

Development of a regional capacity in natural capital accounting of protected areas in West Africa

C. Van den Hoof, L. De Nocker, A. A. Sanon, S. Tiemtoré, M. Buchhorn and B. Smets



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Executive summary

West Africa is characterized by rapid population growth, endemic poverty and poor governance and management of natural resources (Marc, 2015; World Bank, 2022). This situation is exacerbated by the negative effects of climate change (Awojobi, 2017; IPCC, 2022) and is unequivocally leading to the depletion of West African natural capital, including the ecosystems on which the population largely depends (Secretariat of the CBD, 2010). Conservation and management of natural resources, which is a necessity to sustain our planet, requires well-informed decision-making towards sustainable growth and long-term development. Natural Capital Accounting (NCA), also known as ecosystem accounting, can be an answer to the request for evidence-based information for policy-making (Ruijs, 2018; Hein, 2020; Comte, 2022).

As part of the implementation of the Regional Indicative Programme (RIP) of the European Union in West Africa (11th EDF), IUCN has benefited from a grant for the implementation of the “Support Programme for the Preservation of Biodiversity and Fragile Ecosystems, Regional Governance and Climate Change in West Africa – PAPBio” of which component 2 concerned the “Regional Governance of Protected Areas in West Africa” project (IUCN, n.d.). One of the flagship actions of the “Regional Governance” project was the development and establishment of a regional capacity in terms of ecosystem natural capital accounting, an action implemented with the support of the partner VITO, co-applicant of the grant.

Natural capital accounting is the umbrella term used to indicate the use of an accounting framework to provide a systematic way to measure and report on stocks and flows of natural capital. Along the years, several accounting frameworks have been developed. The “Ecosystem Natural Capital Accounting (ENCA)” framework (Weber, 2014), which follows the methodology of the international System of Environmental-Economic Accounting-Experimental ecosystem accounting (SEEA EAA) (UN SEEA, n.d.-b.), provides essential information for decision-making in the context of sustainable management of natural capital, based on the combination of geospatial data, observational data and socio-economic statistics. ENCA measures, through its geospatial approach, the sustainable capacity of ecosystems to supply the services needed by humankind and assess human accountability for ecosystem degradation by inappropriate management. Within this framework, the accounts are built on a simplified ecosystem model with three major components: biocarbon, fresh water and all intangible regulating and socio-cultural services taken as a whole.

Due to the huge amount of data needed to set up an ENCA account and its complexity in geospatial processing, statistical offices and environmental agencies, which emerge as new user communities need support. Therefore, the semi-automated Sys4ENCA platform was developed (Buchhorn, 2023); it supports the implementation of ecosystem natural capital accounting by bringing together different data infrastructures to unlock the value of big data for policy matters from a global to a local scale. It contains automated workflows to generate and pre-process various global, national, regional, and local input data and ingests them in the ENCA data structure.

Sys4ENCA has been piloted in two transboundary regions in West-Africa; i.e. 1) the area between Senegal and Guinea, including the Niokolo Koba national park, the Niokolo Badiar national park, the Badiar Biosphere reserve and the Bafing-Falémé landscape with the recently (2020) established Natural Parc of Moyen-Bafing, and the 2) W-Arly-Pendjari (WAP) complex, a protected area shared Benin, Niger and Burkina Faso. Prior to compiling the ecosystem accounts, a set of on-site ENCA training workshops have been organised, in collaboration with OSS, the Sahara and Sahel Observatory, which is supporting, under the “Copernicea” project, African countries in the development of national ecosystem accounts. Like the PAPBio project (IUCN/VITO), the Copernicea project (OSS) uses the ENCA methodology to compile accounts. During these workshops capacity was built on NCA and, more specifically, on the ENCA methodology, to provide the participants with the necessary background for the subsequent hands-on training on Sys4ENCA. The main objective of this Sys4ENCA training was to train ENCA experts able to train other experts in the region, also named train-the-trainer.

In parallel to this, the accounts of the two pilot areas were generated in close collaboration with local experts. An iterative process was set up through committees of national and local stakeholders. Following from the data inventory and development of the ecosystem accounts, the results of the accounting based on global and freely available datasets were used to engage further with national and local stakeholders. This facilitated the customisation of the Sys4ENCA tool for the accounting at local (parc) level. Besides highlighting obvious data gaps and uncovering further supporting ancillary datasets, this iterative engagement provided opportunities to raise awareness to the approach and gain further input and support from potential end-users. Recommendations were formulated and subsequently used to improve the tool. Thanks to this process, a first step was set towards the establishment of ownership in the accounting, with local experts and relevant partners taking credit and responsibilities of the project outputs that have been released.

The results of the accounting highlighted that Sys4ENCA provides a well-structured basis for the monitoring and evaluation of the impact of current and prospective programmes, projects or management practices on the ecological value of protected areas. As an example, it underpinned the relevance of implementing the protection status of the natural parks and provided guidance on the management actions for the corridor between Niokolo and Bafing-Falémé landscape (Sidibe, 2019). Sys4ENCA allows to assess the ecological value of an ecosystem at a specific time as well as its trend, and by consequence to anticipate the required management practices to avoid further degradation or to take recovery actions. In case of the Moyen-Bafing national park, this might be of relevance for the planned construction of the Koukoutamba dam in the southern part of the park.

Given its automatized nature, the platform reduces human errors, increases efficiency, speed and harmonization of computation. This supports a harmonized and systematic accounting over long timeframes and spatial scales. Experts during the different workshops highlighted the capacity of the tool to provide a panoramic and uniform vision over the entire cross-border regions; habitat fragmentation and connections can easily be visualized. As such the tool can facilitate common and coherent cross-countries decision-making, as well as foster networking and information exchange.

1. Introduction

1.1 Context and objective

Over the last fifty years the world has experienced remarkable economic growth and prosperity, but much has been at the cost of the natural systems that support life on Earth. About 2.7 billion people (70% of all tropical peoples) directly depend on nature to meet their basic needs: water, fuel, shelter, and/or livelihoods (Fedele, 2021). Nature underpins significantly the economy, particularly for sectors that rely on direct natural resources extraction or the provision of ecosystem services. According to the World Economic Forum (2021), roughly half of the world's gross domestic product (GDP) depends on nature, and estimates show that 23% of African GDP comes from industries that are heavily dependent on nature.

West Africa is characterized by rapid population growth, endemic poverty (especially in rural areas) and poor governance and management of natural resources (Marc, 2015; World Bank, 2022). This already alarming picture has been worsened by the increasingly devastating effects of climate change (Awojobi, 2017; IPCC, 2021). This situation is unequivocally leading to the depletion of West African natural capital, including the ecosystems on which the population largely depends, and by consequence might significantly undermining future economic growth, particularly of the poorest economies (IPCC, 2021, 2022; Secretariat of the CBD, 2010). Conservation and management of natural resources, which is a necessity to sustain our planet, requires well-informed decision making towards sustainable growth and long-term development. More systematic and continuous measurement of natural capital becomes necessary, including the stocks of natural capital assets, the flows of benefits to the human economy, and their changes over time.



Kigali, Rwanda © Catherine Van den Hoof



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1.2 The PAPBio Programme

Faced with these threats, the European Union, the Economic Community of West African States (ECOWAS) and the West African Economic and Monetary Union (UEMOA) altogether decided to set up a Regional Indicative Programme (RIP) in West Africa, the Support Programme for the Preservation of Biodiversity and Fragile Ecosystems, Regional Governance and Climate Change in West Africa - PAPBio (IUCN, n.d.). This Programme aims to improve the management of major West African natural ecosystems in order to increase resilience of both the ecosystems and the population to climate change. The PAPBio Programme is a component of the implementation of the United Nations Agenda 2030 and the new Consensus on Development adopted by the European Union. It contributes particularly to the achievement of various Sustainable Development Goals (SDG 13 - Climate Action, SDG 14 - Life below Water, SDG 15 - Life on Land).

