appropriate technologies. Although, the design actions described in this chapter appear anthropocentric, they were framed within ecocentrism and Ubuntu recognizing interconnectedness of living beings and their environment, including technologies. To this effect, *Okuwonga* was conceptualised and partially implemented. In the local indigenous Otjiherero language, ‘*Okuwonga*’ means collection. *Okuwonga* is an integrated digital wildlife monitoring and data collection system, which is comprised of a custom digital data collection mobile application, known as Wildlife Activity Recording (WAR) app, drones and camera traps. *Okuwonga* intends to facilitate and enable harmonious coexistence between local communities and wildlife living in community-managed conservancies, therefore curtailing HWC. This is achieved through the constant non-obstructive collection and dissemination of wildlife data and continuous monitoring, providing insight and consciousness on environmental patterns such as movement and presence of predators. In addition to providing an empirical and fundamental premise onto which a rural digital system can be established, the conceptualisation of *Okuwonga* provides a blueprint on the integration and interface of mainstream and emerging technologies within a rural indigenous space, focusing on the prioritisation of local community and wildlife peculiar use cases and the necessary appropriation of technology to fulfil the use cases.

3.5 Development Approach

In the pursuit of appropriate and intuitive technological solutions for challenges faced by communities that manage conservancies, the authors employ, affirm

and extend Community-Based Co-Design (CBCD) [64] as a design practice and interface to stimulate and propel meaningful innovations. Local rural indigenous communities, through CBCD, were involved in a series of technology design and appropriation activities, transforming established yet inefficient practices and processes, and informing design with their vivid and inestimable knowledge and viewpoints. Their viewpoints, unconventional and novel, beget innovative designs, concepts and use cases that broaden the applicability and successful integration of mainstream and emerging technologies [55]. A revolving emphasis is placed on how the intentional and coordinated involvement of indigenous rural communities and their encompassing ecological views have invoked innovative novel use cases that are explicit and appropriate for rural contexts. In practice, the use cases offer technology developers insights, as they expand initial design and use to actual rural end users [10, 61, 11].

4 Co-design of *Okuwonga*

The co-design activities begin with a contextual inquiry focusing on local practices and the human perspective, followed by the design of technology encompassing the aim of wildlife protection. The last step includes an exploratory design of emerging technologies to complete the integrated system, *Okuwonga* (Figure 6).

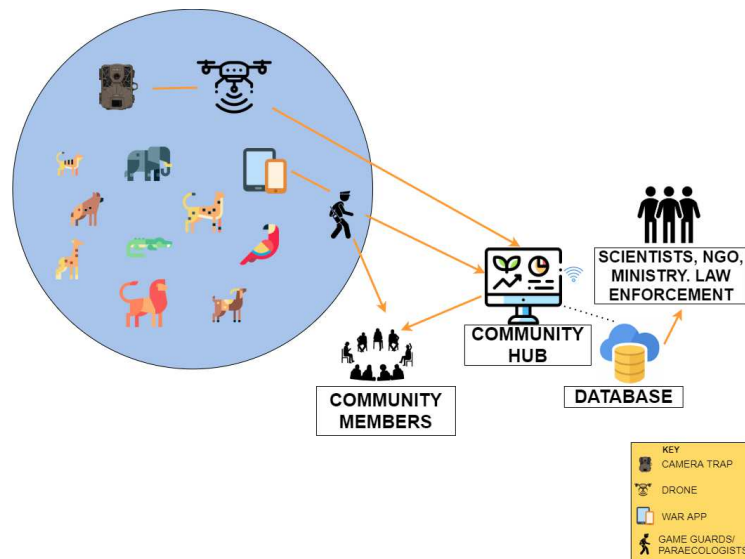


Fig. 1: Okuwonga digital data collection and monitoring system

4.1 The Omuhimba

Indigenous Communities in the TFCA have over time developed several conservation practices partially influenced by their own indigenous practices, such as game patrols. Game guards roam around a conservancy in search of any signs of illegal activities or predator sightings [66]. They use a range of techniques to track intruders and predators, such as inspecting footprints and paws, and detecting animal carcasses either as traps or remains of a predator attack. Additionally, herding is practiced, as a preventative measure practiced for livestock protection. It is a treasured ancient custom dating millenniums, whereby herders stringently supervise, guide and support livestock as it roams and grazes to prevent predatory attacks [47]. Kraals are used as shelter and barriers to prevent livestock from roaming unsupervised, in addition to shielding livestock from predators [49]. There are instances, especially during droughts, where predators obtrude local villages in search of prey. To this effect, they pose a danger to humans and livestock. Hence, community members set up innocuous predator traps to lure and capture predators [43].

