Effect of knowledge about the ecosystem, conservation and pollution on the behavior of the community towards the environment in upstream Maros River basin, Maros, Indonesia

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Abstract. Environmental conditions at the upstream Maros river basin have experienced severe degradation, particularly deforestation, high rate of erosion, and illegal forest logging which are mostly performed by the local communities. As a result of this damage, a decrease in the quantity of water discharge in the downstream area appeared, which had a negative impact on the surrounding communities, particularly concerning the need for water in agricultural areas as well as the need for drinking water for the population in Makassar City and Maros Regency. Damage which occured in the river basin at upstream Maros tends to be the result of community behavior who had no environmental awareness, thus the activities carried out tend to have negative consequences in managing and utilizing natural resources without any consideration to sustainability aspects. The aim of this study was to analyze the level of community knowledge about ecosystems, conservation, and river basin pollution on community behavior with an environmental awareness in utilizing natural resources and the environment in the upstream river basin. This study used a quantitative approach carried out by survey methods. The instruments used and developed included: a questionnaire on community behavior with an environmental awareness, knowledge of river basin ecosystems, knowledge of river basin conservation, and detection of river basin pollution, which were then evaluated using SEM analysis. The results showed that knowledge of conservation (X2) and pollution (X3) had a direct and significant effect on environmental-minded community behavior. Meanwhile, the ecosystem knowledge variable (X1) did not show any direct and insignificant effect on the behavior of people with environmental awareness. Therefore, it can be said that in order to reduce river basin damage, people's knowledge of the river basin ecosystem needs to be improved, thus the local communities have a good understanding of the river basin as an ecosystem unit which will ultimately bring a positive impact on the river basin ecosystem, thus it can be continuously utilized properly.
Key Words: ecosystem, drainage basin, awareness, river basin utilization.

Introduction. The Maros River basin has an area of 115,348.81 ha and was designated by the Government in 1987 as one of the Jeneberang Watershed areas in South Sulawesi. The Maros river basin requires good and sustainable management because it has a large enough potential both economically and ecologically. At the same time, this great potential has serious environmental problems that require separate management by the government by involving the community as the main actor in order to make it to prosper and to maintain environmental sustainability in the Maros sub-river basin (Jeneberang-Walanae Watershed Management Agency 2017). The Maros River basin consists of 3 areas including the Tanralili, Tabo-Tabo, and Maros sub-river basin. The research site was in the Maros sub-river basin with an area of 66.335,85 ha, which is a water catchment area from the Maros River which crosses the Maros City and the Lekopancing River which is the source of water for the PDAM (Indonesian regional water utility company) of Makassar City and the Maros Regency. The Maros River basin is located in the Maros Regency, with a length of about 30 km, it has great potential but has not been optimally utilized. The great potential in the Maros River basin is in the field of agriculture, water resources, transportation and tourism. However, both the government and the community have not maximized the existing potential, thus it has not made a major contribution to the government and the community itself, especially in terms of improving the welfare of the community in the Maros River basin (Jeneberang-Walanae Watershed Management Agency 2017).

The upstream Maros River basin in Tompobulu subdistrict has experienced environmental degradation, particularly deforestation, a fairly high rate of erosion as well as logging which is mostly done by the local communities. Another damage is also caused by the forest conversion to plantation areas (Maros Regency Forestry Department 2015). The data of Maros District Forestry Department in 2015 indicated that the level of forest degradation and decrease in the upstream Maros River basin is estimated at around 7,936.76 ha, where the annual average rate of forest degradation and critical land is around 372.94 ha year^{-1}. If this situation continues, it is estimated that in the next 15-20 years, the forests in the upstream Maros River basin will be gone. This damage has a direct result in decreasing water discharge and has had a negative impact on the surrounding communities, particularly on meeting water needs in agricultural areas and community drinking water sources.

