

COMMUNITY BASED GREEN CITY READINESS INDEX IN RANTAUPRAPAT: THE ROLE OF COMMUNITY AWARENESS AND GREEN ENGAGEMENT

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Abstract

The concept of green cities has gained global attention as a framework for urban sustainability. However, the success of green city initiatives relies heavily on community awareness and active engagement. This factor is still rarely studied in small to medium-sized cities in developing countries. This study aims to measure the readiness of the city of Rantauprapat, Labuhanbatu Regency, Indonesia towards the status of a green city, focusing on two main endogen variables, namely green awareness and green engagement. The study used a quantitative survey approach with a modified green city readiness index (GCRI) instrument, given to approximately 400 respondents spread across 15 urban villages. Respondents' perceptions were measured using a likert scale with 32 statements that included waste management, energy conservation, green open space utilization, sustainable transportation options, and environment-based social activities. The results of the study found that the level of public awareness was moderate with an average score of 3.42 out of 5, while the level of green engagement was lower with an average score of 2.68 out of 5. The overall GCRI score for Rantauprapat based on AHP weighting is 0.409 indicating relatively moderate readiness, and also a simple average analysis puts Rantauprapat in the medium category. These findings show a gap between attitudes and behaviors, where residents have basic knowledge about the environment but have not consistently translated it into real ecological actions. This research makes a theoretical contribution to the development of green city studies by including community behavior indicators in the measurement of city readiness. Practically, the results of the study show that GCRI Rantauprapat is compiled from the dimensions of public awareness and green involvement with a focus on community behavior, not just physical indicators of the city.

Keywords: green city readiness index; Rantauprapat; public awareness; green engagement; urban sustainability; environmental behavior.

INTRODUCTION

Rapid urbanization has put unprecedented pressure on the quality of the environment in cities in developing countries. Indonesia, as one of the countries with the fastest urbanization rate in Southeast Asia, faces significant challenges in managing urban growth while maintaining ecological integrity. In response, the Government of Indonesia has promoted the concept of green cities as a strategic framework to achieve the Sustainable Development Goals (SDGs), specifically goal 11 on sustainable cities and communities and goal 13 on climate action. The green city paradigm is broadly defined as an urban area that improves the quality of the environment (air, water, soil), improves energy efficiency, reduces waste and emissions, and provides adequate green open space for its citizens. Csoppus and Konczos Szombathelyi (2026) explained that the character

of green cities includes green planning, green buildings, green waste management, green transportation, water and energy efficiency, green environment, green communities and green economy strategies. The study also emphasized the importance of an indicator framework in making assessments of green city development, especially in small and medium cities.

Rantauprapat, the capital of Labuhanbatu Regency in North Sumatra, is a medium-sized city that is experiencing rapid physical and demographic expansion. As the administrative and economic center of the region, the city is witnessing an increase in vehicle density, waste generation, and the conversion of green open space into built-up land. The local government has initiated several environmental programs, such as the Labuhanbatu Bersih, Labuhanbatu Hijau campaign which explicitly calls for community participation in maintaining the cleanliness and greenery of the city. Although these efforts have been made, preliminary observations show that community participation is still not optimal, and the city has not been formally evaluated for its readiness to become a green city.

A critical gap in the existing literature is that most urban sustainability assessments rely heavily on objective physical indicators that are top-down such as the percentage of green space, waste treatment capacity, or air quality index. While these metrics are important, they often overlook the crucial human dimension, particularly in the awareness, attitudes, and behaviors of urban dwellers. Various studies have informed that green city policies will not succeed without the active involvement of citizens. A systematic literature review by Adam et al. in 2022 that examined 31 green cities around the world concluded that green cities encourage citizen engagement in green policies while advancing environmental citizenship. Similarly, Raji, et al. (2024) found that the identification of residents with green city branding significantly affected their green citizenship behaviors, including protection, loyalty, and advocacy of green city values.

But most of these studies focus on large metropolitan areas or cities in developed countries. Small to medium-sized cities in developing countries, especially in Indonesia outside Java, are still underrepresented. He further explained that the concept of green engagement, which is defined as active and consistent participation of citizens in pro-environmental actions ranging from waste sorting to participatory in green community activities, is rarely done in measuring the readiness index adjusted to the context in Indonesia.

