

Indigenous people's approach to woody plant species conservation in selected spots in Abia State, Southeastern Nigeria

Godson Chinonyerem Asuoha , Uchenna Paulinus Okafor ✉, Chukwuemeka Anthony Onyekwelu , Romanus Udegbumam Ayadiuno , Philip Ogonnia Phil-Eze 

University of Nigeria, Department of Geography, Faculty of the Social Sciences, Nsukka Road, 410001 Nsukka, Nigeria

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Abstract: The 15th of United Nations' Sustainable Development Goals (SDGs) aims to protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. This paper investigates the approach adopted by indigenous peoples for conservation of woody plant species diversity in some selected spots in Abia State, Southeastern Nigeria.

Relying on mixed method approach to research, data collection comprising field observation, ground truthing, plant species inventory, and key-informant interviews and analysis of data, two spots were purposively sampled, one from each of the two LGAs; Mbom in Bende LGA and Amangwu in Ohafia Local Government Area (LGA). A 50 × 20 m quadrat was sampled from each site, from where plant species inventory was undertaken. Shannon–Wiener diversity index (H') was used to analyse the data.

The result of Shannon–Wiener diversity index, shows that the diversity indices of the plant species for the two sites were 3.20 (Mbom) and 3.95 (Amangwu) respectively. The people of Bende and Ohafia LGAs employ some traditional laws to ensure conservation of woody plant species so as to achieve goal 15th of the SDGs. This paper advocates sustenance of those traditional laws that encourage conservation of woody plant species in the study area with enforceable sanctions to deter defaulters.

Keywords: biodiversity loss, conservation, indigenous people, land degradation, Sustainable Development Goals, woody plant species

INTRODUCTION

Biological diversity and sustainable management of resources are very critical for ecosystem stability and human survival. Regrettably, biodiversity is under threat world over; as a result of rapid and accelerating anthropogenic activities leading to persistent decline in species diversity [BAILLIE *et al.* 1996; IUCN 2001; 2006]. Sequel to the above, biodiversity conservation has become one of the greatest challenges which humans have had to grapple with in both developed and the developing countries [IUCN 2006; LAWTON, MAY (eds.) 1995; MEA 2005; The Royal Society 2003].

To protect, restore, and promote sustainable use of terrestrial ecosystems, sustainable forest management, combating desertification, and halting and reversing land degradation and

biodiversity loss are some of cardinal objectives (15th UN Sustainable Developmental Goal –SDG). If this target is to be met and the expected status of the terrestrial ecosystems maintained, then there is an urgent need to enshrine the culture of biodiversity conservation in the local people. This could be achieved through the use of indigenous knowledge.

Indigenous knowledge, according to GRENIER [1998], refers to the unique traditional knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. They need to be enlightened to willingly participate in the exercise. Hence, the conservation of habitats and landscapes constitutes one of major targets (target 4 of the 169 targets) of the SDGs through the global strategy for plant conservation. To meet this biodiversity conservation target it is necessary for every country or state to be engaged in systematic

conservation planning and related conservation action [UNEP/CBD 1992; UNEP/CBD/COP/6/INF/21/Add.1].

