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Preface

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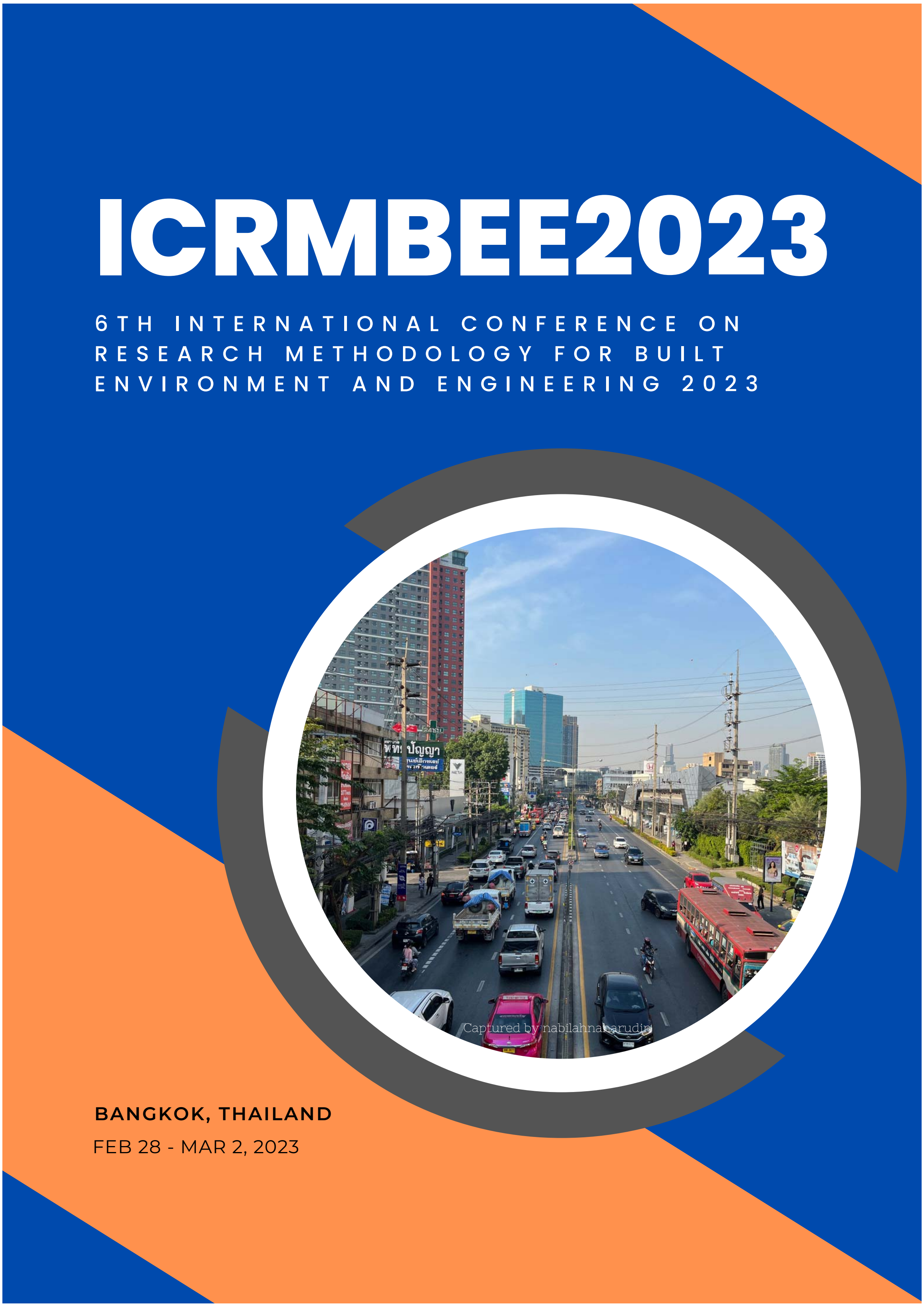
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PREFACE

Greetings from the editorial team of ICRMBEE2023. Papers in this proceeding were presented in the 6th International Conference on Research Methodology for Built Environment and Engineering 2023 (ICRMBEE2023). This year conference was organised by The College of Built Environment, Universiti Teknologi MARA, Shah Alam, Malaysia and co-organized by the Faculty of Architecture, King Mongkut Institute of Technology Ladkrabang, Bangkok, Thailand by physical and virtual platform (hybrid).

