

Adopting forest monitoring tool by considering local knowledge and current technology to increase community participation for effective landscape management in Flores, East Nusa Tenggara, Indonesia

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Abstract. Knowledge of environmental services is still something special. The Mbeliling landscape in Flores Island, West Manggarai Regency, is one of the landscapes rich in Global Threatened Species (GaTS) including the Flores Hawk-eagle and Yellow-crested Cockatoo. In addition, this landscape provides water for most of West Manggarai including Labuan Bajo. The level of awareness to maintain environmental services and community participation in monitoring is emphasized. The method used is to implement monitoring tools in the form of digital questionnaires and manual recording of observation objects measured according to the agreed observation paths of the village. There are 17 villages that have participated from 36 villages in the Mbeliling landscape and produced monitoring data of 42 springs and 18 bird species, 2 of which are Endangered species. The identification process by the community is sufficient to illustrate that the community already understands the objects around them and can be documented in a structured data document. However, what remains a challenge is the low level of community participation from each village, which only amounts to 3-5 people. It is necessary to study the appropriate method for the adoption of this monitoring tool.

1 Introduction

Ecosystem services are components of nature that can be directly enjoyed, consumed, or utilized. They represent the benefits provided to humans through ecosystem assets, including land, water, plants, and the atmosphere which are transformed into flows of essential goods and services, such as clean air, water, and food.[1].

Among the world's mega-biodiversity countries in the tropics, Indonesia has experienced the most severe deforestation in recent decades. It is alarming that the rate is potentially

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disrupting the future provision of ecosystem services. On the other hand, there is a paucity of research on ecosystem services in Indonesia, and its current state is unknown. [3]

Citizen science is an approach to environmental information that actively and genuinely encourages and solicits public input in the scientific process and incorporates the resulting data and information beyond traditional institutional boundaries. In citizen science, the public participates voluntarily in the scientific process, addressing real-world problems in ways that can include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems (National Advisory Council for Environmental Policy and Technology (NACEPT) 2018 [2]).

In Indonesia, there are seven main habitat types and four of them are dry forest habitats. Three of the four dry forest habitats are found in Flores, including two types found in the Mbeliling Forest. Four species of Flores endemic birds can be found in the Mbeliling Forest as well as 17 of the 20 bird species that are important for conservation (DOF - BirdLife Denmark and Burung Indonesia - BirdLife Indonesia, 2010). Among these important bird species, there are four species of endemic birds that are threatened with extinction according to IUCN criteria, namely the Flores Serindit (*Lorisculus flosculus*), Flores Kehicap (Monarca sacerdatum) Flores Crow (*Corvus florensis*), and Flores Celepuk (Otus Alfredi). There are two types of birds that can be found in the Mbeliling Forest which are critically endangered, namely the Flores Eagle (*Nisaetus floris*) and the Yellow Crested Cockatoo (*Cacatua sulphurea*). Other endemic wildlife in the Mbeliling Forest includes a type of blind snake (*Typhlops schmutzii*) and a giant rat (*Papagomis armandvelley*).

Sustainable use of the forest is one way to protect forest resources in order to be maintained. Mbeliling landscape is a natural ecosystem that supports the lives of the people and the species around it. The community is aware of the importance of protecting the natural resources around them because if they do not protect them well, it will threaten their future livelihoods. To be able to achieve ideal conditions where people can make good use of nature and sustain it, it is necessary to monitor natural services wellbeing. Nature's services will protect people's lives and society will keep nature's services running.

The Mbeliling landscape is an imaginary line that defines this landscape as contributing significantly to communities that depend on natural services. It has 36 villages with approximately 58.000 people (Statistical Body of Indonesia, 2018) who rely on Mbeliling's nature services. Burung Indonesia since 2007 has covered approximately 16 villages on the approach of community development. Werang was the first village of The Burung Indonesia intervention program in 2007 at Mbeliling Landscape. Community development was the main approach of the program. One of the component activities that were conducted in 2008-2010 was how to protect forests without leaving the basic needs of people. Part of the program in Mbeliling has a limited environment monitoring called Low Key Monitoring (LKM) has been implemented to assess biodiversity in forest areas with particular attention to avifauna and also changes and threats to forest conditions. The research targeted people living in the Mbeliling landscape, which is estimated to be 34,000 people comprising 36 villages.

