

**NATIONAL UNIVERSITY OF LIFE
AND ENVIRONMENTAL SCIENCES OF UKRAINE**

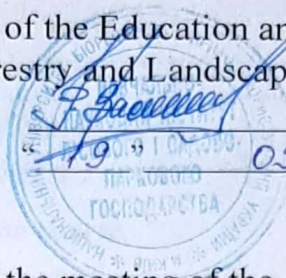
Department of forest mensuration and forest management

«**CONFIRMED**»

Director of the Education and Research Institute
of Forestry and Landscape-Park Management

R. Vasylyshyn

2023 p.



«**APPROVED**»

at the meeting of the department of forest
mensuration and forest management

Protocol № 11 dated May 10, 2023

Acting Head of Department

V. Myroniuk

«**REVIEWED**»

Program coordinator

O. Bala

PROGRAM OF THE COURSE

«Forest Ecosystem Services»

specialization 205 – Forestry
Education and Research Institute
of Forestry and Landscape-Park Management

Developers: Prof., Doctor of Agricultural Sciences Andrii Bilous
Assoc. Prof., Candidate of Agricultural Sciences Ivan Lakyda

Kyiv 2023

1. Description of the course

Forest Ecosystem Services

Field of knowledge, specialization, educational program, educational degree		
Educational degree	<i>Master</i>	
Specialization	<i>205 – Forestry</i>	
Educational program	<i>Forestry</i>	
Characteristics of the course		
Type	Elective	
Total number of hours	120	
Number of ECTS credits	4	
Number of content modules	2	
Course project (work) (if applicable)	–	
Type	Exam	
Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	–
Semester	2	–
Lecture classes	<i>20 hr.</i>	–
Practical, seminar classes	<i>20 hr.</i>	–
Laboratory classes	–	–
Self-study	<i>80 hr.</i>	–
Individual assignments	–	–
Number of weekly classroom hours for the full-time form of study	<i>2 hr.</i>	–

2. Purpose, objectives, and competencies of the course

Objective. Forests as a biological object are of much greater value than the commercial timber harvested from them, especially in densely populated areas. The course addresses the description and quantification of forest ecosystem services, which helps to reflect the cumulative effect of forests on the environment. Quantitative assessment of the above-mentioned forest ecosystem services also creates prerequisites for their further economic evaluation.

The main **objectives** of the discipline are:

1. Expanding the professional and scientific outlook and formation of students' ecological thinking through obtaining basic information about forest ecosystem services.

2. Mastering the theoretical and practical principles of classification of ecosystem services, their role for sustainable development and implementation of the "green" economy.
3. Familiarization with the basics of biophysical and economic valuation of forest ecosystem services.
4. Study approaches to mapping forest ecosystem services.
5. Deepening understanding of economic concepts underlying the economic valuation of forest ecosystem services.

As a result of studying the discipline "Forest Ecosystem Services" the student should:

a) know

- categories and concepts of biophysical and economic valuation of forest ecosystem functions and services;
- directions and approaches to the classification of forest ecosystem services;
- the best available information on the assessment of forest ecosystem services in Ukraine and abroad.

b) be able to:

- apply the acquired knowledge, computer technology in calculations;
- to carry out biophysical and economic assessment of the most important services of forest ecosystems, to justify individual decisions on the importance of ecosystem services in specific conditions, to compare economic indicators for different services of forest ecosystems.

The discipline ensures the formation of

- integrated competency:

IC. Ability to resolve complex tasks in forestry or during the study process that require investigations or innovations.

- of general competencies:

GC 7. Ability to work in an international context.

- professional (special) competencies:

SC 2. Ability to ensure sustainable development of forestry.

SC 4. Ability to develop and implement current and strategic plans for the development of forestry enterprises, taking into account resources, risks, as well as economic, legal and environmental aspects.

SC 6. Ability to carry out educational activities among the population to form environmental thinking, awareness and responsibility for the environment.

As a result of studying the discipline, the student will acquire the following **program learning outcomes:**

PLO 2. Communicate fluently orally and in writing in Ukrainian and foreign languages when discussing professional issues, research and innovation in forestry.

PLO 3. To make effective decisions on forestry issues, including in difficult and unpredictable conditions; to predict its development; to identify factors that affect the achievement of goals; to analyze and compare alternatives; to assess the risks and possible consequences of decisions.