The mission of ICRMBEE 2023 is to facilitate communication between multi-disciplinary teams and especially those involved in built environment and engineering. In this regard, interdisciplinary integration and international cooperation are encouraged. It is the purpose of ICRMBEE 2023 to provide an international forum for the discussion of topics important to developing new knowledge in built environment and engineering disciplines especially in the process of developing the research methodology.

The main aim of this conference is to accumulate diverse research methodologies used in producing the research in the areas of built environment and engineering. The conference also aims at fostering cross-disciplinary discussions and networking to further enhance and enrich the knowledge of academicians, researchers, policy makers and industry professionals in built environment and engineering. The conference program will feature a few keynote speakers, who are internationally recognized experts in their areas as well as paper presentation by both academia and industry practitioners alike.

We would like thanks all the reviewers who have provided constructive comments and suggestions to the abstracts and papers assigned to them. We have received 90 submissions for the papers and 74 quality papers were accepted for the conference. 38 of the papers were selected for publication in this proceedings, while the others in selected journals as special issues. Again, thanks to 82 expert reviewers around the globe.

Lastly, we would like to give a big applause and thanks to all the authors for their presentations and papers. Their contributions have generously contributed to the intellectual exchange of useful information, idea and knowledge that is so vital towards tackling the challenges the world facing now.

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ICRMBEE2023

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CONFERENCE INFORMATION

CONFERENCE DATES
28 February 2023 - 2 March 2023

CONFERENCE VENUE
Bangkok, Thailand

MEDIUM
Hybrid (Physical + Virtual)

KEYNOTE SESSION

Conducted for 2 days with 2 keynote speeches delivered for each day. Each keynote speaker was given 30 minutes to delivery their keynote speech.

KEYNOTE SPEAKERS

Prof. Datin Sr Dr. Hamimah Adnan
Universiti Teknologi Mara (UiTM), Malaysia

Dr. Lynlei L. Pintor
Ecosystems Research and Development Bureau (ERDB-DENR), Philipines

Lt Kol Ali Zakafri Ab Aziz
Commanding Officer of 4th Squadron Royal Engineer Regiment (Bridge), Malaysia

Dr Antika Sawadsri, King Mongkut Institute of Technology Ladkrabang (KMITL), Thailand

PARALLEL SESSIONS

Presenters were divided into 5 different parallel sessions according to their respective track which are:

Construction & Project Management
Architecture and Design
Urban Planning
Geospatial Technology
Engineering

Each parallel session was conducted for 2 days via physical and virtual (hybrid).

Each session had 8-10 presentations. Presenters were given 10 minutes' presentation followed by 5 minutes' Q&A session.

CONFERENCE PARTICIPANTS

Overall, approximately 111 participants joined the conference physically and online via Zoom platform.

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Ecological risk assessment of Kaeng Krachan National Park emphasis on Land Use/Land Cover (LULC)

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Ecological risk assessment of Kaeng Krachan National Park emphasis on Land Use/ Land Cover (LULC)

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Abstract. Land use /land cover (LULC) changes with time, signify disturbances and conservation patterns of landscape types in an environment. Kaeng Krachan National Park (KKNP) is a UNESCO world heritage site with rich biodiversity and provides habitat for indigenous communities who are relying on farming. The study was conducted by calculating landscape ecological risk indices of classified Landsat images based on five landscape classes (Water, Grassland, Built-up-land, Forest, and Cultivated land). Landscape loss indices were calculated based on classified Landsat images. Assigning landscape loss indices in grid cells calculated the ecological risk indices of the area. Ecological risk indices were lowest (ERI ≤ 0.0005), lower (ERI ≤ 0.001), medium (ERI≤ 0.005), higher (ERI ≤ 0.01), and highest (ERI ≤ 0.015). Ecological risk indices were higher on the east border of KKNP proximate to the semi-urban settlements. The highest risk area demarcates waterbodies and extensively cultivated land. The LULC areas which show the higher variation of changes from 2013 to 2022 are grasslands and forest cover. The changes in the LULC pattern have increased the risk in cultivated land areas and grasslands due to farming obligations. The provision of land permits and land use limitations are addressed issues to conserve KKNP for conservation.

1. Introduction

Abundant ecosystems which serve as biodiversity hotspots to a wide range of plant and animal species are important geographic locations. As the third natural world heritage site in Thailand, Kaeng Krachan Forest Complex (KKFC) was accepted on 26 July 2021. Kaeng Krachan Forest Complex is in the Tenasserim range bordering Thailand and Myanmar, below the Western Forest Complex. The forest complex serves for a habitat of over 700 animal species which includes species in the IUCN Red List. The forest complex consists of three national parks and one wildlife sanctuary, among them lies the Kaeng Krachan National Park (KKNP), which is the largest national park in Thailand [1].