The extensive recognition of sustainable development as a concept has transformed forest management policies from traditional to a people-oriented approach in order to harness local knowledge [NOGUCHI *et al.* 2005]. For long, developing environmental management plans has been dominated by the so-called trained experts who are hired for the task. However, empirical evidences show that this approach has led to failures because these managers refused to integrate indigenous people's knowledge in the affected communities [FRASER *et al.* 2006]. Furthermore, like we reported earlier, very little research evidence exists about these conservation practices that involve the use of indigenous knowledge. Such research in Nigeria includes ABDULAHI *et al.* [2013] who studied the importance of indigenous knowledge in biodiversity conservation in Niger State and found that existing traditional conservation methods among the natives include preservation of sacred landscapes for threatened species, myths and taboos restricting use through dos and don'ts, harvesting methods, spiritual values associated with forests and individual species. In line with the above, CARVALHO and FRAZAO-MOREIRA [2011] studied the importance of local knowledge in plant resources management and conservation in two protected areas in Portugal. Local knowledge provides new insights and opportunities for sustainable and multipurpose use of resources and offers contemporary strategies for preserving cultural and ecological diversity, which are the main purposes and challenges of protected areas. They therefore concluded that for the provision of such insights and opportunities to be successful, it is quite necessary to turn the local people into active participants and not just integrating and validating their local knowledge [CARVALHO, FRAZAO-MOREIRA 2011]. CARVALHO and FRAZAO-MOREIRA [2011] also noted that traditional landscapes can provide valuable habitats for many animal species. Moreover, most of actual plant resources are closely dependent on human management and on socioeconomic and agro-ecological combined factors for their continued persistence. This is why it is imperative to integrate the indigenous people into conservation policies and strategies in order to make them active participants in the conservation of woody plant species. This is important not only for the sustainability of the species but also for the provision of habitats for some fauna which live in and on some of these plant species. In their study, RAMPHERI *et al.* [2022] also noted that tree species loss could threaten the stability of ecosystem services which sustain human wellbeing. They highlighted the major human threats to biodiversity loss as deforestation, bush encroachment, pollution, and poor management practices. This is another implication of woody plant species conservation with the aid of indigenous knowledge to avoid depopulation or even extinction of the species. It is to be noted that the International Union for the Conservation of Nature has already red-listed some of these woody plant species in the two spots of woody plant species conservation in the study area as in other parts of Nigeria [BOROKINI 2014]. This is mostly why conservation of such species is an imperative especially in the study area.

Along the same line, MARU *et al.* [2020], in their study of indigenous ways of environmental protection in the Geodeo community of Southern Ethiopia, found that indigenous institutions, traditional beliefs, taboos, and local rules (seera) play an enormous role in promoting environmental protections and

cultural conservation. Thus, setting aside sacred forest for ritual purposes has also entrenched traditions as indigenous mechanism of tree biodiversity conservation. They also noted that following the prohibition systems (taboos), the traditionally protected area (e.g. amba sacred forest) has highest tree diversity and is better preserved than adjacent non-sacred farming habitats [MARU *et al.* 2020]. Additionally, MSUYA and KIDEGHESHO [2009] have observed that traditional management practices have an immense contribution to conservation of the medicinal plants and other resources. They further noted that although the objective of traditional management practices may not necessarily be conservation of medicinal plants, the fact that most of these plants have medicinal value makes them automatically conserved. As regards the United Nations sustainable development goal agenda, all stakeholders are expected to establish modalities that aim to achieve these goals, especially the 15th goal; but surprisingly, HENS [2006] notes that at the governmental policy level it is remarkable that indigenous knowledge has no place in biodiversity conservation strategies. Nevertheless, he posits that there is need to involve communities in such policies. In addition, OLORUNFEMI *et al.* [2016] state that Indigenous traditional knowledge and biodiversity are complimentary phenomena essential to human development and sustainable resource management. They also opine that the rural communities have a significant role to play in maintaining the integrity of ecosystems to ensure that they continue to support livelihood activities.

STUDY MATERIAL AND METHODS

GENERAL INFORMATION

The case studies include two communities in the Abia State – Amokwe Item in the Bende Local Government Area (LGA) and Amangwu in the Ohafia Local Government Area (LGA) (Fig. 1) and examines strategies employed by the locals in woody plant species conservation in order to achieve the sustainable development goals, especially SDG 15. The approach taken in this study is based on mixed methods. Relying on this approach, data collection methods included field observation, ground truthing, plant species inventory, and key-informant interviews and analysis of data. Samples were collected from two spots, one from each LGA. One sample was collected from Mbom, a traditionally protected area (TPA), and one from Ohafia, known as the Amangwu Communal Barn System (ACBS). A 50 × 20 m quadrat was sampled from each site, from where the plant species inventory was undertaken. Shannon–Wiener Diversity Index (H') was used to analyse the data.

The research was conducted in September to October 2020. The researchers went for field observation/reconnaissance survey in the study area to critically observe the spots under study while taking note of the vegetation composition and structure. There were key informant interviews with two key informants – one from each of the two spots. The criteria for selection of key informants were their possession of competent and requisite knowledge of the area, availability during the research period, and willingness to be interviewed. After the interviews, a visit was paid to the Mbom Traditionally Protected Area (MTPA) and Amangwu Communal Barn System (ACBS). This was for the purpose of ground truthing, or matching issues discussed with what was on the ground.

