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Analysis Of Policy Priority In Conservation Of Water Resources On Various Types Of Land Uses (*Case Of Flood Prevention Models In Kendari City*)

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ABSTRACT: *The area of Kendari City with landforms dominated by plains causes potential for flooding and inundation. In the soil and water conservation efforts program in an area, the problem of flooding related to the level of danger is one of the very important aspects to be taken into account. Need to study priorities and alternatives for conserving water resources in order to reduce the level of flood hazard in Kendari City. The purpose of this study is to determine the strategy of conserving water resources as an alternative to flood prevention in Kendari City. The strategy of conserving water resources in flood prevention is determined by the process hierarchy analysis (AHP) method. The results of research show that the priority of water resources conservation policies in order to prevent flooding in various types of land use namely: (i) reforestation methods can be applied to the types of land use of forests, campun gardens, and mangrove forests; (ii) the green open space method is applied to the alang-alang land types, settlements, shrubs; (iii) pond land; (iv) the biopore method is applied to uplands or fields and government offices. The main actor in the application of conservation of water*

KEYWORDS: *Conservation, Flood, Reforestation, Water Resources*

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I. INTRODUCTION

City growth is closely related to land use change, which is generally dominated by land built up. As a result, increased surface runoff volume and low infiltration quantity. In an uncontrolled situation, this condition as a source of flooding in rainy season and drought in dry season. The impact of these flooding events can cause economic and social value lossesin an area. Kousky dan Walls (2014); Eriega, (2014); Chen *et al.* (2015), Svetlana *et al.* (2015) and Alwi *et al* (2016a), stated that flood events was the most responsible disasters for economic losses and social problems such as casualties and various property damage.

Kendari City is one of the cities that still has problems related to puddles and floods.. Kendari landforms area was dominated by plain could potentially cause for flooding puddle becomes large. Based on historical data within the last 10 (ten) years, Kendari City has been a area where floods occur almost every year. According to Gandri, *et al*. (2019), the results of an analysis of flood hazard levels based on the MAFF-Japan model showed that Kendari City was dominated by floodingpotential areas at 52.43%, vulnerable areas at 13.62%, while safe areas at 33.95%.

As a developing city, the conversion of land into a built upland has occurred on a massive scale for infrastructure development such as road construction, Pertamina, hospitals, residential, hotel and shop houses. These conditions, causing land needs to continue to increase which affects the water catchment area decreases. This is in accordance with the opinion of Eriega, (2014); Iswandi *et al.* (2015) and Alwi *et al* (2016b); Reinhart and Rifani (2019 and Wicaksono *et al*. (2019), which states that an increase in the construction of socio-economic facilities and infrastructure is very potential for flooding due to infiltration areas that are covered by the buildings and infrastructures.

In the soil and water conservation program, the problem of flooding related to the hazard level is one of the very important aspects to be taken for (Satriawan, 2010 and Svetlana *et al.* (2015). It is necessary to assessment the priorities and alternatives for conserving water resources in order to reduce the level of flood hazard in Kendari City. Reducing the volume of surface runoff with vegetative conservation is seen as more appropriate because it also increases oxygen and soil fertility. Mechanical conservation in the form of land surface slope regulation is expected to increase the effectiveness of controlling surface erosion rates and

supporting slope stability conditioning. Surface runoff and meterial results of surface erosion and landslides must be anticipated by efforts to make civil buildings as controllers. The combination of vegetative, mechanical and constructive conservation is generally very effective in controlling floods (Kustamar, 2013; Saiff, 2011; and Brooks 2003). The purpose of this study is to determine the water resources conservation model as an alternative to flood prevention in Kendari City.

II. METHOD

2.1. The Concept of Water Resources Conservationin Order to Prevent Flooding

The conservation strategy of water resourcesin order to prevent flooding can be determined by breaking down important issues into important components, then organizing these components into a hierarchy. To support an effort to conserve water resources, it is necessary to identify the factors that cause floods so that a program of action to conserve water resources that is effective in reducing and preventing flooding can be formulated.

Land use is a important factors in flood event, so based on these factors, it can be easy to determine important actors and their role in carrying out water resources conservation program actions to reduce and preventing flood. This is in accordance with the opinion of Umar et al. (2019); In Palma et al. (2016); Rejani et al. (2016); and Olang et al. (2011) that land use form and slope characteristics are the main parameters that need to be considered in flood control planning in that area. This analysis resultsare also supported by research conducted by Purnama (2013) where based on the results of dynamic model behavioral simulations, concluding that by reducing the rate of conversion of land to settlements, will be able to sustain a reduction in groundwater recharge and reduce the rate of reduction in the amount of stored groundwater significantly. Likewise also with the opinion of Subarna (2015), from the hydrological point, the quality of land cover is very influential on the ratio between the maximum and minimum discharge of a watershed. The worse the quality of land cover, the greater this ratio will be. Thus, the hierarchy that has been formed can be built in a conceptual analysis of the process hierarchy in order to produce a water resource conservation model for reducing and preventing flooding in Kendari.