Kaeng Krachan national park serves as a diverse ecosystem as it is providing the largest habitat for most of the animals and plant species categorized under the IUCN Red list. The habitats suit for diverse biodiversity and contains different ecological zones with five forest types. KKNP is the home for indigenous residing Karen communities bordering and inside the national park. These communities rely on agriculture as their source of food and income. Conflicts prevailed for a long period of time for residences of Karen communities with the authorities. The land disputes are partially resolved by continuous monitoring of the world heritage [1]. Relocation of the indigenous communities and preventing the re-establishment of the Karen communities in their original lands, were provided with land permits for settlements and agricultural activities on crops such as sugarcane, maize, pineapple, and rice. Land nominations submitted as a world heritage site has been amended with time to demarcate the protected region of KKNP as a part of KKFC. There were land disputes observed in the originally nominated land and the latest submission with respective to changes in biodiversity population in the region. Natural disasters like floods and droughts, have been the source of destroying crops in some years putting the pressure on the communities to meet their food demands [2].

Land use changes demarcate ecological processes influenced by human influences and natural environment. A study on national park prioritizes the forest ecosystem and negatively concern on the threat by human influences. Land use land cover (LULC) studies are prominent in understanding the distribution of landscape types in the region. LULC classification with pixel-based Landsat images is based on training samples for supervised classification. Supervised classification is based on selecting sample area as training sites with accuracy of the knowledge by researchers. Acquiring satellite images from decades ago can be challenging with number of errors in the images obtained. Landscape ecological risk assessment identifies the impacts within an ecosystem in respective to human activity and environmental change. With the prevailing nature and human interference, KKNP is an important site of landscape ecological risk assessment. The objective of this study is to visualize the spatio-temporal distribution of land use patterns in Kaeng Krachan National Park and quantify the landscape ecological risk based on landscape indexes. The landscape indices calculated from the study reflects the landscape disturbances caused with time and variations that have taken place due to natural and human interferences.

2. Data origin and Research methods

2.1. Study Area

Kaeng Krachan National Park is in the Indo-Burma region of the Tenasserim range, below the Western Forest Complex in Thailand, it borders with the Tanintharyi national park in Myanmar. Lies below the Mae Nam Pachee wildlife sanctuary and Chaloem Phrakiat Thai Prachan National Park (Figure 1). The national park belongs to Phetchaburi and Prachuap Khiri Khan Provinces and demarcates a land area of 2417.50 km^2 as per the revised world heritage site nomination, even though, the original land area occupied was 2914.70 km^2.

2.2. Data Sources and Accuracy Assessment

The LULC datasets for this study were Landsat 8-9 OLI/TIRS C2 L2 for the year 2022 and Landsat 7 ETM+ C2 L2 for the year 2013. These images are used to generate land cover maps based on five LULC classes as water, cultivated land, built-up-land, forest, and grassland. The Landsat images were obtained from USGS explorer (https://earthexplorer.usgs.gov/) in the path:130 and row:051, with a spatial resolution of 30m × 30m. The satellite images from Landsat 7 required to be enhanced due to scanline errors. The errors were removed using Landsat tool 'Fix Landsat 7 Scanline Errors' in ArcGIS software (version 10.8.2, ESRI software).

Supervised classification of satellite images based on pixel values was conducted using training samples based on Support Vector Machine (SVM) classifier using ArcGIS software. The classifier SVM is associated with regression analysis based on classification algorithms. For validation of the classified images, accuracy assessment was conducted based on the changes in land cover of the classified images verses the true ground points obtained from the Google Earth. The inaccuracy of satellite images relies on cloud cover of images and the extent of coverage. Pixel based images interfere at different elevations leading to errors of identification. True ground points correlate with

IOP Conf. Series: Earth and Environmental Science 1217 (2023) 012035 doi:10.1088/1755-1315/1217/1/012035

the classified images to ensure that the pixel values are defining same or different LULC classes. Based on the observed classifications of true ground points and pixel points of the selected simple, a confusion matrix was built up to calculate kappa co-efficient by bootstrapping random samples. Based on validation of the supervised classification the land use area changes were interpreted.