Deforestation in the upstream Maros river basin generally occurs due to the conversion of forests into plantations and rice fields. The conversion of forest land is inseparable from the pressures on economic needs and the need for clothing and boards, such as harvesting firewood to build house, forest conversion into rice fields and plantation area, and collecting firewood for fuel. These community activities have resulted in increased forest degradation and an increase in critical land resulted in decreasing water discharge in the Maros River basin. Based on this fact, it can be assumed that the damage on upstream Maros River basin was mostly caused by lacking environmental awareness of the communities, thus bad community behavior towards the environment have negative consequences and damage nature and do not pay attention to sustainability aspects. The tendency of community behavior is closely related to the level of community understanding which is still very limited about the river basin environment as a connective integrated ecosystem by understanding the river basin as conservation and protection area, as well as understanding the river basin damage due to pollution (Dirawan & 2010). In this paper, we will report on the results of our study on the correlation between community awareness and behavior in analysis of Maros River basin ecosystems as one of the basic studies that can be used as a reference for the government in making policies so that natural damage can be reduced, thus the function of the drainage as a fishing area, downstream water supply, and other forest protection functions can be maintained.

Material and Method. This research took place from April to September 2018 which was a survey research with a quantitative approach. At this stage, studies and analyzes were carried out on the influence of community knowledge on the river basin ecosystem, river basin conservation, and river basin pollution on community behavior in utilizing natural resources and the environment in the upstream river basin area. The sampling technique used in this study was a proportional sampling method with a total sample size of 200 heads of families, proportionally drawn in 6 rural areas in the upstream sub-river basin area in Tompobulu District, Maros Regency. Samples were grouped (stratified random sampling) based on education with almost the same number of percentages. In this study, all variables are considered homogeneous where all independent variables have a direct correlation to the dependent variable (Figure 1).

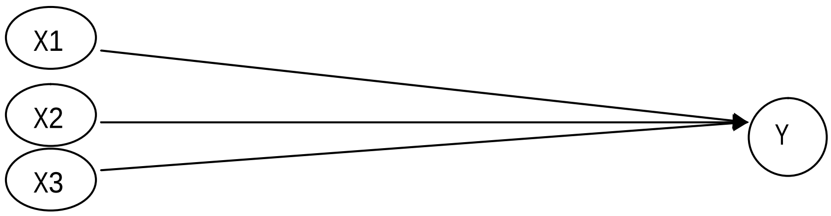

Figure 1. Correlation between variables (Y = community behavior with environmental awareness; X1 = knowledge of the river basin ecosystem; X2 = knowledge of river basin conservation; X3 = knowledge of river basin pollution).

Data analysis method. The analysis technique used in this study is the Structural Equation Model (SEM) Analysis which is operated through the AMOS 4.01 program (Figure 2).

