



## OPEN ACCESS

## EDITED BY

Wulf Rössler,  
Charité Universitätsmedizin  
Berlin, Germany

## REVIEWED BY

Hwee San Lim,  
Universiti Sains Malaysia  
(USM), Malaysia  
Mohammed Jashimuddin,  
University of Chittagong, Bangladesh  
Abdus Subhan Mollick,  
Khulna University, Bangladesh

## \*CORRESPONDENCE

Guek-Nee Ke  
g.n.ke@hw.ac.uk

## SPECIALTY SECTION

This article was submitted to  
Public Mental Health,  
a section of the journal  
Frontiers in Public Health

RECEIVED 17 March 2022

ACCEPTED 05 October 2022

PUBLISHED 10 November 2022

## CITATION

Ke G-N, Utama IKAP, Wagner T,  
Sweetman AK, Arshad A, Nath TK,  
Neoh JY, Muchamad LS and  
Suroso DSA (2022) Influence of  
mangrove forests on subjective and  
psychological wellbeing of coastal  
communities: Case studies in Malaysia  
and Indonesia.  
*Front. Public Health* 10:898276.  
doi: 10.3389/fpubh.2022.898276

## COPYRIGHT

© 2022 Ke, Utama, Wagner,  
Sweetman, Arshad, Nath, Neoh,  
Muchamad and Suroso. This is an  
open-access article distributed under  
the terms of the [Creative Commons  
Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use,  
distribution or reproduction in other  
forums is permitted, provided the  
original author(s) and the copyright  
owner(s) are credited and that the  
original publication in this journal is  
cited, in accordance with accepted  
academic practice. No use, distribution  
or reproduction is permitted which  
does not comply with these terms.

# Influence of mangrove forests on subjective and psychological wellbeing of coastal communities: Case studies in Malaysia and Indonesia

Guek-Nee Ke<sup>1\*</sup>, I. Ketut Aria Pria Utama<sup>2</sup>, Thomas Wagner<sup>3</sup>, Andrew K. Sweetman<sup>3</sup>, Aziz Arshad<sup>4</sup>, Tapan Kumar Nath<sup>5</sup>, Jing Yi Neoh<sup>1</sup>, Lutfi Surya Muchamad<sup>2</sup> and Djoko Santoso Abi Suroso<sup>6</sup>

<sup>1</sup>Department of Psychology, School of Social Sciences, Heriot-Watt University Malaysia, Putrajaya, Malaysia, <sup>2</sup>Department of Naval Architecture, Institute Teknologi Sepuluh Nopember, Surabaya, Indonesia, <sup>3</sup>The Lyell Centre, Heriot-Watt University, Edinburgh, United Kingdom, <sup>4</sup>Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, Serdang, Malaysia, <sup>5</sup>School of Environment and Geographical Sciences, University of Nottingham Malaysia, Semenyih, Malaysia, <sup>6</sup>Bandung Institute of Technology, Bandung, Indonesia

Mangrove forests possess multiple functions for the environment and society through their valuable ecosystem services. Along with this, the mangrove forests have large and diverse social values, in combination contributing to the health and wellbeing of the surrounding communities. This study aims (i) to assess the benefits of mangrove forests and their impact on subjective and psychological wellbeing of coastal communities and (ii) to understand the challenges coastal communities face that limit sustainable wellbeing. We have used a mixed methodological approach, combining workshop, interview, and survey, to obtain qualitative and quantitative information from two coastal communities in Malaysia and Indonesia. For quantitative data, 67 participants from both coastal communities participated using a pre-tested structured questionnaire. To obtain opinions from key informants in Malaysia and Indonesia, we organized two stakeholders' workshops and community interviews. When merging these interviews and workshops, we identified the following three themes related to the perception of mangrove forest benefits: (1) the advantage of living in a natural countryside; (2) the natural resources supporting employment, income, and family security; and (3) the increase in subjective and psychological wellbeing. The mean score of wellbeing for Indonesian participants (28.6) was slightly higher than that for Malaysian participants (26.2) and was significant. Overall, the respondents felt happy because the combination of job security and leisure activities supports feeling content and satisfied. The analyses also suggest that the combination of exposure to coastal environments and stress reduction promotes good mental health; however, diagnostic health data are lacking. The lower score of mental wellbeing in Malaysia is attributed to respondents involved in risky fishing activities and local regions with excessive tourism. The findings from this study imply that coastal mangrove forest management plays an important role in the living conditions of coastal communities and their subjective

and psychological wellbeing. Hence, restoration and sustainability of mangrove ecosystem are important.

#### KEYWORDS

mangrove ecosystems, socio-economic, psychological wellbeing, coastal communities, subjective wellbeing

## Introduction

Mangrove forests possess multiple functions for the environment and society through their valuable ecosystem services, including provisioning, regulating, habitat, and cultural services. These unique forests bordering tropical coastlines worldwide (1–3) have high significance in terms of economy and ecological functions, for example, through provision of storm and tsunami protection for communities who live in coastal areas (4–7). The wide range of ecosystem services provided by mangrove forests have large and diverse social values, in combination contributing to the health and wellbeing of the surrounding communities (3, 8–12). The social value of mangroves is closely associated with deeply held historical, communal, ethical, religious, and spiritual attributes, which are considered as sources of subjective wellbeing (13).

Subjective wellbeing is a multidimensional construct capturing basic human psychological needs, such as security, materials supporting a satisfactory life, health, and successful social relationships (14). It is known as an umbrella that includes individual emotional responses, domain satisfactions, and global judgments of life satisfaction (15, 16). More specifically, subjective wellbeing refers to peoples' opinion and feelings of their surrounding natural environment that impact satisfaction on life and happiness (17, 18), which is considered a key indicator defining quality of life (19). Along with subjective wellbeing, the intrinsic values (e.g., aesthetic, moral, and cultural values) of ecosystem services and the interactions between human and nature have a bearing upon psychological wellbeing of community people (13, 20, 21). It is evidence that direct and indirect contact with nature improves peoples' emotion, reduces stress, makes them feel more alive and cooperative, and thus improves psychological wellbeing of people (22, 23). Various studies have shown [e.g., (24, 25)] that forest-based activities such as forest walk and viewing scenic beauty have positive impacts on mental health, including stress, anxiety, depression, negative emotions, and quality of life.

