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Characteristics of plastic waste and perceptions of coastal communities in the Baluno mangrove ecotourism area, West Sulawesi, Indonesia

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Abstract. *Massiseng ANA, Tuwo A, Fachry ME, Bahar A. 2022. Characteristics of plastic waste and perceptions of coastal communities in the Baluno mangrove ecotourism area, West Sulawesi, Indonesia. Biodiversitas 23: 6262-6274.* Plastic pollution is a global problem that threatens coastal and marine ecosystems and human livelihoods and requires effective solutions that can be adapted to local conditions. Management of coastal areas is one sector focusing on world development in general and Indonesia in particular. This research was conducted from July to October 2021 in the mangrove ecotourism area of Baluno (Mangrove Learning Center of Baluno, MLC Baluno), Sendana Sub-district, Majene District, West Sulawesi Province, Indonesia. The type of data used is the primary data from measurements and observations at ecotourism sites. The purpose of this study was to identify the characteristics of plastic waste and analyze its impact on the socio-economic community in the MLC Baluno mangrove ecotourism area. The results showed (i) The percentage of plastic waste types from all observation stations in the MLC Baluno mangrove ecotourism area consisted of 22% HDPE, 20% LDPE, 17% PVC, 9% PETE, 12% PE, 10% PP, 6 % PE, and 4% PU, (ii) The volume percentage of plastic waste from observation stations in the mangrove ecotourism area of MLC Baluno mangrove ecotourism by type consists of 32% PVC plastic volume, 17% HDPE, 14% PE, 10% LDPE, 10% PETE, PP 11%, 4% PS and 2% PU, (iii) The influence of plastic waste factors (types and volume) has a positive effect on the socio-economic community (livelihood and income). The variable factors of plastic waste influencing socio-economic based on the perceptions of coastal communities in the MLC Baluno mangrove ecotourism area are TW2, VW3, VW4, LV1, LV2, IC1, IC3, and IC5.

Keywords: Coastal, ecotourism, livelihoods, plastic, waste

INTRODUCTION

Plastic waste is an environmental problem worldwide, especially in coastal areas, and is a significant global ecological threat today; and affects the survival of marine biota (Lozoya et al. 2016; Marzuki et al. 2021). The discovery of plastic as a convenient, easy, and practical material in people's lives has caused plastic waste to threaten ecosystems and humans (Pettipas et al. 2016; Babaremubc et al. 2022). Cauwenberghe et al. (2013) estimate that 10% of all newly produced plastic will be discharged through rivers and end up in the ocean. Meanwhile, the garbage washed up to the coast will disturb the coastal ecosystem, such as corals, seagrasses, and mangroves. The trash will cover coral reefs, seagrass beds, and mangrove roots. Plastic waste is sourced from visitors (tourists) who visit coastal tourism areas. Therefore, knowledge of the kinds of plastic waste is essential because it can be used as an indicator of management and the source of plastic waste (PlasticEurope 2017). Marine debris can refer to a variety of solid materials that are produced and processed continuously, directly or indirectly, intentionally or unintentionally, and are disposed of and left in the marine environment and often consist of plastic materials (NOAA 2013; Jambeck et al. 2015; Martin et al. 2016; Rochman et al. 2016). That is influenced indirectly by the geographical shape of the coast, the level of slope, the level of exposure, and environmental factors such as wind and ocean currents (Galgani et al. 2015; Critchell and Lambrechts 2016; Barboza et al. 2019). Lippiatt et al. (2012) explained that marine debris could be determined based on size.

Plastic waste is a challenge, along with the development of fishery resources to improve the welfare of coastal communities through ecotourism activities. That is contrary to the research of Ma et al. (2019) in Qinling, China, that in terms of ecotourism, it can reduce poverty. Still, it can also increase income inequality due to converting agricultural land into conservation lands and not maximizing community empowerment through ecotourism activities. Studies on the link between plastic waste and tourism have a very close correlation (Wilson and Verlis 2017; Jang et al. 2022). The existence of high plastic waste has an ecological and economic impact, especially could be viewed in the decrease in visitor levels (Bergmann 2015; Massiseng et al. 2020). The environmental impact can be

viewed from the disruption of biota life and ecosystem damage (Li et al. 2019).

Most of the chemicals found in plastic materials provide qualities for hardness, durability, flexibility, and color (Verma et al. 2016; Kehinde et al. 2020). In addition, the garbage entangled in mangrove roots can damage the beauty of the mangrove ecosystem (Thushari and Senevirathna 2020). Types of plastic waste have different impacts on health and the environment, depending on how long it takes to decompose and the chemicals in the plastic. The impact of waste can be seen from three aspects: environmental, economic, and social. First, the accumulation of debris in the coastal environment has implications for silting and narrowing watersheds, decreasing water quality and significantly impacting environmental quality, human health, welfare, and the people who work as fishermen (Beaumont et al. 2019; Deng et al. 2020). Second, the circular economic theory suggests not turning plastic waste into the garbage because it will impact environmental damage and people's social life (Geyer et al. 2017; Qu et al. 2019; Balwada et al. 2021; Pincelli et al. 2021). Third, adopting alternative livelihoods to manage plastic waste can save the ecosystem of fish resources (Vo et al. 2013).

