PRELIMINARY STUDY OF GEOTOURISM PLANS IN GEOTHERMAL AREA: A CASE STUDY IN BUKIT DAUN GEOTHERMAL PROJECT

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ABSTRACT

Bukit Daun is an area located in Bermani Ulu subdistrict, approximately 20 km from Curup City, Bengkulu Province and located about 700 – 1000 masl. This area now is one of the geothermal exploration sites in Indonesia to be developed for electricity purpose. In general, Observations in some geothermal fields show that social supports are one of the most important factors that determine the success rate of development activities in the geothermal area. In the other hand, the Geothermal area provides geotourism potentials and shows promising benefits to educate people because geotourism has been widely accepted by all kinds of society as their welfare. Departing from this point of views, we want to construct a plan that linked geothermal potentials in Bukit Daun area to geotourism in order to serve a good way in educating the people in Bukit Daun area. The method that we conducted to builds a construction plan is literature study, field, and social observations, as well as comparing it to other geothermal fields as case studies and interpretations to choose the most suitable ways of constructing it. The field observation shows that this area has some prospectus places to be developed as geotourism sites, they're Bukit Daun itself that offers beautiful landscapes, geothermal manifestations, Lakes, and Waterfalls. Also, certain places in this area act as recharge area and contain fertile soil to grow any plants including Rafflesia and Amorphophallus as national rare flowers. The main concept that we propose to the plan is "Geodiversity in Geothermal Geotourism", that based on following main values, 1) Rewarding, 2) Enriching, 3) Adventuring, and 4) Learning. From this values, the concept will be brought to education and conservation purpose by providing scientific information about the natural phenomena especially in a geothermal area that based on the appreciation of those phenomena, enrich the people's knowledge and abilities, and initiate participation of people in geotourism activity. Also, in this study we consider other values such as cultural

value to find the most suitable ways to deliver the information to society, economic value to give the benefits to the economic side of local people that lived in the geothermal area, and aesthetic value of the geotourism sites to attract and encourage people's curiosity. From this plans, we believed that geotourism could become good way to educate people in a geothermal area especially in exploration area like Bukit Daun.

Keywords: Bukit Daun, geothermal, geotourism, educations, society

INTRODUCTION

Bukit Daun is an area located in Bermani Ulu Raya subdistrict, Rejang Lebong, Bengkulu Province. This area located about 90 km from Bengkulu's Capital City, and in elevation about 700 – 1000 masl. Bukit Daun is found within the geological – geomorphological setting of Bukit Barisan Mountains. This area is well known as an area that has several potentials, one of it is geothermal potential. The geothermal potential in the area is shown by the presence of manifestations, such as hot pools, hot springs, Mud pools, and altered rocks. These conditions draw some of the national geothermal company to explore and exploit the potential of the area.

Learning from the past events, some of the geothermal development found to be very complicated, especially in social side, where oppositions from society rise up in the early or middle phase of geothermal development, especially when drilling process is about to begin.

Geotourism is a concept of tourism activities that visiting interesting geological spots (Sampurno, 1995 in Hendratno, 2002). Two important elements in geoturism concept are conservations and educations through appreciations a learning (Newsome & Dowling, 2010 in Kubalíková and Kirchner, 2016). Geotourism potential is presented in geodiversity but through exploration and exploitation, only those potential can be used for geotourism purposes (Pralong & Reynard, 2005 in Kubalíková and Kirchner, 2016).

Geodiversity is a concept of diversity of earth features and its systems. Human activities and environments are linked through geodiversity because geodiversity contains geological, natural processes, landforms, landscapes, soils, climates, and others as fundamental elements in affecting human activities (Kubalíková and Kirchner, 2016). Cultural and economics sides of society also the affected by geodiversity because of elements in geodiversity is found to support each other to form conditions for human life, i.e groundwater will be fundamental for residential places, or mountainous landscapes found to be suitable places to grow agriculture's. One of the products formed by geodiversity is geoturism potentials, which its parameter is: 1) geological, 2) geomorphological, 3) soil features (Gray, 2004).

When discussed geotorism, important terms used are geomorphsite and geosite based on Kubalíková and Kirchner (2016). Geosite means some sites on earth/ geosphere that represents geological history based on its prevailing feature, i.e. volcanic, or geothermal (Reynard, 2004, in Kubalíková and Kirchner, 2016). Geomorphsite means geosites that had been defined as landforms comes along with several values thanks to human perceptions. Geomorphsites values can be divided into two main values, there are scientific and added values, where scientific values contains information about genesis, process, evolutions, and dynamics of geomorphsites, while added values contains socials, cultural, aesthetics, ecological, economical, and others (Panizza, 2001 in Kubalíková and Kirchner, 2016).

