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# Integration of Ecosystem Services into Land Use Planning in Mozambique

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## ABSTRACT

The Ecosystem Service (ES) concept needs to be expressed and communicated effectively to be successfully integrated into decision-making. In this paper, we conducted a review of relevant documents to Mozambique's spatial planning by performing a content analysis based on ES categories. Results revealed that of the seven Land Use Planning (LUP) documents analyzed, only the National Development Strategy referenced ES explicitly. However, all documents made implicit references to provisioning ES. Five out of the seven LUP documents referred to regulating and cultural ES. None of the LUP documents made any explicit or implicit references to supporting ES. A Strengths, Weakness Opportunities, and Threats (SWOT) analysis towards ES integration in LUP based on these documents showed that the major strength was acknowledging the need to preserve ecological equilibrium and ensure sustainability. The periodical revision of tools and participatory approaches in LUP opens opportunities for integrating ES into LUP processes. This integration could be achieved by establishing a SEA legal framework based on LUP and Environment legal frameworks assisted by a set of common planning tools that consider ES as an additional indicator applied to spatial planning in Mozambique.

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## 1. Introduction

Ecosystem Services (ES) provide benefits to people, fundamental for human well-being (Mooney et al. 2005; Costanza et al. 2014). The Millennium Ecosystem Assessment (MEA) conceptual framework formed a basis for the development of ES and decision-making (Baker et al. 2013). Within this framework, many organizations developed guidance and other support forms to implement ES concepts into planning policies (OECD 2010a). Changes in ES may impact human well-being requiring sustainable use and management of ecosystems (Millennium Assessment 2003). These changes may be due to direct drivers (e.g. habitat changes, climate change, invasive species, overexploitation, and pollution) and/or indirect drivers (e.g. changes in the human population, economic activity, technology) (Millennium Assessment 2003; Nelson et al. 2006; Syrbe and Grunewald 2017), and can be managed through Land Use Planning (LUP) frameworks (Greiber and Schiele 2011; Sheate and Baker 2012).

The integration of ES concepts into decision-making is possible if aspects, such as common understanding of ES concept among the stakeholders, information availability and official guidelines are considered (Martinez-harms et al. 2015). For this integration to be successful, the ES concept

must be expressed and communicated effectively (Sheate and Baker 2012). This process requires knowledge about ES, which has been acquired through the development of biophysical, economic and social valuation of studies throughout the world (Boyd and Banzhaf 2006; Naidoo et al. 2008; Turner and Daily 2008; Frélichová et al. 2014; Costanza et al. 2014; Felipe-Lucia et al. 2015). However, the use of ES information in planning is quite limited (Martinez-harms et al. 2015; Ruckelshaus et al. 2015), though incorporating ES in planning could be beneficial (Inkoom et al. 2017). This paucity could be due to institutional obstacles, such as the lack of standards in assessment protocols and target, lack of qualified personnel, lack of data, and others (Polasky et al. 2015; Sousa and Alves 2020). Therefore, there is the need to develop approaches that allow planners to better incorporate ES into plan development and implementation (Bendor et al. 2017; Bezák et al. 2017).

The integration of ES into planning has mainly been debated at a theoretical level (Hansen and Pauleit 2014), but there is less evidence on the efforts proposing the integration of ES into decisions made in land utilization (Martinez-harms et al. 2015; Ruckelshaus et al. 2015; Ashnani et al. 2018). Although in the last decade the number of ES assessments has increased, as shown by the recent studies

made at supranational (IPBES 2018a, 2018b, 2018c; Maes et al. 2020), national (Sarukhan et al. 2010; Bateman et al. 2013; Bauler and Pipart 2013; Frélichová et al. 2014; Ouyang et al. 2016; Byg et al. 2017; Sutherland and Mazeka 2019; Mugiraneza et al. 2019) and regional levels (María Paula and Néstor Oscar 2012; Mckenzie et al. 2014; Ruckelshaus et al. 2015; Cabral et al. 2016; Camps-Calvet et al. 2016; Niquisse et al. 2017; Nikodinoska et al. 2018), there are still difficulties in defining and operationalizing ES within planning due to rigid regulatory frameworks and inadequate tools (Di Marino et al. 2019). Additionally, the lack of consensual methodologies for assessing ES in biophysical and economic terms, to represent ES spatially, and to interpret and utilize this information at the normative level in plans and projects, represent important obstacles to the effective integration of ES in LUP.