2.2. Analytical Hierarchy Process to Determine Alternative Water Resources Conservation Model to Prevent Flooding

The structure of the research hierarchy focuses on land use and slopes parameters based on the availability of alternative conservation both vegetatively and technically. Figure 1 shows a hierarchical tree model of conserving water resources in Kendari City

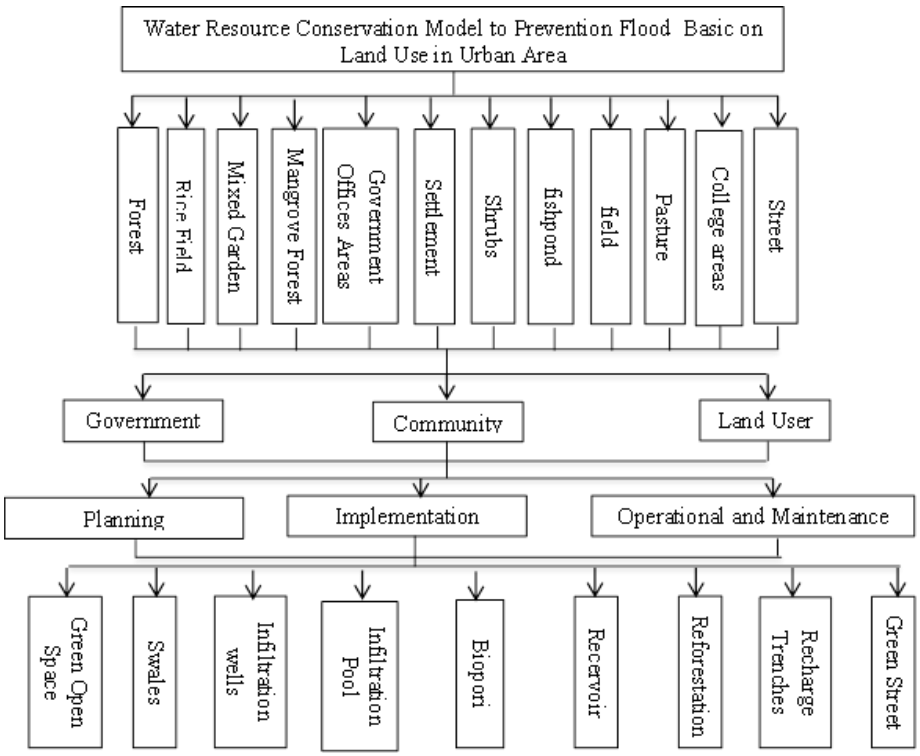


Figure 1. Hierarchy Trees Water Resources Conservation Model in Kendari City

At the weighting stage, this study used seven experts from competent academics as well as from related agencies, namely the Kendari City Public Works Department, Department of Agriculture and Forestry Office on Kendari City, Watershed Management Agency and Sulawesi River Region IV

III. RESULTS AND DISCUSSIONS

3.1 General Condition of Research Area

The topography of Kendari basically varies between flat and hilly. Flat areas are in the western and southern parts of Kendari Bay. Kendari District, located in the north of the bay, consists mostly of hills (Nipa-Nipa Mountains) with a height of ± 459 M above sea level. Southeast Sulawesi Province Central Bureau of Statistics (2019)

According to data from the Central Bureau of Statistics of Southeast Sulawesi Province (2019) that is the land use of Kendari City in 2013 was classified into 14 land use classes. The forest is the largest, which is 10,369 ha or 38.57% of the total area of Kendari City. The land that was used as a settlement was 4,856 ha (18.06%). In addition, mixed gardens are still dominant in Kendari City covering an area of 4,777 ha (17.77%). Other land uses such as scrubs covering 2,035 ha (7.57%), field covering 1,935 ha (7.2%), pasture covering 751 ha (2.79%), paddy fields covering 532 ha (1.98%), grassland of 473 ha (1.76%), fishpond area of 394 ha (1.47%), mangrove forest area of 142 ha (0.53%), college area 86 ha (0.31%), and the government offices area 29 ha (0.1%). Classification of Land Use in Kendari City in 2013 can be seen in table 1 below.