Mangrove Learning Center of Baluno (MLC Baluno) mangrove ecotourism located in Majene District, West Sulawesi Province, Indonesia, has a unique substrate structure, namely in the form of coral overgrown with mangrove plants. This place is a location for domestic tourist visits, student research, and a learning center for schools in West Sulawesi Province (Fachry et al. 2021). Ecotourism activities in this area automatically contribute to plastic waste in the area. Arabi and Nahman's (2020) research show that plastic waste from coastal tourism activities negatively impacts marine habitats, biodiversity, and commercial fishery stocks and affects the community's economy. Plastic waste can come from visitor waste, marine debris, and fishing communities (Daris et al. 2022; Khuu et al. 2020; Nelms et al. 2020). Videla and Araujo (2021) have described on the coast of Brazil that plastic waste can affect the community's economy and other social problems.

MATERIALS AND METHODS

Study area

This research was conducted for five months, namely July-November 2021. During this period, it was used to collect primary data by identifying the characteristics of plastic waste and public perceptions of the socio-economic impacts of plastic waste at the research location, namely the mangrove ecotourism area of Baluno or Mangrove Learning Center of Baluno (MLC Baluno), in Sendana Sub-district, Majene District, West Sulawesi Province, Indonesia (Figure 1).

Types and sources of data

Types of data related to identifying the characteristics of plastic waste and the perceptions of coastal communities about the effect of plastic waste on the socio-economic community in the MLC Baluno mangrove ecotourism area are primary data sourced from measurements and observations at ecotourism sites. That comes from interviews with respondents to a series of questions (questionnaires) to the community. Tables 1 and 2 show the types of data needed in this study.

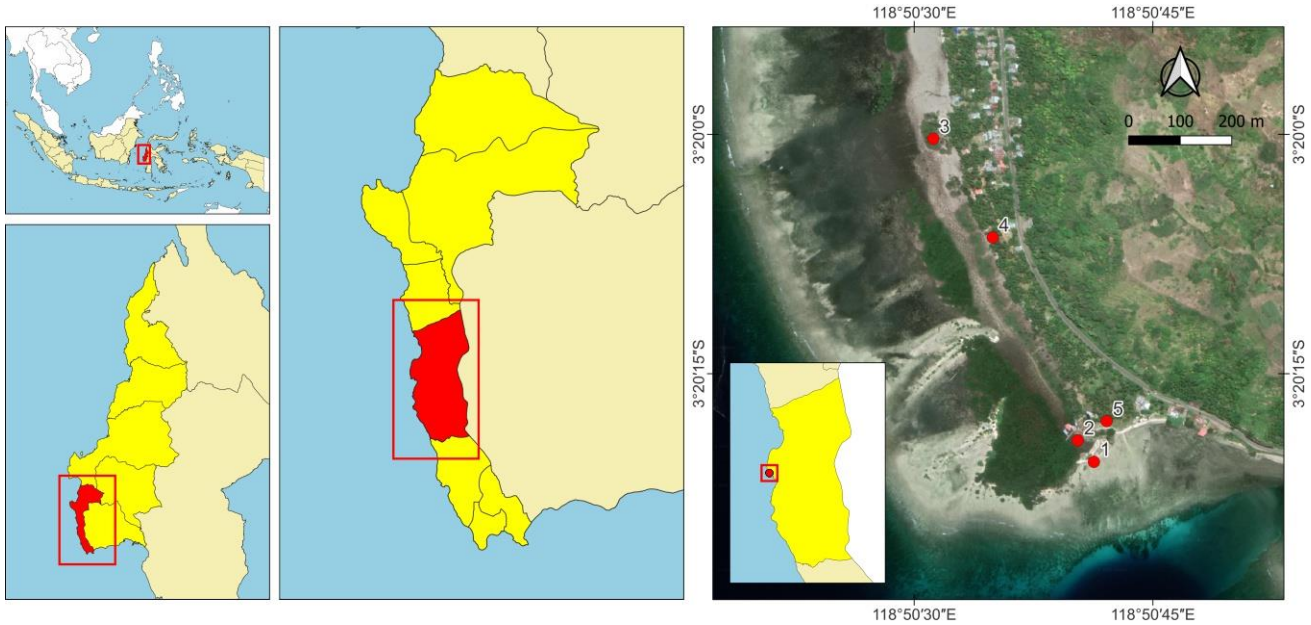

Figure 1. Research location map in Mangrove Learning Center (MLC) Baluno mangrove ecotourism of Sendana Sub-district, Majene District, West Sulawesi Province, Indonesia

Materials

The tools and materials used are based on research objectives and methods: the sampling with plotter techniques and interview techniques using questionnaires. The tools and materials used are presented in Table 3.

Collecting data method

The data collection method to identify the plastic waste type uses a sampling technique (plotter) by making a 10 m x 10 m quadrant transect, and a 100-meter line transect combination carried out at low tide. Plotting was carried out at 5 sample points in the MLC Baluno mangrove ecotourism area with five repetitions. Repetition was performed in the same sampling plot five times to produce accurate data and was taken once a month. The plastic waste in the plot area is then put into a trash bag to be cleaned, dried, and weighed, and the type of plastic is identified based on the plastic category. Furthermore, the recording and documentation of activities are carried out. Sampling data collection stations through plotting techniques, as shown in Table 4 and Figure 1.

