Determining priority infrastructure provision for supporting agrotourism development using AHP method

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Abstract. Agrotourism is a tourism activity using agro-business since beginning to end agriculture products in any system, scale and form as tourism object, with aims to widening knowledge, traveling, recreation, and business relationship in agriculture. Infrastructure divided into hard infrastructures (such as transportation, irrigation, drainage, electric network, clean water piping, communication network, sewerage, and waste management); and soft infrastructures (such as government policy, finance, and insurance services, information and communication services, education services, health services, and travel service). This research aim is to show how to use AHP as a tool to make a decision determining priority infrastructure provision, in the preference to support agrotourism development. This research takes Karo Regency, North Sumatera, Indonesia as a case study that has agrotourism attraction spread almost at 17 subdistricts. This research also uses AHP (analytical hierarchy process) for decision making with comprehensive characteristics, to handle complicated problems, multi-attribute, qualitative and quantitative scope. As research results, a decision with preference to get the biggest benefit value in short time for local government, and for Karo Regency peoples, is getting priority provision to start by hard infrastructure in the form of clean water supply first, then providing soft infrastructure in the form of government policy.

1. Introduction
Based on RTRWN of 2017-2037[1], Karo Regency is still part of the KSN Mebidangro with its main function being the center of tourism activities and the center of agricultural activities which are expected to be a driving force for regional growth. Whereas on Karo Regency RPJMD of 2016-2021 also stated that one of its missions is to increase the development of environmentally friendly agriculture and tourism sector and increase infrastructure development to encourage regional economic growth. One form of tourism that is economically beneficial but still oriented towards environmental sustainability is agrotourism with the concept of tourism that uses agriculture as its main object.

The development of agrotourism in the Karo Regency was introduced by the region through events such as the flower and fruit festival that had been held since 2015. This event aims to promote Berastagi as a tourism city, especially agrotourism. However, data in the field shows that visits to agro-tourism are still less competitive with visits to other tourism in Karo Regency. In 2016, the number of tourist visits to agrotourism was 53,806 tourists while other tourist objects were 512,575 tourists. Based on these data, it can be seen that there is an imbalance in the number of visits to agro-tourism with natural and other artificial tourism, so there is a need for the development of agrotourism in Karo Regency.
The underdevelopment of agrotourism in the Karo Regency itself is due to several inhibiting factors, one of which is the availability of infrastructure that supports agrotourism itself is still limited. Based on regional income and expenditure budget data, Karo Regency’s income is Rp. 935,516,730,579 with a budget for spending in the Karo Regency infrastructure of only Rp. 101,710,723,445 or 10.87% of the total regional income of Karo Regency. Based on the 2015 budget carried out by local governments only Rp. 1,606,896,578 or 0.17% of the total regional income of the Karo Regency is used for tourism development and Rp. 35,053,188,226 or 3.75% of the total regional income of the Karo Regency is used for agricultural development [2].

If seen from the available data, the expenditure budget in the infrastructure, agriculture and tourism sectors only reaches 14.79% of the total regional income of Karo Regency. In addition, the problem of the lack of APBD budget for infrastructure development is due to the limited time and funding allocation, so many infrastructure development activities have been neglected and failed due to hampered land acquisition processes, even for infrastructure built by the government and intended for the public interest.

Based on the above background, the existence of agrotourism potential in the Karo Regency has not been matched by the availability of tourism supporting infrastructure that can serve the needs of tourists. This resulted in the underdevelopment of agrotourism in the Karo Regency. Therefore, a study is needed on the Priority Determination of Infrastructure Provision for Agro-Tourism Development in Karo Regency. This research is important to determine the priority of providing infrastructure for the development of agrotourism that is planned as the motor of Karo Regency development.

2. Method

2.1. Determination of variables

The research variables used in this study are infrastructure consisting of hard and soft infrastructure. "Hard" infrastructure refers to physical networks that are relatively large and functional, whereas "soft" infrastructure is an institution or institution that plays a role in carrying out economic, health, education, social and cultural functions within a country [3]. Basic hard infrastructure includes transportation, irrigation, drainage, electric network, clean water piping, communication network, sewerage, and waste management. Soft infrastructure includes government policy, finance, and insurance services, information and communication services, education services, health services, and travel services.

2.2. Method of analysis

The analytical method used in this study is the Analytic Hierarchy Process (AHP). Analytic Hierarchy Process (AHP) is a technical analysis to help comprehensive decision making because of its multi-attribute nature to deal with complex problems from both qualitative and quantitative aspects. With hierarchy, complex and unstructured problems are broken down into groups, then organized into hierarchical forms [4]. The stages of decision making in the AHP method are:

- Define the problem and set goals. If AHP is used to choose alternatives or set alternative priorities, then this stage is carried out for alternative development.
- Arranging problems into a hierarchical structure so that complex problems can be viewed in terms of detail and measurability. The Hierarchical structure in this study can be seen in Figure 1.
Figure 1. AHP hierarchical structure.

- Establish priorities for each problem element in each hierarchy. This priority results from a pairwise comparison matrix between all elements at the same hierarchical level.

- Conducting consistency testing of comparisons between elements obtained at each level of the hierarchy. Thomas L. Saaty proved that the Consistency Index of the order matrix - n.

| Scale Of Importance | Definition                                   | Information                                           |
|---------------------|---------------------------------------------|-------------------------------------------------------|
| 1                   | Equally important                           | Both factors have the same important support for the goal |
| 3                   | Weak importance of one over another         | The importance of this factor is evident compared to other factors, but it is not convincing |
| 5                   | Essential or Strong Importance              | the real and proven factors are more important than others |
| 7                   | Demonstrated Importance                     | the real and proven factors are far more important than the others |
| 9                   | Extreme Importance                          | Clearly, real and convincingly proven this factor is more important in the most extreme agreement. |
| 2,4,6,8             | Intermediate values between the two adjacent judgment | If a compromise value is needed |
| Opposite of the numbers above | If for activity ‘i’ get one number when compared to activity j, then j has the inverse value when compared to i | A logical response |

2.3. Data collection method

Data is collected by distributing questionnaires to the sampling method. Based on the AHP approach, the resource person for weighting is an expert who understands agrotourism. A Sampling of respondents was carried out purposively, involving farmers, government, tourists, and practitioners/academics. The respondent fills in a pairwise comparison matrix.