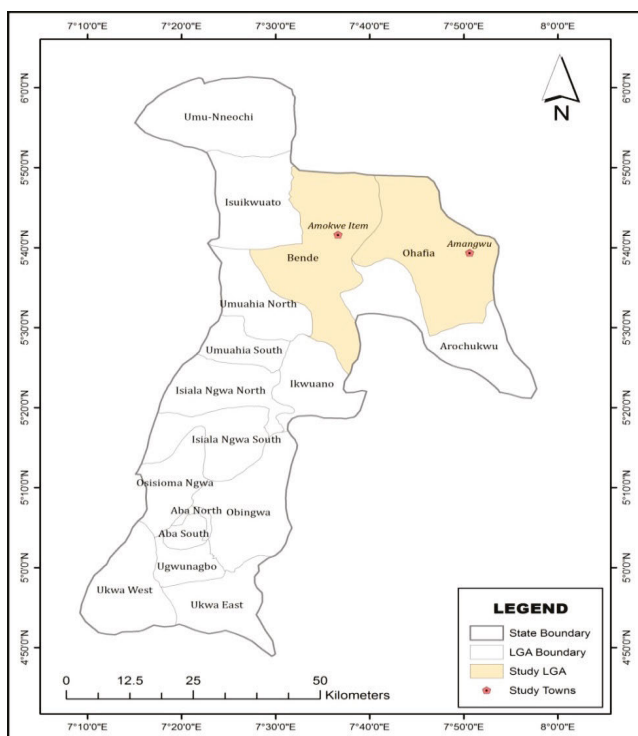


Fig. 1. Abia State showing the study area; source: own elaboration

THEORETICAL FRAMEWORK

Concept of sustainable development goals

The concept of sustainable development was defined worldwide at the United Nations World Commission on Environment and Development [WCED 1987] as development which meets the needs of the current generation without compromising the ability of future generations to meet their own needs. It contains within it two concepts of needs, in particular the essential needs of the world's poor, to which overriding priority should be given, and the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs [GARREN, BRINKMANN 2018]. The above definitions have a general focus on the achievement of environmental sustainability, avoidance of natural resource degradation and attainment of long term environmental quality.

Further, the 2005 World Summit of the United Nations on social development isolated three main sustainable development aspects known as pillars of sustainable development. These are economic sustainability, social sustainability, and environmental sustainability [LAUREYS 2005]. The three pillars are not mutually exclusive as they do not operate in isolation. They are overlapping and mutually reinforcing. The United Nations Millennium declaration identifies principles of sustainable development to include economic development, social development, and environmental protection; it has continued to use the three pillars, economic, environmental and social sustainability. It is important to note that the circles of sustainability perspective distinguish four aspects of the concept as economic, ecological, political, and cultural sustainability. This is in line with the United Nations Agenda 21 [UNSD 1992], which includes culture as the fourth domain of sustainable development. This concept has recently gained recognition among different organisations including the

United Nations Cities Programme and Metropolis [MAGEE 2013]. Among the four domains of sustainability, cultural sustainability and environmental sustainability capture the essence of this study. Environmental sustainability means to live within the means of the environments' natural resources. To do this implies that the resources of the environment such as materials, energy fuels, land, biodiversity, etc. are consumed at a sustainable rate [Circular Ecology 2022]. This further entails that an environmentally sustainable system must maintain a stable resource base, avoid depletion of non-renewable resources, and avoid over-exploitation of renewable resources. This includes atmospheric stability, as well as maintenance and conservation of biodiversity and other ecosystem functions [IPCC 2014]. This research is therefore anchored on Sustainable Development Goals (SDGs15) which seeks to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation in the Communal Barn System (Obin Oba) in Bende and Ohafia LGAs. In these areas, it is forbidden to tamper with trees as defaulters may face various sanctions. There are places designated as evil forests where people are prohibited from entering while there are some sacred groves with tree species that are revered as totems. Each species has its own uniqueness and their conservation halts biodiversity loss. Hence, this research sought to examine the indigenous people's approach to woody plant species conservation in selected spots in the Abia State. Cultural sustainability on its own part deals with various rules put in place by the society to curb unsustainable exploitation of biodiversity, especially woody plant species. This was confirmed in the case of the Mbom Traditionally Protected Area (MTPA), and Amangwu includes the resting place of the resident deity, an indicator of disaster, saviour of the place etc. These plants are strictly restricted from being felled down [SANJITA *et al.* 2017].