Table 1. Types of data to identify the characteristics of plastic waste

Data Type	Source	Unit
Types of plastic waste	Sampling (plot/trapping)	5 station
Volume of plastic waste	Sampling (plot/trapping)	kg/day
Mangrove type	Observation	-
Mangrove area	Image data and service data	ha
Community identity (origin, age, education, occupation, number of dependents)	Interview	kg/day
Amount/volume of plastic waste produced per day	Interview	kg/day
Types of plastic waste generated	Interview	-

Table 2. Types of data to analyze perceptions of coastal communities regarding plastic waste on socioeconomics

No	Data type/ variable	Source	Unit / scale
Primery data			
1	Types of plastic waste	Interview/questionnaire	Likert Scale
2	Volume of plastic waste	Interview/questionnaire	[1] Very not agree/very don't know
3	Livelihood	Interview/questionnaire interview/questionnaire	[2] disagree/don't know
4	Income		[3] slightly disagree
			[4] neutral/doubtful
			[5] somewhat agree/somewhat know
			[6] agree/know
			[7] strongly agree / strongly know

Table 3. Tools and Materials

Types	Function
String of raffia	Tool for creating boundaries when plotting
Roll meter	Tool for measuring plotting based on quadrant and line transects
GPS	Tool for sampling point
Digital scales	A tool for weighing plastic waste obtained from the observation station
Trash bag	A tool for storing plastic waste obtained from the observation station
Clipboards	A tool to facilitate the recording of the data obtained
Stationery	A tool for recording the data obtained and labeling the trash bag
Camera	Tools for documenting activities
Plastic waste	Research object material
Questionnaire	Materials for data collection through respondent interviews

Table 4. The sampling station of the research location is in the mangrove ecotourism area of MLC Baluno

Station	Coordinate		Location
	Latitude (X)	Longitude (Y)	
1	118° 50'41.294" E	3° 20' 20.521" S	The southern part of the tracking
2	118° 50'40.284" E	3° 20' 19.174" S	The center of the tracking
3	118° 50'31.203" E	3° 20' 0.278" S	Entrance before tracking
4	118° 50'34.935" E	3° 20' 6.461" S	Near residential community
5	118° 50'42.093" E	3° 20' 17.972" S	Near residential community

The data collection method for analyzing people's perceptions of the socio-economic factors of plastic waste in the MLC Baluno ecotourism area was carried out by interviewing the coastal and management communities at the MLC Baluno mangrove ecotourism using a simple random sampling technique. These respondents were randomly selected from several people living in settlements close to the ecotourism area and the MLC Baluno mangrove ecotourism management. Sugiyono (2018) states that the simple random sampling technique provides equal opportunities for each population to be selected as a sample. For example, the total population of the Binanga Village community is 416 households. Therefore, based on the Slovin formula, 68 respondents could be taken to represent coastal community households. Therefore, these respondents consisted of 50 coastal communities and 18 community members from the MLC Baluno mangrove ecotourism manager.

Data analysis

Characteristics of plastic waste in the mangrove ecotourism area of MLC Baluno

The data analysis method to analyze the characteristics (type and volume) of plastic waste entering the MLC Baluno mangrove ecotourism area was carried out by descriptive statistical analysis. Descriptive analysis is a statistical analysis used to analyze data by describing or describing the data that has been collected as it is without intending to make conclusions that apply to the public or generalizations (Sugiyono 2018; Strijker et al. 2020). The descriptive analysis in this study is intended to provide an overview of the characteristics and amount (amount/volume) of plastic waste that enters the mangrove ecotourism area in the research locations. That becomes very important considering the type and volume of waste will significantly affect the impact, including the socio-economic environment of the surrounding coastal communities. The data analysis method used to identify the types of plastic waste in the MLC Baluno mangrove ecotourism area is based on the plastic category, then analyzed using descriptive qualitative analysis presented in the form of diagrams to see the types of plastic found in the research location.

Analysis of perceptions of coastal communities regarding plastic waste on socio-economics in the MLC Baluno mangrove ecotourism area

Principal Components Analysis (PCA) was first carried out using SPSS 15.0 to determine which variables could be used in the preparation of the SEM. Factor analysis can be continued by looking at the Keiser-Meyer-Olkin (KMO) and Bartlett's test values where the sig value is <0.05. The variables that can be used are variables with a value of Measures of Sampling Adequacy (MSA) >0.5. Variable factors include:

Types of plastic waste (TW) consisting of TW1, TW2, TW3, TW4, TW5

- TW1: Use of plastic with consideration of packaging
- TW2: Use of plastic with consideration of being environmentally friendly
- TW3: Use of plastics with light considerations used
- TW4: The use of plastic with practical considerations used
- TW5: The use of plastic with consideration of its function

The volume of plastic waste (VW) consisting of: VW1, VW2, VW3, VW4, VW5

- VW1: Use of plastic by considering the number of family members
- VW2: The use of plastic with consideration to reduce
- VW3: Use of plastic for fun
- VW4: Use of plastic with consideration of reuse
- VW5: Use of plastic with consideration of refill packaging

Livelihood (LV) which consists of: LV1, LV2, LV3, LV4, LV5

- LV1: can be an alternative livelihood
- LV2: can be resold
- LV3: can be used as a souvenir
- LV4: can be used as a photo spot
- LV5: can affect the main livelihood

Income (IC) consisting of: IC1, IC2, IC3, IC4, IC5

- IC1: can be recycled
- IC2: can reduce the catch of fishermen
- IC3: can be sold directly
- IC4: can improve the welfare
- IC5: can be a new source of income

The data analysis method used to analyze the characteristic factors of plastic waste on the socio-economic community in the mangrove ecotourism area of MLC Baluno is SEM (Structural Equation Modeling) analysis using PLS-SEM tools. SEM (Structural Equation Modeling) analysis is a statistical technique used to build and test statistical models, usually causal models (Syahrir et al. 2020; Putignano et al. 2021; Alamer 2022). It was further stated that this model was widely developed, considering that one of its functions was to confirm or test the theory. Thus, it is very appropriate to analyze the impact of plastic waste on the socio-economic life of the community in the MLC Baluno ecotourism area. That is in line with the opinion of Schreiber (2022) that the SEM method is a multivariate analysis technique that allows researchers to examine the relationship between complex, recursive, and non-recursive variables to obtain a comprehensive picture of the model being studied.

