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Submission date: 20-Sep-2022 08:39AM (UTC+0700)

Submission ID: 1904100593

File name: Science_in_Landscape_Planning_Earth_Environ._Sci._940_012013.pdf (623.54K)

Word count: 3694

Character count: 21026

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To cite this article: F B Saroinsong *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **940** 012013

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Practical Applications of Sustainability Science in Landscape Planning Preliminary Stage of Bunaken-Tangkoko-Minahasa Biosphere Reserve

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Abstract. Sustainability Science (SS) is important in resource management, however not always well translated into actions. This research aims to find and implement practical applications of SS in the preliminary stage of landscape planning in Bunaken-Tangkoko-Minahasa Biosphere Reserve (BTMBR). The researchers put both perception and role of all local parties from the problem definition stage in landscape planning into account. The primary data was collected by using questionnaires. The secondary data includes literature review of SS in landscape planning, BTMBR's characteristics, regulations and organizations. The researchers analyse landscape firstly by its 3-in-1-components namely space, environment, and human and later as unity. All parties consider watershed management as the entry point to sustainable and resilient landscape planning in this research case. The upstream part is perceived playing an important role, and because it is located in BTMBR core zone, this can be useful in future landscape management programs. The slope degree, which relates to watershed parts, is an important factor therefore landscape planning should consider different demand according to it. The Tondano Lake, as an important water element in BTMBR, do not have any conservation status. The researchers propose efforts to improve regulation and program including all local parties integration and involvement.

1. Introduction

United Nations Development Programme (UNDP) highlights that forest and desertification are still ongoing, with disparity influences between community groups. Moreover, biodiversity is still at risk. Urgent actions are needed to address environmental degradation and biodiversity loss [1]. In a landscape perspective, efforts can be made through sustainability science (SS) based-landscape planning with the target of sustainable and resilient landscape [2]. This is in line with SDGs No. 15 "Life on Land".



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Biosphere Reserves is a nature laboratory, a place to test various approaches in studying and dealing with changes, a place to identify good forms of interaction between humans and nature, as well as a place to practice developed science, technology and art for sustainability purposes [3]. UNESCO science programme supports science for a sustainable future to improve our future and it designates these sites to create knowledge to build peace and sustainable future. Bunaken-Tangkoko-Minahas Biosphere Reserve (BTMBR) was recognized by UNESCO as part of World Network of Biosphere Reserve during the 32th session of the International Coordination Council of the Man and Biosphere (MAB) programme, October 2020. This site is located in the Indo-Pacific Coral Triangle Region in the North Sulawesi, Indonesia. It covers 746,405.92 hectares of terrestrial and marine habitats. UNESCO highlights “the mosaic of ecological systems including a coastal area with coral reefs and seagrass, mangrove and coastal forests, islands and terrestrial ecosystems. BTMBR is home to over 130 species of mammals including the Dian’s tarsier”. This site benefits from the productions of agricultural and fisheries, as well as ecotourism [3]. It encompasses five protected area integrated the protected core zones of the Biosphere Reserve, consisting of mountain, marine, and coastal areas.

Massive literatures based on researches show that SS is a necessity for improving the resource management, and reach the international agendas such the SDGs. However, its concept remains a vague concept and or is not well translated into actions due to several factors as follow. It has wide distribution in the various scales (international, national and local communities) and it is often nested between scales. Moreover, the causes of environmental problems and development are multiple and include a large number of factors. Therefore it is not easy to determine the problems to be solved or set targets in landscape planning with the aim of science sustainability [4–6]. In addition, each landscape has its own characteristics with different needs for planning focus [5–10]. In other cases, there are difficulties in setting methods for identification, analysis and evaluation [7], or because of limited data [10]. This research aims to find and implement practical applications of SS in the preliminary stage of landscape planning in Bunaken-Tangkoko-Minahasa BTMBR.

