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MANAGING FOREST RECREATIONAL AREAS USING  
ENVIRONMENTAL INDICATORS AS A FEEDBACK MECHANISM:  
A CASE STUDY AT SUNGAI TUA, SELANGOR

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## ABSTRACT

A spatial-substitution framework was adopted for studying recreational use and its effects on forested areas in Peninsular Malaysia. In this approach, "after-the-fact" analysis was adopted since recreation in these forested areas were undertaken long before they were designated as Forest Recreational Areas (FRAs). These areas are within the Permanent Reserved Forest and because of their attractiveness in terms of the natural and cultural characteristics, are set aside for purposes of forest recreation.

Increase in disposable income have resulted in more people having greater sums to spend on leisure and this has resulted in a steady growth of recreation in natural settings in the peninsula. As a result of increased participation in forest recreation, it is inadvertent that more pressure are imposed on these FRAs.

Environmental degradation stemming from overuse is already evident in FRAs, especially those that are around urban centres. As such, there is a need to understand these impacts. One such approach is to use environmental indicators such as soil, vegetation and water quality not only to monitor these developments, but also to provide insights for managing both natural resource and recreational opportunities.

Findings of recreational use intensity on soil compaction show that soil is more compacted in the upper layers than the lower layers. Compaction increased with increased recreational use. Soil compaction should not exceed the limits which the soil can recharge itself through capillary action. This is crucial during periods of drought, thereby making water available to the plants for their survival.

Vegetation response varies with different recreational use as well as with different soil depth. Vegetation undergoes morphological modifications in response to increased recreational use until it exceeds the ability of the vegetation to regenerate itself and resulting in environmental degradation. However, light recreational use resulted in increased biodiversity through selective proliferation of the more resistant species.

Water quality, in terms of temperature, pH, turbidity and electrical conductance are indifferent to the various recreational use intensities, but mildly significant to dissolved oxygen, resulting from the oxidation of organic matters and inorganic chemical reactions.

A number of management recommendations on such recreational resource are proposed.

## ABSTRAK

Satu kerangka gantian-ruang (spatial-substitution framework) telah diterimapakai untuk mengkaji penggunaan rekreasi dan kesannya ke atas kawasan-kawasan hutan di Semenanjung Malaysia. Dalam kaedah ini, analisa “after-the-fact” telah digunakan memandangkan aktiviti rekreasi telah lama dilaksanakan di kawasan-kawasan hutan sebelum kawasan-kawasan tersebut diklasifikasikan sebagai Hutan Rekreasi (FRAs). Kawasan-kawasan ini adalah terletak dalam Hutan Simpanan Kekal dan telah diperuntukkan khas bagi maksud rekreasi dan riadah di atas sebab ciri-ciri semulajadi dan kebudayaannya yang menarik.

Peningkatan pendapatan telah menyebabkan lebih ramai penduduk mempunyai lebih wang untuk dibelanjakan bagi aktiviti masa lapang dan ini telah menyebabkan peningkatan rekreasi di kawasan semulajadi yang berterusan di Semenanjung Malaysia. Akibat daripada peningkatan penglibatan orang ramai dalam rekreasi hutan, maka tekanan ke atas kawasan-kawasan FRA kian meningkat.

Kerosakan alam sekitar yang berpunca daripada penggunaan berlebihan sememangnya jelas di kawasan-kawasan Hutan Rekreasi terutamanya yang terletak berhampiran kawasan bandar. Oleh yang demikian, impak ini perlu diteliti dan difahami. Salah satu pendekatan adalah penggunaan petunjuk alam sekitar seperti tanah-tanih, tumbuh-tumbuhan dan kualiti air bukan sahaja untuk memantau perkembangan, tetapi juga untuk memberi tanggapan yang mendalam mengenai pengurusan kedua-dua sumber semulajadi dan keupayaan rekreasi.

