

INTEGRATED STRATEGY FOR MITIGATING ENVIRONMENTAL IMPACTS OF STUDENTIFICATION AROUND IPB DARMAGA CAMPUS

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REGIONAL PLANNING
FACULTY OF AGRICULTURE
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BOGOR
2026

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Bogor, August 2026

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SUMMARY

NOVELLA GIOVANNI. Integrated Strategy for Mitigating Environmental Impacts of Studentification around IPB Darmaga Campus. Supervised by DYAH RETNO PANUJU and BAMBANG HENDRO TRISASONGKO.

The peri-urban area surrounding IPB Darmaga Campus has experienced growing settlement demand associated with an increasing student populations, raising concerns about environmental quality including: thermal conditions, clean water quality, and waste management. This study examined the spatial characteristics of these environmental conditions and formulated integrated mitigation strategies based on empirical analysis and expert judgment.

A mixed-method approach was applied, integrating spatial analysis, environmental measurements, and field data collection. Thermal conditions were assessed using multi-temporal Landsat imagery to derive Land Surface Temperature (LST) and the Urban Thermal Field Variance Index (UTFVI). Spatial relationships between UTFVI and six explanatory variables, namely vegetation index, water index, built-up index, elevation, slope, and population density, were examined using Geographically Weighted Regression (GWR). Clean water quality was evaluated through Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Coliform parameters. Waste management was examined through field observations and household interviews. Mitigation strategies were formulated through the combination of the Strengths, Opportunities, Aspirations, and Results (SOAR) framework and Analytical Hierarchy Process (AHP).

LST and UTFVI patterns indicate increasing and spatially concentrated thermal stress, particularly in settlement clusters near the campus, although the annual comparison should be interpreted cautiously because each year is represented by one Landsat acquisition. GWR results indicate that vegetation loss and impervious surface expansion are the primary drivers, explaining 82% of UTFVI spatial variation. Clean water quality did not follow a clear building-density pattern, suggesting that infrastructure gaps, groundwater vulnerability, and the proximity of wells to sanitation facilities were more influential. A perception-reality gap was identified, where 38 of 39 sampled households reported no clean water quality concerns despite laboratory exceedances. Waste management practices differed clearly between planned and informal settlements. Planned settlements having regular waste collection services, while informal settlements relying more on self-managed disposal.

Integrated mitigation strategies were developed through the SOAR-AHP approach involving eleven expert respondents. Sustainable land use received the highest priority weight (0.51), followed by basic sanitation utilities (0.29) and thermal environment (0.20). Water catchment area protection and building permit enforcement emerged as the two highest-priority specific interventions. Community participation appears consistently across all strategic combinations. This study demonstrates that campus-driven development in peri-urban areas generates interconnected environmental pressures that cannot be addressed through partial approaches alone.

Keywords: SOAR-AHP, studentification, thermal comfort, waste management, clean water quality

RINGKASAN

NOVELLA GIOVANNI. Strategi Terpadu dalam Mitigasi Dampak Studentifikasi terhadap Lingkungan di Sekitar Kampus IPB Darmaga. Dibimbing oleh DYAH RETNO PANUJU dan BAMBANG HENDRO TRISASONGKO.

Wilayah peri-urban di sekitar Kampus IPB Darmaga mengalami peningkatan permintaan permukiman yang didorong oleh pertumbuhan jumlah mahasiswa, sehingga menimbulkan kekhawatiran terhadap kualitas lingkungan diantaranya: kondisi termal, kualitas air, dan pengelolaan sampah. Penelitian ini mengkaji karakteristik spasial dari kondisi lingkungan tersebut dan merumuskan strategi mitigasi terpadu berdasarkan analisis empiris dan penilaian ahli.