The general objective of the Programme is to promote endogenous, sustainable and inclusive economic development, in response to the challenges posed by climate change. The specific objective is to achieve integrated protection of biodiversity and fragile ecosystems, and enhance resilience to climate change. The Programme consists of two components. The first component focusses on the sustainable management of protected and peripheral areas. Experience shows that the integrity of protected areas is more assured when the protected areas are managed together with their peripheries, within real management landscapes. This entire component is based on this logic and includes (i) the conservation of central areas rich in biodiversity, (ii) the development of economic activities linked to ecosystem services, (iii) well established governance systems between protected areas and peripheries and (iv) the consideration of climate issues.

The second component focusses on regional governance and security. This component aims to foster a true regional dynamic for good governance of natural ecosystems, the management of protected areas and the promotion of regional conservation policies and sustainable development in general. This regional dynamic should allow concerned stakeholders to improve the effectiveness of management of their operation zones and to exchange knowledge and experiences. It is within this component, which is under the coordination of IUCN, that a regional capacity in terms of Ecosystem Natural Capital Accounting of protected areas in West Africa has been established by means of the Sys4ENCA tool. The expected results and activities that were defined under component 2 are described in the next section.



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1.3 Contribution of PAPBio to regional capacity in natural capital accounting

As mentioned in the previous section, the second component aims to foster a true regional dynamic for good governance of natural ecosystems, the management of protected areas and the promotion of regional conservation policies and sustainable development in general. Four results were expected to be achieved within this component and are as follows:

1. West Africa should boast of an effective and operational protected areas management system on a regional scale, including the management of climate issues.
2. Knowledge and experience should be shared and built at the local, national and regional levels.
3. Cooperation in the campaign against environmental crime should be enhanced and the security of conservation areas should be ensured.
4. Monitoring and management of knowledge from the PAPBio programme.

One of the flagship actions to boast of an effective and operational protected areas management system on a regional scale is the development and establishment of a regional capacity in terms of ecosystem natural capital accounting, an action implemented with the support of the partner VITO, co-applicant of the grant. This action, which falls under the expected result I., feeds and supports a subsequent activity which consists of developing a harmonized reporting system for use in all protected areas in the region.

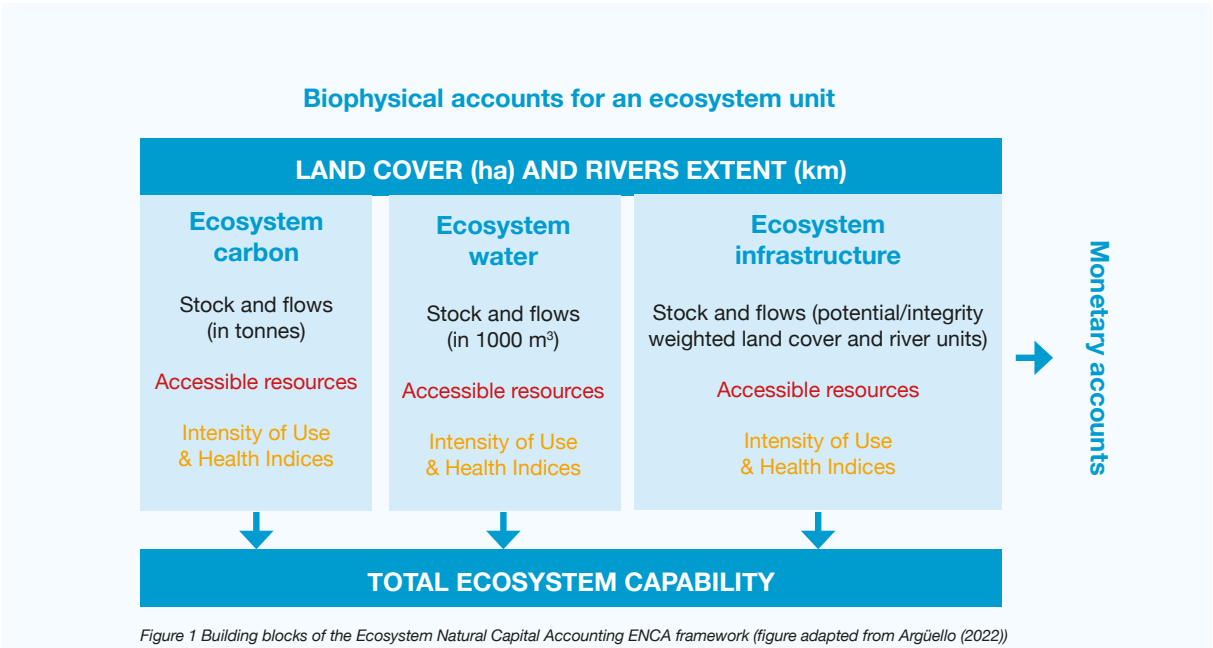
services; (d) improving accountability and transparency around the public expenditures on the environment by recognising expenditure as an investment rather than a cost (NCAVES & MAIA, 2022).

The SEEA EA entails comprehensive spatial identification and mapping, resulting in a more complementary picture of ecosystems and the benefits they provide to various parts of an economy (UN SEEA, n.d.-b.). It provides information in a coherent, integrated, and organised accounting approach facilitating a better understanding of connections among ecosystems, climate change and biodiversity.

2.2 The Ecosystem Natural Capital Accounting (ENCA) framework

The Ecosystem Natural Capital Accounting (ENCA) Quick Start Package (QSP), ENCA-QSP (Weber, 2014), is a response to the requirement of the Convention on Biological Diversity (CBD) for incorporating biodiversity values into national accounting (Weber, 2018; Smets, 2021; Smets, 2022; CBD, n.d.-a., n.d.-b.). It is a technical accounting framework for measuring the sustainable capacity of ecosystems to supply the services needed by humankind and assess human accountability for ecosystem degradation by inappropriate management. ENCA's approach to quantify degradation starts from the capability of the ecosystem, and not from the loss of services benefits, where capability includes ecosystem productivity and health.

The ENCA framework which follows the methodology of the international System of Environmental-Economic Accounting-Experimental ecosystem accounting (SEEA EAA), allows a standardized description of the state of natural and anthropized environments, based on the combination of geospatial data, observational data and socio-economic statistics.



Within this framework, the accounts are built on a simplified ecosystem model with three major components: biocarbon, fresh water and all intangible regulating and socio-cultural services taken as a whole (hereafter referred to as “infrastructure”). Based on the land characteristics, the ENCA framework quantifies the stock and natural flows of the ecosystem in three domains: carbon (expressed in tons per hectare), water (expressed in cubic meter), and infrastructure functional services (expressed in weighted hectares). These three accounts; i.e. carbon,

water and infrastructure functional services, are built following similar steps and accounting structure. Each of the accounts consists of quantitative tables describing the balance of resources (basic balance of stock and flows; estimation of surplus and potential of accessible resources; total use/consumption of resources) and a synthesis table including two indices; i.e. a quantitative index of sustainable intensity of use of the resources and a qualitative index of ecosystem health.