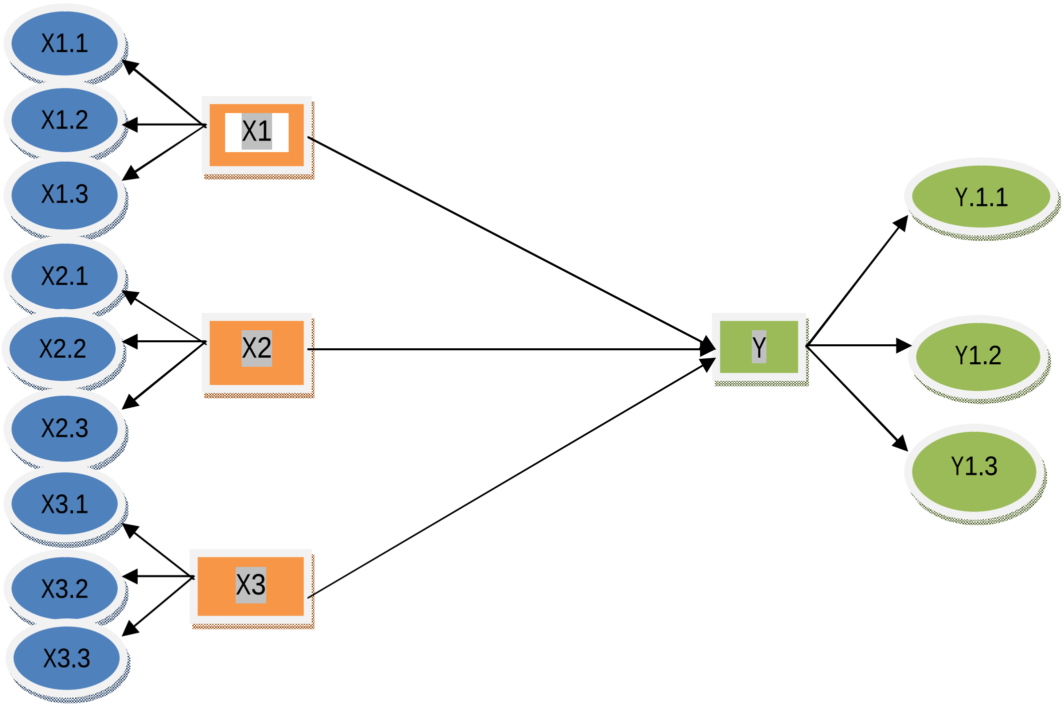

Figure 2. Correlation between variables (X1 = ecosystem knowledge; X1.1 = concept; X1.2 = fact; X1.3 = category; X2 = conservation knowledge; X2.1 = concept; X2.2 = fact; X2.3 = category; X3 = pollution knowledge; X3.1 = concept; X3.2 = fact; X3.3 = category; Y = environamentally friendly behavior; Y1.1 = cognitive; Y2.2 = afective; Y3.3 = conative).

Results and Discussion

Descriptive analysis. Descriptive analysis is aimed to describe study variables through the interpretation of the frequency distribution of whole respondent answers, both in the number of respondents (people) and mean value of the question items on the variable ecosystem knowledge (X1), conservation knowledge (X2), knowledge of pollution (X3), and environmentally friendly behavior (Y) calculated based on the cumulative questions (Table 1).

Table 1

Frequency distribution of the dependent and independent variables

Type of distribution	*Ecosystem knowledge*	*Conservation knowledge*	*Knowledge of pollution*	*Environmentally friendly behavior*
N = valid	200	200	200	200
Missing	0	0	0	0
Mean	7.81	7.2850	7.56	109.225
Standard deviation	2.69448	2.3005	2.59036	8.23062
Minimum	3.00	4.00	4.00	97.00
Maximum	13.00	12.00	13.00	131.00

Based on the results in Table 1, it can be explained that the cumulative average knowledge of the drainage basin ecosystem (X1) is 7.81 with a cumulative minimum value for answers to questions of 3.00 and a maximum value of 13.00. The cumulative average of the conservation knowledge variable (X2) is 7.2850 with a cumulative minimum value of 4.00 and a maximum cumulative value for answers to questions of 12.00. The cumulative average of drainage basin pollution knowledge (X3) is 7.56 with a minimum cumulative of 4.00 and and the maximum cumulative value of 13.00. While the cumulative average of environmentally friendly behavior (Y) is 109.225 with a cumulative minimum value of 97.00 and a maximum cumulative answer to questions of 131.00. Based on the results of goodness of fit (GOF) measures, namely Chi Square, Normed Chi Square, RMSEA, GFI , AGFI, CFI, NFI, IFI and RFI (Santoso 2016), it can be concluded that the model in this study is included in the good fit model (Table 2).

Table 2

Summary of the goodness of fit index (GOF) study results

Fit index	*Recommended value*	*Value*
p-value	*p-value* > 0.05	0.220
RMSEA	≤ 0.08	0.026
NFI	≥ 0.90	0.921
CFI	≥ 0.90	0.990
IFI	≥ 0.90	0.990
RFI	≥ 0.90	0.988
GFI	≥ 0.90	0.951
AGFI	≥ 0.90	0.920

Based on Table 2, the results of the GOF overall test show that all the criteria indicate a very good model.

Statistical inference analysis

Structural model analysist. Assessment of the direct effect hypothesis was carried out by testing the critical ratio (CR) on each direct effect partially. Should the CR value > 1.96 or p value < 0.05, it is concluded that there is a significant effect, on the contrary, if the CR value < 1.96 or the p value > 0.05, it is concluded that there is no effect.

Based on Tables 3 and 4, it can be said that the value of CR for ecosystem knowledge is -0.462 so that ecosystem knowledge has no significant effect on community behavior. Meanwhile, the values of CR for conservation knowledge and pollution knowledge are 3.568 and 4.918 respectively, so that knowledge of conservation and knowledge of pollution have a significant effect on community behavior.