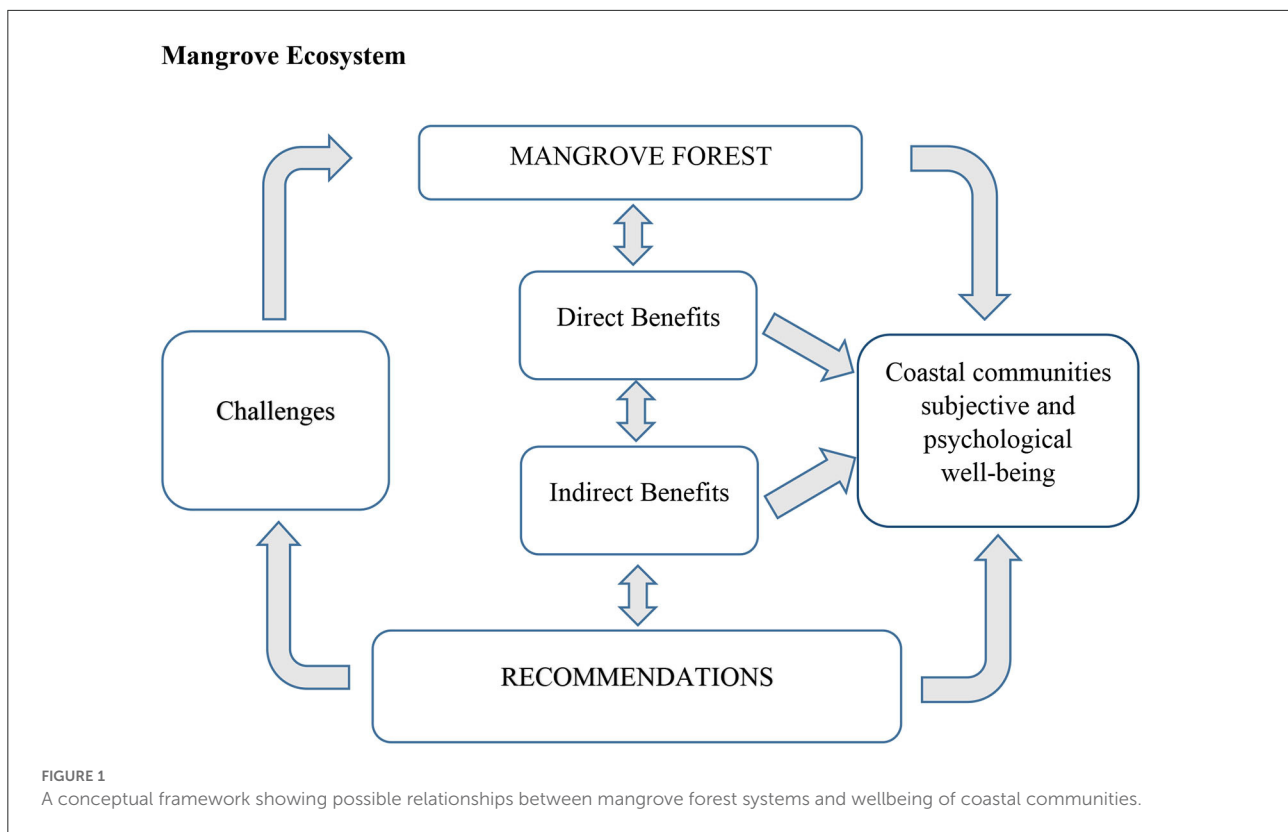
There has been substantial research on the linkages between subjective wellbeing and nature in many countries, particularly in western nations, including Australia, East Asia, European countries, and North America (26, 27). More specifically, within the mangrove forest context, subjective wellbeing refers to a measure that assesses the relationship of individuals with the

forest. Such studies are, however, very limited in Southeast Asia like Indonesia and Malaysia (28). Current understanding emphasizes that understanding subjective wellbeing related to ecosystems services is crucial for balancing a good life while supporting sustainable development (29), and hence, researchers have suggested to include the notion of subjective wellbeing in natural resources management (27). Maintaining and promoting a congenial relationship between forest ecosystem services and subjective wellbeing is an important aspect of regional sustainable development and hence is considered essential (30–32). A comprehension of subjective wellbeing may help to address forest management problems commonly faced by policymakers (28).

To the best of our knowledge, no previous studies on subjective wellbeing effects of forests or nature specifically explored the impact of mangrove forests on psychological wellbeing. As mentioned above, having these research gaps, this study aimed (i) to assess benefits of mangrove forests and their impact on subjective and psychological wellbeing of coastal communities and (ii) to understand the challenges toward sustainable wellbeing of coastal communities. Data for this study were collected from two coastal communities in Malaysia and Indonesia. We approach subjective wellbeing as an assessment based on personal judgments of general happiness or satisfaction (33) and psychological wellbeing indicating the positive functioning of individuals in relation to life satisfaction (34).

## A conceptual framework of subjective and psychological wellbeing and mangrove forests

Research to date has partly tested the benefits of mangrove ecosystem on subjective and psychological wellbeing of coastal communities. We assumed that mangroves through their direct (e.g., timber, firewood, fish, etc.) and indirect (e.g., protection from storms and flood, etc.) benefits influence both subjective and psychological wellbeing of coastal communities (Figure 1). In this study, SWB is comprised of two components, namely, feeling happy and satisfaction with life (15, 35). Satisfaction with life evaluates how the environment, income, livelihood, and work–life balance



impact the subjective wellbeing of people (36–38). Different from that, psychological wellbeing of local people combines feeling confident, relaxed, cheerful, optimistic about future, and close to other people, all linked to their connectivity to mangrove forests (39–41). Mangrove ecosystems are subject to many challenges (e.g., degrade the ecosystem), which need action toward sustainability and improved management. In this study, we collect new information on the relationship between mangrove forests and local peoples' wellbeing and anticipate that they can support recommendations for sustainable forests management to the benefits of the coastal communities.

## Study areas

Two mangrove sites were selected based on the richness of the mangrove ecosystem in the two Southeast Asia countries of Malaysia and Indonesia.

**Matang Mangrove Forest Reserve (MMFR)** is located in the north-west coast of the Peninsular of Malaysia ( $4^{\circ}51'7.14''\text{N}$ – $100^{\circ}38'48.50''\text{E}$ ). The Perak State Forestry Department manages MMFR covering about 40,466 ha and still considered as the best managed mangrove forest in the world (42). MMFR management includes a healthy

charcoal industry (43, 44) with Matang being responsible for 70% of international charcoal export from Malaysia in year 2013 (45). The second important commodity is tourism and education, including bird watching, forest, and biodiversity research (22, 46). These activities have improved the economic condition of local communities in the MMFR area, supported by strict management (47). Data for this study were collected from deliberately selected two villages, namely Kampung Baru Kuala Sepetang and Kampung Menteri, in MMFR.

**Mangrove Wonorejo Surabaya (MWS)** is a protected mangrove area in Surabaya, Indonesia ( $7^{\circ}18'76''\text{S}$ – $112^{\circ}48'922''\text{E}$  to  $7^{\circ}18'328''\text{S}$ – $112^{\circ}50'691''\text{E}$ ). MWS covers ~700 ha and is managed by the Department of Food Security and Agriculture of the City of Surabaya Government and declared as a conservation area by the City Major of Surabaya under Surabaya City Regional Regulation No. 3, 2007 (48, 49). The mangrove ecosystems in Wonorejo are managed to increase human welfare, in sectors such as education, conservation, and rehabilitation (50). Eco-tourism in MWS attracts both local and outside visitors, which directly or indirectly develop and upgrade the welfare of local communities living in and around mangrove forests (51–54), through broad opportunities for economic development (55, 56). Data for this study were collected from Pamurbaya in MWS.

