Conservative valuation of typical volcanic landscapes in the Pleiku basaltic plateau: some improvement

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ABSTRACT

There are tens of typical volcano-related relics such as craters and waterfalls in the Pleiku volcanic plateau, Gia Lai province however, Gia Lai's tourism has underdeveloped. Thus it is vital finding the specific tourist products to promote the provincial nonsmoking industry. Quantifying conservative values of typical volcanic landscapes in the form of money would provide useful information for decision-makers to plan and develop rural tourism. This study was applied to the contingent valuation method to estimate the conservative values of twenty volcanic landscapes in the Pleiku plateau. The results indicated that Bien Ho volcanic landscape got the highest traditional value with above 38.60 billion VND. Subsequently, the conservative value of Chu Dang Ya was 27.28 billion VND. The value of the Phu Cuong waterfall was also estimated quite highly. Furthermore, our new finding is that there was a close relationship between the results coming from the conservative valuation and the results coming from evaluation, classification of geoheritages based on UNESCO's criteria adapting in Vietnam. The study figured out that there was a close relationship between the conservative valuation and information accessibility on twenty landscapes by interviewees before.

Keywords: Conservative valuation; geoheritages; contingent valuation method; non-use value; optional value; existence value.

1. Introduction

There are some relics of young volcanic activities as Ham Rong positive crater, Bien Ho negative crater in the Pleiku plateau belonging to the Gia Lai province. Along with the previous military activities during the Vietnam war, current socio-economic development, especially urbanization, buildings replaced some craters in addition to mining sites and agricultural fields. Consequently, the relics have been modifying (Truong Quang Hai, 2016). The old volcanic remnants hide many values as such science, economic, aesthetic, culture; however, they have not been given adequate attention, especially conservation of the relics as socio-economic development activities and planning. Additionally, the Gia Lai province has been looking for specific tourism products to promote the nonsmoking

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industry (GLDCST, 2016). Therefore, building profiles of volcanic landscape values especially landscape valuation would be critical scientific bases for proposing the geological park and exclusive tourist products.

The volcanic landscapes are natural objects, hence they have total economic values consisting of use, nonuse and free ones (Marbek et al., 2010). The non-use values get existence and bequest ones. It is difficult for determining the existence or bequest value separately, thus they usually estimated along with other ones. Ruijgrok (2006) estimated the bequest and recreational value of cultural heritage. Niels et al. (2014) quantified the existence and optional value of biodiversity in the deep sea. Recently Jia et al. (2019) were determined the existence, bequest and optional value. Jia et al. (2019) estimated the non-used value (existence, bequest, and optional values) of Qingdao coast, a famous Chinese location based on the survey of tourists coming there.

According to Ruijgrok (2006) and Tanya (2012), the field of culture and society by calculation gave us the bequest value. The existing one was usually estimated for the forest and deep-sea ecosystems (Jane, 2003; Hamid et al., 2006; Lavee and Menachem, 2018). While the optional one was applied for two main directions: the first is environmental researches in which the aims are to value wild environmental and recreational resources conservation (Arin and Randall, 2002; Peters and Hawkins, 2009); the second is to estimate values which people are willing to pay to make sure uninterrupted availability of a transport facility and its services (Roson, 2000; Kiyohito, 2018). Jia et al. (2019) stated that the non-use value (existence, bequest and optional) of resources and ecosystems provides one of the most compelling incentives for their preservation.

The conservative value of natural landscapes has no price in the market thus quantification of the value in the form of money must be replied on the willingness to pay (WTP) of a person to enjoy the benefit. The contingent valuation method is a method that is applied popularly to measure the WTP (Venkatachalam, 2003; Anatoli et al., 2006; Peters and Hawkins, 2009; Niels et al., 2014; Xiuhua et al., 2015; Jia et al., 2019). These researches estimated the conservative value of landscapes by using the contingent valuation method through either WTP of people living around the landscapes (Ruijgrok, 2006; Lavee and Menachem, 2018) or tourists (Arin and Randall, 2002; Jia et al., 2019). Both these people living around the landscapes and tourists benefited from natural landscape conservation. Therefore valuation of a natural landscape only is based on neither people or tourists would not make sure its real value.

In order to resolve the above limitations this study quantified the conservative value for both of landscapes which have been exploited and unexploited for tourist, and interviewees included tourists to Gia Lai and people living on Pleiku plateau. Besides, one question arises if there is a relationship between the results of conservative valuation of natural landscapes and the ones coming from evaluation of geoheritages' values. The other question is if there is a relationship between the conservative assessments with information accessibility on landscapes by interviewees before. The study aim is the conservative valuation of typical volcanic landscapes (unknown and well known) in the Pleiku basaltic plateau belonging to the Gia Lai province by the contingent valuation method with improvement to enhance the accuracy of the results, simultaneously answers two mentioned questions.

2. Materials and Methods

2.1. Typical volcanic landscapes in the study area

The Pleiku basalt plateau was formed in the coeval cessation of seafloor spreading in the East Vietnam Sea and extrusion of the

Indochina block. It resulted in the Early Cenozoic India-Asia collision. The collision made the upper mantle shearing toward the southeast along the Ailao Shan-Red River fault, simultaneously pushed the lower mantle toward the east and west. The plateau was built up by two major eruptive episodes: (1) the earlier phase (6.5–3.4 Ma), the upper complex (2.4–0.2 Ma) (Nguyen Hoang et al., 2013). Consequently, the plateau retained some relics on the volcanic activities as such Ham Rong positive crater, Bien Ho negative crater. Volcanic heritages are typical geological structures formed by different volcanic activities. The volcanic heritages were taken into consideration as unique volcanic landscapes. Three typical aspects of the plateau that were selected to estimate their conservative value are positive, negative craters and waterfalls.

(i) Positive crater characters

According to Macdonald (1972), a central eruption type may form positive craters. Its morphology is a truncated cone, funnel-shaped crater, sunken in the middle and higher crater edges. The outer slope of the crater is more comfortable than the inner ones. It nearly circles on maps, for example, Ham Rong mountain. Due to their lava having low volatile substances and relatively high viscosity, it made them extrude, rise gradually and shape a cone hence the creation of caters. By the time around the crater could be truncated and lowered because of eruption rock weathering, even the top of funnel usually was weathered stronger to shape a basin with different shallowness and deepness because rocks in the volcanic throat often have a weak structure and easy to wither.

(ii) Negative crater characters

It is formed by the central eruption type, characterized by the termination of the second eruptive episode. This episode was dominated by low-SiO_2, high-TiO_2, and high-FeO olivine–tholeiite, alkali basalts (Hoang et al., 2013). Consequently, the explosive eruption occurred and hence the craters were formed, for instant Bien Ho landscape. Besides, their lava had low viscosity; thus as erupting, they had not made a volcanic chine and moved around. The volcanic throat also has a weak structure and easy to weather, therefore it often forms a basin with water (Macdonald, 1972).

(iii) Waterfall characters

A waterfall is a cascade of water falling from a height, created when a river or stream flows over a precipice or steep incline. If it is faulted (for example Phu Cuong waterfall) or moving along different landform slopes with above 30°. In both cases, the water column height from bottom to top is more than 3 m (world-of-waterfalls.com).

Based on satellite images, geological documents, and field surveys, 20 volcanic landscapes in the study area were selected to quantify conservative values (Fig. 1).

2.2. Contingent valuation method

The contingent valuation procedure was carried out as below steps (Venkatachalam, 2003; Anatoli et al., 2006; Peters and Hawkins, 2009; Niels et al., 2014; Xiuhua et al., 2015; Jia et al., 2019):

Step 1: Defining objectives: the study aims to quantify the conservative value of 20 volcanic landscapes in the form of money.

Step 2: Determining interviewees and sample size: the contingent valuation method is a method of estimating the willingness of persons to pay in order to enjoy a particular value. In this case, the study interviewees must be people who enjoy the benefits of 20 landscapes directly. They are people living in the Pleiku plateau (8 districts) and tourists.

