

Waterfall Exploration in Banyumas Regency Based on Ecotourism Environmental Protection (EEP) Approach for Water Conservation

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Waterfall Exploration in Banyumas Regency Based on Ecotourism Environmental Protection (EEP) Approach for Water Conservation

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Abstract. Serayu watershed, the largest watershed in Central Java Province of Indonesia, have various condition in the catchment area. Drawback of environmental services occurred in Banjarnegara, Wonosobo and Purbalingga regency due to intensive agriculture activities in the catchment area. However, suitable protected catchment area performed in Banyumas regency as part of Serayu watershed. Nature landscape and water quality (e.g., river and spring) are potential for tourism and domestic water resource. Nowadays, population growth and economical reason may threaten environmental services especially in catchment area. The research aim to identify waterfall potential as ecotourism development in Banyumas regency. Ecotourism Environmental Protection (EEP) approach already implemented in Asian mainland and appropriate tool for describing environmental protect measurement and its effect. EEP modified variables with Analytical Hierarchy Process (AHP) analysis were applied with focusing on water resource and conservation especially on waterfall ecotourism development. Identification of waterfall and survey of local communities, natural community, and government were conducted. We explore 109-waterfall in 17 districts of Banyumas regency with less than 20% manage by local or regional government. Third sector intervention (such local- or regional government and private sector) is indispensable for improving waterfall value as ecotourism attraction. In attractive waterfall destination, local people including local organisation receive economic benefit and might improve their welfare. Ecotourism of waterfall in Banyumas regency is promising strategy for water conservation in catchment area.

Keywords: catchment area, eco-tourism, environmental services, waterfall, water conservation

1. Introduction

Nowadays, services sector such tourism is growing significantly followed by economic growth, however, potential threat on ecological services cannot be ignored. Banyumas regency (Central Java province of Indonesia) with topography and water resource perform potential values on (eco-) tourism development. Drawback of ecological function due to human activities surrounding water resources protected area reported in some region [1, 2, 3]. Human motivation such economic benefit influence on environmental reduction [4]. Alteration of economic source from natural exploitation to services sector such ecotourism could be an alternative solution between environmental protection and local people welfare [5].



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Ecotourism **environmental** approach already applied **in** mainland Asia which analytical hierarchy process procedure for deciding between environmental measures and effects [6]. Correlation between measures and effect was reported, however the effectiveness showed spatial variability. Socio-economic influence on ecotourism sustainability, especially for local community or individually [7]. For example, some research reported that humans should be considered on integrated system of ecosystem development, including ecotourism [8, 9]. However, spatial variability and complexity on water resource ecotourism strategy was provided.

Deciding potential natural landscape on ecotourism strategy was reported in some protected area by Analytical Hierarchy Process (AHP). Integrated AHP and Strengths, Weakness, Opportunity and Threats (SWOT) analysis were applied in natural park [10]. AHP and spatial analysis applied for measurement and effect on ecotourism development in mainland Asia [6]. In Indonesia, AHP method was applied to evaluate ecotourism suitability [11]. Its analysis involve expertise in categories each level structure and value of pair wise interaction. We applied AHP on ecotourism environmental perspective of water resource protection. Thus, these research aim to investigated potential waterfall ecotourism in Banyumas regency and variable influence on ecotourism development for supporting water resource protection.

2. Materials and Method

2.1. Location

The research was conducted in the four sub watershed (i.e. Tajum, Logawa, Klawing, and Serayu hilir) of Serayu watershed hydrological system which located in Banyumas regency (Central Java Province, Indonesia), administratively (Figure 1). Mountainous topography dominated in the north region where around 80% waterfall identified. Regional precipitation is over 2000 mm, annually [12]. Banyumas regency consist of 27 District and we explored 109 waterfall placed in 17 District (Table 1). Mainly, the waterfall located in Baturaden District (43,1%) and 90 waterfall are unmanaged by any institution (82,6%).