## Methods

This study adopted qualitative and quantitative methodologies to collect data.

### Qualitative study

We initiated two qualitative approaches, namely, stakeholder workshop and key informant interviews.

#### Stakeholder workshops

Researchers organized 2 full-day stakeholder workshops at MMFR and MWS in February 2020. The aim of the workshops was to understand the challenges and opportunities of mangrove forests management in both study sites. Representatives (23 in MMFR and 21 in MWS) from 22 organizations joined in the workshops, including: the Department of Forestry, Department of Fisheries, Perak Fishermen's Association, Fisheries Research Institute Malaysia, Malaysian Nature Society of Perak Branch, Maritime Institute of Malaysia, Malaysian Wood Industries Association, Wetlands International Malaysia, Forest Research Institute Malaysia, Department of Survey and Mapping (Perak), Regional Planning and Development Agency (East Java and Surabaya), Fishery and Marine Department of East Java, communities leaders, NGOs, universities, local administrations, and others.

#### Key informant interviews

Key informant interviews are qualitative in-depth interviews with a wide range of people who have first-hand knowledge about the coastal communities. We conducted 67 interviews with the coastal communities (e.g., community leaders, forest rangers, business owners, fisherman, charcoal factory workers, and related stakeholders) at both sites.

### Quantitative study

Quantitative data on socio-demographic characteristics and subjective and psychological wellbeing were collected from the respondents. We used a purposeful structured questionnaire for collecting quantitative data on subjective wellbeing of two core components to explore the relationship between experiences and reactions toward the mangrove ecosystem of coastal communities and their subjective wellbeing. For psychological wellbeing, we followed the Warwick–Edinburgh Mental Wellbeing Scale (SWEMWBS), which is being widely used to understand psychological wellbeing of community people (39–41, 57).

Through the community leaders, we interviewed 67 respondents (40 in MMFR and 27 in MWS) who agreed to participate. All interviews were conducted through phone due to mobility restrictions during COVID-19 pandemic. As English is not the first language of the respondents, the questions were initially developed in English and then translated to Malay, the main language used by the local communities in Matang, Malaysia, and Surabaya, Indonesia.

### Ethical approval

Ethical approval was obtained from the research ethics committee of the School of Social Sciences Ethics Committee, Heriot-Watt University. In addition, we secured respondents' verbal consent for participation and audio-recording for this study. All respondents remain anonymous in this study.

### Data analysis

All qualitative data from the interview transcripts were transcribed and translated into English for data analysis. We used the inductive approach of thematic analysis introduced by Braun and Clarke (58), which describes patterns across qualitative data by identifying, analyzing, and reporting themes within data. The respondents' responses were coded, and codes that had similar emerging patterns were grouped together to form a theme or sub-theme. The data were examined for differences and similarities both within and across themes.

For quantitative data, SWEMWBS scores from respondents were calculated to give a mean score within and between the population sample from Malaysia and Indonesia, respectively. Mean scores for MMFR and MWS were compared according to the score categorization suggested by Warwick Medical School (59, 60). Descriptive attributes (frequency, percentage, and mean) were reported for socio-demographic and psychological wellbeing responses. We conducted the Chi-squared test to find out association between socio-demographic characteristics (age and education) and responses on benefits of mangrove forests.

## Results and discussion

### Socio-demographic characteristics of respondents

Table 1 shows the socio-demographic characteristics of the respondents, separated for Malaysia and Indonesia. In both study sites, male respondents were higher (57.5 and 66.7% in MMFR and MWS, respectively). A majority of respondents in both sites obtained high school education. In terms of occupation, fishing-related employment dominated in MMFR, whereas the majority of the respondents in MWS were

TABLE 1 Socio-demographic characteristics of respondents.

Variable	MMFR		MWS	
	Frequency	Percentage	Frequency	Percentage
<b>Gender</b>				
Female	17	42.5	9	33.3
Male	23	57.5	18	66.7
<b>Age (years) range</b>				
18–30	2	5	10	37.1
31–45	20	50	8	29.6
>45	18	45	9	33.3
<b>Education</b>				
No formal education	3	7.5	–	–
Elementary school	11	27.5	4	14.8
Middle school	15	37.5	6	22.2
High school	10	25	14	51.9
College	1	2.5	3	11.1
<b>Profession</b>				
Community leader	–	–	1	3.7
Fisherman	14	32.6	3	10.8
Food and beverages	–	–	11	39.3
Eco-tourism	4	9.3	11	39.3
Business	2	4.7	1	3.6
Unemployed	4	9.3	–	–
Other (services, house keeper, housewife, odd jobs)	15	34.9	1	3.6
Factory worker	1	2.3	–	–
Supplier	1	2.3	–	–
Forest ranger	1	2.3	–	–
Public servant	1	2.3	–	–
<b>Monthly income range based on USD (Indonesia)</b>				
>268 (Very high)			13	48.2
193–268 (High)			7	25.9
115–192 (Standard)			6	22.2
<115 (Low)			1	3.7
<b>Monthly income range based on USD (Malaysia)</b>				
>2,484	1	2.5		
1,126–2,483	2	5		
<258–1,125	37	92.5		

involved in ecotourism. The monthly household income of the respondents in MWS ranged from USD115 to USD268, which was by far exceeded at MMFR USD258–USD2484.

## Respondents' perception on benefits of mangrove forests

Respondents in both MMFR and MWS reported several direct and indirect benefits from mangrove forests (Table 2). In MMFR, most of the respondents stated that mangrove

forests are the source (direct benefits) of fish and charcoal (19.8%) and other sea food products (18.5%). For respondents in MWS, mangrove forests are important for running ecotourism activities (65.1%), followed by fish (32.6%). Respondents in both sites also reported several indirect benefits, including protection from storm, flood, and strong waves, soil and riverbank erosion prevention, natural beauty, and carbon sequestration (Table 2).

The thematic analysis of qualitative data revealed the following three themes: (1) the advantage of living in a natural countryside; (2) the natural resources supporting employment,

TABLE 2 The frequency distribution of benefits from mangroves in MMFR and MWS multiple responses.