2.3. Landscape ecological risk

Landscape ecological risk (LER) is calculated through a series of indexes which calculates the landscape ecological risk index as mentioned in references [5,6,7,8,9,10]. Analysing the classified images using Fragstat software (version 4.2) to obtain the patches and count of the area of each landscape type was conducted. This allows to quantify spatial patterns in the land cover and their changes over time by land-use planning. The risk evaluation was graphically evaluated by creating a 5km × 5km square grid for equal interval sampling (Figure 2). The risk evaluation grid divided into 166 cells using the Fishnet tool in ArcGIS software (version 10.8.2, ESRI software). The evaluation grids were assigned landscape ecological risk value to evaluation centre points of the grids and proceeded with spatial interpolation.

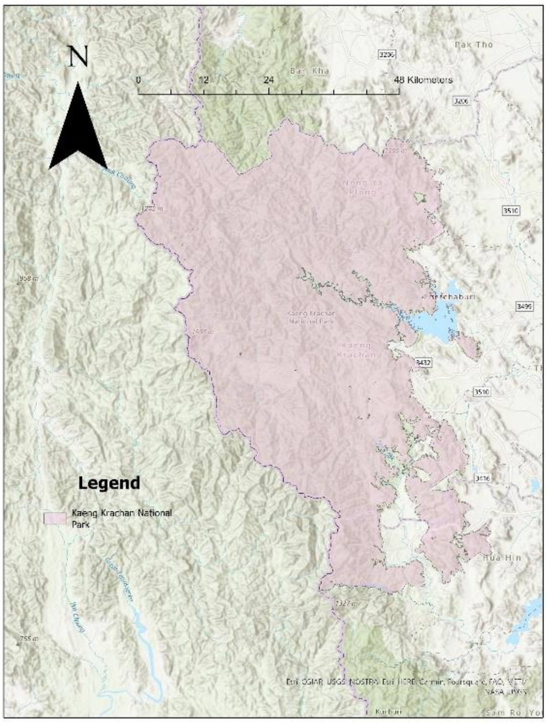


Figure 1 Study area of the research study, Kaeng Krachan National Park

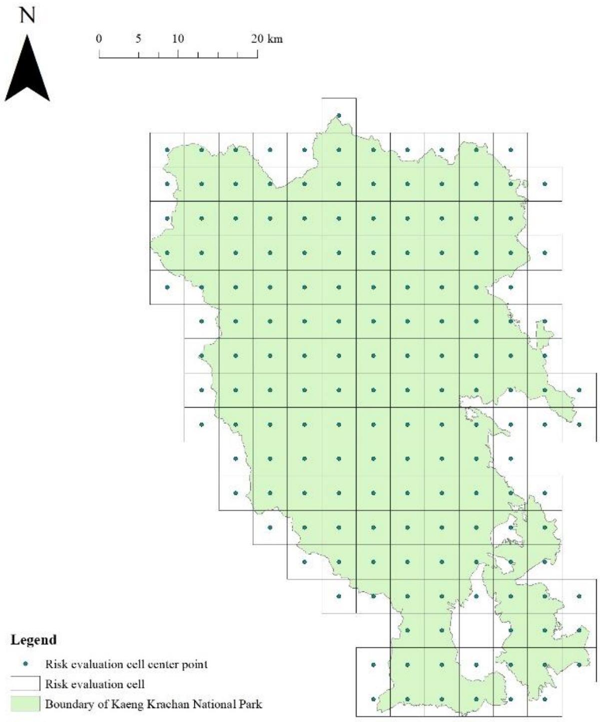


Figure 2. The spatial representation of the grid cell matrix with 5km × 5km size cells, bordering the Kaeng Krachan National Park

Landscape ecological risk (ERI_i) is an integration landscape disturbance index and landscape vulnerability index (Equation 1). Some studies refer landscape vulnerability index, also as landscape fragility index, the overall concept as in a typical risk assessment is hazard × vulnerability. Landscape ecological risk index of each patch calculated based on indexes obtained for each LULC type. The flowchart of the methodology as shown in Figure 3. Landscape disturbance index indicates the disturbance caused to landscapes with regards to an external factor, and it is calculated using landscape fragmentation index, landscape splitting index, landscape dominance index and their corresponding weights (Table 1). Landscape fragmentation index is the degree of change of landscape

Table 1. Calculation formula for landscape loss index (Ri) for each landscape type