The structural model shows that the model developed is related to the characteristics of the impact of plastic waste on the socio-economic community in the MLC Baluno mangrove ecotourism area. That model describes the direct effect of plastic waste (type and volume of waste) on socio-economic factors in the MLC Baluno mangrove ecotourism area based on community perceptions.

RESULTS AND DISCUSSION

Characteristics of plastic waste in the mangrove ecotourism area of MLC Baluno

The results of research conducted in the MLC Baluno mangrove ecotourism area is shown in Figure 2, which presents the types of plastic waste found in the research location based on the observation station. The percentage of plastic waste in the MLC Baluno mangrove ecotourism area is shown in Figure 3, which presents the types of plastic in each observation station. The volume of plastic waste based on the type of plastic waste found at each observation station in the MLC Baluno mangrove ecotourism area is shown in Figure 4. The percentage of plastic waste volume by type is shown in Figure 5, which presents the volume of plastic waste based on observation stations at the research location (Figure 6).

Community perceptions of the effects of plastic waste on socio-economics in the MLC Baluno mangrove ecotourism area

Variable identification

The KMO and Bartlett's test values show a sig value of 0.000 <0.05, indicating that factor analysis can be continued (data not shown). The worthy variables of being a factor in this study are those with MSA values >0.5. The plastic waste type variable that meets the criteria is TW2, for the waste volume variable that meets the criteria are VW3, VW4, and VW5. For livelihood, variables that meet the criteria are LV1 and LV2. For income, variables that meet the criteria are IC1, IC3, IC4, and IC5. The SEM model is prepared based on the selected variables, as shown in Figure 7. The result of the analysis of the impact of plastic waste on the socio-economic community are shown in Figures 8 and 9. In addition, the results of this study show the relationship between the variables related to the impact of plastic waste on the socio-economic community in the mangrove ecotourism area of MLC Baluno.

The convergent validity of the model is used to prove that the questions on each variable in the study can be understood by the respondents in the same way as intended by the researcher. Acceptable convergent validity, which has a loading factor value >0.7. The validity test results show invalid variable factors in plastic waste and the socio-economic community. Therefore the model is refined by eliminating weak variables to fit in. The fit model in this study are shown in Figures 7, 8, and 9. Moreover, to analyze the relationship between plastic waste and the socio-economic community, a bootstrapping test was carried out on SmartPLS with a significance of 5% with the following Figure 9. The results of the analysis can be seen in Table 5.

The plastic waste factor has a positive effect on the socio-economic community. The most influential plastic waste factor is the volume of waste with P (values), and the volume of plastic waste on livelihoods of 0.0021.

Table 5. The relationship of plastic waste variables (types and volume) to socio-economic factors (livelihoods and incomes) in the MLC Baluno mangrove ecotourism area

	Original sample	Sample mean	Standard deviation	T statistic	P values
Types of plastic waste »» Income	0.048	0.054	0.176	0.271	0.786
Types of plastic waste »» Livelihood	0.220	0.232	0.163	1.351	0.177
Volume of plastic waste »» Income	-0.236	-0.261	0.138	1.716	0.086
Volume of plastic waste »» Livelihood	-0.286	-0.299	0.124	2.311	0.021

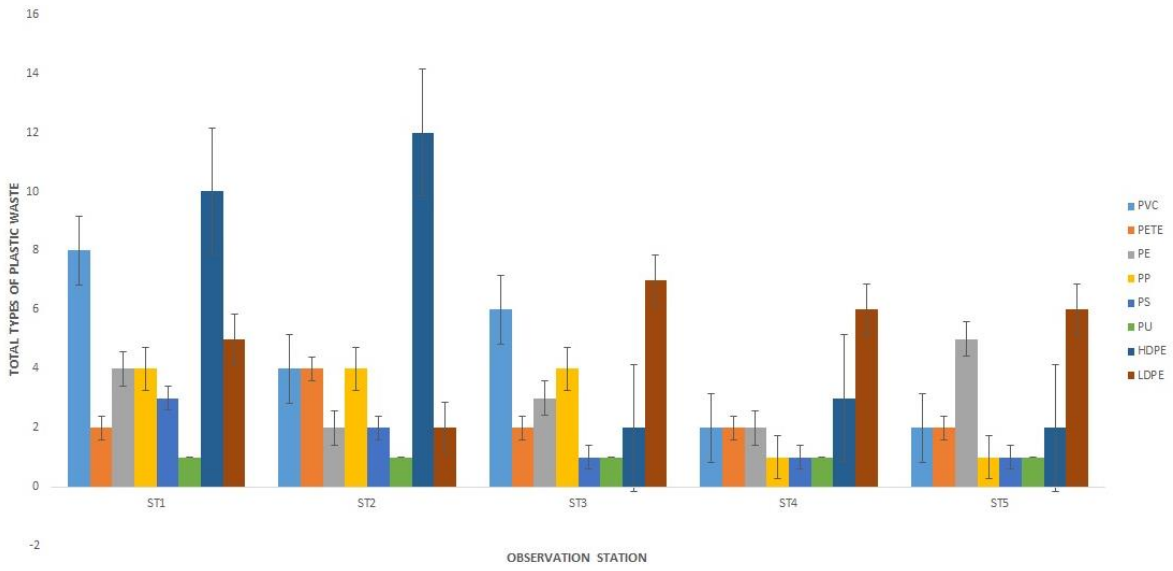

Figure 2. Diagram of types of plastic waste based on stations in the MLC Baluno mangrove ecotourism area