Benefits	MMFR		MWS		Mean of MMFR and MWS
	Frequency	%	Frequency	%	
<b>Direct benefits</b>					
Timber	11	13.6	–	–	8.9
Pole	3	3.7	–	–	2.4
Fish	16	19.8	14	32.6	24.2
Water	2	2.5	–	–	1.6
Wild food	1	1.2	–	–	0.8
Tourism	8	9.9	28	65.1	29.0
Firewood	5	6.2	–	–	4.0
Charcoal	16	19.8	1	2.3	13.7
Other seafood product	15	18.5	–	–	12.1
Other non-timber forest products	4	4.9	–	–	3.2
<b>Indirect benefits</b>					
Protection from storms	28	25.2	15	22.7	24.3
Protection of riverbank	12	10.8	–	–	6.8
Flood protection	19	17.1	8	12.1	15.3
Improve fertility of agricultural land	1	0.9	–	–	0.6
Biodiversity conservation	4	3.6	6	9.1	5.7
Carbon sequestration	16	14.4	8	12.1	13.6
Space for spiritual functions	1	0.9	–	–	0.6
Natural beauty	18	16.2	15	22.7	18.6
Protection from strong waves and tsunami	12	10.8	4	6.1	9
Protect the beach from soil erosion	–	–	10	15.2	5.7

income and family security; and (3) the increase in subjective and psychological wellbeing. Below, we outline some features of these three themes:

#### Theme 1: The advantage of living in a natural countryside

Respondent-013: “I feel that it is more relaxing here because places like fishing village are always more relaxed.” Furthermore, respondent-015: “Since we are living in the countryside, the pace of living here is slower, not like in the city where the pace of living is faster.”

This may illustrate the more laid-back lifestyle in MMFR compared with urban areas that leads to carefree spirit among local communities. Meanwhile, respondent-006 attributed the relaxed and carefree spirit among local communities to the improving economic situation in MMFR: “I think you can see changes, changes from the economy in one family.”

#### Theme 2: The natural resources supporting employment, income, and family security

Natural resources such as wood for charcoal and fisheries have provided support for the livelihood of local communities. Charcoal production has created economic opportunities for small businesses and job opportunities in factory. Many respondents sell charcoal and other products made from charcoal, such as wood vinegar for a living. Mangrove forests in

MMFR provide a breeding ground for fisheries which actively contribute to the abundant fisheries resources. For example, shrimp is one of the main fisheries catch in Kuala Sepetang.

Respondents commented that “we supply it (shrimp) to the wet market” and “it is only here and the nearby areas.”

Local communities can secure basic needs for their daily life due to the improving economic situation in Matang. Most of the respondents showed satisfaction of their current earnings that can be mainly attributed the satisfaction toward being able to support their livelihood.

For instances, respondents commented that “we are fine with current income sources, it’s sufficient for villagers like us” and “It is enough for our spending.” With Kuala Sepetang being located in the countryside,

Respondent-015 mentioned that “it is sufficient to support a living in countryside but not enough for a living at the city.”

Mangrove forests are the natural habitat for many species that are important to keep the food cycle in the ecosystem (61) and hence provide income sources to coastal communities round the year. The positive perception of the local community

in MMFR and MWS on mangrove ecosystems may be associated with many benefits provided by the forests itself.

Themes 3: The increase in subjective and psychological wellbeing

Respondents in MWS also mentioned that they felt happy because there are job security and leisure activities which provide an environment which supports a comfortable lifestyle.

Respondent-026 commented that her husband enjoyed this place as her husband loved fishing. Another respondent-021 also revealed: “*Tourism activities provide jobs for many of the local people in this area. We feel so happy because these jobs can make our economic status get better.*”

Mangroves contribute to the tourism industry with various activities to offer, including nature education center, place for bird or fireflies watching and river cruises (62). Eco-tourism in mangrove areas provides large opportunities for jobs and small business to improve livelihoods of coastal communities (7, 51, 53, 54) as well as economic development of surrounding areas (52, 55, 56).

## Subjective and psychological wellbeing

We investigated two main variables, namely, satisfaction with life and work and feeling happy, to assess the subjective wellbeing of respondents. We asked four questions related to satisfaction with life and work. The results show that more than 70% of the respondents were satisfied with their life and work in coastal areas (Table 3). Iqbal (3) reported that mangroves provide several important sources of income to coastal communities in Bangladesh and so local people are happy and satisfied with living in mangrove areas. Moreover, Jones et al. (63) found that people living near a protected area have higher subjective wellbeing level.

The results of psychological wellbeing of respondents due to the presence of mangrove forests showed that the mean scores of SWEMWBS for Indonesian respondents (mean = 28.6, SD = 3.14) are higher than those for Malaysian respondents (mean = 26.29, SD = 4.37). A non-parametric (Mann-Whitney) test was conducted to examine the differences between mean scores for Malaysian and Indonesian respondents to accommodate for the unequal number of participants in both study areas. The analysis shows that the differences between mean scores of SWEMWBS for Indonesia and Malaysia were significant ( $U = 748.00, z = 2.67, p < 0.05$ ).

Following SWEMWBS, the scores were categorized into high, average, and low mental wellbeing using the following cut-off points: high mental wellbeing (mean score 28–35), average mental wellbeing (20–27), and low mental wellbeing (7–19). Figure 2 illustrates the breakdown of SWEMWBS score categorization within each study site. Among Malaysian

respondents, 33% reported having high mental wellbeing and 65% having average mental wellbeing. As for Indonesian respondents, 70% belonged to the high mental wellbeing category. However, we are cautious to draw a conclusion that Indonesian respondents were enjoying a high level of mental wellbeing because the number of interview respondents was small.

This outcome of mental wellbeing is associated with the neighborhood mangrove environment in which coastal communities of Matang and Wonorejo live. White et al. (64, 65) suggested that the association of exposure to coastal environments and stress reduction may promote good mental health. Grabowska-Chenczke et al. (23) commented that nature relatedness is a basic psychological need, which is strongly connected to affective and cognitive aspects of human wellbeing. Furthermore, environmental aspects of a coastal area may be described as an attractive, quiet, and peaceful settings, supporting high levels of mental wellbeing (66). In addition, a well-managed mangrove forest could bring psychological benefits in terms of identity, belonging, and self-esteem (67) of coastal communities, which is clearly seen in MMFR and MWS. Stakeholder efforts in conserving the mangrove forest and promoting ecotourism may further increase the connectivity between MMFR and MWS, and local communities.