PLO 5. Manage complex activities in the field of forestry and in broader contexts, ensure quality, evaluate efficiency and effectiveness of activities.

PLO 6. To assess the state of forest phytocoenoses, forest resources in specific forest vegetation conditions, their potential and predict the possibilities of use.

PLO 7. Develop and implement scientific and applied projects in the field of forestry, taking into account available resources and risks, as well as economic, legal and environmental aspects.

PLO 8. Develop and improve technological and production processes, implement modern digital technologies.

PLO 9. Determine performance criteria and choose the optimal forestry strategy depending on external and internal conditions.

PLO 10. Clearly and unambiguously communicate their own knowledge, conclusions and arguments on forestry and related issues to specialists and non-specialists, including students.

PLO 11. Apply modern experimental and mathematical methods, digital technologies and specialized software to solve complex problems of forestry and hunting.

3. Program and structure of the course

PROGRAM OF THE COURSE

MODULE 1. Classification and biophysical assessment of ecosystem services.

Topic 1. Introduction to Ecosystem Services.

Definition of ecosystem services. Classification of ecosystem services according to various criteria. The Common International Classification of Ecosystem Services.

Topic 2. Ecosystem services: Provisioning (biotic and abiotic).

Division: Biomass. Division: Genetic material from all biota. Division: Other types of provisioning service from biotic sources. Division: Water provisioning. Non-aqueous natural abiotic ecosystem outputs.

Topic 3. Forest ecosystem services: Regulation & Maintenance.

Biotic forest ecosystem services of regulation and maintenance. Abiotic forest ecosystem services of regulation and maintenance.

Topic 4. Forest ecosystem services: Cultural.

Biotic cultural forest ecosystem services. Abiotic cultural forest ecosystem services.

Topic 5. Ecosystem Services and Biodiversity.

The role of biodiversity in ecosystem services. Mapping and assessing ecosystem services. Valuation of ecosystem services. The importance of systems thinking.

MODULE 2. Economic valuation and certification of ecosystem services.

Topic 6. Forest ecosystem services and types of values.

General concepts of economic valuation of goods and services. Classification of values.

Topic 7. Basics of economic valuation of ecosystem services.

Public and private goods. Methods of economic valuation of ecosystem services.

Topic 8. Overview of direct methods of economic valuation of ecosystem services.

Direct methods of economic valuation of ecosystem services. Contingent valuation method. Travel cost method. Hedonic pricing method.

Topic 9. Overview of indirect methods of economic valuation of ecosystem services.

Market-based valuation method. Avoided cost method. Replacement cost method. Opportunity cost method.

Topic 10. Certification for ecosystem services.

Forest management and chain-of-custody certification. Reasons for certification. FSC Ecosystem Service verification.

STRUCTURE OF THE COURSE

Names of content modules and topics	Number of hours													
	Full-time form							Part-time form						
	weeks	total	including					total	including					
			1	p	lab	ind	self		1	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Module 1. Classification and biophysical assessment of ecosystem services														
Topic 1. Introduction to Ecosystem Services	1	12	2	2			8							
Topic 2. Ecosystem services: Provisioning (biotic and abiotic)	2	12	2	2			8							
Topic 3. Forest ecosystem services: Regulation & Maintenance	3	12	2	2			8							
Topic 4. Forest ecosystem services: Cultural	4	12	2	2			8							
Topic 5. Ecosystem Services and Biodiversity	5	12	2	2			8							

Total module 1	5	60	10	10			40						
Module 2. Economic valuation of ecosystem services.													
Topic 6. Forest ecosystem services and types of values	6	12	2	2			8						
Topic 7. Basics of economic valuation of ecosystem services	7	12	2	2			8						
Topic 8. Overview of direct methods of economic valuation of ecosystem services	8	12	2	2			8						
Topic 9. Overview of indirect methods of economic valuation of ecosystem services	9	12	2	2			8						
Topic 10. Certification for ecosystem services	10	12	2	2			8						
Total module 2	5	60	10	10			40						
Total hours	x	120	20	20			80						