The concept of green cities has been defined in various ways but consensus has emerged around three core dimensions, namely (1) environmental quality, (2) human welfare, and (3) political and social actions aimed at achieving the first two dimensions. Various international indices have been developed to assess how green a city is. The European Green City Index from the economist intelligence Unit uses 30 indicators in eight categories, namely (1) CO2 emissions, energy, buildings, land use, transportation, water, waste, and air quality. UI Green City Metrics is designed specifically for cities in Indonesia. The index consists of six categories; Building and Infrastructure Planning, Energy, and Climate Change, Waste Management, Water Management, Access and Mobility, and Governance. Although comprehensive, these indices rarely adequately capture aspects of people's behavior. A recent review by Gursoy Haksevenler et al., (2025) introduced a strategic Green City Index for cities that includes not only environmental quality indicators but also dimensions of community well-being, emphasizing the need for citizen-centric metrics. Similarly, the UK-developed Go Zero Index maps local readiness for a green future using 30 datasets covering housing, transport, health, employment, and social data, suggesting that people's readiness is multi-dimensional.

Community awareness refers to the level of knowledge, understanding, and concern that citizens have about environmental issues and the principles of green cities. High awareness is a necessary condition but not enough for pro-environmental behavior. Adam et al., (2022) conducted a systematic literature review of 25 empirical studies covering 31 green cities and concluded that fostering environmental citizenship characterized by knowledge, skills, attitudes, values, and behaviors is essential for the success of green cities. The Education for Environmental Citizenship (EEC) model argues that citizen engagement with green policies facilitates the development of

these five dimensions, leading to sustainable pro environmental action. In the Indonesian context, the UI Green City Metric 2025 emphasizes new indicators related to changes in people's behavior as the key to sustainability. The metric now includes an explicit focus on raising public awareness as a critical success factor.

Green engagement goes beyond passive awareness to include active and consistent participation in pro-environmental actions. These include waste sorting, participation in recycling programs, use of public transportation, tree planting and maintenance, water conservation, participation in environmental campaigns, and advocacy for green policies. Green engagement is influenced by a variety of factors, including social norms, perceived efficacy, access to facilities, and institutional support. Research has shown that online engagement with municipal government social media platforms can positively influence citizens' attitudes, information value, and environmental concern for green initiatives. Raji et al. (2024) demonstrate that green city self-connection and environmental benefits significantly affect residents' identification with green city branding, which in turn drives green city protection, loyalty, and advocacy behaviors. Their study of 1,217 residents in 15 green cities in six countries found that social and economic benefits did not affect population identification, suggesting that intrinsic environmental values are stronger as motivators than extrinsic rewards.

The concept of the readiness index for the transition of a green city is relatively new. Most existing indices measure the current level of greenness rather than readiness to go green. The Go Zero Index is one of the efforts to map local readiness towards a just green future. Koop and van Leeuwen (2015) found a strong correlation between the City Blueprint Framework and the ND GAIN climate readiness index ($r = 0.86$), the environmental awareness index ($r = 0.85$), and the European Green City Index ($r = 0.86$). This shows that awareness and readiness are closely intertwined. Based on the literature, this study operationalized the Green City Readiness Index (GCRI) as a composite of two main dimensions: Public Awareness (knowledge of green principles, environmental concern, perception of the severity of local issues, understanding of personal responsibility, and awareness of existing green programs) and Green Engagement (participation in waste management, energy conservation actions, green space utilization, sustainable mobility choices, and social participation in green activities). Each dimension consists of five indicators, and each indicator is measured through several survey items. The combination of these two dimensions results in a comprehensive assessment that goes beyond physical infrastructure and includes society as an active agent in the green transition.

Although the literature on green cities continues to grow, three critical gaps remain. First, most empirical studies focus on large cities, while medium-sized cities in developing countries, which make up the majority of urban areas, are neglected. Second, the behavioral dimensions of green city readiness, particularly the interaction between awareness and engagement, are rarely quantitatively measured in a comprehensive index. Third, there is no known research to systematically measure the readiness of green cities in Rantauprapat, so local policymakers do not have basic data for strategic planning. This research aims to fill this gap.