Defining a sample size and a method choosing a sample: the survey population is 882.100 people (in 2017) living in the Pleiku plateau (GSO, 2016) and domestic tourists visiting Gia Lai province is 98.070 (GCCTC,

2018) (Table 1). Therefore, Slovin's equation (1) (cited by Jeffry and Joyce, 2012) defined the sample size to interview i.e.

$$n = N/(1+N*e^2) \quad (1)$$

Where: n: sample size; N: the population; e: marginal error $(=10\%)$

So, $N = 980,170$, $e = 10\%$, the minimum sample size: $n = 100$. However the population includes eight districts and tourists, random stratification should be assigned to get the representative sample (2).

$$n_h = (n/N)*N_h \quad (2)$$

Where: n_h: a sample size of the hth district (8 districts and tourists considered as a district); n: the sample size; N: the population; N_h: Population for each district.
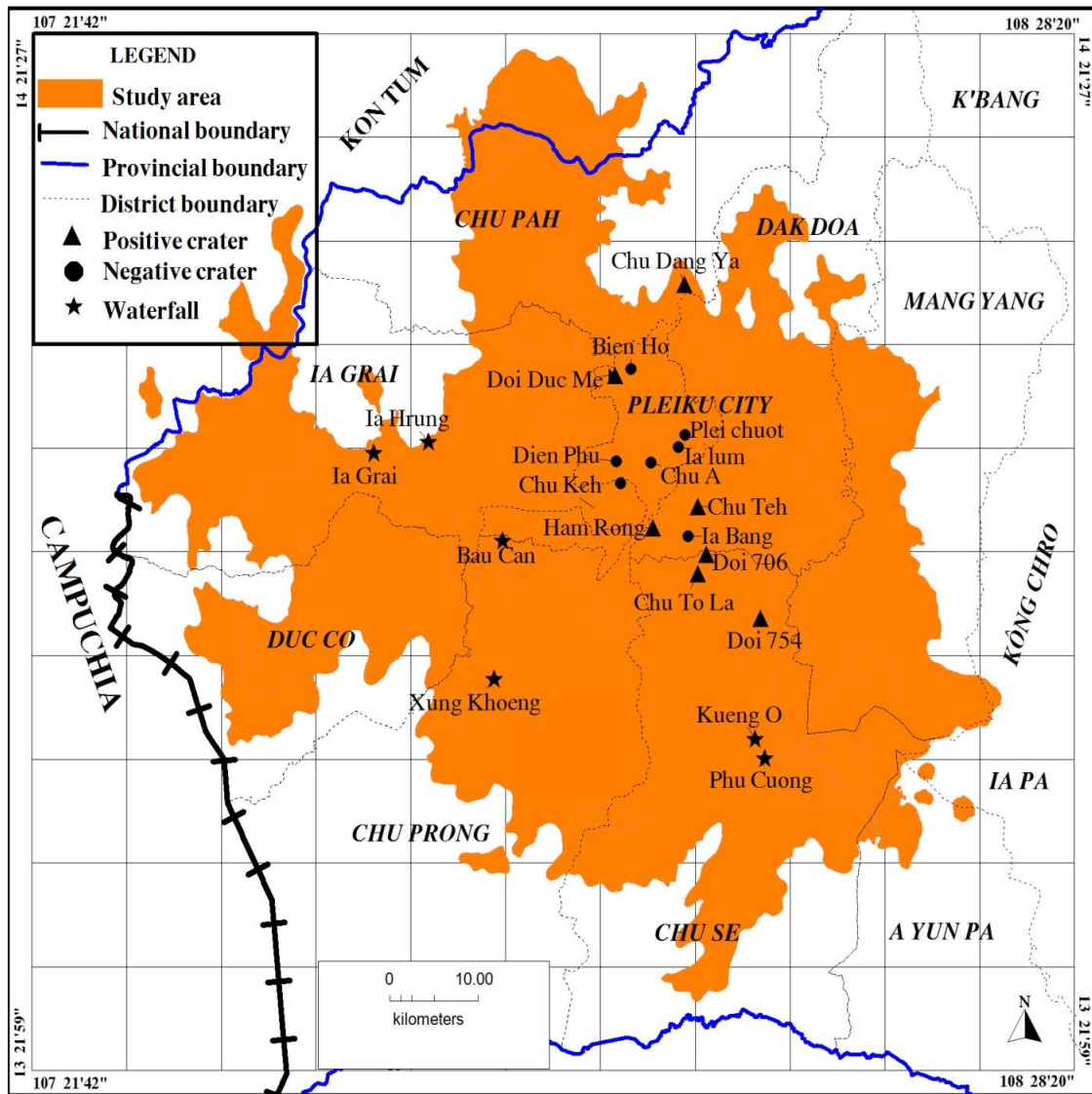

Figure 1. Map of 20 landscape sites in the Pleiku plateau

Table 1. Population of the eight surveyed districts in Gia Lai province and total of 2016 domestic tourists in the plateau and the sample size

District	Population in 2017 (person)	Expected questionaires	Questionaires done
Pleiku	234,254	24	30
Ia Grai	98,014	10	15
Mang Yang	64,567	7	8
Dak Đoa	111,473	11	13
Chu Pah	73,821	7	8
Duc Co	70,627	7	9
Chu Prong	110,808	11	15
Chu Se	118,536	12	13
Tourists	98,070	10	28
SUM	980,170	100	139

While interviewing in the districts, the sample size of each district was classified into two groups including urban and rural residents to enhance the result confidence.

Step 3: Designing questionnaires and a scientific profile of 20 landscapes, determining tools supporting during the surveying and interviewing trip:

The profile was built based on published articles, scientific reports and field trips (Appendix A). It was presented shortly, easily understandable, cut down academic languages. It consisted of below information: (1) Map of 20 landscapes site; (2) Common characters as their formation origin (20 landscapes); (3) Common characters of each landscape group (Positive, negative craters, waterfalls); (4) There is unique information for each landscape including a landscape image (coming from the field trips or internet or Google map), location, extent, outstanding values: scientific, education, aesthetic, cultural, and tourist infrastructures.

The questionnaires were designed to get personal information, social factors affecting WTP of interviewees as such age, job, sex, education, income (Jia et al., 2019), family size, marital status (Abebe et al., 2019), ethnic, urban, rural, information accessibility on landscapes by interviewees before (Appendix B). Questions for interviewers also were prepared to make facilities of asking and

answering. For example, (a) a willingness to pay to preserve the landscape for future use, such as for recreational purposes. This value is called the option value; (b) a person willing to pay for conservation, even if he/she does not use or intend to use it. He/she desires that his/her children or the next generation have the opportunity to use it. This information is called the bequest value. (c) A person who is willing to pay for preserving it because he/she wants the landscape to continue to exist. It could come from its real or spiritual value and the right of other living creatures in the landscape or depending on the landscape existence. It is referred to as existence value (Vu Tan Phuong, 2006). Like this, to assure the willing to pay for three above mentioned values, the question is "How much are you willing to pay to conserve and embellish a volcanic landscape,... for now, and next generations?"

Step 4: Integrating, analyzing data and calculating the results;

Step 5: Assessing the result's confidence.

Software that supports data storage, processing and analysis are Excel 2010 and IBM SPSS Statistics 20.

2.3. Statistic method

To distinguish between the WTP and social factors, the Pearson correlation coefficient was used and analyzed. The coefficient measures the linear correlation between the two variables. The Pearson correlation coefficient was calculated by the following formula:

$$r = \left. \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \middle/ \sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2} \right. \quad (3)$$

Where: x and y: two variables, n: the sample size; r: the Pearson correlation coefficient.

It ranges from 1 to -1 and the geoheritage condition which the correlation is significant is the sig. value below 0.05 (Hoang Trong and Chu Nguyen Mong Ngoc, 2008).