This paired comparison matrix is filled using numbers to represent an element's relative importance to other elements. This is done by comparing each element of the criteria and alternative pairs. The
numbers entered in the pairwise comparison matrix where obtained from questionnaires filled out by respondents. An example of a paired comparison matrix can be seen in Table 2.

Table 2. Hard infrastructure comparison.

| Criteria Value | Criteria |
|----------------|----------|
| Transportation | Irrigation |
| Transportation | Drainage |
| Transportation | Electric Power |
| Transportation | Telecommunication |
| Transportation | Clean Water |
| Transportation | Waste Water |
| Transportation | Waste Management |
| Irrigation | Drainage |
| Irrigation | Electric Power |
| Irrigation | Telecommunication |
| Irrigation | Clean Water |
| Irrigation | Waste Water |
| Irrigation | Waste Management |
| Drainage | Electric Power |
| Drainage | Telecommunication |
| Drainage | Clean Water |
| Drainage | Waste Water |
| Drainage | Waste Management |
| Electric Power | Telecommunication |
| Electric Power | Clean Water |
| Electric Power | Waste Water |
| Electric Power | Waste Management |
| Clean Water | Clean Water |
| Clean Water | Waste Water |
| Clean Water | Waste Management |
| Telecommunication | Waste Water |
| Telecommunication | Waste Management |
| Waste Water | Waste Management |

3. Results and discussion

AHP uses pairwise comparisons to compare in pairs a homogeneous thing so that the things being compared will be easier and more objective. Here are the results of a pairwise comparison matrix on the criteria.

Table 3. Pairwise comparison matrix for hard infrastructure assessment criteria.

| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|----|----|----|----|----|----|----|----|
| 1  | 5  | 4  | 4  | 1/5| 4  | 3  | 3  |
| 2  | 5  | 4  | 1/3| 1/5| 1/2| 2  | 2  | 2  |
| 3  | 4  | 4  | 1/3| 1/3| 1/5| 1/2| 1  | 1  |
| 4  | 4  | 1/3| 1/3| 4  | 1/5| 4  | 4  | 3  |
| 5  | 1/5| 1/5| 1/5| 1/5| 4  | 5  | 5  | 5  |
| 6  | 4  | 2  | 1/2| 4  | 5  | 3  | 2  | 2  |
| 7  | 3  | 2  | 1  | 4  | 5  | 3  | 1  | 1  |
| 8  | 3  | 2  | 1  | 3  | 5  | 2  | 1  | 1  |

Source: Data Processing Results, 2019
Information:
1 = Transportation  
2 = Irrigation  
3 = Drainage  
4 = Electric  
5 = Clean Water  
6 = Telecommunication  
7 = Waste Water  
8 = Waste Management
Table 4. Pairwise comparison matrix for soft infrastructure assessment criteria.

|     | 1   | 2    | 3    | 4    | 5    | 6    |
|-----|-----|------|------|------|------|------|
| 1   | 5   | 5    | 5    | 5    | 5    | 5    |
| 2   | 5   | 1/3  | 2    | 1/3  | 1/3  | 1/3  |
| 3   | 5   | 3    | 3    | 1/3  | 1/3  | 1/3  |
| 4   | 5   | 3    | 1/3  | 1/3  | 3    | 3    |
| 5   | 5   | 1/3  | 1/3  | 1/3  | 3    | 3    |
| 6   | 5   | 1/3  | 1/3  | 1/3  | 3    | 3    |

Source: Data Processing Results, 2019

Information:
1 = Government Policy
2 = Financial and Insurance Services
3 = Information and Telecommunication Services
4 = Education Services
5 = Health Services
6 = Travel Services

In processing the Analytical Hierarchy Process (AHP) data in this study, using AHP expert choice 11 software. Based on the analysis results, alternative infrastructure priorities in supporting agro-tourism are obtained as follows:

**Figure 2. Priority infrastructure.**

Based on the figure 2 above, it can be concluded that the top priority is in the hard infrastructure category which has a value of 0.750.

**Figure 3. Priority alternatives: Hard infrastructure.**

Based on previous results which state the highest value is in hard infrastructure, the category that most influences hard infrastructure is in the clean water category which has a value of 0.389 with a data validity level of 91%.

**Figure 4. Priority alternatives: Soft infrastructure.**
Based on the above analysis using the Analytical Hierarchy Process (AHP) method, it can be concluded that the infrastructure priority for agrotourism development in Karo Regency is hard infrastructure with a value of 0.75 with a priority of clean water development with a value of 0.389.

4. Conclusion
The problem faced by the Karo Regency government in the development of agritourism is the lack of APBD budget for infrastructure development, causing the existence of the potential for agritourism in Karo Regency has not been matched by the availability of supporting tourism infrastructure that can serve the needs of tourists. To overcome these problems, it is necessary to determine the priority of providing infrastructure for the development of agritourism that is planned as the motor of Karo Regency development.

The results of this study are setting priorities for infrastructure development in supporting agritourism development first with the development of a hard infrastructure sector in the water supply sector, further developing soft infrastructure in the form of government policy, that is the best combination with agritourism potential conditions and availability of development funds at Karo Regency.

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