Daripada penemuan-penemuan kajian rekreasi dan pemadatan tanah-tanah, adalah didapati bahawa lapisan-lapisan tanah-tanah dipermukaan adalah lebih padat jika dibandingkan dengan lapisan-lapisan bawah. Tahap pemadatan meningkat dengan peningkatan kadar penggunaan rekreasi. Pemadatan tanah seharusnya tidak melebihi had keupayaan tanah-tanah untuk memperolehi semula kelembapan melalui tindakan kapilari. Ini amatlah penting untuk menjamin bekalan air demi kehidupan tumbuh-tumbuhan semasa musim kemarau.

Respon tumbuh-tumbuhan adalah berbeza dengan perbezaan penggunaan rekreasi dan kedalaman tanah-tanah. Tumbuh-tumbuhan akan mengalami perubahan morfologi sekadar dengan peningkatan penggunaan rekreasi sehingga suatu tahap di mana tumbuh-tumbuhan tersebut tidak dapat tumbuh semula secara semulajadi dan seterusnya mengakibatkan kerosakan alam sekitar. Walau bagaimanapun, kadar penggunaan rekreasi yang rendah akan meningkatkan kepelbagaian biologi melalui pembiakan secara memilih spesies-spesies yang lebih tahan lasak.

Kualiti air, dari segi suhu, pH, kekeruhan dan pengaliran elektrik adalah tidak bergantung dengan intensiti penggunaan rekreasi, tetapi ada sedikit terpengaruh terhadap tahap oksigen terlarut yang terjadi daripada pengoksidaan bahan-bahan organik dan reaksi kimia bukan organik.

Beberapa syor mengenai pengurusan sumber rekreasi adalah dicadangkan.

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## LIST OF ABBREVIATIONS

### 1. Terminology and Organisation

1.1. ANOVA	= Analysis of Variance
1.2. BOD	= Biological Oxygen Demand
1.3. COD	= Chemical Oxygen Demand
1.4. DOE	= Department of Environment DOE
1.5. FDPM	= Forestry Department Peninsular Malaysia
1.6. FELDA	= Federal Land Development Authority
1.7. FR	= Forest Reserve
1.8. FRA	= Forest Recreational Area
1.9. FRAs	= Forest Recreational Areas
1.10. FRIM	= Forest Research Institute, Malaysia
1.11. IBI	= Index of Biotic Integrity
1.12. LCC	= Land Capability Classification
1.13. MANOVA	= Multivariate Analysis of Variance
1.14. MCT	= Multiple Component Test
1.15. MTC	= Malaysian Timber Council
1.16. MTIB	= Malaysia Timber Industries Board
1.17. MPI	= Ministry of Primary Industries, Malaysia
1.18. NFC	= National Forestry Council
1.19. PCA	= Principal Components Analysis
1.20. Sg.	= Sungei
1.21. SSFD	= Selangor State Forestry Department

## 2 Vegetation

- |      |                         |   |                              |
|------|-------------------------|---|------------------------------|
| 2.1  | <i>Ag. macrophyll</i>   | = | <i>Agelaea macrophylla</i>   |
| 2.2  | <i>A. cadamba</i>       | = | <i>Anthocephalus cadamba</i> |
| 2.3  | <i>B. dactyloides</i>   | = | <i>Buchloe dactyloides</i>   |
| 2.4  | <i>C. iners</i>         | = | <i>Cinnamomum iners</i>      |
| 2.5  | <i>E. mollis</i>        | = | <i>Elephantopus mollis</i>   |
| 2.6  | <i>H. scyphus</i>       | = | <i>Herschelia scyphus</i>    |
| 2.7  | <i>M. cordata</i>       | = | <i>Mikania cordata</i>       |
| 2.8  | <i>Mim. pudica</i>      | = | <i>Mimosa pudica</i>         |
| 2.9  | <i>P. horsfieldii</i>   | = | <i>Pterygota horsfieldii</i> |
| 2.10 | <i>R. repens</i>        | = | <i>Ruellia repens</i>        |
| 2.11 | <i>Sc. purpurascens</i> | = | <i>Scleria purpurascens</i>  |
| 2.12 | <i>S. leprosula</i>     | = | <i>Shorea leprosula</i>      |
| 2.13 | <i>S. parvifolia</i>    | = | <i>Shorea parvifolia</i>     |
| 2.14 | <i>V. arborea</i>       | = | <i>Vernonia arborea</i>      |