From the description above, the central problem addressed in this study is the lack of systematic measurement of Rantauprapat readiness to transition into a green city as seen through the influence of awareness and citizen involvement. Without baseline data, local policymakers cannot design effective, evidence-based strategies. The focus of the research is directed at two main aspects, namely public awareness and green involvement. This research is important because medium-sized cities in Indonesia, especially outside Java, are still rarely the object of measuring green city readiness based on community behavior. As for the formulation of the problem, namely (1) what is the level of awareness of the Rantauprapat community towards the principles and practices of green cities? (2) what is the level of green involvement of the Rantauprapat community and (3) what is the value of the Rantauprapat green city readiness index based on community awareness and green involvement?. This study uses the framework of community behavior readiness, where community awareness is placed as a cognitive dimension, while green

involvement is placed as a behavioral dimension, both of which form community readiness to support the transition to a green city.

RESEARCH METHODS

This study uses a cross-sectional quantitative survey design. This approach is appropriate for measuring the level of green awareness and engagement and green city readiness of a community in a given population at a single point in time. The research was carried out in Rantauprapat City, Labuhanbatu Regency, North Sumatra Province, Indonesia, between January and March 2026. The target population is all residents of Rantauprapat who are 17 years old and above and have lived in this city for at least one year. According to data from the Central Statistics Agency of Labuhanbatu Regency (2024), the adult population of Rantauprapat is around 86,000 people. The sample size of 400 respondents was determined using the Slovin formula with a margin of error of 5% and a confidence level of 95%. The sampling technique was using stratified random sampling based on 19 villages in North Rantau and South Rantau sub-districts.

The research instrument is a structured questionnaire consisting of four parts: (1) Demographic Information: Age, gender, education level, occupation, length of stay. (2) Public/Public Awareness (10 items): Measuring responses to statements about green principles, environmental concern, perception of the severity of local issues (waste, air, water), personal responsibility, and awareness of local green programs. (3) Green Engagement (12 items): Measure the frequency of pro-environmental actions, including waste sorting, plastic use reduction, water and electricity conservation, use of public or non-motorized transportation, tree planting, and participation in environmental campaigns. (4) Additional Perceptions (10 items): Perceived barriers to green behavior (lack of facilities, time, cost) and perceived support from local governments. All items use a five point Likert scale: 1 = Strongly Disagree (or Never), 2 = Disagree (Rarely), 3 = Neutral (Sometimes), 4 = Agree (Often), 5 = Strongly Agree (Always). The questionnaire was developed in Indonesian, piloted with 50 respondents in a neighboring city (Kisaran), and refined based on Cronbach's alpha reliability coefficient (awareness: $\alpha = 0.85$; engagement: $\alpha = 0.87$), which showed good internal consistency.

Data collection was conducted by five trained enumerators using face-to-face interviews to maximize response rates. Respondents were visited on weekends and weekday evenings to capture a representative sample of different walks of life. Each interview lasts 15–20 minutes. A total of 400 questionnaires were distributed, with 387 filled out completely and valid for analysis (96.75% response rate). Data analysis was carried out using SPSS version 26 and Microsoft Excel. The analysis takes place in three stages:

1. Descriptive Analysis: Averages, standard deviations, and frequency distributions are calculated for all items and constructs.
2. Green City Readiness Index (GCRI) calculation: GCRI is calculated as a weighted composite index. Based on the weights derived from AHP in the existing literature (Gursoy Haksevenler et al., 2025) and adjusted to the context, the Public Awareness dimension is weighted 45%, and Green Engagement 55%. The higher weight on engagement reflects the importance of actual behavior over passive awareness in achieving green city transformation. The formula used is:

$$\text{GCRI} = (\text{Awareness Score} \times 0.45) + (\text{Engagement Score} \times 0.55)$$

The final GCRI value ranges from 0 to 1. Based on the standard readiness classification, the scores are categorized as Very Low (0–0.20), Low (0.21–0.40), Medium (0.41–0.60), High (0.61–0.80), or Very High (0.81–1.00).

3. Bivariate Analysis: Pearson's correlation is used to test the relationship between awareness and engagement, both overall and for specific sub-dimensions.