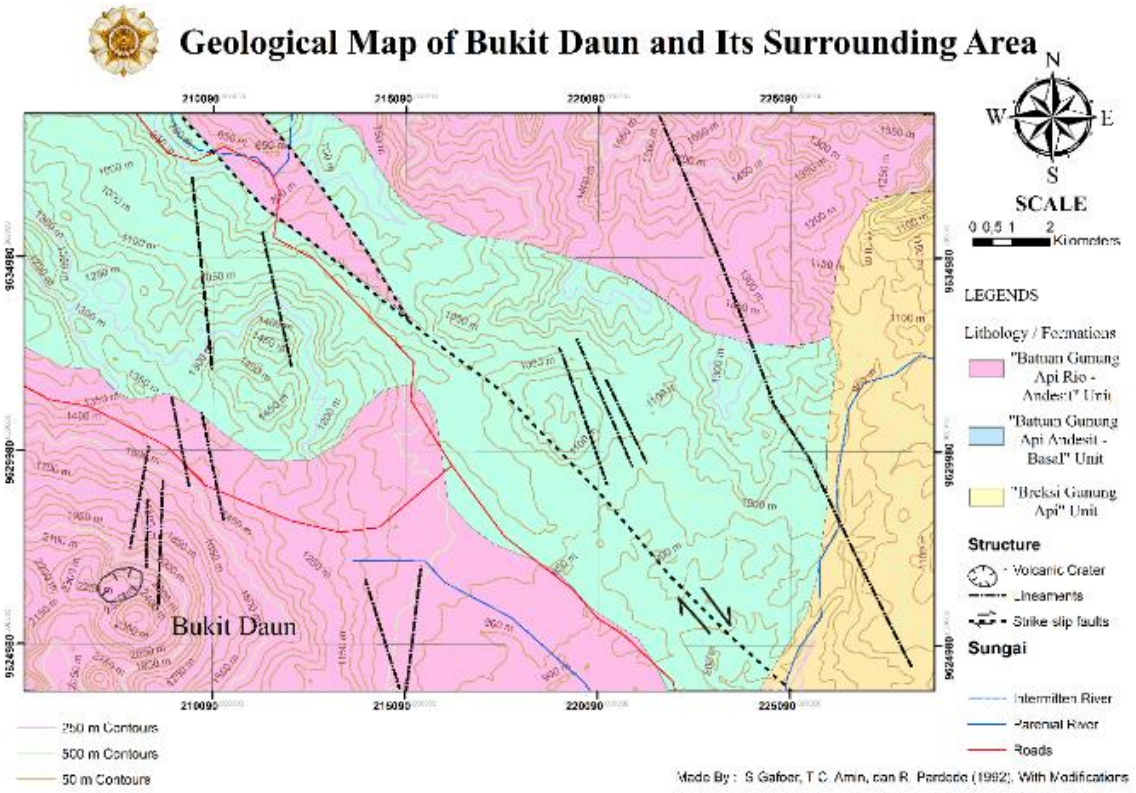

Figure 1:. Geological map of Bukit Daun and its surrounding area (Gafoer et al, 1992)

The concept of geodiversity, geosites, geomorphsites, and geoturisms are very important, also could be applied on some of geothermal area where geodiversity is rich that appear as geosite and geomorphsites that have potentials to be developed as geotourism. In this case, preliminary studies are needed to explore and exploit the geotourism potentials. In this study, we proposed a concept that will be used as a "tool" in educating the people that live within or around the geothermal area.

GEOLOGICAL AND GEOMORPHOLOGICAL CONDITIONS

Regional Geomorphology

Bukit Daun Area is located at Bukit Barisan mountains region geomorphologically. The study area is volcanic landform and surrounded by some hills/ mountains, such as Mt. Kaba, Mt. Condong, Mt. Kalang, Mt. Lalang, Mt. Naning, Mt. Hulupalik, Mt. Sanggul, Mt. Hulupalak, Mt Engas, Mt. Basa and others. Some Lineaments are found in study area showing N – S orientations (Gafoer et al, 1992).

Regional Geology

The study area is consists of some geological formations and rocks units, according to Gafoer et al (1992), the formation/ rock units are:

"Breksi Gunung api" Unit

This unit is composed of Volcanic breccia, Lava, Andesitic – Basaltic Tuff. Mt Kaba, Mt. Dempo, Mt. Lumut, Mt. Hulusulup, Mt. Balai, and Mt. Besar is expected to be the main source of this rocks unit.

"Batuan Gunung Api Andesit – Basal" Unit

This unit is composed by Lavas with the main composition are Andesite to Basalt, Tuff, and Laharic Breccia. Mt. Lumut, Mt. Hulusulup, Mt. Daun, and Mt. Dingin are expected to be the main source of this unit. The thickness of this unit is about 300 meters.

"Batuan Gunung Api Rio – Andesit" Unit

This unit is composed by Rhyolitic Lavas, Dacites, and Andesites, Hybrid Tuff, and Volcanic and or Pumice Breccia. The thickness of this unit is about 350 meters.

METHOD

To complete this paper, the method we use is literature studies, social observation, as well as performing interpretation to build a preliminary geotourism plan in Bukit Daun area. The early stage of method is done by collecting the related publications and literature to the study area. Then, the analysis is done by comparing and also analyzing the other geothermal fields to look for the parameters that made a geothermal field accepted or denied by society. Also, qualitative and quantitative analysis of some geomorphsites are done in order to found out the gaotourism activity can be done in each geomorphsites, also the further development can or must be done in each geomorphsites. Through that analysis, the parameter produced appear as the point of questions will be used in constructing geotourism plan and considering the challenge that needs to overcome.

GEOTOURISM EDUCATION IN GEOTHERMAL AREA

The main goal of this geotourism's preliminary study is to looking for some ways where geotourism activity could enriched the local people's and visitor's knowledge about geothermal and the fitures in it as well as to be linked on

indirect use electricity development of Bukit Daun Geothermal area. By looking from some events in the past, lack of knowledge of the geothermal system and how geothermal indirect use development are done have created some obstacles, that conduct local people resistence in the reasons of social, culture, and nature. By Serving geothermal education thorough geotourisms activity, educations and conservation of the geotourism sites could be reached through appreciations and learning (Newsome & Dowling, 2010 in Kubalíková, 2013).

