Elective Module 2

Teaching-Learning-Assessment Plan

SARUA Curriculum Innovation Network SCIN

Climate Change and Ecosystem Services

Elective module 2 in Southern African Master's in Climate Change and Sustainable Development

This elective module sits at the interface between climate change, anthropogenic activities and indigenous knowledge. The module draws on disciplines such as ecology; environmental economics; ecosystem dynamics; and governance to develop our ability to manage ecosystem services sustainably in the face of climate change in the African context. Students will learn to understand societies' interaction with ecosystems and the services they provide, approaches to valuation of ecosystem services, and opportunities for using ecosystem services to mitigate and adapt to climate change impacts.

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Important note: This TLA Plan does not provide details of the key resources. Details and guidelines are found in the Courseware Guidelines, designed as an essential complement to the TLA Plan.

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Introduction to the Teaching-Learning-Assessment Plan

The Teaching-Learning-Assessment (TLA) Plan is intended as a guide to the teaching, learning and assessment activities of the module. It aims to be more than merely the syllabus or content of the module. It includes the development of knowledge, skills and competencies, guidelines on teaching methodology, formative feedback and summative assessment – all of which contribute to the learning experience and therefore outcomes of the student. However, it is not a textbook. More detailed guidelines on the use of the resources is found in the module Courseware Spreadsheet.

In order to understand the TLA Plan better, the following points should be noted before reading it:

Assessment and feedback: Assessment is an integral component of the entire teaching and learning process rather than a final adjunct to it, and for this reason, assessment tasks are spread across the module. The curriculum upholds a supportive, proactive approach to the student's continuous development and achievement of the desired outcomes through frequent formative feedback from either the lecturer or the peer group. The student's grades are compiled from the summative tasks across the module.

All assessment and feedback should be based on clear, transparent criteria, provided (or developed by the class) in advance of the assignment. Assessment tasks can be completed by the individual student or a group of students. In the latter case, guidelines for awarding individual marks are provided in the Assessment Guidelines on the ePlatform.

There are two types of assessment: formative and summative.

i) Formative assessment/ feedback:

The student should receive formative feedback, from either the lecturer or peers, ideally for every assignment. This feedback outlines strengths and weaknesses and allows for reflection on areas for improvement, thus supporting the student's progress and development. Effective feedback is prompt, frequent, specific and personalised.

ii) Summative assessment:

The goal of summative assessment is to build up marks that ultimately contribute to the student's grade for the module. Summative assessment measures student achievement by comparing it against standard criteria (i.e. the desired module outcomes). Because summative assessment is for marks, it is 'high stakes' and has a motivational effect on student engagement. To avoid contention, summative tasks should be assessed by the lecturer and an independent

moderator and should be based on clear, explicit and transparent criteria. It is recommended that summative tasks account for about 20% of the student notional hours of a module and do not place too big a burden on the lecturer. Careful consideration must be given to ensuring proactively that plagiarism is avoided.

Additional activities: The TLA Plan provides activities for 200 student notional hours. It also provides additional activities for those universities that require additional hours in the module.

Courseware Guidelines: The TLA Plan gives only abridged references for the prescribed resources. The number in [ ] links to the associated module Courseware Guidelines, which is a spreadsheet with full references to key and additional resources (see the different tabs). The Courseware Guidelines contains further guidelines for using the resources.

Exam: Should an institution require students to write an exam at the end of the module, the time allocated for the exam would be over and above the 200 notional hours provided by the TLA Plan. It is recommended that the exam questions are broad and integrated across the module, so as to demonstrate achievement of the broader competency outcomes of the module. Examples of exam type questions are provided at the end of the TLA Plan.

Grades: Grades are calculated from summative tasks. These may be weighted according to the institution's requirements. An example of a module grade table is provided in the Overarching Resources on the ePlatform.

Group work: Group work is encouraged as this builds the essential outcome of teamwork, defined as the ability to work flexibly in teams, engage effectively with peers and successfully complete team tasks. There are several ways to award individual scores for group work (see Assessment Guidelines on the ePlatform). It is important that the lecturer plays a key facilitating role in supporting group work to achieve the desired outcomes. We suggest that group process/ participation skills are assessed by students rather than the lecturer and therefore that the assessment of group participation skills is used formatively but not for marks, to avoid contention.

Key concepts: The key concepts detailed under some of the Learning Themes refer to concepts that the student should be familiar with before the first class in the Learning Theme. This means that if the student is not familiar with the term,

s/he should undertake a simple search to get a basic understanding of the term, in advance of the class.