The understanding and the existence of a practical strategy for mainstreaming these concepts into LUP are still relatively new to many governments in Africa (Inkoom et al. 2017). In the African context, South Africa is the country where most studies have been conducted (Pierce et al. 2005; Cowling et al. 2008; Egoh et al. 2008; Wangai et al. 2016). Some West African countries, such as Ghana and Nigeria, have also experienced studies to integrate ES into LUP (Inkoom et al. 2017). Although Southern African countries have, in general, experienced research in ES (Wangai et al. 2016), the lack of integration of ES into policy-making has been pointed as a gap between science and management processes (CEPSA 2008; Byg et al. 2017; Fagerholm et al. 2019).

Soon after the MEA synthesis report was released (MEA 2005), the International Institute for Sustainable Development (IISD) and the United Nations Environment Program (UNEP) assessed ES and poverty of seven countries under a series scoping studies: Kenya (Wong et al. 2005a), Mali (Wong et al. 2005b), Mauritania (Wong et al. 2005a), Rwanda (Wong et al. 2005a), Tanzania (Wong et al. 2005a), Uganda (Wong et al. 2005a), and Mozambique (Wong et al. 2005a). The assessment outcomes showed that, in five out of the 10 provinces of Mozambique, all ES were threatened, and improvement in the management of ES was recommended to go along with poverty alleviation (Wong et al. 2005a). Other assessments pointing to the need for improving LUP were carried out for Mozambique, such as environmental threats and opportunities assessment (Byers et al. 2013) and the state of forest ES and wellbeing (Norfolk and Cosijn 2013). ES have also been assessed monetarily (Niquisse and Cabral 2017) and through the impact of land cover changes on ES (Von Maltitz et al. 2016; Niquisse et al. 2017). However, these ES assessments do not yet fill the gap between science and management processes

since none of these studies addressed integrating ES into existing decision-making processes.

Developing a specific policy is one option to integrate ES in LUP, another option is integration through a Strategic Environmental Assessment (SEA) (Geneletti 2011), which is a higher-level structured approach for obtaining and evaluating environmental information (Abaza et al. 2004). The environmental information obtained by a SEA includes social, economic, health, and environmental aspects, as well as the effects created by the implementation of policies, plans and other strategic instruments (Abaza et al. 2004; Rozas-vásquez et al. 2019). SEA can effectively enhance spatial planning processes' effectiveness in terms of sustainability by implementing the ES approach transparently through participatory approaches, scenario modeling, and trade-off analysis (Helming et al. 2013; Geneletti 2015; Rozas-vásquez et al. 2019). There are general SEA guidelines, such as the ones defined by the World Bank (Kjørven and Lindhjem 2002; The World Bank Group 2012), and by the OECD (OECD 2006). However, a SEA as a tool can differ depending on the context where it is applied, resulting in the need for specific guidelines to be developed to address the integration of ES into LUP, such as biodiversity (Brownlie and Treweek 2018), climate change (OECD 2008; Byer et al. 2018), and ES (Partidário 2010; OECD 2010b; Brownlie and Treweek 2018).

Some pioneer experiences of SEA were carried out in Mozambique since the late 1990s, for example, for the coastal area of the Inhambane province (Dalal-Clayton and Sadler 2004), for the Mozambique Coastal Zone (República de Moçambique 2013), for the special planning of the Zambezi valley (Ministério de Planificação e Desenvolvimento – Agência de Desenvolvimento do Vale do Zambeze, Ministério para a Coordenação e Ação Ambiental 2014) and, more recently, the SEA on the National Plan for Territorial Development (Ministério de Ambiente Terra e Desenvolvimento Rural 2019). These initiatives have resulted in large quantities of environmental data being collected, updated, and systematized. It has also brought fruitful results for ecosystems, such as the special spatial planning for the Zambezi valley, where there were areas identified with high natural value or high ecological sensibility. However, all these initiatives have been conducted without a clear mandate for coordinating SEA processes across sector ministries, making its implementation ineffective (NCEA 2020). Setting the SEA legal framework, besides a local policy, could help to harmonize the process within the country and favor the integration of ES into LUP. This integration could benefit from the use of software tools which are being developed for ES assessment such as Integrated Valuation of Ecosystem Services and Tradeoffs

(InVEST), Artificial Intelligence for Ecosystem Services (ARIES), Multiscale Integrated Models of Ecosystem Services (MIMES), Social Values for Ecosystem Services (Solves), Land Utilisation Capability Indicator (LUCI), Integrated Model to Assess the Global Environment (IMAGE), Co\$ting Nature, Ecosystem Valuation Toolkit, ESM-App and others (Palomo et al. 2017).