RESULTS AND DISCUSSION

Of the 387 valid respondents, the demographic profile is as follows:

1. Gender: 52% female, 48% male
2. Age: 16% aged 17–25, 31% aged 26–35, 28% aged 36–45, 18% aged 46–55, 7% aged >55
3. Education: 15% elementary school or less, 34% junior high school, 32% high school, 19% diploma or bachelor's degree
4. Occupation: 22% civil servants/state-owned enterprises, 18% private employees, 27% self-employed, 20% housewives, 13% others
5. Length of stay: 8% < 1 year, 24% 1–5 years, 31% 6–10 years, 37% >10 years

This sample is fairly representative of the adult population of Rantauprapat, with a slight overrepresentation of the population who have lived longer.

Public Awareness Level

The average score for the 10 items of consciousness, the average overall consciousness is 3.42 out of 5, with a standard deviation of 0.68 indicating moderate consciousness. The results can be seen in Table 1 below:

Indicator	Statement	Average
Green Principles	I understand the concept of a green city and its importance	3.61
Environmental Concern	I am worried about environmental problems in Rantauprapat (garbage, pollution)	4.02
Perception of Severity	I believe the problem of garbage and flooding is a serious issue here	4.15
Personal Responsibility	I feel personally responsible for protecting the environment	3.85
Awareness of green programs	I know about the local government's green campaign (Labuhanbatu clean, Labuhanbatu green)	2.94
Green practice knowledge	I know how to sort garbage properly	3.28
Energy conservation knowledge	I understand how to reduce electricity consumption	3.62
Green open space awareness	I know the location and function of green open spaces in Rantauprapat	2.87
Understanding of environmental regulations	I know the local regulations on garbage disposal and tree felling	2.73

The highest awareness was recorded in the recognition that garbage and flooding are serious local problems (mean = 4.15), indicating that residents are indeed experiencing the negative impacts of environmental degradation themselves. In contrast, the lowest scores were for awareness of local environmental regulations (2.73), awareness of green open spaces (2.87), and awareness of existing green campaigns (2.94). This suggests that although general environmental concern exists, specific knowledge and institutional awareness are still lacking.

Green Engagement

Level Table 2 presents the results for 12 engagement items. The average overall engagement was significantly lower at 2.68 out of 5, with a standard deviation of 0.79.

Indicator	Statement	Average
Waste management	I sort organic and inorganic waste at home	2.35

	I use reusable shopping bags and avoid single-use plastics	2.61
	I participate in a community waste collection or recycling program	2.08
Energy conservation	I turn off lights and electronic devices when not in use	3.54
	I use energy-efficient equipment	2.98
	I take action to reduce water consumption	3.22
Green transport	I use public transportation or walk/cycle for short trips	2.45
	I share a vehicle (carpool) with a neighbor or co worker	2.19
Utilization of green space	I visit a park or green open space for recreation	2.73
	I participate in tree planting or garden maintenance activities	1.96
Social participation	I participate in environmental campaigns or community clean-up activities	2.14
Advocacy	I encourage family and friends to adopt green behaviors	2.93

The highest engagement item was turning off lights and devices when not in use (average = 3.54). This is likely influenced by economic motivation (saving electricity costs) rather than purely environmental motivation. The lowest engagement items involved active social participation: participation in tree planting or garden maintenance (1.96), participation in community waste programs (2.08), and participating in environmental campaigns (2.14). Participation in waste sorting (2.35) and use of public or non-motorized transportation (2.45) was also low. A clear pattern emerges: engagement is higher for individual actions, low effort, and cost saving, and lower for collective, effort-intensive, or socially visible actions.

Comparison of Green City Readiness Index (GCRI)

- The public awareness score is calculated as the average of all awareness items: 3.42. converted to a scale of 0-1 : $(3.42 - 1) / 4 = 0.605$
- Green engagement score is calculated as the average of all engagement items: 2.68 converted to a scale of 0-1: $(2.68 - 1) / 4 = 0.420$
- Applying a composite formula with a weight of 45% for awareness and 55% for engagement:

$$GCRI = (0.605 \times 0.45) + (0.420 \times 0.55) = 0.272 + 0.231 = 0.503$$

However, weighted GCRI can be refined by including AHP derivative weights from similar indices. Using AHP-based weighting (40% awareness, 60% engagement) the calculation yields:

$$GCRI = (0.605 \times 0.40) + (0.420 \times 0.60) = 0.242 + 0.252 = 0.494$$

The initial GCRI scores (0.503 and 0.494) placed Rantauprapat in the Medium readiness category (0.41–0.60). To provide a more comprehensive assessment, the GCRI was further validated with expert consultation from ten local stakeholders (urban planners, environmental officers, academics). Based on their recalibration, the final GCRI for Rantauprapat was 0.494, which falls into the category of moderate readiness (0.41–0.60) when using enhanced embedded weighting (40% awareness, 60% engagement).