2.4. Method evaluating and classifying geoheritage

The objective of the evaluation of geoheritages was to determine the conservative significance of these heritages. In 2005, the International Union for Conservation of Nature (IUCN), an independent consultant institution supporting UNESCO to assess geoheritage profiles, proposed a guideline to prepare documents for areas where have outstanding geomorphological, geological values in the world. According to the guideline, 13 geoheritages were classified, and the volcanoes and volcanic systems are one of them (Paul et al., 2005).

Generally, each country develops its evaluation system based on UNESCO's principles. Like all countries around the world, Tran Tan Van et al. (2010) developed the criteria system to evaluate and classify geoheritages in Vietnam. It is composed of 6 criteria groups: (1) Education and scientific values, (2) Geomorphological, geological diversity, (3) Aesthetic and landscape values, (4) Historical, social and cultural values, (5) Threats and conservative demands, (6) Usage and exploitation potential. Each criterion has a scoring scale. According to each scales, geoheritages belonging to the same type in a given region would be assigned scores by experts. Experts who participated in the field strips in 2017, 2018, studied the components and values of the landscapes. The profile of each landscape (geoheritage) summarized briefly as Appendix A. On the basis of this profile, experts would assign by scoring landscapes. The experts usually assign scores by comparing relatively a considering geoheritage to other ones in the study area and the other one in different regions. The total score that each geoheritage could obtain is 100. From the overall score, geoheritages will be classified: national geoheritages (above 50 ratings), local ones (below 50 ratings). Concerning the national geoheritages, the ones which have a total score of criteria group 1 (Education and scientific values) and 2 (Geomorphological, geological diversity) above 35 will be taken into consideration to international extent. The procedure was carried out as the following steps:

Step 1: Defining geoheritages

Step 2: Developing the geoheritages' profiles based on the criteria and articles, scientific reports, other documents

Step 3: Rating geoheritage values based on the score scales proposed by Tran Tan Van et al. (2010).

Step 4: Calculating total scores and ranking

3. Results

3.1. The sample size characters

The sample size was 139 persons (interviewees). The Kinh occupied the majority of the surveyed people. Males and females, persons, living in urban and rural were similar. Concerning age, interviewees ranging from age group 23 to 40 accounted for 70%. Subsequently, the 41 − 55 accounted for 28%, and group 55 and above occupied 15%. For the marital status, interviewees graduating high school were 57% in the sample size. Despite the diversity of the interviewees', the majority of them were agricultural labors. Based on the income, interviewees having an income ranging from 4 to 5 million VND accounted for 38%. The ratio of interviewees who knew Bien Ho was very high (100%), while interviewees did not know the Doi 706, Chu To La, and Doi 754.

3.2. Conservative valuation of positive craters

3.2.1. Conservative valuation

Figure 2 shows that the WTP of interviewees for conserving the Chu Dang Ya positive crater is the highest (27.28 billion VND–1.24 million USD), subsequently the Ham Rong, the Doi Duc Me, and the last one is the Doi 706.
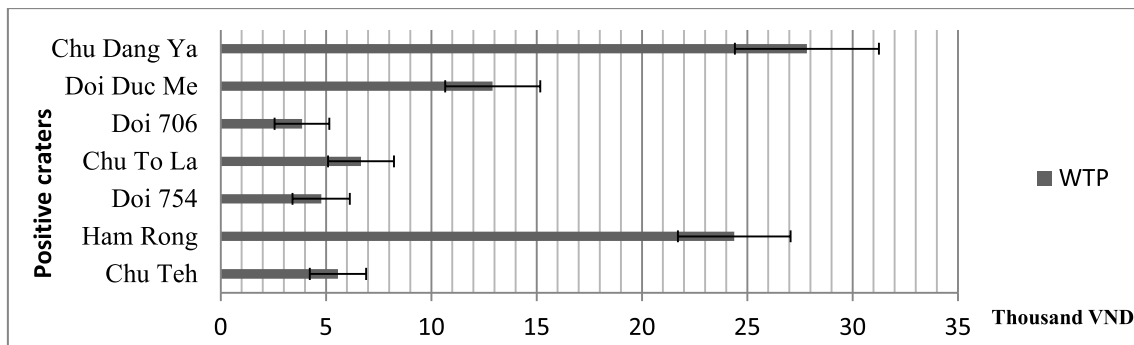
Figure 2. The average WTP per capita for conserving the positive craters in the Pleiku

The Chu Dang Ya has been a quite famous crater to a large extent in Vietnam up to now; there were 100% of interviewees knowing it before. Two reasons lead to the results: first, it is a majestic mountain conserved intact and covered by wild sunflowers and maize, sweet potato fields; secondly, the wild sunflower festival has been held in the landscape since 2017. Consequently, the media has contributed importantly to the advertisement of the landscape values. This led to the highest conservative valuation of the Chu Dang Ya. Like the Chu Dang Ya, the Ham Rong mountain with 1000 m elevation preserved intact and was a tourist symbol of the Gia Lai province before. It has been the Rong house symbol of local ethnic, too. But the site has been set up a transceiver station, and people have been restricted to arrive there. Therefore, the conservative valuation was quite high, 23.9 billion VND. Unlike the above-mentioned landscapes, the Doi Duc Me's extent was not significant, it has not been intact, but its location is situated in the center of Pleiku city thus visitors can see the whole town at the site. The other word, there was a spiritual symbol of the statue of Our Lady. Hence the landscape has conservative values not only nature but also spirit. Finally, the traditional valuation of the Doi Duc Me was 12.66 billion VND (576.000 USD). The remaining positive craters got a low conservative estimate, ranging from 3.7 to 6.5 billion VND (168.000–295.000 USD) due to their extent is small, and they have destroyed quite much by cultivation.

The statistical analysis results showed that the mode of the WTP of interviewees for the Chu Dang Ya was 10,000 VND, meaning that persons who were willing to pay at 10,000 VND to preserve the Chu Dang Ya were the highest. The median for the Chu Dang Ya and Ham Rong was 10,000 VND, while the one for the Doi Duc Me and the remaining landscapes was 1000 VND and 0 VND, respectively (Table 2). Like this, at least 50% of interviewees were willing to pay 1000 VND for conserving the Doi Duc Me, at least 50% of interviewees were willing to pay 0 VND for preserving the remaining positive crater landscapes (Doi 706, the Chu To La, Doi 754 và Chu Teh). Almost all interviewees evaluated the low conservative value of the remaining landscapes. They thought that not only were landscape not intact but also there was no need to preserve. The standard errors of the WTP for conserving the Chu Dang Ya, Ham Rong, and Doi Duc Me landscape were 2,260–3,421 VND, while the ones for the remaining landscapes were low because almost interviewees assessed low the conservative value of the landscapes.

21

Table 2. Statistic parameters of the WTP of interviewees for conserving the positive craters

Unit: 1000 VND

Parameters	Name of landscapes						
	Chu Dang Ya	Doi Duc Me	Doi 706	Chu To La	Doi 754	Ham Rong	Chu Teh
Mean	27.83	12.91	3.86	6.66	4.78	24.39	5.57
Standard errors	3.421	2.260	1.300	1.568	1.358	2.675	1.333
Median	10.00	1.00	0.00	0.00	0.00	10.00	0.00
Mode	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	200.00	200.00	100.00	100.00	100.00	150.00	100.00
Valuation	27,282,573	12,657,591	3,786,700	6,529,765	4,682,251	23,904,865	5,457,925

3.2.2. Effects of social factors on the conservative valuation

To analyze the effects of social factors on the conservative valuation of the positive crater landscapes, the Pearson correlation coefficient was determined and assessed.

Table 3 indicated that the WTP of interviewees for conserving the positive crater landscapes depended on the social factor. Especially, for the age factor, there were 6/7 of the landscapes which their conservative valuation depending on this factor.