In a geothermal area, education of geothermal are needed in order to create the well-understood society of geothermal, as they will be the organizer of the geotourism activity. Thorugh field observation in one of the well-developed geotourism sites in Lahendong Geothermal Area, the educative geotourism activity are done by could be held by serving: 1) Educative infrastructures, such as information signs, 2) provides the once-in-a-year geothermal celebrations that invite all group society, Childrens, Teenagers, and adults to participates in it, 3) Created the geothermal lover community or geothermal geoturism community as pioneers in passing the latest information and issue in geothermal utilization developments, 4) Creates a collaboration of Stakeholders, people, and CSR Progam fro company developer im developing to build a Geothermal Education Center that contains all kinds of informations for local people and tourists, 5) Inviting the social activity from all of the nations that have interests in Geothermal society character buildings, like Kuliah Kerja Nyata (KKN), 6) others.

In order to create the educative geothermal geoturism activity, 1, 2, 5, 10, or even 15 years are needed as the process of development, so that the indirect use development have to be developed together with the geothermal geotourism so that the the people not only act as the eye-witness but also have roles, one of it in geothermal society-based geotourism activity. As the organizer, knowing about geothermal and how to conserve it are basic capability for local people. In the end, all of the process will created the atmosphere of geothermal in harmony of geothermal development. In order to educate the society, the simplest way are needed in the first, and growing as the knowledge of the society are increased.

Figure 2: Information signs that contains geothermal informations are one of the ways to educate the local people and tourists to learn about geothermal, in order to create the society that approve the geothermal indirect use electricity development (Photo credit to Halim dkk, 2015)

Figure 3. Geothermal Education Center (GEC) of Lahendong Geothermal Field as the center of informations of basic scientific of geothermal science, geothermal development, and many kinds of geothermal utilization for society. GEC are formed by the collaborations of Pertamina Geothermal Energy, Tomohon City's Staholder, and BPPT, with the initiation from KKN PPM UGM 2017

GEOTOURISM COMPARISON WITH OTHER GEOTHERMAL FIELDS

Comparison are done to look for the parameters that can be considered in developing the geotourisms plan in Bukit Daun Geothermal Area. The geothermal fields that'll be compared are chosen by these parameters that have the same conditions in Bukit Daun Geothermal Area, those are: 1) Area must be a located at residences area 2) Area are in contact with protected rainforest, 3) society of the geothermal area development isn't well understood about geothermal activity and development

Lahendong Geothermal Field

Lahendong Geothermal Field is located in North Sulawesi Province. Geologically, the area is located at arc-arc collision zone from the collision of Sangihe arc and Halmahera Arc (Utami et al, 2015). Field and literature studies show that several parts of society accept the geothermal development and the other parts denied it. It is considered, the education and cultural conditions of the society are the main reasons why the conflict happens between Geothermal development company and society, because of the villager's area lived there before the geothermal development. Until now, educations steps are done by stakeholder and its partners to serve an information to geothermal and its dynamics through geoturisms development and direct uses plan of geothermal potentials, even actually the society is lived for a long time with geothermal phenomena, but the information doesn't reach the society, so that the resistance happened.

Kamojang Geothermal Field

Kamojang Geothermal Field is at West Java Province. Geologically, the area is located at island arc subduction zone from subduction of Indo-Australia and Eurasia tectonic plates. The Kamojang geothermal area estimated area is about 21 km2, which its electric potential are estimated 300 MWe (Sudarman, 1995, in Utami, 2000). Literature studies show that geothermal development and society are live in harmony with each other. In Kamojang, direct use utilization is present in order to give

opportunities to society who comes and stay after Kamojang WKP (*Wilayah Kerja Panas Bumi*) area are developed. Direct use utilization can be found in Kamojang are educative geo tourism, such as a beautiful landscape enriched with agricultural activity i.e. Tea garden and hot water bathing activity has given a good potential of geotourism for visitor, and also direct use utilization in agricultural activity, i.e. Oyster Mushroom cultivated (Suyanto et al, 2010 ; Fadli et al. 2015).

Dieng Geothermal Field

Dieng Geothermal Field is located in Central Java Province. Geologically, the area is located at island arc subduction zone from subduction of Indo-Australia and Eurasia tectonic plates (Harijoko et al, 2010). Field and literature studies show that Dieng is an area where society and geothermal development company are lived in harmony, even if sometimes there are conflicts between them. Educative geotourism and direct uses of geothermal are the ways of society to take parts in geothermal activities in Dieng Geothermal Area, where society developed a special interest in tourists activity, also by geothermal exploitation of the company, some of the unexploited fluids are used by people as direct uses utilization, i.e. Bathing, also in Dieng visitor could find many kinds of local products. Some of the geotourism activity can be seen in Kawah Sikidang Dieng, where local people build a semipermanent house to sold sulphuric mud in bottles or handicrafts as local products of Kawah Sikidang, also by built photobooth like-infrastrucutres, the visitors can take photos. The geotourism activity of Kawah Sikidang is also enriched with the knowledge of local people who know about the history of natural geothermal activity and its development. (Geomagz, 2015; Diengnesia, 2016).