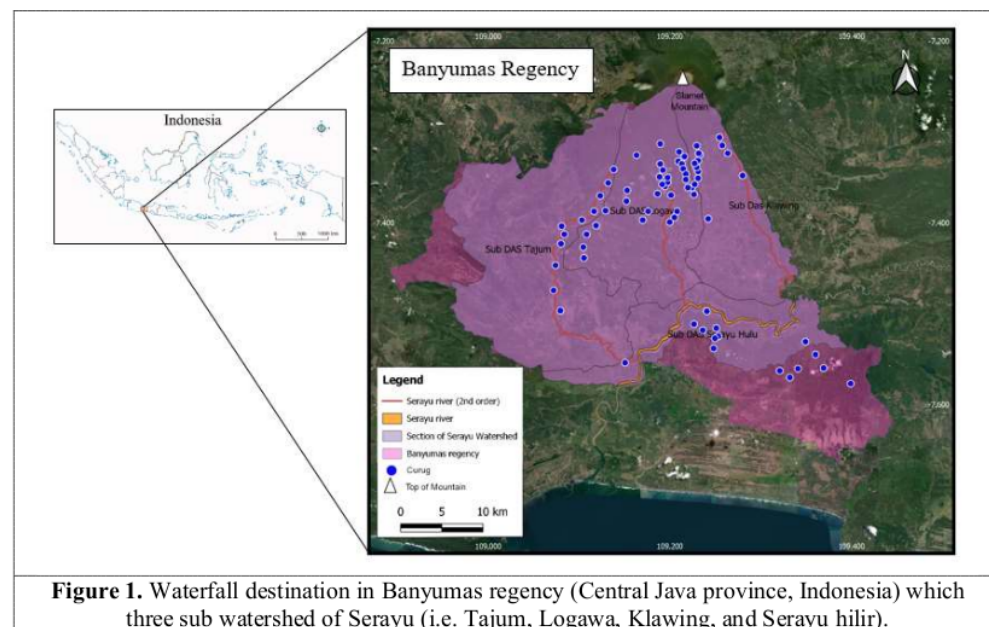


Figure 1. Waterfall destination in Banyumas regency (Central Java province, Indonesia) which three sub watershed of Serayu (i.e. Tajum, Logawa, Klawing, and Serayu hilir).

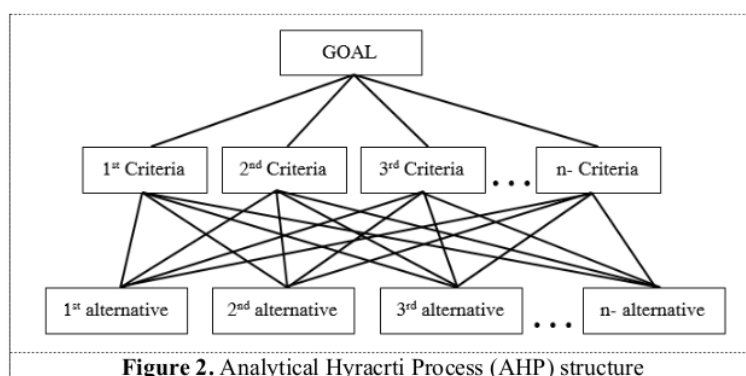
Table 1. Description of waterfall place in 17 District of Banyumas regency

No	District	Quantity	Percentage (%)	Management Responsibility			
				PM	LG	RG	NM
1	Cilongok	2	1,8	-	-	1	1
2	Karanglewas	4	3,7	-	-	-	4
3	Pekuncen	12	11,0	-	1	-	11
4	Rawalo	1	0,9	-	-	-	1
5	Lumbir	2	1,8	-	-	-	2
6	Ajibarang	1	0,9	-	-	-	1
7	Gumelar	3	2,8	-	-	-	3
8	Baturaden	47	43,1	1	6	3	37
9	Kedung banteng	10	9,2	-	2	1	7
10	Kembaran	1	0,9	-	-	-	1
11	Somagede	1	0,9	-	-	-	1
12	Sumbang	10	9,2	1	3	-	6
13	Kebasen	6	5,5	-	-	-	6
14	Sumpiuh	3	2,8	-	-	-	3
15	Tambak	2	1,8	-	-	-	2
16	Banyumas	1	0,9	-	-	-	1
17	Kemranjen	3	2,8	-	-	-	3
Total		109	100	2	12	5	90