2. Method

The literature review carried out related to the application of SS in landscape planning which was published after the SS was introduced (above 2001) but mainly for recent references (above 2011). The secondary data includes characteristic of BTMBR (spatial and non-spatial), regulations, and organizations related to watershed management. The primary data was collected by using preliminary questionnaires of the participants. The researchers had a total of 241 questionnaires respondents. The researchers use ecosystem services methodology to collect information, inspired by the experience implemented by the UNESCO Chair on Sustainable Development and Environmental Education, University of Basque Country, Spain.

The context of this research methodology is as follows. Considering the situation due to COVID-19 pandemic, the researchers carried out discussion forum and questioner distribution by online. There were two different webinars organized by Sam Ratulangi University, i) the E-lifelong Learning for Youth Webinar, held on 12 August 2020 and ii) the Water, Nature and Human Webinar, held on 10 November 2020. The questionnaire respondents were also participants in the webinars. Participants were all who live, study, and or work in the BTMBR area, invited via WhatsApp (in group or personally), phone, conventional letter, and social media, representing as many parties as possible.

A first analysis for this research project was to understand the environmental perception of the youth [3]. This analysis highlighted the important contribution of water cycle in the BTMBR. Based on this result, the second seminar was organized focusing on the water component in this site. Using a landscape approach and focusing on watershed integrated management, the researchers tried to understand how local actors perceive the water connector role among ecosystem in the Biosphere Reserve. The objective is not to obtain a score on what are the most important watershed areas (upstream, midstream, downstream, coastal or ocean) but to highlight the connectivity role of water and to help decision makers to develop management tools under a landscape approach as well as support local actors to become leaders of actions.

3. Results and discussion

3.1. Translating Sustainability Science (SS) Concept in Landscape Planning – Preliminary Stage

SS is interdisciplinary field focusing on problem solving, works at multiple scales of landscapes, applying sustainability and resilience theory in goals setting and analysis process [4,11]. SS is solution oriented. It highlights interactions between social and environment. SS also addresses supporting social, meaningful participation by stakeholders, to face environmental problems [3,12–14].

The principle in landscape planning for sustainable and resilient landscape, is not as simple as “the more ecosystem service (ES), the better” because usually it is not feasible to do so [2,7]. The factors that influence landscape vary widely and some are unpredictable [2,5]. Implementation of SS may focus on a variety of trend objectives depending on landscape characteristics, time, and circumstances [5,10,15]. In order to improve resilience capacity through landscape planning, it is important to firstly identify the problem of the landscape to solve. Further, the analyses should be carried out on how the landscape can build the adaptive capacity (ecologically and socio-economically) to overcome problems [4]. In conditions that there are several conflicting objectives, the use of multi-criteria analyses can help in decision making [10].

The researchers determine principles of SS to be applied in the first stage of landscape planning, inventory and problem definition, as follows:

- (a) The identification of the research problem should direct the research problem identification towards solution or solution oriented [11,16],
- (b) applying transdisciplinary vision that would allow a more holistic point of view [3,12–14], addressing interactions between natural land social systems (ecological and socio-economic) [4,7,10,11],
- (c) engaging stakeholder participation and analyzing perception or preferences, working under integration and cooperation in planning process [13,16], participatory processes of decision making since defining the problem to be solved [14,16]
- (d) under complex condition, the feasible way is to start with one entry point to holistic approach with appropriate connectivity [1,4,5]
- (e) the decisions are not made once and forever, later need to be evaluated and readjusted [5,7]
- (f) to achieve a sustainable and resilient landscape, landscape planning requires “multifunctionality”. Multifunctionality is important in dealing with the increasing scarcity/decrease of resources demanding efficient use of natural resources, as well as increasing the ability to use natural resources to meet different demands and preferences of various stakeholders through diversity in the functions. Multifunctionality unites the concept of SS with the concept of Green Infrastructure [5,9,12]
- (g) to understand landscape and discuss it under SS concept, Bruni [5] distinguished landscape components into environment, territory and man, that should be analysed singularly at first, then together. Badach and Raszeja [6] divided landscape into: ecological, structural, and visual.