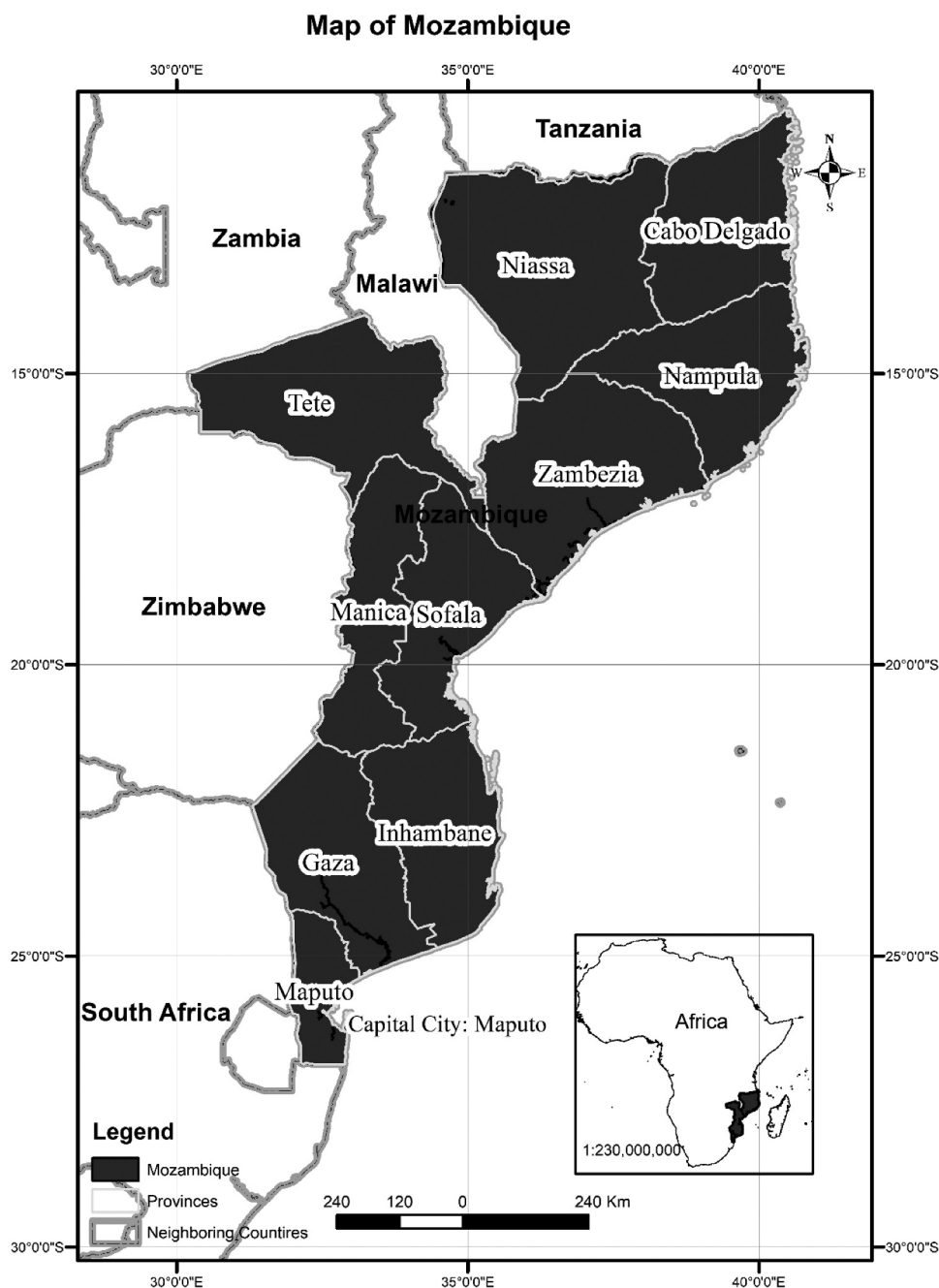
This paper aims to assess the current LUP documents regarding its suitability for mainstreaming the ES concepts in Mozambique and propose a framework for ES integration in LUP processes through an operational SEA which integrates ES information. The study's outcomes will be useful for designing and implementing approaches mainstreaming ES into LUP the country. The results

could also enhance the existing capabilities to produce, share and use spatial data among Mozambican government institutions (Atumane and Cabral 2019), and help operationalize SEA legal framework.

## 2. Methodology

### 2.1. Study area

Mozambique is a country of southern Africa bordered by Tanzania in the north, Malawi, Zambia, Zimbabwe, and South Africa in the west, Swaziland and South Africa in the South, and the Indian Ocean in the east (República de Moçambique) (Figure 1). The country spans 799,380 km<sup>2</sup> with 27,909,798 population in 2017



**Figure 1.** Study area.

(INE 2019a), growing at an annual-rate of 2.8% and a population density of 35 inhabitants/km<sup>2</sup> (INE 2019b). In 2017, the Gross Domestic Product (GDP) per capita was 466,18 USD (INE 2019c). The country's GDP (current prices in 10<sup>6</sup>MT) in 2018 was 887.806 USD with the following top export products: mineral coal, aluminum bars and rods, electricity, natural gas, heavy sands, tobacco, sugar, bananas, prawns, and woods. The top import products were machinery, diesel, automobiles, petrol, medicines, food oil, hydraulic cement, and beer (INE 2019b).