4. Practicals' topics

№	Topic	Hours
1.	What are the benefits people from ecosystems?	2
2.	Assessment of biophysical parameters of forest biomass	2
3.	Assessment of biophysical parameters of energy accumulated in forest biomass	2
4.	Provisioning forest ecosystem services	2
5.	Biodiversity assessment of forest ecosystems	2
6.	Forest ecosystem services and types of values	2
7.	Benefit transfer	2
8.	Economic assessment of carbon sequestrative function of forest ecosystems	2
9.	Economic valuation of oxygen productive function of forest ecosystems	2
10.	Identification of communication activities related to FSC ES claims	2

5. Independent assignment topics

No	Topic	Hours
1.	Getting acquainted with ecosystem services of urban forests and trees	40
2.	Peculiarities of economic valuation of ecosystem services	40
TOTAL:		80

6. Samples of control questions, tests for assessing the level of knowledge acquisition by students

1. What are the examples of ecosystem services?
2. The hierarchical structure of CICES (V5.1)?
3. The provisioning (biotic) section contains the divisions?
4. The provisioning (abiotic) section contents the divisions?
5. What is the benefit provided by ecosystem processes that moderate natural phenomena?
6. What are ecosystem services by Costanza et al. (1997)?
7. What are the divisions that are contained the cultural (biotic) section?
8. What are the explanations that are behind the concepts of "rivalry" and "excludability"?
9. What is the definitive goal of the ecosystem services concept in policy?
10. What is the largest driver of biodiversity loss over the last 50 years?
11. What is the right relationship between policies to monitor and protect ecosystem services and monitor and protect biodiversity?
12. Provide the examples of excludable things and services
13. Pick the statement that characterize the concept of "excludability".
14. What are "collective or club goods"?
15. What are "common goods or common pool resources"?
16. Choose the statement that best fits the idea behind "Direct methods" of economic valuation of ecosystem services.
17. Choose the statement that best fits the idea behind "Explicit methods" of economic valuation of ecosystem services.
18. Choose the statement that best fits the idea behind "Implicit methods" of economic valuation of ecosystem services.
19. Choose the statement that best fits the idea behind "Indirect methods" of economic valuation of ecosystem services.
20. What are "private goods"?
21. What are "public goods"?
22. Choose the statement that best describes the idea behind "benefit transfer" method of economic valuation of ecosystem services.

**A set of tests for assessing the level of knowledge acquisition by students
in the discipline «Forest Ecosystem Services»**

1. Please, connect the definitions with the sources

- Ecosystem services are "the benefits people obtain from ecosystems"

Відповідь 1

- A subset of the interactions between ecosystem structure and processes that underpin the capacity of an ecosystem to provide goods and services

Відповідь 2

- Ecosystem services are benefits human populations directly or indirectly derive from ecosystem functions

Відповідь 3

- Ecosystem services are the benefits that people obtain from nature

Відповідь 4

2. The hierarchical structure of CICES (V5.1):

- Section

Відповідь 1

- Division

Відповідь 2

- Group

Відповідь 3

- Class

Відповідь 4

- Class type

Відповідь 5

3. Please, connect the three major sections with definitions.

- This Section covers all nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs (including water).

Відповідь 1

- All the ways in which living organisms can mediate or moderate the ambient environment that affects human health, safety or comfort, together with abiotic equivalents.

Відповідь 2

- All the non-material, and normally non-rival and non-consumptive, outputs of ecosystems (biotic and abiotic) that affect physical and mental states of people.

Відповідь 3

4. The provisioning (biotic) section contains the divisions:

- Biomass
- Water
- Genetic material from all biota
- Other types of provisioning service from biotic sources
- Non-aqueous natural abiotic ecosystem outputs

5. The provisioning (abiotic) section contents the divisions:

- Non-aqueous natural abiotic ecosystem outputs
- Biomass
- Genetic material from all biota
- Water
- Other types of provisioning service from biotic sources

6. The benefit provided by ecosystem processes that moderate natural phenomena is

- regulating service
- provisioning service
- cultural service

7. The regulation & maintenance (biotic) section contents the divisions:

- Transformation of biochemical or physical inputs to ecosystems
- Other types of regulation and maintenance service by abiotic processes
- Regulation of physical, chemical, biological conditions
- Regulation of physical, chemical, biological conditions
- Transformation of biochemical or physical inputs to ecosystems
- Other types of regulation and maintenance service by living processes

