

Natural Disaster Impact on Annual Visitors of Recreation Area: The Taiwan Case

Ya-Fen Lee and Yun-Yao Chi

Abstract—This paper aims to quantify the impact of natural disaster on tourism by the change of annual visitors to scenic spots. The data of visitors to Alishan, Sun Moon Lake, Sitou and Palace Museum in Taiwan during 1986 to 2012 year is collected, and the trend analysis is used to predict the annual visitors to these scenic spots. The findings show that 1999 Taiwan earthquake had significant effect on the visitors to Alishan, Sun Moon Lake and Sitou with an average impact of 55.75% during 1999 to 2000 year except for Palace Museum. The impact was greater as closer epicenter of 1999 earthquake. And the discovery period of visitors is about 2 to 9 years. Further, the impact of heavy rainfall on Alishan, Taiwan is estimated. As the accumulative rainfall reaches to 500 mm, the impact on visitors can be predicted.

Keywords—Impact, Natural disaster, tourism, visitors.

I. INTRODUCTION

TAIWAN is called as Formosa, a beautiful island, which has the special geography and human environments, and attracts many domestic and foreign tourists to undertake recreational activities. In 2008 years, Taiwan formulated the development principles and action plans of service industry, in which tourism industry was regarded as the key industry. According to the Executive Information System of Tourism Bureau, M.O.T.C. Republic of China, total income of tourist industry is 61,840 million NT dollars and the international tourists to Taiwan are up to 7311470 visitors, who bring 38,450 million NT dollars of tourist income in 2012 years. It is shown that the tourist industry is playing an important role for the Taiwanese economic development.

However, earthquakes, typhoons and heavy rains are the frequent natural disasters in Taiwan, the occurrences of which are often attributed to the broken geology and steep topography. There natural disasters often cause severe property damage and casualties. The catastrophic event, the 1999 Chi-Chi, Taiwan earthquake was still a fresh reminder of the magnitude of the possible destruction and tragedy. The 1999 earthquake killed 2400 people, injured 8000 people and left about 100,000 homeless. Besides, in recent decade, there are more than two torrential rains every year in Taiwan, which case accumulatively 1171 killed, 293 missed, 3450 injured, 2353 buildings collapsed, 4437 buildings partial-collapsed and

landuse loss of 4700 million NT dollars. Especially, Typhoon Morakot in August, 2009 with an accumulative rainfall of 2,361mm, buried more than 300 people at once and destructed many famous recreation areas including Alishan at Chiayi, Baolia at Kaohsiung, Lushan at Nantou, and Jihiben at Taitung. Similarly, tourists to these scenic spots descended obviously due to the devastating disaster.

There are many literatures on travel decision-making. It is proven that the natural disaster has a different influence on travel decisions. Reference [1] pointed out that the international tourist to Taiwan dropped by 15% from September to December 1999 owing to the 1999 earthquake event. This paper aims to quantify the impact of natural disaster on tourism by the change of annual visitors to scenic spots. Fig. 1 is principal scenic spots and visitors in Taiwan by year. Although influence factors of visitors are many and complicated, it is clearly presented that the increasing total visitors contributes to the increasing scenic spots, the implement of Two-Day Weekend and Taiwan's Open-Door Policy to Mainland Chinese Tourists. Based on the regional and temporal characteristic of natural disaster, it is assumed a scenic spot in a disaster area will be influenced by a disaster occurrence; otherwise, it will not be influenced. As a period of time passes, the influence degree of natural disaster on scenic spot will descend to be zero. And the economic impact of the natural disaster on scenic spot can be expressed by the decrease of annual visitors. According to above-mentioned assumptions, the annual visitors are estimated and the decrease of annual visitors induced by the natural disaster is discussed further.