Table 3. The correlation coefficient of conservative valuation and social factors

Unit: 1000 VND

Names	Parameter	Ethn.	Age	Sex	Urban-Rural	Marital status	Numb. Person	Educat.	Job	Income	Know
Chu Dang Ya	Correlation	0.126	0.153	0.078	0.001	0.065	-0.050	0.088	0.160	0.402[b]	0.047
	Sig.	0.138	0.071	0.363	0.992	0.445	0.604	0.304	0.061	0.000	0.588
Doi Duc Me	Correlation	0.126	0.186[a]	0.095	0.013	0.067	-0.087	0.113	0.072	0.018	0.272[b]
	Sig.	0.140	0.029	0.267	0.882	0.435	0.368	0.187	0.400	0.835	0.001
Doi 706	Correlation	0.055	0.257[b]	0.069	0.043	0.080	-0.129	0.258[b]	0.097	0.090	.c
	Sig.	0.519	0.002	0.419	0.619	0.349	0.183	0.002	0.258	0.291	
Chu To La	Correlation	0.101	0.269[b]	0.134	0.101	0.041	-0.123	0.165	0.113	0.152	.c
	Sig.	0.239	0.001	0.117	0.237	0.634	0.204	0.053	0.184	0.075	
Doi 754	Correlation	0.081	0.238[b]	0.107	0.084	0.068	-0.114	0.274[b]	0.079	0.105	.c
	Sig.	0.344	0.005	0.212	0.328	0.424	0.239	0.001	0.356	0.218	
Ham Rong	Correlation	0.226[b]	0.222[b]	0.085	0.002	0.042	-0.117	-0.045	-0.008	0.011	0.007
	Sig.	0.007	0.009	0.322	0.982	0.623	0.228	0.603	0.926	0.898	0.933
Chu Teh	Correlation	0.105	0.213[a]	0.060	0.087	0.102	-0.043	0.191[a]	0.092	0.116	0.148
	Sig.	0.219	0.012	0.482	0.306	0.233	0.658	0.024	0.284	0.173	0.084

Note: [a]: Correlation is significant at the 0.05 level; [b]: Correlation is significant at the 0.01 level; c. Cannot be computed because at least one of the variables is constant

Concerning the education one, there were 2/7 of the landscapes that their conservative cost depended on this factor. Basing on other factors like ethnicity, income and know, there was only one landscape which its conservative cost depended on their factors. The remaining factors including the gender, urban-rural, marital status, several persons in household and job have had no effects on the conservative valuation of the landscapes. For the landscapes: the Doi 706, Chu To La and Doi 754, their morphology mostly was destroyed and

replaced by crops. Thus 100% of interviewees answered: "didn't know before". Each volcanic landscape has a different location, morphological characters, extent, aesthetic, cultural, scientific, education values hence the correlation between the WTP and the social factors is different, too. Notably, the WTP for conserving the Chu Dang Ya landscape had the highest Pearson correlation (at significance below 0.05) with the income factor (0.402). It means that the higher her/his income had, the higher her/his WTP was. Concerning the landscapes are known as little such as the Doi 706, Chu To La, Doi 754 and Chu Teh, the WTP depended on the age and education factors. While for the Ham Rong landscape, the WTP correlated with the ethnicity and age factor. It means the higher the Kinh was willing to pay, the lower the non-Kinh was, and the higher, the older persons were willing to pay, the lower, the younger ones were.

3.3. Conservative valuation of negative craters

3.3.1. Conservative valuation

Bien Ho is a national famous beautiful site. It is formed by three negative craters, which is a typical negative crater in the Tay Nguyen region. Many legends are related to it, too. There are seven negative craters in the Pleiku plateau that were selected to study. The results of conservative valuation indicated that the Bien Ho obtained the highest conservative estimate (38.6 billion VND–1.75 million USD). The cost was much higher than the one of the remaining negative crater landscapes. Among these remaining landscapes, the conservative valuation of Ia Bang was a little higher than the others. The conservative valuation of the Plei Chuot, Ia Lum, Chu A, Chu Keh, and Dien Phu landscape was the same, from 4.3 to 5.8 billion VND (195,000 USD–264,000 USD) although their extent was either large or small (Fig. 3, Table 4).

Figure 3. The average WTP per capita for conserving the negative craters in the Pleiku

Table 4. Statistic parameters of the WTP of interviewees for conserving the negative craters

Unit: 1000 VND

Parameters	Name of landscapes						
	Bien Ho	Plei Chuot	Ia Lum	Chu A	Chu Keh	Dien Phu	Ia Bang
Mean	39.39	5.56	4.77	5.81	4.41	5.90	10.76
Standard errors	4.27	1.47	1.27	1.34	1.26	1.44	1.68
Median	20.00	0.00	0.00	0.00	0.00	0.00	1.00
Mode	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	200.00	100.00	100.00	100.00	100.00	100.00	100.00
Valuation	38,607,414	5,450,873	4,675,199	5,690,627	4,322,620	5,782,298	10,542,116

These landscapes have not been intact. They have been exploited for the cultivation of paddy rice, and most interviewees knew them. Unlike these landscapes, the Ia Bang

has been kept negative crater primary and known by many people because there have some tourist activities at weekends as well as fishing. The reasons lead to the above results. For the conservative valuation of Bien Ho, the standard error of the WTP is 4,267 VND, while the median is 20,000 VND, while for the one of remaining negative crater landscapes, the standard errors of the WTP range from 1,262–1,676 VND and the modes are 0 VND (it means that almost interviewees thought the landscapes were not needed to preserved).

3.3.2. Effects of social factors on the conservative valuation

Table 5 presented that the age, education and ethnic factors that affected the conservative valuation of negative craters: the Bien Ho, Plei Chuot, Ia Lum, Chu A và Chu Keh, while the WTP of interviewees for conserving the Dien Phu and Ia Bang did not have effects surveyed by social factors. According to Bien Ho, the conservative valuation was directly proportional to the ethnicity and age factor. The higher the WTPs were, the older ones were.

Table 5. The correlation coefficient of conservative valuation and social factors

Name	Parameter	Ethn.	Age	Sex	Urban - Rural	Marital status	Numb. Person	Educat.	Job	Income	Know
Bien Ho	Correlation	0.197[a]	0.278[b]	0.085	-0.075	0.109	-0.019	-0.149	0.053	0.008	0.091
	Sig.	0.020	0.001	0.319	0.380	0.203	0.844	0.080	0.533	0.921	0.291
Plei Chuot	Correlation	0.087	0.170[a]	0.080	0.097	0.128	-0.027	0.270[b]	0.090	0.101	0.028
	Sig.	0.310	0.045	0.349	0.254	0.134	0.780	0.001	0.293	0.235	0.747
Ia Lum	Correlation	0.080	0.184[a]	0.062	0.106	0.108	-0.088	0.229[b]	0.085	0.111	-0.074
	Sig.	0.348	0.030	0.465	0.212	0.206	0.365	0.007	0.318	0.194	0.387
Chu A	Correlation	0.111	0.224[b]	0.033	0.080	0.131	-0.088	0.165	0.074	0.090	-0.045
	Sig.	0.191	0.008	0.700	0.350	0.125	0.366	0.053	0.387	0.292	0.602
Chu Keh	Correlation	0.075	0.130	0.048	0.138	0.078	-0.066	0.198[a]	0.119	0.125	-0.064
	Sig.	0.381	0.127	0.577	0.106	0.360	0.498	0.019	0.163	0.142	0.458
Dien Phu	Correlation	0.093	0.117	-0.026	0.053	0.105	0.055	0.077	0.037	0.066	-0.030
	Sig.	0.276	0.171	0.764	0.539	0.220	0.574	0.366	0.661	0.443	0.727
Ia Bang	Correlation	0.118	0.097	0.064	0.051	0.041	0.004	0.051	0.059	0.032	-0.087
	Sig.	0.168	0.257	0.454	0.554	0.628	0.967	0.555	0.489	0.712	0.312

Note: [a]: Correlation is significant at the 0.05 level, [b]: Correlation is significant at the 0.01 level