PM= private management; LG= local government (e.g. village, civil organisation); G= government (regency); NM= no management responsibility

2.2. Data collection and analysis

Analytical Hierarchy Process (AHP) applied ecotourism development of waterfall potential in Banyumas regency. To understand waterfall potential in Banyumas regency, criteria and alternative variable decided by expert and practitioners who concern with water conservation and tourism such as researcher, ecologist, government, civil organisation, nature community (Table 2 and 3). Data collection and analysis followed Saaty's procedure (Figure 2; [13]). Based on AHP structures, we collected questioners from 55 respondents of natural community member as waterfall visitors regularly. In assessment process, each alternative scored by Likert scale, i.e. 1 to 7 as poor to very good value then calculate.

**Figure 2.** Analytical Hierarchy Process (AHP) structure

3. Results and Discussion

Ecology and environmental aspect should be considered on waterfall development, followed by economy function, infrastructure, operational management, and naturalness (Table 2). Ecology and environmental services should be compromised with economic benefit such as local people community.

Mainly waterfall located in rural region as its community received simple economic reward, however they contribute on conservation with sophisticated social-ecological relation [14, 15]. In regional development, including ecotourism destination, human bring significant influence on ecological function [16, 17]. For example, drawback due to lack of people education was reported weakness significantly in National Park Serbia [18]. Ecotourism can increase human capability on their ecosystem protection awareness [19].

11 Table 2. Pair wise comparison matrix, criteria's weight and validity

Criteria	C1	C2	C3	C4	C5	Sum	Weight	Consistency
Ecology & environmental (C1)	1,00	4,40	0,88	1,00	3,87	1,72	0,32	5,21
Economic benefit (C2)	0,23	1,00	4,40	1,97	1,29	1,21	0,23	5,07
Landscape/Naturalness (C3)	1,14	0,20	1,00	0,77	0,38	0,58	0,11	5,71
Infrastructure (C4)	1,00	0,51	1,29	1,00	1,00	0,92	0,17	4,52
Operation Management (C5)	0,26	0,77	2,65	1,00	1,00	0,88	0,17	4,52
Total	3,62	6,88	10,22	5,74	7,54		CI=	0,0010
							RI=	1,12
							CR=	0,0009

Based on alternative result, water resources and benefit for local people are the most important on waterfall ecotourism developing strategies. Increasing economic benefit can be addressed by intensification and diversification strategy [20] however should be considered not only on economic but also water resources conservation. Biodiversity and landscape surrounding waterfall location are the attractiveness for tourism, nonetheless improving management such public services and facilities are more valued factor (Table 3). Tourism development level was indicated by the development of public service quality [21]. All alternative strategies should be concern to ecological factor due to increasing tourism followed by economic growth but decrease ecological quality [22].

Table 3. Criteria and alternative's weight

Criteria	Alternatives	C1	C2	C3	C4	C5	Weight
Ecology & environmental (C1)	Biodiversity protection	0.10	0.09	0.08	0.06	0.06	0.08
	Water quality and quantity	0.15	0.13	0.11	0.09	0.09	0.12
Economic benefit (C2)	Income (local people/community)	0.13	0.13	0.10	0.08	0.09	0.11
	Income (government)	0.05	0.13	0.11	0.03	0.09	0.08
Landscape/naturalness (C3)	Scenery/Naturalness	0.12	0.06	0.16	0.07	0.12	0.10
	Culture/local attraction	0.08	0.09	0.14	0.08	0.17	0.10
Infrastructure (C4)	Public facilities	0.12	0.09	0.07	0.11	0.14	0.11
	Accessibility	0.11	0.05	0.04	0.13	0.07	0.09
Operation & management (C5)	Management (system & organization)	0.10	0.11	0.07	0.14	0.08	0.10
	Services	0.03	0.12	0.11	0.20	0.11	0.10

Water resources in 109 identified water-fall show moderate potential of waterfall attraction on ecotourism environmental perspective (Table 4). Water quality perform good quality year-round, either the rainy or dry season. Stream water quality correlate to temporal effect such seasonality [23, 24]. Waterfall attraction in Banyumas regency stash natural potential such landscape, local people hospitality and biodiversity. Conversely, lack of public facilities, management and accessibility are identified. Government and local people receive less and moderate benefit income from these attraction, respectively. In waterfall ecotourism development, government role (e.g. regulation and facilities construction) is required, while private and local sector can assist on management and services [7, 25, 26].