These two indexes are then combined to obtain an index of internal ecological value for each resource. This index of internal ecological value provides an indication of the state of the resource based on its use and resilience capacity. These indexes can further be combined to calculate an overall index of ecosystem capability, which summarises the various quantitative and qualitative changes recorded in the ecosystem carbon, water and infrastructure biophysical accounts and is expressed in a unit called Ecosystem Capability Unit (ECU). The ecosystem capability for carbon, water and infrastructure can then be aggregated into a Total Ecosystem Capacity (TEC) to calculate a trend over time. The accounts results are compiled and reported by socio-ecological landscape units (SELUs). These spatial units can be aggregated at any level; e.g. at the regional and national level. At country level, the aggregated TEC expressed in ECU can provide a measurement of performance in terms of ecological value in a similar way as the GDP does in terms of economic value.

Within the context of this project, in addition to these biophysical accounts, an initial exploration was performed to add monetary accounts. These monetary accounts are based on a combination of the biophysical quantity of a service and the value indicators for that service. Different valuation methods are required to estimate the value (e.g. market prices, “shadow prices” based on avoided damages, productivity changes, replacement cost methods). Monetary indicators were produced for the carbon account, water account and ecosystem infrastructure functional service account.

This ENCA framework provides essential information for decision makers in the context of sustainable management of natural capital, and in particular of protected areas; i.e. it supports the monitoring of (i) the evolution over time of the state of socio-ecological systems, (ii) the progress of the implementation of a new policy; e.g. change in protection status, and (iii) the effects on nature itself and on the populations, who interact with the ecosystems. For example, the reporting of local degradation makes it possible to guide corrective actions for restoration or prevention and provides an objective basis for calculating the cost of compensating for the degradation and for rewarding the positive results of conservation actions. ENCA provides thus information that can be integrated into Land Use planning. For park managers, for example, the ENCA framework can be both, an instrument that puts the information that has been collected into perspective and a receptacle of this information that gradually enriches the ENCA over time.

2.3 Development of a semi-automatised ENCA platform: Sys4ENCA

Due to the huge amount of data needed to setup an ENCA account and its complexity in processing, statistical offices and environmental agencies, which emerge as new user communities, need support. Therefore, a semi-automatised ENCA platform, Sys4ENCA, which supports the compilation of ecosystem natural capital accounting by bringing together different data infrastructures to unlock the value of big data for policy matters from global to local scale, has been developed (Buchhorn, 2023). Sys4ENCA contains automated workflows that generate and pre-process various national, regional and local input data (geo-data, non-located statistical data, Earth Observation data, etc.) and that ingest them in the ENCA data structure. The system generates the accounts and produces automatic reports for aggregation units.

Sys4ENCA assimilates the input datasets into a grid fitting scale where accounts are produced. Data assimilation to grids allows easy extraction of data as well as ingestion of earth observation data to fill data gaps and provide objective high-detailed information. Data sources and formats can be of many types: geographical references, social and economic statistics (typically in administrative divisions), satellite/drone images, in situ monitoring data.

The data processing depends on the type of data available, but in every case, it starts by the quality assessment of the input data. Then, according to the data type, processing will consist in classification, resampling, extrapolation, etc. to feed into the reference grid format. For the analysis and reporting, the resulting gridded accounts are resampled to SELUs, which can further be aggregated to an administrative unit such as a country or protected area. Compared to the original ENCA-QSP (Weber, 2014), an additional indicator has been implemented; i.e. the Total Ecosystem Capacity (TEC) trend indicator (TEC-TI). The TEC-TI is an indicator of ecosystem degradation based on the temporal analysis of the TEC for a reporting area compared to a reference year and is currently based on a linear model.

The Sys4ENCA platform allows semi-automatic generation of natural capital accounts without the hassle to be an expert in data processing. Given its automatized nature, the platform reduces human errors, increases efficiency, speed and harmonisation of computation over long timeframes and spatial scales. The Sys4ENCA platform, which is open-source and freely available, is accessible through a user-friendly interface as a QGIS plugin. QGIS is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, printing, and analysis of geospatial data. All workflows and pre-processes within the Sys4ENCA plugin have been written in Python Programming Language. Python is developed under an OSI-approved open source license, making it freely usable and distributable too. This means that IT experts can alter the Python code within the different Sys4ENCA modules, if needed, and that GIS experts can further analyse the data within QGIS.

Once developed, Sys4ENCA has been piloted in two transboundary regions in West-Afrika; i.e. 1) the area between the Republic of Senegal and the Republic of Guinea, including the the Niokolo Koba national park, the Niokolo Badiar national park, the Badiar Biosphere reserve and the Bafing-Falémé landscape, and the 2) W-Arly-Pendjari (WAP) complex, a protected area shared by the Republics of Benin, Niger and Burkina Faso.

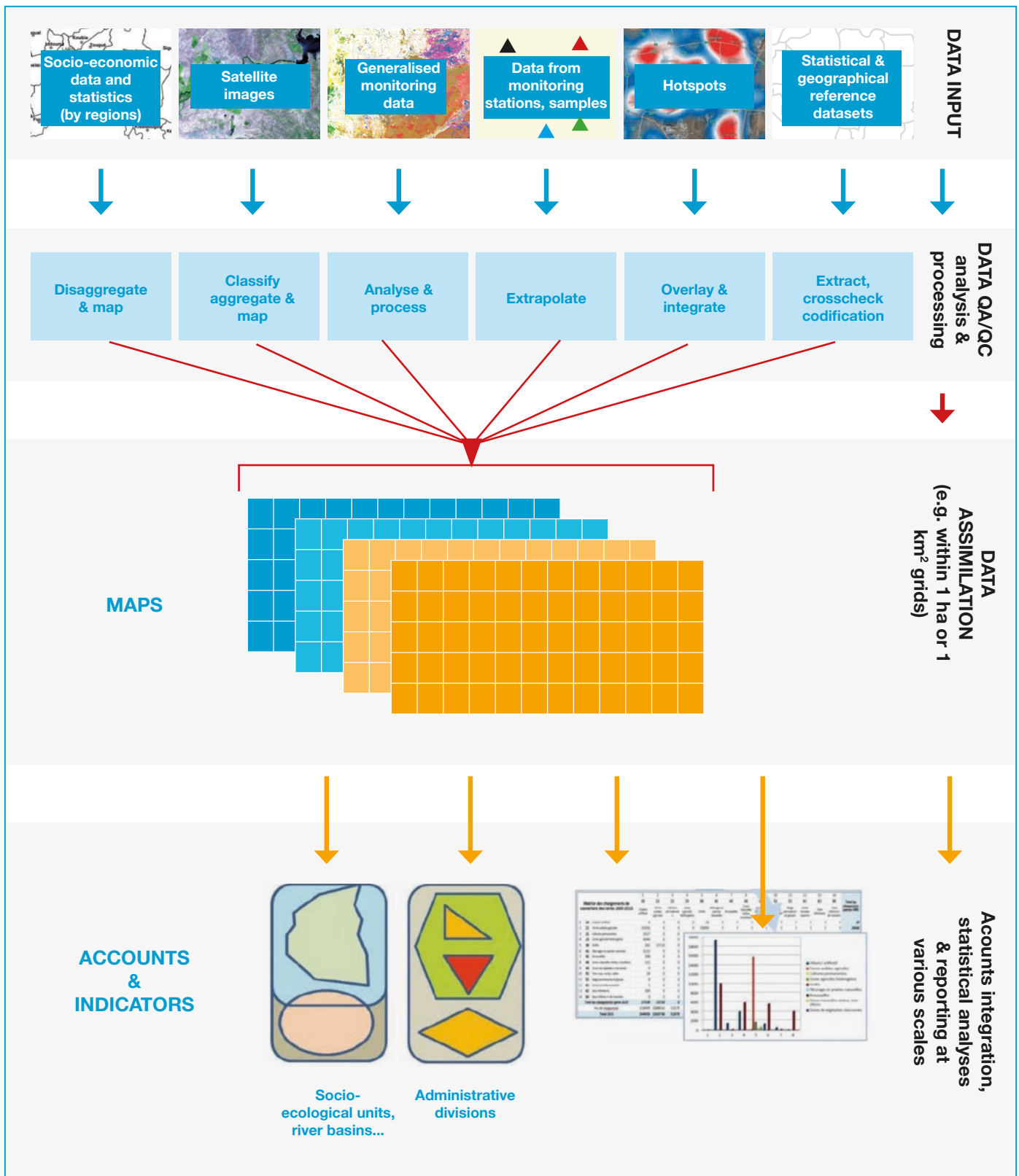


Figure 2 The Ecosystem Natural Capital Accounting (ENCA) Quick Start Package (QSP) data structure—assimilation and data integration of statistics and geo-data (figure adapted from Weber (2014)).