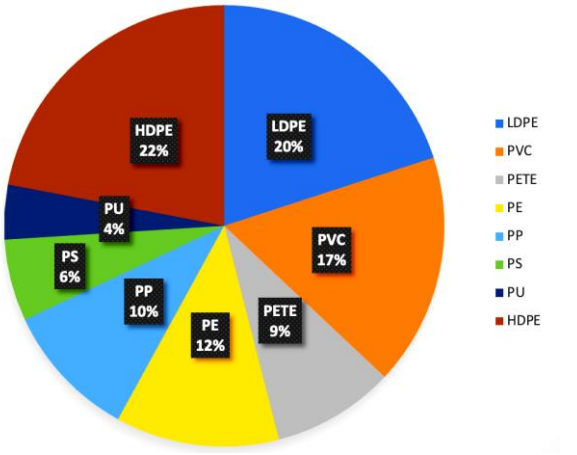

Figure 3. Types of plastic waste in the MLC Baluno mangrove ecotourism area at all observation stations

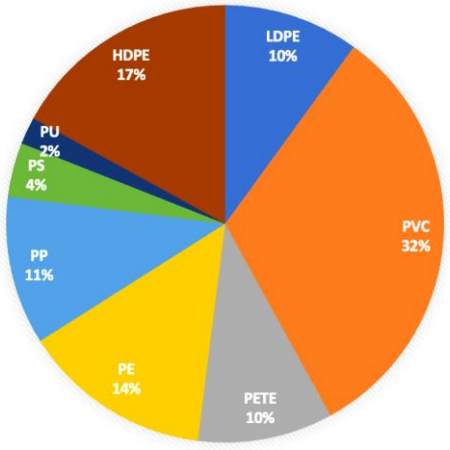

Figure 5. Percentage of the volume of plastic waste by type in the MLC Baluno mangrove ecotourism area

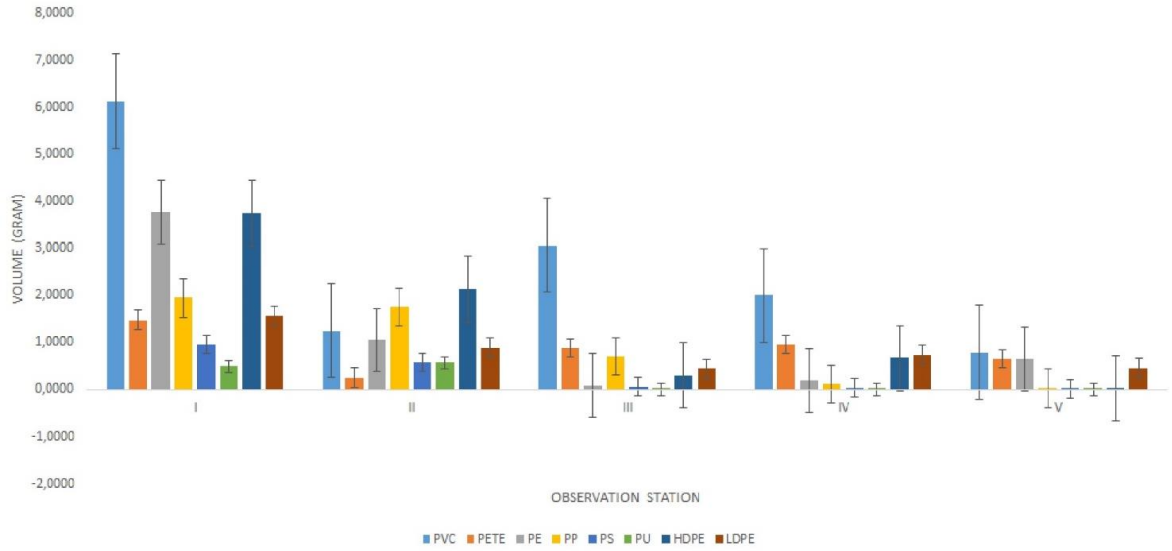

Figure 4. The volume of plastic waste by type in the mangrove ecotourism area of MLC Baluno