Correlation Analysis

Pearson's correlation analysis revealed a positive and significant relationship between Public Awareness and Green Engagement: $r = 0.487$, $p < 0.01$. This confirms that higher awareness is associated with higher engagement, but the strength of the current correlation suggests that other factors are mediating or moderating these relationships. Residual indicates a substantial attitude behavior gap: many citizens know what they have to do but do not consistently act accordingly.

Discussion

The findings of this study provide nuanced insights into the dynamics of community-based green transition in Indonesia's medium-sized cities. The overall GCRI value of 0.503 indicates that Rantauprapat has a fairly good foundation in terms of citizen awareness but lacks in translating that awareness into meaningful and consistent action. This pattern is in line with a broader critique in environmental psychology that awareness is often a poor predictor of behavior when external barriers (lack of infrastructure, time constraints, social norms) are present.

Relatively high awareness of local environmental problems (average = 4.15 for severity perception) shows that Rantauprapat residents are not indifferent. They acknowledge that garbage and flooding are serious problems that affect their daily lives. A moderate score for personal responsibility (3.85) indicates that most citizens acknowledge their role in problems and solutions. However, low scores for awareness of specific green campaigns (2.94) and local regulations (2.73) indicate a failure of top-down communication. Local governments may implement programs, but they do not effectively reach the public.

The most worrying finding is the absence of active community participation in collective environmental action. Participation in tree planting (1.96), community waste programs (2.08), and environmental campaigns (2.14) was at or below the midpoint of the scale. This reflects what can be termed a passive caring model: citizens care but are inactive. This pattern was also observed by Raji et al. (2024), who found that the social and economic benefits of green cities do not affect population identification; Only environmental benefits and self-connections are influential. In Rantauprapat, even substantive environmental benefits may not be explicitly linked to individual actions, or residents may feel that their participation will not result in real change (i.e., low perceived efficacy).

A systematic review by Adam et al. (2022) found that green cities around the world have varying degrees of success in fostering environmental citizenship. Cities that actively engage citizens in the co-design and co-delivery of green policies tend to achieve engagement rates above 3.0 on a similar Likert scale. In contrast, Rantauprapat's engagement score of 2.68 was lower, indicating that the city is in the early stages of this transformation. This is not surprising given the introduction of green concepts in local planning relatively recently. The attitude-behavior gap observed in this study is consistent with previous research. A study on the implementation of green open space in developing countries noted that even when green space is provided, its utilization remains low without the accompanying social, educational, and incentive programs. In Rantauprapat, low utilization of available green open space (mean = 2.73) and low participation in park maintenance (1.96) confirm that the physical provision of infrastructure alone is not enough; An active community engagement strategy is needed.

Correlation analysis showed that engagement mediated the relationship between awareness and actual ecological behavior. In practical terms, this means that policies that aim only to raise awareness (e.g., public service announcements, posters, lectures) will have limited impact if they are not accompanied by mechanisms that lower barriers to action and provide incentives for participation. Several policy recommendations emerged from this study:

- (1) Strengthening the Information Ecosystem: Low awareness of existing green campaigns and regulations indicates the need for more creative and multi-channel communication. Social media platforms, which have been shown to positively influence environmental attitudes and the value of information, must be utilized to the fullest. Local governments should also use community radio, mosque announcements, and school-based programs to reach diverse demographic segments.
- (2) Providing Real Infrastructure and Incentives for Green Engagement: The low engagement in waste sorting (2.35) can be addressed by providing sorted bins at the household level, introducing door-to-door collection schedules, and implementing reward systems (e.g.,

points that can be exchanged for goods or reduced waste disposal costs). Similarly, low use of public or non-motorized transportation (2.45) requires investment in safe pedestrian and bicycle infrastructure, better bus services, and perhaps a bike-sharing program.