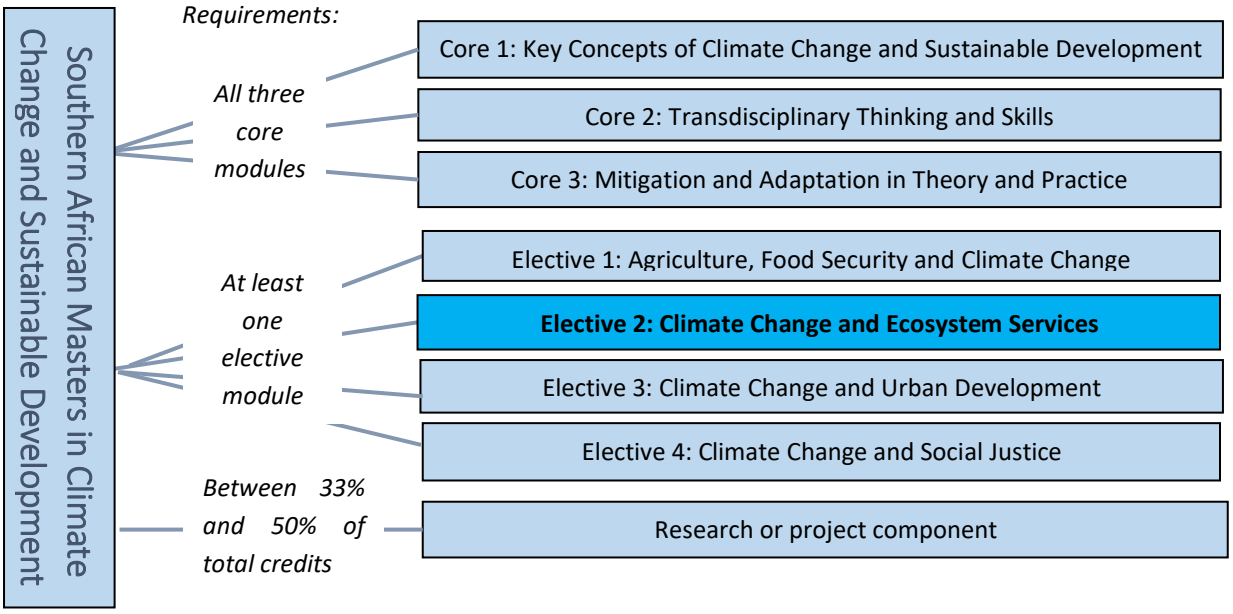
Marking rubrics: An assessment rubric with clear criteria should be provided (or developed by the class as a group) in advance for all student assignments to ensure that assessment is transparent and fair. The student should know, in advance, what is expected of the assignment, how the task links to the outcomes of the module and what is valued in the module. The following standard rubrics are found in the *Assessment Guidelines and Tools* on the ePlatform and can be adapted and weighted as necessary: Presentation, Report, Analytical Essay and Development of Writing Rubric. These are to be adapted to assess the desired outcomes of each task.

Outcomes: The TLA Plan provides topic-level and module-level outcomes that align with the curriculum-level outcomes. The curriculum outcome categories are derived from the South African Qualifications Authority (SAQA) National Qualifications Framework Master's level outcomes (Level 9) and the Critical Cross Field Outcomes, as these are consistent with regional requirements.

Student notional hours: The guidelines for hours in the TLA Plan refer to 'student notional hours'. A student notional hour is the estimated learning time taken by the average student to achieve an average pass rate for a specified task. Student notional hours are suggested for each activity to give an indication of the envisioned effort. The module provides for 200 student notional hours, with additional hours for institutions requiring a longer module.

Introduction to Module

Climate Change and Ecosystem Services is the second optional elective module in the Southern African Master's in Climate Change and Sustainable Development.



Module rationale

All development activities in both rural and urban settings are based on adequate functioning of ecosystems. An integrated approach to management of natural resources ensures sustainability. Climate change impacts will undermine the functioning of ecosystems and the services they provide, while ecosystems can also help with climate change mitigation and adaptation. Emerging issues relating to climate change impacts on ecosystems need to be integrated and accounted for in ecosystem governance and management systems. African governments and their citizens depend largely on the functioning of ecosystems, multiple ecosystem services and biodiversity as a basis of their economy. The productivity of major economic sectors such as agriculture, energy, tourism, forestry, fisheries among others draw directly or indirectly on ecosystem services provided by different ecosystems. Thus sustainability is at the core of how African governments, societies and research institutions view and think about ecosystems under climate change.

Ecosystems are important to everyone, but our demand for the services provided by ecosystems and biodiversity, and strategies to cope, adapt and mitigate climate change impacts are under increasing pressure. For this reason there is a demand for graduates who possess a thorough understanding of climate change and its impact on ecosystems and ecosystem services. From this basis, we students can better understand the governance and social implications of decisions that we make and strategies we use to find sustainable solutions in the management and use of ecosystems and their services for development without adverse interference on African traditions of utilizing ecosystem services for livelihoods.

Overview of Module

This module sits at the interface between climate change, anthropogenic activities and indigenous knowledge and their interactions. The module draws on disciplines such as ecology; environmental economics; ecosystem dynamics; and governance to develop our ability to manage ecosystem services sustainably under the influence of climate change in the African context. Students will learn to understand societies' interaction with ecosystems and the services they provide, approaches to valuation of ecosystem services, and opportunities for using ecosystem services to mitigate and adapt to climate change impacts.

Module Learning Outcomes

The module starts with introducing the concepts of ecosystems and the services they provide in enhancing human wellbeing and livelihoods, and aims to build knowledge and understanding of the complex interactions between climate change and ecosystem services. The module illustrates how ecosystems can contribute to climate change adaptation and mitigation. Finally, the module provides the student with knowledge and skills for the management and governance of ecosystem services for climate resilience and sustainable development.

In addition to knowledge, the module aims to develop practical skills in valuing ecosystem services and modelling ecosystems under climate change impacts. Furthermore, the skill of teamwork is enhanced through the design of collaborative team projects as well as the use of peer assessment approaches: A key outcome from this peer assessment approach is that the student develops the ability to engage sensitively with others. The ethics of stakeholder engagement is also incorporated, and opportunities are provided to undertake practical, meaningful stakeholder engagement.

Overall, the module builds on the competencies of problem solving in complexity, context and systems thinking, and transdisciplinary engagement.

Knowledge Outcomes

Specialist Knowledge - The student is able to demonstrate knowledge with regards to:

- Ecosystem services and human well-being and livelihoods;
- Ecosystem functioning, health and resilience to anthropogenic threats;
- Market-based approaches to valuing ecosystem services;
- Different approaches, benefits and weaknesses of Ecosystem based Adaptation (EbA) and Ecosystem based Mitigation (EbM)
- Different structures, policies and actors governing and managing ecosystems and ecosystem services at different scales.