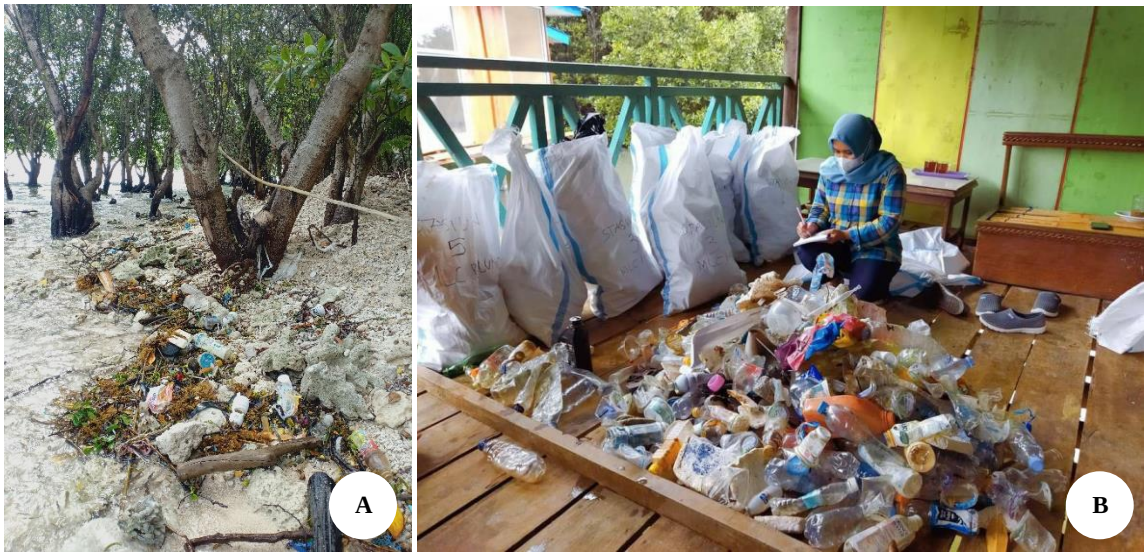

Figure 6. A. Plastic waste trapped in mangroves; B. Types of plastic waste obtained at the observation station

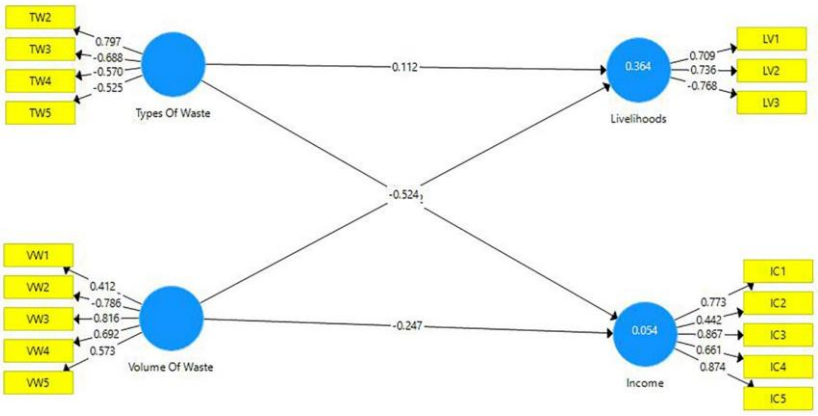

Figure 7. SEM model of coastal community perceptions of the effects of plastic waste on socio-economics in the MLC Baluno mangrove ecotourism area

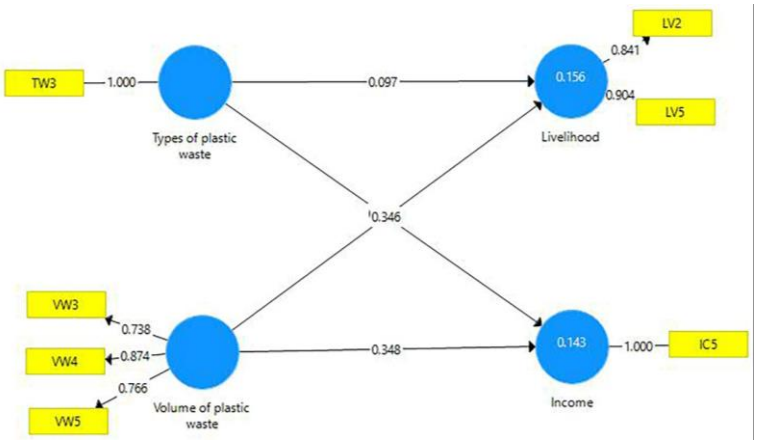

Figure 8. Fit model for the suitability of plastic waste for the socio-economic community in the MLC Baluno mangrove ecotourism area

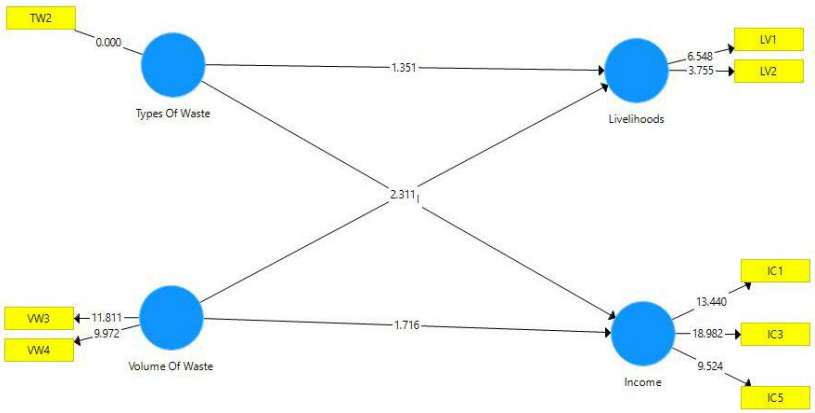

Figure 9. The effect of the plastic waste factor on the socio-economic community in the MLC Baluno mangrove ecotourism area