Traditional laws of the land and conservation of species through the laws

The people in the study area have already laid down laws guiding the operation of these two spots – the MTPA and ACBS (Obin Oba) in Bende and Ohafia LGAs. Everybody needs to obey the laws or risk serious sanctions as may be deemed fit by the elders of the land. In the case of the MTPA, the rule is that you cannot climb the *Elaeis guineensis* (oil palm trees) with climbing ropes. You do not cut fronds or fell trees. People go there to pluck ripe oil palm fruits as a means of livelihood. Hence, it is popularly called "Ozo Umuogbenye" which means saviour of the poor. Most of the poor people in the area use palm fruits plucked from the MTPA to produce palm oil which they sell for money. Others crack and sell the kernel to make money which they use to feed and educate their children. With the customary law in place, the plant species is conserved as it grows luxuriantly. In a similar fashion, at the Amangwu Communal Barn System (ACBS), the people in the community preserve their tuber crops like yams (*Dioscorea rotunda*), cocoyam (*Colocasia esculenta*), three leaved yams (*Dioscorea dumetorum*) etc. in their individual barns. They carry them from the farms straight to the barns after harvest. During the planting season, they also carry them to the farms from the barns. They only keep few tubers that are meant for food at home. Everybody has their individual barn separated from those of other people by fences made with woody plant species, with a barn door securely locked. Nobody tampers with other

people barns nor tamper with any of the trees used to fence the barns. This made it possible for the plant species to grow very well and flourish without any human intervention. There are sanctions for any breach of these rules.

RESULTS AND DISCUSSION

Shannon–Wiener diversity index (H') shows that the diversity indices of the woody plant species for the two sites were 3.2 (Mbom) and 3.95 (Amangwu), respectively. H' ranges as a rule between 1.5 and 3.5 but reaches 4 in rare cases [TÜRKMEN, KAZANCI 2010]. Diversity indices from the two spots imply that the woody plant species are conserved and guarded against human disturbance. The study also revealed that the people so much revere these two spots that nobody defaults in any of the customary laws guiding the management of these biodiversity repositories. Cutting down *Elaeis guineensis* at the MTPA is strictly prohibited. People are also not allowed to climb the trees with climbing robes, cut the fronds, or fell the trees. According to our key informant, this was introduced to maintain the sacredness of the grove as well as instil moderation in using the site among the people. The people go there from time to time to pluck ripe palm fruits as much as they could.

On the other hand, the people of Amangwu preserve their tubers in the communal barns. Each barn is fenced from others with woody plant species and the door is always locked by the owner. Photo 1 shows some clearances to the entrance of the barns done by farmers who were ready to bring in their harvested crops. Other barns that were covered by grasses were owned by farmers who were not ready for the harvest yet. As nobody is allowed to tamper with the trees that mark the boundaries between one barn and another, the trees enjoy luxuriant growth conditions all year round. Therefore, the result indicates that the sites are repositories of biodiversity and should be sustained.

The difference between the two conservation centres is that at the MTPA puts emphasis on *Elaeis guineensis*, while the Amangwu barns do not make such a distinction. All species are strictly out of bounds. Nobody is ever permitted to touch any of the trees. Hence, there are many species such as *Ficus exasperata* (sand paper tree), *Iringia gabonensis* (bush mango), *Newbouldia laevis* (West African border tree), *Pterocarpus mildbraedii* (Oha/ora trees) etc.