3.4. Conservative valuation of waterfalls

3.4.1. Conservative valuation

The results showed that the conservative valuation of waterfall landscapes was often quite high, from 16.5 to 26 billion VND (0.75–1.18 million USD). The reason due to the exception of the conservative value since it was easy to find the recreational values by interviewees such as crossing a stream, swimming, fishing, besides sightseeing (Fig. 4). The conservative valuation of the

Phu Cuong waterfall landscape was the highest (26 billion VND–1.18 USD). This waterfall was planned for developing provincial tourism. Thus the media activities have been carrying out actively. There were 36% of interviewees answering "have been there before". The mode value of the WTP for preserving the Phu Cuong was 10,000 VND. The standard errors of the WTP for conserving the waterfalls were also the same and ranged from 2,710 to 3,376 VND (Table 6).
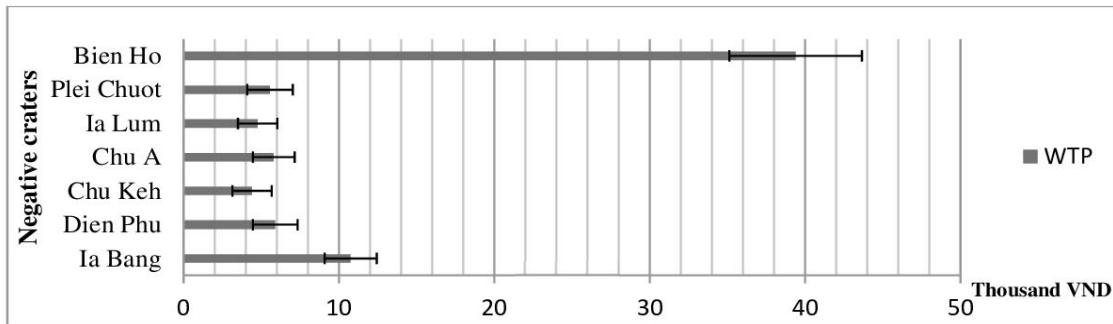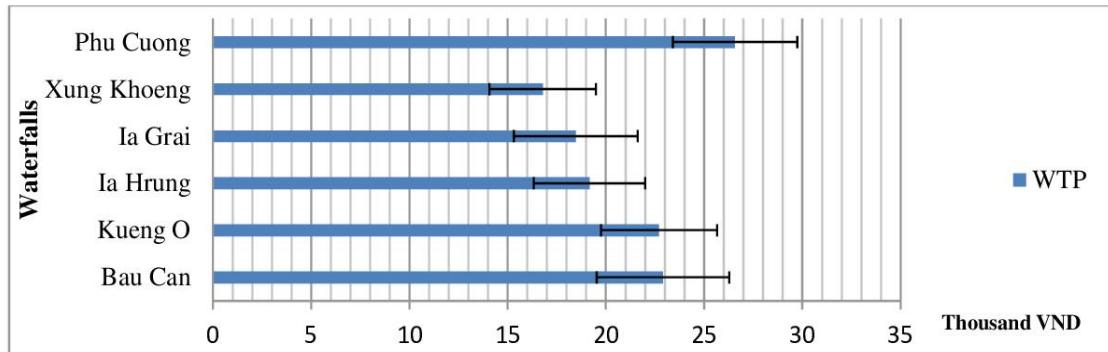
Figure 4. The average WTP per capita for conserving the waterfalls in the Pleiku

Table 6. Statistic parameters of the WTP of interviewees for conserving the waterfalls

Unit: 1000 VND

Parameters	Name of landscapes					
	Phu Cuong	Kueng O	Ia Hrung	Ia Grai	Xung Khoeng	Bau Can
Mean	26.58	22.71	19.17	18.47	16.78	22.91
Standard errors	3.17	2.95	2.83	3.16	2.71	3.38
Median	10.00	10.00	5.00	5.00	5.00	10.00
Mode	10.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	200.00	200.00	200.00	200.00	200.00	200.00
Valuation	26,048,546	22,254,794	18,785,416	18,101,412	16,451,342	22,452,239

3.4.2. Effects of social factors on the conservative valuation

Among the six surveyed waterfalls, the WTP for conserving the Phu Cuong and Bau Can only correlate with the age factor, the Pearson correlation coefficient was 0.186 and 0.221, respectively. The remaining waterfall landscapes, the WTP for preserving them did not correspond with the surveyed social factors (Table 7).

Table 7. The correlation coefficient of conservative valuation and social factors

Names	Parame.	Ethn.	Age	Sex	Urban-Rural	Marital status	Numb. Person	Educ.	Job	Income	Know
Phu Cuong	Correlation	0.160	0.186[a]	0.141	0.041	0.076	-0.123	-0.025	0.050	0.035	0.013
	Sig.	0.059	0.028	0.098	0.633	0.372	0.205	0.766	0.556	0.685	0.879
Kueng O	Correlation	0.084	0.117	0.165	0.041	0.031	-0.098	-0.068	0.028	0.036	-0.088
	Sig.	0.326	0.171	0.052	0.635	0.719	0.313	0.427	0.747	0.676	0.302
Ia Hrung	Correlation	0.083	0.123	0.140	0.030	0.034	-0.069	-0.071	-0.033	0.004	-0.112
	Sig.	0.333	0.149	0.100	0.724	0.690	0.481	0.403	0.702	0.964	0.192
Ia Grai	Correlation	0.083	0.142	0.088	-0.027	0.084	-0.059	-0.121	-0.087	-0.012	-0.146
	Sig.	0.330	0.095	0.304	0.755	0.323	0.544	0.156	0.306	0.886	0.088
Xung Khoeng	Correlation	0.082	0.137	0.112	0.035	0.068	-0.021	-0.070	-0.017	0.005	0.147
	Sig.	0.339	0.109	0.188	0.680	0.427	0.827	0.415	0.845	0.956	0.086
Bau Can	Correlation	0.116	0.221[b]	0.137	0.000	0.091	-0.044	-0.079	-0.051	0.013	0.037
	Sig.	0.173	0.009	0.108	0.997	0.285	0.652	0.358	0.549	0.878	0.666

Note: [a]: Correlation is significant at the 0.05 level; [b]: Correlation is significant at the 0.01 level

3.5. The results of the evaluation, classification of geoheritages in the Pleiku plateau

Table 8 presented the results of the evaluation, classification of geoheritages for 20 the above volcanic landscapes in the Pleiku plateau. The results indicated that with respect to "Education and scientific values" the Bien Ho was obtained with the highest score (34/40), for "Geomorphological, geological diversity" the Bien Ho was evaluated with a high score of (7/10), with respect to "Aesthetic and landscape values" the Bien Ho also was assigned the highest off (10/10), for "Historical, social and cultural values" the Bien Ho was also assessed the largest score of (9/10), for "Threats and conservative demands"; the Bien Ho was obtained the biggest score of (9/10), the lower were Phu Cuong and Chu Dang Ya (8/10), with respect to "Usage and exploitation potential", the Bien Ho and Phu Cuong were assigned with absolute score of (20/20). According to the six criteria groups, three landscapes including the Bien Ho negative crater, Ham Rong positive crater and Phu Cuong waterfall were evaluated with high total scores which were: 89/100, 65/100, and 60/100, respectively. Subsequently, the Chu Dang Ya positive crater was 57/100, the Ia Grai waterfall obtained a total score of 50/100. The other landscapes obtained overall score were less than 50 and classified as the local geoheritages.