Table 1. Classification of Land Use in Kendari City in 2019

No	Land Use	Land Area	
		ha	%
1	Forest	10.369	38,57
2	Settlement	4.856	18,06
3	Mixed Garden	4.777	17,77
4	Semak belukar	2.035	7,57
5	Field	1.935	7,2
6	Pasture	751	2,79
7	Paddy Field	532	1,98
8	Grassland	473	1,76
9	Fishpond	394	1,47
10	Mangrove Forest	142	0,53
11	College Area	86	0,31
12	Government Offices Area	29	0,1

Source: Central Bureau of Statistics of Southeast Sulawesi Province (2019)

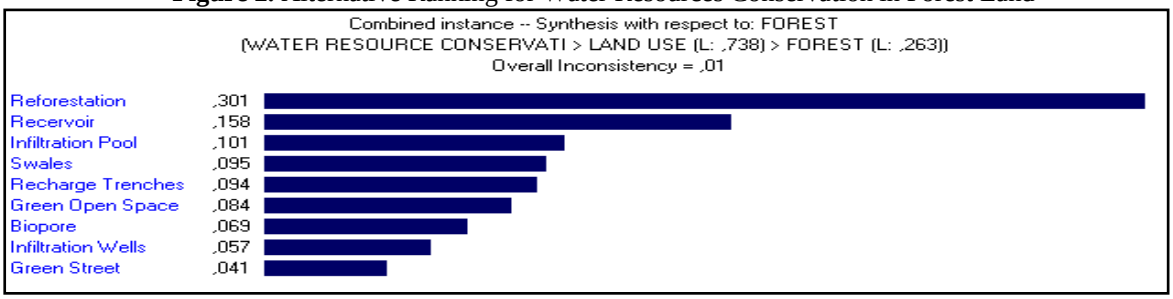
3.2 The Priority Criteria in Water Resources Conservation for Flood Prevention Based on Land Use

AHP analysis results for the conservation of water resources in the context of flood prevention based on land use criteria with 12 parameters can be seen that the weight of forest land use is more priority, 26.3%, followed by settlements (15.8%), mixed gardens (12.2%), Street (8.6%), fields (6.9%), scurb (6.3%), pasture (5.1%), rice fields (4.0%) , ponds (3.9%), Government Offices Area (3.7%), College Area (3.6%), and mangrove forest (3.4%).

a. Forest Land

Based on the results of AHP analysis, alternative water resources conservation of flood prevention is obtained by reforestation, where this alternative has a weight of 30.1% and the creation of reservoirs with a weight of 15.8%. Reforestation and embungs are priority aspects in land use as a flood prevention effort in Kendari City because reforestation with tree roots will be protected by soil and retain water, as well as reservoirs can hold rainwater so as to reduce the potential for flooding. This is in accordance with the statement of Mahmud et al. (2019); Cai et al. (2012) and Demsey et a.l (2017), states that reforestation is a natural way to deal with floods with a plant system that has strong roots that can effectively withstand flood disasters, likewise the reservoir system can hold rain water so as to reduce the potential for flooding. The ranking of Alternative Water Resources Conservation in Forest Land can be seen in Figure 2.

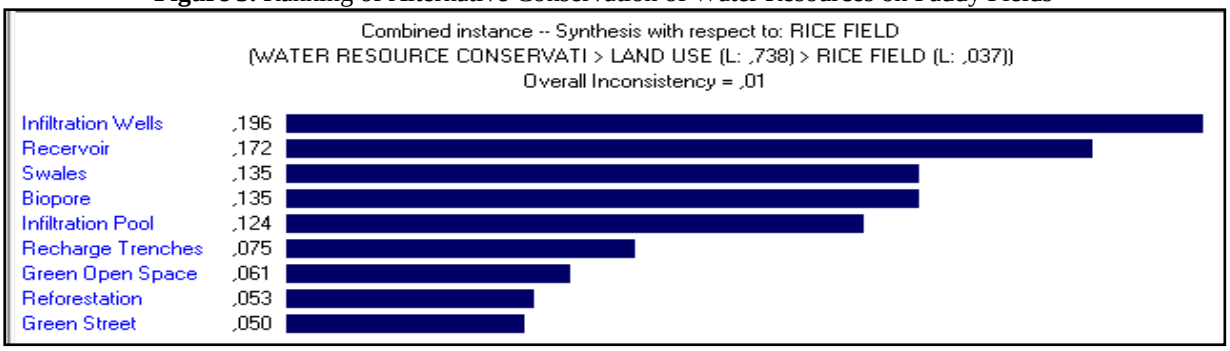
Figure 2. Alternative Ranking for Water Resources Conservation in Forest Land



b. Paddy Fields Land

Cultivation of paddy fields can cause a thin waterproof layer at the bottom of the paddy fields, thereby reducing water infiltration into the ground (Fakhrudin and Daruati, 2017). The most priority alternative for water resources conservation to be applied on paddy fields as a flood prevention effort is to make infiltration wells with weighing 19.6% and create a recervoir that weigh 17.2%. Support this statement, Suprapto et al. (2006), states that in order to overcome the scarcity of water for plants on paddy fields, farming technique wells can be carried out that can hold rainwater. Likewise, research conducted by Fitri and Ulfa (2015); Indrihastuti et. al. (2016), concluded that the application of zero run off in areas that dominated by settlements and rainfed paddy fields was effective by applying Infiltration Wells. Ranking of Alternative Conservation of Water Resources on Rice Fields can be seen in Figure 3.