Photo 1. Sections of the communal barn system at Amangwu in Ohafia LGA, Abia State (phot. G.C. Asuoha)

The study also shows that the indigenous people's approach to species conservation could be harnessed to enhance conservation of species, thereby preventing them from becoming extinct. In other words, the people of Amokwe Item in the Bende local government area of the Abia State have customary rules guiding the use of their resources at the Mbom, one of the spots of woody plant species conservation. These rules make it difficult for people to defile the sacredness of the grove. Likewise, at Amangwu in the Ohafia local government area of the state, the people are also familiar with such rules guiding the use of their barns. Hence, it is important to sustain the trend in these two spots and even replicate same in other parts of the study area in order to conserve local plant species. The Mbom is a form of traditionally protected area which origin was divine according to our key informant. Our interview discovered that a woman was directed by God in older days to pour out a collection of palm nuts from a calabash at the place now called the Mbom. When she did it, the seedlings upon germination appeared in double lines as if they were arranged by human. *Elaeis guineensis* (oil palm) trees grew up and started yielding fruits which people of the area harvested following customary rules and regulations. Those rules and regulations are kept until today in order to maintain the sacredness of the Mbom. One striking thing about the Mbom is that if anybody falls from any of the oil palm trees, he does not get hurt no matter the height from which he falls.

Likewise, the Amangwu Communal Barn system is another indigenous conservation strategy in which indigenous knowledge is used in woody plant species conservation. It was found at the Amangwu community in the Ohafia LGA, Abia State. According to the key informant, the name of the community barn is Obin Oba. There is a river behind the barn called Obin. Hence, the name Obin Oba. In other words, the barn was named after the river. It shares some similarities with the MTPA in the sense that it is an indigenous conservation strategy established solely for preservation of yam tubers. Though set up primarily for other purposes than species conservation, the practices and principles guiding their usage enable to designate them as traditionally protected areas (TPA). It is a large expanse of land covering several hectares. Nobody cuts down any of the trees in the barns just as in the case of the MTPA. This rule by implication encourages species conservation in the area.

According to the key informant, the barns have always been there. Every family has their own barn delimited from those of other families with woody tree species.

Trees around the barns are never tampered with by anybody and so they enjoy undisturbed luxuriant growth conditions (see: Photo 1). Some of the woody plant species found at the two spots are presented in Table 1.

Undoubtedly, this by extension will ensure quality and sustainability of the environment. An examination of both spots reveals that the species are not under serious human interference. If these customary or traditional laws, which enable the indigenous people to imbibe the culture of species conservation, are encouraged and maintained, they will restore the natural environment and forestall further environmental degradation. This will also make the ecosystem services available to the people.

This study therefore advocates replication of these laws in other parts of the study area and also includes other woody tree species as forbidden from being tampered with in the case of MTPA where the focus is mainly on *Elaeis guineensis*. If more

Table 1. Names of some woody plant species found in the study area

S/No.	Scientific name	English name
1	<i>Pentaclethra macrophylla</i>	oil bean tree
2	<i>Alchornea cordifolia</i>	Christmas bush
3	<i>Irvingia gabonensis</i>	African bush mango
4	<i>Alstonia boonei</i>	cheese wood
5	<i>Artocarpus altilis</i>	bread fruit
6	<i>Myrianthus arboreus</i>	corkwood
7	<i>Psidium guajava</i>	guava
8	<i>Newbouldia laevis</i>	West African border tree
9	<i>Nauclea latifolius</i>	African peach
10	<i>Dracaena manii</i>	English asparagus tree
11	<i>Gambeya albida</i>	African white star apple
12	<i>Gmelina arborea</i>	gmelina tree
13	<i>Pterocarpus mildbraedii</i>	African rosewood plant
14	<i>Symphonia globulifera</i>	boarwood
15	<i>Anchomanes difformis</i>	forest anchomanes
16	<i>Harungana madagascariensis</i>	dragons blood tree / orange blood tree
17	<i>Elaeis guineensis</i>	palm tree
18	<i>Ficus exasperata</i>	sand paper tree

Source: own study.

areas are designated as traditionally protected areas (TPAs) with a diversity of species considered, more species would be conserved and sustainable development goals will be achieved.

We also recommend that the government should make the rural poor an integral part of conservation policies and their implementation; this way it would be all inclusive by making the people feel that they are part of the conservation exercise. This will change their attitude in favour of species conservation. By extension, when these trees are preserved, they will attract wild animals and their habitats within forests restored. The overall result of this will be the maintenance of ecosystem stability.