Table 4. Scoring potential waterfall attraction in Banyumas regency regarding to ecotourism water protection

District	Alternative (weight, %)										Score
	A1 (12,1)	A2 ₉ (11,3)	A3 (10,9)	A4 (10,3)	A5 (10,3)	A6 (10,3)	A7 (10,2)	A8 (8,6)	A9 (8,2)	A10 (7,9)	
Cilongok	6.50	5.00	3.00	4.00	5.00	6.50	3.00	3.00	6.00	3.00	4.56
Karanglewes	5.75	4.00	3.00	5.25	4.50	5.75	3.00	2.50	6.00	2.75	4.30
Pekuncen	5.83	4.17	3.17	5.75	3.42	6.00	3.67	2.58	5.58	2.08	4.30
Rawalo	5.00	3.00	3.00	5.00	5.00	6.00	3.00	3.00	6.00	2.00	4.13
Lumbir	6.00	3.00	3.00	6.00	3.00	6.00	3.00	2.00	6.00	2.00	4.06
Ajibarang	6.00	3.00	3.00	6.00	3.00	6.00	3.00	2.00	6.00	1.00	3.98
Gumelar	6.00	5.00	3.00	6.00	3.00	5.33	3.00	1.67	5.67	2.33	4.19
Baturaden	6.25	4.77	3.44	5.29	3.85	5.83	3.54	3.19	5.69	2.81	4.53
Kedungbanteng	6.00	4.33	3.00	6.00	3.00	5.67	3.00	2.67	5.33	2.33	4.21
Kembaran	6.00	5.00	3.00	6.00	3.00	5.00	3.00	3.00	6.00	3.00	4.35
Somagede	5.00	5.00	3.00	6.00	3.00	5.00	3.00	3.00	6.00	3.00	4.23
Sumbang	6.40	4.10	3.60	5.20	4.10	5.70	3.50	2.90	5.80	3.00	4.49
Kebasen	5.50	4.00	3.00	5.83	3.00	5.33	3.33	2.33	5.50	2.17	4.06
Sumpiuh	5.00	3.67	3.00	5.67	3.67	5.33	3.00	3.00	5.67	2.33	4.07
Tambak	6.00	3.00	3.00	6.00	3.00	5.00	3.00	2.00	6.00	2.00	3.96
Banyumas	6.00	5.00	3.00	6.00	3.00	6.00	3.00	2.00	6.00	2.00	4.29
Kemranjen	5.67	4.33	3.00	6.00	3.67	5.33	3.00	3.00	6.00	2.33	4.28
Average	5.82	4.14	3.07	5.65	3.54	5.63	3.12	2.58	5.84	2.36	4.23

A1= Water quality and quantity; A2= Benefit (local people/community); A3= Public facilities; A4= Services; A5= Management (system & organization); A6= Scenery/Naturalness; A7= Culture/local attraction; A8= Accessibility; A9= Biodiversity; A10= Income (government)

4. Conclusion

Based on 109-waterfall identification in three sub-watershed (i.e, Logawa, Tajum, and Serayu hilir sub-watershed) and ecotourism assessment on ecosystem perspective, mainly waterfall attraction perform potential value on tourist attractiveness. Further, contribution of government, local people and private sector needs to be included especially on public services, hospitality, and accessibility. In attractive waterfall destination, local people including local organisation receive economic benefit and might improve their welfare. It might impact on decreasing natural source exploitation when service sector provided. Ecotourism of waterfall in Banyumas regency is promising strategy for water conservation in the catchment area.

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