Lawu Geothermal Field

Lawu Geothermal Field is located at two Province, Central and East Java Province. In 2016, the project of Lawu geothermal field geothermal development was suspended in order to mass protest of some communities. The reasons of the protest are based on the WKP area are located at Lawu conservational forest where many people depend on it as life resources, i.e. water, food, and also the Lawu area act as the center of spiritual activity in Java (Konsorsium Pembaruan Agraria et al, 2017). Some steps are done in order to negotiate the people that lived in Lawu Geothermal Field, such as held socializations, but until now the status of geothermal development in Lawu geothermal Field is still unclear.

Bedugul Geothermal Field

Bedugul Geothermal Field is located in Bali Province. The project of geothermal development is suspended in 2005, where some oppositions come from public communities in Bali, also with the support from Bali House of Representatives. The reasons of the oppositions are because of the WKP area of Bedugul Geothermal forest are located in the sacred forest of Bali, also because of the forest act as water recharge area, so it must remain undisturbed. In society's opinion, geothermal development activity in the Bedugul Geothermal Field could disturbed the nature balance of the forest and also disturbed the cultural activity (Richter, 2015).

STUDY AREA CONDITIONS

Social Condition of the Study Area

The study area is consists of several conditions in social sides. The people lived in the study area mainly is original people who've lived for a long period in Bukit Daun area, they are Rejang ethnics, with a little number of other ethnics. Social observation shows that the people that lived in Bukit Daun area reach the number of 10.294 persons, with the growth rate is 6 – 24% (*Badan Pusat Statisik (BPS), 2016)*. Social observation based on several parameter like: 1) Education, 2) Heatlh, 3) Labor force. Observation shows that the education activity in Bukit Daun area are in good conditions which mean the each stage Preliminary school, Junior, and senior high school are presents, even if there are some problems where after graduate from senior high school, the people prefer to choose continuing their agricultural activity, or even there are some groups that didn't attend the school. The health condition of society is in good conditions where health faccility such as Clinic, *Puskesmas*, and *Posyandu* are present, but, not in very good conditions like the ones that present in the Rejang Lebong capital's. The latest data shows that labor force number in Bukit Daun geothermal field area, especially in Bermani Ulu Raya district is diversed in some of economical activity, but the largest number shown the agricultural activity as the most (BPS, 2016).

Figure 4: Lahendong Geothermal Field now was using Geotourism and direct use geothermal utilization as the ways to educate society, one of it is Linow Lake. (Photo Credit to Muhammad Sidqi)

Economic Conditions of the Study Area

The study area consist of several conditions in economical sides. The Society that lived in Bukit Daun area is mainly lived in need to agricultural activity, where about 62% of the society of Rejang Lebong lived in Agriculture by, especially in the study area, where the percentage is higher (BPS, 2015). Agricultural activity are done by planting vegetables, coffees, fruits, woods, and even teas.

Figure 5: Geotourism activities in Dieng Geothermal Field, the beautiful and unusual views of Geothermal field, enhanced with infrastructure development has made this is very attractive for tourism, one of it is in Kawah sikidang (Photo credit to the author)

Culture Conditions of the Study Area

Bukit Daun area is a place that still holding tight their cultural activities. In the study area, special culture day is celebrated, i.e. youngs marriage by showing traditional dance "Kejei". Some history, legends, and myths are also present like Pat Petulai or presence of Spirits that stayed in Bukit Daun forest, and the others.

INVENTARIZATION AND ANALYSIS OF BUKIT DAUN GEOTHERMAL GEOTOURISM POTENTIALS

Qualitative Analysis

Qualitative analysis is done through describing the conditions of geomorphsites in the study area that producing geotourism potentials, geological, geomorphological, and soil features, as well as describing the activity can be done in each of geomorphsites (Gray, 2004). Activity in the geotorism spots is analyzed based on REAL TRAVEL from Hendratno (2002), that which the parameters are rewarding, enriching, adventuring, and learning in order to build a concept of the geoturism plan in Bukit Daun area.

Seven colors Hot pools

Seven Colours hot pools are geothermal manifestations. Those spots are located at coordinates ranges from 212800.8 - 214688.6 Easting and 9631379.1 - 9629148.4 Northing. These spots are located in Rimbo Pengadang, Bermani Ulu Raya administratively. The elevation of those spots is about 1097 masl. This place located in Bukit Daun national park, and to reach it, the visitor has to do it by walking pass the Bukit Daun Forest National Park. Some of geotourism potential are present thanks to the geological conditions of the area. Geotourism potential appears as the product of geothermal activity from Bukit Daun Tertiary-Quaternary-aged volcano.

Geotourism potential can be found in this area are:

a. Attractive adventuring geotourism
b. A good place to photo shooting especially when it comes to nature
c. Beautiful view of seven pools that have different colors
d. Good place in learning about geothermal activity and its dynamics that showed by its manifestations
e. Others

Through further developments, the geotourism potential can be created are: (further development, see in quantitative analysis)

a. By the presence of information signs, this spot could be an educative and adventuring geotourism b. An enjoyable and safe place for learning about geothermal activity
c. With some photobooth-like infrastructure, A good photo shootings place when it comes to nature and scientific knowledge
d. A place to find local products of Geotourisms, like sulfur powder, or sulfuric mud for healty skin
e. Others

Figure 6: One of the hot pools foundin Bukit Daun area Where through this spots could be a good way to deliver the information to the society of tourism visitor (Photo credit to Redi Harisusanto)

Bukit Daun "Garden of Tea"