Landscape index	Formula
Landscape fragmentation index (C_i)	$C_i = \frac{n_i}{A_i}$; $A_i = \sum_{j=1}^{a} a_{ij}$
Landscape splitting index (S_i)	$S_i = \frac{L_i A}{A_i}$; $L_i = \frac{1}{2}\left(\frac{\sqrt{n_i}}{\sqrt{A}}\right)$
Landscape dominance index (D_i)	$D_i = \frac{(Q_i + G_i + 1)}{3}$; $G_i = \frac{A_i}{A}$; $Q_i = \frac{n_i}{N}$
Landscape disturbance index (LDI_i)	$LDI_i = aC_i + bS_i + cD_i$
Landscape vulnerability index (LVI_i)	From previous studies and their normalized values
Landscape loss index (R_i)	$R_i = LDI_i \times LVI_i$

Note: A_i – the total area of LULC type i, A – the total area of the entire landscape, N – total number of patches of all landscape types, a,b and c – the weight indices of C_i, S_i and D_i obtained from previous studies 0.5,0.3 and 0.2 respectively.

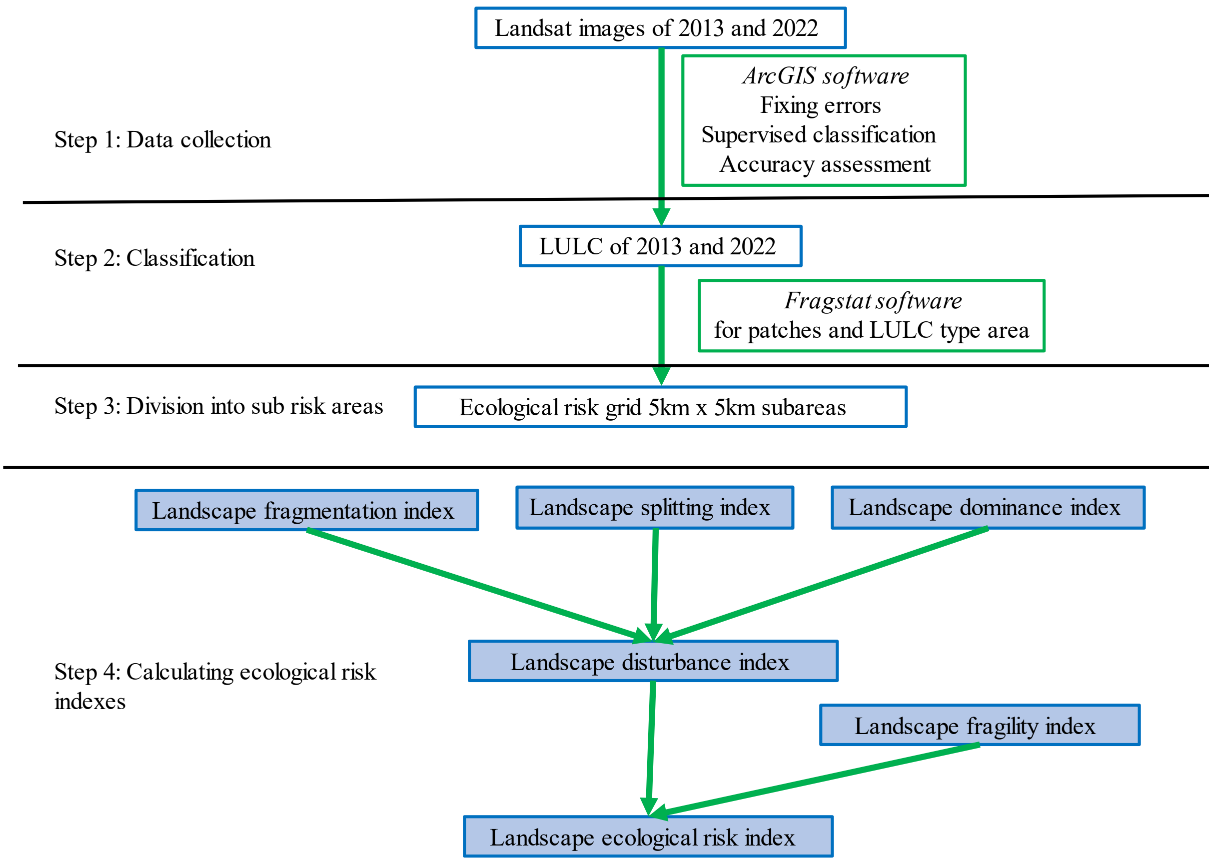


Figure 3 Methodology framework of the Landscape Ecological Risk Assessment

type from a continuous patch to discontinuous patch changed by human or natural disturbances. Landscape splitting index is the degree of splitting between two landscape types and known as landscape segmentation or separation index. Landscape dominance index is the degree of dominance of one landscape type over another, that signify its dominance.