As part of CBNRM, the government of Namibia runs yearly game counts, which are routine wildlife censuses [53], in collaboration with the communities to inform national strategies in regard to ecosystem management decisions. Regular data is collected through paper event books, which the game guards carry and complete to the best of their skills. Community members work alongside with scientists as local para-ecologists, collecting and providing essential ecological data, knowledge and insight, which the scientists would have found difficult to otherwise discover [41]. It has been planned that the para-ecologists will be compensated and recognised for their contributions, consequently creating an alternative source of income. Simultaneously, the para-ecologists will observe, record and preserve the data, and thereafter, pass it down to younger generations.

Furthermore considering that, an integration and automated analysis of all data [56] is not readily available, local community members will do a first-level analysis of the data collected through *Okuwonga*.

4.2 The lion

Throughout the project, Muashekele et al [36] co-designed with local game guards the WAR app (Figure 4). The app went through several iterations, starting with its co-design, development and validation, until its subsequent deployment. The co-design endeavours were based on comprehending the context of the conservancies in the TFCA by establishing the current conservation tools and practices, their advantages and demerits, as well as identifying appropriate alternatives. During a series of co-design workshops, the game guards, together with the authors, outlined designs comprising features and functionality that ensure the WAR app's intuitiveness within its context of use. As reference points for the designs, the game guards expounded their local conservation practices and deliberated on their experiences with different applications such as WhatsApp. The deliberations extended to the specific features and functions that the game

guards deem as necessary for a wildlife data collection tool. Thereafter, the features were sketched on paper, offering the game guards a visual representation of the WAR app. Features include custom icons, custom buttons, a camera module and a voice recorder, necessitated by the low literacy rate and overall preference of visual and audio among the game guards. The icons designed represent various wildlife, activities and local practices, thus meaningful and aligned to the local conservation practices and wildlife that the game guards are accustomed to. An automated location tracker and date and time picker were also incorporated, after the game guards detailed the challenges they faced reading conventional maps, and identifying conventional date and time, which are auxiliary tools for the use of the Event Book.



Fig. 2: Co-designing WAR app



Fig. 3: WAR app in use

The WAR app has been used in different scenarios; HWC incident recording, encroachment, conservancy meetings, game patrols and predator sightings, with specific focus on capturing scarce carnivores - lions, cheetahs, hyenas and leopards. Imperatively, the game guards affirmed the above affordances as essential in eradicating HWC. During use, the game guards affirmed the app's appropriateness. Stating that it is their 'memory', as they store and reference what they have seen through the app. Images taken with the app serve as evidence of transgressions against wildlife, for which if there was no visual evidence would have gone unpunished, which is a common occurrence in conservancies. The app achieves additional pertinence through its instant data sharing and amalgamation abilities. The data is decisive for determining wildlife behaviour and phenology indicators, and fostering wildlife awareness and appreciation amongst community members. In addition, it is used to intensify HWC warning and prevention - for instance, alerting the game guards about the presence of lions, giving game guards enough time to enforce conflict preventative measures.

However, there are challenges associated with the synchronisation of the data to the database. The WAR app currently requires an Internet connection for the synchronisation to take place. This is challenging because the areas in which the game guards are based have intermittent network connectivity, thus the

data is not frequently and timely synchronised to the database. Ergo, provisions have recently been established in the form of community technology hubs with satellite Internet, a data portal and rugged computers for the transfer and display of WAR app data.

4.3 The Drone

Camera traps In the first phase of the project, camera traps, as an established conservation monitoring technology that enables the collection of large amounts of digital wildlife data remotely [68] were used. They capture footage of wildlife in their natural habitat without human interference [41], reducing wildlife inconvenience and exasperation, whilst extending post-human data collection. Ergo, co-design activities with game guards were undertaken, whereby contextual applications of camera traps were devised. The primary application, as stated by the game guards, is the collection of wildlife data in strategic locations within conservancies. Given the limited number of camera traps that were available, the game guards deliberated amongst themselves, extensively, to determine the locations that are appropriate for camera trap placement. Several locations were selected, based on the different experiences and knowledge of the game guards regarding the primary locations of wildlife. Thereafter, camera traps were installed in the selected locations. A set of camera traps were placed at the edge of the main river separating Namibia and Angola, with the intention of continuously recording wildlife and other occurrences at the river. Another set of camera traps were placed at wildlife hot spots. The spots were selected due to the high frequency of animals in those areas for water and feed. Also, the areas had little human movement or interference, thus making them ideal for the placement of camera traps. The game guards further specified where and how the camera traps should be attached, to avoid meddling by wildlife and humans.



Fig. 4: Installing camera trap



Fig. 5: Camera trap image

Due to its omnipresence, the game guards view the camera trap as their proxy. According to them, camera traps will conciliatory capture images of sporadic wildlife such as lions, hyenas and leopards, which would otherwise be difficult to do with traditional means. As well, the camera traps will cause caution amongst encroachers, as they will be aware of the constant surveillance in a conservancy. Therefore, reducing wildlife maltreatment and extermination.