Discussions

Characteristics of plastic waste in the mangrove ecotourism area of MLC Baluno

The research results presented in Figure 3 show that the types of plastic waste in the mangrove ecotourism area based on the observation station consist of PVC, PETE, PE, PP, PS, PU, HDPE, and LDPE plastic waste. Each station has different results, including the type of plastic waste that dominates at each station. At station 1, located to the south of the MLC Baluno mangrove ecotourism, most plastic waste is HDPE. The type of HDPE plastic obtained from station 1, which is in the southern part of the MLC Baluno mangrove ecotourism tracking, consists of waste in the form of colored plastic bottles, baskets, combs, soap

containers, bucket lids, and lipstick packaging. The characteristics of the trash show that it comes from household and visitor waste. The minor type of plastic at station 2 is PU type, namely used shoes, which is also indicated to come from household waste or marine debris. At station 2, the most significant type of plastic comes from HDPE plastic which consists of medicine bottles, deodorant bottles, powder bottles, baby pacifier covers, shavers, machine oil packaging, and others. These characteristics indicate that the waste comes from households, communities, or marine debris. Station 3 is dominated by LDPE plastic waste, which comes from plastic waste packaging biscuits, candy packaging, crackle bags, bread packaging, cracker packaging, and others. Those characteristics of discarded plastic waste can be indicated as waste from ecotourism visitors. At station 4, the most significant type of plastic waste is produced from LDPE plastic, with waste in the form of instant noodle packaging, coffee packaging, cracker packaging, crackle bags, flavoring sachet packaging, bread packaging, and others. These characteristics indicate that household waste or ecotourism visitors can confirm these characteristics. The last observation station is station 5, which is dominated by LDPE plastic waste in the form of chocolate packaging, crackle bags, candy packaging, cracker packaging, coffee packaging, instant noodle packaging, and others. These characteristics of the plastic waste produced indicated that the plastic waste is sourced from household waste originating from community settlements and visitors.

The percentage of types of plastic waste in the mangrove ecotourism area of MLC Baluno is presented in Figure 4. These results show the type of plastic found in each observation station in the research location. The most common type is HDPE plastic, which is 22%, followed by 20% LDPE, 17% PVC, 12% PE, 10% PP, 9% PETE, 6% PS, and 4% PU. The characteristics of plastic waste found at each station are very random because it combines residential, and visitor wastes with marine debris. Types of HDPE plastic include seasoning packaging waste, CD boxes, make-up packaging, colored beverage bottles, flour packaging, detergent packaging, milk powder packaging, gallon caps, and others. The type of LDPE plastic waste comes from biscuit packaging, ship engine wrapping, infusion bottles, crackle bags, snack packaging, instant noodle packaging, coffee packaging, chocolate packaging, and others. The plastic type that was ranked 3rd most in all observation stations was the PVC, which consisted of plastic waste from waist bags, boat patch pipes, children's toys, fisherman's hats, carpet pieces, hand fans, mattress pieces, basins, buckets, used bags, lamp hangers, and more. In 4th place, the type of plastic is dominated by PE plastic, which comes from the plastic waste of used sandals, used nets, shampoo sachet packaging, deodorant sachet packaging, soy sauce sachet packaging, flavoring sachet packaging, clothing zippers, and others. The next type of plastic is PP plastic which is in the range of 10% of plastic waste at all observation stations. This type of PP plastic is sourced from plastic waste in the form of glass drinking water packaging, sacks, ropes, bottle caps, ice plastic, straws, ice cream packaging, cement packaging, food containers, and others. PETE is the type of plastic that dominates 9% of all observation stations; plastic waste originating from the PETE type comes from plastic waste packaging, drinking water bottles, food boxes, and others. The plastic type that can be indicated to be less than other types of plastic is PS plastic, which is only 6% of the total types of plastic that are only available at observation stations 1, 2, and 3. fish containers, net floats, styrofoam food containers, glass noodle packaging. The last type of plastic from all plastic waste obtained was PU plastic, at 4% of all types found only at stations 1 and 2. The plastic waste came from PU plastic, usually used shoes.

Based on the research results at all observation stations, the volume of plastic waste in the MLC Baluno mangrove ecotourism area consists of 8 types: PVC, PETE, PE, PP, PS, PU, HDPE, and LDPE. The highest volume of plastic-type for station 1 is PVC plastic of 6.04 kg. The highest type of plastic found at station 2 is HDPE plastic, which is 2.13 kg. At station 3, the type of plastic with the highest volume is PVC plastic, which is 3.06 kg. Station 4 has the most types of plastic, PVC, with a weight of 2.00 kg. Finally, at station 5, there is a type of plastic with the most significant volume: PVC plastic, which weighs 0.78 kg.

The percentage of plastic waste volume by type at all stations is shown in Figure 6. Based on the results, the type of plastic waste with the highest importance at all observation stations is PVC plastic, with a volume percentage of 32%. The second highest book of plastic types is HDPE, with a rate of 17%. PETE and LDPE plastic types both have a percentage of 10% of the total plastic waste. PE has a volume of plastic waste with a rate of 14%, then PP plastic with a ratio of 11%. The lowest types of plastic waste obtained from all stations were PS and PU plastics, with rates of only 4% and 2%, respectively.

Community perceptions of the effects of plastic waste on socio-economics in the MLC Baluno mangrove ecotourism area

In the section on types of plastic waste, the most explicit statement is the statement in TW3 code, which relates to the type of plastic bag that is more practical and easier to use. This statement aligns with respondents' answers on average on numbers 6 and 7, namely, agree and strongly agree. That indicates that the respondents have a realistic character in using plastic. Plastic or crackle bags are included in the type of LDPE plastic, with 20% of all plastic waste obtained from all stations. The community usually uses plastic bag waste to unite their luggage; besides being light, it is also practical. Therefore, the option of plastic bags is lovely to respondents. Lavelle et al. (2020) say that psychological and demographic factors influence the habit of using plastic bags.