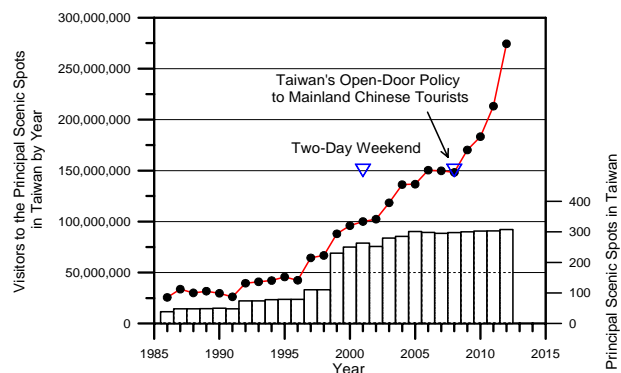


Fig. 1 Principal scenic spots and visitors in Taiwan

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II. LITERATURE REVIEW

The amounts of tourists are often expressed by tourist numbers, visitors and visitor-day. The tourist numbers reflect the net tourists to a recreational zone in a period of time. The visitor-day is the stay period of tourist at a scenic spot. The more visitor-day is, the more local impact (i.e. Economic income) is. Reference [2] suggested a model for estimating the visitors in a recreation zone. Reference [3] divided the estimation of tourist amount into four categories including Delphi technique, time series, trend extension model, and System or simulation model. Besides, the total quantity proportion method is also adopted to predict the visitors at a specific scenic spot by predicting the national visitors and the proportion viewpoint of a specific scenic spot to national spots. Reference [4] pointed out that the trend extension model is often used to analyze the change trend of visitors and to predict the visitors at a given time, which is based on the historic visitor data. It is assumed that the trend of visitors is invariable in the predicted period.

III. METHODOLOGY

The influence factor of tourists amount include individual character, amounts and quality of recreational opportunity, traveler perception, traveler cognition, potential traveler, spatial distribution of recreational resources (i.e. distance, travel costs) and other obstacles (i.e. natural disaster, traffic). It is difficult to determine the impact of a given factor on tourists amount. This paper collects the annual visitors to Alishan National Scenic Area, Sun Moon Lake National Scenic Area, Sitou Forest Recreation Area, Boalai Hot Springs, GuanZihLing Hot Springs and National Palace Museum during 1986 to 2011 years based on the statistic database of visitors to the principal scenic spots from Tourism Bureau, Taiwan. Table I is the classes and features of six scenic spots. The visitor trend analysis is adopted to estimate the annual visitors to every scenic spot. Finally, compared to the natural disaster history, the impact of natural disaster on recreational area is determined.

TABLE I
CLASSES OF SIX SCENIC SPOTS

Scenic Spots	County	Class	Type / Feature
Alishan	Nantou	National Scenic Areas	Outdoor experience/ Mountain
Sun Moon Lake	Chiayi	National Scenic Areas	Outdoor experience/ Lake
Sitou	Nantou	National Scenic Areas	Outdoor experience/ Mountain
Boalai	Kaohsiung	National Scenic Areas	Outdoor experience/ Hot spring
GuanZihLing	Tainan	County Scenic Areas	Outdoor experience/ Hot spring
Palace Museum	Taipei	Government Sites	Indoor exhibition/ Cultural relic

Two trend curves are used in this paper. The first trend curve of visitors over the years is defined by the regression linear of minimum error of historic data according to the trend extend method, which is named as trend I. Another trend curve of visitors over the years is the minimum variety curve and is defined by the ratio linear of change of total visitors in Taiwan by year based on the proportion portion of total quantity, which is named as trend II. In the trend II, it is assumed that the variance of start point at 1986 years is zero and the variance of end point at 2011 years is less than the average variance. And the trend I and trend II can be used to predict the visitors by year. In this paper, the impact of natural disaster is expressed by the decreased rate of visitors as follows.

$$\begin{aligned} \text{Impact of natural disaster} &= \text{Decreased rate of visitors} \\ &= (\text{actual visitors} - \text{predicted visitors}) / \text{predicted visitors} \\ &\times 100\% \end{aligned} \tag{1}$$

IV. RESULTS AND DISCUSSIONS

Fig. 2 is the annual visitors to six scenic spots in Taiwan (see Table I) during 1986 to 2011 years. The annual visitors to Sun Moon Lake National Scenic Area in 2009, 2010 and 2011 years are 2620, 6380 and 5350 thousand persons respectively, which are greater than 2,500 thousand persons and are not marked in Fig. 2. It is significant that the annual visitors to Alishan, Sun Moon Lake and Sitou decreases visibly as a result of the 1999 Taiwan earthquake. The change of annual visitors to Boalai is similar to Alishan, Sun Moon Lake and Sitou. But the change of annual visitors to GuanZihLing is different from others. We can guess that the GuanZihLing is a local spots, which induces the different change of annual visitors. Owing to lack of data in Boalai and GuanZihLing, only Alishan, Sun Moon Lake and Sitou and Palace Museum are discussed in the next content. Equation (1) is used to calculate the impact of natural disaster.