Workshop Dakar, Senegal (23-26 October 2023). © Catherine Van den Hoof

3. The deployment of the ENCA methodology

3.1 Strengthening the capacity to measure and value natural capital

Prior to compiling ecosystem accounts, it is important to increase awareness of natural capital and its accounting, and in particular the concepts, objectives, methods and use. Therefore, a range of training workshops have been organised with the main objective to build capacity on Natural Capital Accounting (NCA) and, more specifically, on the Ecosystem Natural Capital Accounting (ENCA) methodology. The workshops' specific objectives were to:

- Strengthen participants' knowledge of the concept of ecosystem accounting, and raise awareness of the role they could play in the implementation of ecosystem preservation and restoration,
- Strengthen the capacities of participants in the Ecosystem Accounting for Natural Capital ENCA methodology,
- Strengthen participants' knowledge of the principles of selection, preparation and ingestion of input data for systematic accounting at the national and local level, including the possibilities of accessing and using relevant international databases,
- Strengthen the capacities of participants to analyse the ENCA results and indicators, and to provide quantitative and qualitative information to inform policy decisions, e.g. identifying hotspots of degradation, assessing causes and formulating remediation strategies.

The three NCA-ENCA workshops have been organised between December 2022 and April 2023 and took place in (1) Ouagadougou, Burkina Faso (September 2022), (2) Conakry, Guinea (December 2022), and (3) Cotonou, Benin (April 2023). Although these workshops targeted primarily GIS and field experts, analysts, statisticians and decision makers from agencies and NGO's of Senegal, Guinea, Niger, Burkina Faso and Benin, dealing with the management of the protected areas within the two transboundary regions that were selected as pilot studies under the PAPBio project coordinated by UICN/VITO, stakeholders of the Copernicea project, under the aegis of OSS, the Sahara and Sahel Observatory, also attended the workshops in Ouagadougou and Benin. OSS is supporting, under the "Regional Cooperation for New Ecosystem Natural Capital Accounting Indicators in Africa | Copernicea" project, six French-speaking African countries; i.e. Burkina Faso, Guinea -Conakry, Morocco, Niger, Senegal and Tunisia, in the development of ecosystem accounts. Like the PAPBio project (UICN/VITO), the Copernicea project (OSS) uses the ENCA methodology to compile accounts. A collaboration between UICN/VITO and OSS seemed thus beneficial for all stakeholders, and was subsequently set-up. This resulted in the joint organisation of some of the workshops and trainings.

These ENCA workshops provided the participants with the necessary background for the hands-on training on the Sys4ENCA tool that took place in Dakar, Senegal in October 2023. This joint training, IUCN/VITO and OSS, had as main objective the training of Sys4ENCA experts able to train other experts in the region. During this training, the participants familiarised themselves with all the stages of the systematic creation of ecosystem accounts at the national and local level using the Sys4ENCA tool. Analysis and interpretation of the Sys4ENCA results were tackled as well. The workshops specific objectives were to:

- Build capacities in the use of the Sys4ENCA tool, in view of a full appropriation of the tool by the stakeholders,
- Provide technical guidance for the development of ecosystem accounts in the participant's own context,
- Build a network of ENCA and Sys4ENCA experts beyond the PAPBio project through regional training, workshops and technical material developed for use by the whole SYS4ENCA community.

3.2 Fostering ownership through stakeholder engagement

The development of the Sys4ENCA platform as well as its practical application and implementation were the result of a collaborative and iterative process in which a wide range of stakeholders were involved; i.e. GIS and field experts, analysts, statisticians and decision makers from relevant agencies and NGO's in West Africa, in particular those active in the management of the protected areas within the two pilot studies.

For the compilation of the ecosystem accounts, in particular at regional and local level, it is important to generate the accounts jointly with local experts, as local knowledge for the identification and integration of local data from multiple disciplines is crucial. Therefore, an iterative process was set up through committees of national and local stakeholders involved in the management of the protected areas within the two pilot studies. Following from the data inventory and development of the ecosystem accounts, the results of the accounting based on global and freely available datasets (Tier-1) were used to engage further with national and local stakeholders. This facilitated the collection of local data and the customisation of the Sys4ENCA tool for the accounting at regional (Tier-2) and local level (Tier-3). A set of iterations per pilot site were needed to come to the final Tier-2 and Tier-3 accounts. These iterations were then discussed during a set of on-line meetings and the on-site workshops that followed the following steps:

- Presentation by UICN/VITO of the results of the ecosystem accounts of the pilot sites based on global and freely available datasets (Tier-1),
- Evaluation by the experts of the results of the Tier-1 ecosystem accounts for the different components (water, carbon and infrastructure) by e.g. assessing the representation, within the accounts, of the areas identified as at risk in the field (e.g. low ecological value, degradation, etc.),
- Identification, by the experts and UICN/VITO of regional (Tier-2) local (Tier-3) datasets that could replace global datasets (Tier-1) and hence provide a more detailed and/or more accurate representation of the ecosystem within the pilot sites,
- Verifying and preparing the local datasets for use as input for the ecosystem accounting,
- Reiterating the process with regional/local (Tier-2/3) instead of global and freely available (Tier-1) datasets.

The processes showed to be very important for the selection of landcover datasets as input for the accounting of the WAP complex, one of the two pilot sites. Field knowledge and the use of local data were crucial. The experts flagged that the ecosystem value within the parks as represented by the accounting, were far too low compared to



Workshop Dakar, Senegal (23-26 October 2023). © Catherine Van den Hoof

what can be observed in the field. According to the land cover data that were originally used, a significant fraction of these parks was classified as cropland instead of shrubland or forest. The use of local data corrected for this.

Besides highlighting obvious data gaps and uncovering further supporting ancillary datasets, this iterative engagement provided opportunities to raise awareness to the approach and gain further input and support from potential end-users. As the relevancy of the accounts depends largely on input data, methodology and functionality, the evaluation of these elements is capital and must be held jointly with the developers, in this case UICN/VITO, and the potential end-users, in this case the regional/local experts. During the online meetings and the on-site workshops, the capabilities, gaps and technical limitations of the Sys4ENCA tool were discussed and recommendations were formulated. Most of the recommendations could be regrouped into one of the following three bullet points:

- facilitate the access to the tool as well as the ingestion of national or local datasets,
- further adapt the tool to the needs of decision-makers, by expressing the account in a common and tangible monetary value,
- further promote and foster the collaboration and networking at local, regional and cross-countries level, leading to more collaborative modalities of operation.