The LKM system is intended to gather data relevant to participants as natural resource managers and operate as a decision-making tool for use in the sustainable management of the Mbeliling Forest. From a BirdLife perspective, it aims to detect change to sample forest areas of key bird habitat at an early stage through collecting data on species presence and forest disturbance. From a government perspective, it provides evidence of forest encroachment or use in conflict with regulations, while from a community perspective, it monitors the condition of natural resources and environmental services that are essential to livelihood activities. An opportunity to review this participatory monitoring process and lessons learned during its implementation emerged at the conclusion of the first project phase.

The knowledge that is not well documented and knowledge transfer that is not running makes this research important to do. Documentation is one of the tools to verify to the public that the Mbeliling landscape is an important area. It is hoped that the process of monitoring natural services will be a process that encourages knowledge documentation to become more popular and more widely practiced. Raising awareness of the importance of nature services is an important first step and can have a wider impact.

2 Method

This research uses a field survey method or primary data. This data was collected using a questionnaire called Low Key Monitoring in 2010 but changed in 2018 to Nature Service Monitoring (PLA). The questionnaire was developed based on the results of focus group discussions that produced questions in the form of water sources or springs, types of biodiversity, potential disasters, etc. The use of questionnaires is still divided into 2 ways, namely using GPS tallysheets and digital tallysheets with applications. This paper was conducted at the end of 2024 while the data itself was collected from 2018 to 2020. The location of this research is in the Mbeliling landscape on Flores Island, precisely in West Manggarai Regency, East Nusa Tenggara Province. The Mbeliling landscape covers approximately 94,000 hectares and consists of 36 villages.

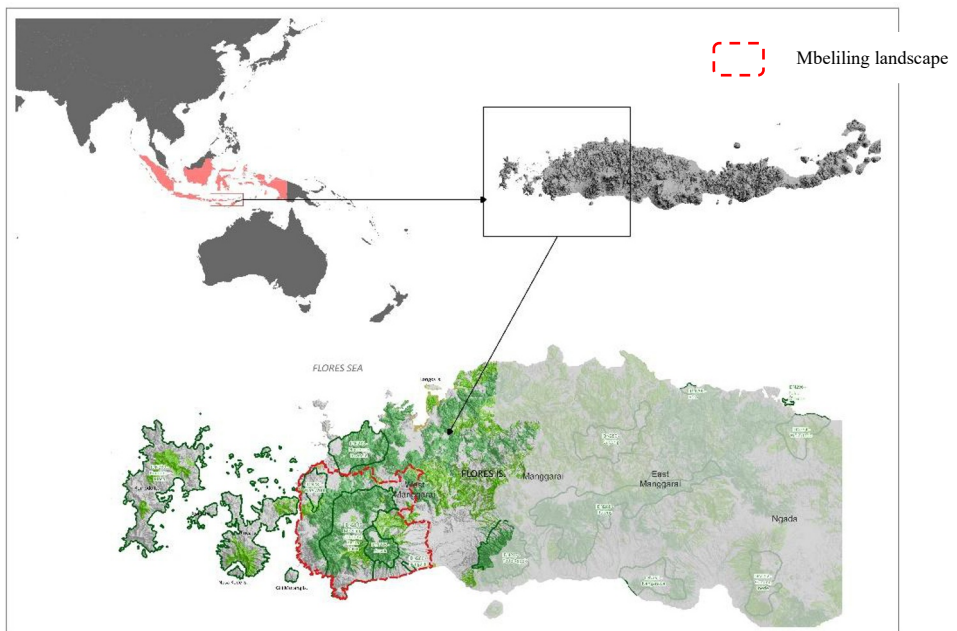


Fig. 1. The location of the Mbeliling landscape in West Manggarai Regency

The tool used in this research is primary data obtained using a digital tally sheet that is read using the Kobotoolbox/KoboCollect application. This application is a free application available in Playstore and can be used for social, economic, and spatial data surveys. The team that conducts the data recording process in the field is at least 3 people with their respective roles such as guide/type identifier, enumerator / digital questionnaire filler, and documentation. Data processing is done using a laptop and web browser for data

management. Other software used is Power BI and Microsoft Excel as visualization of monitoring data.