$$ERI_i = \sum_i^N \frac{A_{ki}}{A_k} R_i \quad (1)$$

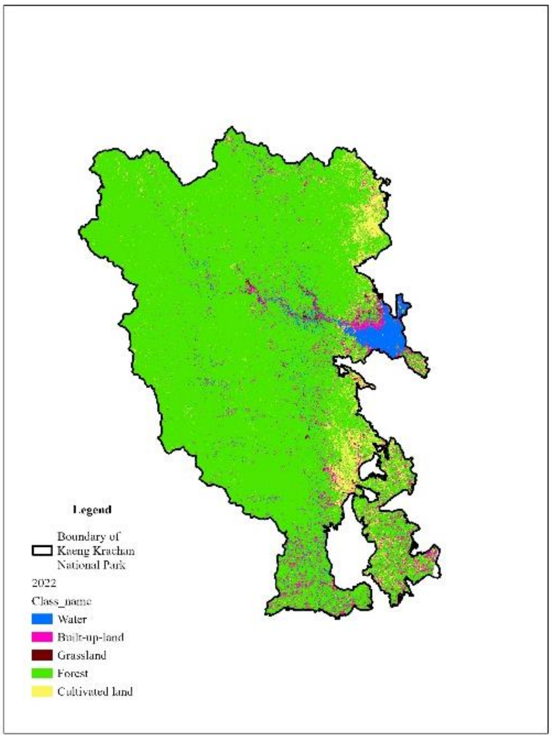
Where A_{ki} is the area of the i[th] LULC type in the k sampling area; N is the number of landscape types; A_k is the total area in the k sampling area and R_i is the landscape loss index.

Landscape vulnerability represents the sensitivity and resistance of the landscape types to external disturbances. And the values denoted for landscape vulnerability index are normalized weights from 1 to 6 as; waterbodies=5, cultivated land=4, grassland=3, forest=2 and built-up-land=1 by referring to previous studies [3,4,6]. Waterbodies cover up the dams constructed that collects water during floods from the rivers and reservoirs which also supply water to farmlands. Cultivated lands are mainly farms of the Karen communities who reside inside the forest and their marginal lands bordering the forests boundary. The houses of the Karen communities are built up from environmentally friendly material that serve the communities household along with their farmlands. Grasslands are low vegetation regions which are possibly evacuated regions from the past years, animal grazing regions and natural soil conditions leading to low vegetation. Forest ecosystem is versatile from evergreen to deciduous types which provides the habitat for wild species, and it leads to upstream of river basins of Phetchaburi and Pranburi river.

3. Results and Discussion

3.1. Land use changes

Land use land cover are predominant in all parts of the world with sparse vegetation, high urbanization, growth of the population and land for need requirements. The Landsat images were classified based on five classes; grassland, water, built-up-land, cultivated land and forest. The spatial variation of 2013 and 2022 were approximately similar with slight differences in terms (Figure 4). Based on the accuracy assessment of the classified image kappa coefficients values in both images were 76.26% individually. The land cover change was high in forest from the year 2013 to 2022, there



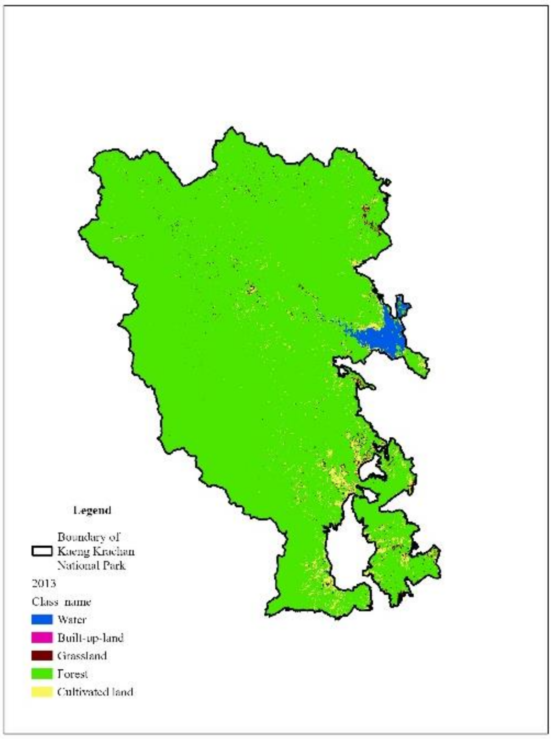


Figure 4 LULC classification of Kaeng Krachan National Park for year 2022 (left) and 2013 (right)