8. The regulation & maintenance (abiotic) section contains the divisions:

- Regulation of physical, chemical, biological conditions
- Other types of regulation and maintenance service by living processes
- Transformation of biochemical or physical inputs to ecosystems
- Other type of regulation and maintenance service by abiotic processes

9. The non-material benefits people obtain from nature. They include recreation, aesthetic enjoyment, physical and mental health benefits and spiritual experiences are

- regulating services
- provisioning services
- cultural services

10. The cultural (biotic) section contents the divisions:

- Direct, in-situ and outdoor interactions with living systems that depend on the presence in the environmental setting
- Other abiotic characteristics of nature that have cultural significance
- Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting
- Direct, in-situ and outdoor interactions with natural physical systems that depend on presence in the environmental setting
- Other characteristics of living systems that have cultural significance

- Indirect, remote, often indoor interactions with physical systems that do not require presence in the environmental setting

11. The cultural (abiotic) section contains the divisions:

- Other characteristics of living systems that have cultural significance
- Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting
- Indirect, remote, often indoor interactions with physical systems that do not require presence in the environmental setting
- Direct, in-situ and outdoor interactions with living systems that depend on the presence in the environmental setting
- Other abiotic characteristics of nature that have cultural significance
- Direct, in-situ and outdoor interactions with natural physical systems that depend on presence in the environmental setting

12. What are ecosystem services by Costanza et al. (1997)?

- Ecosystem services are resources for human populations directly or indirectly derive from forest ecosystems
- Ecosystem services are benefits human populations directly or indirectly derive from ecosystem functions
- Ecosystem services are goods human populations directly or indirectly derive from ecosystems

13. What is the definitive goal of the ecosystem services concept in policy?

- Maximizing a single or few ecosystem services in the short term.
- Long-term, stable provision of ecosystem services.

14. What is the largest driver of biodiversity loss over the last 50 years?

- The focus on maximizing provisioning services.
- The focus on minimizing provisioning services.
- Ignoring the meaning of provisioning services.

15. What is the right relationship between policies to monitor and protect ecosystem services and monitor and protect biodiversity?

- Policies to monitor and protect ecosystem services should not replace those designed to monitor and protect biodiversity.
- Policies to monitor and protect ecosystem services should replace those designed to monitor and protect biodiversity.

16. Please, choose sections of provisioning ecosystem services.

- Biotic
- Synthetic
- Abiotic
- Anthropogenic

17. Please, choose the three major sections in CICES (V5.1):

- Provisioning
- Genetic material
- Regulation and Maintenance
- Cultural
- Biomass

18. What are the explanations that are behind the concepts of "rivalry" and "excludability"?

- Rivalry is

Відповідь

1

Subtractability is

Відповідь

2

19. Provide the examples of excludable things and services by choosing from the list below:

- national defense
- public trash bins
- public roads
- scenic views
- fisheries
- cellphone service
- natural gas supply
- public transport

20. Pick the statement that characterizes the concept of "excludability".

- If someone did not pay for a thing he is not allowed to use it.
- People usually do not pay for excludable goods, however, they are allowed to enjoy them.
- The marginal cost for supplying an extra unit of excludable goods to customers equals zero.

21. What are "collective or club goods"?

- Goods that you have to pay for, and by acquiring them you are preventing someone else from having that same item.
- Goods and services you have to pay for or do something to help upkeep it, but all the people that have paid into it don't subtract from other people's ability to use it.
- Goods and services that are hard to stop people from using them, but the items you take cannot be shared with someone else.
- Goods and services that are usually not paid for, and it is hard (if possible at all) to prevent people from using them.

22. What are "common goods or common pool resources"?

- Goods that you have to pay for, and by acquiring them you are preventing someone else from having that same item.
- Goods and services you have to pay for or do something to help upkeep it, but all the people that have paid into it don't subtract from other people's ability to use it.

- Goods and services that are hard to stop people from using them, but the items you take cannot be shared with someone else.
- Goods and services that are usually not paid for, and it is hard (if possible at all) to prevent people from using them.

23. Choose the statement that best fits the idea behind "Direct methods" of economic valuation of ecosystem services.

- Values are found from those individuals who are affected by the environment, and by environmental changes.
- Values are found from experts, policy makers, or others who represent those individuals.
- Asking individuals (and experts) about the respective values.
- Inferring environmental values from observations of economic behavior.