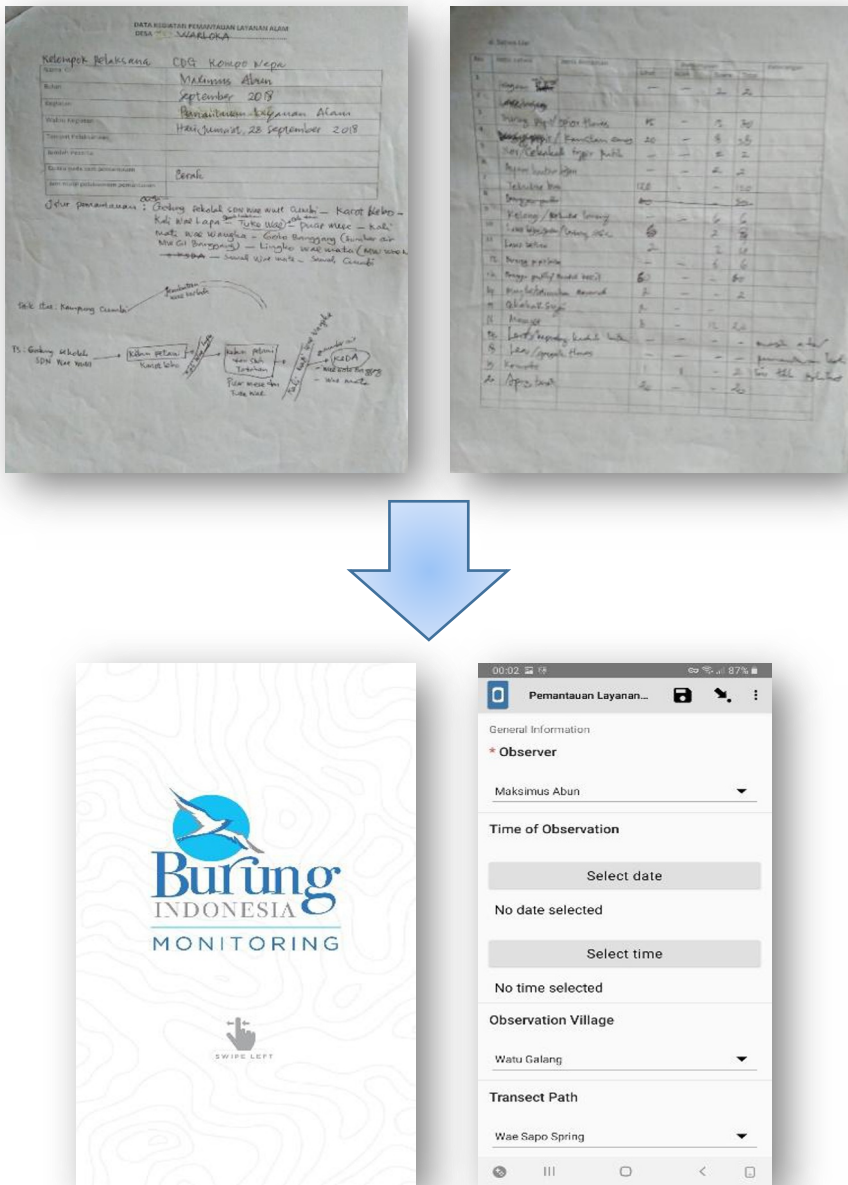


Fig. 2. Question form using tally sheet and Kobocollect



Fig. 3. Nature Services monitoring participants

The use of androids in data collection promotes effectiveness in field data collection as the monitoring process involves fewer people. A team of 2-3 people is sufficient with 1 person holding the android and the digital tallysheet, 1 person pointing the way, and 1 person identifying the species. The digital tally sheet using Kobotoolbox made it easy for the team to record information due to simplified information entry with options, coordinates already integrated into the digital worksheet, and good data storage on the smartphone. It was agreed that monitoring would be carried out periodically in each village for a period of 6 months.