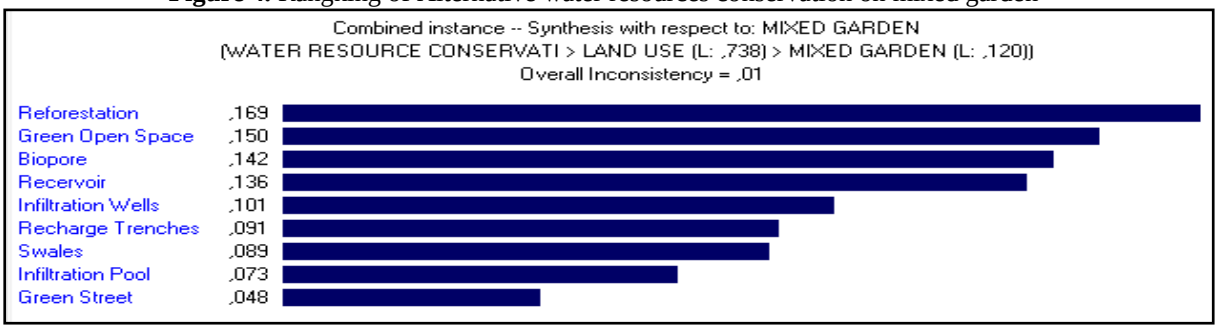
Figure 3. Ranking of Alternative Conservation of Water Resources on Paddy Fields



c. Mixed Garden Land

The most priority alternative conservation of water resources to be applied to mixed garden land use as a flood prevention effort is to reforestation with a weight of 16,9% and green open space with a weight of 15,0%. Supported by research of Ruslan (2013); Walangitan (2014): Kogoya (2018) that mixed gardens need to be rehabilitated through enrichment of superior plants and strengthening agroforestry patterns.Rangking of Alternative water resources conservation in mixed garden can be seen in Figure 4.

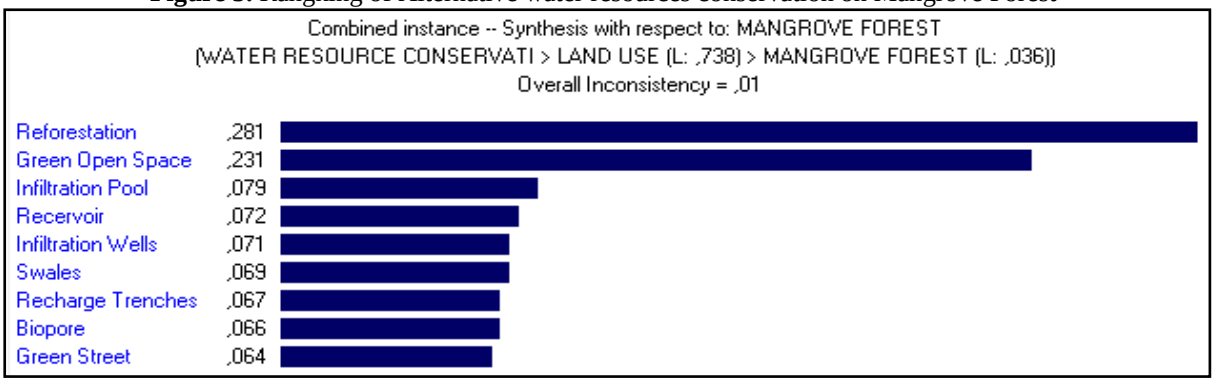
Figure 4. Rangking of Alternative water resources conservation on mixed garden



d. Mangrove Forest Land

Mangrove ecosystems can reduce the risk of flooding by providing ecosystem services so that people's vulnerability to flood hazards can be reduced (Karanja and Saito (2017); Losada, et. Al. (2018)). Therefore, mangrove forest conservation needs to strived for to restore its function.The most priority alternative for water resources conservation to be applied to mangrove forest land use in the context of flood prevention is by reforestation efforts that have a weight of 28.1% and the determination of the area as a green open space with a weight of 23.1%. Rangking of Alternative water resources conservation on Mangrove Forest can be seen in Figure 5.

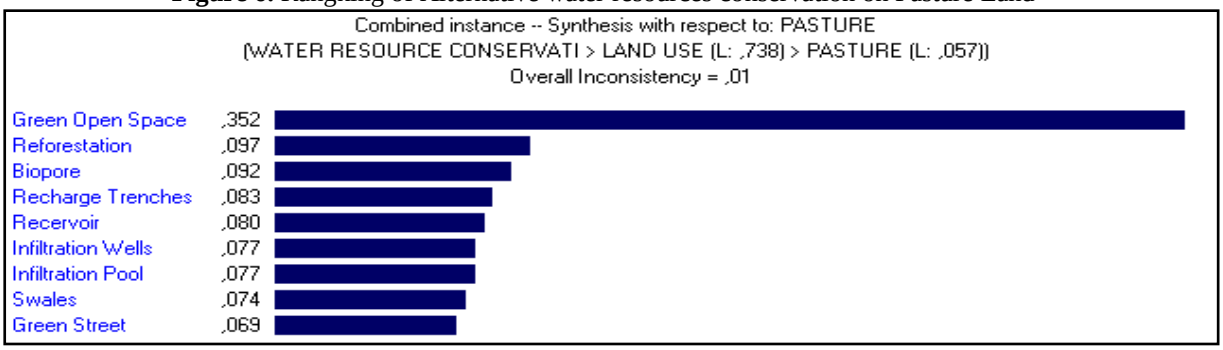
Figure 5. Rangking of Alternative water resources conservation on Mangrove Forest