Relating to SS concept, the researchers analyse the landscape by its 3-in-1 components as follows:

- i. Space, which can be discussed based on different land uses, based on specific zones (i.e., zones of biosphere reserve), based on spatial and function division area (i.e., up-mid-down stream of watershed), territory delineation, etc.
- ii. Environment, including environmental services, characteristics (i.e. topography, climate, accessibility), natural phenomena and natural disasters existence, abundance, scarcity, diversity, distribution, density, etc.
- iii. Human, including perception, preference, regulation, legal aspect, political aspect, ideology, philosophy, socio-culture, habit, custom and culture, activities, programs, management regime, etc.

3.2. ⁴ Practical Applications of SS in BTMBR Landscape Planning Preliminary Stage

Similar research was developed in different context, under the Millennium Ecosystem Assessment [17]. The analysis implemented in the Mt. Marsabit Forest in the Northern Kenya, provides evidence provisioning and cultural services are easily perceived by the communities living around the protected forest. Similarly to BTMBR, the research site also includes a multi-use landscape that can provide different perceptions. In the previous research, perception was analysed and community engagement was considered for management stage. In this research, similarly the researchers analysed the social perception of the nature and its contribution to community, furthermore the researchers also tried to provide space for all parties to communicate in discussions and jointly define the BTMBR problem. The researchers put both perception and role of all local parties from the problem definition stage in landscape planning into account. This research promotes participatory approach, to identify jointly with local community, local authorities, civic society including NGO, and university, line of action from the preliminary stage of the BTMBR landscape planning.

Because the previous research result on this showed that local community perceive water as the most important environmental services [3], the researchers further analyse it. The participants can be divided into two groups (students and “professors/professionals”), based on age division. However, 77% (186 ind.) of the participants came from student group. The question was: “Which part do you think is most important upstream, midstream, downstream, coastal or ocean? Why?” In spite of the question was very focused on choosing the most important area (“select one”), it is very interesting to see that a large number of community answered that each area has different roles and all of them are important (19%), as can be seen in Figure 1 and Table 1.

The researchers divided in different group sections:

- Some of the participants mentioned a specific area (upstream, etc...) and others they insisted that all the areas have the same importance (Global mentioned).
- The researchers can see that more than half of the community identified upstream as the most important zone (58%), that also corroborated the concept of interconnectivity.
- It was also mentioned that the freshwater is more important (Watershed) (71%) than salty water (coastal or marine areas).

All parties consider that watershed (Figure 1) management can be used as the entry point to sustainable and resilient landscape planning for BTMBR. The upstream part plays an important role and based on BTMBR zonation, it is also in the core zone which has nature and water conservation function. In spite of coastal significant importance for community needs (tourism, food, etc) it is not considered as the most important. It could be important to educate on the coast and marine importance, and as well as, the promotion of marine protected areas. It is interesting to understand that there are not a big difference between “students” and “professors” groups, so the researchers can consider that community are aware of the water values importance and its interconnectivity role.

The researchers can identify the different slope degree class of the watershed in the zoning system of the BTM Biosphere Reserve (Figure 2). The upstream is the part of the river located in the mountains or hills areas. The midstream of the river is usually located in an area on a relatively flat part. The downstream or river estuary is the end of the river flow, close to the coastal zone where the river end. Human settlements are located in the midstream and downstream zones. The researchers can consider that slope degree, and in the same time watershed parts, is an important factor to determine the different demand of landscape planning and management watershed areas. Beside the Bunaken Marine National Park, the most of the upstream zone are part of the protected areas located in the core zone of the Biosphere Reserve (green line in Figure 2). It confirms the merging of the watershed and the zoning system of the BTMBR (upstream as core zone).

The researchers collect regulations and related policies to water and watershed management of the area. The related regulation regarding water and watershed management of North Sulawesi Province, namely Law no. 41 of 1999 concerning Forestry, Government Regulation no. 37 of 2012 concerning Watershed Management which was later elaborated in the North Sulawesi Provincial Regulation No. 1 of 2013 concerning the Management of the Tondano River Basin as the most important one in the

Biosphere Reserve. The Regional Regulation on Management of the Tondano River Watershed explains how watershed management should be carried out by related parties, including the government (provincial and district / city), the community and stakeholders in maintaining and maintaining the existing watershed. However, the researchers find that the Tondano Lake, as an important water element in the centre of this site, does not have any conservation status, however it concentrates some settlement areas. It could be important to put in place a regulation system and in the same time educate community on the water values for human and nature to support social initiatives.