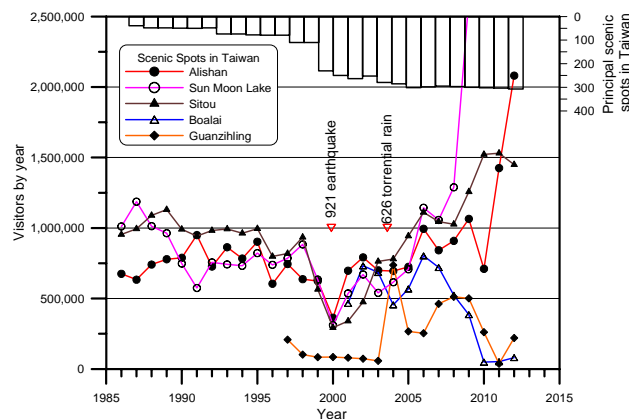


Fig. 2 Annual visitors in every scenic spot in Taiwan

A. Annual Visitors to Scenic Spots

Fig. 3 shows the actual and predicted visitors of Palace Museum by year. The annual visitors to Palace Museum are

about 2,000 thousand persons. The lowest visitors are at 2003 years. The phenomenon of the increasing visitors at 2000 years reflects that the negative effect of 1999 earthquake is not significant at Palace Museum. The amount of principal scenic spots and Two-Day weekend have no effect on the visitors to Palace Museum. However, the implement of the Taiwan's Open-Door Policy to Mainland Chinese Tourists has a positive effect on the increasing visitors.

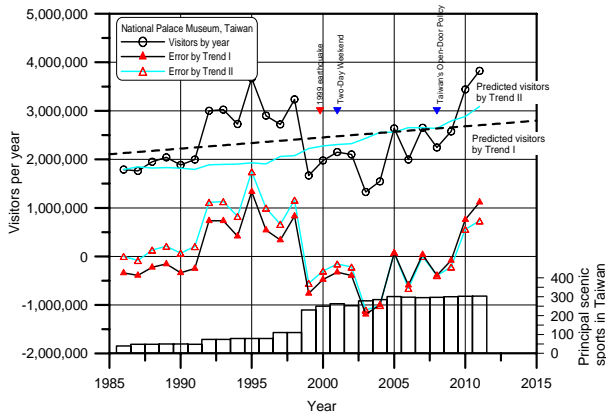


Fig. 3 Visitors by year at Palace Museum, Taiwan

Fig. 4 shows the actual and predicted visitors of Alishan by year. The annual visitors to Alishan range from 700 to 1200 thousand persons. The visitors at 2000 years and 2010 years are lowest, which are affected clearly by the 1999 earthquake and 2009 Morakot Typhoon. Besides, the 2003 landslide at Alishan Highway make visitors of 2004 years reduce as well. The Two-Day weekend and Taiwan's Open-Door Policy to Mainland Chinese Tourists have a positive effect of the increasing visitors to Alishan.

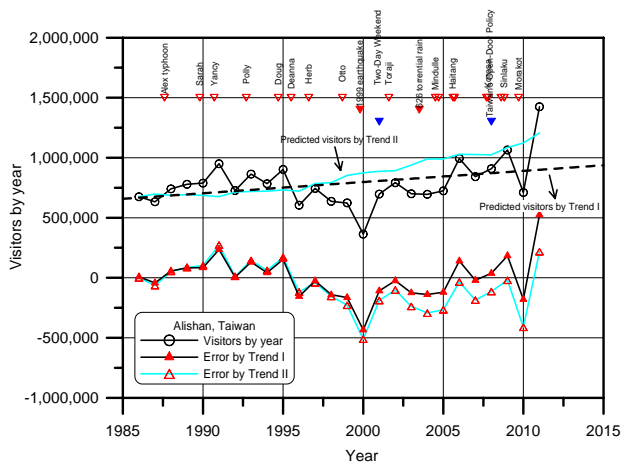


Fig. 4 Visitors by year at Alishan, Taiwan

Fig. 5 shows the actual and predicted visitors of Sun Moon Lake by year. The character of Sun Moon Lake is similar to that of Alishan. The lowest visitors years are at 2000 years and 2004

years, which corresponds to 1999 earthquake and 2004 Mindulle Typhoon. The Two-Day weekend and Taiwan's Open-Door Policy to Mainland Chinese Tourists have a positive effect of the increasing visitors to Sun Moon Lake.