Knowledge of applications — student is able to understand, evaluate and select appropriate methods, tools, processes or technologies for ecosystem assessment(species distribution, spatial distribution, ecological niche modelling) of different ecosystem types; approaches for mitigating and adapting to climate change using ecosystems; and various policy instruments at different governance levels in the sustainable management of ecosystems for climate resilience

Knowledge literacies —Student is able to understand and evaluate knowledge production processes for analysing climate change impacts on ecosystems, the valuing of ecosystem services, community EbA and EbM approaches and policy development for climate resilient ecosystem governance

Research literacies- student is able to:

- choose an appropriate process of enquiry into the impacts of climate change on ecosystem services, the valuing of ecosystem services;
- conduct a literature review;
- demonstrate insights from theory and research data
- use appropriate, ethical research principles

Skill Outcomes

Method and procedure — Student is able to model and map ecosystem services production and flow and future scenarios, using software such as Maxent and SWAT; and to apply and evaluate the efficacy of software such as InVEST to map and value ecosystem services

Producing and communicating information — student is able to produce a range of different genres, in writing and orally, to communicate complex information relating to ecosystem services and climate change to different academic and non-academic audiences

Independent learning — student is able to demonstrate effective self-driven learning, independent learning and academic or professional development.

Teamwork - student demonstrates an ability to work in teams, communicate effectively with fellow students and successfully complete projects that require group processes and outcomes.

Competency Outcomes

Stakeholder engagement — student is knowledgeable on the ethics of stakeholder engagement and is able to engage effectively and ethically with local communities about their use of ecosystem services, and can empathise with different actors involved in the governance of ecosystems

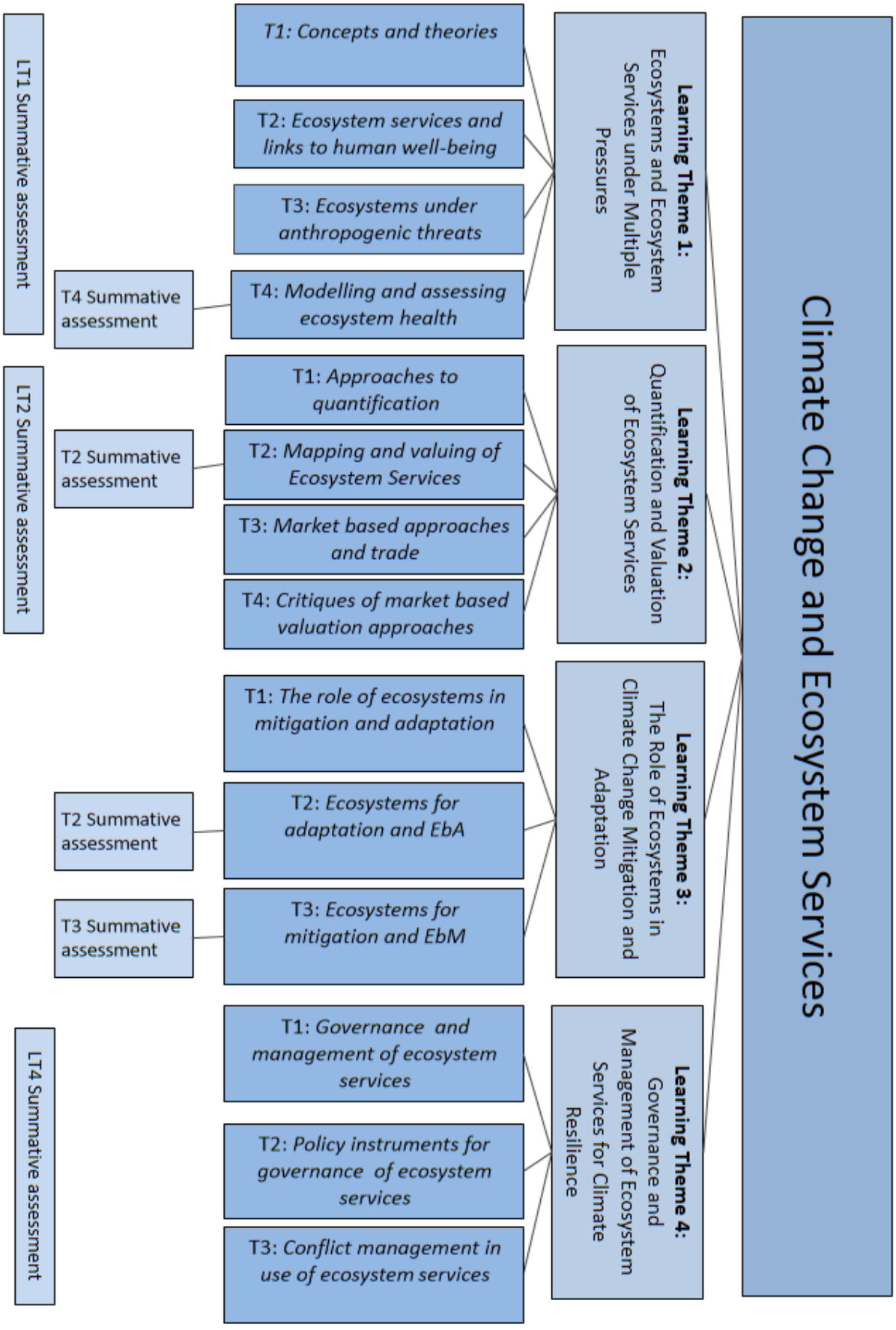
Problem solving — drawing from different sources, student is able to evaluate the outcomes of different projects and interventions at different scales involving ecosystems and ecosystem services

Context and systems-thinking — student is able to link livelihoods to ecosystems; recognise the trade-offs in environmental accounting and valuation of ecosystem services; recognise the trade-offs and wins in the use of ecosystems for climate change mitigation and adaptation; and link issues from local, regional levels to global situations in ecosystem governance for climate resilience.

Transdisciplinary thinking – student is able to demonstrate recognition and integration of different knowledge systems (i.e. academic and community knowledge) and disciplines (i.e. ecology, environmental science); student has the experience of engaging with and valuing community participation

Assumptions about students' prior knowledge and skills upon module entry

It is assumed that the student has achieved the curriculum core modules outcomes. Of special relevance are the sections on and drivers of climate change and climate economics and finance in Core Module 1. Transdisciplinary thinking would have been introduced in Core Module 2, and mitigation and adaptation in Core Module 3. As it cannot be assumed that students have prior knowledge of ecosystems, there is an introductory section in the first learning theme of the module.