Currently, the camera traps installed in the conservancies are not connected to any wireless network, thus requiring game guards to manually retrieve data. This is arduous because the camera traps are located many kilometres away from the villages where game guards reside. Therefore, game guards have to walk for prolonged periods, amounting to several days, to collect the data on the camera traps, risking predatory attack. Thus the idea of integrating a drone arose.

Drone usage scenarios Ongoing improvements in unmanned aerial vehicles (drones) have made them ideal tools to support conservation efforts [5]. An automated drone system offers conservationists and scientists a means of automating and enhancing laborious and manual data collection processes [21]. Such systems provide new prospects for the ecocentric study of habitat and behaviour of species [37]. Thus, it can be argued that drones can be used to enable the comprehension of native wildlife and surrounding ecosystems, leading to enhanced conservation and resource management efforts [21].

A series of co-design workshops, during which game guards designed the integration of a drone into the TFCA, proffered a data collection and transfer process as part of *Okuwonga*. First, the game guards and community members flew a drone in order to familiarise themselves with its functionality and possible use. Thereafter, they had focus group discussions, together with the authors, in order to determine the possible use cases of the drone. The primary use cases identified were wildlife monitoring, surveillance and data collection by capturing aerial footage during patrols and game counts. It was advanced that the drone presents an opportunity to create new patrol and game count routes as the drone can carry out surveillance and monitor in areas which are deemed most appropriate but difficult to navigate by foot or vehicle. According to the game guards, drone-enabled monitoring will produce new forms of data that offer an elevated ecocentric viewpoint regarding wildlife movement and possible encroachment activities.

Last, the game guards and the authors outlined a future drone protocol, which prescribes how the drone will be used in relation to other technologies, specifically the camera trap. The protocol encompasses a drone attached with a Raspberry Pi microcomputer that creates an ad-hoc network for the transfer of data from a camera trap to the microcomputer for temporary storage. First, a drone will fly to the location of a specific camera trap. Thereafter, the camera trap will connect to the network broadcast created by the microcomputer. Upon successful connection, a script to commence data transfer and other maintenance tasks will be executed automatically, compensating for the intermittent Internet connection. Second, the drone will fly to a community technology hub, where

servers, a data portal and computers for data storage will be hosted for data extraction, processing and transfer. The data will then be assessed by community members and replicated to cloud servers to enable remote access by different stakeholders such as the Ministry of Environment, conservation scientists, NGOs and law enforcement agencies for further action.



Fig. 6: Game guards and community members flying drone

5 Community-based co-design as an innovation enabler

Previous applications of CBCD have demonstrated its methodological strength in creating innovative technologies, such as the secret sign language app with a Penan community in Borneo [67], the augmented reality mementos with a rural San community in Namibia [65], or a crowd sourcing tool with an Ovahimba community in Namibia [8]. CBCD prioritises technology improvements and appropriation activities, ultimately leading to innovative products with higher product quality and enhanced relevance [13, 24]. Based on the premises of participatory design, when indigenous rural communities are involved, they infuse their own local practices and values into the design of the technology. It is thus at the intersection of cultures and epistemologies, within a specific design context, that novel and unique ideas and technology concepts are created as enabled through CBCD. This epitomises the creation of innovation ‘through new combinations of knowledge’ as accented by Hooli et al [20].

In the case study presented, *Okuwonga* encompasses indigenous perspectives as much as an ecocentric approach, thereby representing a unique and novel

solution. Its use cases are novel and anomalous, as they prescribe and align mainstream technology into a rural context, expanding initial design and use. They conform to the established delineation of innovation, which emphasises new or improved products and processes [17]. Key was the close collaboration and number of co-design sessions held over a period of three years, whereby all stakeholders learned about each others perspectives as well as explored, physically and conceptually, possible usages of technologies. Ubuntu was not only guiding design interactions in terms of emphasising interrelations as design partners but also influenced the design outcome in terms of creating a solution which reconciles positions of humans, animals and technology.

In the pre-design sessions, local communities delineated and reflected on their own CBNRM challenges. In collaboration with the authors possible solutions were co-designed and in a number of cycles prototyped and re-designed until a workable solution was developed [36]. Thereby the local community members acquired technical as well as design skills which amalgamated with their indigenous knowledge and practices resulted in very mature design contributions, incorporating their holistic worldview. The Ovahimba's indigenous inclination to ecosystem interconnectedness, communities advocated for technologies to be used to benefit nonhuman species. Hence, during the CBCD sessions, game guards placed particular emphasis on the consideration of wildlife's essentiality.

6 Conclusion

In this chapter the authors presented a case study demonstrating that CBCD enabled the design of a complex, novel and unique integrated wildlife management system, which reconciled three different perspectives, namely the communities', the wildlife's and the technologies'. Framed in ecocentrism, integrating indigenous perspectives and following the ubuntu philosophy, joint co-design and exploration sessions were carried out emphasizing connectedness. The authors argue that CBCD is an innovation practice which promotes digital transformation of Global South communities in their own terms, embracing local practices and epistemologies.

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