Bukit Daun "Garden of Tea" is located at coordinates 213269.8 Easting and 9623960.2 northing, 1259 masl. Administratively, this spot is located in Air Dingin Villages, Bermani Ulu Raya Subdistrict, Rejang Lebong. To reach this spot, the visitor can do it by using motor vehicles. Geotourism potentials in this spots appear thanks to its geomorphological and soil features, where geomorphology has gave the beautiful views and conditions, i.e. temperature, and rate of rainfall that support the grow of vegetations, as well as the fertile soil feature that gace the nutritions to the vegetations.
Geotourism Potential can be found in this place are:

a. A Good place for family recreation
b. Some good views of Bukit Daun volcanic landform are presented
c. Volcanic deposits that covered all of this area from Bukit Daun eruption has enriched the floras and faunas, on of them is Tea
d. There are some beautiful spots for photo shooting
e. Others

Through further developments, the geotourism potential can be created are: (further development, see in quantitative analysis)

a. By a little direct-use improvement from the tea company developer, The Tea as local products can be sold right on the spot
b. By infrastructure additions, Presence of fun attractive games, like outbound, or paragliding.
c. By the presence of cottage or rest house, this spot could be nice resort to spend the holidays with family or colleagues
d. Others

Figure 7: Bukit Daun Garden of Tea is serving nice geomorphological views of Bukit Daun volcanic landform (Photo credit to Kurniawan Oka)

Telapak Lake

Telapak Lake is located in the proximal zone of Bukit Daun Volcanic Landform. Located in Rimbo Pengadang Village, Bermani Ulu Raya, Rejang Lebong District. Geographically, this spots located in 208013.6 Easting and 9625667.9 Northing, 2371 masl. Telapak lake is believed to be the leftover of past volcanic processes that forming a depression where surface water and shallow groundwater accumulated. To reach it, visitor need to walking pass the Bukit Daun forest to the one of the peaks in Mt. Bukit Daun, where Telapak Lake lies and expected as the edifices product of past volcanic activity.

Geotourism potentials can be found in this place are:

a. Good place for nature-based adventuring
b. A good place for enjoying the beautiful view of volcanic lake
c. A place to saw and learn some of the endemic flora and fauna
d. Good destination for nature lover students/ community
e. Others

Through further developments, the geotourism potential can be created are: (further development, see in quantitative analysis)

a. By the presence of tracks/ trails, safer adventuring activity through tracks/trails while enjoying the view of Bukit Daun National Park
b. By the presence of information signs, information of the Telapak lake characteristics will reach the visitors
c. By its unique shape, Telapak lake's shape could be the icon of the geotourism activity in Bukit Daun
d. Others

Figure 8: A bird view of Telapak Lake of Bukit Daun, where past volcanic activity produced this lake (Photo credit to Dio Gala Putra)

Bukit Daun National Park

Bukit Daun National Park located in the proximal zone of Bukit Daun Volcanic Landform. This area is located 200330.3 – 210675.8 Easting and 9621176.9 – 9626293.2 Northing, 926 – 2449 masl. Administratively, this area located in Bermani Ulu Raya area subdistrict, and continued to exceed the administrative border of Rejang Lebong, Lebong, and North Bengkulu district. In 2014, Bukit Daun exceeds 176.290 ha. Geotourism potentials present as the product of geological, soil feature and geomorphological of the area as the main factor, where volcanic deposits that cover all of the areas have enriched the variety of vegetations in the study area. High rainfall rate also accelerates the weathering process that produces fertile soil as the medium of the vegetations to grow.

Geotourism potentials can be found in this place are:

a. Nature-based adventuring geotourism
b. A good place to study about the heterogenization of vegetations in rain forest
c. One of the best places for Rafflesia flower to grow, especially Rafflesia arnoldi and Rafflesia bengkuluensis that only can be found in Bengkulu.
d. Good views for Flora and Fauna photoshoot in its natural habitat
e. A place to feel the cleanest air in the rain forest
f. Others

Through further developments, the geotourism potential can be created are: (further development, see in quantitative analysis)

a. By additions of guard station or safety infrastructures, enjoyable and safer sites for geotourisms could be created
b. By Presence of tracks/ trails, good views of Bukit Daun forest can be seen more
c. By the presence of information signs, the visitor could learn much about the Bukit Daun Forest
d. By presence of local tour guide, visitor will get more information
e. Others

Figure 9: Geotourism activity in Bukit Daun National Park. A tourist that took photo with Refflesia arnoldi as one of rarest flower in the world, that naturally only can be found in Bengkulu Province (Photo credit to Danang Prasetya)

Quantitative Analysis

Quantitative analysis is done by giving some scores to several parameter and subparameter from 0 – 1. By giving some scores, can be seen that in each of geomorphsites have different scores in subparameters that showing the sides that need to be improved in order to serve a good geotourisms activity. The quantitative analysis used in this study will be based on several parameters that proposed by Kubalíková (2013), that based on five main parameters, such as Scientific and intrinsic value, educational, economical, conservational, and added value.