Table 8. The system of evaluation, classification of geoheritages in the Pleiku plateau

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
1	Education and scientific values (40-4 scores)																					
1.1	*Intactness (10-1 scores)*																					
-	Very good, have not or little affected by natural/human factors (10–7 scores)	7							7					7	8	9	8	7	7			9-It is quite wild, although there has been spontaneous tourism activities and there are no traces of collapsing at the foot of the waterfall. 8-It is quite wild, there has been spontaneous tourism activities and there are traces of collapsing at the foot of the waterfall. 7-L1: there are cultivating activities on the crater surface but there are no changes in its morphology; L8: there are some constructions around the Bien Ho as such the embankment, observation hut, spillway. Beside mining activities are used to occur at the Bien Ho (Nguyen Thi Minh Thuyet et al., 2016); L15: there is a staircase was constructed in the waterfall and there are

26

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
																						traces of collapsing; L19 and L20: There is a hydroelectric plant close to the waterfall toward upstream.
-	Quite good, have been affected by natural/human factors but the scientific values have still safeguarded, and reduction solutions are feasible as applied (6-4 scores)						6	6		5	5	5	5	5	4							6-L6: it was the signaling station of the US military base in the Vietnam war. It was cleared, leveled as a road, with a military base at the foot of mountain; after the war, there was stone exploitation at the foot of the mountain (Nguyen Thi Minh Thuyet et al., 2016); today it is a provincial broadcast station. However, its morphology and extent have not been changed much; L7: There have been farming activities on the crater surface but have not changed its morphology, but due to lying close to the road, the human impacts are quite great. 5- There have been farming activities on the crater surface but its morphology have not changed. There are feasible mitigation solutions. 4- There have been farming activities in the crater; infrastructures for recreational activities such as road access to the lake, fishing and restaurants have been built; There are gem mining activities around the crater.
-	Relatively good, have been affected much by natural/human factors, reduction solutions are difficultly feasible as applied (3-1 scores)		3	3	3	3																	3- There are activities of exploiting construction materials at the foot of the crater. Other human activities: road construction, leveling, building houses... Due to being partially excavated and leveled, the mitigation measures are difficult to implement.

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
1.2	*Rareness (10-1 scores)*																					
-	Very rare in the national and international scale (10 – 7 scores)						8		9													9-Large extent: 230 ha, called as "Sea"; The Bien Ho consists of 3 adjacent negative craters, 21 m deep (EOS, 2018). With the above characteristics, the Bien Ho is unique in Vietnam. 8-Large scale (over 1028 m high, extent: 70 ha). Although there are some positive craters in Tay Nguyen, only Ham Rong has large extent and high elevation.
-	Quite rare, could be seen in one or two different places on the national scale (6-4 scores)	6													6	4			5	4		6-L1 and L14: It is quite rare, however it can still be seen in one or two other places in Tay Nguyen, Vietnam. 5-L18: There is a foot cave, formed by fault and on basalt. 4-L15, L19: formed by fault, on basalt.
-	Relatively rare, could be seen in more two (some) different places on the national scale (3 – 1 scores)		1	1	1	1		1		1	1	1	1	1		3	3				3	3- Waterfalls formed on basalt and they can be found in some places in Tay Nguyen, Vietnam. 1- These craters can be found in many places in Tay Nguyen, Vietnam.
1.3	*Representativity (10-1 scores)*																					
-	Very representative, show very clearly geomorphological, geological processes, phenomena, events (10-7 scores)						8		9							8			8	8		9-L8: shows clearly the eruption process, as a storage of eruption rhythms, the sediment samples which are very important for paleogeographical researches; The crater covered on ancient metamorphic rocks; shows eruption activities of 3 negative craters in the same narrow area. 8-L6: According to Trinh Danh, there are 3 eruption rhythms in β Q₂ in the geological cross section. The horseshoe shape clearly shows the eruption process. L15, L18, L19:

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
-																						demonstrate the process of tectonic fault (downgrade to create walls).
-	Quite representative, show geomorphological, geological processes, phenomena, events (6-4 scores)	5													5		4	4			4	5-L1: demonstrates the high viscosity lava eruption process. Explosion eruption to create tuffs. L14: shows the high viscosity lava eruption process. The process of gem formation. 4-demonstrating tectonic activities; There is a phenomenon of headward erosion.
-	Relatively representative, geomorphological, geological processes, phenomena, events could be recognized (3-1 scores)		2	2	2	2		2		3	3	3	3	3								3- demonstrate high viscosity eruption process, show more clearly the eruption process than the negative craters (has score 2). 2- demonstrate low viscosity eruption process.
1.4	*Typical level (10-1 scores)*																					
-	Very typical in the similar kind of geoheritages (10-7 scores)						8		9													9-Typical morphology of crater's lip (circle, radiate). Large extent and high typical level for eruption with low viscosity. 8-Large extent and typical morphology for volcanic positive craters: horseshoe-shaped.
-	Quite typical in the similar kind of geoheritages (6-4 scores)	6													6	4			5	4		6- Quite typical in size and shape, however, can still be seen one or two craters similarly in the Tay Nguyen, Vietnam. 5-L15: Quite typical for waterfalls that are formed by fault, on basalt, and there is a foot cave. 4-L15, L19: Quite typical for waterfalls that are formed by fault, on basalt.
-	Relatively typical in the similar kind of geoheritages (3-1 scores)		1	1	1	1		1		1	1	1	1	1			3	3			3	3- Relatively typical; the waterfalls that are formed on basalt but they can be found in some places in Tay Nguyen.

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
																						1- Relatively typical, the waterfalls and craters are formed on basalt but they can be found in many places in Tay Nguyen.
	Total score of criteria group 1	24	7	7	7	7	30	10	34	10	10	10	10	10	21	23	18	19	26	23	17	
2	Geomorphological, geological diversity (10-1 score)																					
-	Very diversity, how many (above 4) Geomorphological geological processes, phenomena, events, characters (10 – 7 scores)								7													7- L8: Very diversity, shown: (1) The eruption process, (2) The Aluvial and Deluvial accumulating processes, (3) can see the geological exposures of metamorphic rock along the lakeside, (4) can see the basalt section covering the intrusive magmatic rocks, (5) can see sediments in the lake bed showing palaeoenvironment changing processes.
-	Quite a diversity, show quite many (3 -4) Geomorphological geological processes, phenomena, events, characters (6-4 scores)	4					4								4	4			4	4		4- L1, L6: shown (1) Central eruption process, (2) Explosive eruption activities making tuffs, (3) Erosional processed creating grooves on the surface. L14: shown (1) eruption process, (2) exogenesis process, (3) gem formatting processes. L15, L18, L19: shown (1) tectonic activity, fault, (2) collapse, (3) erosion.
-	Relatively diversity, show some (1 -2) Geomorphological geological processes, phenomena, events, characters (3-1 scores)		2	2	2	2		2		2	2	2	2	2			3	3			3	3- shown (1) the collapse process, (2) the erosion processes. 2- shown (1) eruption process, (2) exogenesis process.
	Total score of criteria group 2	4	2	2	2	2	4	2	7	2	2	2	2	2	4	4	3	3	4	4	3	
3	Aesthetic and landscape values (10-1 scores)																					
-	Very beautiful, have been confirmed as a national/international beautiful site (10 – 7 scores)								10													10- Bien Ho was granted by the Ministry of Culture and Information with the National scenic spot on

No	Criteria	Name																			Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
																						November 16, 1988.
-	Quite beautiful, have prospect admitted as beautiful national site (6-4 scores)	4					6									4							6-L6: Quite beautiful, has many prospects. Trinh Danh's study (2004): Ham Rong was proposed a geological heritage at national level. 4- Quite beautiful, promising to be recognized as a provincial beauty spot.
-	Relatively beautiful, not bright prospect admitted as beautiful national site (3-1 scores)		1	1	1	1		1		1	1	1	1	1	3		2	2	3	2	2	3-In planning (GLDCST, 2016) is assessed as a provincial level tourism resource. 2-Waterfalls have a higher aesthetic value than the remaining craters; 1-Relatively beautiful.
	The total score of criteria group 3	*4*	*1*	*1*	*1*	*1*	*6*	*1*	*10*	*1*	*1*	*1*	*1*	*1*	*3*	*4*	*2*	*2*	*3*	*2*	*2*	
4	Historical, social and cultural values (10-1 scores)																					
-	Very high, was already confirmed or had been considering as national/international cultural, social, historical relics (10 – 7 scores)								9													9-L8: (1) Bien Ho is an archaeological site establishing a new archaeological culture in the Tay Nguyen, Vietnam called as the Bien Ho Culture, that occupied the area in the Late Neolithic to the Early Metal Period (4000-3500 year BP; Nguyen Khac Su, 2007). (2) Bien Ho is a national scenic spot; (3) There are many legend stories associated with the Bien Ho.
-	Quite high, have prospect admitted as national cultural, social, historical relics (6 – 4 scores)						5															5- (1) The culture symbol of Jrai people called as the roof of Rong house; (2) There are many legend stories associated with the Ham Rong.
-	Relatively high, not clear prospect admitted as national cultural, social, historical relics (3-1 scores).	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	3	1	1	3-L18: There is a legend about the Le Kim waterfall. 1- There is no clear cultural value.
	Total score of criteria group 4	*1*	*1*	*1*	*1*	*1*	*5*	*1*	*9*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*3*	*1*	*1*	