The objects observed are natural services around the village, which can be in the form of observing animals, springs, landslides, NTFPs, and so on. These objects will become material for the team in each village to submit the results to the village government and be followed up by the village government

3 Results

The participation rate of people involved in this monitoring reached 60 people in the Mbeliling Landscape. This resulted in 181 data entries into the server for further processing. The years 2018-2020 were the years when the data was uploaded quite a lot, with animals and springs being the dominant objects in this landscape. There are 17 villages and 12 observation objects that are well recorded and uploaded.

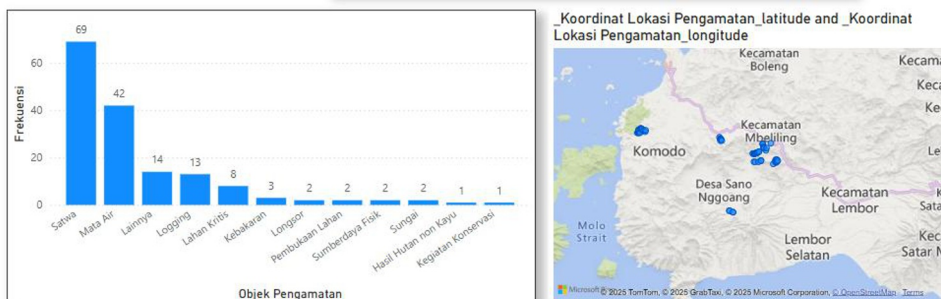


Fig. 4. Spatial distribution of nature services monitoring

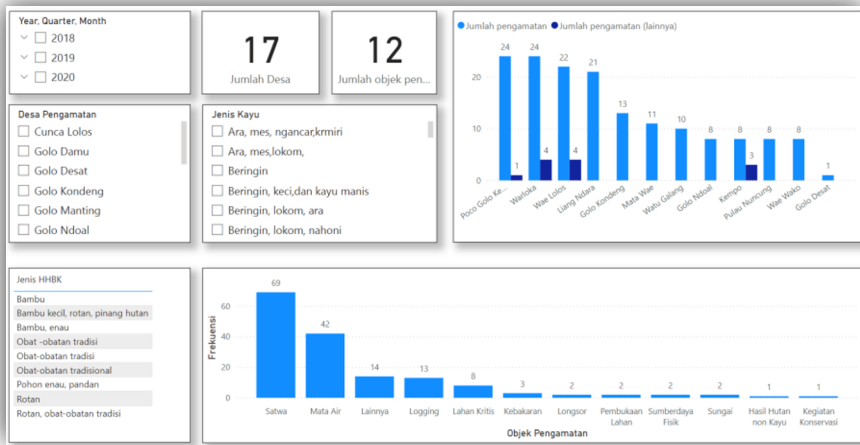


Fig. 5. Number of all data object monitoring (2018-2020)

In addition to the high number of animal observations, springs are also a priority for the monitoring team to observe, where there are 42 spring observation points from 10 villages that conduct monitoring.