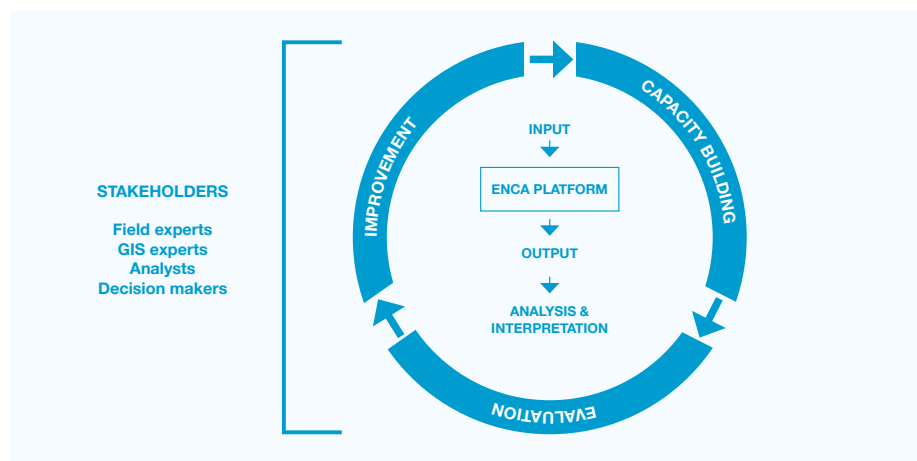


Figure 3 Collaborative and iterative process with regional and local stakeholders.

These recommendations were subsequently used to improve the tool and to initiate the discussion on the valorisation of the results from the perspective of decision-making, such as the strengths and weaknesses of monetary valuation. With this process, a first step was set towards the establishment of ownership in the tool development and the accounting, with local experts and relevant partners taking credit and responsibilities of the project outputs that have been released.

4. Sys4ENCA in support of protected area management

4.1 The two transboundary protected areas selected as pilot sites

As mentioned previously, Sys4ENCA has been piloted in two transboundary areas of West-Africa. The first site consists of the area between the Republic of Senegal and the Republic of Guinea, including the Niokolo Koba national park, the Niokolo Badiar national park, the Badiar Biosphere reserve and the Bafing-Falémé landscape. The Bafing-Falémé landscape includes the Moyen-Bafing national park. This park, located in the north of Guinea, hosts the largest continuous population of chimpanzees in West Africa, a subspecies classified as 'critically endangered' by IUCN, the International Union for Conservation of Nature (WCF, 2017). The park is currently managed by WCF, the Wild Chimpanzee Foundation, and OGPR, Office Guinéen des Parcs et Réserves (WCF, 2021). The design of the national park includes several zones with different degree of anthropogenic usage: a core area incorporating seven classified forests, a buffer area in which only sustainable activities may be conducted, and a zone called 'development zone' (WCF, 2015). In 2021, Guinea received funding from the Global Environmental Facility, GEF, for the 'Integrated management of natural resources in the Bafing-Falémé landscape' project (MEEF, 2020). The objective of this project is to promote integrated and sustainable management of natural resources by introducing a landscape approach, creating and operationalising a cluster of protected areas; i.e. (i) the Moyen-Bafing National Park, in the centre of the landscape, (ii) the Gambia-Falémé Faunal Reserve, in the north-west, which plays a role as migration corridor for large fauna between the Moyen-Bafing national park to the east and the Niokolo Koba national park, the Niokolo Badiar national park and the Badiar Biosphere reserve to the west, and (iii) three community forests that will be rehabilitated in the north-east of the landscape (MEEF, 2012, 2018). Therefore, the whole transboundary region between Senegal and Guinea including the Niokolo Koba national park, the Niokolo Badiar national park, the Badiar Biosphere reserve and the Bafing-Falémé landscape was considered in the accounting.

The second pilot site is the W-Arly-Pendjari (WAP) complex, a protected area shared by Benin, Niger and Burkina Faso. It is considered as the largest and most important continuum of unharmed ecosystems in the West African savannah belt. Shared by Benin, Burkina and Niger, this network of protected areas is a UNESCO World Heritage Site, and since October 2020, a UNESCO Transboundary Biosphere Reserve (UNESCO, n.d.). The complex is composed by the W Transfrontier Park (W-Niger, W-Benin and W-Burkina Faso), the national parks of Arly and Pendjari, and a complex of contiguous protected areas and hunting reserves regulated by different statutory regulations, restrictions and type of rights (Clerici, 2007). The natural resources of the WAP Complex represent a major asset for the local populations. The WAP Complex is, however, subject to multiple pressures and threats, mainly conflicts of use, poaching, overgrazing, agricultural lands expansion, transhumance, bushfires, surface water pollution, unsustainable fishery and use of wood and non-wood products. All these are exacerbated by climate change and large precipitation inter-annual variability.

The different parks within the complex have harmonized decennial management plans (2014-2024). The main management activities are focused on water supply for fauna, controlled burning of some grassland areas, antipoaching and co-management with communities living outside the boundaries of the national parks. Since 2019, however, the security situation has sharply deteriorated, resulting in increased poaching, reduced surveillance and the cessation of tourism.

4.2 Assessing value and trend of natural capital in two pilot sites

The results of the Sys4ENCA accounting, generated in collaboration with local experts, highlights the high ecological value of the transboundary areas, and in particular of the natural parks within these areas, mainly through their ecosystem capability to provide regulating and socio-cultural services (infrastructure-based services). Their protected status and the low fragmentation seem to be important drivers of their ecological integrity.

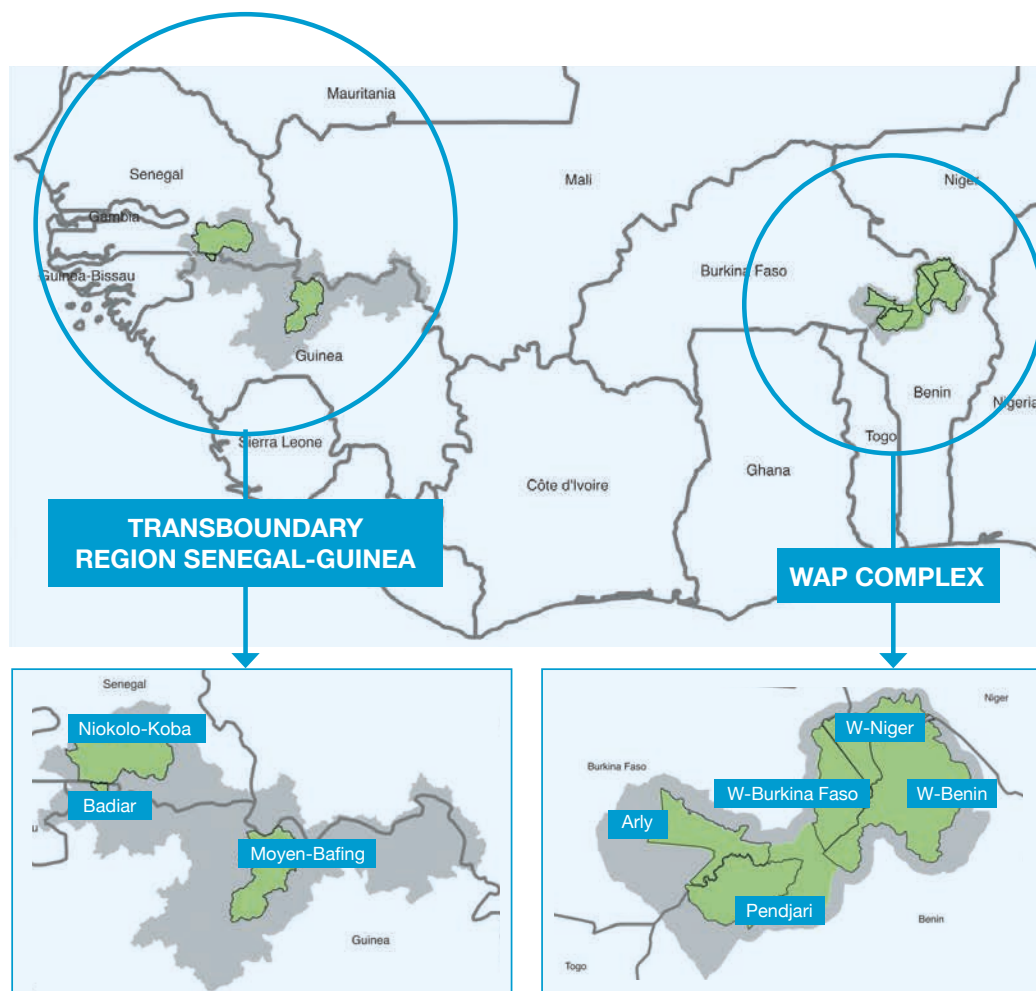


Figure 4 The protected areas (in green) within the two transboundary regions (grey).