Penelitian ini menggunakan pendekatan metode campuran dengan mengintegrasikan analisis spasial, penilaian lingkungan, dan pengumpulan data lapang. Kondisi termal dianalisis menggunakan citra Landsat untuk memperoleh *Land Surface Temperature* (LST) secara multi-temporal, yang kemudian diturunkan menjadi *Urban Thermal Field Variance Index* (UTFVI). Keterkaitan spasial antara UTFVI dan variabel penjas kenyamanan termal seperti indeks vegetasi, indeks air, indeks lahan terbangun, ketinggian, kemiringan lereng, dan kepadatan penduduk dianalisis menggunakan *Geographically Weighted Regression* (GWR). Kualitas air bersih dievaluasi melalui parameter *Biochemical Oxygen Demand* (BOD), *Chemical Oxygen Demand* (COD), dan *Total Coliform*. Pengelolaan sampah dikaji melalui observasi lapangan. Strategi mitigasi dirumuskan menggunakan kombinasi kerangka *Strengths, Opportunities, Aspirations, and Results* (SOAR) dan *Analytical Hierarchy Process* (AHP).

Pola LST dan UTFVI menunjukkan adanya peningkatan stres termal yang terkonsentrasi di kawasan pemukiman, meskipun perbandingan antar tahun perlu ditafsirkan secara hati-hati karena setiap tahun hanya diwakili oleh satu citra Landsat. Hasil GWR menunjukkan bahwa tutupan vegetasi dan permukaan kedap air merupakan faktor dengan tingkat asosiasi tertinggi sebesar 82% dari variasi spasial UTFVI. Kualitas air tidak mengikuti pola kepadatan bangunan, didorong oleh kesenjangan infrastruktur, kerentanan air tanah, dan kedekatan antara sumur dengan fasilitas sanitasi. Terdapat kesenjangan antara persepsi masyarakat dan hasil pengukuran kualitas air bersih, di mana rumah tangga sampel melaporkan tidak ada masalah kualitas air meskipun hasil laboratorium melebihi baku mutu. Praktik pengelolaan sampah juga berbeda antara permukiman terencana dan permukiman swadaya. Permukiman terencana umumnya memiliki layanan pengangkutan sampah rutin, sedangkan permukiman swadaya lebih banyak mengandalkan pengelolaan sampah secara mandiri.

Strategi mitigasi terpadu dikembangkan melalui pendekatan SOAR-AHP yang melibatkan sebelas responden ahli. Penggunaan lahan berkelanjutan memperoleh bobot prioritas tertinggi (0,51), diikuti oleh utilitas sanitasi dasar (0,29) dan lingkungan termal (0,20). Perlindungan kawasan tangkapan air dan penegakan izin mendirikan bangunan merupakan dua intervensi spesifik dengan prioritas tertinggi. Partisipasi masyarakat muncul secara konsisten di seluruh kombinasi strategi. Penelitian ini menunjukkan bahwa pembangunan yang didorong oleh keberadaan kampus di wilayah peri-urban menghasilkan tekanan

lingkungan yang saling terkait dan tidak dapat ditangani hanya melalui pendekatan parsial.

Kata kunci: kenyamanan termal, kualitas air bersih, pengelolaan sampah, SOAR-AHP, studentifikasi

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INTEGRATED STRATEGY FOR MITIGATING ENVIRONMENTAL IMPACTS OF STUDENTIFICATION AROUND IPB DARMAGA CAMPUS

NOVELLA GIOVANNI

A thesis
submitted in fulfilment of the requirement for the degree of
Master of Science
in
Regional Planning Study Program

**REGIONAL PLANNING
FACULTY OF AGRICULTURE
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ACKNOWLEDGEMENT

All praises and thanks be to Allah *Rabb-ul-Alameen*.

This thesis would not have come to life without His mercy, the prayers of my family, and the support of many kind-hearted individuals and institutions throughout this academic journey.

I would like to express my deepest gratitude to my supervisors, *Ibu* Dyah Retno Panuju, S.P., M.Si., PhD., and *Bapak* Bambang Hendro Trisasongko, S.P., M.Si., PhD., for their guidance, patience, constructive feedback, and continuous academic support throughout the research and thesis writing process. Their insights and encouragement have been invaluable in shaping this study.

I would also like to extend my sincere gratitude to my supervisor from Kyoto University, Professor Izuru Saizen, for his kindness, guidance, and support during my double degree journey, which greatly enriched my academic experience and broadened my perspective as a student.

My sincere appreciation is also extended to Prof. Dr. Ernan Rustiadi, M.Agr., as the thesis examiner, for his valuable comments, suggestions, and constructive inputs, as well as to Dr. Dra. Khursatul Munibah, M.Sc., as the thesis defense moderator, for her assistance and support during the examination process.