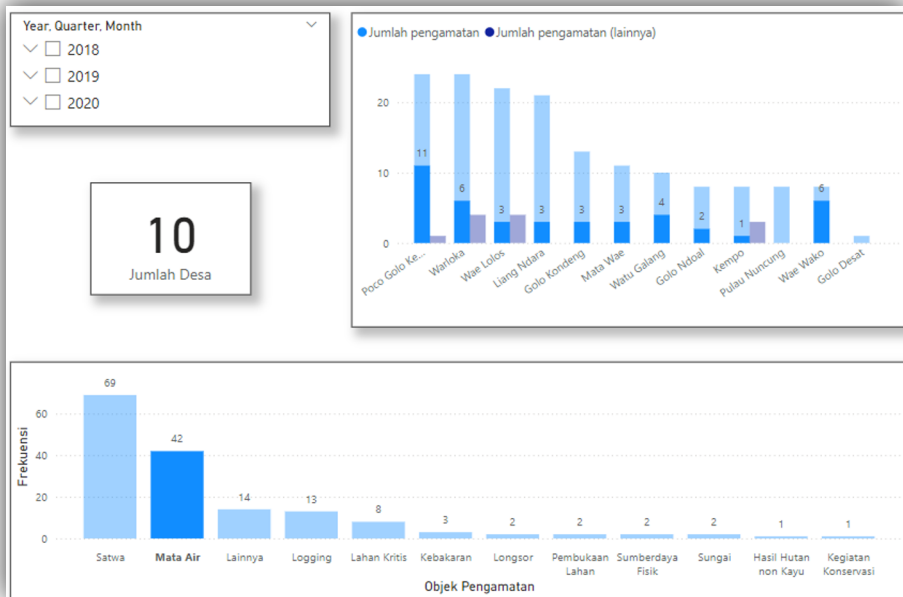


Fig. 6. Number of water spring data object monitoring (2018-2020)



Fig. 7. Water spring monitoring (2018-2020)

The introduction of technology such as the use of smartphones in field data collection is part of LCG's capacity building in nature service monitoring. Villagers involved in monitoring natural services are provided with training in the use of KoboCollect using an android. Although villagers are already familiar with owning an android, there are parts that need to be improved so training is still needed.

The level of species monitoring is indicated in each village that conducts nature service monitoring and 12 of 17 villages have confirmed species data.

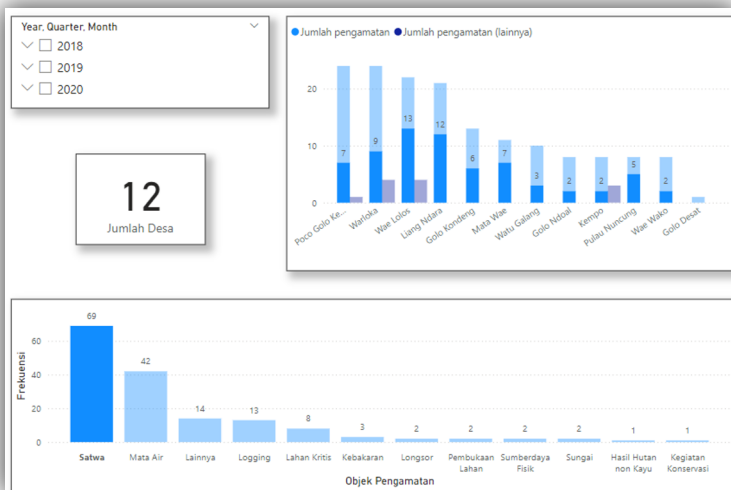


Fig. 8. Number of species data object monitoring (2018-2020)

The species recorded by the nature service monitoring team can be seen in the chart below. There were a total of around 48 species presence of 18 different species with 2 species Endangered (EN) and 16 Least Concerned (LC) status of species.

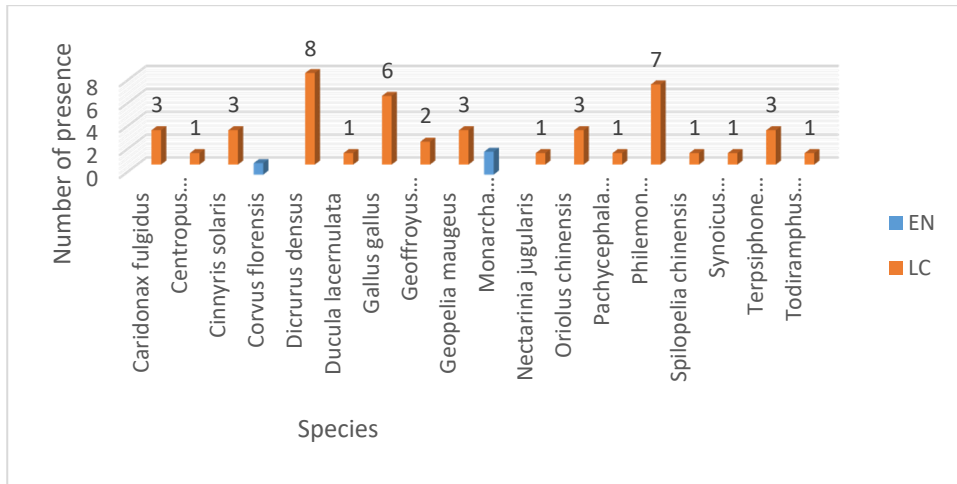


Fig. 9. Number of species data object monitoring based on presence (2018-2020)