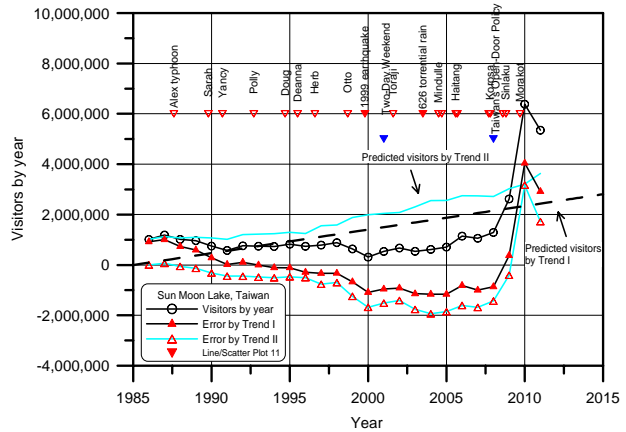


Fig. 5 Visitors by year at Sun Moon Lake, Taiwan

Fig. 6 shows the actual and predicted visitors of Sitou by year. The lowest visitors occur at 2000 years, which corresponds to 1999 earthquake. The Two-Day weekend and Taiwan's Open-Door Policy to Mainland Chinese Tourists have a positive effect of the increasing visitors to Sitou as well.

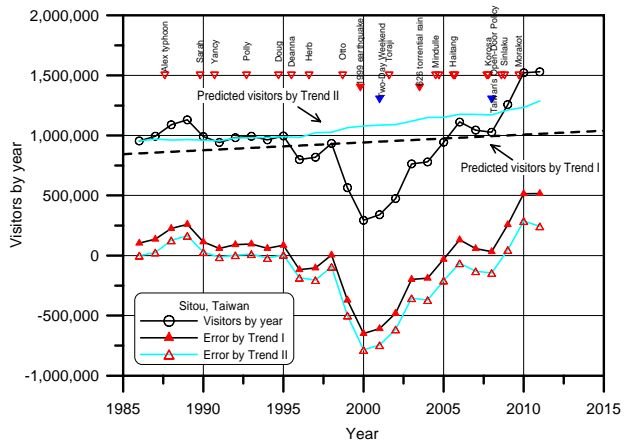


Fig. 6 Visitors by year at Sitou, Taiwan

B. Impact of 1999 Taiwan Earthquake to Scenic Spots

The epicenter of 1999 Chi-Chi earthquake was in Nantou County, central Taiwan. The Alishan is located in Chiayi, the south of central Taiwan. The Sun Moon Lake and Sitou are located in Nantou County. These areas experienced various types of failures induced the 1999 earthquake. Therefore, the drop of travel willing to these spots can be guessed rationally. The impact of 1999 earthquake on Alishan, Sun Moon Lake and Sitou are estimated as shown in Table II. The average

impact of disaster by 2000 years on Sun Moon Lake, Sitou and Alishan are 58.9%, 43.25% and 23.85%, respectively. The average impact of disaster by 2001 years on Sun Moon Lake, Sitou and Alishan are 81.15%, 70.78% and 56.5%, respectively. The total average impact on Sun Moon Lake, Sitou and Alishan are 55.75%. It shows clearly that the impact of disaster is greater as the closer seismic epicenter and tourists tend not to go scenic spot in a disaster area because of the fear and travel security.

From Figs. 4~6, the visitors to Alishan descended till 2002 years, those to Sun Moon Lake descended till 2009 years and those to Sitou descended till 2003 years. We inference that the recovery period of 1999 earthquake-induced impact in Sun Moon Lake, Sitou and Alishan are 9 years, 3 years, and 2 years, individually. It also shows the impact is greater, and the recovery period is longer. The earthquake-induced impact owns a character of large-scale region and long-term.

TABLE II
IMPACT ESTIMATION OF 1999 EARTHQUAKE ON SCENIC SPOTS

Spots	Impact	1999 year	2000 year	Average (%)
Alishan	Impact by Trend I	20.9	54.5	37.7
	Impact by Trend II	26.8	58.5	42.65
	Average	23.85	56.5	40.18
Sun Moon Lake	Impact by Trend I	51.5	77.9	64.7
	Impact by Trend II	66.3	84.4	75.35
	Average	58.9	81.15	70.03
Sitou	Impact by Trend I	39.6	68.8	54.2
	Impact by Trend II	46.9	72.8	59.85
	Average	43.25	70.8	57.03
Total average (%)		42	69.48	55.75

C. Impact of Torrential Rain to Scenic Spots

The rainfall-induced impact on visitors is discussed here. In Fig. 4, the impact of 2009 Morakot Typhoon on visitors to Alishan was very significant, about 37%. But compared to Figs. 5 -6, the impact of 2009 Morakot Typhoon on visitors to Sun Moon Lake and sitou were not obvious. In addition, the impact of visitors to Alishan by 20003 was about 30% because of occurrence of 2003 torrential rain. Refer to 1999 earthquake; the rainfall-induced impact owns a character of small-scale region and short-term.