Climate Change and Ecosystem Services
Learning Theme 1: Ecosystems and Ecosystem Services under Multiple Pressures
T1: Concepts and theories
T2: Ecosystem services and links to human well-being
T3: Ecosystems under anthropogenic threats
T4: Modelling and assessing ecosystem health
T4 Summative assessment
LT1 Summative assessment
Learning Theme 2: Quantification and Valuation of Ecosystem Services
T1: Approaches to quantification
T2: Mapping and valuing of Ecosystem Services
T3: Market based approaches and trade
T4: Critiques of market based valuation approaches
T2 Summative assessment
LT2 Summative assessment
Learning Theme 3: The Role of Ecosystems in Climate Change Mitigation and Adaptation
T1: The role of ecosystems in mitigation and adaptation
T2: Ecosystems for adaptation and EbA
T3: Ecosystems for mitigation and EbM
T2 Summative assessment
T3 Summative assessment
Learning Theme 4: Governance and Management of Ecosystem Services for Climate Resilience
T1: Governance and management of ecosystem services
T2: Policy instruments for governance of ecosystem services
T3: Conflict management in use of ecosystem services
LT4 Summative assessment

Learning Theme 1: Concepts and Theories

Rationale for Learning Theme

Different types of ecosystems supply different goods and services. The concept of ecosystem services describes how natural elements in ecosystems, with or without human influence or management, generate goods and services to society through the functioning of these systems. The understanding and appreciation of the linkages, services and values within ecosystems require knowledge on the different theories and concepts that underpin the functioning of ecosystems.

Climate change will likely result in complex long term consequences on ecosystems, their functioning and the associated production systems and services. The impacts of climate change on ecosystems and the services they provide pose a challenge to poverty reduction and threatens to deprive the livelihoods of the poor in southern Africa who often depend on ecosystem functioning, and to undermine sustainable development. Understanding how climate change impacts ecosystems and the services they provide can help to manage or reduce these impacts.

Cross-cutting resource for LT1

WRI (2007) Millennium Ecosystem Assessment

LT1. Topic 1: Introduction to the concepts and theories of ecosystems and ecosystem services

Outcomes

- ***Specialised knowledge***: Student is able to demonstrate specialised knowledge relating to how ecosystems and the services they provide are categorised and distributed across southern Africa
- ***Knowledge of applications:*** Student is able to recognise and understand ecological niche modelling

LT1	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T1.1	**Student: Pre-readings with questions** Students to read the Key readings and watch the video, responding to the key questions provided by the lecturer.	3	*Videos:* [11] Bronfenbrenner's ecological systems theory *Readings:* [73] Bull (2016) [33] Franklin (2010)
T1.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, covering: Concept of ecosystem services Characterization of ecosystem services Ecosystem services and biodiversity	3	*Readings:* [44] Kindler (2016) [14] Chapin et al. (2002) [68] Wallace (2007) [70] Yesson (2015)
T1.3	**Student: Pre-readings with questions** Students to read the Key readings, responding to the key questions provided by the lecturer.	3	
T1.4	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, covering: • Ecosystems, ecosystem functioning, components interactions • Regional and local perspectives of ecosystem distribution Ecological niche modelling	3	

LT1. Topic 2: Ecosystem services and links to human well-being and livelihoods

Outcomes

- ***Specialist knowledge***: Student demonstrates specialised knowledge relating to the links between ecosystem services, livelihoods and well-being
- ***Stakeholder engagement:*** Student is able to engage ethically and effectively with a local community about ecosystem services and livelihoods
- ***Teamwork:*** Student is able to work democratically and collaboratively with peers, distributing work fairly and effectively.

LT1	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T2.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [47] Kumar&Yashiro (2014) [65] UNEP (2010)
T2.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on ecosystem services and the link to well-being/ livelihoods and preparation for stakeholder engagement field trip	3	
T2.3	**Class activity: Field trip** Class visit to local site to engage with community on how ecosystem services support livelihoods, under the supervision and guidance of the lecturer. Feedback to be given on stakeholder engagement.	4	
T2.4	**Students: Group report and presentation** In groups, students to prepare a report on the links between ecosystems and human well-being/ livelihoods	2	
T2.5	**Class activity:** Groups present findings(5 minutes per student) for formative feedback	2	

LT1. Topic 3: Ecosystem health and resilience under anthropogenic threats

Outcomes

- ***Specialist knowledge***: Student is able to demonstrate specialised knowledge on the anthropogenic threats to ecosystems in southern Africa, derived from an understanding of ecosystem functioning and resilience, and of human use and interactions with ecosystems.
- ***Producing and Communicating Information:*** Student is able to synthesise different sources of information, illustrating complex linkages between systems through a mind map.

LT1	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T3.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	3	[67] Vandewalle et al. (2008) [49] Lafortezza and Jiquan (2016) [3] Ahmed et al. (2009)
T3.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on: – Ecosystem health and resilience under anthropogenic threats – Threats to ecosystem health – Impacts of climate change on ecosystems – Interactions between the impacts of climate change and other global environmental pressures (land degradation, alien invasions, biodiversity loss, desertification, etc.) on ecosystems and human wellbeing. – Processes and dynamics of ecosystems under environmental change, ecosystem processes, primary production, global, regional and local ecosystem services and their dynamics, factors influencing ecosystem dynamics and ecosystem services, anthropogenic threats.	3	
T3.3	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on – Theoretical assessment of ecosystem services	3	

	– Assessment of ecosystem in a local environment		
T3.4	**Students: Mind map poster and presentation** Students work in groups to develop outline of mind map showing interactions between global environmental pressures on ecosystems and human wellbeing/ livelihoods	2	
T3.5	**Class activity:** Each group shares mind map poster with class for feedback	1	