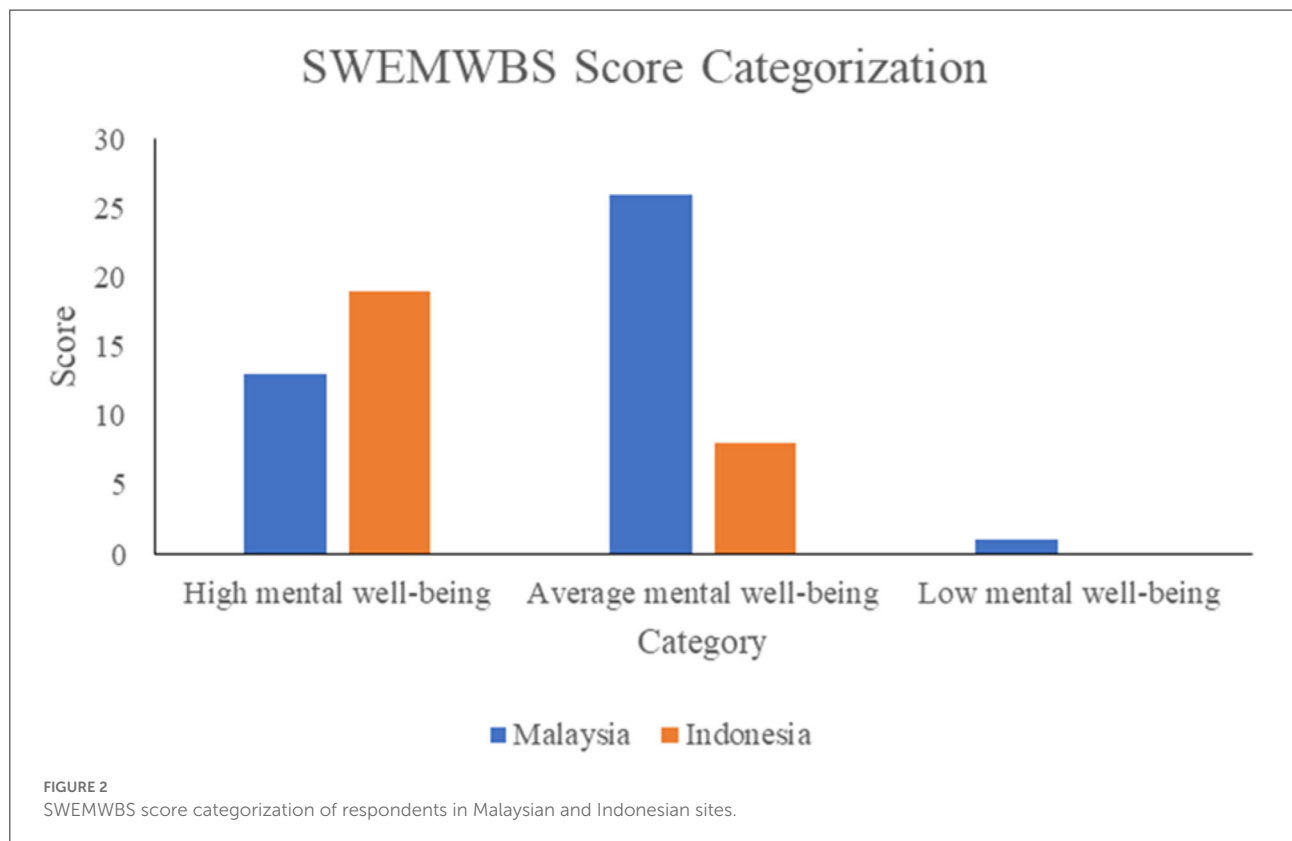
The lower score of mental wellbeing in MMFR is attributed to the involvement of respondents in risky fishing activities. Fishing is known to be dangerous, at times, and can be exposed to multiple risks, including weather and sea conditions (12, 68). In addition, intense and prolonged working activity associated with fishing can cause fatigue where such hazardous working conditions become the stress factors in life (69). The association of health-related risks may develop unfavorable outcomes which in turn can increase the impact of psychological stress experienced (69). In contrary to MMFR, MWS has been declared as a conservation area by the City of Surabaya in 2007. Hence, the main industry sector of coastal communities of MWS, ecotourism, is still in its early phase with potential to grow and diversify. The management of MWS has been keeping up with efforts in restoring the mangrove area bringing in more paying visitors to support MWS and local communities (48, 70).

## Challenges and suggestions for improvement

Representatives in the workshops held in both study sites identified several challenges that may jeopardize the benefits of mangrove forests. They also suggested various mitigation measures toward sustainable management of mangrove forests and enhancement of community development. Participants expressed that MMFR was well managed specifically in terms of timber production for charcoal. Despite having good

TABLE 3 Respondents' opinion on SWB of the benefits of mangrove forests in MMFR and MWS.

Variable	MMER		MWS		Both sites (%)
	Frequency (Yes answer)	%	Frequency (Yes answer)	%	
<b>Satisfaction with life and work</b>					
Are benefits of MMFR/MWS important to your livelihood?	29	73	27	100	87
Are you currently satisfied with your income?	35	87	26	96	92
Are you currently satisfied with your occupation?	16	40	27	100	70
Do you feel that your livelihood would be affected if you do not obtain benefits from mangrove forests?	40	100	27	100	100
<b>Feeling happy</b>					
Are you happy living in coastal areas and benefiting from mangrove forests?	24	60	22	81	71



management plans, one of the main concerns regarding the MMFR management plans shared by the participants was risk of infrastructure development and expansion of

urbanization in forest areas along with incidences of illegal logging, forest degradation, and funding constraints for forest rehabilitation (Table 4). Representatives also worried about



TABLE 4 Challenges of MMFR and MWS identified by workshops participants in Malaysia and Indonesia.

Challenges	Suggestions for improvement
<b>MMFR</b>	
1. Development and urbanization	1. Create inter-agencies collaboration and have a public engagement before the development of policies
2. Illegal logging and forest degradation	2. Planning of land use and proper monitoring by state and local government
3. Risk of forest degazettement	3. Strengthen local community association and their participation in forest management
4. Funding constraints for forest rehabilitation	4. Enforcement toward reducing single-use plastic
5. Lack of direct engagement from local communities in forest management	5. Community engagement in waste management
6. River pollution and lack of awareness in waste management among local communities	6. Create more job opportunities (more products)
7. Erosion of riverbanks	7. Create a National Mangrove Forest Conservation Day
8. Arrival of high volume of tourists causing discomfort to local communities	
9. Migration from Matang to other places to look for alternative income	
<b>MWS</b>	
1. Smaller area of MWS and not well known to people	1. Strengthen bonding between government agencies, companies, and local communities
2. Less awareness among local people about mangrove resources and conservation	2. Specialized the agency for appropriate management of MWS resources
3. Lack of funding to maintain/improve the MWS area	3. Provide visitor guide and information
4. Lack of community engagement	4. Install barriers around the mangrove area to protect from rubbish
5. Single agency to manage all resources in MWS	5. Conduct routine monitoring and cleaning the area
6. Educational issue	6. Limitation of food sellers, food place and provide rubbish bins
7. Rubbish and organic waste	7. Create community-based environment awareness and conservation programme

MMFR in favor of development and land use changes. They also highlighted waste management issues, for instance, open dump of garbage into the river and sea, and lack of garbage bin that were available for the local communities and tourists. Participants shared that waste was generated by the villages nearby, and socio-economic activities such as ecotourism, charcoal production, and fisheries were not properly handled by the local communities and authorities. They also reported that community people were not involved with the forestry department to plan/conduct forest management activities. In order to mitigate these challenges, participants suggested several measures (Table 4), which the MMFR authority can consider for further improvement in the management of mangrove forests.