e. Pasture Land/Grassland

The most priority alternative conservation of water resources to be applied to the use of land for grassland / alang-alang as a flood prevention effort is by strengthening the Green Open Space which has a weight of 35.2% and by reforestation with a weight of 9.7%. This is supported by the statement of Ruslan and Rosdiana (2013) that pasture lands / Grassland need to enrichment of vegetation and convert the land into the forest again. Rangking of Alternative water resources conservation on Pasture Land/Grassland can be seen in Figure 6.

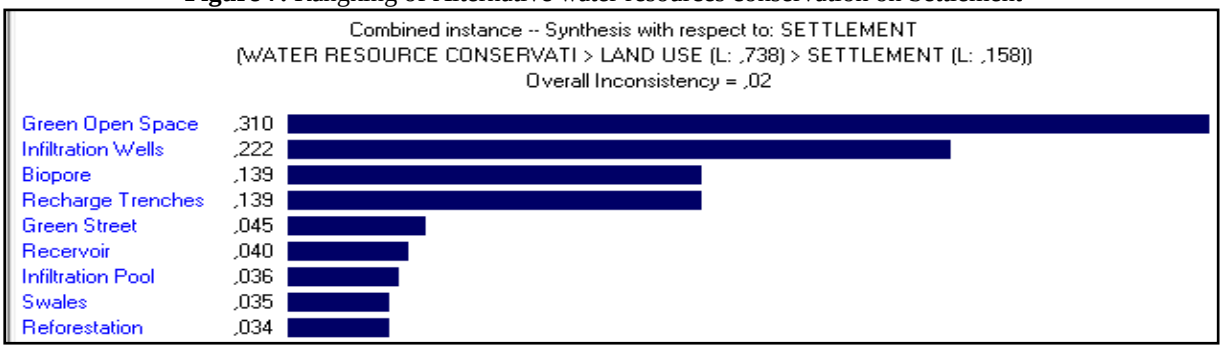
Figure 6. Rangking of Alternative water resources conservation on Pasture Land



e. Settlement Land

The most priority alternative conservation of water resources to be applied to settlement as a flood prevention effort is to Strengthen Green Open Space which has a weight of 31.0%, Infiltration Wells with a weight of 22.2%, and can be done by making biopori infiltration holes that have weight of 13.9%. According to Samsudi (2010); Setyati (2015), that urban areas are centers of settlements that are always followed by centers of urbanization, it is important for space and land planning to provide adequate green open space, so that the development of the built up space can go in harmony and balance. supported by the statement of Leurenco et al. (2020) that the lack of open space in urban areas can exacerbate one of the main problems faced by cities today which is the risk of flooding.Rangking of Alternative water resources conservation on Settlement Land can be seen in Figure 7.

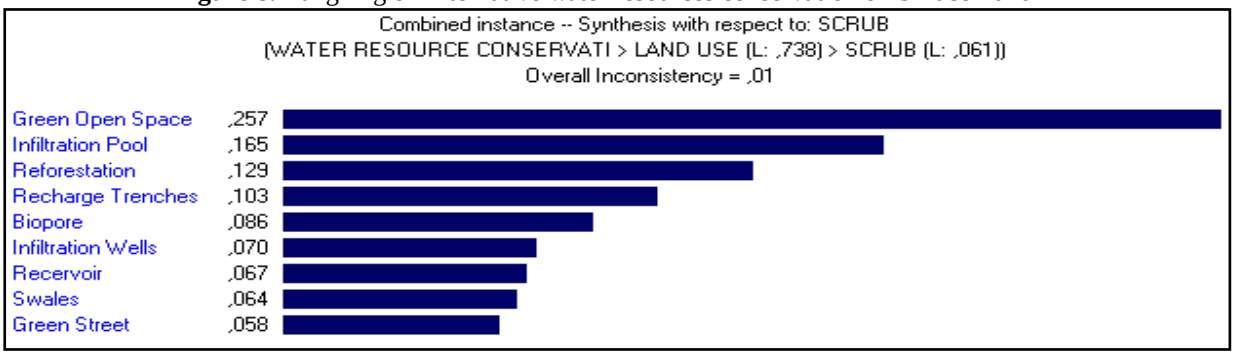
Figure 7. Rangking of Alternative water resources conservation on Settlement



f. Shrubs Land

The most priority alternative water conservation to be applied to the use of shrubs land as a flood prevention effort is the Strengthening of Green Open Space with a weight of 25.7% and with the Infiltration Pool weighing 16.5%. In addition, reforestation can be carried out with a weight of 12.9 %. This result is in accordance with the statement of Faradilla et al. (2017), that shrub land is marginal in line with a city park and quite suitable for making artificial lakes/catchment ponds. Ruslan (2013) states that on shrub land also needs reforestation with vegetation enrichment. Rangking of Alternative water resources conservation on Shrubs Land can be seen in Figure 8.