LT1. Topic 4: Modelling and assessing ecosystems

Outcomes

- ***Knowledge of applications***: Student is able to understand and evaluate different methods and tools used to model ecosystems and predict the impact of climate change on ecosystems
- ***Method and procedure:*** Student is able to practice ecosystem modelling software (Maxent and SWAT) using real data

LT1	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T4.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	3	*Readings:* [28] European Commission (2014) [69] WRI (2007) Millennium Ecosystem Assessment *Website* [78] MEA website & https://www.unpei.org/sites/default/files/PDF/ecosystems-economicanalysis/MEA-A-Toolkit.pdf
T4.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on the potential response ecosystems will have to climate change under different emissions scenario, and the impacts of climate change on biodiversity and ecosystem services. The discussion will cover the criteria for assessing climate change impacts on ecosystems, various types of modelling tools for predicting impacts of climate change on biodiversity and ecosystem services, understanding and quantifying environmental impacts on ecosystems	3	
T4.3	**Class activity: Practical using MaxEnt and ArcSwat** Students will conduct a series of supervised exercises on the application of different ecosystem modelling software: Maxent and SWAT.	8	*Videos on ecosystem modelling software* [71] How to use Maxent https://www.youtube.com/watch?v=PEW

	Students should be able to use the software in modelling ecosystem the production and flow of ecosystem services Real data obtained from different ecosystems will be used during the exercises.		p1QSAgRg [76] Basic MaxEnt tutorial https://vimeo.com/100714322 [77] SpierWIUClasses (2013) ArcSwat Tutorial 2
Summative assessment activity for T4			
T4.4	**Class activity:** Short online test on ability to apply Maxent/ SWAT **Summative assessment** Students run Maxent/ SWAT models using selected sample data and prepares a report on the output and results	2	

Cross-cutting summative assessment activity for LT1

Outcomes

Research literacy: Student is able to access and process relevant sources of information to critique and evaluate the application of the Millennium Ecosystem Assessment in a selected country. The evaluation to include where and how the country has been able to implement the MEA in the country's ecosystems

Problem solving: Student is able to engage with different sources of information to assess the consequences of an intervention at the local level. Student searches relevant literature on concepts and theories of ecosystem services evaluate on how and to what extent these are applied or have been applied at local or country scale and outcomes thereof

Summative assessment activity for LT1	***Hrs***	***Key resources***
Student: Report Drawing from the Key and additional readings for this Learning Theme, and any further resources the student identifies, student undertakes a 2000-word critique of the application of the Millennium Ecosystem Assessment in a selected country. The report should focus on the impact this has had on the provision of local ecosystem services. Summative assessment: The report will be assessed using the Report Rubric, including the use of appropriate resources, development of argument, and valid conclusion.	4	Key and additional readings for this Learning Theme, and any further resources the student identifies

Learning Theme 2: Quantification and Valuation of Ecosystem Services

Rationale for Leaning Theme

Ecosystems provide and deliver a wide range of services that are variously utilized by different stakeholders. Ecological valuation is important because nature's economic value is usually hidden from view. Because ecosystem goods and services tend to be shared, public goods that are not bought and sold, we do not see their value through the lens of market transactions. We do not buy and sell ecosystem services, which may lead us to under-appreciate their value. Among the arguments for ecological valuation and 'putting a price on nature' is so that our natural resources are seen and appreciated on an equal footing with market commodities.

Valuation of ecosystem services depends on the quantification of ecosystem services, and thus quantifying ecosystems is the first step to assessing their market value. This Learning Theme introduces students to these concepts and their applications, linking ecosystem services, well-being and economic development, and mainstreaming ecosystem services into national accounting systems.

Key concepts the student should understand before the activities

Public goods; national accounting systems; payment for ecosystem services; REDD+; environmental externalities

LT2. Topic 1: Approaches to quantification of ecosystem services

Outcomes

- ***Knowledge of applications***: Student is able to understand and evaluate different approaches and criteria relating to the quantification of ecosystems in different contexts
- ***Teamwork:*** Student is able to communicate democratically with peers, listening to other's perspectives and opinions, critically reflecting, and building on these with their own positionality and thinking.

LT2	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T1.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [62] Scarlett and Boyd (2011) [80] EU (2015) [23] Dwyer et al. (2015)
T1.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, covering: Quantification of ecosystem services; Criteria for identifying, measuring and quantifying ecosystem services; Indicators of ecosystem services; Quantification of ecosystem services in forests and agricultural-based ecosystems.	3	

LT2. Topic 2: Mapping and valuing of ecosystem services

Outcomes

- ***Knowledge of applications***: Student is able to understand and evaluate different approaches and techniques used to map, model and value ecosystems and ecosystem services
- ***Methods and procedure***: Student is able to apply and evaluate the limitations of software (InVEST) to map and value ecosystem services

LT2	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T2.1	**Student: Pre-readings and with questions** Students to read the Key readings, framing their reading around key questions. Students to log on and experiment briefly with software in advance	4	*Readings:* [66] UNEP MA (2003) [13] Canham et al. (2003) [30] Fisher & Turner (2008) [40] InVEST Software
T2.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, covering: • Concepts and principles in mapping and valuing of Ecosystem Services; • Concepts of ecosystem valuation; • Mapping - problem analysis, data requirement, conceptualization (e.g. flow diagrams, mathematical equations, etc.), model analysis and interpretation of results.	3	
T2.3	**Class activity: Practical exercise using InVEST ecosystem valuing software** a) Lecture: In preparation for use of InVEST software, lecturer presents different approaches for mapping of ecosystem services b) Practical exercises in mapping and valuing ecosystem services using a tool such as InVEST software. Focus on understanding the constraints and limitations of using the software. c) Discussion of the constraints and limitations of the software and the concept	2 3 1	

Summative assessment activity for T2			
T2.4	**Class activity:** Short online practical test on ability to apply InVEST **Summative assessment** Students run InVEST model using selected sample data and prepare a report on the output and results	2	