CONCLUSIONS

This research aimed at examining the use of the indigenous people's approach to species conservation. It highlighted the various traditional rules and regulations guiding the use of resources in the two spots and sanctions imposed on defaulters. The results showed that the people revere the Mbom Traditionally Protected Area (MTPA) as well as the Amangwu Communal Barn System (ACBS) following the punishment meted to anybody who breaches the laws of the land pertaining to these protected areas. Moreover, it was noted that the environment suffered various degree of degradation due to anthropogenic activities. These activities range from slash and burn, bush burning, over exploitation of non-timber forest products (NTFPs), fuel wood

gathering, to harvesting of medicinal plants etc. As a result, some of the species have either been threatened, endangered, or even extinct. This perhaps led to International Union for Conservation of Nature red-listing some of the tree species in Nigeria.

Therefore, we conclude that efforts should be made to encourage and maintain this less emphasised approach to woody plant species conservation – the indigenous people's approach. We reiterate that if more areas are designated as traditionally protected areas (TPAs) with a diversity of species considered, more species would be conserved and as such the 15th sustainable development goal will be achieved.

Furthermore, the government should make the rural poor an integral part of conservation policies and their implementation; that way it would be all inclusive by making the people feel that they are part of the conservation exercise. This will change their attitude in favour of species conservation. By extension, when these trees are preserved, they will attract the wild animals and their habitats within the forests. The process will lead to the maintenance of ecosystem stability and subsequent achievement of the 15th sustainable development goal.

REFERENCES

- BAILLIE J., GÄRDENFORS U., GROOMBRIDGE B., RABB G., STATTERSFIELD A.J. 1996. Red list of threatened species [online]. Gland. IUCN. ISBN 978-2-8317-0335-0 pp. 448. [Access 06.01.2012]. Available at: <https://portals.iucn.org/library/sites/library/files/documents/RL-1996-001.pdf>
- BOROKINI T.I. 2014. A systematic compilation of IUCN red-listed threatened plant species in Nigeria. *International Journal of Environmental Sciences*. Vol. 3(3) p. 104–133.
- CARVALHO A.M., FRAZÃO-MOREIRA A. 2011. Importance of local knowledge in plant resources management and conservation in two protected areas from Trás-os-Montes, Portugal. *Journal of Ethnobiology and Ethnomedicine*. Vol. 7(1) p. 1-13. DOI 10.1186/1746-4269-7-36.
- Circular Ecology 2022. Sustainability and sustainable development – what is sustainability and what is sustainable development? [online]. [Access 25.04.2021]. Available at: <https://circularecology.com/sustainability-and-sustainable-development.html>
- FRASER E.D.G., DOUGILL A.J., MABEE W.E., REED M., MCALPINE P. 2006. Bottom-up and top down: Analysis of participatory processes for sustainability indicators identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management*. Vol. 78(2) p. 114–127. DOI 10.1016/j.jenvman.2005.04.009.
- GARREN S.J., BRINKMANN R. 2018. Sustainability definitions, historical context, and frameworks. In: *The Palgrave handbook of sustainability*. Eds. R. Brinkmann, S.J. Garren. Cham. Springer International Publishing. Palgrave Macmillan p. 1–18. DOI 10.1007/978-3-319-71389-2_1.
- GRENIER L. 1998. Working with indigenous knowledge: A guide for researcher. Ottawa. International Development Centre. ISBN 0-88936-847-3 pp. 130.
- HENS L. 2006. Indigenous knowledge and biodiversity conservation and management in Ghana. *Journal of Human Ecology*. Vol. 20(1) p. 21–30. DOI 10.1080/09709274.2006.11905897.
- IPCC 2014. Climate change 2014: Synthesis report. Contributions of Working Groups I, II and III to the Fifth assessment report of the Intergovernmental Panel on Climate Change. Eds. R.K. Paduri, I. A. Meyer. Geneva, Switzerland. IPCC pp. 151.

