Possibility of astronomical phenomena to be used to support tourism industry

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Abstract. Several astronomical events in the past have shown their potential to attract tourists. This motivates some astronomers and tourism activists to create tourism related events when an interesting astronomical phenomenon occur. The most attractive recent astronomical phenomenon for tourists was the solar eclipse as was proven during the total solar eclipse of March 9, 2016. Similarly, other phenomena such as the lunar eclipse, meteor shower, Mars Opposition have some potential to be exploited as events to attract tourists. Belitong Geopark had organized a sky observation event, for example super blue blood moon event on January 31, 2018 and Mars opposition event on July 21, 2018. It successfully drew attention far and wide, but it needed more effort and creativity to make these events more attractive and marketable. Other cultural heritage sites which contain inherent astronomical tie-in knowledge, such as Borobudur Temple, are also strong prospective to be developed for astro-tourism destinations. In the future, astro-tourism permanent facilities may be developed, for example, sky observation facilities for amateurs in Dark Sky National Park, near Mount Timau National Observatory in Kupang, East Nusa Tenggara Province.

Keywords: Astro-tourism and Astronomical Phenomena

1. Introduction

Astro-tourism is a tourism activity with astronomical phenomena or facilities as the main attraction. Astronomy related tourism activities have existed around the world for a long time. They are mostly sporadic; depend strongly on some very attractive sky phenomena, involving not so many professional astronomers, and almost without any ecosystem support. In recent years, the potential of astronomical phenomena to be used as a tourism attraction has begun to be explored more systematically. A few international conferences or workshops on this topic had been organized in some countries. The latest was held in the Osservatorio Polifunzionale del Chianti, Firenze, Italy, July 11-13, 2018. It discussed the existing astronomy related tourism activities and their development in the future.

Developing astro-tourism in Indonesia is in line with one of Indonesian government priority programs, namely, sustainable tourism. The concept of Astro-tourism has a big economic potential; it can contribute to support the existing tourism industry, provided a good ecosystem support exists. It also meets with the International Astronomical Union Strategic Plan 2010 – 2020 – “Astronomy for the Developing World” – where the appeal of astronomy is not only for astronomy world itself but also to support development in other fields and for the benefit of the community at large. To make

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attractive, effective and successful events based on celestial phenomena, for the benefit of the larger populous community, it is necessary to develop astro tourism ecosystem. This paper is written as a pioneering work to develop astro tourism ecosystem in Indonesia.

2. Potential of astro-tourism in Indonesia

In Indonesia and South East Asian countries in general, the ecosystem supporting astro-tourism has yet to be developed. There are sporadic activities related to sky phenomena which attract tourists, for example Total Solar Eclipse. However, this is a rare phenomenon, occurring only once in several decades over the same region. There are also infrastructure facilities providing astronomy related attraction, such as a planetarium and Skyworld in the capital city of Indonesia, to name a few, but these are independently run, and not collectively a part of an astro-tourism ecosystem. Tourism agencies in developed countries could better exploit the phenomena to create marketable events entertaining tourists, but Indonesian agencies are still far behind. Some hotels and tourist destinations do enjoy the spill over benefits from phenomena like the solar eclipse, in the form of increased room occupancy with corresponding higher number of tourists. There are many other celestial objects and phenomena which would be interesting enough to garner a wide appeal if special events connecting the common people and the sky are well planned, designed and marketed.

In the past, professional astronomers exposed and explained, through various observatory activities, in order to guide others to enjoy astronomical phenomena; resulting in intermittent educational exposure to the interested public and the local tourism industry inadvertently benefitting from the sky phenomena through such a guidance from these astronomers. However, these activities are not sustainable within the tourism industry, due of its voluntary nature and the astronomers themselves did not get comparable benefits for their expertise shared.