24. Choose the statement that best fits the idea behind "Explicit methods" of economic valuation of ecosystem services.

- Values are found from those individuals who are affected by the environment, and by environmental changes.
- Values are found from experts, policy makers, or others who represent those individuals.
- Asking individuals (and experts) about the respective values.
- Inferring environmental values from observations of economic behavior.

25. Choose the statement that best fits the idea behind "Implicit methods" of economic valuation of ecosystem services.

- Values are found from those individuals who are affected by the environment, and by environmental changes.
- Values are found from experts, policy makers, or others who represent those individuals.
- Asking individuals (and experts) about the respective values.
- Inferring environmental values from observations of economic behavior.

26. Choose the statement that best fits the idea behind "Indirect methods" of economic valuation of ecosystem services.

- Values are found from those individuals who are affected by the environment, and by environmental changes.
- Values are found from experts, policy makers, or others who represent those individuals.
- Asking individuals (and experts) about the respective values.
- Inferring environmental values from observations of economic behavior.

27. What are "private goods"?

- Goods that you have to pay for, and by acquiring them you are preventing someone else from having that same item.
- Goods and services you have to pay for or do something to help upkeep it, but all the people that have paid into it don't subtract from other people's ability to use it.
- Goods and services that are hard to stop people from using them, but the items you take cannot be shared with someone else.
- Goods and services that are usually not paid for, and it is hard (if possible at all) to prevent people from using them.

28. What are "public goods"?

- Goods that you have to pay for, and by acquiring them you are preventing someone else from having that same item.
- Goods and services you have to pay for or do something to help upkeep it, but all the people that have paid into it don't subtract from other people's ability to use it.
- Goods and services that are hard to stop people from using them, but the items you take cannot be shared with someone else.
- Goods and services that are usually not paid for, and it is hard (if possible at all) to prevent people from using them.

29. Choose the statement that best describes the idea behind "benefit transfer" method of economic valuation of ecosystem services.

- A systematic summary of available studies, for the same or similar good, from «elsewhere».
- Values are found from experts, policy makers, or others who represent those individuals.
- Asking individuals (and experts) about the respective values.

- ○ Valuation from "elsewhere" is used to predict value at a particular site.

30. Choose the statement that best describes the idea behind "meta-analysis" in economic valuation of ecosystem services.

- ○ A systematic summary of available studies, for the same or similar good, from «elsewhere».
- ○ Values are found from experts, policy makers, or others who represent those individuals.
- ○ Asking individuals (and experts) about the respective values.
- ○ Valuation from "elsewhere" is used to predict value at a particular site.

7. Teaching methods

In the process of teaching the discipline "Forest Ecosystem Services" the following methods are used:

- 1) methods of organizing and implementing educational and cognitive activities (conversation, lecture; illustration; practical work, abstracts; independent work of students);
- 2) methods of stimulation and motivation of educational and cognitive activity (educational discussions, analysis of life situations);
- 3) methods of control (self-control, mutual control), correction (self-correction, mutual correction) of the effectiveness of educational and cognitive activity;
- 4) binary, integrated (universal) methods.

8. Forms of assessment

The main forms of control organization in the process of studying the discipline "Forest Ecosystem Services" are individual, group and frontal testing of students' knowledge, skills and abilities (oral and written).

The form of final control is an exam.

9. Distribution of grades received by students

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated April 26, 2023, protocol No 10).

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Not passed

To determine the student's (trainee's) rating in mastering the discipline R_{DIS} (up to 100 points), the attestation rating (up to 30 points) is added to the student's (trainee's) rating in academic work R_{NR} (up to 70 points): $R_{DIS} = R_{NR} + R_{AT}$.