4 Discussion

The approach used in the adoption of nature service monitoring here is to encourage or emphasize a sense of belonging to nature. At the beginning of the application of nature monitoring, there were still constraints with the monitoring tools used such as worksheets or tally sheets. Low Key Monitoring tally sheet is still too scientifically based so that in digesting the tally sheet LKM is a challenge for the community to understand. Even so, the use of the MFI tally sheet in recording ecosystem conditions continues. Realizing that the LKM is quite difficult to take, a different understanding is needed to be able to convey the purpose and purpose of this recording. The debate that was going on at the time was the understanding of ecosystem services, which were still understood as environmental services. However, the term “environmental services” was still not quite right for the people in West Manggarai, so the term “environmental services” was agreed to be “Nature Services” which was quite acceptable.

Sense of belonging is the main goal in the introduction of this natural service monitoring tool. The obstacle faced later when the monitoring tool was adjusted to the community's ability to use the tally sheet was good documentation. The use of tally sheets does not necessarily make it easier for the community to document and manage data properly. This is because there are still people who are not good enough at storing the results of monitoring data. Therefore, it is necessary to consider other things to support better documentation. One of the tools used is the Open Data Kit (ODK) application, Kobotoolbox, which can be obtained and used for free from PlayStore. Although this application provides a challenge back to the community to introduce new things to them. The use of this application provides convenience to the community in collecting data because everything is in digital form and data security is better than manual.

Through the use of monitoring tools both tally sheet and integrated into the Kobotoolbox application, it is hoped that these two tools will provide awareness to the public about the importance of maintaining natural services around us. Whatever tool we use, it is hoped that the tool will encourage a sense of ownership from the community in preserving nature. In

addition, the simple target of recording the natural services that the community depends on for life is part of the monitoring so that it can encourage them to participate willingly and consciously. At the very least, they will not commit vandalism because they understand the relevance of conservation to their daily lives.

The level of community participation in nature services monitoring data collection is different when the LKM is running than when the digital tally sheet is used. Where the participation rate with the use of Android is less but more effective in data collection. However, this is not the main goal of nature service monitoring, but community awareness of nature services around them and their awareness to protect their environment is the main thing that is encouraged. If we look at the data that has been documented, the community is quite familiar with the use of tally sheets and digital worksheets. It is hoped that by using tally sheets and digital worksheets, the documentation process of Nature Service monitoring will be better in the future.

Participation in nature service monitoring is carried out by LCGs (Local Conservation Groups) formed in each village. This group of participants consists of village government and community members who are assisted by Burung Indonesia. The number of monitoring members varies for each monitoring based on the monitoring tools used. When the LKM was implemented, the number of members could reach 7-8 people in one monitoring team while when the PLA was implemented and used Android for data collection, the involvement of people in the team decreased to around 2-3 people in the monitoring team. This is because when the LKM is carried out, it still uses the tallysheet worksheet provided and 1 tallysheet can be filled in by 2-3 people according to the responsibility of each theme or object observed, while the rest have roles in guiding, holding gps, and identifying species of both flora and fauna.

The community's ability to collect data and begin to understand the presence of natural services around them encourages them to collect better-quality data. The data generated from this monitoring has been shared with the respective village governments and some villages have followed up. The follow-up is in the form of financial assistance to a women's farmer group in planting trees around the springs in Wae Lolos Village. In addition, this data was also displayed and presented in a public forum with the Regent of West Manggarai to convey the data in general.

5 Conclusion

Retrieval of data using either a tally sheet or digital form has different effectiveness. The tallysheet filled in by the monitoring operator can provide more information in one question variable but there will be minimal diversity of data in one path. Unlike the digital form which is more compact and simple but has the advantage of being practical, as it shortens the monitoring time so that more data will be taken. These advantages and disadvantages will continue to be developed so that manual data collection will be of the same quality as using digital forms. The public's response to the ability of each data collection method still tends to the practicality of data collection so smartphones are currently still a data collection tool in the field. In the future, smartphones will still be used to maintain current data quality

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