Furthermore, the organizations related to Tondano Watershed management are as follows:

- BPDASHL Tondano as the coordinator
- The Regional Forestry Service of North Sulawesi Province,
- The Regional Environmental Service of North Sulawesi Province,
- Department of Public Works and Regional Spatial Planning (Bappeda) of North Sulawesi Province,
- FORDAS

Integration of all this organizations can bring meaningful contribution to watershed management.

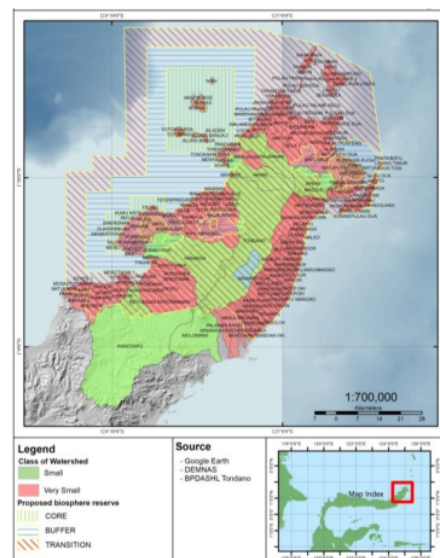


Figure 1. Watershed in BTMBR area.

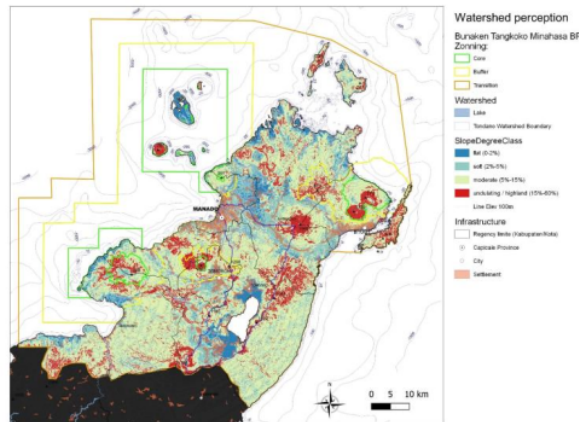


Figure 2. Slope degree classes in BTMBR area.

Table 1. Participants response.

| Area which is perceived the most important | | | Respondents (%) | | |
|--|---|------------|-----------------|------------|------------|
| | | | Students | Professors | All |
| 1 | Upper areas | Upstream | 58 | 54 | 58 |
| | Central to end of river | Midstream | 8 | 7 | 7 |
| | | Downstream | 7 | 4 | 6 |
| | Marine areas | Coastal | 8 | 13 | 9 |
| | | Sea/ocean | 19 | 22 | 20 |
| Total | | | 100 | 100 | 100 |
| 2 | Watershed (fresh water) | | 73 | 65 | 71 |
| | Non-watershed/coastal and sea (salty water) | | 27 | 35 | 29 |
| Total | | | 100 | 100 | 100 |

The researchers find that researchers' practical application of SS in this research case is in line with Smart City Concept. Smart City Concept is applied in term of use big data in environment inventory and analysis, use smart technology in social data collection, give space to express opinion, support integrative discussion and cooperation, and involve community in planning process, to improve sustainability and resilience [18].

4. Conclusion

Stakeholder participation engagement is applied from the preliminary stage of landscape planning process defining the problem to be solved. Within the framework of the SS concept, firstly the researchers analyse landscape by its components, namely space, environment, and human, and then analyse it as a unity. Local community are aware of the water values importance and its interconnectivity role. Watershed management is the entry point to sustainable and resilient landscape planning in this research case. The upstream is perceived playing an important role and because it is in core area of BTMBR, the researchers consider this can be useful in future BTMBR landscape management programs. On the other side, it can be important to educate on the coast and marine importance, also promote marine protected areas. The slope degree, relating to watershed parts, is an important factor therefore landscape planning should consider different demand of appropriate managements according to it. The Tondano Lake, as an important water element in the centre of this site, does not have any conservation status, however it (concentrates) some settlement areas. The

researchers propose (an) effort(s) to improve appropriate regulation program including empowering local community participation and integration of all related organizations.