LT2. Topic 3: Market based approaches and trade in ecosystem services

Outcomes

- ***Specialised knowledge***: student is able to demonstrate specialised knowledge and critical thinking relating to different market based approaches to ecosystems, in particular for PES and REDD+
- ***Producing and communicating information***: Student is able to communicate and substantiate, orally, substantive concepts and arguments for and against different market based approaches to ecosystems

LT2	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T3.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [46] Kroegera and Casay (2007) [48] Kumar (2005) [16] Corbera et al. (2006) [4] Angelsen et al. (2012) [8] Bayon R. (2004)
T3.2	**Class activity: Lecture and Discussion** Lecture followed by class discussion on markets for ecosystem services. This will cover: • Payment for ecosystem services – PES (watershed services, climate services) • REDD+ • Other ecosystem services • Trade in ecosystem services as an alternative and non-consumptive use of natural resources • PES systems as incentives for measures to reduce human induced impacts on ecosystems and sustainable ecosystem management, opportunities and critiques in marketing ecosystem services The lecturer to provide feedback on individuals' contributions to the discussion.	4	

LT2. Topic 4: Critiques of market based approaches

Outcome

- ***Specialised knowledge***: student is able to demonstrate specialised knowledge and critical thinking relating to environmental accounting
- ***Context and systems thinking***: Student is able articulate understanding of the strengths and weaknesses of environmental accounting mechanisms

LT2	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T4.1	**Student; Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	3	*Readings:* [51] McVittie&Hussain (2013) [64] TEEB (2012)
T4.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, environmental accounting, covering environmental externalities, and how externalities cause divergence between social costs and private costs.	3	
T4.3	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class on the implications for resource allocation and policy options, internalization of environmental externalities to improve social welfare,	3	
T4.4	**Class activity: Debate** Lecturer to facilitate a class debate on the strengths and weaknesses of different approaches to managing environmental externalities.	1	

Cross-cutting summative assessment activity for LT2

Outcomes

- ***Research literacy***: Student is able to access and process relevant sources of information to review and critically evaluate the quantification and valuation of ecosystem services
- ***Producing and communicating information:*** Students are able to summarise and succinctly present findings, and articulate an argument for how market systems influence human resource utilisation and conservation.

Summative assessment activity for LT2	***Hrs***	***Key resources***
Student: Essay and presentation Student to write a 2000 word essay, undertaking a critical analysis of the concept of quantification and valuation of ecosystem services, showing how market systems influence human resource utilization and conservation. Draft essay formatively assessed by lecturer **Summative assessment**: The essay is assessed using the essay marking rubric.	6	Student to identify resources Marking rubric for essay with criteria
Student: Student to prepare a presentation on findings (1 hour).	1	
Class activity: Student presents findings in a short (5-minute) presentation to the class **Summative assessment**: The presentation is assessed using the presentation rubric.	2	

Learning Theme 3: Ecosystems in Climate Change Mitigation and Adaptation

Rationale for Learning Theme

Communities dependent on natural resources will be most severely affected by climate change, as climate change threatens the services that ecosystems provide. Proper management and sustainable use of these natural resources can increase the resilience of both ecosystems and people while reducing their vulnerability to climate change.

Two response strategies to climate change are ecosystem based mitigation (EbM) and ecosystem based adaptation (EbA). These strategies provide effectiveness and efficiency and can enhance participation of developing countries in mitigation while preparing for adaptation. Both responses promise win-win solutions - adaptation and mitigation costs can be reduced while co-benefits can be increased.

Key concepts the student should understand before the activities

Ecosystem based adaptation (EbA); ecosystem based mitigation (EbM)

LT3. Topic 1: The role of ecosystems in mitigation and adaptation

Outcomes

Specialised knowledge: Students will be able to demonstrate an understanding of the different approaches, benefits and drivers of success for EbA and EbM

LT3	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T1.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Case studies:* [19] Doswald and Osti (2011) [52] Midgley et al. (2012)
T1.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on how EbA and EbM approaches can bring a number of environmental, social, and economic benefits in addition to adaptation or mitigation. The discussion should focus on how EbA approaches can contribute to EbM and vice versa, and the key elements of success (such as stakeholder engagement and communication, monitoring and adaptive management).	2	
T1.3	**Class activity: Lecture and Discussion** Possible case study: Lecture focused on the case study of the Black River pathway, Cape Town. This is a potential field site for students to do practical exercise and opportunity to document potential EbA & EbM activities for future academic research/ mini thesis. For example, the case study proposes new spaces created for recreation which will in turn allow the communities to better manage the river and avoid illegal dumping. This example has a potential to address both adaptation and mitigation to climate change through these additional benefits. Worcester Polytechnic Institute (2012)http://wp.wpi.edu/capetown/projects/p2012/pathway/ The class discussion should move towards identifying similar examples in their own city/region.	2	

LT3. Topic 2: Ecosystems for adaptation and Ecosystem based Adaptation

Outcomes

Specialist knowledge: Student demonstrates specialised knowledge on different EbA approaches
Knowledge of applications: Student is able to understand and evaluate the variety of tools, strategies, approaches and plans used in relation to EbA
Research literacy: Student is able to choose an appropriate process of enquiry to understanding EbA in their context, and to draw conclusions from this process
Stakeholder engagement: Student is able to engage sensitively and ethically with local community leaders

LT3	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T2.1	**Student: Pre-readings with questions** Students browse the website and watch the video.	2	*Website:* [15] Conservation International *Video:* Tingcungcu project
T2.2	**Class activity: Lecture and Discussion** Lecture on EbA followed by discussion with the class, covering: – Biodiversity and ecosystem services – Vulnerability assessment (impacts of climate change on biodiversity and ecosystem services), – EbA related approaches such as ecosystem based disaster risk reduction (Eco-DRR), other complementary approaches to EbA, – Ecosystem based adaptation (EbA) as part of a country's overall climate change adaptation strategy. – Key climate change hazards, climate change-related social problems and solutions in southern Africa. – The cross cutting nature of EbA interventions, co-benefits of EbA in contributing towards a broader set of socio-economic and developmental goals. – National and International policy imperatives of EbA. – Benefits and critiques of EbA		