Participants in the Indonesian workshop reported that MWS is a newly declared mangrove forest reserve, and all resources were being managed by a single government agency, the “Food and Agriculture Agency.” Being a new forest reserve, local people were not very much aware about resource conservation, and they were not involved in the management. Participants identified limited funding

opportunities for MWS management. They also reported river pollution and lack of educational resources for visitors and local guides as challenges. They suggest various measures for mitigating these issues. Table 4 also shows that there are few common challenges in both mangroves such as lack of funding, community engagement in forest management, and river pollution.

## Practical implications

Mangrove forests have many benefits for coastal communities of the MMFR and MWS in terms of socio-economic opportunities which directly or indirectly impact the subjective and mental wellbeing of coastal communities. Respondents from both study areas identified the development of the tourism sector as one of the primary economic opportunities for local communities with the creation of diverse job opportunities in tourism, accommodation, and catering. Albeit the main income opportunity in MMFR is related to charcoal industries,

other opportunities have been identified, including tourism and fisheries. In MWS, the opportunities stemmed from tourism industries where participants worked as staff and food sellers. However, the coastal communities in MMFR and MWS are also aware of challenges that could possess threats to their wellbeing and livelihoods, driven by declining yields for fisheries over the years, rubbish pollution, inconsistencies in the rehabilitation programme for the mangrove forest, and a general lack of mangrove management staff.

## Conclusion

Respondents from both regions have high to average mental wellbeing based on SWEMWBS scores. This outcome shows that the benefits provided by mangrove ecosystems lead to stress reduction when economy resources and job opportunity are secure, and a good mental health of local communities. The difference in the SWEMWBS mean scores between both study sites is rather small among the participants and likely attributed to differences in the nature of industry in the coastal communities (MMFR: charcoal and fisheries industries, MWS: tourism activity and food/restaurant industries). Thus, proper mangrove forest management plays an important role in safeguarding and developing subjective and psychological wellbeing of coastal communities through ensuring the availability of long-term benefits provided by mangrove forests and co-ownership/active engagement in future development plans and implementation.

## Study limitations and future research

One of the main limitations of this study was a small number of interviews, which might affect the generalization of results. Future research may focus on having a larger number of interviews to provide a statistically reliable analysis. Our research only assessed the respondents' perception on benefits and did not quantify the benefits. Adding an economic valuation of ecosystem services would provide a more complete evaluation of mangrove ecosystem services, requiring further studies. In addition, the association between coastal communities' subjective and psychological wellbeing, and the mangrove ecosystem are under study. Such a relationship is pertinent for coastal communities to improve and sustain contentment and life satisfaction. Hence, this study warrants stakeholders and scholars to explore factors that associate for better wellbeing of coastal communities.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

## Ethics statement

The studies involving human participants were reviewed and approved by the Heriot-Watt University, Social Sciences Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

G-NK, IU, TW, AS, AA, and TN conceived of the idea and apply for research funding. G-NK, IU, TW, AS, AA, TN, JN, and LM developed the workshop and interview materials. G-NK, IU, JN, and LM performed data collection and data analysis. All authors discussed the results and contributed to the final manuscript.

## Funding

This research was funded by Global Challenges Research Fund, The Scottish Funding Council, grant number SFC: P20GCRF7.