Acknowledgements

The researchers acknowledge the financial support of UNESCO Jakarta Office in 2020 to organize webinars to promote the new nomination of Bunaken-Tangkoko-Minahasa Biosphere Reserve.

References

- [1] Saroinsong F B 2020 Supporting plant diversity and conservation through landscape planning: A case study in an agro-tourism landscape in Tampusu, North Sulawesi, Indonesia *Biodiversitas* **21** 1518–26
- [2] de Groot R S, Alkemade R, Braat L, Hein L and Willemen L 2010 Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making *Ecol. Complex.* **7** 260–72
- [3] Hernández-Salinas A, Viota M, Onaindia M, Ametzaga-Arregi I, Peña L, Fernández B, Unzueta J, Purwanto Y, Tasirin J S, Mamangkey N G F and Saroinsong F B 2020 Promoting the Co-Creation of Knowledge under Physical Distancing Conditions through the Participation of Youth in the Bunaken-Tangkoko-Minahasa Biosphere Reserve (North Sulawesi, Indonesia) *Environ. Sci. Proc.* **5** 21
- [4] Ahern J 2011 From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world *Landscape Urban Plan.* **100** 341–3
- [5] Bruni D 2016 Landscape Quality and Sustainability Indicators *Agric. Agric. Sci. Procedia* **8** 698–705
- [6] Badach J and Raszeja E 2019 Developing a framework for the implementation of landscape and greenspace indicators in sustainable urban planning. Waterfront landscape management: Case studies in Gdańsk, Poznań and Bristol *Sustain.* **11**
- [7] Uehara T, Hidaka T, Tsuge T, Sakurai R and Cordier M 2021 An adaptive social-ecological system management matrix for guiding ecosystem service improvements *Ecosyst. Serv.* **50** 101312
- [8] Tumbelaka S and Saroinsong F B 2020 Land suitability evaluation in agricultural landscape planning to support food security of Tomohon City, North Sulawesi **6** 619–24
- [9] Lindholm G 2017 The implementation of green infrastructure: Relating a general concept to context and site *Sustain.* **9**
- [10] Saroinsong F, Harashina K, Arifin H, Gandasasmita K and Sakamoto K 2007 Practical application of a land resources information system for agricultural landscape planning *Landscape Urban Plan.* **79** 38–52
- [11] Kates R W 2011 What kind of a science is sustainability science? *Proc. Natl. Acad. Sci. U. S. A.* **108** 19449–50
- [12] Monteiro R, Ferreira J C and Antunes P 2020 Green infrastructure planning principles: An integrated literature review *Land* **9** 1–19
- [13] Petriello M A, Redmore L, Sène-Harper A and Katju D 2021 Terms of empowerment: Of conservation or communities? *Oryx* **55** 255–61
- [14] Hamid H 2016 *Evaluasi Manajemen Pemberdayaan Masyarakat* vol 5
- [15] Kajikawa Y 2008 Research core and framework of sustainability science *Sustain. Sci.* **3** 215–39
- [16] Kauffman J and Arico S 2014 New directions in sustainability science: promoting integration and cooperation *Sustain. Sci.* **9** 413–8
- [17] Ouko C A, Mulwa R, Kibugi R, Owuor M A, Zaehring J G and Oguge N O 2018 Community perceptions of ecosystem services and the management of Mt. Marsabit forest in Northern Kenya *Environ. - MDPI* **5** 1–14
- [18] Fialová J, Bamwesigye D, Łukaszkiwicz J and Fortuna-Antoszkiewicz B 2021 Smart Cities Landscape and Urban Planning for Sustainability in Brno City *Land* **10** 870

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