Table 3

Regression Weights: (Group number 1 - Default model)

Correlation of direct influence	*Estimation*	*S.E.*	*C.R.*	*P*	*Lable*
BEHAVIOR ← ECO KNOW	-0.075	0.161	-0.462	0.644	par_7
BEHAVIOR ← CON KNOW	0.258	0.072	3.568	***	par_8
BEHAVIOR ← POLL KNOW	0.262	0.053	4.918	***	par_9

*** value of p < 0.05 shows a significant effect.

Table 4

Standardized Regression Weights: (Group number 1 - Default model)

Correlation of direct influence			*Estimation*
BAHAVIOR	←	ECOSYSTEM KNOWLEDGE	-0.041
BEHAVIOR	←	CONSERVATION KNOWLEDGE	0.779
BEHAVIOR	←	POLLUTION KNOWLEDGE	0.141

From the Tables 3 and 4 it can be assumed that the level of knowledge of river basin conservation (X2) and knowledge of river basin pollution (X3) have a direct and significant effect ($p < 0.05$) on environmentally friendly behavior (Y). Meanwhile, knowledge of river basin ecosystems (X1) does not have a direct influence on environmentally friendly behavior (Y). This is indicated by a significance value of p - value > 0.05. The same result was also stated by Dirawan & Pertiwi (2010) that most people in the river basin have insufficient knowledge and understanding of the function of the river basin as an integrated ecosystem. The upstream and downstream areas have an inseparable linkage, thus the managing and handling of said areas must be carried out in an integrated and comprehensive manner through an ecosystem approach. Therefore, knowledge of the concept of river basin ecosystems is very important to be carried out and improved, thus the community can be directly involved in managing the river basin in a sustainable manner.

Direct correlation among variables. The correlation between exogenous variables and endogenous variables illustrates the value of the direct effect between variables. A direct correlation occurs when there are no intermediate variables. The direct correlation between variables can be explained as follows:

1) The influence of river basin ecosystem knowledge on environmentally friendly behavior of the community: based on the results of data analysis, it shows that knowledge of river basin ecosystems has not positive and siqnificant effect on community environmental awareness with $\alpha = 5\%$ ($p = 0.644$) with a coefficient of -0.075. This value shows that there is little influence on the environmentally friendly behavior of the community towards the river basin ecosystem in terms of utilizing, maintaining and managing the upstream Maros River basin area. Community behavior in managing the environment in agricultural areas still needs to be improved, especially with regard to understanding of agricultural ecosystems. Furthermore, Mulyadi (2010) added that farmers' understanding of the concept of ecosystems is still lacking, thus the positive attitude generated in managing the environment is also lacking by not giving enough consideration to environmental aspects and the long-term consequences that can be caused.

2) The influence of river basin conservation knowledge on environmentally frienly behavior of the community: the results of data processing show that conservation knowledge has a positive and significant effect on environmental awareness behavior in the community with $\alpha = 5\%$ ($p = 0.000$) with a coefficient of 0.258. This shows that the higher the community's knowledge on conservation, the higher the community's environmental friendly behavior. According to Garnadi (2004), people around the forest understand that forest damage in sloping areas can cause erosion and landslides, which in turn will lead to silting of rivers. Therefore, knowledge and conservation activities need to be carried out so that forest damage does not occur in forest areas that have a high level of steepness.

3) The influence of river basin pollution knowledge on environmentally friendly behavior in the community: the results of data analysis show that pollution knowledge has a positive and significant influence on environmental-minded behavior with $\alpha = 5\%$ ($p = 0.000$) with a coefficient of 0.262. This shows that the higher the knowledge of community toward pollution, the higher the community's environmentally friendly behavior in utilizing, maintaining and managing the river basin area. Agussalim et al (2014) describes the relevant results for coastal communities in the city of Pare-pare, South Sulawesi who have understood the impact of marine pollution on their area and livelihoods, thus these coastal communities carry out their activities with full consideration on environmental aspects and protecting the environment from all forms or activities that can have a negative impact on it.

The correlation effect among variables and indicators. There are 2 variables, namely exogenous variables and endogenous variables. Exogenous variables consist of variables of river basin ecosystems knowledge (X1), river basin conservation knowledge (X2), river basin pollution knowledge (X3). Meanwhile, endogenous variables consist of environmentally friendly behavior in the upstream Maros river basin area. Every exogenous variable and endogenous variable has indicators that will affect every exogenous variable and endogenous variable.