The spatial variability in ecosystem capacity clearly shows that different protection and restoration targets, hence different management practices, lead to different ecological values; i.e. north vs. south of the Niokolo-Koba vs. Badiar protected areas and the center of the Bafing-Falémé landscape vs. the outer zones. In the Niokolo Koba natural park, located in Senegal, conservation activities are in practice over the whole area. On the other hand, in the Badiar natural park, located in Guinea, conservation activities are solely in practice in the core area, while on the periphery, a co-management system is in place to allow the various communities to use the site for agricultural (rice cultivation) and wood supply (Pellegrini, 2005). The difference in statutory regulations, restrictions and type of rights also explains the higher ecological value of the inner zone, compared to the outer-zone, of the Moyen-Bafing National Park. Similar pattern can be observed for the WAP complex and its buffer zone, which presents lower ecological value.

Areas with low ecological value are here often the results of pressure on land in combination with weak governance. This reduces the capability of the ecosystem to deliver the required services in a sustainable manner; i.e. in the eastern part of the Bafing-Falémé landscape mining and intensive agriculture are fueling loss of natural capital.



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Significant changes in management practices will be required; this part of the landscape is targeted to be rehabilitate into three community forests (MEEF, 2020). Same is valid for the corridor between the Niokolo and Bafing-Falémé landscapes, which has a significantly lower ecosystem capability to provide the required services in a sustainable manner compared to the regional average. This corridor is expected to be developed into a functional zone of passage for fauna between the parks and hence increase biodiversity (MEEF, 2020). To achieve this, the landscape management plans of the region will also need to be reinforced.

Sys4ENCA allows not only to assess the ecological value of an ecosystem at a specific time but also its trend over time. At the center of the Moyen-Bafing National Park, within the Bafing-Falémé landscape, a zone of degradation, which is in contrast with the high ecological value of the park, can be identified. This hotspot is probably connected to the activities related to the prospected construction of a hydro-electricity dam (Koukoutamba) in the southern part of the park (MEHH, 2015). This dam is expected to affect the natural capital of the entire park, as the Bafing river, on which the dam will be constructed, is running northwards through the park. The development of scenarios using the Sys4ENCA tool could help to assess the impact of such a dam on the natural capital of the park and to anticipate the required management to avoid further degradation.

Degradation, which is a negative trend over time in ecosystem capacities, is fortunately not commonly observed within the natural parks. It is, however, more widespread on their outer limits. Increased pressure on land due to increased population, poverty and insecurity explains the fast degradation in the buffer zone around the WAP complex, in particular south and west of the W as well as west of the Pendjary. Also, along the roads within the WAP-complex but outside the parks, the ecosystem capacity is gradually decreasing due to expansion of agricultural land. Concerning the other transboundary area, small hotspots of degradation can be observed in the neighboring villages around the Niokolo and Moyen-Bafing national parks. Good governance and adaptations of the practices in place might be required. It is therefore crucial to keep monitoring the parks to preserve their ecological value.

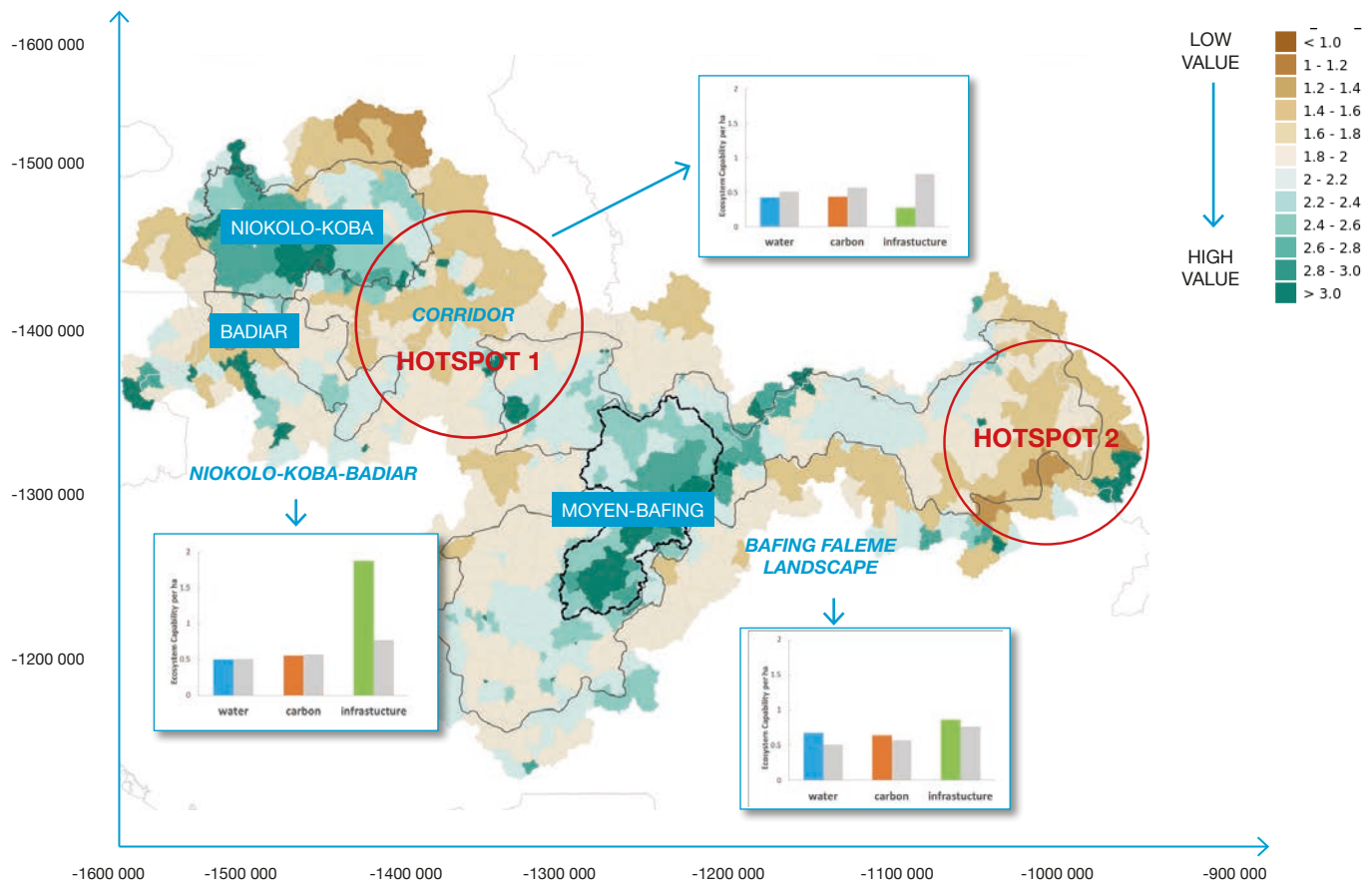
4.3 Effective accounting to better inform policy decision

As part of the PAPbio support programme for the preservation of biodiversity and fragile ecosystems, regional governance and climate change in West Africa, the semi-automatized Ecosystem Natural Capital Accounting (ENCA) platform Sys4ENCA was developed to support the regional capacity in natural capital accounting and the set-up of a harmonized system for all protected areas in western Africa. The platform computes yearly ecosystem capability of targeted areas by combining the contribution of ecosystem carbon, water and infrastructure-based services. The results are available on the platform through maps and tables, which can be used by the stakeholders to assess the ecological value of the area, identify hotspots of degradation or low ecological value, as well as trace back potential causes of changes in ecological value. The initial exploration to link monetary indicators to the carbon, water and ecosystem infrastructure functional service accounts of the Moyen-Bafing national park has shown that it is possible to perform a monetary valuation of the ecosystem services for national parks in West Africa, building on the ENCA methodology.