I would like to thank the lecturers and academic staff of the Regional Planning Study Program, Faculty of Agriculture of IPB University, for the knowledge, assistance, and support provided during my study. I am grateful to all respondents: local communities around the IPB Darmaga Campus area, students, and experts who kindly participated in this research and supported the data collection process.

I gratefully acknowledge the institutions and data providers that supported this research, including *Direktorat Riset dan Inovasi IPB* for research funding under *Pendanaan Riset Aksi IPB*, *Badan Informasi Geospasial (BIG)*, *Badan Pusat Statistik (BPS)*, *Badan Meteorologi, Klimatologi, dan Geofisika (BMKG)*, NASA and USGS, OpenStreetMap and Google Open Buildings, as well as the use of QGIS and R, which were essential for the analyses conducted in this study.

I would also like to thank my friends, classmates of PWL 2022, and Darmaga University Town 2025 research team: Awfa Septiyan, Ghadah Nurarih Mufthi, and Naelis Sazqia Kamalin, who assisted during field surveys, water sampling, questionnaire distribution, data processing, and thesis discussions.

Last but certainly never least, this thesis is dedicated to my beloved parents, *Bapak* Nasrul Irwan and *Ibu* Hanifah Gusti, and my dearest sister, Novia Zora Hagnas. Their unconditional love, constant prayers, endless patience, and unwavering support have always been the foundation of everything I do.

I carry deep gratitude for every prayer, kindness, and support that has made this journey possible. I consider myself a fortunate individual. May this thesis become a small contribution to knowledge and future discussions on sustainable university town development.

Bogor, August 2026

Novella Giovanni



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LIST OF ABBREVIATION

Abbreviation	Description
AHP	Analytical Hierarchy Process
BIG	<i>Badan Informasi Geospasial</i> /Geospatial Information Agency
BMKG	<i>Badan Meteorologi, Klimatologi, dan Geofisika</i> /Meteorology, Climatology, and Geophysical Agency
BOD	Biochemical Oxygen Demand
BPS	<i>Badan Pusat Statistik</i> /Statistics Indonesia
CI	Consistency Index
COD	Chemical Oxygen Demand
CR	Consistency Ratio
DEM	Digital Elevation Model
EEI	Ecological Evaluation Index
EVI	Enhanced Vegetation Index
GIS	Geographic Information System
GPS	Global Positioning System
GWR	Geographically Weighted Regression
IDW	Inverse Distance Weighted
IPB	<i>Institut Pertanian Bogor</i> /IPB University
KDB	<i>Koefisien Dasar Bangunan</i> /Building Coverage Ratio
LST	Land Surface Temperature
LP2B	<i>Lahan Pertanian Pangan Berkelanjutan</i> /Sustainable Food Agricultural Land
MAUP	Modifiable Areal Unit Problem
MNDWI	Modified Normalized Difference Water Index
MPN	Most Probable Number
NASA	National Aeronautics and Space Administration
NDBI	Normalized Difference Built-up Index



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Abbreviation	Description
OLI	Operational Land Imager
OSM	OpenStreetMap
PDAM	<i>Perusahaan Daerah Air Minum</i> /Local Government Owned Water Utilities
PET	Physiological Equivalent Temperature
PPLH	<i>Pusat Penelitian Lingkungan Hidup</i> /Environmental Research Center
QGIS	Quantum Geographic Information System
RDTR	<i>Rencana Detail Tata Ruang</i> /Detailed Spatial Plan
RI	Random Index
RTH	<i>Ruang Terbuka Hijau</i> /Open Green Space
SOAR	Strengths, Opportunities, Aspirations, and Results
SRTM	Shuttle Radar Topography Mission
THI	Temperature Humidity Index
TM	Thematic Mapper
TIRS	Thermal Infrared Sensor
TOD	Transit-Oriented Development
TPA	<i>Tempat Pemrosesan Akhir</i> /Final Disposal Site
TPS	<i>Tempat Penampungan Sementara</i> /Temporary Waste Collection Site
UHI	Urban Heat Island
USGS	United States Geological Survey
UTCI	Universal Thermal Climate Index
UTFVI	Urban Thermal Field Variance Index
VFI	Variance Inflation Factor