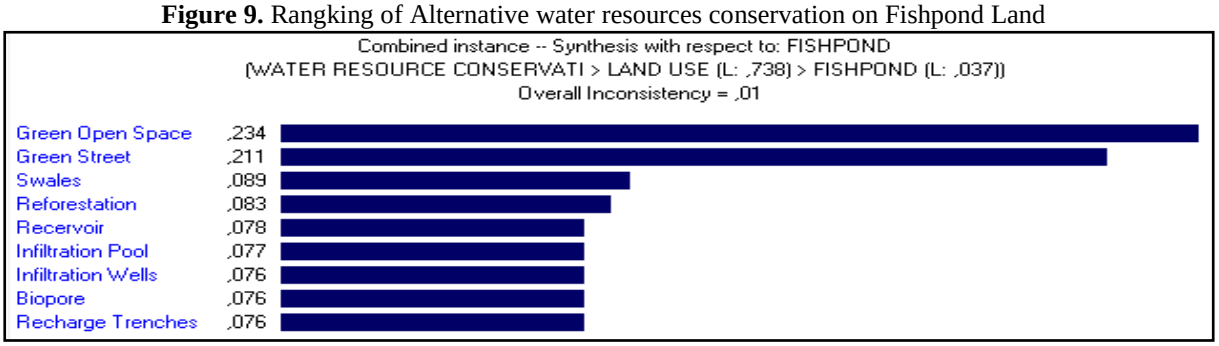
Figure 8. Rangking of Alternative water resources conservation on Shrubs Land



g. Fishpond land

The most priority alternative conservation of water resources to be applied to the use of pond land as a flood prevention effort is the RTH which has a weight of 23.4%, and Green Street with a weight of 21.1%. On the farm land can also be done by making a terrace as a support plant plants reinforcing green open space. According to Turisno (2010); Hastuti (2017), that planting mangroves in aquaculture or silvofishery can expand Green Open Space, in addition based on the results of research by Hastuti & Budihastuti (2016) that pond waters with silvofishery models significantly affect the content of TSS, organic matter, nitrogen, phosphorus and DO ponds .Rangking of Alternative water resources conservation on Fishpond Land can be seen in Figure 9.

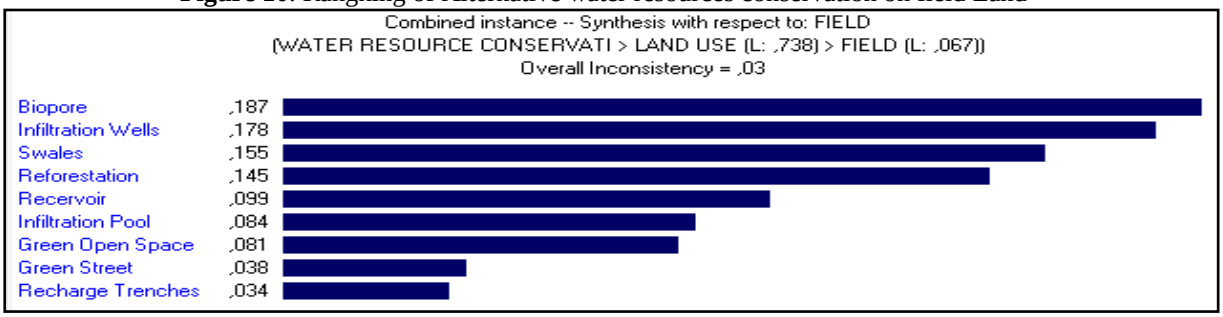
Figure 9. Rangking of Alternative water resources conservation on Fishpond Land



h. Field Land

The most priority alternative for conserving water resources to be applied to upland / field land use as a flood prevention effort is the more priority biopori infiltration hole, which is 18.7% and making infiltration wells weighs 17.8%. According to Mahrup (2020), making biopori on dry land is a very practical alternative to water management at the land level, and has a long-term effect in the form of restoring physical, chemical and biological soil fertility. Likewise, the results of Indrihastuti et al. (2016) that efforts to rehabilitate drylands with civil conservation techniques include biopore techniques and infiltration wells. Rangking of Alternative water resources conservation on Field Land can be seen in Figure 10.