9. Recommended literature

Main:

1. Ecosystem Services of Ukrainian Forests: a Case Study of the Polissya Region: monograph / P. Lakyda, A. Bilous, A. Shvidenko, V. Myroniuk, M. Matsala, R. Vasylyshyn, D. Holiaka, I. Lakyda – Kyiv: NULES of Ukraine, 2018. – 188 p.
2. Bilous A., Holiaka D., Kovbasa Ya., Holiaka M., Bilous V., Kotliarevska U., Slyva O., Matsala M. Tables for Ecosystem Services Assessment of Soft-leaved Forests of Ukrainian Polissya. Kyiv: NULES of Ukraine, 2018. 190 p.
3. Білоус А. М. Екосистемні функції м'яколистяних лісів Українського Полісся. Монографія. – Глобус, 2020. – 152 с.
4. Білоус А.М. Біопродуктивність та екосистемні функції м'яколистяних лісів Українського Полісся. Монографія / А. М. Білоус. Житомир : ТОВ «Видавничий дім «Бук-Друк», 2021. – 816 с.
5. Bouma and Van Beukering (2015) Ecosystem services: from concept to practice, Cambridge University Press Ruhl, Kraft, and Lant (2007) *The Law and Policy of Ecosystem Services*, Island Press
6. Kareiva, Tallis, Ricketts, Daily, and Polasky, eds. (2011) *Natural Capital: Theory and Practice of Mapping Ecosystem Services*, Oxford University Press
7. Daily, ed. (1997) *Nature's Services: Societal Dependence on Natural Ecosystems*, Island Press
8. Daily and Ellison (2002) *The New Economy of Nature*, Island Press
9. Лісотаксаційний довідник (доповнене видання) / уклад. А.М. Білоус, С.М. Кашпор, В.В. Миронюк, В.А. Свинчук, О.М. Леснік. – Київ : Видавничий дім «Вініченко», 2021. 420 с.
10. Lakyda P., Shvidenko A., Bilous A., Myroniuk V., Matsala M., Zibtsev S., Schepaschenko D., Holiaka D., Vasylyshyn R., Lakyda I., Diachuk P., Kraxner F. Impact of Disturbances on the Carbon Cycle of Forest Ecosystems in Ukrainian Polissya. Forests. 2019. 10 (4). 337. doi.org/10.3390/f10040337
11. Білоус А.М., Голяка Д.М., Ковбаса Я.В., Голяка М.А., Білоус В.М., Аврамчук О.О., Котляревська У.М., Слива О.І. Нормативно-довідкові матеріали для оцінювання екосистемних послуг м'яколистяних лісів Українського Полісся : [довідник]. К.: НУБіП України, 2017. 190 с.

Additional:

1. Закони України, нормативні документи Кабінету Міністрів України, міністерств і відомств України, органів місцевого самоврядування з питань екологічної політики.
2. Ecosystem Marketplace: <http://www.ecosystemmarketplace.com>
3. Ecosystem services podcast tutorial: http://www.keckfutures.org/conferences/ecosystems-services_podcast_home.html

4. The Economics of Ecosystems and Biodiversity (TEEB):
<http://www.teebweb.org>

5. TEEB lecture series: <http://environment.yale.edu/TEEB>

6. A community on ecosystem services (ACES):
<http://www.conference.ifas.ufl.edu/aces/index.html>

7. National ecosystem services partnership:
<http://nicholasinstitute.duke.edu/initiatives/nationalecosystem-services-partnership>

8. Bilous, A.; Holiaka, D.; Matsala, M.; Kashparov, V.; Schepaschenko, D.; Lakyda, P.; Shvidenko, A.; Myroniuk, V.; Otreshko, L. 90Sr Content in the Stemwood of Forests within Ukrainian Polissya. *Forests* 2020, 11, 270.
<https://doi.org/10.3390/f11030270>

10. Information resources

In order to study the discipline "Forest Ecosystem Services", documents in information systems (libraries, archives, funds, data banks, etc.) can be used, in particular:

1. [Національна бібліотека ім. В.І.Вернадського: http://www.nbuv.gov.ua.](http://www.nbuv.gov.ua)
2. [International Institute for Sustainable Development: http://www.iisd.org.](http://www.iisd.org)
3. [FAO: http://www.fao.org.](http://www.fao.org)
4. [WWF: http://wwf.panda.org.](http://wwf.panda.org)
5. [Center for International Forestry Research: www.cifor.org.](http://www.cifor.org)
6. [European Forest Ecosystem Research Network: iff.boku.ac.at/efern/](http://iff.boku.ac.at/efern/)
7. www.elsevier.com
8. <https://www.itreetools.org>
9. <https://cices.eu/>