Table 1: Assessment of Geotourism potentials (Kubalíková, 2013)

Parameters	
Scientific and Intrinsic Values	
Integrity	0 – Totally destroyed site 0,5 – Disturbed site, but with visible abiotic features 1 – site without any destructions
Rarity (number of similar sites)	0 – more than 5 sites 0,5 – 2-5 similar sites 1 - the only site within the area of interest
Diversity	0 – only one visible feature/ processes 0,5 – 2-4 visible feature/ processes 1 – the only sites within the area of interest
Scientific Knowledge	0 – unknown site 0,5 – scientific paper on national level 1 – high knowledge of the site, monographic studies of the sites
Educational Values	
Representativeness and Visibility/ Clarity of the Features / Processes	0 – low representativeness/ clarity of the form and the processes 0,5 – medium representativeness, especially for scientists 1 – high representativeness of the form or processes, also for public
Exemplarity, Pedagogical use	0 - very low exemplarity and pedagogical use of the form and process 0,5 - existing exemplarity, but with limited pedagogical use, 1 - high exemplarity and high potential for pedagogical use, goedidactics and geotourism
Existing Educational Products	0 - no products 0,5 - leaflets, maps, web pages 1 - info panel, information at the site
Actual Use of a Site for Educational Purpose	0 - no educative use of the site 0,5 - site as a part of specialized excursions (students), 1 - guided tours for public
Economic Values	
Accessibility	0 - more than 1000 m from the parking place, 0,5 - less than 1000 m from the parking place 1 - more than 1000 m from the stop of public transport
Presence of Tourist Infrastructure	0 - more than 10 km from the site existing tourist facilities, 0.5 - 5 – 10 km tourist facilities 1 - less than 5 km tourist facilities

Local Products	0 - no local products related to a site, 0,5 - some products, 1 - emblematic site for some local products.
Conservational Values	
Actual Threat and Risk	0 - high both natural and atrophic risks, 0,5 - existing risks that can disturb the site, 1 - low risks and almost no threats
Potential Threat and Risks	0 - high both natural and athrophic risks, 0,5 - existing risks that can disturb the site, 1 - low risks and almost no threats
Current Status of a Site	0 - continuing destruction of the site, 0,5 - the site destroyed, but now with management measures for avoid the destruction, 1 - no destruction
Legislative Protection	0 - no legislative protection, 0,5 - existing proposal for legislative protection, 1 - existing legislative protection (Natural monument, Natural reservation…)
Added Values	
Presence of Cultural Value	0 - no cultural features, 0,5 - existing cultural features but without strong relation to abiotic features, 1 - existing cultural features with the strong relations to abiotic features
Ecological Value	0 - not important, 0,5 - existing influence but not so important, 1 - important influence of the geomorphologic feature on the ecologic feature
Aesthetical Value: number of colors; structure of the space, viewpoints	0 - one color, 0,25 - 2-3 colors, 0,5 - more than 3 colors; 0 - only one pattern, 0.25 - two or three patterns clearly distinguishable, 0.5 - more than 3 patterns; 0 - none, 0.25 - 1-2, 0.5 - 3 and more

From the quantitative analysis, can be seen that there are some of the parameters needed to be improved in order to construct a geotourism plans in Bukit Daun area.

From the scientific and intrinsic values, can be seen that the range of the values is 62,5 – 100%. The lowest value is lies at Bukit Daun Garden of Tea, and the highest value lies on Seven Colors Hot Pools "*Putri 7 Warna*". it happened because in some spots can be found some destruction processes that can threaten the sites, i.e. the human activity who throw garbage in the sites. The acts that need is to raise the integrity and scientific values of the sites

From the educational values, the values are ranged from 25% to 50%. Low values are present in order to the lack of the educational products of the sites, and also the places are still highly nature status where people are seldom using the sites for geotourism activity and only small number of people who already know about the sites. The acts need to do in order to increase the values are to serving more information to the visitor about the sites, the information may come from the information boards, flyers, brochures, websites, or even by serving a guide in geotourism sites.

From the economical values, the values are ranged from 0 – 66,7 %. Low values are present because mainly in accessibility and local products. Low accessibility happened because of the area are located in national parks of Bukit Daun forest, so that only small number of accessibility could be accessed. Low values of local product are also present because of the society in this area gave less-aware of their area's geotourism potentials. The acts need to do are by increasing the accessibility and presence of local products value. Accessibility as parts of infrastructures is needed by building a safe trail/ tracks to reach the geotourism sites, as well as to serving local product of each sites, in order to serving visitors something to bought to their relations as gifts.

From the conservational values, the values are ranged from 75 – 100%. Such a high values are present because of the area are a conservation area of Bukit Daun national park. The acts need to be done is just to determine the regulations how to keep the area keep conserved when the geotourism activity is about to begin, to keep the area from any threats of destructions that could lower the values of geotourisms itself.

Added values are presents because of the difference in cultural, aesthetical, and ecological in each site. The presence of added values are believed could relate the abiotic features and processes to cultural issues as biotic features (Kubalíková, 2013). The acts that need to be done are to promote more of these added values in order to create a more interactive geotourism activity.