## 2.2. Methods

An exploratory research was conducted by the research team to find and describe the existing LUP documents in Mozambique. The search and collection process of documents included a previous consultation of websites, email exchanges, and phone interviews with people from governmental institutions dealing with LUP, specifically the Ministry of Land, Environment and Rural Development through the National Directorate of Land and the National Directorate of Land Use Planning; the Ministry of State Administration and Civil Service through the National Department of Territory Organization; and the Ministry of Economy and Finances. All these institutions deal with LUP processes, except the last one, which deals with LUP implementation through development programs. The search for data and their collection were carried out from February to August 2019. The objective was to understand the LUP context better and to learn about possible sources of information. After selecting the relevant documents for LUP processes and implementation, a content analysis (Hsieh and Shannon 2005) based on ES categories defined by the Millenium Assessment (2003), i.e., provisioning, regulating, supporting, and cultural, was carried out. The analysis of the documents was made hierarchically in terms of importance, from the fundamental principles or objectives (policies or strategies) to official rules (laws and regulations). The content analysis was made by identifying any explicit or implicit match between the LUP documents content with the ES categories (Bauler and Pipart 2013; Mascarenhas et al. 2015; Inkoom et al. 2017). The explicit reference to ES in the documents was considered as a direct reference to ES or its synonyms, such as Environment Services or Ecological Services. The implicit reference to ES in the documents consisted in looking for proxies representing the same concept but using different designations, e.g., measurements of biophysical values and benefits related to the ES.

Then, a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis to set up an ES framework

was carried out by the authors of this study based on the LUP documents using the approach described in Inkoom et al. (2017). The aim of the SWOT analysis was to place in evidence the way the endogenous and exogenous variables of the system impact the success of developing and implementing future strategies regarding the ES integration into LUP through a SEA (Inkoom et al. 2017). Strengths were endogenous variables, such as direct citations of ES types and/or examples on LUP documents that could provide specific strategies to increase ES awareness and contribute to mainstream ES into planning goals. Weaknesses were considered the opposite of strengths. Opportunities were exogenous variables to policies, such as political, economic, and technical aspects, which could potentiate ES's mainstream into plans overcoming weaknesses. Threats were exogenous variables to policies that made the mainstream of ES into LUP impossible. Finally, the information gathered from the SWOT analysis enabled the construction of a conceptual framework showing the possible strategies to mainstream ES into an LUP.

## 3. Results and discussion

### 3.1. LUP documents retrieved for content analysis

A total of seven documents were evaluated for the content analysis: three policies, two laws, and two regulations were retained for analysis (Table 1).

The Land Policy (Conselho de Ministro 1996) focuses on access and land use mechanisms while the Land Use Policy (Conselho de Ministro 2007) focuses on LUP on a sectoral basis. The National Development Strategy (República de Moçambique 2014) sets industrialization as the development path through economic diversification, research, and innovation. The National Development Strategy (República de Moçambique 2014) is drawn based on the Land Use Policy (Conselho de Ministro 2007) and deals with a sectoral strategy.

**Table 1.** Reference to ES in the land use policy documents.

Type	Description	Year	Source
Policy	Land Policy	1996	(Conselho de Ministro 1996)
	Land Use Policy	2007	(Conselho de Ministro 2007)
	National Development Strategy 2015–2035	2014	(República de Moçambique 2014)
Law	Land Law	1997	(Assembleia da República 1997a)
	Land Use Law	2007	(Assembleia da República 2007)
Regulation	Land Law Regulation	1998	(Conselho de Ministro 1998)
	Land Use Law Regulation	2008	(Conselho de Ministro 2008)