Exogenous variables and indicators

Ecosystem knowledge. Based on the results of the linear regression analysis listed in Table 5, it can be seen that the concept indicator (X1.1) has an influence on each ecosystem knowledge variable with a value of 0.845, while the fact indicator (X1.2) has a value of 0.724, and finally the category indicator (X1.3) with a value of 0.703. Therefore, it can be said that the factor that dominates people's ecosystem knowledge is the knowledge of ecosystem concept indicators. River basin must be managed with a holistic and integrated ecosystem approach (Effendi 2008). The ecosystem approach includes the community's understanding that the river basin from upstream to downstream is a unit that cannot stand alone and the parts are interrelated with one another.

Table 5

Correlation between variables and indicators

No	*Variable*	*Indicator*	*Estimation*	*Dominant*
1	Ecosystem knowledge	a. Concept;	0.845	Ecosystem;
		b. Fact;	0.724	Concept.
		c. Category.	0.703	
2	Conservation knowledge	a. Concept;	0.716	Conservation;
		b. Fact;	0.917	Fact.
		c. Category.	0.752	
3	Pollution knowledge	b. Concept;	0.795	Pollution;
		c. Fact;	0.851	Category.
		d. Category.	0.862	
4	Environmentally friendly behavior	a. Utilizing;	0.767	Environmental
		b. Managing;	0.864	management
		c. Maintaining.	0.721	activities.

Source: Data analysis results, 2018.

River basin conservation knowledge. Based on the results of linear regression analysis, it can be seen that the indicators influencing the conservation knowledge variable are concept indicators (X2.1) with a value of 0.716, followed by fact indicators (X2.2) with a value of 0.917, and finally category indicators (X3.3) with a value of 0.752 (Table 5). In accordance with this, it can be said that what has an influence on river basin conservation indicators is conservation fact indicators. Similar to the statement of Asdak (2007) that the river basin area can be good and sustainable if the upstream area is avoided from harmful activities such as illegal logging but is encouraged to become a plantation area. Apart from that, it is also necessary to carry out rehabilitation and reforestation activities on critical land to prevent natural disasters such as landslides and erosion. The community will find it easier to understand the importance of protecting river basins if they see the reality directly that conservation activities will have a direct impact on the lives of the community itself, especially on the availability of river water throughout the year as a community's basic need for farming as well as for consumption and other household needs.

River basin pollution knowledge. Based on the results of linear regression analysis, it is known that the indicator that has an influence on pollution knowledge variable is the concept indicator (X3.1) with a value of 0.795, then followed by the fact indicator (X3.2) with a value of 0.851, and finally the indicator category (X3.3) with a value of 0.862 (Table 5). In accordance with this, it can be said that the indicator which dominates the knowledge variable of river basin pollution is a category indicator. In general, rivers in Indonesia have been polluted, so there is a need for treatment and control by the

Government and the community (Harihanto 2010). River water pollution, especially in areas along the river, occurs as there is a community habit of throwing garbage into the river. Waste disposal activities, especially in the category of plastic waste and household waste, are found in rivers which cause river pollution and have a direct impact on the community, especially in agricultural areas and community consumption and other household needs.

Endogenous variables with indicators

Environmentally friendly behavior in upstream river basin areas. Based on the results of linear regression analysis, it can be said that the indicators that have an influence on environmentally friendly behavior in the upstream river basin area are utilization indicators (Y1.1) with a value of 0.767, then the control indicators (Y2.1) with a value of 0.864, and finally maintenance indicator (Y3.3) with a value of 0.721. Therefore, it can be said that the one that dominates the environmentally friendly behavior variable is an indicator of environmental control.

Conclusions. Based on the results previously described, it can be concluded that river basin conservation knowledge and river basin pollution knowledge have a direct influence with a positive correlation to environmentally friendly behavior on environmental management in the upstream river basin area. Meanwhile, ecosystem knowledge does not have a positive influence and correlation to the environmentally friendly behavior of the community in the Maros upstream river basin. Ecosystem knowledge that most influences environmental-friendly behavior is an understanding of the ecosystem concept. Meanwhile, the level of community knowledge about conservation has a high effect on conservation.

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