With the ominous lack of ecosystem connecting the astronomers and the tourism industry in Indonesia, information regarding specific sky phenomenon would usually be made available not long before the actual event, through newspapers, television, online news etc., except during Total Solar Eclipse. Consequently, this usually leave the tourism industry with very little time to prepare an attractive event which could satisfy tourists well, both from the appropriate accommodation availability to the public relatable understanding of the actual scientific concept of the phenomenon. Even when a sky event could only to be observed within Indonesia, foreign tour and travel agencies could immediately reap more benefits by exploiting the event as part of their tourism business because they have access to a more established system and information channel, much to the detriment of Indonesian tour and travel agencies which could not benefit from their own local event.
Table 1. International Visitors Arrivals to Indonesia 2015-2017 [1]

|       | 2015  | 2016  | 2017   |
|-------|-------|-------|--------|
| January | 785,973 | 814,303 | 1,107,968 |
| February | 843,928 | 888,309 | 1,023,388 |
| March | 841,071 | 915,019 | 1,059,777 |
| April | 801,873 | 901,095 | 1,171,386 |
| May | 852,388 | 915,206 | 1,148,588 |
| June | 872,385 | 857,651 | 1,144,001 |
| July | 877,584 | 1,032,741 | 1,370,591 |
| August | 911,704 | 1,031,986 | 1,393,243 |
| September | 920,128 | 1,006,653 | 1,250,231 |
| October | 877,798 | 1,040,651 | 1,161,565 |
| November | 835,408 | 1,002,333 | 1,062,030 |
| December | 986,519 | 1,113,328 | 1,147,031 |

Notwithstanding, tourist destinations usually need events to attract additional volume of tourists – events like annual festivals, sports competitions, cultural and traditional ceremonies, and artistic performances must be staged either routinely or specifically scheduled. The Indonesian government has continuously placed the tourism industry as one of the priority sectors to be developed, because of its very rich natural resources, enhanced by its diverse cultural and historical heritage, which support the growth of the domestic tourism industry.

Ten tourist destinations have been chosen as the top priority to be developed, namely: Borobudur, Toba Lake, Bromo-Tengger-Semeru mountain complex, Komodo Island, Seribu Archipelago, Belitung Island, Mandalika, Wakatobi, Morotai, and Tanjung Lesung [2]. The development of these tourism areas is targeted to boost the country’s income from the tourism sector to US$20 billion in the next five years, from the current range of US$10 billion. Table 1 shows that foreign tourists is in an increasing trend in the recent years.
3. Previous events
Over the last 4 decades, several great astronomical phenomena had occurred and quietly passed without any event aiming at attracting tourists, be they local and foreign. For example, in June 1983, one of the longest total solar eclipse, occurred over Java Island. At that time, no tourism events were staged, despite earlier socialization through activities by astronomers. The government even prohibited people to view the eclipse, warning about the risk of blindness due to extended exposure of the solar eclipse when observed with the naked eyes. Some astronomers who planned to observe this in public areas were even ordered to leave by the local police. In recent years, with more people being educated and the flow of information easily spread, more astronomy related events were staged, taking full advantage of opportunities available through astronomical phenomena.

3.1. Super Blue Blood Moon
On January 31, 2018, a celestial phenomenon nicknamed Super Blue Blood Moon, occurred. It is quite a rare combination of three phenomena, namely moon near perigee, second full moon in a month and lunar eclipse. Such a combination is very rare and it is widely publicised in media. With such wide media exposure, this phenomenon made people more curious. Many institutions and astronomy clubs, in several cities organized observational events, and opened them to the public for a wider appreciation of this rare spectacle. One of the many events, stretched across the southern hemisphere, was held in Nyiur Melambai beach, Belitung island. It was held in cooperation with schools, travel bureau, local government and Belitong Geopark Management Agency. One of the motivations to hold such an event is to attract tourists and promote Belitung island as a new Geo-park and tourist destination. The success of the event motivated the tourism agency union in Belitung to hold another astronomical event in the same year - Mars Opposition event on July 21, 2018.

3.2. Mars Opposition and lunar eclipse
Near the peak of Mars Opposition of July 27, 2018, the longest total lunar eclipse in a century occurred. Not only was the coincidence of the total lunar eclipse and Mars opposition happening simultaneously, but other bright planets, Venus, Jupiter, Saturn were also visible. Those with access to
a telescope had a chance to observe many interesting objects in the galaxy in the same night. An observation event in Malang, East Java was held with the cooperation of Universitas Ma Chung, a local hotel with an open rooftop deck, a local newspaper as a media partner which featured a fortnight of background information about the phenomenon, and other participating universities hosting international students during their summer break.