## Acknowledgments

The authors would like to express gratitude to the participants from the villages around (Kampung Baru Kuala Sepetang and Kampung Menteri) Matang Mangrove Forest Reserve (MMFR), Northwest Coast of Peninsular Malaysia area and Mangrove Wonorejo Surabaya (MWS), Pamurbaya, East Java, Surabaya area, who participated in this study.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Quarto A. Mangrove restoration-natural protection from natural disasters. *Biodiversity*. (2005) 6:3–12. doi: 10.1080/14888386.2005.9712753
- Romañach S, DeAngelis D, Koh H, Li Y, Teh S, Raja Barizan R, et al. Conservation and restoration of mangroves: Global status, perspectives, and prognosis. *Ocean Coast Manag.* (2018) 154:72–82. doi: 10.1016/j.ocecoaman.2018.01.009
- Iqbal H. Valuing ecosystem services of Sundarbans Mangrove forest: approach of choice experiment. *Glob Ecol Conserv.* (2020) 24:e01273. doi: 10.1016/j.gecco.2020.e01273
- Valiela I, Bowen J, York J. Mangrove forests: one of the world's threatened major tropical environments. *Bioscience*. (2001) 51:807. doi: 10.1641/0006-3568(2001)051[0807:MFOOTW]2.0.CO;2
- Reid WV, Mooney HA, Carpenter SR, Chopra K. *Millennium Ecosystem Assessment. Ecosystem and Human Well-being. Synthesis*. Island Press: United States of America (2005).
- Brander LM, Wagtendonk AJ, Hussain SS, McVittie A, Verburg PH, de Groot RS, et al. Ecosystem service values for mangroves in southeast Asia: a meta-analysis and value transfer application. *Ecosyst Serv.* (2012) 1:61–9. doi: 10.1016/j.ecoser.2012.06.003
- Martínez-Espinosa C, Wolfs P, Vande Velde K, Satyanarayana B, Dahdouh-Guebas F, Hugé J. Call for a collaborative management at Matang Mangrove Forest Reserve, Malaysia: an assessment from local stakeholders' viewpoint. *For Ecol Manag.* (2020) 458:117741. doi: 10.1016/j.foreco.2019.117741
- Barbier E. Natural barriers to natural disasters: replanting mangroves after the tsunami. *Front Ecol Environ.* (2006) 4:124–31. doi: 10.1890/1540-9295(2006)004[0124:NBTNDR]2.0.CO;2
- White MP, Sabine P, Benedict W, Depledge MH, Lora FE. Natural environments and subjective wellbeing: different types of exposure are associated with different aspects of wellbeing. *Health Place.* (2017) 45:77–84. doi: 10.1016/j.healthplace.2017.03.008
- Himes-Cornell A, Pendleton L, Atiyah P. Valuing ecosystem services from blue forests: a systematic review of the valuation of salt marshes, sea grass beds and mangrove forests. *Ecosyst Serv.* (2018) 30:36–48. doi: 10.1016/j.ecoser.2018.01.006
- Hooyberg A, Roose H, Grellier J, Elliott L, Lonnavillea B, White MP, et al. General health and residential proximity to the coast in Belgium: results from a cross-sectional health survey. *Environ Res.* (2020) 184:109225. doi: 10.1016/j.envres.2020.109225
- Anna Z, Yusuf A, Alisjahbana A, Ghina A, Rahma. Are fishermen happier? Evidence from a large-scale subjective well-being survey in a lower-middle-income country. *Mar Policy.* (2019) 106:103559. doi: 10.1016/j.marpol.2019.103559
- Godstime KJ, Jimmy OA, Sylvester O, Saba E, Nwilo P, Akinyed J. Social valuation of mangroves in the Niger Delta region of Nigeria. *Int J Biodivers Sci Ecosyst Serv Manag.* (2013) 9:311–23. doi: 10.1080/21513732.2013.842611
- Diener E, Diener M, Diener C. Factors predicting the subjective well-being of nations. *J Pers Soc Psychol.* (1995) 69:851–64. doi: 10.1037/0022-3514.69.5.851
- Diener E, Suh E, Lucas R, Smith H. Subjective well-being: three decades of progress. *Psychol Bull.* (1999) 125:276–302. doi: 10.1037/0033-2909.125.2.276
- Ke GN, Grajfoner D, Wong RM, Carter S, Khairudin R, Lau WY, et al. Building the Positive emotion-Resilience-Coping efficacy model for COVID-19 pandemic. *Front Psychol.* (2022) 13:764811. doi: 10.3389/fpsyg.2022.764811
- King MF, Reno VF, Novo EM. The concept, dimensions and methods of assessment of human well-being within a socioecological context: a literature review. *Soc Indic Res.* (2014) 116:681–98. doi: 10.1007/s11205-013-0320-0
- Wang BJ, Tang HP. Human well-being and its applications and prospects in ecology. *J Ecol Rural Environ.* (2016). 32:697–702. doi: 10.11934/j.issn.1673-4831.2016.05.002
- Costanza R, Fisher B, Ali SH, Beer C, Bond LA, Boumans R, et al. Quality of life: an approach integrating opportunities, human needs, and subjective well-being. *Ecol Econ.* (2007) 61: 267–76. doi: 10.1016/j.ecolecon.2006.02.023
- Goldberg L, Lagomasino D, Thomas N, Fatoyinbo T. Global declines in human-driven mangrove loss. *Glob Chang Biol.* (2020) 0:1–12. doi: 10.1111/gcb.15275
- Palup L. Psychological wellbeing of coastal communities in Surabaya: a preliminary study. *IOP Conf Series Earth Environ Sci.* (2021) 649:012033. doi: 10.1088/1755-1315/649/1/012033
- Nath T, Dahalan M, Parish E, Rengasamy N. Local peoples' appreciation on and contribution to conservation of peatland swamp forests: experience from peninsular Malaysia. *Wetlands.* (2017) 37:1067–77. doi: 10.1007/s13157-017-0941-1
- Grabowska-Chenczke O, Wajchman-Switalska S, Woźniak M. Psychological well-being and nature relatedness. *Forests.* (2022) 13:1048. doi: 10.3390/f13071048
- Jeon JY, Kim IO, Yeon P-S, Shin WS. The physio-psychological effect of forest therapy programs on juvenile probationers. *Int J Environ Res Public Health.* (2021) 18:54–67. doi: 10.3390/ijerph18105467
- Stier-Jarmer M, Throner V, Kirschneck M, Immich G, Frisch D, Schuh A. The psychological and physical effects of forests on human health: a systematic review of systematic reviews and meta-analyses. *Int J Environ Res Public Health.* (2021) 18:1770. doi: 10.3390/ijerph18041770
- Liu Y, Xiao T, Liu Y, Yao Y, Wang R. Natural outdoor environments and subjective well-being in Guangzhou, China: comparing different measures of access. *Urban Forest Urban Green.* (2021) 59:127027. doi: 10.1016/j.ufug.2021.127027
- Takahashi T, Asano S, Uchida Y, Takemura K, Fukushima S, Matsushita K, et al. Effects of forests and forest-related activities on the subjective well-being of residents in a Japanese watershed: an econometric analysis through the capability approach. *For Policy Econ.* (2022) 139:102723. doi: 10.1016/j.forpol.2022.102723
- Takahashi T, Uchida Y, Ishibashi H, Okuda N. Subjective well-being as a potential policy indicator in the context of urbanization and forest restoration. *Sustainability.* (2021) 13:3211. doi: 10.3390/su13063211
- Wu R, Tang H, Lu Y. Exploring subjective well-being and ecosystem services perception in the agro-pastoral ecotone of northern China. *J Environ Manag.* (2022). 318:115591. doi: 10.1016/j.jenvman.2022.115591
- Huang Q, Yin D, He C, Yan J, Liu Z, Meng S, et al. Linking ecosystem services and subjective well-being in rapidly urbanizing watersheds: Insights from a multilevel linear model. *Ecosyst Serv.* (2020) 43:101–6. doi: 10.1016/j.ecoser.2020.101106
- Wheeler B, White M, Stahl-Timmins W, Depledge M. Does living by the coast improve health and wellbeing? *Health Place.* (2012) 18:1198–201. doi: 10.1016/j.healthplace.2012.06.015
- Britton E, Coulthard S. Assessing the social wellbeing of Northern Ireland's fishing society using a three-dimensional approach. *Mar Policy.* (2013) 37:28–36. doi: 10.1016/j.marpol.2012.04.011
- Kim-Prieto C, Diener E, Tamir M, Scollon C, Diener M. Integrating the diverse definitions of happiness: a time-sequential framework of subjective well-being. *J Happiness Stud.* (2005) 6:261–300. doi: 10.1007/s10902-005-7226-8
- Ryff CD. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *J Pers Soc Psychol.* (1989) 57:1069–81. doi: 10.1037/0022-3514.57.6.1069
- Compton WC, Hoffman E. *Positive Psychology: The Science of Happiness and Flourishing*. London, CA: Sage (2020).
- Biswas-Diener R. Material wealth and subjective well-being. In M. Eid and R. Larsen, editors. *The Science of Subjective Well-Being*. New York, NY: Guilford Press (2008). p. 307–22.
- Myers DG. The funds, friends, and faith of happy people. *Am Psychol.* (2000) 55:56–67. doi: 10.1037/0003-066X.55.1.56
- Ke GN, Grajfoner D, Wong RM, Carter S, Khairudin R, Lau WY, et al. Psychological well-being and employability of retrenched workforce during COVID-19: A qualitative study exploring the mitigations for post pandemic recovery phase. *Front Public Health.* (2022) 10:907797. doi: 10.3389/fpubh.2022.907797
- Stewart-Brown SL, Platt S, Tennant A, Maheswaran H, Parkinson J, Weich S, et al. The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): a valid and reliable tool for measuring mental well-being in diverse populations and projects. *J Epidemiol Commun Health.* (2011) 65:A38–9. doi: 10.1136/jech.2011.143586.86
- Taggart F, Friede T, Weich S, Clarke A, Johnson M, Stewart-Brown S. Cross-cultural evaluation of the Warwick-Edinburgh mental well-being scale (WEMWBS)—a mixed methods study. *Health Qual Life Outcomes.* (2013) 11:27. doi: 10.1186/1477-7525-11-27
- Bass M, Dawkin M, Muncer S, Vigurs S, Bostock J. Validation of Warwick-Edinburgh Mental Well-being Scale (WEMWBS) in a population of people using Secondary Care Mental Health Services. *J Mental Health.* (2016) 25:323–9. doi: 10.3109/09638237.2015.1124401