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
5	Threats and conservative demands (10-2 scores)																					
5.1	*Threats and conservative demands (5-1 scores)*																					
-	Not threatened (5-4 scores)	4							4							4	4	4	4			4-L8: it is a national scenic spot, therefore it has its own protection rules; L1: now, it has unexploited for Tourism. Department of Culture, Information and Tourism has chosen to organize a wildflower festival so it has not threatened. L15, L16, L17, L18 have not threatened.
-	Quite threatened, should be conserved (3-2 scores)						2			2	2	2	2									2- Being threatened by the farming human activities. L6: having stone exploitation activities at the foot.
-	Threatened, need to be conserved (1 score)		1	1	1	1		1						1	1					1	1	1-L19, L20: There is a hydroelectricity (upstream) very near the waterfall. Other craters located near or in residential areas, so they have been threatened by: cultivation activities, housing construction and leveling.
5.2	*Legal status of conservation (5-1 scores)*																					
-	Was protected by laws (5-4 scores)	4							5						4							5- L8: because it is a national scenic spot, it was protected by laws. 4-L1: now, it has unexploited for Tourism. Department of Culture, Information and Tourism has chosen to organize a wild sunflowers festival so it is being preserved by the province.
-	Have been recommending "is protected by laws) (3-2 scores)						3															3- There is a broadcasting station of the province, so it has limited travel.
-	Have been protected by temporal		1	1	1	1		1		1	1	1	1	1	1		1	1	1	1	1	1- Protected by Land Law - a common law for

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
	regulations (1 score)																					all types of land use.
	Total score of criteria group 5	*8*	*2*	*2*	*2*	*2*	*5*	*2*	*9*	*3*	*3*	*3*	*3*	*2*	*2*	*8*	*5*	*5*	*5*	*2*	*2*	
6	Usage and exploitation potential (20-4 scores)																					
6.1	*Outstanding, easy to identify (5-1 scores)*																					
-	Very outstanding, visitors could identify by themselves (5-4 scores)								5						5	5	5	5	5	5	5	5- Large lake, waterfalls are easy to identify.
-	Quite outstanding, visitors could identify as introduced preliminarily (3-2 scores)	3					3															3-Large extent, easy to recognize.
-	Relatively outstanding, visitors could identify as a detailed introduction (1 score)		1	1	1	1		1		1	1	1	1	1								1-Due to the characteristic morphology, visitors could identify as a detailed introduction.
6.2	*The geographical location (5-1 scores)*																					
-	Very convenient (a site has exploited for tourist, good infrastructure, residential concentration, communities are aware of heritage values (5-4 scores)	5					4		5						4	5						5- Located near residential area, near traffic road, convenient to move. 4-L6: Located next to the national highway, however, it is not currently exploited for tourism due to the location of the province's broadcast station, thus limiting it to the top; L4: Located along the city. However, there is a potential for weekend travel.
-	Relatively convenient (a site has bases for exploiting tourist) (1 score)	1	1	1	1	1		1		1	1	1	1	1			1	1	1	1	1	1-Relatively convenient because the places has not good infrastructure.
6.3	*Traveling conditions (5 -1 scores)*																					
-	Very convenient (favorable for traveling, near main roads, there are roads to get the site) (5-4 scores)	4	5	4	4	4	5	4	5	5	5	5	5	5		5				5		5- Located in or near residential area. L8: There are observation huts, lakeside road, L15 – there was a stair to go down the foot of the waterfall. 4- L6: Due to the

No	Criteria	Name																				Score-reasons
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	
																						location of the province's base station, limited travel;
-	Quite convenient (quite favorable, near main roads, there are roads to get nearly the site) (3-2 scores)														3		2	2				3- L14: the road to the lake is a trail. 2- the road next to the waterfalls. However, there are only trails from the road to the foot of the waterfalls.
-	Relatively convenient (could approach the site, have the prospect to construct a road to the site) (1 score)																1		1			1- There no road.
6.4	*Prospect for creating new jobs (5-1 scores)*																					
-	Very good (have had an investment project on developing tourist and relational services) (5-4 scores)								5							5						5- L8 is a national scenic spot; L15 is upgraded. Both belong to investment priority projects (GLDCST, 2016).
-	Quite good (have had a project called for investing to exploit tourist and relational services) (3-2 scores)	3					3								3							3-L1 was selected for the wild sunflowers festival; L6: is currently a location within the main tours in Gia Lai. L14 had activities of exploiting recreational value: fishing, eating and drinking.
-	Relatively good (have the prospect for planning a project to call for investing to exploit tourist and relational services (1 score)		1	1	1	1		1		1	1	1	1	1			1	1	1	1	1	1-Prospective if they included in the list of proposed Geoparks of Gia Lai province.
	Total score of criteria group 6	*16*	*8*	*7*	*7*	*7*	*15*	*7*	*20*	*8*	*8*	*8*	*8*	*8*	*15*	*20*	*8*	*9*	*9*	*12*	*8*	
	Total score (maximum 100 scores)	57	21	20	20	20	65	23	89	25	25	25	25	24	46	60	37	39	50	44	33	

L1: Chu Dang Ya; L2: Doi Duc Me; L3: Doi 706; L4: Chu To La; L5: Doi 754; L6: Ham Rong; L7: Chu Teh; L8: Bien Ho; L9: Plei Chuot; L10: Ia Lum; L11: Chu A; L12: Chu Keh; L13: Dien Phu; L14: Ia Bang; L15: Phu Cuong; L16: Kueng O; L17: Ia Hrung; L18: Ia Grai ; L19: Xung Khoeng; L20: Bau Can

4. Discussions

(1) General comment

The study estimated the conservative value of 20 characteristic volcanic landscapes in the Pleiku. They include both landscapes that have been invested, exploited and ones where people and tourists have not known. The previous researches of valuation often were done for an ecosystem, park or natural conservation area where people or/and tourists knew such the studies carried out by Arin and Randall (2002), Venkatachalam (2003), Anatoli et al.

(2006), Peters and Hawkins (2009), Niels et al. (2014), Xiuhua et al. (2015), Jia et al. (2019). Besides, interviewees in the study were people and tourists who enjoy directly from the conservation of the landscapes, while interviewees usually were either people (Ruijgrok, 2006; Lavee and Menachem, 2018) or tourists (Arin and Randall, 2002; Jia et al., 2019) in the previous researches of valuation. The improvement made the results of the conservative valuation approach a real value of the studied object.

(2) The relationship between the conservative valuation and the results coming from evaluation, classification of geoheritages in the Pleiku

Table 9 showed the relationship between the conservative valuation estimated by the WTP and the results made by evaluating and classifying geoheritages of 20 volcanic landscapes based on six criteria groups. It presented that the Pearson correlation coefficient between the conservative valuation and the results made by evaluating,

classifying geoheritages of 20 volcanic landscapes based on six criteria groups were quite high along with the significance below 0.05: [0, 0.002], it means all of them were statistical significance. It also meant that the conservative valuation of the landscapes had a close correlation with the results coming from evaluation, classification of geoheritages.