3.3. Total solar eclipse
Indonesia is the only big country traversed by the Total Solar Eclipse on March 9, 2016. Many foreign tourists and local visitors, including professional astronomers, flooded the designated cities for best unblocked observation views of the spectacular event. The Indonesian Ministry of Tourism promoted the event abroad to attract foreign tourists and inform local hotels and travel agents to prepare several months in advance. Many hotels in the cities traversed by the eclipse were even booked one year ahead of the event. Foreign travel agents arranged special eclipse tour to Indonesia.

| Table 2. Hotel occupancy rate in few cities traversed by total solar eclipse [1] |
|-----------------|-----------------|-----------------|-----------------|
|                 | March 2015      | March 2016      | March 2017      |
| Palu            | 58.6%           | 72.3%           | 58.1%           |
| Palangkaraya    | 53.3%           | 55.8%           | 65.5%           |
| Tanjung Pandan  | 33.3%           | 46.7%           | 41.2%           |
| Palembang       | 55.4%           | 61.6%           | 53.2%           |

![Hotel Occupancy Rate](image)

**Figure 2.** Hotel occupancy rate in few big cities traversed by the total solar eclipse, March 9, 2016 [1]

Astronomers, both amateurs and professionals, did public outreach informative programs and education activities prior to the event, while some of them freely provided assistance for the public to observe the eclipse in a correct way during the eclipse in order for them to enjoy the rare and spectacular phenomenon and to avoid possible blindness. Aside from the international media coverage of this event, a report on the eclipse event in the city of Palu, west Sulawesi and Malang, East Java had been published by Rachmadian et al. (2016) [3].
In every city traversed by the eclipse in totality, the crowd of local and foreign tourists could easily be found, much more than any earlier congregation of visitors previously gathered. Table 2 indicates that the solar eclipse provided a boost in hotel room occupancy. It is a year-to-year monthly data collected over the same period. Unfortunately, we don’t have the daily data, which could be expected to show the drastic jump of hotel occupancy number around the day of the solar eclipse.

4. Cultural related astro-tourism

Traditionally, Indonesians of yore, had some form of ancient astronomical knowledge which were integrated into their lives, and this was used mainly to determine the seasons for agricultural and particularly harvest timing. Then fishermen and sailors needed celestial knowledge for navigation. Tracing the track of astronomical knowledge found in some ancient temples, especially Buddhist temples, it was believed that the architects of the Borobudur temple, a 9th century Mahayana Buddhist temple in Magelang Regency of Central Java, had a very astute knowledge of astronomy. A massive 15,000 sq m stone structure, its East-West and North-South gates were accurately aligned. The biggest stupa sitting atop at the highest level had a role as a gnomon, marking a new season when its shadow would fall onto one of the stupas on the second highest floor. Without such an in-depth knowledge of astronomy, it would be unthinkable, how the alignment of such a giant structure, laid brick by brick, could be so acutely precise, considering no modern civil engineering knowledge and tools existed in the 9th century Java Island.

These temples have already been tourist attractions till the present day, but only the cultural aspects are highlighted. The astronomical aspects of these ancient structures could be one of the astro-tourism objects. However, further research is needed to delve into the astronomical content of the archeocultural objects. From the extensive compilation of knowledge as a result of research, the tourism industry could then create well designed communicative materials to be used as attractive presentations for tourists.

5. Dark Sky Tourism

Dark Sky tourism refers to the utilizing of the night sky as the main attraction in local tourism. It is a new term in Indonesia, and has yet to be done systematically. It is comparable to Astro-tourism. To date, there is no permanent site nor facility for Dark Sky tourism in Indonesia. The idea of Dark Sky tourism surfaced when a group of Indonesian astronomers chose Timau Mountain, Kupang Regency, Timor Island, East Nusa Tenggara province, in south east Indonesia, for the future site of the Indonesian big telescope [4].