42. Goessens A, Satyanarayana B, Van der Stocken T, Quispe Zuniga M, Mohd-Lokman H, Sulong I, et al. Is Matang Mangrove Forest in Malaysia sustainably rejuvenating after more than a century of conservation and harvesting management? *PLoS ONE*. (2014) 9:1–14. doi: 10.1371/journal.pone.0105069
43. Walters BB, Ronnback P, Kovacs JM, Crona B, Hussain SA, Badola R, et al. Ethnobiology, socio-economics and management of mangrove forests: a review. *Aquat Bot*. (2008) 89:220–36. doi: 10.1016/j.aquabot.2008.02.009
44. Kamaruzaman J, Dahlan HT. Managing sustainable mangrove forests in Peninsular Malaysia. *J Sustain Dev*. (2009) 1:88–96. doi: 10.5539/jsd.v1n1p88
45. Hooi GK, Haron H, Yahya K. Khay hor charcoal factory: challenges of a sunset industry. *IUM J Case Stud Manage*. (2013) 4:1–11.
46. Razak NA, Afandi SHM, Shuib A, Ghani ANA. Visitors traveling time cost for ecotourism at matang mangrove forest reserve. *Int J Bus Soc*. (2018) 19 S1:117–27.
47. Abdul Aziz A, Dargusch P, Phinn S, Ward A. Using REDD+ to balance timber production with conservation objectives in a mangrove forest in Malaysia. *Ecol Econ*. (2015) 120:108–16. doi: 10.1016/j.ecolecon.2015.10.014
48. Murtini S, Astina I, Utomo D. SWOT Analysis for the development strategy of mangrove ecotourism in Wonorejo, Indonesia. *Mediterr J Social Sci*. (2018) 9:129–38. doi: 10.2478/mjss-2018-0144
49. Idajati H, Pamungkas A, Kukinul SV. The level of participation in Mangrove ecotourism development, Wonorejo Surabaya. *Procedia Soc Behav Sci*. (2016) 227:515–20. doi: 10.1016/j.sbspro.2016.06.109
50. Murtini S, Kurniawati A. Mangrove area development strategy wonorejo as ecotourism in Surabaya. *IOP Conf Ser J Phys*. (2017) 953:012174. doi: 10.1088/1742-6596/953/1/012174
51. Salam MA, Ross LG, Beveridge MCM. Eco-tourism to protect the reserve mangrove forest the sundarbans and its flora and fauna. *J Anatolia*. (2000) 11:56–66. doi: 10.1080/13032917.2000.9686983
52. Zambrano AMA, Broadbent EN, Durham WH. Social and environmental effects of ecotourism in the Osa Peninsula of Costa Rica: the Lapa Rios case. *J Ecotour*. (2010) 9:62–83. doi: 10.1080/14724040902953076
53. Persha L, Agrawal A, Chhatre A. Social and ecological synergy: local rulemaking, forest livelihoods, and biodiversity conservation. *Science*. (2011) 331:1606–8. doi: 10.1126/science.1199343
54. Funck C, d'Hauteserre AM. Innovation in island ecotourism in different contexts: Yakushima (Japan) and Tahiti and its Islands. *Island Stud J*. (2016) 11:227–44. doi: 10.24043/isj.345
55. Barkauskiene K, Vytaitas S. Ecotourism as an integral part of sustainable tourism development. *J Econ Manag*. (2013) 18:2029–9338. doi: 10.5755/j01.em.18.3.4272
56. Hakim L, Siswanto D, Nakagoshi N. Mangrove conservation in East Java: the ecotourism development perspectives. *J Trop Life Sci*. (2017) 7:277–85. doi: 10.11594/jtls.07.03.14
57. Stewart-Brown S. The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): performance in different cultural and geographical groups. In CLM Keyes, editor. *Mental Well-Being: International Contributions to the Study of Positive Mental Health*. Dordrecht, Netherlands: Springer (2013). p. 133–50.
58. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. (2006) 3:77–101. doi: 10.1191/1478088706qp0630a
59. McKay MT, Andretta JR. Evidence for the psychometric validity, internal consistency and measurement invariance of Warwick-Edinburgh mental well-being scale scores in Scottish and Irish adolescents. *Psychiatry Res*. (2017) 255:382–6. doi: 10.1016/j.psychres.2017.06.071
60. Neha S, Mizaya C, William A, Dilini W, Stewart-Brown SL. Responsiveness of the Short Warwick Edinburgh Mental wellbeing scale (SWEMWBS); evaluation in a clinical sample. *Health Qual Life Outcomes*. (2018) 16:239. doi: 10.1186/s12955-018-1060-2
61. Hendy IW, Michie L, Taylor BW. Habitat creation and biodiversity maintenance in mangrove forests: teredinid bivalves as ecosystem engineers. *Peer J*. (2014) 2:e591. doi: 10.7717/peerj.591
62. Aziz AA, Thomas S, Dargusch P, Phinn S. Assessing the potential of REDD+ in a production mangrove forest in Malaysia using stakeholder analysis and ecosystem services mapping. *Marine Policy*. (2016) 74:6–17. doi: 10.1016/j.marpol.2016.09.013
63. Jones N, Malesios C, Kantartzis A, Dimitrakopoulos PG. The role of location and social impacts of protected areas on subjective wellbeing. *Environ Res Lett*. (2020) 15:114030. doi: 10.1088/1748-9326/abb96e
64. White MP, Alcock I, Wheeler B, Depledge M. Coastal proximity, health and well-being: results from a longitudinal panel survey. *Health Place*. (2013) 23:97–103. doi: 10.1016/j.healthplace.2013.05.006
65. White MP, Sabrina P, Ashbullby K, Herbert S, Depledge M. Feelings of restoration from recent nature visits. *J Environ Psychol*. (2013) 35:40–51. doi: 10.1016/j.jenvp.2013.04.002
66. Takahashi Y, Pease CR, Jean-Baptiste P, Viding E. Genetic and environmental influences on the developmental trajectory of callous-unemotional traits from childhood to adolescence. *J Child Psychol Psychiatry*. (2021) 62:414–23. doi: 10.1111/jcpp.13259
67. Bond L, Kearns A, Mason P, Tannahill C, Egan M, Whitely E. Exploring the relationships between housing, neighbourhoods and mental wellbeing for residents of deprived areas. *BMC Public Health*. (2012) 12:1–14. doi: 10.1186/1471-2458-12-48
68. Windle M, Neis B, Bornstein S, Binkley M, Navarro P. Fishing occupational health and safety: a comparison of regulatory regimes and safety outcomes in six countries. *Mar Policy*. (2008) 32:701–10. doi: 10.1016/j.marpol.2007.12.003
69. Chopra P. Mental health and the workplace: issues for developing countries. *Int J Ment Health Syst*. (2009) 3:4. doi: 10.1186/1752-4458-3-4
70. Mukherjee N, Sutherland W, Dicks L, Hugé J, Koedam N, Dahdouh-Guebas F. Ecosystem service valuations of mangrove ecosystems to inform decision making and future valuation exercises. *PLoS ONE*. (2014) 9:e107706. doi: 10.1371/journal.pone.0107706