**Table 2.** Types of Ecosystem Service vs Land Use Planning documents.

Land Use Documents		Land Policy	Land Use Policy	National Development Strategy	Land Law	Land Use Law	Land Law Regulation	Land Use Law Regulation
Provisioning	Food, fuel, fiber, fresh water, biochemical & genetic resources	Chapter 3, nº 14 Chapter 4, nº 15	Chapter 3, nº 3.2, line a) Chapter 3, nº 3.3 Chapter 3, nº 3.4	Chapter 3, nº 3.2.3.1 Chapter 3, nº 3.2.3.2	Chapter 2, Article 8	Chapter 3, Article 5, nº 1 Chapter 3, Article 7, nº 2	Chapter 2, Article 5 & 6	Chapter 3, Section II, Article 18, line a) Chapter 3, Section III, Article 21 Chapter 4, Article 27 & 28 Chapter 5, Article 33 & 34 Chapter 6, Section II, Article 42 & Section III, Article 44 & Article 46 Chapter 3, Section III, Article 21 Chapter 4, Article 27 & 28 Chapter 5, Article 33 & 34 Chapter 6, Section II, Article 42 & Article 43 line c) Chapter 6, Section IV, article 46
Regulating	Air quality maintenance, climate regulation, erosion control, regulation human diseases, water purification & pollination	Chapter 3, nº 14	Chapter 3, nº 3.2, line a) Chapter 3, nº 3.3 Chapter 3, nº 3.4		Chapter 2, Article 7	Chapter 3, Article 4, line d) Chapter 3, Article 5, nº 1 Chapter 3, Article 5, nº 2 line d) Chapter 3, Article 7, nº 2		
Cultural	Spiritual & religions, education, recreation & ecotourism, aesthetic, inspirational & sense of place	Chapter 4, nº 15	Chapter 3, nº 3.4	Chapter 3, nº 3.2.3.3		Chapter 3, Article 5, nº 2, line e) Chapter 3, Article 7, nº 2		Chapter 4, Article 28 Chapter 5, Article 34 Chapter 6, Section III, Article 44 & Section IV, Article 46
Supporting	Primary production, production of oxygen, soil formation, nutrient cycle, water cycling & provision of habitat							

The Land Law (Assembleia da República 1997a) focuses is on land rights while the Land Use Law (Assembleia da República 2007) focuses is on the organization of national land and sustainable use of natural resources.

The Land Law Regulation (Conselho de Ministro 1998) deals with cadastral, and the Land Use Law Regulation (Conselho de Ministro 2008) focuses on land use planning tools at national, provincial, district and municipal levels.

We found that all the documents referenced ‘sustainability,’ but only the National Development Strategy (República de Moçambique 2014) made explicit reference to ‘Environmental Services,’ but without any further details. All the other documents did not make any explicit reference to ES. The implicit reference analysis revealed that most of the LUP documents’ content is related to provisioning ES (Table 2). All the analyzed LUP documents referred to at least one provisioning ES benefit. The Land Use Law Regulation (Conselho de Ministro 2008) was the document that contained more implicit references to ES (four chapters). Five out of the seven LUP documents referred to regulating ES, the Land Use Law Regulation (Conselho de Ministro 2008) being the one with more references. Both Land Law (Assembleia da República 1997a) and Land Law Regulation (Conselho de Ministro 1998) did not made reference cultural ES while all the other LUP instruments did, for instance, through references to the management of areas with high ecological value, landscape, and heritage. None of the LUP documents made any explicit or implicit references to supporting ES.

## 3.2. SWOT analysis

### 3.2.1. Strengths

The major strength found in the LUP documents is the common acknowledgement of the need to plan land use to ensure the sustainable use of ecosystems, i.e., the actual policies place sustainability as a fundamental aspect of LUP. The National Development Strategy (República de Moçambique 2014) recommends planning the land use to guide a sustainable development strategy. The Land Policy (Conselho de Ministro 1996) states the commitment to preserve natural resources, while the Land Use Policy (Conselho de Ministro 2007) addresses specific considerations for local populations. Both Land Policy (Conselho de Ministro 1996) and Land Use Policy (Conselho de Ministro 2007) have a strong orientation towards preserving the ecological equilibrium to ensure the sustainable use of natural resources.

### 3.2.2. Weaknesses

The main weakness found was the lack of ES integration in the existing LUP documents. The existing LUP documents are old and/or ignore the ES

concept making its mainstreaming into LUP difficult. LUP is developed according to what the Land Use Law (Assembleia da República 2007) states at a national level (national plan for territorial development and special plans for spatial planning), provincial level (provincial-territorial development plans and interprovincial territorial development plans), district level (district land use plans) and, municipal level (urban structure plans, general urban development plans, partial urbanization plans, and details plans). However, specific regulations for implementing these specific plans are not yet in place making it impossible to operationalize effectively the LUP. Another identified weakness was the shortage of trained staff in ES principles, which may compromise the existence and implementation of an ES integrative framework in LUP.

### 3.2.3. Opportunities

The periodic and systematic revision of planning tools for land use within the timescale stated in the Land Use Law Regulation (Conselho de Ministro 2008) is an opportunity to integrate new tools that may improve the LUP process and ensure sustainability. Other identified opportunities were the institutional development and the participatory approach recommended by the Land Policy (Conselho de Ministro 1996), which might be useful towards an ES integrative framework. The investment in information technologies and the existence of government institutions already working on spatial data (Atumane and Cabral 2019) are also major opportunities towards a successful ES integrative framework.