T2.3	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [18] Devisscher(2010) [7] Ayers & Huq (2009) [26] Enfors& Gordon(2008) [58] Paavola(2008)
T2.4	**Class activity: Lecture and Discussion** Lecture, followed by discussion with the class, on the identification and mapping of EbA priority areas, covering: – Tools, strategies, approaches and plans underpinning identification and mapping of EbAs, – Systematic approach to biodiversity plans focusing on ecosystems and processes. – The role of spatial plans at different scales in EbAs (e.g. provincial biodiversity plans, municipal, bioregional or biodiversity sector plans).	2	
T2.5	**Class activity: Lecture and Debate** a) Lecture on EbA effectiveness and implementation – Understanding the effectiveness of EbA approaches, monitoring & evaluation of EbA approaches, – Understanding of EbA to other adaptation sectors (Agriculture, Forestry and Fisheries); Rural development & land reform; Water & sanitation; Health and Environmental sector in terms of adaptation to climate change impacts on ecosystems as mentioned above, – Understanding how EbA can be implemented on the ground, Understanding of the linkages between EbA and the sustainable development goals in southern Africa b) Lecturer facilitates a class debate, based around the case study of ecosystem products and adaptation of local communities (example in Tanzania, forest products for consumption or additional incomes during dry spells, diversification with firewood, charcoal, timber or fruits as adaptive strategy).	1	

	The class debates the question, 'How effective has EbA been in addressing climate change impacts for the rural poor?'		
T2.6	**Class activity: Lecture** Lecture on the Economics of EbA, covering the cost effectiveness of EbA; the economic impact of EbA at municipal and provincial levels, and cost-benefit analysis of EbA investments.	2	
T2.7	**Class activity: Field trip – stakeholder engagement** – The class identifies local EbA project to visit. Students can identify their own local EbA priority areas by assessing an area that was exposed to an extreme climate change event that affected poor communities and used biodiversity and ecosystem services as a solution to help people adapt to climate change. – Preparation: context, logistics – Preparation: students to complete university ethics procedures for stakeholder engagement – Field trip to engage with community leaders about challenges and opportunities in local EbA project. Students can setup questions and come up with solutions for managing the ecosystem through local knowledge complimented with scientific knowledge for multiple benefits.	0.5 0.5 1 3	
Summative assessment activity for T2			
T2.8	**Student**: Group report on EbA project – each individual member completes a section, including stakeholder process learnings Summative assessment using report rubric	3	
T2.9	**Class activity:** Group presentation on project (each student has a 5-minute slot) Assessment criteria for group presentation: – Shows learnings from stakeholder engagement process – Captures the adaptation opportunities and challenges – Conveys complexity/ trade-offs of EbA project – Summative assessment using presentation rubric	2	

LT3. Topic 3: Ecosystems for climate change mitigation and Ecosystem based Mitigation

Outcomes

- Specialist knowledge: Student demonstrates specialised knowledge on different EbM approaches, in particular REDD/REDD+
- Knowledge of applications: Student is able to understand and evaluate the variety of tools, strategies, approaches and plans used in relation to EbM
- Research literacy: Student is able to choose an appropriate, ethical process of enquiry to understanding EbM in their context, and to capture and draw conclusions from this process
- Problem solving: Student is able to understand the consequences of EbM projects for a specific, local context.

LT3	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T3.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Budgeting and forecasting tool:* CIFOR Seeing the costs of REDD +
T3.2	**Class activity: Lecture and Debate** a) Lecture on REDD and REDD+, biochar b) Lecturer facilitates a class debate on the value (pros and cons) of REDD/ REDD+	 2 1	
T3.3	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [6] Armah et al. (2011) [34] Garrity et al. (2010) [22] Durban case study
T3.4	**Class activity: Lecture and Discussion** a) Lecture looking at EbM with case studies: e.g. Buffelsdraai Landfill site, Durban case study b) Class discussion: How could/ should this model of EbM be used in local context? Here students can interrogate the issue of win-win in both approaches. Tip: There is not always win-win in these two approaches for example, in the project above they can investigate the type of species planted. Reforesting for carbon sequestration with species that consume a lot of water can lead to more vulnerability of downstream users to water scarcity (this compromises EbA) while on the	 2 1	

	other hand reforestation benefits the EbM through carbon sequestration thereafter reducing emissions of methane gas in the atmosphere.		
T3.5	**Class activity: Field trip – stakeholder engagement** – The class identifies local EbM project for visit – Preparation: context, logistics – Preparation: students to complete university ethics procedures for stakeholder engagement – Field trip to engage with community leaders about challenges and opportunities in local EbM project	6	
Summative assessment activity for T3			
T3.6	**Student:** Group report on EbM project – each individual member completes a section, including stakeholder process learnings **Summative assessment using report rubric**	3	
T3.7	**Class activity:** Group presentation on EbM project (5 minutes per student) Assessment criteria for group presentation: – Shows learnings from stakeholder engagement process – Captures the adaptation opportunities and challenges – Conveys complexity/ trade-offs of EbM project **Summative assessment using presentation rubric**	1	

Learning Theme 4: Governance and Management of Ecosystem Services

Rationale for Learning Theme

Governance is the process of formulating decisions and guiding the behaviour of humans, groups and organisations in formally, often hierarchically organised decision-making systems or in networks that cross decision-making levels and sector boundaries. Ecosystems are managed to deliver a wide range of ecosystem services required by stakeholders with different needs and demands, sometimes conflicting and overlapping. Proper governance of ecosystems and the services they provide is thus important as many ecosystems provide goods and services that are public goods that cross political boundaries and require an integrated approach to management. Climate change poses additional challenges to the sustainable management of ecosystems.