The typhoon-/rainfall-induced disaster relates to rainfall intensity and accumulative precipitation [5]. The accumulative precipitation and rainfall-induced impact in Alishan are plotted as shown in Fig. 7. The records of accumulative precipitation in Alishan, Taiwan were based on the Alishan meteorological station, Taiwan as shown in Table III. The trend I and trend II are used to estimate the visitors without natural disaster occurrence. The Equation (1) is used to calculate the decreased rate of visitors induced by natural disaster. Fig. 7 shows that the accumulative precipitation and decreased rate of visitors has a positive relation, which can be depicted by an exponent function.

$$Y = 0.05 + \left[\frac{(X - 500)}{100000} \right]^u \tag{2}$$

where Y is decreased rate of visitors because of occurrence of natural disaster; X is accumulative precipitation (mm). u is a positive number, which is smaller than 1. Fig. 7 shows the u value is in the range of 0.3 to 0.45. For conservation viewpoint, we suggest u=0.3. That is to say, when the accumulative precipitation at Alishan, Taiwan reaches to 500 mm, the rainfall-induced impact will produce. For example, the decreased rate of visitors by year is about 0.2 to 0.33 with a 2000mm of accumulative precipitation.

TABLE III
RAINFALL-INDUCED DISASTER EVENT AT ALISHAN, TAIWAN

Event	year	Accumulative Precipitation(mm)
Herb Typhoon	1997	1987
Toraji Typhoon	2002	758
Torrential rain	2004	783.5
Mindulle Typhoon	2005	1181.5
Torrential rain	2006	666
Korosa Yyphoon	2008	1093
Torrential rain	2009	613.5
Morakot Typhoon	2009	3059.5

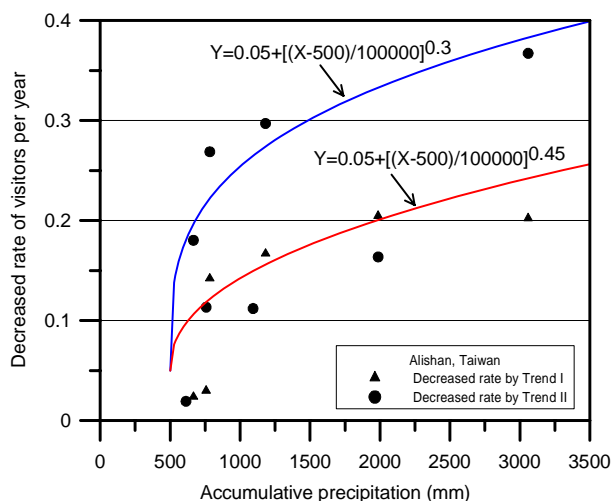


Fig. 7 Accumulative precipitation and decreased rate of visitors in Alishan, Taiwan

V. CONCLUSION

The natural disasters induced by earthquake and heavy rainfall are frequent in Taiwan. This paper presents the impact of natural disaster on tourism by the decreased rate of visitors by year to the principal scenic sport, Taiwan. The analysis results show that the impact of earthquake on the recreational area is large-scale and long-term and that of typhoon/ torrential rainfall on the recreational area is small-scale and short-term. The 1999 Chi-Chi earthquake, Taiwan had an average annual impact of 55.75% to Sun Moon Lake, Sitou and Alishan during

1999 to 2000 years. As closer seismic epicenter, the impact is greater. The recovery period of 1999 earthquake are inferred to be 2 to 9 years. Moreover, the impact of typhoon-/ torrential rain- induced disaster and accumulative precipitation have a positive influence at Alishan, Taiwan. As the accumulative precipitation exceeds to 500mm, the impact of natural disaster will occur. The impact of Typhoon-/torrential rain-induced disaster is about 0.2 to 0.33 with the accumulative precipitation of more than 2000 mm. The impact of natural disaster on visitors in scenic spots is presented clearly in this paper.

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