### 3.2.4. Threats

Negative political interference and/or lack of political willingness to integrate ES into LUP may threaten some initiatives and lead towards an ineffective ES

**Table 3.** SWOT analysis.

Strengths	Weaknesses
Strong orientation of LUP documents to preserve ecological equilibrium and ensure sustainable use of natural resources. Consideration for local populations. Recommendation to use LUP to guide the development strategy.	No references to ES in LUP documents. Outdated LUP documents. Lack of regulations for implementing land use plans. Lack of trained staff in ES.
Opportunities	Threats
Periodic and systematic revision of land use planning tools within the timescale stated in Land Use regulation. Participatory LUP processes. Investment in information technologies. Existence of Government institutions working with spatial data.	Political interferences and influences contrary to ES integration in LUP processes. Lack of funds to invest in technology to monitor natural resources.

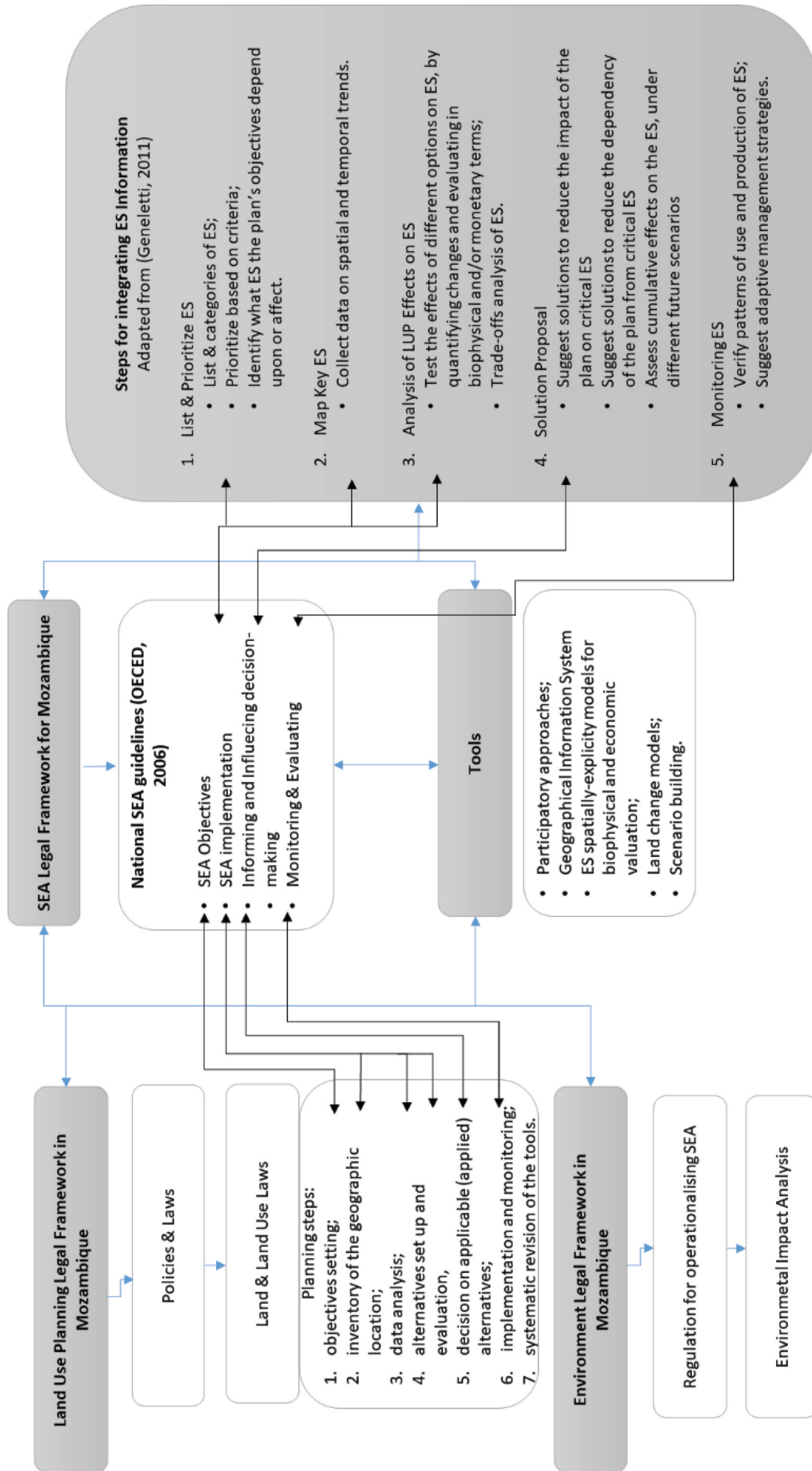


Figure 2. Proposal of framework to integrate ES in LUP through SEA in Mozambique.



integration in LUP. The lack of funds and technology to effectively monitor the natural resources exploitation may also cause existing LUP policies to be ignored or deficiently implemented.