Sys4ENCA has thus the potential to provide a well-structured basis for the monitoring and evaluation of the impact of current and prospective programmes, projects or management practices on the ecological value of protected areas. As an example, it underpinned the relevance of implementing the protection status of the natural parks and provided guidance on the management actions for the corridor between Niokolo and Bafing-Falémé landscape (Sidibe, 2019). Sys4ENCA allows to assess the ecological value of an ecosystem at a specific time as well as its trend, and by consequence to anticipate the required management practices to avoid further degradation or to take recovery actions. In case of the Moyen-Bafing national park, this might be of relevance for the planned construction of the Koukoutamba dam in the southern part of the park.

Given its automatized nature, the platform reduces human errors, increases efficiency, speed and harmonization of computation. This supports a harmonized accounting over long timeframes and spatial scales. Nevertheless, it is important to mention that the knowledge and input of local experts are essential for translating the outcomes of the accounting into information relevant for decision-makers. The Sys4ENCA, is thus a valuable tool to facilitate protected area management as it provides not only consolidated information at local scale but also a broader context, which allows to evaluate the impact of external pressure such as climate change and more generally global change; i.e. increased demand for land. Experts during the different workshops highlighted the capacity of the tool to provide a panoramic and uniform vision over the entire cross-border regions; habitat fragmentation and connections can easily be visualized. As such the tool can facilitate common and coherent cross-countries decision-making, as well as foster networking and information exchange. In this context, the OBAPAO platform (BIOPAMA, n.d.-a.) could play a significant role. OBAPAO is a repository of data and information on biodiversity and protected areas in Western Africa that has been set-up in the context of the BIOPAMA Programme (BIOPAMA, n.d.-b.), an initiative funded by the European Union. Making relevant Sys4ENCA outputs, as well as their analyses and interpretation, available on the OBAPAO platform would facilitate diffusion of information to the policy and decision makers.

ECOSYSTEM VALUE PER HA (2018), expressed in ECU



TREND IN ECOSYSTEM VALUE OVER THE 2000-2018 PERIOD

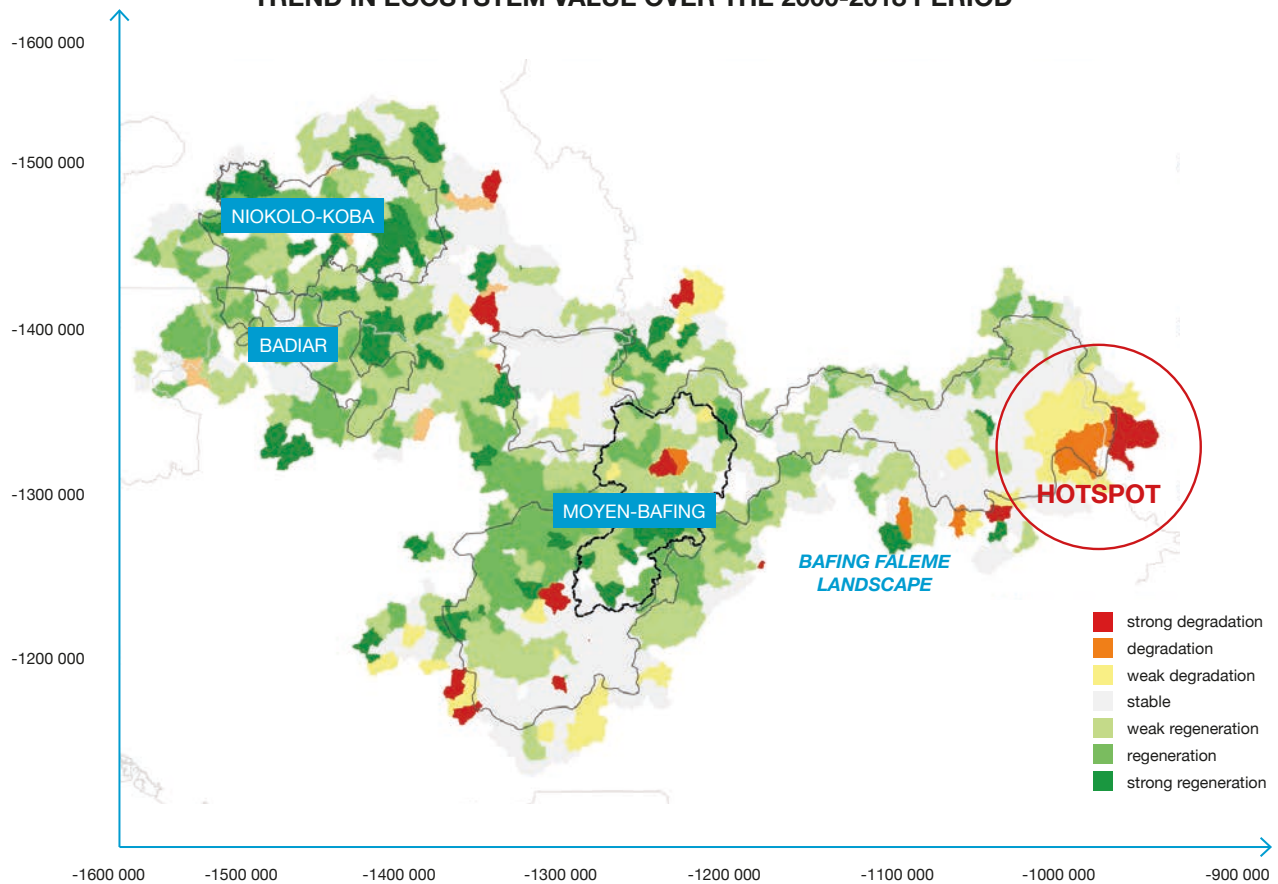


Figure 5 Ecosystem value (2018) and trend (2000-2018) of the transboundary area between Senegal and Guinea. The histograms represent the contribution of each component; i.e. carbon, water and infrastructure, to the total ecosystem capability for the Niokolo-Koba-Badiar and the Moyen-Bafing protected area and the corridor between both. The grey bars represent the contribution of the components to the total ecosystem capability of the transboundary area.