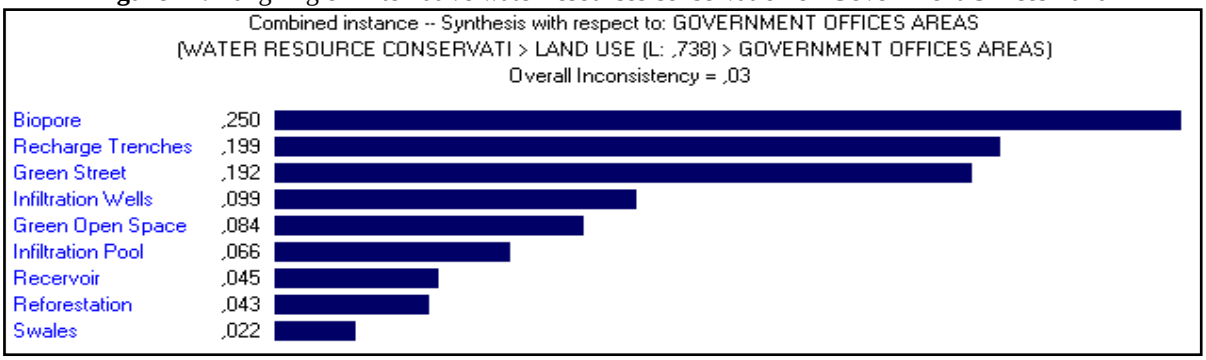
Figure 10. Rangking of Alternative water resources conservation on field Land



i. Government Offices Land

The most priority alternative for conserving water resources in the context of flood prevention is the Biopori infiltration pit where this alternative has a weight of 25.0% and the manufacture of infiltration trenches with a weight of 19.9%. Sanitya and Burhanudin (2013) in their statements recommend that for areas that have high enough building densities such as offices, making biopore infiltration holes is a most effective alternative to water conservation. Rangking of Alternative water resources conservation on Government Offices Land can be seen in Figure 11.

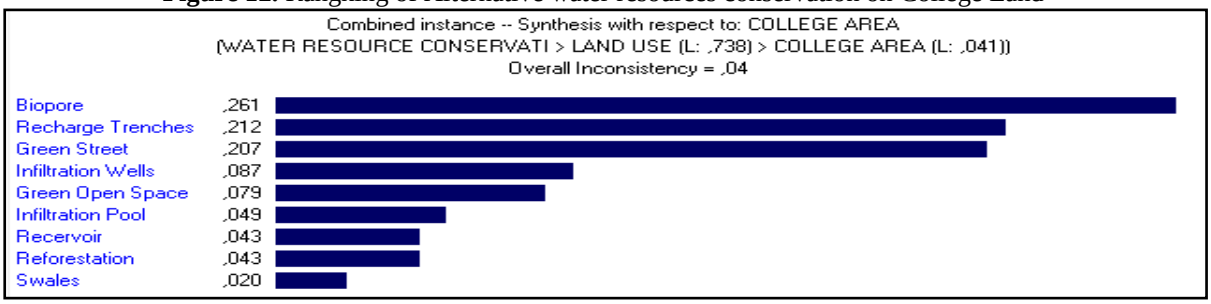
Figure 11. Rangking of Alternative water resources conservation on Government Offices Land



j. College Land

The most priority alternative for water resource conservation to be applied to college land use as a flood prevention effort is with a biopore infiltration hole which has a weight of 26.1%, an infiltration trench with a weight of 21.2%. The results of this calculation are in line with research by Wulandari (2016), that making biopori can improve hydrological recycling in the campus environment and its development aims to ensure the availability of water sources. Likewise, Ikhsan and Refiyanni's (2017) statement that to anticipate inundation flooding due to changes in land use and reduced open land in the campus area, it is necessary to increase the infiltrated rainwater through the Biopori Infiltration Hole (LRB). The ranking of Alternative water conservation resources on College Land can be seen in Figure 12.

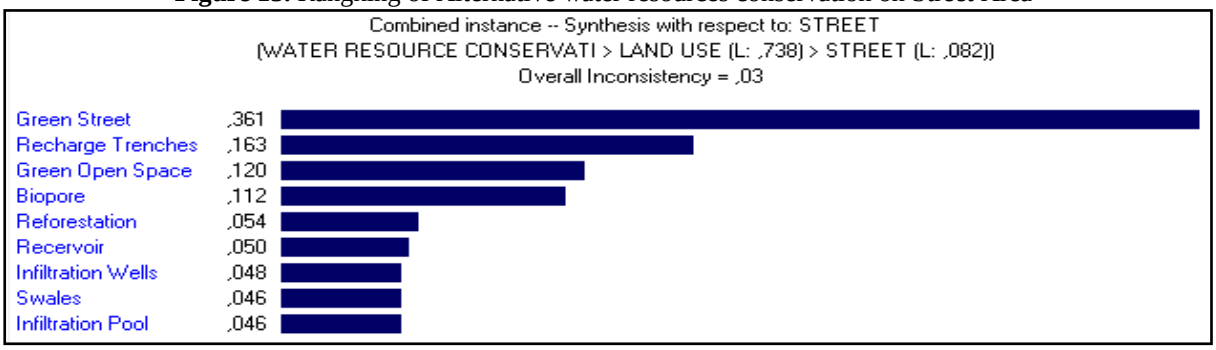
Figure 12. Rangking of Alternative water resources conservation on College Land