Table 3 summarizes the SWOT results from the policy documents review and content analysis.

### 3.3. Integration of ES in Land Use Planning in Mozambique through a SEA

Based on the results of the content and SWOT analysis of LUP documents, a possible framework that can be adopted by governmental agencies and diverse stakeholders is proposed (Figure 2).

This framework combines and adapts existing LUP and Environment legal instruments to mainstream ES into LUP through an integrative and yet to be created SEA assisted by a set of common tools.

The Land Use Law regulation (2008) sets seven stages to be followed in the LUP process for Mozambique: (1) objectives setting; (2) inventory of geographic locations; (3) data analysis; (4) setting up alternatives and evaluation; (5) decision on applicable (applied) alternatives; (6) implementation and monitoring; and (7) systematic revision of the tools. However, as mentioned before in the SWOT analysis, the tools for implementing plans at a national, provincial, and municipal level are not yet in place.

On the other side, the Environment Law (Assembleia da República 1997b) which defines the legal basis for the correct use and management of the environment and its components, could also help in mainstreaming ES into LUP. The first decree-law regarding Environmental Impact Assessment (EIA) dates back from 1998 (Decree n°76/98). Its subsequent updates in 2004 (Decree n°45/2004), 2008 (Decree n°42/2008) and 2015 (Decree n° 54/2015) defined the EIA guidelines, i.e. ‘the necessary environmental studies, the public participation process, the review study process, the environmental feasibility decision process and the issuance of an environmental license for all public or private activities with direct or indirect influence on environmental components.’ Therefore, there are clear guidelines for environment assessment at an operational level.

At strategic level, several policies, plans, and programs in the country have gone through SEA; however, there are no regulations yet in place to help operationalising the SEA (NCEA 2020) effectively. Therefore, one crucial step would be the creation of a new regulation under the Environmental Law (2007) to overcome this problem and update the Land Use Law regulation (2008) accordingly to create an effective SEA with ES information.

Under an operational SEA legal framework, the currently inexistent official SEA guidelines also need to be defined for Mozambique. The National SEA

Guidelines should go through the following stages (OECD 2006): (1) objectives definition; (2) implementation; (3) informing and influencing decision-making; and (4) monitoring and evaluation. To operationalize the SEA, the SEA stages within the country could be integrated into equivalent planning steps defined by the Land Use Law regulation (2008) and by the yet to be created Environment Law regulation. This step would be beneficial since fitting SEA with other assessment systems would lead to efficiency and easy understanding (Therivel 2010). Accordingly, five steps are proposed for mainstreaming ES into LUP in Mozambique under a SEA framework (Geneletti 2011, 2015):

- *Prioritize ES based on criteria* (Rabe et al. 2016), such as the spatial importance, the importance of the ES for the population, rank in the ES concept (no overlap with other ES), comprehensibility, and origin of ES.
- *Map the key ES*: Ecosystems can be mapped by interpreting available land cover data, and ES can also be represented spatially through existing Land Use and Land Cover (LULC) data set (Sheate and Baker 2012). Therefore, significant ES can be matched with LULC within the spatial planning process in Mozambique. This process will require expert judgements about the different land cover types’ capacities to provide various ES (Burkhard et al. 2009). The model can be used at various spatial and temporal scales. Some LULC data set are available through the Global Land Cover (Global Land Cover 2015), National Mapping Agency – CENACARTA (CENACARTA 2012), and the planning area’s inventory in the LUP process. The process must be completed through a participatory approach with stakeholders.
- *Analysis of LUP effects on ES*: The assessment of LUP impacts on ES can be carried out through the quantification of ES based on land cover using two approaches: (i) using assumptions from literature reviews; or (ii) using process-based modeling (Altwegg and Grêt-regamey 2011). Both approaches have limitations and require data beyond land cover. The required additional data is a challenge. However, process-based models use spatially explicit data, such as soil characteristics, geology, topography, etc., which is mostly available within LUP processes and could facilitate the quantification of ES and analyze ES tradeoffs (Altwegg and Grêt-regamey 2011).
- *Solution proposal*: The appropriate ways of presenting and communicating the findings from the analysis of LUP effects on ES are fundamental. For each scenario in LUP, assessing the

cumulative effects on the ES and solution proposal to reduce the impact on critical ES and reducing the dependence of the plan from these ES is recommendable (Geneletti 2011). This solution proposal model should lead to the response in securing and improving the continuous delivery of ES.

- *Monitoring ES*: Through the same information used in the assessment of the potential effect of the plan on ES, data will be required to understand the actual effect and changes on ES.