Table 2: Assesments of Potential Geotourism Spots in Bukit Daun Geothermal Area

Parameter		Bukit Daun Garden of Tea	Seven Colors Hot Pools "*Putri 7 Warna*"	Telapak Lake	Bukit Daun National Park
Scientific And Intrisic Values	*Integrity*	0.5	1	1	1
	Rarity (number of similar sites)	1	1	1	1
	Diversity	0.5	1	0.5	0.5
	Scientific Knowledge	0.5	1	0.5	0.5
%		62.5%	100%	75%	75%
Educational Values	*Representativeness and Visibility/ Clarity of the Features / Processes*	1	1	1	1
	Exemplarity, Pedagogical use	1	0	0	0.5
	Existing Educational Products	0	0.5	0	0
	Actual Use of a Site for Educational Purpose	0.5	0.5	0	0.5
%		50%	50%	25%	50%
Economical Values	*Accessibility*	1	0	0	0
	Presence of Tourist infrastructure	0.5	0,5	0.5	0.5
	Local Products	0.5	0	0	0
%		66.7%	16,7%	16.7%	16.7%
Conservational Values	*Actual threat and Risk*	1	0.5	1	1
	Potential Threat and Risks	0.5	1	1	1
	Current Status of a Site	0.5	1	1	1
	Legislative Protection	1	1	1	1
%		75%	86,6%	100%	100%
Added Values	*Presence of Cultural Value*	0	1	0,5	0,5
	Ecological Value	1	1	1	1
	Aesthetical Value	0.5	0,5	0,25	0,25
	%	60%	100%	70%	70%
Mean		**62,84 %**	**70,66%**	**57,34%**	**62,34%**

GEOTHERMAL GEOTOURISM EDUCATION PLAN

Based on social condition and other analysis results, and linked to comparison to other geothermal fields, the the parameters need to be considered to construct an educative geothermal geotourism plans are summarized below:

The geotourism concept must answer the curiosity of the society and visitor about the nature of geothermal activity in Bukit Daun Geothermal field

1) The geotourism concept must serve an amusing activity of geotourism to the society and the visitors
2) How to involve the Society as the organizer of the geotourism activities?
3) How long will it be needed to build the infrastructures for those geotourism plans?

The geotourism concept must answer how to rises up the conservational value as reward for natureThe concept we proposed of geothermal education based on values proposed by Hendratno (2002), those values are REAL Travel, means 1) Rewarding, 2) Enriching, 3) Adventuring, and 4) Learning. Rewarding means reward for geological and environmental phenomenon objects, enriching means enrichment of knowledge for geological and environmental phenomenon objects, adventuring means doing an active trip to observe geological objects, and also learning means that trip there are learning aspects for geological and environmental phenomenon objects. In order to connect the abiotic features (Geological uniqueness) to biotic features, added values are something important that needs to be analyzed (Kubalíková, 2013). Several added values are present in the study area are cultural values, aesthetic values, ecological, and economical.

Cultural Values

One of the most interesting values that can supports this geotourism plan is cultural values in Rejang Lebong called *Pat Petulai*. *Pat* means four, and *Petulai* means *mergo* or groups of member of Rejang Ethnic. Those member of Rejang Ethnic are Mergo Bermani, Mergo Bejinggo, Mergo Sepanjang Jiwo, dan Mergo Bimbo, which are spreaded in North Bengkulu, Kepahiang, Rejang Lebong, and Central Bengkulu districs.This cultural values can be linked with four geotourism spots as four main geotourism spots with its own uniqueness.

The other values can be seen is the presence of myth that in the Seven Colors Hot Pools "*Putri 7 Warna*", there are tutelary spirits with with the appearance of princess, that lives in white hot pool, for the other six hot pools, it's believed to be the place where the guardians of the princes-like spirit lies.

Ecological and Aesthetical Values

As a district that located within and around of Bukit Daun National Park, and also from activity of people who dominantly do agricultural activity, ecological conditions of Bukit Daun Geothermal field could supports the geotourism activity. Agricultural activity could serving beautiful view of vegetables or fruits that has been planted, or by creative thoughts, the farm/ field owner could let the visitor pick the vegetables or fruits itself, this also could increase the economical values of the geotourism activities.

Figure 8: An example of Curup's Strawberry farm (20 Km to the East of Study Area) where the visitor could picks the farm's product by themselves (Photo credit to Yurike Anggraini).

RESULTS

From the Concept of Real TRAVEL (Hendratno, 2002), we proposed a concept of geotourism in Bukit Daun Geothermal Area. The concept of geotourism we brought is *Geodiversity in Geothermal Geotourism*. It Means that geodiversity in geothermal could become powerful tools to educate the society. The geotourism concept plan are brought because of it contains the values summarized in Table 1. besides of educational purposes, thanks to it, geotourism spots has to be conserved thorugh geoconservation as the basis of geotourism activity (Kubalíková, 2013).

Geodiversity in geothermal geotourism also a concept we proposed by linked geological, cultural, economical, and social sides of society lived within and around the Bukit Daun geothermal area in order to construct a geothermal geourism plan, so that the society will be ready to act as the organizer of those geotourisms sites, but that does not mean their old social-economical activity is gone after geotourism activitites are present. The cultural value of the Rejang Lebong such as Pat Petulai also could enrich the value of geotourism. Those are what it means what we proposed about geodiversity in geothermal geotourism, so that the visitors could found an exciting area with all of the uniqueness in Bukit Daun geothermal area, and to fill the visitor expectations; 1) sightseeing as a part of trip agenda, 2) Uniqueness photo opportunities, 3) scientific or educational study interest, and 4) curiosity and ambitions to see something unusual (Erfurt-Cooper, 2010)

Four main spots of Geotourism, Bukit Daun Garden of Tea, Seven Colors Hot Pools "*Putri 7 Warna*", Telapak Lake, and Bukit Daun Protected Rain Forest could act as the main "actors" to educate the society and visitor that lived within the Bukit Daun geothermal area differently based on their geological, Geomorphological, and soil features uniqueness , such as :

a. Bukit Daun Garden of tea, could give the information about the relation between biotic especially many varieties of vegetations with geological conditions and geomorphological conditions, that geological conditions supports the biotic features to be present, and also the economic activities in Bukit Daun. Bukit