Statements related to the volume of plastic waste with a loading factor >0.7 are statements with codes VW3, VW4, and VW5. Respondents prefer to use plastic bags when traveling, reuse plastic containers for other product containers, and use plastic packaging contents to buy household needs. Based on the results obtained, it can be indicated that respondents tend to use and purchase types

of plastic that can be reused so that the waste discharged into the environment comes from hard and reusable plastic types, such as HDPE, LDPE, and PVC plastics. Of these three types of plastic found at all stations with a volume percentage of 17% HDPE, 10% LDPE, and 32% PVC. That is confirmed by the research of Greenwood et al. (2021). The preference to buy plastic that can be reused as refills and other containers is triggered by the material, type, and model of plastic packaging.

Statements related to livelihoods with a loading factor >0.7 are reported to be associated with LV2 and LV5 codes. Plastic waste in the MLC Baluno mangrove ecotourism area can be resold, and the increase in plastic waste in the MLC Baluno mangrove ecotourism area can reduce community livelihood. Based on the results of interviews with community respondents in the research location, it was found that the answers to LV2 and LV5 were in the average range of numbers 6 and 7, namely Agree and Strongly Agree. Therefore, it is considered that the community's livelihood as fishermen and the sale of mangrove seedlings can be crippled if plastic waste increases. Fisher respondents complained that plastic waste could damage their fishing gear and cause silting in the fishing area, thereby reducing catches. As for people who have a livelihood as sellers of mangrove seeds, they are disturbed by the presence of plastic waste because it can cover mangrove seedlings and prompt death. Based on the results of this study, the new livelihood, namely collecting plastic waste in the mangrove ecotourism area and then selling it, has not been comparable to the losses on the community related to their other work as fishermen and mangrove seedlings. That is in line with the research results of Posadas et al. (2021) that marine debris was able to reduce shrimp catches in Mississippi by 80%, loss of operational fishing time by 82%, and ship repairs by 75% emphasized by Stacey et al. (2021) that the ecological conditions of the fishing area strongly influence people's livelihoods in small-scale fisheries.

The plastic waste type effect on the study site's socio-economic concept is insignificant, with a P value> 0.05. The community knowledge around the study location regarding plastic waste type is still very inadequate. People only choose certain types of plastic waste to sell and do not take all types. Plastic waste mostly taken by the public for sale is bottled drinking water and glass water packaging. This type of plastic waste comes from the PETE type, which has a volume of 10% of all observation stations. Types of plastic waste packaging drinking water bottles are often found in the mangrove ecotourism area of MLC Baluno, which come from visitors and restaurants around the ecotourism area that are dumped into the sea and entangled in the mangrove roots. The waste volume factor's influence on the community's socio-economic factors, namely livelihoods and income, has a significant effect with a P value <0.05. That is because the concepts of plastic waste recycling management have begun to be promoted around the location of the activity. Warren and Steenbergen (2021) suggest that management related to livelihoods and environment-based must be appropriately implemented because it can cause conflict and decrease fishery yields in an area.

The impact of plastic waste on socio-economic based on community perceptions in the MLC Baluno mangrove ecotourism area can be seen in Figure 9. The influential variables are: TW2, VW3, VW4, LV1, LV2, IC1, IC3, and IC5.

The variable factor TW2 assumes that people use plastic waste by considering it as a packaging container. For the variable factor VW3, people prefer to use plastic as containers. However, they still prefer plastic containers if they must choose. The next variable factor from the volume of plastic waste is VW4, which people choose plastic in their daily lives because it can be reused in other containers. As for the variable livelihood factor, the influencing factor is LV1, which means it can become a new alternative livelihood by selling plastic waste to collectors in their area. The other influential factor in livelihood LV2, the people in the MLC Baluno mangrove ecotourism area, are used to resell after being enumerated into plastic pellets. Another significant variable is the income factor, which has an IC1 effect. Plastic waste in the MLC Baluno mangrove ecotourism area can be recycled into plastic pellets, photo spots, and souvenirs which could become an income for the community, especially the MLC Baluno ecotourism management community. Another influential factor in the income variable is IC3, meaning people can sell directly to plastic waste collectors, which could then buy household needs. Finally, the IC5 income variable factor, namely plastic waste in the MLC Baluno mangrove ecotourism area, could become a new source of income if appropriately managed by the community or the MLC Baluno mangrove ecotourism management community.

In conclusions of this study are, (i) The percentage of plastic waste from all observation stations in the mangrove ecotourism area of MLC Baluno consists of 22% HDPE, 20% LDPE, 17% PVC, 9% PETE, 12% PE, 10% PP, 6% PS, and PU 4%; (ii) The percentage of plastic waste volume from observation stations in the mangrove ecotourism area of MLC Baluno by type consists of 32% PVC plastic volume, 17% HDPE, 14% PE, 10% LDPE, 10% PETE, 11% PP, PS 4% and PU 2%; (iii) The influence of plastic waste factors (type and volume) has a positive effect on the socio-economic community (livelihood and income). The variable factors of plastic waste influencing socio-economic based on the perceptions of coastal communities in the MLC Baluno mangrove ecotourism area are TW2, VW3, VW4, LV1, LV2, IC1, IC3, and IC5.

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