The large area surrounding the observatory site is mainly a savanna expanse, with some isolated trees, making it beautiful like a botanical garden. While the population density of the area is expectedly low, the area is under developed economically, with minimal infrastructural support including no electricity grid from the state electricity company (PLN) – this is an absolute advantage as there is almost no light pollution there. However, in near future, when the national observatory unit is established, electricity will be an inevitable necessity and it would be certain that the electricity grid will enter the region soon enough.

Establishing an observatory should provide positive impact for the local society, otherwise problems will arise in the future. The observatory needs to cooperate with the surrounding landowners and villagers to protect the sky from light pollution. Without any benefit for them, it will be difficult to persuade these locals to cooperate. The lesson learned from the Bosscha observatory taught a very important lesson – the importance of people participation. Bosscha observatory now suffers from increasingly bad light pollution slowly degrading the observation quality. The effort to communicate and educate those surrounding the observatory to reduce light pollution has not help much, and participation rate is low, because the local population there could not feel the tangible benefit of participating in the observatory sky protection program.

Learning from this particular experience, it is important to anticipate the potential ‘worsening’ sky condition surrounding Timau Mountain. It is expected that social development in that area should not
be stopped, but the progressive intensity of light pollution in that area could be carefully monitored and inhibited (if necessary) so that the life of an expensively invested observatory could be sustained longer. Community development program since the preparation of the observatory can appropriately motivate people participation in the observatory protection program. Everyone concerned must feel the benefit of protecting the sky from light pollution. But how could the locals enjoy such benefits, if it is ever tangible? Would it be plausible that their dark sky be convertible to be one of their sources of income? Therefore cooperation between observatory management, Astro-tourism activists and surrounding community is critical and be made beneficial for all, in their effort to protect the dark sky for astronomical research and at the same time accelerating the local economy.

One of the ideas for Astro-tourism activity involving the local community is to create home-stay program in local residents’ houses. The biggest challenge to execute this idea is to change the local lifestyle and habits from the local trappings into a more tourist-friendly environment, while keeping its traditional nuance. There must be a house upgrading program to modify their current houses including its interior and standard of sanitation, which needs considerable amount of investment. They also need hospitality training so that their homes can be comfortable for tourists.

One other necessary change is the design of lamps to be used in the city for it to be dark sky friendly – every lamp must have an upper cover so that each source emanating light must be directed downward, to minimize light pollution. The building material and exterior paint colour of the houses must also be restricted to, once again, reduce light pollution to a minimum.

To facilitate tourists enjoying the natural sky after dark, an observation plaza could be built near the observatory. The plaza could be a concrete flat space where tourists and interested parties could install their own small telescope and camera on a tripod easily and participate in their own observation activity, at their own pace. The plaza should also be equipped with electricity sources and Wi-Fi hotspots. Not so far from it, there should be a rest area or shelter for those wanting to lounge when the sky is cloudy or when it rains. To make it more interesting, cafés and a barbeque pit could be built to facilitate a star party event. Also, a telescope rental shop could be provided for the Astro-tourists who do not bring their own telescope or camera. It could sell telescope/camera accessories and to also provide information services related to astronomy and the incumbent telescopes.

Figure 3. Observation plaza for amateur astronomers to do independent observation, not so far from the observatory.
6. Conclusion
Indonesia has the infinite potential and absolute necessity to develop Astro-tourism. Previous celestial events which drew public attention have merely indicated the initial potential to attract tourists. Astro-tourism activities could be incorporated in the existing tourism destinations with careful analysis of climate and seasonal changes. One of the potential sites to be developed to become a permanent Astro-tourism site is Timau Mountain in Timor Island because of its dry climate, long dry seasons and an underdeveloped society. Other existing tourist destinations could also get additional benefits from astronomical phenomena when events are staged to attract tourists. Currently, there is negligible amount of research done in the field of Astro-tourism in Indonesia, while it has become necessary to develop Astro-tourism ecosystem in Indonesia. Moving forward, more research in this field is recommended for the benefit of the tourism industry.

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