- (3) **Fostering Collective Efficacy and Social Norms:** The low participation of community activities in this study (1,96–2,14) suggests that residents may not believe that their individual actions will make a difference, or they may lack opportunities to act collectively. Organizing environment-based competitions for greener villages and forming community-led green working groups can build collective efficacy and change social norms.
- (4) **Embedding Green Engagement into Governance Structures:** Local governments should not treat green engagement as a one-off campaign but as an ongoing feature of urban governance. Rantauprapat can form a City Environment Council that includes citizen representatives, community leaders, and youth groups, ensuring that engagement is institutionalized rather than event-driven.
- (5) **Addressing Behavioral Attitude Gaps Through Behavioral Nudges:** Based on behavioral economics, small nudges such as placing recycling bins in visible and convenient locations, sending SMS reminders to households on collection day, or providing visual feedback on energy consumption can help close the gap between intent and action.

CONCLUSION

This study aims to measure the Green City Readiness Index (GCRI) of Rantauprapat, Labuhanbatu Regency, Indonesia, with a special focus on community awareness and green engagement. The findings revealed that although residents had moderate awareness of green principles and expressed concern about local environmental issues, their actual green engagement was mainly in collective actions that required low effort. The final GCRI value of 0.494 placed Rantauprapat in the category of Medium readiness when using enhanced AHP-based weights (40% awareness, 60% engagement). However, index calculations are sensitive to weighting assumptions, and simple averages place cities in the Medium category. Regardless, the dominant finding is the existence of significant gaps in attitudes and behaviors, where knowledge and concerns are not reliably translated into action. The correlation between awareness and engagement ($r = 0.487$) was positive but only moderate, suggesting that substantial external barriers and internal psychological factors mediated the relationship. Without targeted interventions to close this gap, the aspirations of the green city of Rantauprapat may remain unrealized, despite the existence of basic awareness.

Limitations

Some of the limitations of this research must be acknowledged; (1) This research is cross sectional, capturing a certain moment of time. This study cannot determine the direction of causality between awareness and engagement, nor can it track changes over time. (2) This study relies on self-reported behavior, which may be susceptible to social desire bias, respondents may overreport pro-environmental behavior to appear socially responsible. (3) The GCRI weighting scheme, although based on the literature, remains specific in different weighting contexts can result in different categories of readiness. (4) this study does not include objective physical indicators (e.g. air quality, waste diversion rate, tree canopy cover). A complete green city assessment requires the integration of subjective and objective metrics. (5) this research only focuses on the community dimension; Institutional factors (e.g. government budgets, staff, political will) are not measured but are crucial for actual implementation.

Recommendations for Future Research

Future research should address these limitations through a multi-method and longitudinal approach. Panel studies that track the same respondents for one to three years can examine how green engagement evolves in response to policy interventions. A mixed-methods design that combines surveys with in-depth interviews or focus group discussions will explain the qualitative reasons behind low engagement scores, particularly barriers such as lack of time, distrust of the government, lack of facilities, or competing priorities. In addition, future research should integrate the community-based readiness index used here with the UI Green City Metric physical indicators to create a comprehensive multi dimensional green city assessment tool tailored to Indonesian cities. Finally, comparative studies in several medium-sized cities in Indonesia will help set benchmarks and identify best practices.

Practical Recommendations for Rantauprapat

Direct and actionable recommendations for the Rantauprapat local government include:

- (1) Launched a community-based green ambassador program, recruiting and training locals to model green behaviors and facilitating environmental-level activities.
- (2) Install visible and accessible recycling and composting facilities in each village, accompanied by simple signage and household sorting guides.
- (3) Exemplify the Green Village competition with small financial prizes for the environment that shows the best improvement in waste management, greening, and energy conservation.
- (4) Require all new public buildings to include rainwater harvesting, efficient lighting, and at least 30% of green open space on site.
- (5) Establish a Green City Task Force within the regional planning body, with dedicated staff and budget to coordinate cross-sector green initiatives.
- (6) Starting school-based environmental literacy programs in all primary and secondary schools, ensuring that future generations grow up with green engagement as a habitual practice.

By acting on these recommendations, Rantauprapat can go beyond moderate readiness and become a real model of sustainable urban development in North Sumatra.

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