This Learning Theme equips students to understand the governance of ecosystem services and biodiversity at local and international scale, the policy instruments at different governance levels and their strengths and weaknesses. The Learning Theme also equips students to evaluate programs, policies, and institutions that manage and protect ecosystem services, for efficiency, equity, intergenerational sustainability and climate resilience.

LT4. Topic 1: Principles of ecosystem management for climate resilience

Outcomes

- ***Specialist knowledge:*** Student is able to demonstrate knowledge of ecosystem management
- ***Producing and communicating information***: Student is able to demonstrate ability to integrate gained knowledge about ecosystem management from readings and from the lecture both orally and in writing

LT4	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T1.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	2	*Readings:* [72] IUCN (2010) [42] IUCN (2011) [10] Brody S.D. (2003) [20] Drakou et al. (2015) [25] EKOCLIM 4
T1.2	**Class activity: Lecture and discussion** Interactive lecture on the principles of ecosystem management for climate resilience, covering: – Guiding principles for ecosystem management – Factors influencing production and flow of ecosystem services – Planning for implementation of management principles	2	
T1.3	**Student: Essay and Presentation** Student prepares a short essay (1000 words)critically assessing the principles of ecosystem management **Summative assessment of** the essay, using Essay rubric.	3	
T1.4	**Class activity:** Follow-up Students to present their findings in a short (10-minute) presentation to the class The presentations are peer assessed for Formative feedback task.	2	

LT4. Topic 2: Concepts of environmental governance

Outcomes

Specialised knowledge: Student is able to demonstrate specialised knowledge in environmental governance and to critically engage with different sources on this topic

Teamwork: Student is able to work democratically with peers, listening to other's perspectives and opinions, critically reflecting, and building on these with their own positionality and thinking.

LT4	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T2.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	4	*Readings:* [9] Bourne et al. (2016) [42] IUCN (2011) [31] Folke et al. (2015) Videos: [57] Ostrom E. The Myth of Tragedy of the Commons [56] Ostrom E. Sustainable development and the tragedy of commons
T2.2	**Class activity: Lecture and discussion** Interactive lecture on ecosystems as the basis of production and the need for governance structures	2	
T2.3	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on governing the commons	2	
T2.4	**Class activity: Debate** Lecturer to facilitate a class debate centred on the questions, 'How can governance structures and tools help in safeguarding ecosystem services for the marginalised poor?' Lecturer to provide feedback on students' participation and contributions.	2	

LT4. Topic 3: Policy instruments and tools for ecosystem governance

Outcomes

Stakeholder engagement: Student is able to demonstrate empathy and an understanding for the roles, values and mandates of different actors engaged in governing ecosystems and managing conflict

LT4	*Teaching-Learning-Assessment Activity*	*Hrs*	*Key resources*
T3.1	**Student: Pre-readings with questions** Students to read the Key readings, framing their reading around key questions.	4	*Readings:* [61] Primmer et al.(2015) [21] Duraiappah (2006) [23] Green et al. (2013) [60] Primmer & Furman (2012) [39] Harris &Hao(2010) [45] King et al. (2015) Additional local case studies required.
T3.2	**Class activity: Lecture and Discussion** Lecture followed by discussion with the class, on governing the commons	3	
T3.3	**Class activity: Role playing** Role playing activity with students taking opposing positions in a case study on conflict management. Class to develop or find a Roleplaying guidance document with criteria for the activity. Lecturer to provide feedback and facilitate a reflective discussion. Student to write-up learnings from the activity.	4	

Cross-cutting summative assessment activity for LT4

Outcomes

- ***Method and procedure***: Student is able to select and apply an appropriate process for undertaking a comparative study on ecosystem governance systems.
- ***Teamwork:*** Student is able to work democratically with peers, distributing work fairly and contributing to the shared responsibility of the task

Summative assessment activity for LT4	***Hrs***	***Key resources***
Students: Group report Comparative analysis of ecosystem governance systems Students write a group comparative analysis of ecosystem governance systems in at least 2 countries. Each student contributes by writing up on a selected country. Students should each contribute 1000 words to the report (5 hours). **Summative assessment using report rubric**	5	Student to identify resources
Student: Each student prepares a presentation on findings for a specific country	1	
Class activity: Each student presents findings to class (5 minutes per individual student) for peer assessment **Summative assessment using presentation rubric**	2	

Summary of summative assessment in the module

The student's grades are compiled from summative individual and/ or group tasks across the module.

Summative assessment measures the student's achievement by comparing it against standard criteria (i.e. the desired module outcomes). Because summative assessment is for marks, it is 'high stakes' and has a motivational effect on student engagement. To avoid contention, it is recommended the lecturer and an independent assessor provide summative assessment, based on clear, explicit and transparent criteria. Standard rubrics are found in the *Assessment Guidelines and Tools* on the ePlatform and can be adapted and weighted as necessary. Careful proactive consideration must be given to ensuring that plagiarism is avoided.

It is recommended that summative tasks account for about 20% of the student notional hours of a module and do not place too big a burden on the lecturer.

LT	Topic	Type of task	Subject	Hrs	Group/ individual
LT1	T4	Online tool	Use of Maxent/ SWAT	2	Individual
	Cross-cutting	Literature Review	Critique of the Millennium Ecosystem Assessment	4	Individual
LT2	T2	Online tool	Use of InVEST	2	Individual
	Cross-cutting	Essay & presentation	Quantification and valuation of ecosystem services	9	Individual
LT3	T2	Report& presentation	EbA project	5	Group project
	T3	Report& presentation	EbM project	5	Group project
LT4	Cross-cutting	Report& presentation	Comparative analysis of ecosystem governance in different countries	8	Group project

Note for printing:

This TLA Plan has been formatted to be printed as an A5 booklet, with a gutter margin. Ensure that you select 'Booklet' on your Printer Settings, under the 'Layout' tab.

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