The effective integration of ES in planning requires understanding the current planning tools (Albert et al. 2014; Di Marino et al. 2019). The LUP and Environment legal framework should be assisted by common tools necessary to implement the steps defined for integrating ES knowledge into the SEA. These tools include, among others, found necessary, participatory approaches techniques, Geographical Information Systems, ES spatially explicit models for biophysical and economic valuation, land change models, and scenario building techniques. The use of ES as a basis for land-use decisions requires information quantity and quality, stakeholder engagement, and tradeoff analysis (Bendor et al. 2017). It also requires measuring, visualizing and storytelling, and demonstrating impacts of decisions on ES supply (Brunet et al. 2018). The approach to integrate ES in Mozambique could consider ES, such as water yield, water quality, erosion regulation, climate regulation, and biodiversity (Niquisse et al. 2017), or others depending on the ES target being addressed and judged relevant by stakeholders through a participatory approach.

The existence of opportunities to integrate ES could be shaped through established government agencies, such as the National Directorate of Territorial Planning and Resettlement and the National Sustainable Development Fund under the Ministry of Land, Environment and Rural Development. The agencies responsible for proposing to the government the national plan for territorial development have the responsibility and opportunity to plan the integration of ES and involve other relevant stakeholders, such as other government agencies, infrastructure companies, universities, civil society, and other organizations. This might lead to a greater importance of ES on the national agenda and to neutralize the threats detected by the SWOT analysis. In addition to the national plan for territorial development, the agencies could also develop guidelines for administrative subdivisions (subnational level) to overcome the identified weaknesses. These guidelines could include mandatory consultation of populations, and the systematic integration of ES into territorial development plans based on the

principles of SEA. At the same time, it will be necessary to build capacity through training of technical staff to support regional and local authorities. Government agencies with capacity and universities could play an important role in capacity building. The universities can also be very important for research on the impacts of plans on ES to provide knowledge to optimize land use change plans while safeguarding ES. Some ES researches have been conducted at national level, such as modelling land cover changes and impacts on production and monetary value of ES (Niquisse et al. 2017; Niquisse and Cabral 2017, 2018). We can also find some examples at sectoral level, such as the assessment of forest (Norfolk and Cosijn 2013). Therefore, the universities can contribute to bridge the gap between theoretical and practical integration of ES in land use plans, and to make visible their relevance/contribution for achieving territorial development goals and welfare.

### 3.4. Limitations

The experts who identified and judged the criteria of the SWOT analysis were the authors of this study as in a previous study (Inkoom et al. 2017). We are aware that it would have been preferable to use the approach by Bull et al. (2016) in which the information for the SWOT analysis was obtained from different people through a survey. However, this approach would not have been possible to implement in Mozambique because the number of people with knowledge about these instruments is very limited making difficult to use interviews/survey to collect this information. Nevertheless, the SWOT analysis provided an understanding of how LUP is developed to mainstream ES into decision-making in Mozambique. Future developments of this study would benefit from the consultation of stakeholders to confirm the results of the SWOT analysis.

Regarding the proposed framework for integrating ES into LUP through a legal SEA, it should also be considered as a proposal and not as a definite guideline. In the construction of this framework, we used information from other studies carried out for Africa (Inkoom et al. 2017), together with published literature on how to integrate ES into LUP and SEA (Geneletti 2011, 2015; Rozas-vásquez et al. 2019). The information from these studies helped us to look for relevant documentation and to adapt it to the Mozambique case. However, the framework proposed here would also benefit, as with the SWOT analysis, from validation and discussion with stakeholders.

Previous experiences of SEA in Mozambique carried out in the 1990s were left out from the SWOT analysis since these initiatives were not mentioned in the LUP documents. However, future studies should

include a more detailed analysis of these experiences' results so the lessons learnt could be used in the establishment of the new legal SEA.

Lastly, and knowing that SEA is applied to plans and programs, but its necessary regulations are still inexistent (e.g. the Environment Law regulation), we argue that there is still an important vacuum affecting importantly the possibility of implementing a SEA effectively in the country.

#### 4. Conclusion

Integrating ES concepts into decision-making is crucial for improving decision-making and achieving environmentally sustainable objectives. It also enhances the interpretation and communication of the interactions between humans and Nature (Bull et al. 2016). This paper assessed the current LUP documents regarding its suitability for mainstreaming the ES concepts in Mozambique. The content analysis and SWOT analysis show that current legal documents do not sufficiently support this country's integration process. To revert this situation, and despite the inexistence of a legal SEA in Mozambique, we propose a framework with a new legal SEA which integrates ES information in LUP based on updated LUP and Environment regulations. We also suggest a set of actions assisted by common tools for mainstreaming ES into LUP. The proposed framework matches the requirements to include information on ES on LUP and can be used as a starting point by stakeholders to implement it through an operational legal SEA.

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No potential conflict of interest was reported by the author(s).

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