has been a reduction of around 401 km^2. And the landscape show increment in grassland and cultivated land from 2013 to 2022. The land demarcated as the boundary of Kaeng Krachan National Park was revised for the submission as the World heritage site reducing the land extent of 346 km^2, comparative to this reduction, there is significant change in the land area demarcated as forest cover, meantime, the land area occupied as forest is comparatively very high compared to land extent occupied as waterbodies, grassland, built-up-land and cultivated lands (Table 2).

Table 2. Land use land cover changes in percentages and properties based on classified classes of Kaeng Krachan National Park

LULC classes	Change in landscape from 2013 to 2022	Change in proportion from 2013 to 2022 (%)
Grassland	10.22	-2.955
Built-up-land	-9.79	2.83
Forest	-401.28	115.98
Cultivated land	41.60	-12.02
Water	13.25	-3.83

3.2. Assessment and Spatial Distribution of Landscape ecological risk

The landscape loss index signifies overall reduction in all LULC types from 2013 to 2022 which is possibly due to reduced land area extent that borders KKNP with the revision of nominated UNESCO world heritage site from 2019 that caused to reduce 346 km^2 as from land extent nominated in 2014. There is increase in land area occupied as grassland which is a form of poor soil vegetation that could be due to geographic soil distribution, natural disasters like floods caused along the Petchaburi River and Pranburi river. It is also possible that the land area was leftover sites of anthropogenic disturbances like cutdown forest for timber and land use for shifting cultivation. The landscape loss index was lowest in land occupied as forest which is having the highest extent of land in KKNP, therefore the abundant availability cause to reduce the ecological landscape loss (Table 3).

Table 3. Ecological risk indices for land use land cover of classified regions for the years 2013 and 2022

LULC classes	Year	No of patches	Area (ha)	C_i	S_i	D_i	LDI_i	LVI_i	R_i
Grassland	2013	5.3	7.29	0.73	87.26	0.33	2.11	0.2	0.42
	2022	136	1137.5	0.12	2.83	0.35	0.12	0.2	0.02
Cultivated land	2013	1758	12101.58	0.15	0.96	0.52	0.10	0.27	0.03
	2022	737	17881.25	0.04	0.42	0.46	0.03	0.27	0.008
Built-up-land	2013	1246	13831.74	0.09	0.7	0.47	0.51	0.06	0.0043
	2022	1085	14043.75	0.077	0.65	0.5	0.058	0.67	0.0038
Forest	2013	201	274532.04	0.0007	0.014	0.65	0.00093	0.133	0.000123
	2022	117	265005.25	0.0004	0.011	0.64	0.00065	0.133	0.000087
Water	2013	256	4914.72	0.052	0.9	0.36	0.046	0.33	0.015
	2022	274	7062.5	0.039	0.65	0.38	0.034	0.33	0.011

C_i: Landscape fragmentation index; S_i: Landscape splitting index; D_i: Landscape dominance index; LDI_i: Landscape disturbance index; LFI_i: Landscape fragility index; LER_i: Landscape ecological risk index

Ecological risk index (ERI) is an indicator of negative environmental impacts which can occur due to one or more external factors (Figure 5). Risk levels were classified to five ecological risk indexes with geometric interval classification: lowest risk area (ERI $\leq$ 0.0005), lower risk area (ERI $\leq$ 0.001), medium risk area (ERI≤ 0.005), higher risk area (ERI ≤ 0.01) and highest risk area (ERI ≤ 0.015). The ecological risk is lower in the western part of KKNP and higher in eastern part of KKNP. The eastern border of KKNP locates proximate to semi-urban region of Phetchaburi and Prachuap Khiri Khan Provinces that is densely occupied by communities. The variations in elevations affect the changes in LULC types based on soil conditions that facilitate soil erosion in slopes areas. The impact from floods and drought conditions are lower in the protected areas of KKNP as the occurrence of incidences are not regular throughout the time. The region with highest risk denotes the Kaeng Krachan Dam which borders the Headquarter campsite that is popular among tourists to visit in KKNP. The dam is man-made reservoir that discharge water when rainfall accumulate excess water causing to flood lowlands of Phetchaburi province.