- IUCN 2001. IUCN red list categories and criteria: version 3.1. Gland. International Union for Conservation of Nature. ISBN 978-2-8317-0633-7 pp. 30.
- IUCN 2006. 2006 Red list of threatened species [online] Gland. International Union for Conservation of Nature. [Access 15.03.2013]. Available at: https://www.iucn.org/sites/dev/files/import/downloads/iucn_red_list_of_threatened_species_2006.htm
- LAUREYS S. 2005. The neural correlate of (un) awareness: lessons from the vegetative state. *Trends in cognitive sciences*. Vol. 9(12) p. 556–559. DOI 10.1016/j.tics.2005.10.010.
- LAWTON J.H., MAY R.M. (eds.) 1995. Extinction rates. Oxford. Oxford University Press. ISBN 0-19-854829 pp. 233. DOI 10.1046/j.1420-9101-1996.t01-1-9010124.x.
- MARU Y., GEBREKIRSTOS A., HAILE G. 2020. Indigenous ways of environmental protection in Gedeo community, Southern Ethiopia: A socio-ecological perspective. *Cogent Food & Agriculture*. Vol. 6(1), 1766732. DOI 10.1080/23311932.2020.1766732.
- MAGEE T. 2013. A field guide to community based adaptation. London. Routledge. ISBN 9780415519304 pp. 248.
- MEA 2005. Ecosystem and human well-being: Synthesis. A Report of the Millennium Ecosystem Assessment [online]. Washington D. C. USA. Island Press. ISBN 1-59726-040-1. [Access 28.04.2021]. Available at: <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>
- MSUYA T.S., KIDEGHESHO J.R. 2009. The role of traditional management practices in enhancing sustainable use and conservation of medicinal plants in West Usambara Mountains, Tanzania. *Tropical Conservation Science*. Vol. 2(1) p. 88–105. DOI 10.1177/194008290900200109.
- NOGUCHI T., SALAM. M.A., KOIKE M. 2005. Factors influencing the sustained participation of farmers in participatory forestry: A case study of Central Sal forests in Bangladesh. *Journal of Environmental Management*. Vol. 74(1) p. 43–51. DOI 10.1016/j.jenvman.2004.08.007.
- OLORUNFEMI F., FASONA M., OLOUKOI G., ELIAS P., ADEDAYO VIDE 2016. Traditional knowledge in the use and management of forest ecosystem for livelihoods and food security in Nigerian savanna. *Journal of Human Ecology*. Vol. 53(2) p. 167–175. DOI 10.1080/09709274.2016.11906969.
- RAMPHERI M., DUBE T., DHAU I. 2022. Use of remotely sensed data to estimate tree species diversity as an indicator of biodiversity in Blouberg Nature Reserve, South Africa. *Geocarto International*. Vol. 37(2) p. 526–542. DOI 10.1080/10106049.2020.1723717.
- SANJITA C., SINGH T.B., SINGH T.R. 2017. Role of totem trees in the conservation of biodiversity in sacred groves of Manipur, Northeast India. *NeBIO An International Journal of Environment and Biodiversity*. Vol. 8(3) p. 182–186.
- The Royal Society 2003. Measuring biodiversity for conservation [online]. London. The Royal Society. ISBN 0-85403-593-1 pp. 56. [Access 29.04.2021]. Available at: https://royalsociety.org/~media/royal_society_content/policy/publications/2003/4294967955.pdf
- TÜRKMEN G., KAZANCI N. 2010. Applications of various biodiversity indices to benthic macroinvertebrate assemblages in streams of a national park in Turkey. *Review of Hydrobiology*. Vol. 3(2) p. 111–125.
- UNEP/CBD 1992. Convention on biological diversity. Sustaining life on Earth: How the convention on biological diversity promotes nature and human well-being [online]. Montreal. Secretariat of the Convention on Biological Diversity World Trade Centre. ISBN 92-807-1904-1 pp. 20. [Access 20.01.2011]. Available at: <http://https://www.cbd.int/doc/publications/cbd-sustain-en.pdf>
- UNEP/CBD/COP/6/INF/21/Add.1. Global strategy for plant conservation: Refinement of the 16 Targets [online]. Nairobi. United Nations Environment Programme pp. 66. [Access 25.04.2021]. Available at: <https://www.cbd.int/doc/meetings/cop/cop-06/information/cop-06-inf-21-add1-en.pdf>
- UNSD 1992. United Nations Conference on Environment and Development [online]. 3–14.06.1992 Rio de Janeiro, Brazil. New York, NY. United Nations Sustainable Development pp. 351. [Access 29.04.2021]. Available at: <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf>
- WCED 1987. Report of the World Commission on Environment and Development: Our common future [online]. Brundtland. World Commission on Environment and Development pp. 91. [Access 5.03.2020]. Available at: https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/152/WCED_v17_doc149.pdf