Consequently, the excellent point is that the conservative valuation of landscapes had the highest correlation with the criteria groups of "education and scientific values" (the Pearson correlation coefficient above 0.88), sequently was the criteria groups of "aesthetic and landscape values", and the third was the criteria groups of "threats and conservative demands". It indicated that the higher the criteria group score was, the higher the WTP was. Additionally, the average WTP got the highest correlation with the total score of each geoheritage. It means that the conservative values which were determined are sure of accuracy and confidence.

Table 9. The relationship between the average WTP and total scores of 6 criteria groups

		Education and scientific values	Geomorphological, geological diversity	Aesthetic and landscape values	Historical, social and cultural values	Threats and conservative demands	Usage and exploitation potential	Total scores
The average WTP	Correlation	0.88[b]	0.77[b]	0.85[b]	0.64[b]	0.83[b]	0.77[b]	0.897[b]
	Sig.	0	0	0	0.002	0	0	0
	N	20	20	20	20	20	20	20

Note: [a]: Correlation is significant at the 0.05 level; [b]: Correlation is significant at the 0.01 level

This is the first study that analyzes the correlation between the results of the natural landscape conservative valuation with the criteria groups for evaluating, classifying UNESCO's geoheritage. It is considered as a new way to validate the findings of natural landscape conservative valuation. The approach would enhance the confidence of the results, hence allowing the development of a regression function between the effects of conservative valuation with the criteria groups for some case studies. Combining the

results of conservative valuation and the ones coming from evaluation, classification of geoheritages, planners, decision-makers have more scientific bases to affirm that a natural landscape should be preserved. For example, if the results coming from evaluation, classification of geoheritages are less than 50 scores then they are classified as local geoheritages, but as its conservative valuation result is low, then we can suggest "not conserve the heritages at the local scale".

(3) Relationship between the conservative valuations with the volcanic extent and information accessibility on landscapes by interviewees before in the Pleiku.

The Pearson correlation between the conservative valuations with the crater landscape areas and the waterfall widths was 0.41 and 0.092, respectively, but the significance was 0.145 and 0.863, respectively (above 0.05). This shows that the conservative valuation of the typical volcanic landscapes in the Pleiku had no linear relations with the factors mentioned above. This explained why the extent factors had not been included in the lists of criteria for evaluation and classification of geoheritages.

The Pearson correlation coefficient between the conservative valuations with information accessibility on the landscapes by interviewees before in the Pleiku was 0.867 with the significance of 0 (below 0.05). It means that there were close relations between the conservative valuation and information accessibility on the landscapes by interviewees before.

5. Conclusions

This research estimated the conservative value of 20 natural volcanic landscapes in the Pleiku. They also included the landscapes that have been invested, exploited and also the unknown to local people and tourists. The conservative valuation of Bien Ho negative crater landscape was the largest, 38.6 billion VND–1.75 million USD, while the cost of Chu Dang Ya and Ham Rong positive crater landscape was 27.28 billion VND (1.24 million USD) and 23.9 billion VND (1.09 million USD). The conservative valuation of waterfall landscapes was quite high, ranging from 16.5 to 26 billion VND (0.75–1.18 million USD), the highest one was the Phu Cuong waterfall. Among the surveyed social factors affecting the WTP of people and tourists, the age factor had significant effects

on the WTP, and close correlation with the WTP of the estimated 55% landscapes. The conservative valuation of the landscapes had no linear relations with their extents, while had close ties with information accessibility on the landscapes by interviewees before.

The conservative valuation had a close relationship with the results coming from evaluation, classification of geoheritages for 20 volcanic landscapes. This valuation is considered as a new way to validate the findings of natural landscape conservative valuation. The approach would enhance the confidence of the moderate valuation results for natural landscapes.

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APPENDIX A: A BRIEF PROFILE OF LANDSCAPE

CHU DANG YA
(According to the J'rai language, Chu Dang Ya mean wild ginger)

1. Location

Ploi lagri village, Chu Dang Ya commune, Chu Pah district (far from the Pleiku 30 km to the north)

2. Extent

- Area: 58 ha;
- Height: 981 m.

3. Outstanding values

Scientific and education value:
- Evidence for the second eruption period, the absolute age: c 2,2–1,8 M.a.
- Evidence for the seafloor spreading in the East Vietnam Sea and extrusion of the Indochina block.
- Relics show a transition from NE to SW to the north-south extension within the Indo-china block.
- Tholeiite, olivine basalt, sometimes alkaline basalt, some crumbling volcanic products (volcanic tuff and ash) can be observed there.
- The central eruption type with high viscosity lava following the volcanic throats can be observed there.
- The positive crater morphological characters as a truncated cone, funnel-shaped crater, sunken in the middle and higher crater edges,… can be seen there.
Aesthetic and cultural values
- Chu Dang Ya is a majestic mountain intact and covered by wild sunflowers, and maize, sweet potato fields.
- The wild sunflower festival has been held annually in the landscape in November.
- You can take stunning images and clips on typical volcanic landscapes. This place also brings inspiring.

4. Tourist infrastructure

- There are asphalt roads to the volcanic crater bottom.
- There have not been service infrastructures as stop stations,...

CHU DANG YA

Source of photo: https://news.zing.vn/nui-lua-chu-dang-ya-hung-vi-giua-nui-rung-tay-nguyen-post633584.html

Photographer: Nguyen Thanh Tuan, 2017

APPENDIX B: QUESTIONNAIRE
Questionnaire
(For local people)

I. Information of interviewees

Name:……………………………………. Ethnic:……… Year of birth:……. Sex: Male ☐; Female ☐
Current residence: …………………………………………………………………………………..
Phone no.: …………………………………………………………………………………………..
Marital status: Married ☐, No. people in household…..;   Single ☐
Education:……………………… Job:………………………………………………………………...
Income (VND/month):……………………………… Spending (VND/month): ……………………….

II. Information related to knowledge and the willingness to pay for landscapes

Questions: "How much are you willing to pay to conserve and embellish a volcanic landscape …. for now, and next generations?"

Her/his ideas on some typical volcanic landscapes in the Pleiku

No	Landscape	District	Knowledge (0: have not known; 1: knew)	WTP	Coordinates	
					Latitude	Longitude
Positive craters						
1.	Chu Dang Ya	Chu Pah			108.057182	14.120528
2.	Doi Duc Me	Pleiku			107.983300	14.033300
3.	Doi 706 (Ia Lan)	Chu Se			108.076737	13.858416
4.	Chu To La	Chu Se			108.067721	13.840245
5.	Doi 754 (Kon Bar Maih)	Chu Se			108.135696	13.793819
6.	Ham Rong (Chu Ha Rong)	Pleiku			108.020938	13.884836
7.	Chu Teh	Dak Doa			108.068794	13.905077
Negative craters						
8.	Bien Ho (To Nung lake)	Pleiku			107.999672	14.039437
9.	Plei Chuot	Pleiku			108.055859	13.974294
10.	Ia Lum	Pleiku			108.049132	13.963179
11.	Chu A	Pleiku			108.020128	13.948045
12.	Chu Keh	Pleiku			107.987845	13.928773
13.	Dien Phu	Pleiku			107.983300	13.950000
14.	Ia Bang	Dak Doa			108.058025	13.876255
Waterfalls						
15.	Phu Cuong	Chu Se			108.136116	13.660936
16.	Kueng O (Queng O/Khueng O/Kueng Thoa/Queng Thoa/Thac Ba)	Chu Se			108.125562	13.679795
17.	Ia Hrung	Ia Grai			107.785722	13.971701
18.	Ia Grai (Le Kim, Grai Glong Blang waterfall)	Ia Grai			107.727743	13.961503
19.	Xung Khoeng	Chu Prong			107.852127	13.740992
20.	Bau Can (Doi 3)	Chu Prong			107.862690	13.874845

Time…………, date….month….2018   Place interviewing:……………………..
         Interviewer   Interviewee