k. Street Area

The most priority alternative for water resource conservation to be applied to the street area as a flood prevention effort is with green street which has a weight of 36.1%, catchment trenches with a weight of 16.3%. Green streets are primarily implemented within the right-of-way and facilitate stormwater treatment along with diverse street designs providing multiple benefits such as flood management, wildlife habitat and natural pathway creation, neighborhood beautification, cost-effective solution, and more (Im, 2019). Everett (2018) added that Green Street's program policies focused on reducing flooding on the road and filtering rainwater before reaching the river. Ranking of Alternative water resources on the Street Area can be seen in Figure 13.

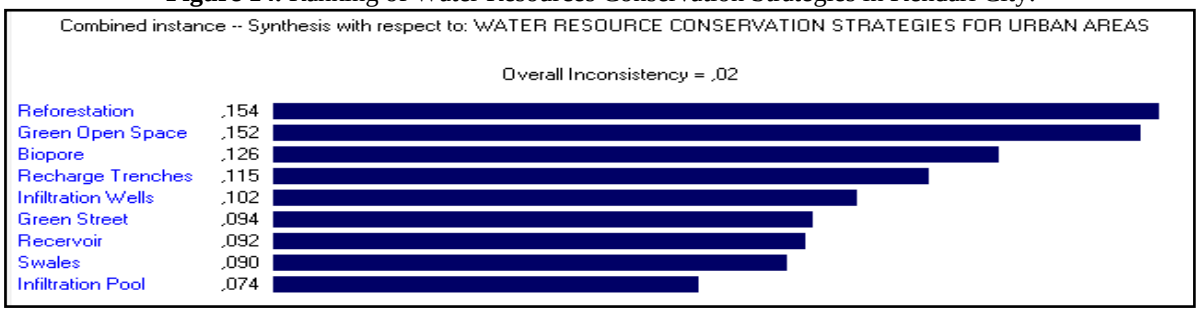
Figure 13. Rangking of Alternative water resources conservation on Street Area



3.3 Water Resources Conservation Strategy for Flood Prevention

Based on AHP analysis, the main priority in conserving water resources in the context of flood prevention in Kendari City is to reforest with a weight of 15.4% and Green Open Space with a weight of 15.2%. Ranking of Water Resources Conservation Strategies in Kendari City can be seen in Figure 14.

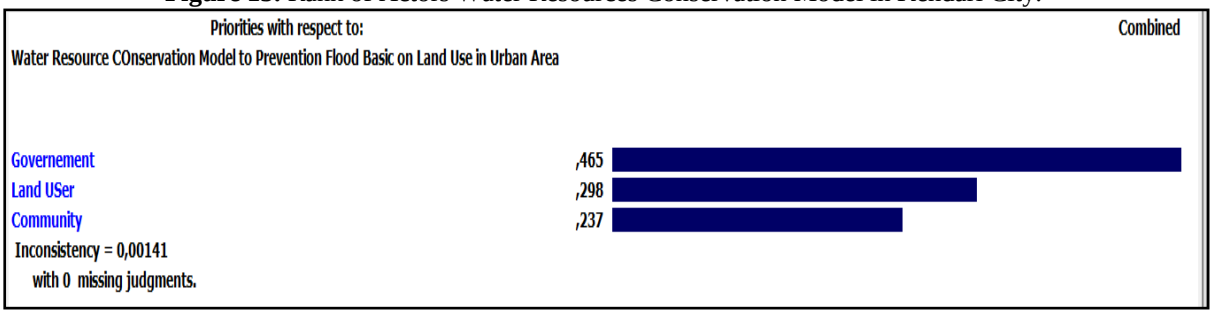
Figure 14. Ranking of Water Resources Conservation Strategies in Kendari City.



3.4 Main Actor in Flood Prevention Through of Water Resources Conservation

The most important actor in the conservation of water resources based on land use criteria is the Government with a weight of 46.5%, followed by land users with a weight of 29.8% and the Community with weight of 23.7%. The government will play an important role in the process of planning and implementing water resources conservation through policy making and budgeting in implementing conservation activities on various land uses. While the operational and maintenance stages will be very effective if the community and land users can contribute maximally to the conservation of water resources. The main actor in the conservation of water resources in flood preventing in Kendari City can be seen in the following figur 15.

Figure 15. Rank of Actors Water Resources Conservation Model in Kendari City.



IV. CONCLUSION

Based on the results of research conducted, it can be concluded that the priority of water resources conservation policies in order to prevent flooding in various types of land use namely: (i) reforestation methods can be applied to the types of land use of forests, campun gardens, and mangrove forests; (ii) the green open space method is applied to the alang-alang land types, settlements, shrubs; (iii) pond land; (iv) the biopore method is applied to uplands or fields and government offices. The main actor in the application of conservation of water resources is the government.

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