The overall ecological risk has reduced from 2013 to 2022, which is possible due to restrictions imposed in KKNP after being accepted as a UNESCO world heritage site. And the COVID-19 pandemic situation closed access of tourists to indigenous community sites, certain tourist attraction sites and removed activities like rafting along Petchaburi river. This also resulted the communities to rely more on farming activities than tourist engagements.

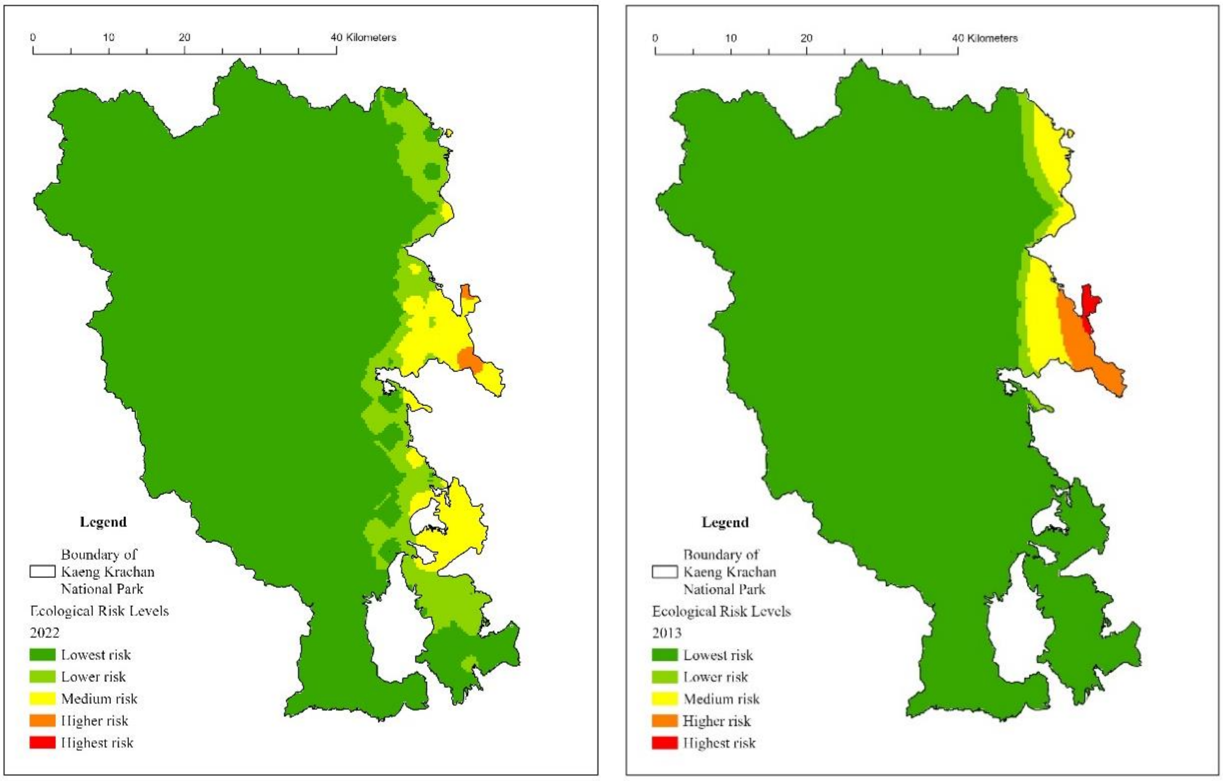


Figure 5 Ecological risk values of Kaeng Krachan National Park for year 2022 (left) and 2013 (right)

4. Conclusion

The research focused on changes of LULC types in KKNP from 2013 to 2022, based on diverse establishment of communities, promoted tourism and rich biodiversity. Spatio-temporal changes in the distribution of all LULC types were contributors to overall landscape loss index in 2013 and 2022. And the landscape ecological risk reduced from 2013 to 2022, along the eastern border of KKNP which potentially shows higher ecological risk index. The ecological risk along marginal farmlands have reduced which denotes that the conservation strategies implemented inside the KKNP are supportive of resource management. Awareness program on forest conservation and environmentally friendly house plans were some successfully administered plans on wellbeing of community. Landscape ecological risk has reduced with availability of grasslands that expresses minimum anthropogenic disturbances. The patrol stations located at multiple entry points to KKNP have helped in controlling deforestation and animal poaching activities conducted illegally by village communities, these influences in reducing the risk associated with conservation of KKNP.

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