Daun Garden of the also gives the informations about the geomorphological phenomena of Mt. Bukit Daun.

b. Seven Colors Hot Pools "Putri 7 Warna, could give the informations about how the geothermal system works as a cycle where its elements support each other to transport the heats below to the surface, and appear as manifestations, as well as the other processes appear within and around the manifestation area, i.e. hydrothermal alterations.
c. Telapak Lake could give the information about how past volcanic activity of Mt. Bukit Daun could created something amazing, in this issue is Telapak Lake. Telapak Lake also gives the information about how are the processes happened between the surface water, Lake, and the forest that support each other in their existences.
d. Bukit Daun National Park, could give the information how the volcanic activity of Bukit Daun produce volcanic deposits, and by its geomorphological conditions has made special soil features, and serving a very good place for vegetations to grow, the Bukit Daun forest itself. One of the most spectacular products of this area is Rafflesia arnoldi and Rafflesia bengkuluensis flower as provinces and national icon that only can be found in Bengkulu with Bukit Daun as the place where most of the Rafflesia flower lives.

CHALLENGES

Developing a geotourism plans is a long ways and steps, there're no guaranteed that developer does will be the success. Based on analysis before, there is five main question that needs to fulfill by developers in developing geoturism in Bukit Daun Sector, for educational purposes about geothermal phenomena and potentials, they are:

1) How are preparations we need to do in developing geothermal geotourism especially in a populated area and rain forests? The presence of rainforest is also the main factor need to be considered, because large scale of geoturism activity can be held in protected areas. The background of this question is because usually a conflict will happen between the society and the developers in the populated area where the local people are afraid if their area are exploited for some self-importance.
2) What Infrastructures are needed to build a geotourismactivity? Infrastructures are the important sides need to be improved through geotourism spots, because it will attract visitors to come to the place, besides it will serve a better and safer tourism activity, both for society and the visitor.
3) How to create the conditions where the roles of society in geotourism activity will be the organizer of it? To create the geotourism that based on education, the society have to be the organizer of the tourism activity, so they'll have to know the conditions of the area
4) Who and how the management and further development activity will be done? The further development is needed in order to create a geotourism based educations, to create it, stakeholder and the company are the responsible parties who has a better power and sometimes better knowledge about the geological and other conditions of the area.
5) How to perform geoconservation of the Bukit Daun Geothermal Area? Conservation of the sites is the final relationship and responsibility between Stakeholder, Developer company, society, and visitors to keep the nature in its good state. The acts need to do is to serve a sanitation facilities, as well as to serve the functionary staffs. is to serve a sanitation facilities, as well as to serve the functionary staffs.

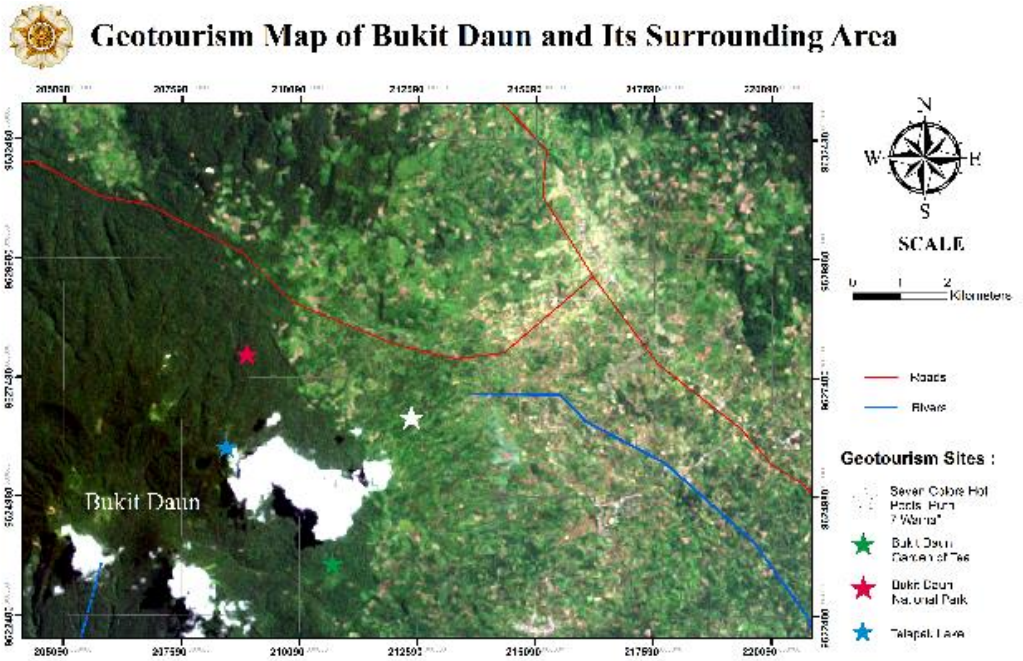

Figure 9: Geotourism maps of Bukit Daun Geothermal Area (Landsat 8 OLI/ TIRS)

CONCLUSIONS

The conclusions from this publications are Bukit Daun Geothermal Fields contains some sites/ places that have high potentials to be developed in geotourism, they are Bukit Daun Garden of tea, Seven Colors Hot Pools " Putri 7 Warna, Telapak Lake, and Bukit Daun National Park, but now the utilizations is only in its simplest ways. The collaboration of Stakeholder, company developer, and society are needed to construct a geotourism activity that based on rewarding, enriching, adventuring, and learning.

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