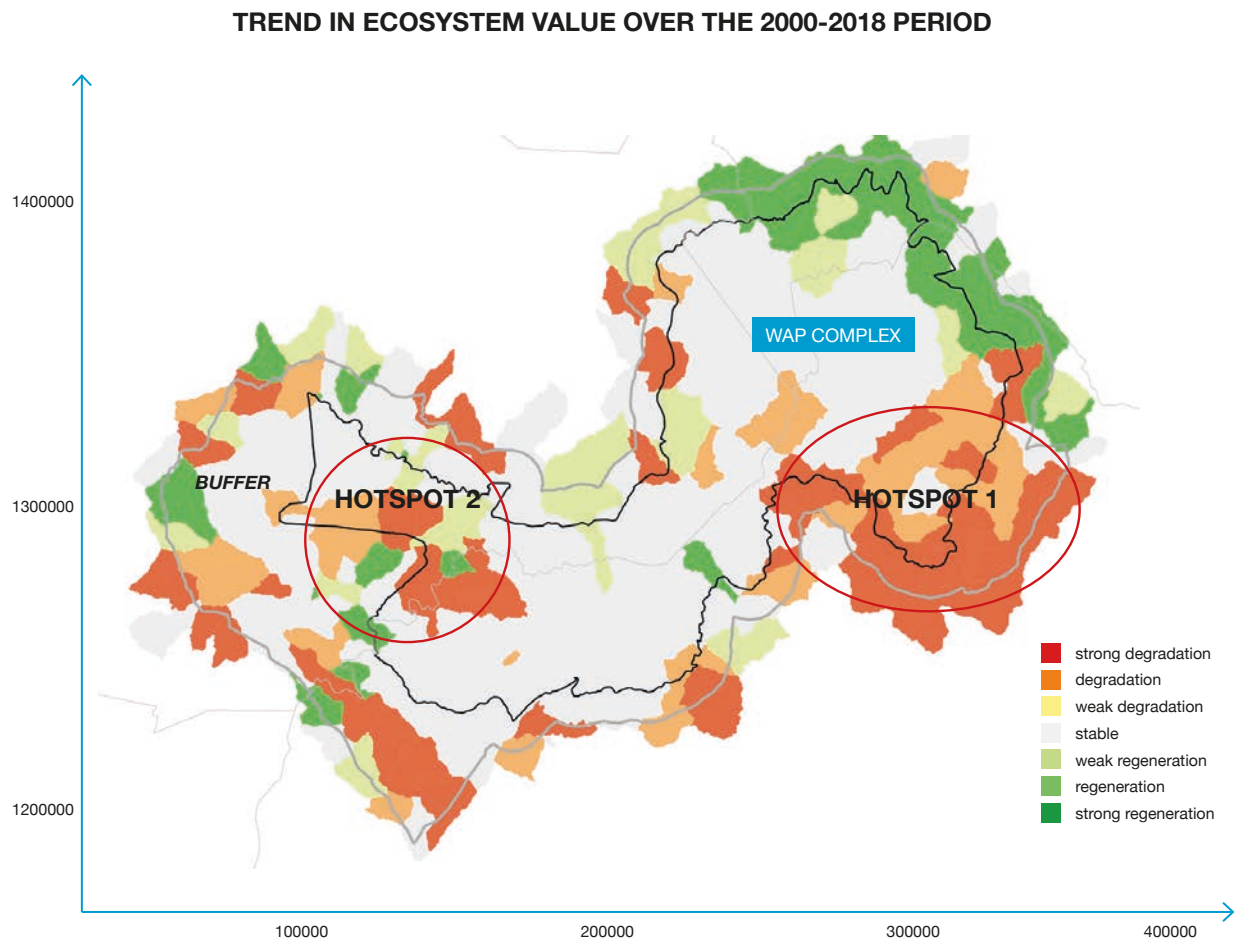
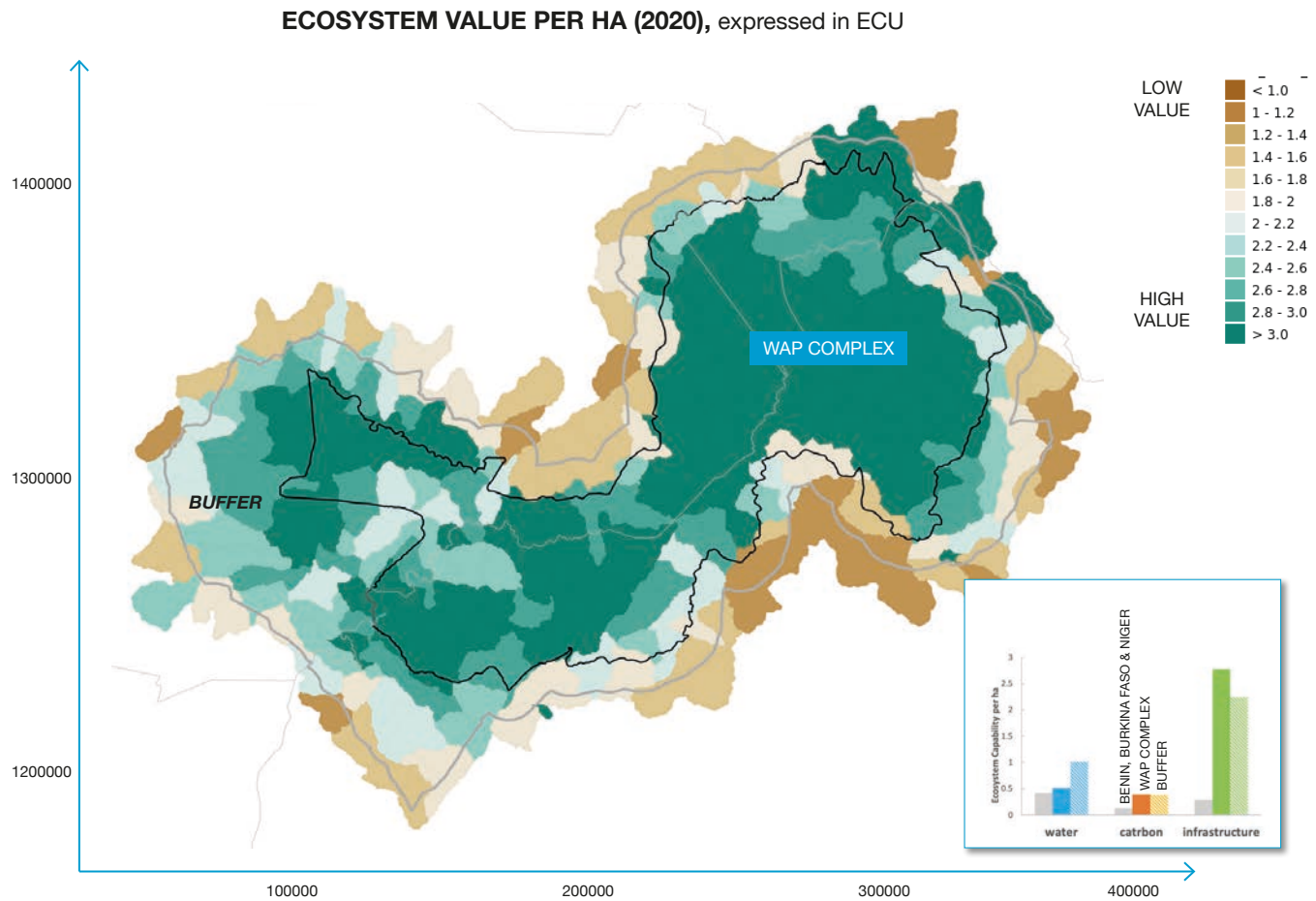


Figure 6 Ecosystem value (2020) and trend (2000-2020) of the WAP complex. The histogram represents the contribution of each component; i.e. carbon, water and infrastructure, to the total ecosystem capability for the WAP-Complex, its buffer and the area covering Benin, Burkina Faso and Niger.



Évaluer ces zones par rapport aux zones
identifiées par l'outil SysAENCA.

La variation spatiale des tendances
reflète-elle la réalité?

- Identifier les zones de dégradation ou de
régénération sur le terrain.
- Formuler les prévisions conséquentes.
- Évaluer ces zones par rapport aux zones
identifiées par l'outil SysAENCA (2005-
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